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FOR NOVA SCOTIA

REPORT FOR 2017–13

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Prepared by the Nova Scotia Department of Natural Resources

By: Peter Neily, Sean Basquill,
Eugene Quigley and Kevin Keys

Nova Scotia Department of Natural Resources
Renewable Resources Branch

Foreword by: Ken Baldwin, Canadian Forest Service
Photographer's Note by: Len Wagg, Communications Nova Scotia
Sable Island by: Zoe Lucas, Sable Island Researcher

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Cover Photos

Front cover: Pollett's Cove, Cape Breton Island; Back cover: Coastal forest along Barrington Bay, Southwest Nova Scotia.
PHOTOS: Communications Nova Scotia (Len Wagg)

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Foreword

My first experience with the natural diversity of Nova Scotia was, of course, mediated by the legendary hospitality of its residents. I was attending a national meeting in the area during the week preceding the Labour Day weekend. I had decided that I would extend my stay for the weekend, rent a car and explore the Acadian forest region of Canada. Two Nova Scotia colleagues discovered my intentions at the last minute and, on the spur of the moment, offered to forego their personal holidays and tour me around Cape Breton Island. What followed were two days of ecological discovery with expert guides and jovial company. Although my personalized tour only encompassed Cape Breton Island, this publication provides authoritative guidance to understanding the full ecological diversity of the entire province and is suitable for both technical and casual applications. To add entertainment value to the scientific information, I recommend the company of a Nova Scotia ecologist.

Ecological classification is the practice of classifying naturally occurring entities according to their ecological attributes. Classification is basically a linguistic tool. And, just as any language includes a vocabulary of words with explicit definitions to provide clarity when referring to specific ideas, actions, objects, etc., ecological classification provides a consistent vocabulary of standardized names and descriptions that facilitates unambiguous communication about ecosystems.

Depending on its primary purpose, an ecological classification emphasizes particular ecological characteristics. Some classifications feature distinctions among important **environmental** variables—like soil/site attributes, landform or topographic features, meso- or macro-climate regimes, or hydrological characteristics. Others focus on describing the **biological** constituents of ecosystems—such as vegetation or animal communities. In some cases, the classification reflects **temporal** relationships between organisms or communities—like vernal vs. summer species, or seral relationships within a successional sequence.

In Canada, the term "ecological land classification (ELC)" refers to ecological classifications in which **spatial** relationships between classes are explicitly emphasized, so that the classification can serve as a map legend.

ELC schemes are widely used as tools for informing land management decisions. Landscapes (and waterscapes) are partitioned into areas of similar ecological character, typically using a combination of classification factors including climate, geological or aquatic conditions, terrain-topography-soil characteristics, and natural vegetation or habitat qualities. The actual selection of factors for a particular ELC depends on the purpose of the classification and the scale of its mapped representation.

ELC maps are distinguished from both single-theme maps and interpreted remote sensing images by the degree of multifactorial ecological interpretation that is used to define the boundaries of each polygon. This complexity of ecological synthesis that is embedded in an ELC helps us understand the functional ecological properties underlying the classified ecosystems, and thus better assess impacts from land management, climate change and other human activities.

Numerous ELC products can be consulted to put Nova Scotia into an ecological context at any of global, continental, national or regional scales—but different classifications can be counted on to have different opinions. In its Terrestrial Ecoregions of the World [1], World Wildlife Fund partitions Nova Scotia between three global ecoregions: "New England/Acadian Forests," "Gulf of St. Lawrence Lowland Forests" and "Eastern Canadian Forests." At the continental scale, the NAFTA Commission for Ecological Cooperation [2] divides Nova Scotia between three similar Level III ecoregions: "Northern Appalachian and Atlantic Maritime Highlands," "Maine/New Brunswick Plains and Hills" and "Maritime Lowlands." Alternatively, however, The Nature Conservancy's treatment of North American terrestrial ecoregions [3] places Nova Scotia into a single ecoregion ("Northern Appalachian / Acadian"), together with Prince

Edward Island, New Brunswick, the Gaspé and southern mountainous portions of Québec, most of Maine and Vermont, and higher elevation areas in New Hampshire and upstate New York.

Within the Canadian context, Nova Scotia shares the Atlantic Maritime national ecozone [4] with Prince Edward Island and southeastern New Brunswick. In general, according to Ecoclimatic Regions of Canada [5], this ecozone is characterized by a High Cool Temperate climate similar to that in central Ontario and southern Quebec. However, as a peninsula and island surrounded by cold North Atlantic waters, Nova Scotia's coastal areas and the Cape Breton highlands have boreal climatic tendencies. In these portions of the province, the combination of cold temperatures, persistent winds, high humidity and, in some locations, salt spray, results in "Maritime Boreal" ecological conditions that are recognized at the provincial scale in this publication as well as in the Forest Ecosystem Classification for Nova Scotia (Neily et al, 2013).

This combination of climatic influences creates a wide variety of natural vegetation patterns in the province, many of which are unique in Canada. Temperate Acadian forests cover most of Nova Scotia, typified by various tree species combinations of fir, spruce, pine, hemlock, beech, oak, ash, maple and birch. However, in the Maritime Boreal areas, many of the temperate species are infrequent or absent, resulting in species mixes that are more commonly associated with boreal or sub-boreal domains (e.g., white & black spruce, balsam fir, paper & heart-leaved birch, red maple, understory species of the heath family). In extreme environments, such as exposed coastal areas, wide-ranging temperate and boreal/subarctic plant species combine with temperate Atlantic Coastal Plain plant species to create vegetation communities that are shared only with parts of New Brunswick and Maine.

Nova Scotia is geologically diverse. The province is part of the Appalachian physiographic region, with terrestrial bedrock and offshore continental shelf comprised of a complex mixture of both ancient and recent geological formations, modified by continental drift and glaciation. Accordingly, the terrain and underlying rock changes dramatically over relatively short distances, affecting soil conditions, land productivity and natural ecosystems.

Most Canadian provinces have a least one ELC for their territory, and some have multiple classifications with different emphases. For Nova Scotia, this tradition dates back to early works by Loucks (1962) and Bailey and MacAulay (1976). This current ELC for Nova Scotia builds on the ecological and spatial information contained in these and other earlier products, and combines it into a formal, spatially hierarchical ecological classification for the province. It includes revisions to earlier versions of the classification, cross-reference to the Nova Scotia Forest Ecosystem Classification [Neily et al, 2013], photographs and maps, as well as more complete supporting documentation.

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Photographer's Note

Years ago, when I wrote a regular photography column, I illustrated one with an aerial picture shot from high above showing a lone fir tree amongst a stand of hardwoods.

The caption read "*A lone pine tree….*"

The tree was, in fact, spruce, and the reaction was swift from the readers. It was then I learned the hard way that all trees are not the same.

Years later, high above the forests of Nova Scotia in late spring, I marvel at the one hundred and fifty shades of green. From the deep greens of the firs to the light shades of leaves just coming into their own, nature serves us a colour palette that no computer can reproduce.

On these days when your eyes get lost in the subtle shades that differentiate the tree type, the challenge literally becomes trying to photograph the tree through the forest.

Shooting from a helicopter enables one to get a vertical perspective while looking straight down to try to capture some of the subtle shade differences. It is these subtleties that enable the forest's character to shine through.

Character can come out in other ways. In the canyon of the Margaree Valley, where dark low cumulous clouds roll through, rain spatters on the carpet of brilliant red that is the hardwood canopy. Then, bursts of sun shine through the moisture laden air, bringing rays that illuminate the leaves until they are supersaturated, presenting themselves as a scene from nature's highlight reel. In the late fall, the brilliant huckleberry of the Canso lowlands seems to be on fire as the setting sun's rays touch the scene. The eagles perched on the trees around Eel Lake, waiting for the moment to swoop down and get lunch. It is these scenes that show the forest is alive.

Trying to photograph the ecoregions and ecodistricts in the province is both challenging and rewarding.

How do you photograph different forests and landscape that will tell the story yet make them interesting and visually appealing?

Once you start, you begin to learn and understand that the many species of flora and fauna in different parts of the province tell their own story. The moose cow with her calf in the barrens of the highlands, the bear in the huckleberry near Shelburne, the deer and coyote in the hardwoods of the Cobequid mountains.

Each area has its own personality. The plants and animals that live there tell their own story.

When these stories present themselves, you begin to see the tree through the forest.

Len Wagg
Photographer, Communications Nova Scotia
Halifax, Nova Scotia

Acknowledgements

This 2015 version of the Ecological Land Classification (ELC) represents the collective work of many ecologists, biologists, foresters, forest technicians, geologists and planners from throughout the Department of Natural Resources for close to 20 years. In particular, Lawrence Benjamin, Sherman Boates, Tony Duke, Brian Kinsman, Art Lynds and Bruce Stewart were integral in the development of the first approximation in 2000. Since that time, the Department's three regional Integrated Resource Management teams have provided significant feedback and support during their preparation of ecological landscape analyses for each ecodistrict.

Even before that, the biophysical land classification completed in the 1970s by staff of the Department of Lands and Forests, created the first template for this current edition. As authors we are thankful for both past and present contributions by our colleagues who have recognized the importance of classifications for advancing our understanding of the natural environments.

We thank Robert Cameron, Nova Scotia Department of Environment, for his thorough review of the manuscript, and his thoughtful suggestions for improving the clarity of our classification methodology. We thank James Bridgland, Cape Breton Highlands National Park, for bringing his knowledge of classification methodology and more specifically his thorough review of the unique ecosystems in his part of the province.

We are extremely pleased Zoe Lucas agreed to author the chapter on Sable Island, and thank her for the detailed descriptions of this remarkable place, which capture her lifetime of careful observation and passionate study.

Our special thanks go to Ken Baldwin, for providing his introductory commentary in the Foreword. Ken has been our mentor and colleague for many, many years on all things pertaining to ecosystem classification, and has always been available to provide scientific support, advice and feedback.

We are very appreciative of the photographic enthusiasm Len Wagg brought to the team, and thank him for his eagerness to hit the skies and photograph the variety of ecosystems in our special province. Hanging out the open door of a helicopter (even with a safety harness) at 1000 feet above ground illustrates his dedication to the art and science of producing premium photographs.

It goes without saying that our aerial photos required the skilled services of the Department's Air Services Division to get us safely airborne and we thank the helicopter pilots, engineers and staff for working through the uncertainties of weather, copter availability, light conditions and scheduling.

We would like to thank Ian MacInnis, Frances MacKinnon, and the many other GIS (geographic information systems) technologists and analysts in the Department for their geomatic advice and support. Much of the summary information, and improvements to the analytical routines we used for revising ELC linework, and for making this digital information available, were greatly enhanced through their help and expertise. A special thanks goes to Catherine Turner-Robert for her preparation of the provincial map of ecoregions and ecodistricts included in the back pocket of the book.

We extend our gratitude and thanks to our editor and designer, Susan Corning (Susan Corning Communications & Graphic Design). Her expertise in managing our never-ending need to revise text, exchange and edit photos, and re-arrange content was an essential component of this project. We very much appreciate her patience and proficiency.

PART 1

Development of the Ecological Land Classification for Nova Scotia

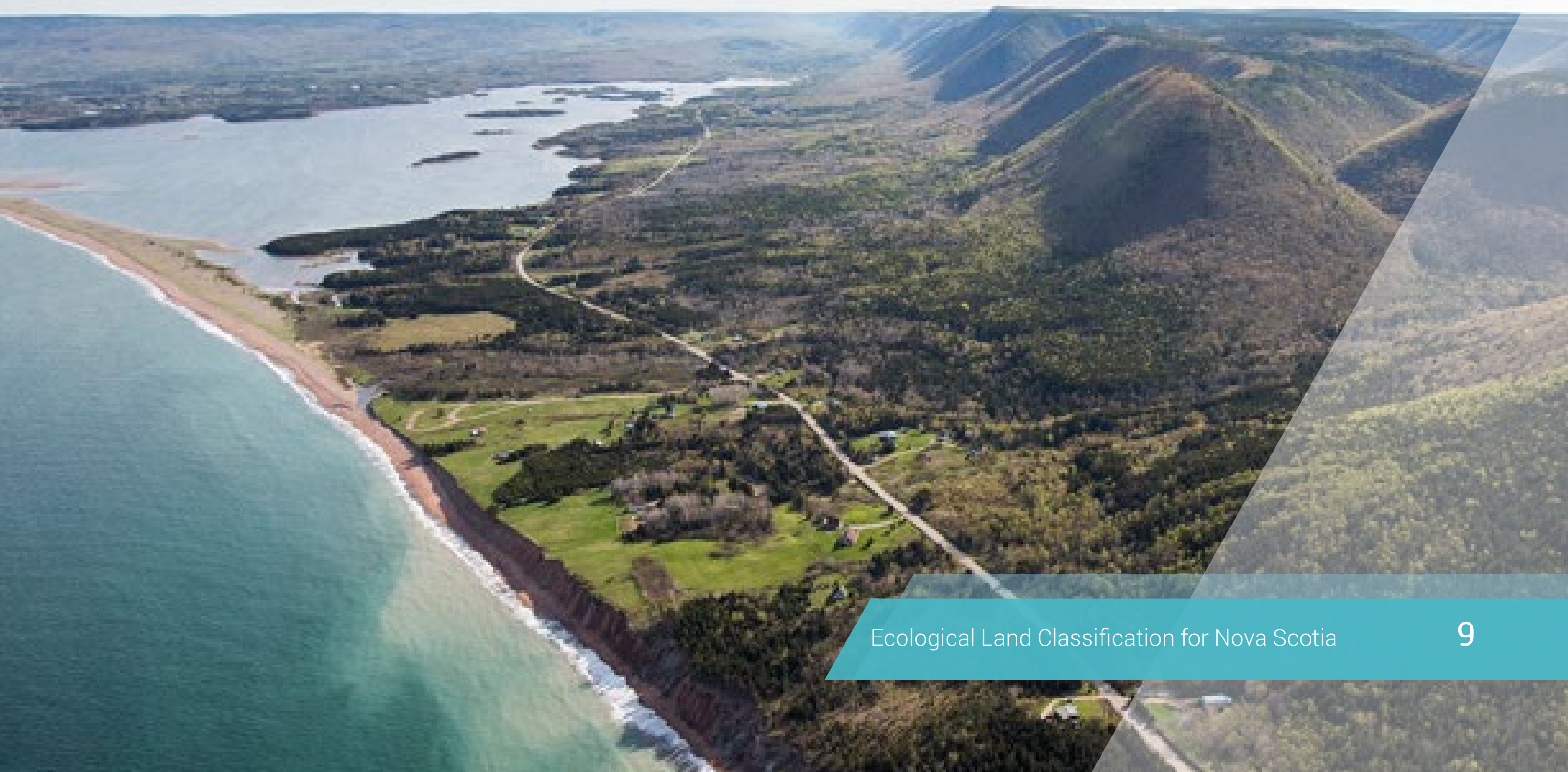


PHOTO (page 9)
Looking southwest along the Aspy Fault from Cabot Landing Provincial Park in the Victoria Lowlands (220).
PHOTO: CNS (Len Wagg)

Part I: Introduction

Ecological Land Classification (ELC) is a widely accepted scientific method for identifying and delineating areas of land with similar ecological patterns and processes. Significant ecological variations are recognized across multiple levels in a nested hierarchy. Within each layer, landscape-based ecosystem units capture ecologically meaningful differences at a specific scale of spatial generalization. ELC hierarchies are typically developed from the top-down. Coarser scaled landscape ecosystems are sequentially partitioned into finer scale units, through iterative analyses. Unlike traditional soil or vegetation classification, ELC seeks to fully integrate climatic, geological, (potential) vegetation, and soil data.

ELC provides a comprehensive summary and description of the primary physical and biological factors shaping ecosystem structure and function. As one of the major tools employed in ecosystem-based approaches to natural resource management, ELC provides a common language for biodiversity and resource distribution analyses. Biodiversity occurs at multiple scales and includes a multitude of elements, including: species, habitats, ecosystems, vegetation age and seral classes, species associations, and components of genetic variability. ELC lends itself to this complexity and facilitates a common understanding of provincial biodiversity.

The idea of systematically grouping ecological and biophysical features with shared characteristics is not new. In Canada, land classification originated in the 1960s when the federal government established the **Canada Land Inventory** (CLI) program. The CLI was a multi-theme land inventory aimed at classifying and mapping differences in agricultural, forestry, recreation, and wildlife (primarily ungulates and waterfowl) potential (Anon. 1965). In 1966 a National Committee on Forest Lands created a subcommittee on **Bio-physical Land Classification** (BLC) with a goal to classify the biological and physical features of the land and to organize this information into a useful framework for management. In Nova Scotia, development of the BLC was completed in 1986 (NSDLF, 1986). The classification, a three-level hierarchy of land regions, land districts and land systems, represented the most comprehensive landscape mapping of the province to date—delineating the variation of nine physical attributes (topographic position, slope, relief, landform, drainage, texture, stoniness, parent rock type, and bedrock exposure). Many of the landscape attributes were determined through the interpretation of infrared aerial photography at a scale of 1:63 560. Other features such as soil drainage and texture were derived from soil survey reports. The biotic (living) component, which was to emphasize vegetation succession, was never incorporated into the classification.

In more recent years, there has been a call for more fully integrated and holistic landscape classifications. For example, the **Canadian Biodiversity Strategy** identified the need to improve biophysical inventories by "developing and applying regionally integrated landscape-level classification systems for terrestrial, freshwater and marine areas to provide a framework for the collection of information and the management of resources." (Environment Canada, 1995)

The **National Forest Strategy 1998–2003** stated that to "improve our understanding of forest ecological functions and their response to natural disturbances and human activity" a completed ecological classification of forest lands at the regional level was required (Canadian Council of Forest Ministers, 1998). The Government of Nova Scotia signed both of these strategies, committing the province to develop an Ecological Land Classification to provide a framework for ecosystem management.

By 2000 the development of an ELC for Nova Scotia was completed using the previously mapped Bio-physical Land Classification as its base. Using the enduring features identified in the biophysical as building blocks for a hierarchical classification of ecosystems, maps were created by delineating ELC ecosystem units using standardized criteria and methods. As a nested hierarchy, the spatial boundaries of each ecosystem were geographically constrained by units in the level of the ELC immediately above.

Classification and mapping of an ELC is hierarchical because many ecological patterns express themselves at different spatial scales. For example, climate (which is typically described at the ecoregion scale) exerts an influence on the vegetation composition (represents the biotic component of ecosystems) that cannot be explained by those finer scale factors employed at lower levels (Matson and Power, 1996). In Nova Scotia this is readily apparent along the Atlantic coast where forest communities developing on similar bedrock geology, landforms, and soils as those found inland have different vegetation communities due to coastal climatic influences. Thus by recognizing climatic influence at upper (coarser scale) levels of the ELC, the differences within lower levels can be explained by other factors more relevant at those finer scales, such as landform, soil fertility, soil moisture, slope position, aspect—and not climate.

Hierarchical Classification

Nova Scotia's ELC uses a standardized methodology for defining and describing the geography of terrestrial landscape-based ecosystems. By nesting the ecosystems within a hierarchy (and by providing linkages among ecosystems in the different levels), the integrated system can be tailored to suit resource management objectives at the appropriate scale and level of detail. The ELC is comprised of five levels, each defined at a set spatial scale **(See Table 1)**.

Classification data are available in digital format as **Arc/Info Coverage** and **Arc/Info Export E00** files from the Department of Natural Resources website. http://novascotia.ca/natr/

Landscape-based ecosystems, within each level, are classified using enduring environmental components, such as bedrock geology, surficial materials, landform, present-day climate and topography. Vegetation, which reflects enduring features, is often employed to help understand and calibrate classification outputs. The differentiating criteria of ecosystems at each level of spatial generalization may vary since not all components may be equally significant throughout the classification.

Island Lake (St. Margaret's Bay, 780) *PHOTO: CNS (Len Wagg)*

Nodding trillium, commonly found on richer sites in tolerant hardwood forests as well as floodplain forests
PHOTO: CNS (Len Wagg)

Therefore, the classification will reflect the components that best reflect the origin of ecological patterns and processes at each particular unit or scale. For example, the factors that govern the distribution of wetlands in a given ecodistrict are not driven by climate, which is typically a more important ecological factor at coarser scales (i.e., ecozones and ecoregions).

The climate of Nova Scotia is changing. Elevated levels of greenhouse gases here, and elsewhere around the globe, are widely considered the primary cause of higher temperatures, increased storm frequency and intensity, and anticipated shifts in a wide variety of other climatic attributes.

The ELC is a framework that can be used to study and understand the relationships between biodiversity and the climate of the present day and/or recent past, and to assess potential future climate change impacts on terrestrial ecosystems.

Table 1. Hierarchical levels of the Nova Scotia Ecological Land Classification

Ecological Unit	Map Scale	# of Units	Criteria For Delineating Units
Ecozone	1:1 000 000	1	Global or continental climate as reflected by vegetation
Ecoregion	1:500 000	9	Provincial climate as expressed through soils and vegetation
Ecodistrict	1:250 000	39	Subdivisions of ecoregions characterized by distinctive assemblages of relief, geology, landform, soils and vegetation
Ecosection	1:50 000	707 *	Enduring features of the ecodistrict such as soil drainage, topography, landform and soil texture. These usually arrange as repeating assemblages in the ecodistrict.
Ecosite	1:10 000	N.A.	A uniformity of parent material, soil moisture and nutrient regimes and vegetation as expressed by slope, slope position, aspect and exposure

* Ecosections and ecosites are the only two types of units that are not coded uniquely within higher order levels of the ELC. For example, WCHO (an ecosection unit) may be found in any ecodistrict or ecoregion of NS but it is given the same code regardless of its placement in the classification. That said, each occurrence of WCHO is more similar within a given ecodistrict than it is among different ecodistricts or ecoregion.

Mapping ELC Units

Ecological land classification is more than just the identification and mapping of ecosystems, since it provides an understanding of ecosystem form and function by linking abiotic and biotic components within and across each level in the hierarchy (Sims et al. (1996); Matson and Power (1996)). Ecosystems within the classification must be more than a concept to be useful for management; they must be delineated on the landscape and adequately described.

In Ontario, Hills (1959) recognized the effects of interactions of climate, landform, and soils on the distribution of vegetation, and divided the province into broad macroclimatic regions within which distinct physiographic areas were delineated. Following the hierarchy of the **National Ecological Framework for Canada**, which was released in 1996, Webb and Marshall (1999) provided more in-depth provincial perspectives on Nova Scotia's ecosystems. They suggested that the fundamental basis for delineation of ecological units is to capture the major ecological composition and the linkages between the various components (i.e., landforms, soils, water and vegetation) rather than treating each component as a separate characteristic of the landscape.

Even though ecological land classification is science-based, some subjective interpretation is required to reduce the complexity of ecosystems and to make map units practical and understandable. The key elements in the application of ELC in delineating map units are as follows (Commission for Environmental Cooperation 1997):

- An ELC incorporates all the major components of ecosystems: air, water, land and biota.
- The ELC is holistic since "the whole is greater than the sum of its parts."
- The number and relative importance of factors helpful in delineating ecological units vary from one area to another, regardless of the level of generalization.
- The ELC is based on a hierarchy, with ecosystems nested within ecosystems.
- An ELC involves integration of knowledge and is not simply an overlay.
- An ELC recognizes that ecosystems are interactive and that characteristics of one ecosystem blend with those of another.
- Map lines in an ELC generally depict the location of zones of transition. (Sometimes this zone is quite narrow, e.g., delineating topographic patterns; other times it is wider, e.g., delineating climatic regions).

Western Ecoregion (700) *PHOTO: CNS (Len Wagg)*

On the Northern Plateau (100) looking into the North Aspy River valley *PHOTO: DNR (Sean Basquill)*

Mapped ecosystem boundaries represent a consistent, and often significant, degree of change. This change is usually reflected by the response of vegetation to factors such as climate and enduring features. It is important to recognize that mapped units are spatial generalizations. For instance, a unit identified as having well drained soil, may contain smaller inclusions of imperfectly and/or poorly drained soil.

The first step in developing the ecological land classification for Nova Scotia required digitizing "land system" (a type of landscape) units from **Nova Scotia's Bio-physical Land Classification** (BLC). Subsequently, land system polygon attributes were coded into the BIOSYS layer of the Department of Natural Resource's geographic information system (GIS). Analysis of the BIOSYS by the Department's Ecological Technical Committee, determined that topographic position, soil drainage, and soil texture attributes could be used to form a basis of the ELC. Field work validated this analysis and these enduring landscape features were used to define the ecosection level of the new classification. GIS technology was used to merge adjacent BIOSYS polygons of similar attributes and produce maps at a scale of 1:50 000 for the entire province. These maps were edited using expert knowledge, data on current forest conditions, field surveys, infrared aerial imagery, and many of the original resource maps (soils, geology and surficial geology) used in the creation of the BLC. With the ecosections delineated, other features, (described below) were used to create the ecodistricts and ecoregions. Other provincial land classifications were also consulted during the process. These included: **A Forest Classification for the Maritime Provinces** (Loucks, 1962); **Ecoregions and Ecodistricts of Nova Scotia** (Webb and Marshall, 1999); **Natural History of Nova Scotia Theme Regions, Volume 2** (Davis and Browne, 1996), and **Natural Landscapes of Nova Scotia** (NSDEL, 2002). The above classifications were very useful in helping to advance this classification and report.

The Ecological Levels

The Ecological Land Classification has five levels, giving a scientific description of the variety of terrestrial ecosystems across the province at ecologically relevant scales. This framework enables resource managers and scientists to work with the diverse factors each ecosystem presents. The broadest scale division of ecosystem geography recognized in the ELC is the **ecozone** which is further subdivided into finer scaled ecoregions, **ecodistricts**, **ecosections** and **ecosites**. Each unit of each level is distinguished by various factors which may include: climate, topography, landform, soils, vegetation, nutrient and moisture regimes, as well as site characteristics (aspect, steepness, slope position) to distinguish between the various units of the classification at each level. Subsequently finer levels of the classification provide additional detail about the ecosystem.

The entire **Ecological Land Classification for Nova Scotia** can be viewed on the Department of Natural Resources website through the Provincial Landscape Viewer at https://sgi.novascotia.ca/plv/

Ecozone

Ecozones describe ecological features at a sub-continental level. They are generalized ecological units characterized by large contiguous areas of similar macroclimate, physiographic and geological features and vegetation. Usually the vegetation is a reflection of the macroclimatic elements such as solar radiation and heat totals.

The Canadian Council on Ecological Areas revised the national mapping of ecozones (Ecological Stratification Working Group, 1995) in 2014. It divides Canada into 18 terrestrial ecozones with all of Nova Scotia within the Atlantic Maritime ecozone (CCEA, 2014).

Nova Scotia, even with some boreal-like conditions along the Atlantic coast and in the Cape Breton Highlands, is represented by one ecozone. This ecozone also occurs in southern New Brunswick, Prince Edward Island, and several New England states. These areas share a similar continental climate and forest. In Canada this forest is called the Acadian Forest Region (Halliday, 1937), and is broadly defined as that area where red spruce is characteristic (climax dominant). This classification was further refined by Rowe (1972) in his Forest Regions of Canada where he described a forest "closely related to the Great Lakes–St. Lawrence Forest Region and, to a lesser extent, to the Boreal Forest Region. Red spruce is a characteristic though not exclusive species, and associated with it are balsam fir, yellow birch and sugar maple, with some red pine, eastern white pine, and eastern hemlock (Beech was formerly a more Important forest constituent than at present, for the beech bark disease has drastically reduced its abundance)."

Near Fishing Cove (Cape Breton Hills, 310) *PHOTO: CNS (Len Wagg)*

Ecoregions

Ecoregions are subdivisions of ecozones and capture distinctive ecological responses to regional climate in soils and vegetation patterning. Ecoregions are characterized by ecological factors, including climatic, physiography, vegetation, soil, water, fauna, and land use (ESWG, 1995). In Nova Scotia, climate is often influenced by proximity to cool coastal waters and by elevation.

Therefore, at the ecoregion scale, boundaries drawn on the basis of these criteria often coincide with the major physiographic features, and ecoregions can be delineated around topography and/or proximity to the ocean. However, the delineation of climatic zones in the province is challenging and the boundaries are sometimes indistinct due to the often mixed effects of coastal and elevational influences. Climatic factors that affect biodiversity in terrestrial ecosystems include some factors that were not always used when determining the typical climatic units. Minimum winter temperatures and snowfall are two factors that were considered in the determination of ecoregions in Nova Scotia for this ELC. Soil, water and fauna also mirror the interaction of climate and vegetation at this scale. Vegetation patterns are strongly correlated with these climatic influences, and the terrestrial ecosystems of each region display distinctive characteristics.

Nine ecoregions have been mapped for Nova Scotia—ranging in size from 416 km^2 to 16 870 km^2.

Ecodistricts

Ecodistricts are unique, distinct subdivisions of the ecoregions. ESWG (1995) defines an ecodistrict as part of an ecoregion characterized by distinctive assemblages of relief, geology, landforms and soils, vegetation, water, fauna, and land use. Together, these regulators influence all terrestrial and aquatic ecosystems.

In general, ecodistricts are discernible as distinct, large-scale, physiographic areas that can be used to separate uplands and lowlands. They may be further defined by landform pattern, surficial and/or bedrock geology, soils, water bodies, or vegetation within the larger ecoregion.

Thirty-nine ecodistricts are currently identified for Nova Scotia in the 2015 ELC. This is one less than in the 2003 and 2005 versions because the former **Eastern Drumlins (420)** is now part of **Eastern Interior (440)**. The ecodistricts range in size from 31 km^2 to 4575 km^2.

Ecosections

Ecosections are distinct subdivisions of ecodistricts. These are the smallest mapped units of the 2015 version of the ELC. As the building block for the ELC, this unit describes the enduring physical features: soil drainage, soil texture, topographic pattern and sometimes landform. At this level of mapping, biological processes such as climax forest association and natural disturbance regime can be interpreted. Together, the physical and biological attributes of the ecosection determine the ecological processes and structures affecting biodiversity.

Each ecodistrict has several dominant ecosections repeating across the landscape in a pattern which may be unique to that ecodistrict. Ecodistricts within the same ecoregion are more than likely to share ecosections with perhaps no noticeable physical differences. Significant differences in both physionomic (general appearance)and floristic components, as well as response to management inputs, are expected between ecosections of different ecoregions.

In this classification wetland ecosystems are classified as poorly drained ecosections of smooth topography. These wetlands are typically non-forested, although they may include small forested areas. Recently the Department of Natural Resources completed an inventory of wetlands interpreting large-scale photography and satellite imagery to describe dominant Vegetation Types (VTs) within the wetland boundary using the **Canadian Wetland Classification System**. This wetland inventory can be viewed on the Provincial Landscape Viewer at: https://nsgi.novascotia.ca/plv/

In Part 2 of this report, a map of a representative area is included for each ecodistrict. The maps show typical distribution of the dominant ecosections in each ecodistrict.

Bedrock ridging near Salters Lake, (Rossignol 750)

Infrared photography used for biophysical mapping. Hardwoods are pink, softwoods green-brown, wetlands are grey.

PHOTO: DNR

Ecosites

Ecosites is a further subdivision of an ecosection. They represent ecosystems that have developed under a variety of conditions and influences, but which have similar moisture and nutrient regimes. An ecosite has a finite range of soil and site conditions and characteristic vegetation patterns that develop naturally under those conditions.

Ecosites can be used to predict forested and non-forested communities, biodiversity, successional development and site productivity. Typically the attributes are delineated at a mapping scale between 1:10 000 and 1:50 000, making this level of the ELC compatible with other resource layers such as forest covertype, wildlife habitat, etc. Subsequent versions of the ELC will include additional ecosites to describe conditions for non-forested ecosystems. These have not currently been defined at this scale.

Management applications for ecosites include forest/landscape-level planning, forest ecosystem management prescriptions, habitat supply modeling, silviculture prescriptions and estimates of wood supply. At present the ecosite layer has not been identified and mapped. The Nova Scotia Department of Natural Resources is currently developing a digital ecosite map layer for the province (based on model-predicted soil moisture and nutrient regimes). Once this map layer is complete, ecosite locations may be predicted using this model. However, field determination of ecosite will always be more definitive than mapped occurrences and/or model predictions. Field procedures for identifying ecosites are available in the **Forest Ecosystem Classification for Nova Scotia** (Neily et al., 2013). novascotia.ca/ natr/forestry/veg-types/

Ecosection Attributes

Each ecosection polygon has a four letter code (e.g., WCHO) that describes the enduring physical features (i.e., soil drainage, soil texture, topographic pattern and sometimes landform) as interpreted for the Land System level in the Bio-physical Land Classification. The first letter in the name represents dominant soil drainage, the second letter represents dominant soil texture, and the final two letters represent the topographic pattern or landform.

X	X	X X
SOIL DRAINAGE	SOIL TEXTURE	TOPOGRAPHIC PATTERN OR LANDFORM

The tables below explain the codes for each category.

Soil Drainage

Dominant soil drainage conditions are identified for each ecosection polygon. It is important to realize that a polygon that is “well drained” can still contain up to 30% imperfect or poorly drained soils within its boundaries.

The **first letter** in the ecosection name denotes soil drainage: ‘W’ for well drained, ‘I’ for imperfectly drained, and ‘P’ for poorly drained. Definitions are as follows:

ELC Code	Description	Definition
W	Well drained	soils > 60% well drained
P	Poorly drained soils	soils > 60% poorly drained
I	Imperfectly drained soils	soils neither well or poorly drained

Soil Texture

In this classification wetland ecosystems are classified as poorly drained ecosections of smooth topography. These wetlands are typically non-forested although they may include small forested areas.

Soil texture refers to the relative percentage of sand, silt and clay particles in a soil. Texture is often described using "classes" which have defined ranges of sand, silt and clay. Several classification schemes are available to describe soil texture (Neily et al., 2013). For the ELC, soil textures were combined into four texture classes.

The **second letter** in the ecosection name represents soil texture class. 'C' for coarse texture, 'M' for medium texture, 'F' for fine texture, and 'O' for organic. Soil textures definitions:

ELC Code	Description	Definition
C	Coarse textured soils	gravel, coarse sand, sand, loamy sand and coarse sandy loam (Note: soils with a high content of gravel were also included in this category)
M	Medium textured soils	sandy loam, fine sandy loam, very fine sandy loam, loam
F	Fine textured soils	silt, sandy clay loam, clay loam, sandy clay, silty clay, clay
O	Organic	decomposing plant material

Mabou Highlands (Cape Breton Hills, 310)
European settlers in the 1800s cleared the tolerant hardwood forests and today these areas are used as community pastures.
PHOTO: CNS (Len Wagg)

Topographic Pattern and Landform

There are seven topographic patterns and landforms that describe ecosections in the ELC. Topography and landform are three-dimensional segments of the earth's surface consisting of soil and rocks produced by natural processes.

The **last two letters** in the ecosection name identify the topographic pattern or landform.

ELC Code	Description	Definition
DM	Drumlinoid	a pattern of elongated landforms caused by glacial ice movement (drumlins and flutes) often occurring in clusters
DS	Canyons and Steep Slopes	sharply sloped terrain along rivers/streams or associated with hilly topography. Slopes usually between 20–80%
FP	Floodplains, Intervals and Deltas	areas adjacent to rivers and streams that are annually or periodically flooded and enriched by sediment
HO	Hummocky	a series of small rounded hills with a gentle slope usually 15% or less
KK	Hills	a series of knobs and knolls with moderate to steep slopes between 5–30%. Relief amplitude ranges from 15–60 m
RD	Ridges	a pattern of linear or curvilinear ridges of bedrock or glacial till origin
SM	Smooth or Flat (Level) e.g. lake plain, open bogs and wetlands	land with no particular pattern, flat or very gently sloping, uni-directional surface with a generally constant slope not broken by marked changes in elevation or by depressions. Slopes are generally less than 1%

Non-conforming Ecosection Names

There are four ecosections that do not conform to the 4-letter coding described above:

ELC Code	Description	Definition
XXDK	Dykeland	areas converted from salt marsh through drainage ditches and dykes
XXCB	Coastal Beach	deposits of wave-washed sands, gravel, and/or cobble
XXMS	Salt Marsh	coastal areas flooded with ocean waters, usually associated with the twice daily high tide, and supporting *Spartina* grass species
XXUR	Urban	cities and the associated residential, commercial and industrial areas

Ecosite Groups

Ecosites represent general productivity units. They provide an ecological setting where vegetation and soil type combinations can be grouped and compared.

Ecosites, as an expression of relative moisture and nutrient regimes, are influenced by regional climate conditions. Nine climate-based ecoregions have been identified in Nova Scotia's ELC system. Theoretically, each ecoregion could have its own set of ecosites to represent relative moisture and nutrient regimes. However, it has been determined through analysis of tree growth data that Nova Scotia can be effectively represented by two main ecosite groups, hereafter referred to as **Acadian** and **Maritime Boreal**. **(See Table 1)**.

The application of regional climatic factors at the ecosite level is a divergence from ELC tradition; climate is typically only applied at the ecozone and ecoregion levels. In Nova Scotia, broad scale climatic influences (particularly temperature and humidity) have noticeable effects on local scale patterns. For practical reasons, two sets of ecosites (Acadian and Maritime Boreal) were created to capture this variability.

Seventeen Acadian and 11 Maritime Boreal ecosites have been identified **(See Tables 2 and 3)**. Each name describes the general moisture/nutrient condition and typical climax forest community associated with the ecosite.

Soil moisture regime represents average moisture availability for plant growth. This is assessed by integrating moisture supply (as related to climate) with soil drainage and moisture holding capacities. In general, very dry to dry moisture regimes have severe to moderate moisture deficits; fresh to moist moisture regimes have little to no moisture deficits; and wet moisture regimes typically have excess moisture during the growing season.

Soil nutrient regime represents the relative availability of nutrients for plant growth. Determination of nutrient regime requires consideration and integration of several environmental parameters including soil texture and depth, soil A-horizon type, forest floor humus form, seepage class and ground water (Neily et al., 2013).

Looking westward from Centrelea on the Annapolis River (Annapolis Valley, 610) *PHOTO: CNS (Len Wagg)*

Table 1. FEC ecosite groups and associated ecoregion and ecodistrict units

Acadian Ecosite Group	Maritime Boreal Ecosite Group
Victoria Lowlands ecodistrict (220)	Cape Breton Highlands ecodistrict (210)
Nova Scotia Uplands ecoregion (300)	Northern Plateau ecoregion (100)
Eastern ecoregion (400)	Atlantic Coastal ecoregion (800)
Northumberland / Bras d'Or ecoregion (500)	
Valley and Central Lowlands ecoregion (600)	
Western ecoregion (700)	
Fundy Shore ecoregion (900)	

Table 2. Acadian group ecosites

Ecosite	Ecosite Name	Ecosite	Ecosite Name
AC1	Dry-Very Poor / Jack pine-Black spruce	**AC10**	Fresh-Medium / Red spruce-Hemlock
AC2	Fresh-Very Poor / Black spruce-Pine	**AC11**	Moist-Medium / Red spruce-Yellow birch
AC3	Moist-Very Poor / Black spruce-Pine	**AC12**	Wet-Medium / Red maple-White ash-Fir
AC4	Wet-Very Poor / Black spruce-Tamarack	**AC13**	Fresh-Rich / Sugar maple-Beech
AC5	Dry-Poor / White pine-Oak	**AC14**	Moist-Rich / Sugar maple-Yellow birch
AC6	Fresh-Poor / Black spruce-White pine	**AC15**	Wet-Rich / White ash-Red maple
AC7	Moist-Poor / Black spruce-White pine	**AC16**	Fresh-Very Rich / Sugar maple-White ash
AC8	Wet-Poor / Spruce-Fir-Red maple	**AC17**	Moist-Very Rich / Sugar maple-White ash
AC9	Dry-Medium / Red maple-Spruce		

Table 3. Maritime Boreal group ecosites

Ecosite	Ecosite Name	Ecosite	Ecosite Name
MB1	Dry-Poor / Black spruce-Jack pine	**MB7**	Wet-Medium / Red maple-Fir
MB2	Fresh-Poor / Black spruce	**MB8**	Fresh-Rich / Birch-Fir
MB3	Moist-Poor / Black spruce	**MB9**	Moist-Rich / Birch-Fir
MB4	Wet-Poor / Black spruce	**MB10**	Wet-Rich / Red maple
MB5	Fresh-Medium / Fir-Spruce	**MB11**	Fresh Moist-Very Rich / Red maple-Birch
MB6	Moist-Medium / Fir-Spruce		

Acadian Ecosites

The Acadian group contains 17 ecosites representing the full range of forest site conditions. **(See Figure 2)**

Zonal ecosites typically support climatic forests containing mainly shade tolerant and shade intermediate species (such as red spruce, hemlock, white pine, sugar maple, red maple, yellow birch, beech and white ash). **Edaphic** ecosites define site-driven climax forests and typically support species such as black spruce, white pine, red pine, jack pine, balsam fir, tamarack, red oak, red maple and white ash. **Transitional** ecosites may contain both types of climax conditions with similar moisture and nutrient regimes.

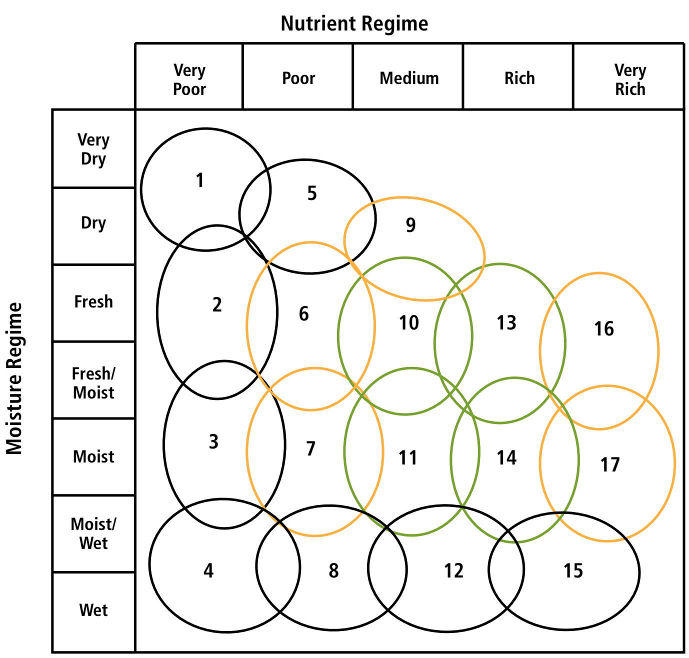
Several successional plant communities are also associated with these ecosites, with tree species such as trembling aspen, large-tooth aspen, red oak, white birch, grey birch, red maple, black cherry, balsam fir, and white spruce.

It is possible for Vegetation Types (VTs) normally associated with Maritime Boreal ecosites to be found in geographic areas classed as Acadian **(See Table 1, pg 21)**. This would most likely occur near saltwater coastlines (e.g., along the Bay of Fundy and Northumberland Strait) or at higher elevations (e.g., within the **Bras d'Or Lowlands (510)** ecodistrict). Where Maritime Boreal VTs are found in Acadian areas, Maritime Boreal ecosite descriptions and productivity interpretations should be applied.

Flowering mountain sandwort among reindeer lichen

PHOTO: DNR (Peter Neily)

For more information on site characteristics, vegetation types and soil types associated with ecosites, refer to the **Forest Ecosystem Classification for Nova Scotia** (Neily et al., 2013).



1. Dry-Very Poor / Jack pine-Black spruce
2. Fresh-Very Poor / Black spruce-Pine
3. Moist-Very Poor / Black spruce-Pine
4. Wet-Very Poor / Black spruce-Tamarack

5. Dry-Poor / White pine-Oak
6. Fresh-Poor / Black spruce-White pine
7. Moist-Poor / Black spruce-White pine
8. Wet-Poor / Spruce-Fir-Red maple

9. Dry-Medium / Red maple-Spruce
10. Fresh-Medium / Red spruce-Hemlock
11. Moist-Medium / Red spruce-Yellow birch
12. Wet-Medium / Red maple-White ash-Fir

13. Fresh-Rich / Sugar maple-Beech
14. Moist-Rich / Sugar maple-Yellow birch
15. Wet-Rich /White ash-Red maple

16. Fresh-Very Rich / Sugar maple-White ash
17. Moist-Very Rich / Sugar maple-White ash

Figure 2.
Edatopic grid showing relative moisture and nutrient regimes for Acadian ecosites. **Green** = zonal ecosites. **Black** = edaphic ecosites. **Gold** = transitional ecosites which can support both edaphic and zonal vegetation types

AC1

Dry - Very Poor / Jack pine - Black spruce

Occurring on upper slopes and crests of bedrock ridges and/or on coarse textured glacial till and glaciofluvial deposits, this ecosite has dry, nutrient very poor soils that generally support open stands of stunted black spruce, red pine, jack pine, red maple and red oak.

Ericaceous species dominate the shrub layer (mainly huckleberry, lambkill and blueberry), with broom-crowberry, wild raisin and false holly also common. There are usually low levels of herb cover, with bracken and teaberry the main species. The forest floor is dominated by reindeer lichens and Schreber's moss.

Following disturbance or natural mortality in mature forest stands, this ecosite typically regenerates to species similar to those found in the edaphic climax forest dominated by black spruce. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.

AC1 sites are scattered throughout Nova Scotia wherever near-surface bedrock and sandy soils are found. Ecodistricts with increased rockiness include **Eastern Granite Uplands (430)**, **Eastern Interior (440)**, and **Chignecto Ridges (560)**. Significant glaciofluvial deposits are found in **Annapolis Valley (610)** and **Minas Lowlands (620)** ecodistricts.

AC2

Fresh - Very Poor / Black spruce - Pine

Occurring mainly on gentle slopes or well-drained, level areas with coarse textured glacial till or glaciofluvial deposits, this ecosite has fresh, nutrient very poor soils that generally support poorly stocked forests of black spruce, red pine, jack pine and white pine.

Ericaceous species dominate the shrub layer (mainly lambkill, rhodora and blueberry) often with significant black spruce regeneration. Bracken cover can be extensive in the herb layer, with teaberry and bunchberry also common. The forest floor is dominated by Schreber's moss.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce. White pine may form a super canopy over black spruce on some sites. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.

AC2 sites are distributed throughout Nova Scotia wherever fresh, nutrient poor soils are found. Areas of higher occurrence include **Northumberland Lowlands (530)**, **Annapolis Valley (610)**, **Minas Lowlands (620)** and **South Mountain (720)** ecodistricts.

Fresh - Very poor / Black spruce - pine (AC2) (Western Ecoregion, 700) *PHOTO: DNR (Sean Basquill)*

AC3

Moist - Very Poor / Black spruce - Pine

Occurring mainly on imperfectly drained, level areas, or on middle and lower slopes with coarse textured glacial till or glaciofluvial deposits, this ecosite has moist, nutrient very poor to poor soils that generally support poorly stocked stands of black spruce, red pine, jack pine and white pine.

Ericaceous species dominate the shrub layer (mainly lambkill, rhodora and blueberry) often with significant black spruce regeneration. Bracken cover can be extensive in the herb layer, with teaberry and bunchberry also common. The forest floor is dominated by Schreber's moss. Plants indicative of moist soils are also found, including false holly, Labrador tea, cinnamon fern, creeping snowberry and peat mosses.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce. White pine may form a super canopy over black spruce on some sites. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.

AC3 sites are distributed throughout Nova Scotia wherever moist, nutrient poor soils are found. Areas of higher occurrence include the **Bras d'Or Lowlands (510)**, **Northumberland Lowlands (530)**, **Annapolis Valley (610)**, **Minas Lowlands (620)**, and **South Mountain (720)** ecodistricts.

AC4

Wet - Very Poor / Black spruce - Tamarack

Occurring mainly on poorly to very poorly drained, level areas and depressions with coarse textured glacial till and/or organic deposits, this ecosite has wet, nutrient very poor to poor soils that generally support poorly stocked stands of slow growing black spruce.

False holly and ericaceous species dominate the shrub layer (mainly lambkill, blueberry, rhodora and Labrador tea). Creeping snowberry, bunchberry, cinnamon fern, bracken and three-seeded sedge are common herbs. The forest floor is dominated by peat mosses and Schreber's moss. Forest AC4 sites are generally associated with treed bogs and/or poor, coniferous treed swamps.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce. Fluctuating

Wet - Very poor / Black spruce - Tamarack (AC4)
PHOTO: DNR (Sean Basquill)

water table levels, windthrow, insects and disease are significant disturbance agents. Seasonal moisture deficits, combined with the flammability of ericaceous vegetation, can sometimes create favourable fire conditions.

AC4 sites are found throughout Nova Scotia, usually embedded as small or large patches within the matrix forest. In the **Bras d'Or Lowlands (510)**, **Northumberland Lowlands (530)**, **Central Lowlands (630)**, and **Sable (760)** ecodistricts, AC4 sites can also be matrix forming.

AC5

Dry - Poor / White pine - Oak

Occurring mainly on well to rapidly drained slopes with coarse textured and/or shallow soils, this ecosite has dry, nutrient poor soils that generally support poorly stocked stands with white pine (often as a super canopy) and other species capable of withstanding harsh site conditions (e.g., black spruce, red pine, red maple, large-tooth aspen and red oak). On soils of slightly better fertility, red spruce and/or hybrid spruce are possible.

Ericaceous species dominate the shrub layer (mainly lambkill and blueberry), with wild raisin, witch-hazel and huckleberry also common. Herb coverage and diversity are low and favour species which tolerate dry, acid soils (e.g., bracken, teaberry, mayflower and bunchberry). The forest floor is dominated by Schreber's moss and broom mosses.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce and white pine. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.

AC5 sites are mainly found in western Nova Scotia, but are scattered elsewhere wherever dry, nutrient poor soils can be found. Areas of higher occurrence include the **Eastern Interior (440)**, **South Mountain (720)**, **Rossignol (750)**, and **Western Barrens (770)** ecodistricts.

AC6

Fresh - Poor / Black spruce - White pine

Occurring mainly on well drained slopes with coarse textured glacial till deposits, this ecosite has fresh, nutrient poor soils that generally support closed canopy stands of white pine and black spruce. When balsam fir is present, it is generally intermediate in the canopy and of low vigour. Early successional stands are dominated by large-tooth aspen, red oak and red maple. On slightly better soils, red spruce and/or hybrid spruce are possible.

Ericaceous species dominate the shrub layer (mainly lambkill and blueberry), with wild raisin, witch-hazel and huckleberry also common. Herb coverage and diversity are low, and favour species that tolerate acid soils (e.g., bracken, teaberry, mayflower and bunchberry). The forest floor is dominated by Schreber's moss.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce and white pine. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.

AC6 sites are distributed throughout Nova Scotia wherever well drained, nutrient poor soils can be found. Areas of higher occurrence include the **Eastern Interior (440)**, **Bras d'Or Lowlands (510)**, **Northumberland Lowlands (530)**, **Minas Lowlands (620)**, **Central Lowlands (630)**, **South Mountain (720)**, and **Rossignol (750)** ecodistricts.

Lambkill *(Kalmia angustifolia)*
PHOTO: DNR (Eugene Quigley)

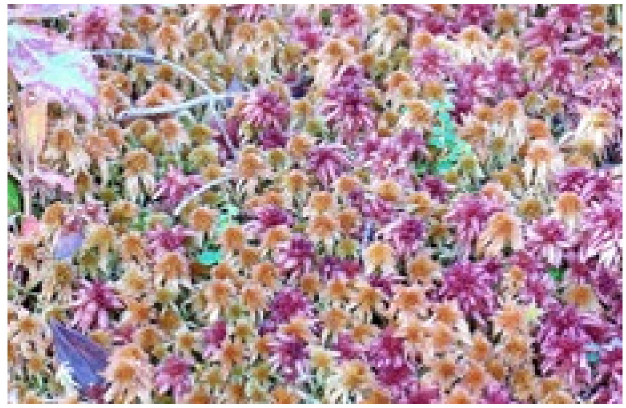
AC7

Moist - Poor / Black spruce - White pine

Occurring mainly on imperfectly drained slopes and level areas with coarse textured glacial till deposits, this ecosite has moist, nutrient poor soils that generally support closed canopy stands of black spruce, with white pine and red pine. When balsam fir is present, it is generally intermediate in the canopy and of low vigour. Early successional stands are dominated by large-tooth aspen, red oak and red maple. On slightly better soils, red spruce and/or hybrid spruce are possible.

Imperfect drainage is indicated by the presence of peat mosses, cinnamon fern and creeping snowberry. Bracken and bunchberry are also present in the herb layer. Ericaceous shrubs still dominate the shrub layer (mainly lambkill and blueberry), but black spruce regeneration (from layering) can also be extensive in the understory.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.



Sphagnum mosses. There are over 30 species in Nova Scotia, most of which are green. *PHOTO: DNR (Peter Neily)*

AC7 sites are distributed throughout Nova Scotia wherever moist, nutrient poor soils can be found. Areas of higher occurrence include the **Eastern Interior (440)**, **Bras d'Or Lowlands (510)**, **Northumberland Lowlands (530)**, **Minas Lowlands (620)**, **Central Lowlands (630)**, **South Mountain (720)**, and **Sable (760)** ecodistricts.

AC8

Wet - Poor / Spruce - Fir - Red maple

Occurring mainly on poorly to very poorly drained, level areas and depressions with medium to coarse textured glacial till and/or organic deposits, this ecosite has wet, nutrient poor to medium soils

Moist – Poor / Black spruce – White pine (AC7) near Canaan (St. Margaret's Bay, 780) *PHOTO: CNS (Len Wagg)*

that generally support softwood stands containing spruce (red, black, hybrid), balsam fir, hemlock, tamarack, and (occasionally) eastern white cedar. Slightly better sites support red maple mixedwoods, with balsam fir and white ash.

False holly, wild raisin, speckled alder and softwood regeneration dominate the shrub layer. The herb layer is moderately diverse, with cinnamon fern and sedges the main species. Bryophyte diversity is also moderate, with peat mosses dominant. Forest AC8 sites support coniferous and mixedwood treed swamps that receive seepage flows and/or ground water inputs.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to either an edaphic climax softwood forest (dominated by balsam fir, red spruce and hemlock), or an edaphic climax mixedwood forest (dominated by red maple, balsam fir, and/or spruce). Along with senescence, windthrow and fluctuating water table levels are the main disturbance agents.

AC8 sites are found throughout the province, usually embedded as small or large patches within the matrix forest. AC8 sites with red spruce and hemlock are usually found in the **Western Ecoregion (700)**. Mixedwood sites with red maple and balsam fir are found throughout the province, with higher occurrence in the **Northumberland Lowlands (530)** and **Central Lowlands (630)** ecodistricts.

AC9

Dry - Medium / Red maple - Spruce

Occurring mainly on well drained steep slopes with shallow glacial till and/or colluvium deposits, this ecosite has dry, nutrient medium soils that generally support mixed forests of sugar maple, red maple, white birch and beech. Red spruce, hybrid spruce, white spruce and occasionally hemlock can also be present. Understory vegetation diversity is usually low, and coverage is generally sparse to moderate.

Ericaceous shrubs such as blueberry and lambkill are present in low numbers. Herbs include typical upland forest species such as starflower, evergreen wood fern, sarsaparilla and bracken. Hay-scented fern coverage can sometimes be extensive in hardwood dominated vegetation types. The extent of bryophyte cover depends on the tree species mix—usually increasing with softwood cover (mainly Schreber's moss and broom mosses).

Dogtooth violet is a spring ephemeral common in the shade tolerant hardwood forests of the Nova Scotia Uplands (300)
PHOTO: DNR (Peter Neily)

AC9 sites are often associated with mafic bedrock and/or mafic rock colluvium which make these sites inherently more fertile than AC5 sites.

Following disturbance, succession in this ecosite depends on the residual overstory condition and the presence/survival of advanced regeneration. Intense disturbance can promote early successional stages dominated by shade intolerant species. Lightly disturbed late successional stages can continue to develop as uneven-aged forests of long-lived species.

AC9 sites are scattered throughout Nova Scotia. Areas of higher occurrence include the **Cape Breton Highlands (210)**, **Cape Breton Hills (310)**, **Pictou Antigonish Highlands (330)**, **Cobequid Hills (340)** and **North Mountain (920)** ecodistricts.

AC10

Fresh - Medium / Red spruce - Hemlock

Occurring mainly on well drained slopes with medium textured glacial till deposits, this ecosite has fresh, nutrient medium soils that generally support late successional forests dominated by red spruce, hemlock and yellow birch. Earlier successional forests contain balsam fir, white birch, red maple and trembling aspen.

The shrub layer is usually dominated by regenerating softwoods, and typical softwood forest plants are found in the herb layer (e.g., wild lily-of-the-valley, starflower, bluebead lily, partridge-berry and wood ferns). Schreber's moss is the main bryophyte, along with stair-step moss and bazzania.

Natural stand-level disturbances are infrequent and usually due to windthrow (hurricanes) and/or fire. Following disturbance, succession in this ecosite depends on the residual overstory condition and the presence/survival of advanced regeneration. Intense disturbance can promote early successional stages dominated by shade intolerant species. Lightly disturbed late successional stages will continue to develop as uneven-aged forests.

In Nova Scotia, the majority of Acadian climax softwood forests are found on AC10 and AC11 sites. Areas of higher AC10 occurrence include the **South Mountain (720)**, **Rossignol (750)** and **St. Margaret's Bay (780)** ecodistricts (red spruce, hemlock and white pine dominant); and the **Central Uplands (380)**, **Eastern Interior (440)**, **Governor Lake (450)**, **Cumberland Hills (540)** and **Parrsboro Shore (910)** ecodistricts (red spruce dominant).

AC11

Moist - Medium / Red spruce - Yellow birch

Occurring mainly on imperfectly drained lower slopes and level areas with medium textured glacial till deposits, this ecosite has moist, nutrient medium soils that generally support mixedwood climax communities dominated by red spruce, hemlock and yellow birch. Earlier successional forests contain balsam fir, aspen, white birch and red maple.

The shrub layer usually includes regenerating tree species (especially balsam fir) along with striped maple and fly-honeysuckle. Many fern species are found in the herb layer, usually dominated by New York fern and wood ferns, with club-mosses also present. Bryophyte cover varies depending on tree species mix—usually increasing in both diversity and coverage as the softwood component increases.

Natural stand-level disturbances are infrequent and usually due to windthrow (hurricanes) and/or fire. Following disturbance, succession in this ecosite depends on the residual overstory condition and the presence/survival of advanced regeneration. Intense disturbance can promote early successional stages dominated by shade intolerant species. Lightly disturbed late successional stages will continue to develop as uneven-aged forests of long-lived species.

In Nova Scotia, the majority of Acadian climax softwood and mixedwood forests are found on AC11 and AC10 sites. Areas of higher AC11 occurrence are similar to AC10, with mixedwood climax forests more prominent in the **Rawdon/Wittenburg Hills (410)**, **St. George's Bay (520)**, **Central Lowlands (630)**, **Clare (730)** and **LaHave Drumlins (740)** ecodistricts.

Fresh - Medium / Red spruce - Hemlock (AC10) at West Branch Lake, Pictou County (Central Uplands, 380)
PHOTO: DNR (Peter Neily)

Fall colours highlight a wet red maple forest (AC12) on the Black River near Loch Ban, on Lake Ainslie (Inverness Lowlands, 320)
PHOTO: DNR (Bob Gusett, retired DNR)

AC12

Wet - Medium / Red maple - White ash - Fir

Occurring mainly on poorly to very poorly drained level areas and depressions with medium to fine textured glacial till and/or organic deposits, this ecosite has wet, nutrient medium to rich soils that generally support hardwood stands dominated by red maple and/or trembling aspen. Slightly richer sites will also have a component of white ash. Balsam fir, red spruce and hemlock can also contribute to a mixedwood condition on slightly poorer sites.

Shrub cover consists mainly of regenerating trees, wild raisin and speckled alder. Herb layers are often species poor, but with cinnamon fern, sensitive fern, dwarf raspberry and sedge species the most common. Bryophyte coverage is moderate and consists mainly of peat mosses (with lesser amounts of common upland mosses). Forest AC12 sites are generally associated with mixedwood and hardwood treed swamps that receive nutrient rich seepage flows and/or ground water inputs.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, usually leading to an edaphic climax mixedwood or hardwood forest. Along with senescence, windthrow and fluctuating water table levels are the main disturbance agents.

AC12 sites are scattered throughout Nova Scotia, usually embedded as small or large patches within the matrix forest. Areas of higher occurrence include the **Northumberland/Bras d'Or (500)** and **Valley** and **Central Lowlands (600)** ecodistricts.

AC13

Fresh - Rich / Sugar maple - Beech

Occurring mainly on well drained slopes with medium textured glacial till deposits, this ecosite has fresh, nutrient rich soils that generally support late successional forests dominated by sugar maple and beech, along with yellow birch, red maple, white ash, and occasionally ironwood.

Earlier successional forests contain aspen, white birch and red maple. Old field forests of white spruce and white pine are also common where upland hardwood forests were cleared for agriculture and later abandoned.

Vernal pools are common in the shade tolerant hardwood forests of ecosites AC13 and AC14. This one is in the Gully Lake Wilderness Area (Cobequid Hills, 340) *PHOTO: CNS (Len Wagg)*

The shrub layer usually includes regenerating trees along with beaked hazelnut, striped maple, mountain maple, fly-honeysuckle and hobblebush. Ferns are extensive in the herb layer and include hay-scented, New York fern and wood fern species. Bryophytes are typically absent on the forest floor, occurring on rotten stumps and logs, and on tree trunks, especially near the base.

Most natural disturbance is small scale (individual trees or small patches), which promotes uneven-aged forests. Natural stand-level disturbances are infrequent and usually due to windthrow (hurricanes). However, insects, disease, and/or abiotic stresses have also caused significant mortality in some regions (e.g., beech scale disease and sugar maple die-back). These large scale disturbances have impacted species distribution and dynamics in affected stands.

Following disturbance, succession in this ecosite depends on the residual overstory condition and the presence/survival of advanced regeneration. Intense disturbance can promote early successional stages dominated by shade intolerant species. Lightly disturbed late successional stages will continue to develop as uneven-aged forests of long-lived species.

In Nova Scotia, the majority of Acadian climax hardwood forests are found on AC13 and AC14 sites. The **Nova Scotia Uplands (300)** ecoregion has the greatest percentage of AC13 sites. Other areas of high occurrence include drumlin sites in the **Eastern Interior (440)**, **Clare (730)**, and **LaHave Drumlins (740)** ecodistricts.

AC14

Moist - Rich / Sugar maple - Yellow birch

Occurring mainly on moderately well to imperfectly drained slopes with medium textured glacial till deposits, this ecosite has moist, nutrient rich soils that generally support late successional forests dominated by sugar maple, with lesser amounts of white ash, yellow birch and ironwood. Mixedwood stands of red spruce, hemlock, sugar maple and yellow birch can also found.

Earlier successional forests are rare as vegetation types in this unit are usually small patches embedded within a larger matrix forest. Plant diversity is very high and typical of rich hardwood sites.

The shrub layer usually includes regenerating trees along with alternate-leaved dogwood, mountain maple, striped maple, beaked hazelnut and fly-honeysuckle. Fern diversity is the greatest of all ecosites and includes Christmas fern, silvery spleenwort, northern beech fern, oak fern and lady fern. Bryophyte cover is usually sparse. This ecosite can support several rare and endangered plant species including foamflower, thimbleweed, grape fern species and sedge species.

Most natural disturbance is small scale (individual trees or small patches), which promotes uneven-aged forests. Natural stand-level disturbances are infrequent and usually due to windthrow (hurricanes). However, insects, disease, and/or abiotic stresses have also caused significant mortality in some regions (e.g., sugar maple die-back and yellow birch die-back). These large scale disturbances have impacted species distribution and dynamics in affected stands.

Following disturbance, succession in this ecosite depends on residual overstory condition and the presence/survival of advanced regeneration. Intense disturbance can promote early successional stages dominated by shade intolerant species. Lightly disturbed late successional stages will continue to develop as uneven-aged forests.

In Nova Scotia, the majority of Acadian climax hardwood forests are found on AC14 and AC13 sites. The **Nova Scotia Uplands (300)** ecoregion has the greatest percentage of AC14 sites. Other areas of high occurrence include long slopes in the **Northumberland Lowlands (530)** and **Central Lowlands (630)** ecodistricts.

AC15

Wet - Rich / White ash - Red maple

Occurring mainly on poorly drained level areas with medium to fine textured glacial till or alluvium deposits, this ecosite has wet, nutrient rich to very rich soils that generally support a well-developed canopy dominated by white ash, with frequent red maple, sugar maple and yellow birch.

The herb layer is well developed, usually dominated by sensitive fern and lady fern. The bryophyte layer is composed of small pockets of upland species and nutrient demanding wetland species such as prickly sphagnum. Shrub cover and diversity are low. Forest AC15 sites typically support development of hardwood treed swamps that receive nutrient rich seepage flow, ground water inputs, and/or flood waters.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax hardwood forest. Along with senescence, windthrow and fluctuating water table levels are the main disturbance agents.

AC15 sites are scattered throughout mainland Nova Scotia with areas of higher occurrence in the **Northumberland Lowlands (530)**, **Annapolis Valley (610)**, and **Central Lowlands (630)** ecodistricts.

AC16

Fresh - Very Rich / Sugar maple - White ash

Occurring mainly on well to moderately well drained alluvial floodplains, this ecosite has fresh, nutrient very rich soils that generally support closed canopy forests dominated by sugar maple and white ash (sometimes multi-layered). Earlier successional stages may contain various levels of red maple, balsam poplar, black cherry and white spruce.

The species rich understory is typically dominated by ferns, especially ostrich fern. Earlier successional stages may also have significant coverage of meadow-rue and goldenrod species. Shrub cover is variable and includes choke cherry, beaked hazelnut and alternate-leaved dogwood. Bryophyte cover is typically very low except where white spruce cover is dominant. Although mainly associated with active floodplains, AC16 sites can also be associated with stands of Sugar maple - White ash / Silvery spleenwort - Baneberry (TH4) found on rich, glacial till deposits. This ecosite can support several rare and/or at risk plant species including wild leek, blue cohosh, Canada lily and wood-nettle.

The floodplain climax forest, dominated by sugar maple and white ash, is expected to endure small disturbances caused by windthrow or fluctuating

Christmas fern is a shade tolerant plant that is a good indicator of rich, fresh to moist soils with moder and mull humus forms.

PHOTO: DNR (Eugene Quigley)

Bloodroot, an early spring flowering plant, is associated with rich ecosites along floodplains. Near Margaree Centre on the Northeast Margaree River (Inverness Lowlands, 320)

Photo DNR (Peter Neily)

water levels. However, earlier successional stages are usually even-aged and prone to larger disturbances and loss (e.g., black knot fungus on black cherry). Flood events and/or ice scour can also cause individual tree and stand-level disturbance. On upland sites, the climax forest is expected to endure scattered gap disturbances and develop (or maintain) an uneven-aged condition.

AC16 floodplain sites occur primarily along major rivers in central and northern Nova Scotia. Other areas of occurrence include the **Annapolis Valley (610)** and **Inverness Lowlands (320)** ecodistricts, and along the east and west branches of the St. Mary's River. Upland AC16 sites are typically small patches embedded within larger AC13 forests and are mainly associated with the **Nova Scotia Uplands (300)** ecoregion.

AC17

Moist - Very Rich / Sugar maple - White ash

Occurring mainly on imperfectly drained alluvial floodplains and upland lower slopes, this ecosite has moist, nutrient very rich soils.

On floodplains the closed canopy is dominated by sugar maple, with lesser amounts of yellow birch, white ash, red spruce and hemlock. Earlier successional stages have red maple, balsam poplar and black cherry. Typical understory shrubs and herbs include a mix of floodplain and wetland species.

On upland sites the closed canopy is dominated by white ash and sugar maple with understory shrubs and herbs including alternate-leaved dogwood, silvery spleenwort and sweet cicely. Bryophyte cover is typically very low.

Although mainly associated with active floodplains, AC17 sites support upland stands of Sugar maple - White ash / Silvery spleenwort - Baneberry (TH4) found on rich, glacial till deposits.

This ecosite can support several rare and/or at risk plant species including wild leek, blue cohosh, Canada lily and wood-nettle in floodplain sites; and wild leek, foamflower, thimbleweed, and grape fern and sedge species in upland sites.

The floodplain climax forest dominated by red maple is expected to endure small disturbances caused by windthrow or fluctuating water levels. However, earlier successional stages are usually even-aged and prone to larger disturbances and loss (e.g., black knot fungus on black cherry). Flood events and/or ice scour can also cause individual tree and stand-level disturbance. On upland sites, the climax forest of sugar maple and white ash is expected to endure scattered gap disturbances and develop (or maintain) an uneven-aged condition.

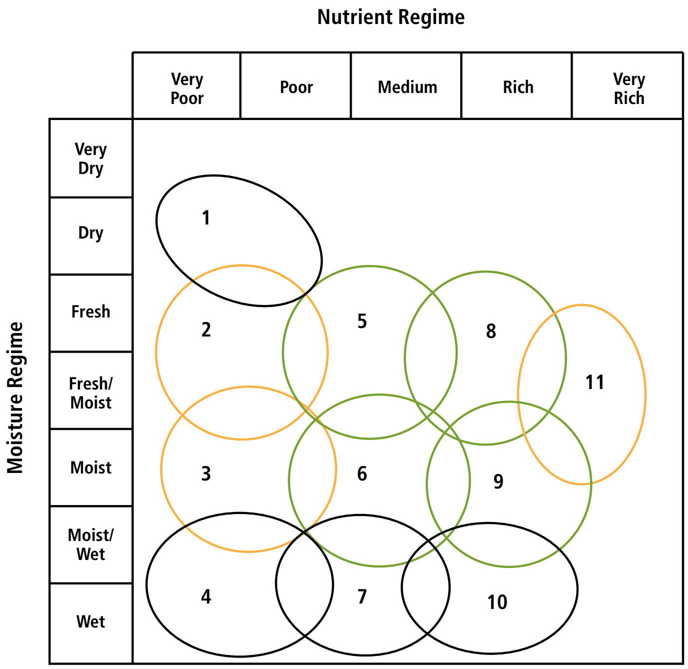
AC17 floodplain sites occur primarily along major rivers in central and northern Nova Scotia. Other areas of occurrence include the **Annapolis Valley (610)** and **Inverness Lowlands (320)** ecodistricts, and along the east and west branches of the St. Mary's River. Upland AC17 sites are typically small patches embedded within larger AC14 forests and found within the **Nova Scotia Uplands (300)** ecoregion.

Maritime Boreal Ecosites

The Maritime Boreal group includes 11 ecosites representing a range of forest site conditions, but with less coverage and precision than the Acadian group **(See Figure 3)**. This is due, in part, to the lower intensity of sampling, thereby limiting the basis from which finer divisions within this group can be made. For example, no treed ecosystems have been defined within the moist to wet, very rich edatopic grid position.

Exposure and climate differentiates the Maritime Boreal group from the Acadian group. These differences lead to zonal climax forests containing balsam fir, white spruce, black spruce, red spruce, red maple, white birch and yellow birch (in various combinations). Climate differences also promote thicker forest floors and more extensive moss cover in Maritime Boreal ecosites compared to similar Acadian units. Edaphic climax ecosites contain mainly black spruce, white spruce, red maple, and/or balsam fir. In both edaphic and climatic Maritime Boreal forests, tree species associated with early successional communities are similar to those found in later successional forests.

Note:
It is possible for zonal Vegetation Types (VTs) normally associated with Acadian ecosites to be found in geographic areas classed as Maritime Boreal **(See Table 1, pg 21)**. This could occur, for example, in sheltered locations along the Atlantic coast. Where zonal Acadian VTs are found in Maritime Boreal areas, Acadian ecosite descriptions and productivity interpretations should be applied. For more information on site characteristics, vegetation types and soil types associated with the ecosites refer to the **Forest Ecosystem Classification for Nova Scotia** (Neily et al., 2013).



1. Dry-Poor / Black spruce-Jack pine
2. Fresh-Poor / Black spruce
3. Moist-Poor / Black spruce
4. Wet-Poor / Black spruce
5. Fresh-Medium / Fir-Spruce
6. Moist-Medium / Fir-Spruce
7. Wet-Medium / Red maple-Fir
8. Fresh-Rich / Birch-Fir
9. Moist-Rich / Birch-Fir
10. Wet-Rich / Red maple
11. Fresh Moist-Very Rich / Red maple-Birch

Figure 3.
Edatopic grid showing relative moisture and nutrient regimes for Maritime Boreal ecosites.
Green = zonal climax ecosites. **Black** = edaphic climax ecosites. **Gold** = transitional ecosites which can support both edaphic and zonal vegetation types.

MB1

Dry - Poor / Black spruce - Jack pine

Occurring mainly on upper slopes and crests of bedrock ridges and/or on coarse textured glacial till deposits, this ecosite has dry, nutrient very poor to poor soils that generally support open stands of stunted black spruce, balsam fir, white spruce, red maple and jack pine. On extremely exposed sites (such as coastal headlands, ridges and mountain tops), tree growth can become even more scrubby and twisted (referred to as krummholz).

The shrub layer can be extensive, with lambkill, blueberry, black crowberry, common juniper and bayberry. There are usually low levels of herb cover, with bracken, teaberry and bunchberry the main species. The bryophyte/lichen layer can be well developed, with Schreber's moss, broom mosses and several reindeer lichens. MB1 sites occur as small to large patches within a larger softwood matrix forest wherever near-surface bedrock and sandy soils are found.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce, white spruce, balsam fir and/or jack pine. Windthrow and fire are significant disturbance agents, and frequent fires can lead to increased ericaceous cover.

Highland MB1 sites are found scattered throughout the **Northern Plateau (100)** ecoregion and **Cape Breton Highlands (210)** ecodistrict. Coastal MB1 sites are mainly found in the **Atlantic Coastal (800)** ecoregion, but also support with Coastal (CO) vegetation types in other areas.

MB1 sites with jack pine are uncommon, with known stands on the eastern slopes of the Cape Breton Highlands near Neil's Harbour, and along the Atlantic coast near Isle Madame, Canso, Peggy's Cove and Blandford.

MB2

Fresh - Poor / Black spruce

Occurring mainly on well drained slopes and level areas with coarse textured glacial till and/or near surface bedrock, this ecosite has fresh, nutrient very poor to poor soils that generally support poorly stocked stands of black spruce. Other

Dry - Poor / Black spruce - Jack pine (MB1) at Blandford (South Shore, 830) *PHOTO: DNR (Peter Neily)* minor species include balsam fir, jack pine, white pine, red spruce, white spruce and red maple. This ecosite also includes coastal areas with stabilized marine and windblown sands supporting white spruce growth.

Ericaceous shrubs such as lambkill, blueberry and huckleberry dominant the shrub layer, along with black spruce regeneration. The herb layer consists mainly of bracken, teaberry and bunchberry. In coastal areas, frequently occurring plants include twinflower, bunchberry and foxberry. In Highland forests, wood-sorrel and large-leaved goldenrod is common. A thick forest floor is typically overlain by Schreber's moss, plume moss and stair-step moss.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, usually leading to an edaphic climax forest dominated by black spruce. Windthrow is the primary disturbance agent, usually occurring in small to large patches. Secondary disturbance agents include insects and diseases, which take advantage of trees weakened by wind and breakage.

In the Highlands, MB2 sites are mainly found in the **Northern Plateau (100)** ecoregion and eastern slopes of the **Cape Breton Highlands (210)** ecodistrict.

Coastal MB2 sites occur on all saltwater coastlines, but areas of highest occurrence are the **Cape Breton Coastal (810)**, **Eastern Shore (820)**, and **South Shore (830)** ecodistricts.

MB3

Moist - Poor / Black spruce

Occurring mainly on imperfectly drained gentle slopes and level areas with medium to coarse textured glacial till deposits, this ecosite has moist, nutrient very poor to poor soils that generally support poorly stocked stands of black spruce. Other minor species include balsam fir, jack pine, white pine, red spruce, white spruce and red maple.

Non-tree species found are similar to MB2 sites, but also include plants associated with higher moisture levels including false holly, cinnamon fern, creeping snowberry and peat mosses. In coastal areas, frequently occurring plants include twinflower, bunchberry and foxberry. In Highland forests, wood-sorrel and large-leaved goldenrod are common.

Wet - Poor / Black spruce (MB4) (Northern Plateau, 100)
PHOTO: DNR (Sean Basquill)

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, usually leading to an edaphic climax forest dominated by black spruce. Windthrow is the primary disturbance agent, usually occurring in small to large patches. Secondary disturbance agents include insects and diseases, which take advantage of trees weakened by wind and breakage.

In the Highlands, MB3 sites are mainly found in the **Northern Plateau (100)** ecoregion and eastern slopes of the **Cape Breton Highlands (210)** eco-district. Coastal MB3 sites occur on all saltwater coastlines, but areas of highest occurrence are the **Cape Breton Coastal (810)**, **Eastern Shore (820)**, and **South Shore (830)** ecodistricts.

MB4

Wet - Poor / Black spruce

Occurring mainly on poorly to very poorly drained level areas and depressions with glacial till and/or organic deposits, this ecosite has wet, nutrient very poor to poor soils that generally support black spruce dominated stands with scattered balsam fir, and (in a few localized areas) jack pine. Crown closure in these stands can be low to high, with some sites supporting densely populated stands of stunted trees.

The shrub layer is dominated by ericaceous species such as Labrador tea, lambkill and rhodora. Characteristic herbs include cinnamon fern, three seeded sedge, goldthread and creeping snowberry. The bryophyte layer is dominated by Sphagnum mosses. Forest MB4 sites generally support treed bogs and/or nutrient-poor, coniferous treed swamps.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by black spruce. Fluctuating water table levels and windthrow are the main disturbance agents.

Highland MB4 sites are found only in the **Northern Plateau (100) ecoregion** and **Cape Breton Highlands (210)** ecodistrict. Coastal MB4 sites are mainly found in the **Atlantic Coastal (800)** ecoregion, but also occur in association with Coastal (CO) vegetation types in other areas.

Balsam fir forest (MB5) 40 years after the last spruce budworm outbreak, late 1970s (Cape Breton Highlands, 210) *PHOTO: CNS (Len Wagg)*

PHOTO: DNR (John Gillis, retired DNR)

Goldthread is commonly found in Maritime Boreal ecosites. Its yellow-gold coloured underground stem has been used as a medicinal herb for canker sores and similar ailments.

MB5

Fresh - Medium / Fir - Spruce

Occurring mainly on well drained slopes with medium to coarse textured glacial till and/or colluvium deposits, this ecosite has fresh, nutrient poor to medium soils that generally support closed canopy forests of balsam fir and spruce (mainly white, but occasionally red and black). Red maple, white birch, heart-leaf birch and mountain-ash are also present, but seldom extend into the overstory.

The shrub layer is dominated by regenerating overstory species, while the herb layer is sparse to moderate with typical woodland flora such as starflower, bluebead lily, sarsaparilla and wood aster. Frequently occurring plants in coastal areas include twinflower, bunchberry and foxberry. In Highland forests wood-sorrel and large-leaved goldenrod are common. A thick forest floor is typically overlain by Schreber's moss, broom mosses and stair-step moss.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands. Earlier successional stages may contain red maple, white birch and pin-cherry, but exposure impacts quickly return these sites to softwood species. Windthrow is the primary disturbance agent in coastal areas, usually occurring in small to large patches. Mortality can also be caused by spruce bark beetle or spruce budworm. On the Highlands, spruce budworm periodically causes a collapse of the balsam fir forest, resulting in landscape-scale disturbance. In the absence of spruce budworm, balsam fir longevity is typically 70–80 years.

Highland MB5 sites are found only in the **Northern Plateau (100)** ecoregion and **Cape Breton Highlands (210)** ecodistrict. Coastal MB5 sites occur on all saltwater coastlines, but most frequently in the **Atlantic Coastal (800)** ecoregion. Vegetation type CO3 (Red spruce / Mountain-ash/ Foxberry) is only found in the **Fundy Shore (900)** ecoregion and the **Tusket Islands (840)** ecodistrict.

MB6

Moist - Medium / Fir - Spruce

Occurring mainly on imperfectly drained gentle slopes and level areas with medium to coarse textured glacial till deposits, this ecosite has moist, nutrient poor to medium soils that generally support closed canopy forests of balsam fir and spruce (mainly white, but occasionally red and black). Red maple, white birch, heart-leaf birch and mountain-ash are also present, but seldom extend into the overstory.

Non-tree species found are similar to MB5 sites, but also include plants associated with higher moisture levels (e.g., false holly, cinnamon fern, creeping snowberry and Sphagnum mosses). Frequently occurring plants in coastal areas include twinflower, bunchberry and foxberry. In Highland forests wood-sorrel and large-leaved goldenrod are common.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands. Earlier successional stages may contain red maple, white birch and pin-cherry, but exposure impacts quickly return these sites to softwood species. Windthrow is the primary disturbance agent in coastal areas, usually occurring in small to large patches.

Mortality can also be caused by spruce bark beetle or spruce budworm. On the Highlands, spruce budworm periodically causes a collapse of the balsam fir forest, resulting in landscape-scale disturbance. In the absence of spruce budworm, balsam fir longevity is typically 70–80 years.

Highland MB6 sites are found only in the **Northern Plateau (100)** ecoregion and **Cape Breton Highlands (210)** ecodistrict. Coastal MB6 sites occur on all saltwater coastlines, but most frequently in the **Atlantic Coastal (800)** ecoregion. Vegetation type CO3 (Red spruce / Mountain-ash / Foxberry) is only found in the **Fundy Shore (900)** ecoregion and the **Tusket Islands (840)** ecodistrict.

MB7

Wet - Medium / Red maple - Fir

Occurring mainly on poorly drained level areas and depressions with glacial till and/or organic deposits, this ecosite has wet, nutrient poor to medium soils that generally support a closed canopy dominated by balsam fir and/or red maple.

Shrub layer development can be variable, but usually contains regenerating trees, false holly, wild raisin, and scattered ericaceous species such as Labrador tea and lambkill. Herb cover is moderate to high, consisting of cinnamon fern, wood aster, creeping snowberry and three seeded sedge. The forest floor has a well-developed bryophyte layer dominated by Sphagnum mosses. Forest MB7 sites are generally associated with coniferous and mixedwood treed swamps that receive seepage flows and/or ground water inputs.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by red maple. Fluctuating water table levels and windthrow are the main disturbance agents.

Highland MB7 sites are scattered throughout the **Northern Plateau (100)** ecoregion and **Cape Breton Highlands (210)** ecodistrict, but mainly in association with vegetation type WC6 (Balsam fir / Cinnamon fern - Three seeded sedge / Sphagnum). Coastal MB7 sites are mainly found in the **Atlantic Coastal (800)** ecoregion, but also occur in association with Coastal (CO) vegetation types in other areas.

MB8

Fresh - Rich / Birch - Fir

Occurring mainly on well drained slopes with medium to coarse textured glacial till and/or colluvium deposits, this ecosite has fresh, nutrient medium to rich soils that generally support closed canopy forests of white birch, yellow birch (Highlands only) and red maple. Heart-leaf birch and balsam fir can also form a portion of the overstory.

The sparse shrub layer consists mainly of regenerating trees and mountain-ash. Ericaceous shrubs are also present in coastal areas including lambkill and blueberry. In Highland areas, mountain maple and striped maple are also common. The coastal herb layer is generally sparse and includes bunchberry, goldthread and wood ferns. On Highland sites wood fern coverage can be extensive, along with wood-sorrel and bunchberry. Bryophyte coverage is usually moderate, with Schreber's moss the dominant species.

A forest of yellow birch and white birch with an extensive fern layer along the shoulder of the Cape Breton plateau near Cape Clear (Cape Breton Highlands, 210) *PHOTO: DNR (Peter Neily)*

These fir cones show an extended seed bract (bristle), the distinguishing feature of a variety of balsam fir found in coastal or mountainous habitat (Maritime Boreal).
PHOTO: DNR (Sean Basquill)

Most natural disturbance is small scale, with regeneration to species similar to those found in mature stands (mainly red maple and white birch in coastal areas, and yellow birch in Highland areas). A conifer-dominated successional stage is also possible where more intense stand-level disturbances occur. Along with natural senescence, windthrow and insects are the primary disturbance agents. The transitional climax yellow birch-balsam fir forest of the Highlands may have an uneven-aged structure owing to the longevity of birch, which has been aged at 225 years. In coastal areas, red maple and white birch seldom exceed 125 years.

Highland MB8 sites are mainly found in the **Cape Breton Highlands (210)** ecodistrict. Coastal MB8 sites occur on all saltwater coastlines, but occur most frequently in the **Atlantic Coastal (800)** ecoregion (especially in more sheltered areas). Vegetation type CO3 (Red spruce / Mountain-ash/ Foxberry) is only found in the **Fundy Shore (900)** ecoregion and the **Tusket Islands (840)** ecodistrict.

MB9

Moist - Rich / Birch - Fir

Occurring mainly on imperfectly drained, gentle slopes and level areas with medium to coarse textured glacial till deposits, this ecosite has moist, nutrient medium to rich soils that generally support closed canopy forests of white birch, yellow birch and red maple. Heart-leaf birch and balsam fir can also form a portion of the overstory.

Non-tree species found are similar to MB8 sites, but also include plants associated with higher moisture levels. These include cinnamon fern, interrupted fern, New York fern and sedge species. Old Field forests (OF1, OF2, OF4) have flora typical of these vegetation types, along with a well-developed bryophyte layer (mainly Schreber's moss and stair-step moss).

Most natural disturbance is small scale, with regeneration to species similar to those found in mature stands (mainly red maple and white birch in coastal areas, and yellow birch in Highland areas). A conifer dominated successional stage is also possible where more intense stand-level disturbances occur. Along with natural senescence, windthrow and insects are the primary disturbance agents.

Low tide along the Tusket Islands of Lobster Bay
PHOTO: CNS (Len Wagg)

Broom crowberry, a heathland plant
PHOTO: DNR (Sean Basquill)

The transitional climax yellow birch-balsam fir forest of the Highlands may have an uneven-aged structure owing to the longevity of birch, which has been dated at 225 years of age. In coastal areas, red maple and white birch seldom exceed 125 years.

Highland MB9 sites are mainly found in the **Cape Breton Highlands (210)** ecodistrict. Coastal MB9 sites occur on all saltwater coastlines, but areas of highest occurrence are in the **Atlantic Coastal (800)** ecoregion (especially in more sheltered areas).

MB10

Wet - Rich / Red maple

Occurring mainly on poorly drained, level areas and depressions with glacial till and/or organic deposits, this ecosite has wet, nutrient medium to rich soils that generally support a closed canopy dominated by red maple, with lesser amounts of other species.

Regenerating trees, wild raisin and downy alder provide moderate cover in the shrub layer. The herb layer is typically dominated by fern species including cinnamon fern and sensitive fern. The forest floor has a well-developed bryophyte layer dominated by peat mosses. Forest MB10 sites often contain hardwood treed swamps that receive nutrient rich seepage flows and/or ground water inputs.

Following disturbance or natural mortality, this ecosite regenerates to species similar to those found in mature stands, leading to an edaphic climax forest dominated by red maple. Fluctuating water table levels and windthrow are the main disturbance agents.

Highland MB10 sites are absent from the **Northern Plateau (100)** ecoregion and infrequent in the **Cape Breton Highlands (210)** ecodistrict. Coastal MB10 sites are mainly found in sheltered areas along the **Atlantic Coastal (800)** ecoregion.

MB11

Fresh Moist - Very Rich / Red maple - Birch

Occurring mainly on moderately well drained, gentle slopes with medium to coarse textured glacial till deposits, this ecosite has fresh to moist, nutrient rich to very rich soils that generally support closed canopy forests of white birch, yellow birch and red maple. Sugar maple is occasionally present in Highland areas both in the overstory and understory layers. Increased site fertility is evident by the presence of lady fern, northern beech fern, shining club-moss, and the overall diversity of flora. Old Field forests (OF1, OF4) have flora typical of these vegetation types, along with a well-developed bryophyte layer (mainly Schreber's moss and stair-step moss).

Most natural disturbance is small scale, with regeneration to species similar to those found in mature stands (mainly red maple and white birch in coastal areas, and yellow birch in highland areas). A conifer-dominated successional stage is also possible where more intense stand-level disturbances occur. Along with natural senescence, windthrow and insects are the primary disturbance agents. The transitional climax yellow birch-balsam fir forest of the Highlands may have an uneven-aged structure owing to the longevity of birch, which has been recorded at 225 years old. In coastal areas, red maple and white birch seldom exceed 125 years.

Highland MB11 sites are found only on the transitional slopes of the **Cape Breton Highlands (210)** ecodistrict. Coastal MB11 sites are mainly found in more sheltered areas along the **Atlantic Coastal (800)** and **Fundy Shore (900)** ecoregions.

Future Application and Development

In **The Path We Share—A Natural Resources Strategy for Nova Scotia 2011–2020** (NSDNR, 2011) the ecological land classification was identified as a means to provide the ecosystem mapping required for landscape-level (large scale) planning and management of land, freshwater, and coastal environments. Using an ecosystem approach, governments and interested groups could make informed decisions and take responsible action for the conservation and sustainable use of natural resources in Nova Scotia.

Currently, the ELC forms the foundation for the **Ecological Landscape Analysis** (ELA) that has been completed for all 38 ecodistricts. For each ecodistrict, characteristic features such as structure and function, forest composition, age class, natural disturbance regimes, connectivity and fragmentation have been described, analyzed and mapped. Other issues are also addressed including patterns of road density, special features, old growth stands and other conservation concerns.

These analyses provide a comprehensive ecological description and inventory of the ecodistrict that will guide the setting of goals and objectives, and direct the development of Long Range Management Frameworks. These frameworks will be an integral component of the ecosystem-based approach required to manage Nova Scotia's natural resources.

The **Nova Scotia Code of Forest Practice** (NSDNR, 2012) states that "forest management practices will be planned and conducted according to the Ecological Land Classification system for Nova Scotia." It is expected that the ELC will provide the framework for landscape-level planning, and will be supplemented with data and inventories for forests, non-forested ecosystems, wildlife, parks and protected areas. The ELC will be used to characterize landscape spatial structure, natural disturbance processes and forest composition.

While the concepts behind the hierarchical ELC are sound, it has been recognized that new information, often through field work and consultation, may create the need for revisions. A major revision occurred in 2005, a second in 2007, and the latest one in 2015. Future revisions will take advantage of new data technology such as Light Detection and Ranging (LiDAR) imagery, and enable 3-D digital mapping of the ecosite layer.

Any ELC should never be considered a finished product. As Loucks (1962) stated, maps and descriptions are only as good as the knowledge available at the time of writing. As more information accumulates, revision is to be expected. The improvement of the ecoregional boundaries, particularly along the coastal areas, will be one such example of potential revision. The influence of a strong, climatic driver such as the Atlantic Ocean adds to the complexity of vegetation classification and will be a source of on-going research and development.

Barrier beaches along the Atlantic Coast, such as these at Blanche (South Shore, 830), are subject to periodic storm surges that can cause dramatic changes to beach features and structure.
PHOTO: CNS (Len Wagg)

PHOTO (page 43)
The North Mountain (920) escarpment meets the Annapolis Valley (620) near the community of Delhaven (where the Pereaux River enters the Minas Basin). *PHOTO: CNS (Len Wagg)*

PART 2

Descriptions of the Ecoregions and Ecodistricts

Part II: Introduction

Part I, Development of the Ecological Land Classification for Nova Scotia, provided information describing the purpose, mapping methodology and different components of the classification. In Part II, the Ecoregion and Ecodistrict levels of the classification are described in more detail. It is our hope that readers will be able to identify these large-scale ecosystems when travelling throughout Nova Scotia. Knowing when a boundary has been crossed and recognizing the distinctive environmental components that characterize each classification unit, will increase enjoyment and knowledge of our ecologically diverse province.

Each of the nine Ecoregions is described with a chapter that includes a broad ecoregional overview followed by sections providing detailed information on each of the ecodistricts that are nested within it. A map is provided at the beginning of each Ecoregion and Ecodistrict description to help the reader place the unit within the province. A larger folded 1:775,000 provincial map of ecoregions and ecodistricts is included in the back pocket of the book. Boundaries are intentionally approximate and should be regarded as transitional zones rather than discrete lines. Mapping of the ecosection level is available on-line at: https://nsgi.novascotia.ca/plv/.

Ecodistricts are introduced with a few concept paragraphs that provide defining characteristics. The sections following provide more detailed description of the geology and soils, forest, and non forest ecosystems. The reader is encouraged to consult the **Natural History for Nova Scotia, Volume 2** (Davis and Browne, 1996) and Roland (1982) for additional information on geology and landscape development.

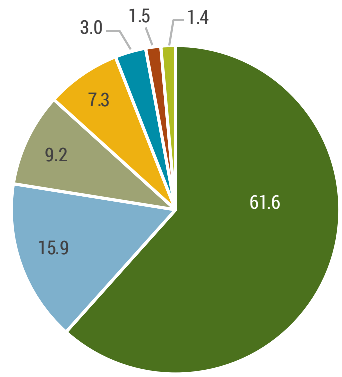
St. Paul's Island, Northeast Point. The lighthouse and buildings are on a smaller island, which at one time was connected to the main island by a footbridge (and later a boatswain's chair) to cross "The Tickle." The abutments for the steel supports are visible to the right of the lighthouse. *PHOTO: DNR (Sean Basquill)*

Interpreting the Ecodistrict Pie Charts

The ecodistrict land cover pie charts display the percentage of land occupied by nine major land cover types. These include forest, woodland, wetland, shrubland, and heathland—all of which are described in the glossary.

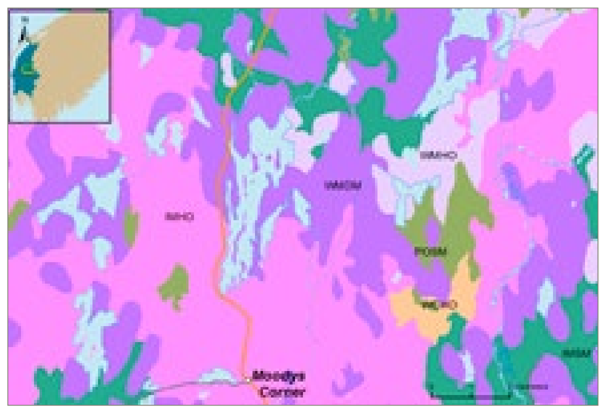
The **water** cover class includes all fresh water; **Agriculture** includes farmland, orchards, wild blueberry production, Christmas tree farms, cranberry production bogs, etc.; **Sparsely Vegetated** includes rock outcrops, open areas of beaches and dunes, talus slopes, etc.; and **Urban/Industrial** includes residential, right-of-way corridors, gravel pits and mining sites, etc. The data are taken from the most recent Nova Scotia Forest Inventory.

Percentage Land Cover	
Forest/Woodland	61.6
Wetlands	15.9
Shrub/Heathland	9.2
Urban/Industrial	7.3
Water	3.0
Sparsely Vegetated	1.5
Agriculture	1.4



Ecosection Maps

A representative area of each ecodistrict is shown with mapped ecosections. A table adjacent to these maps provides the percentage of the ecosection occurring in the ecodistrict and a cumulative percentage of ecosections ranking largest to smallest. Ecosection coding is explained in **Part I**.



Gaspereau Valley, near Wallbrook *PHOTO: CNS (Len Wagg)*

100 Northern Plateau

The Northern Plateau (formerly called Cape Breton Taiga) is the least forested ecodistrict in Nova Scotia, with about half the landscape covered in open peatlands, small ponds, and various types of shrubland. It includes the highest elevations in the province and is characterized by an expansive tableland broken by low ridges and broad shallow valleys. The region's harsh climate and generally poor drainage both contribute to the low stunted vegetation. This is the coldest area of Nova Scotia and the strongest expression of boreal (and in some cases, even alpine and subalpine) conditions.

The higher elevations of the Cape Breton Plateau have been classified as a distinct ecoregion due to harsh climatic factors, including extreme wind exposure and a shortened growing season. The landscape is covered mainly by heathlands, ground lichens (*Cladonia spp.*), stunted fir and spruce, krummholz, treed and shrub swamps, and expansive bogs. Most of the Northern Plateau ecoregion is located within Cape Breton Highlands National Park. The terrain is gently undulating with large expanses of exposed bedrock and ombrotrophic bogs. Elevation of much of the ecoregion exceeds 425 m, with its maximum elevation at White Hill (535 m), the highest point in Nova Scotia. Total area is 416 km^2 or 0.8% of the province.

The climate is one of the coldest and wettest in Nova Scotia, with long cold winters of heavy snowfall and almost constant winds. The average daily temperature is about 6° C and the average annual precipitation estimated to be 1600 mm. In sheltered areas, isolated patches of snow can still be found in July.

Small, shallow glacial lakes are margined by bog vegetation. Sloped and raised bogs are common. In many cases the bogs contain ponds arranged in either a concentric configuration around a domed centre, or in a random pattern on a flat surface. The Wreck Cove hydroelectric project constructed in the 1970s has created several flowage reservoirs collecting drainage water from 216 km^2 that also includes area in **Cape Breton Highlands (210)**.

Some of the oldest rocks in Nova Scotia are found on the Northern Plateau—exposed by a long history of erosion. Bedrock is predominantly composed of strongly altered Paleozoic rocks called schists, and gneisses which have been cut by intrusive granites.

The Northern Plateau is characterized by stony soils with variable drainage due to the influence of near-surface bedrock. Orthic Humo-Ferric[1] and Ferro-Humic Podzols dominate well drained areas, with Gleyed subgroups associated with imperfectly drained sites. Less developed Dystric and Gleyed Dystric Brunisols can also be found. Thick organic soils (Fibrisols and Mesisols) are associated with extensive wetlands found on the plateau. These grade into poorly drained Gleysols around wetland edges.

Balsam fir forests with a minor component of white spruce (Highland Forest Group) are confined to zonal sites on sheltered, middle to lower slopes. Wetter areas are dominated by black spruce and tamarack.

Dominating the landscape are extensive barrens with exposed bedrock that may be completely devoid of vegetation or may be covered in lichens predominately from the genus *Cladonia*. Where a thin layer of mineral soil has developed on this bedrock, various mosses and other plants can establish.

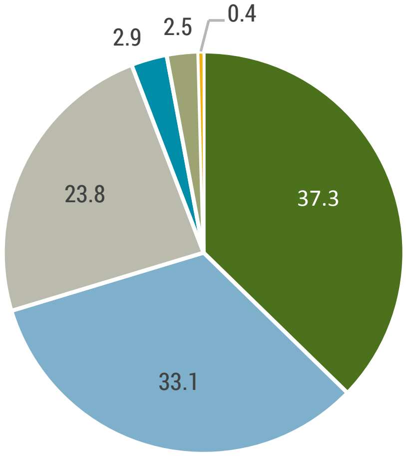
Scattered throughout the Northern Plateau is a krummholz-type forest of stunted spruce and balsam fir. Nichols (1918) found it common for dwarf trees, only three feet in height (90 cm), to be 50 years old, with some trees reaching ages of at least 150 years. These krummholz associations develop into relatively closed stands, which are difficult to pass through.

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

Early spring on the Ingonish Barrens, Cape Breton Highlands National Park, looking east towards South Clyburn Brook
PHOTO: CNS (Len Wagg)

Ecodistrict 100
Percentage Land Cover

Forest	37.3
Wetland	33.1
Shrub/Heathland	23.8
Water	2.9
Sparsely Vegetated	2.5
Urban/Industrial	0.4



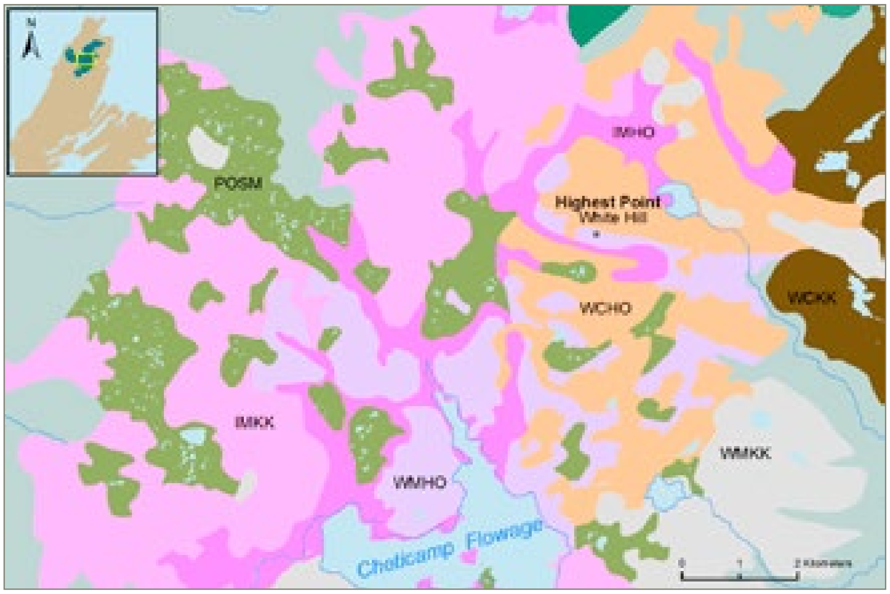
Bogs are another common ecosystem of the Northern Plateau, occurring as raised bogs, flat bogs, sloping bogs, and depressions. A great variety of peat mosses (*Sphagnum spp.*) are found in these locations, in association with low ericaceous plants and sedges (*Carex spp.* and *Trichophorum spp.*). Alder, bog birch and mountain-ash form buffers along streams.

Natural disturbances in this ecoregion include the spruce budworm, windstorms, and fire. The most recent spruce budworm outbreak occurred from 1975 to 1981 and devastated most of the balsam fir forests of the Northern Plateau. Currently ecologists with Parks Canada (Bridgland et al, 2011) have been examining the role of fire in the National Park and have concluded that until further research is completed (e.g., analyses of stratigraphic records of prehistoric fire from soils, lake sediments, and peat cores for charcoal), there is no definitive answer on the role of fire on the Northern Plateau.

Woodland caribou, which would have certainly used the area for grazing, were extirpated by hunting in the mid-1920s and unsuccessfully re-introduced in 1968. Moose were also extirpated but successfully re-introduced in 1947 from Alberta populations. There is no history of logging since the stunted trees of the ecoregion are of no commercial importance.

The reasons for distinguishing the distinct vegetation communities of the Northern Plateau can be attributed to either a climatic influence or edaphic conditions exacerbated (directly or indirectly) by exposure and topography. In most land classifications the higher, more exposed northern elevations of the Cape Breton plateau have been separated from lower elevations due to a distinct vegetation character.

Treed and open wetlands occupy a large proportion of the Northern Plateau landscape. *PHOTO: © J.-F. Bergeron (Enviro Foto)*



Ecodistrict 100

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMKK	21.0%	21.0%
WCHO	16.6%	37.5%
WMKK	14.2%	51.8%
IMRD	11.3%	63.0%
POSM	10.9%	73.9%
WCKK	8.2%	82.1%
IMHO	7.2%	89.3%
WMHO	4.8%	94.1%
XXWA	3.4%	97.5%
WCRD	2.2%	99.7%
ICHO	0.2%	99.9%
IMSM	0.1%	100.0%

Despite the advantages of modern data and computer mapping technologies, it has still been difficult to determine a conclusive biogeographic reason for distinguishing this area on the basis of climate and vegetation. The influence of climate cannot be distinguished using changes in tree species composition and is only weakly expressed by isolated pockets of subalpine vegetation. There are a number of variables which have confounded our interpretations, most notably the combined effects of elevation and oceanic exposure, as well as topography, soil, and disturbance.

The Northern Plateau is not particularly high, and while elevation drives the presence of boreal vegetation on Cape Breton, most of the island is characterized by temperate forest, even to the upper shoulders of the highland slopes. The topography of the highlands is characterized by a broad plateau that makes it difficult to detect banded elevational vegetation changes which are due to elevation, as would be seen on longer slopes of mountains with peaked summits (e.g., Rocky Mountains). This area of the plateau is also dominated by wet (azonal) soils. Since it is zonal soils and zonal vegetation that are traditionally used to map ecoclimatic regions, it has been challenging to identify changes in zonal vegetation expression. Finally the last spruce budworm epidemic in the late 1970s caused extensive fir forest mortality. The recovery of the forest has been limited by unusually high moose populations which have browsed the regenerating fir to the extent that large areas are not reforesting but instead are reverting to an herbaceous cover dominated by blue joint (*Calamagrostis canadensis*). This in turn has clouded our understanding of vegetation response after disturbance.

Nichols' (1918) early descriptive study of the Northern Plateau strongly suggested that it was edaphic conditions, not climate, that gave rise to the various community types. Dr. Nichols suggested that the abundance of moisture and lower transpiration losses created a uniformity of vegetation character and distribution due to the persistently moist soils. He stated "…. that owing largely to the prolific development of mosses and liverworts and the copious accumulation of humus, not only is the substratum kept constantly moist, but it is invariably acid to litmus, thus approximating the conditions which prevail in bogs and in the majority of swamps."

The tendency for different edaphic vegetation types to merge into one another is so pronounced on the Northern Plateau that it is difficult to separate the upland and wetland vegetation. Nichols' work still seems to be valid, but further sampling of this unique ecosystem is required to delineate and expand our understanding of processes that influence vegetation response to these sites and conditions.

Harsh winters contribute to stunted forest conditions *PHOTO: DNR (Peter Neily*

Geology and Soils

The Northern Plateau ecoregion is underlain mainly by Ordovician–Silurian age metamorphic rock intruded by Devonian age igneous rock. Dominant types include gneiss, schist, meta-basalt, meta-rhyolite, amphibolite, granite, and granodiorite. It is thought that most Carboniferous period sediments deposited on these basement rocks were long ago lost to erosion.

Surficial glacial till deposits on the plateau are often stony and thin, with near-surface bedrock having a strong influence on local drainage. Indeed, bedrock-controlled drainage, relatively flat terrain, and boreal climate conditions have promoted the formation of extensive peatlands.

Due to its remoteness and lack of suitability for agriculture, most of northern Cape Breton has not been subject to systematic soil survey and is simply classed as Rough Mountain Land (RML). However, based on limited forest ecosystem classification surveys, RML areas associated with forest cover can vary considerably in depth, fertility, texture, and drainage depending on topography, parent material mineralogy, and depth to bedrock. What is not classed as RML in this ecoregion is classed as non-forested organic peatlands (**See Table 4**).

Forests

On 59% of the ecodistrict a boreal forest of balsam fir dominates zonal sites, with scattered white spruce, white birch, heart-leaf birch, and mountain-ash. This is the matrix forest, usually confined to the less exposed sites of the Northern Plateau. It occurs as small stands of balsam fir and white spruce on hummocky and hilly terrain, with well to imperfectly drained, medium textured soils. Occasionally a few white birch and mountain-ash will make it into the canopy.

Large-leaved goldenrod (*Solidago macrophylla*) is characteristic of this forest, along with other typical woodland herbs and a well-developed bryophyte layer. Black spruce occurs on azonal sites, usually associated with riparian soils along streams or on shallow soils over bedrock ridges. However, the moist cool conditions of the plateau tend to create a uniformity of vegetation regardless of drainage, making it difficult to separate the upland sites from the edaphic sites. The cool, moist climate also slows decomposition rates, resulting in sites with unusually thick duff layers. Coarse woody debris loads are among the highest for any forested element in Nova Scotia due to frequent stand-level disturbances and slow decomposition.

Table 4
Summary information for dominant soils found in the Northern Plateau ecodistrict (100)

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
RML *	66	Glacial Till, Colluvium, Bedrock	Medium- Coarse	Variable	ST2, ST3, ST15, ST4	Podzol, Gleysol, Brunisol
Organic	34	Organic	-	Poor-Very Poor	ST14	Organic

RML = Rough Mountain Land. * Stony (S) phases are common (e.g., ST2-S).

On sites with increased exposure to winds and higher snow depths, a weather-beaten forest scrub type occurs where trees only reach heights of 3 to 5 m. Balsam fir tend to develop as short trees with wide diameters and wide spreading crowns. They often have several dead leaders; the length of the leader depending on time between severe winters. Black spruce tends to grow with a prostrate krummholz form, largely devoid of a trunk. Tamarack seems to withstand the wind and snow and develops a gnarly, scraggly appearance.

A krummholz-type forest of fir and tamarack can occur on mesophytic (not excessively dry or wet) sites. This krummholz is found on somewhat sheltered sites and is thought to be due to the combined effects of snow and winter wind. Exposed areas are swept clean of snow which is deposited on the more sheltered sites. Tree shoots that extend above the snow are killed by excessive transpiration or are blasted by the winds and snow. The undergrowth is often devoid of lichens and ericaceous plants that are common on the barrens. Instead, these plants are replaced with other herbaceous plants, including bluebead lily (*Clintonia borealis*), goldthread (*Coptis trifoila*), and twinflower (*Linnaea borealis*), and other mosses and liverworts typical of most coniferous forests. Tamarack krummholz and fir have been aged at 150 years.

The dwarf shrub spruce heath ecosystem is widely distributed on the Northern Plateau and occurs as a patch work of low mounds or hummocks (1–3 m in diameter and 30–90 cm in height). They are densely overgrown with reindeer lichens and have a thick growth of low ericaceous shrubs. Depressed black spruce seldom reaches 60 cm in height but can spread laterally for several feet and be 50 years old. Scattered tamarack also occurs. Reindeer lichen carpets the ground between the hummocks. The hummocks consist of raw humus derived from the lichens, leaves, and sometimes peat moss.

On the Northern Plateau the highland fir forest is an even-aged late successional community with earlier successional stages including pin cherry, white birch, raspberry, mountain-ash and other

Patterned earth mounds, most likely due to the freeze-thaw action on these lichen-dominated heathlands, near Two Island Lake, Cape Breton Highlands National Park. *PHOTO: CNS (Len Wagg)*

An alpine heath ecosystem dominated by reindeer lichens and low ericaceous shrubs. *PHOTO: DNR (Sean Basquill)*

woody shrubs. However, succession takes place rapidly, as the trees of the climax forest—balsam fir in particular, being present at the outset—quickly overtakes the earlier successional species.

The main stand-level disturbance agents are either spruce budworm defoliation or windthrow. In the absence of defoliation, the lifespan of balsam fir in this ecosystem is about 75 years, after which tree senescence initiates stand renewal through advanced regeneration. In sheltered areas individual balsam fir can be expected to reach 125 years of age.

Non Forests

Treed and open wetlands occupy a greater relative proportion of the landscape than in any other ecodistrict in Nova Scotia. Most treed wetlands are so severely stunted that they fall below the height threshold typically applied for classification and mapping of forest and woodland ecosystems. Canopy height in these black spruce dominated communities rarely exceeds 3 m. They are similar in composition and growth form to the krummholz or tuckamore of insular Newfoundland. This krummholz occurs around open peat bogs, in sheltered hollows, and sometimes on better drained hummocks embedded in open wetland. Trees are characterized by layering, where lateral branches extend outward and often root near their distal tips. As a result the krummholz is nearly impenetrable, save for the moose paths which wind regularly throughout. Aside from the frequent presence of Bartram's serviceberry (*Amelanchier bartramiana*), the vascular plants in the wet krummholz are similar to lowland black spruce peat forests in other ecoregions; it is largely the bryophytes and lichens that distinguish the floristics of this community from its Acadian counterparts. Prominent bryophytes include shaded wood moss (*Hylocomiastrum umbratum*), greater broom moss (*Dicranum majus*), slender bog moss (*Sphagnum subsecundum*), and goose neck moss (*Rhytidiadelphus loreus*).

Open wetlands on the Northern Plateau include extensive raised bogs, sedge fens, shrub swamps, and wet meadows. Plateau peatlands were the subject of a Master's thesis in the early 1970s (Comeau and Beil, 1984) but, outside of rare plant botanical surveys and (largely bird) zoological studies, they have had little ecological investigation since. Although raised bogs on the Northern Plateau share similar woody bog plants as the wet krummholz described above, they are additionally characterized by Pickering's reed grass (*Calamagrostis pickeringii*), coastal sedge (*Carex exilis*), bakeapple (*Rubus chamaemorus*), narrow-leaved cottongrass (*Eriophorum angustifolium*), tufted clubrush (*Trichophorum caespitosum*), and northern blueberry (*Vaccinium boreale*), among other plants. Speckled alder, willows (*Salix spp.*), and Canada burnet (*Sanguisorba canadensis*) form shrub swamps in the narrow floodplains and drainage gullies.

An additional feature of note on the Northern Plateau is the prevalence of heathland (sometimes called "barrens") on dry, often rocky, upland soils. Heathland is a shrub dominated ecosystem characterized by woody species from the *Ericaceae* family. Low bush blueberry, alpine bilberry (*Vaccinium uliginosum*), black crowberry, bearberry (*Arctostaphylos uva-urs*i), foxberry (*Vaccinium* vitis-idaea), and a number of reindeer lichen (*Cladonia spp.*) are prominent in the heathlands. The heathlands also support a variety of rare vascular plants, bryophytes, and lichens.

The Northern Plateau is one of two ecodistricts in Nova Scotia with extensive areas of upland meadow formerly occupied by dense boreal fir forests. These forests were heavily impacted by the most recent spruce budworm outbreak and since then, post-budworm forest recovery has been limited by unusually high moose densities.

Moose numbers on Cape Breton are elevated because the island is free of large predators and includes sizable protected areas where hunting is either not permitted, or is strongly limited. Today moose browsing pressure has reduced much of the post-budworm forest to a kind of grassland. Dubbed "moose meadows" by local resource managers, this vegetation is composed of blue joint grass (*Calamagrostis canadensis*), red raspberry (*Rubus ideaeus*), large-leaved goldenrod (*Solidago macrophylla*), bunchberry (*Cornus candensis*), and other plant species. Aside from species less palatable to moose (e.g., white spruce, rhodora, and lambkill, the meadows are largely devoid of woody vegetation (See photos, pgs 60, 61).

Large wetland complex, Caribou Barren, Cape Breton Highlands National Park. *PHOTO: DNR (Sean Basquill)*

200
Cape Breton Highlands

The Cape Breton Highlands ecoregion encircles the higher elevations that make up the **Northern Plateau (100)**. Dominated by a gently undulating terrain, this portion of the plateau is underlain by metamorphic and granitic rock generally 300 m above sea level, and rising to a maximum of 450 m. It covers 2053 km^2 or approximately 3.7% of the province. Long cold winters, short cool summers, and high precipitation give rise to the extensive boreal forests, bogs, and shrublands that cloak the broad plateau.

The climate of the Cape Breton Highlands ecoregion is influenced by elevation and by strong winds blowing off the Atlantic Ocean. Its climate differs from the colder **Northern Plateau (100),** which is higher and more wind-swept. Fog events are common, and precipitation ranges from 1400–1600 mm annually, with about 400 cm of snow.

The rocks of the Highlands reflect a long and complicated geological history of repeated mountain building episodes. Some of the oldest rocks in Nova Scotia are found here, dating back to the Precambrian period (1 billion years ago), and are similar to the rocks of the Canadian Shield. Plutonic (granite, diorite, gabbro) and metamorphic (gneiss, schist) rocks constitute the majority of the plateau. Faults have been a significant element in defining the morphological character of the Highlands, especially along the east and west sides of the plateau. The principal fault is the Aspy, which runs southwards from Cape North forming a straight escarpment for 40 km and then reappears in the Northeast Margaree River valley.

Small glacial lakes and wetlands provide headwaters for several major rivers including the Margaree, Middle, and Cheticamp Rivers. Fast flowing watercourses originating on the plateaus flow through steep-sided ravines with many waterfalls pouring off the escarpments. Headwaters of several brooks and rivers in a 216 km^2 catchment area—including area in the **Northern Plateau (100)**—have been dammed to create flowages as part of the Wreck Cove hydroelectric project.

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

Soils in the **Cape Breton Highlands (210)** ecodistrict are similar to those found in the **Northern Plateau (100)**, except on steep-sloped areas where more Brunisols are found (associated with "younger" colluvium deposits). In the **Victoria Lowlands (220)** ecodistrict, most soils are derived from stony glacial till or gravelly/sandy glaciofluvial deposits. Orthic Humo-Ferric[1] and Ferro-Humic Podzols dominate well drained areas, with Gleyed subgroups found on imperfectly drained sites. Cemented (Ortstein) subgroups are also common in these coarse soils, especially near the coast.

The ecoregion supports Maritime Boreal ecosites with balsam fir, white spruce, heart-leaf birch, and white birch dominant on zonal sites. On rocky outcrops and sites with higher moisture, forests of black spruce are typical. The cool, moist climate conditions slow decomposition rates, resulting in sites with unusually thick duff layers. High winds common to these sites generally limit tree growth to under 15 m. Balsam fir dominated forests are even-aged and frequently renewed by landscape-scale spruce budworm epidemics or through natural senescence, with stands seldom exceeding 75 years in age.

The ecoregion is home to endangered wildlife including Canada lynx, American marten and Bicknell's thrush.

With the completion of the Cabot Trail in 1932 and the opening of the Cape Breton Highlands National Park in 1936, the area became accessible as a tourism destination. Today, thousands of people visit the park annually, but the rugged and mountainous terrain keeps all but a few of these tourists from accessing much of the wilderness found within this ecoregion.

(above) Skyline Trail, Cape Breton Highlands National Park
(below) The Cheticamp River flowing to the Gulf of St. Lawrence, with Montagne Noir in the foreground PHOTOS: CNS (Len Wagg)

210
Cape Breton Highlands

The Cape Breton Highlands ecodistrict is made up of boreal and near-boreal ecosystems. Conditions are similar to those described for the **Northern Plateau (100)**, except the Cape Breton Highlands is much larger and more extensively forested. It occurs at slightly lower elevation than the aforementioned ecodistrict and is characterized by marginally warmer climatic conditions.

The rolling topography of hummocks and hills provides the setting for an almost unbroken boreal-like forest of balsam fir, spruce, heartleaf birch, and white birch. A climatic transition zone occurs at the shoulder of the plateau where a blending of the boreal-like balsam fir forest and the Acadian hardwood forest of the steep slopes creates a mixedwood forest of yellow birch and balsam fir. Shrublands and wetlands are dispersed throughout, and the headwaters of the Island's major rivers start their descent down the escarpment through steep sided ravines. Freshwater in small lakes and flowages covers 2900 ha or 1.6% of the ecodistrict. Total area of the Cape Breton Highlands ecodistrict is 1868 km^2 or 91% of the ecoregion.

When viewed from a distance, the top of the Highlands looks perfectly flat, however, at closer range, the variations in topography are more evident. Underlain with ancient erosion-resistant rocks, the plateau is gently rolling with numerous knolls, small hills or hummocks, and gently sloping valleys. Residuum and bedrock are

partially covered with a thin discontinuous veneer of moderately coarse textured stony till, 1–4 m thick. Extensive areas of exposed bedrock with thick carpets of reindeer lichen and dwarf woody shrubs occupy much of the eastern plateau. The ecodistrict has cold, late springs and snow cover lasts into May. Heavy snowpack exceeding 3 m is typical, and the Highlands are subjected to some of the highest winds in the province.

A mature balsam fir forest has returned to the highlands following the spruce budworm epidemic of the late 1970s
PHOTO: CNS (Len Wagg)

Highland balsam fir forests have abundant woodland flora including bunchberry, wood-sorrel and various woodferns.
PHOTO: DNR (Peter Neily)

The Highland soils have not been extensively surveyed and are described as "rough mountain land"—well drained, moderately coarse textured soils derived from a thin, stony glacial till.

Repeated attacks by the spruce budworm have been the major disturbance to the fir dominated forests of the Cape Breton Highlands ecodistrict. The fir and spruce forests destroyed by the budworm during the last outbreak in the late 1970s have been re-established, and this young forest is being intensively managed in an effort to reduce the impact of the next outbreak on the wood supply.

In the 1830s settlement and land clearing moved into the mountains surrounding Middle River, however, by the late 1950s much of this farmland was abandoned. Today, areas such as Crowdis, Gairloch, and Gillanders Mountains have regenerated to old field white spruce.

Geology and Soils

As with the adjoining **Northern Plateau (100)**, the north and northwest sections of the **Cape Breton Highlands (210)** ecodistrict are mainly underlain by Ordovician–Silurian age metamorphic rock with intrusions of Precambrian to Devonian age igneous rock. Dominant types include gneiss, schist, amphibolite, marble, quartzite, granite and granodiorite.

Faulting has generally defined the straight sides of the Highlands as well as the drainage patterns of major rivers and streams. A defining feature of this ecodistrict is the Aspy Fault and associated escarpment that runs northeast for 40 km into the Highlands along the North Aspy River.

Surficial glacial till deposits are often stony and thin on the plateau, where relatively flat terrain, bedrock controlled drainage and boreal climate conditions have also promoted the formation of many peatlands. Overall drainage is improved where the plateau meets the slopes of the adjoining Cape Breton Hills ecodistrict. These sloped areas are often covered with stony colluvium deposits.

Due to its remoteness and lack of suitability for agriculture, most of northern Cape Breton has not been subject to systematic soil survey and is simply classed as Rough Mountain Land (RML). However, based on limited forest ecosystem classification surveys, RML areas under forest cover vary considerably in depth, fertility, texture and drainage depending on topography, parent material mineralogy, and depth to bedrock. Most soil not classed as RML in this ecodistrict is classed as non-forested organic peatlands (**See Table 5**).

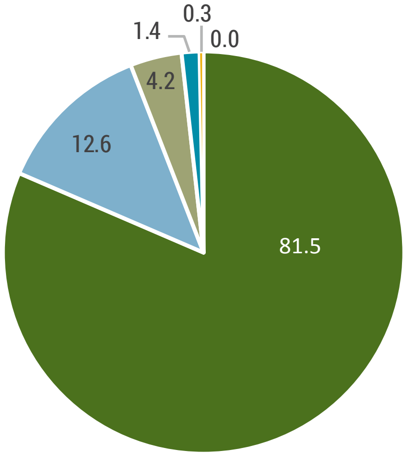
Table 5
Summary information for dominant soils found in the Cape Breton Highlands ecodistrict (210).

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
RML *	89	Glacial Till, Colluvium, Bedrock	Medium-Coarse	Variable	ST2, ST3, ST15, ST4	Podzol, Gleysol, Brunisol
Organic	11	Organic	-	Poor-Very Poor	ST14	Organic

RML = Rough Mountain Land. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 210
Percentage Land Cover

Forest/Woodland	81.5
Wetland	12.6
Shrub/Heathland	4.2
Water	1.4
Urban/Industrial	0.3
Agriculture	< 0.1



Forests

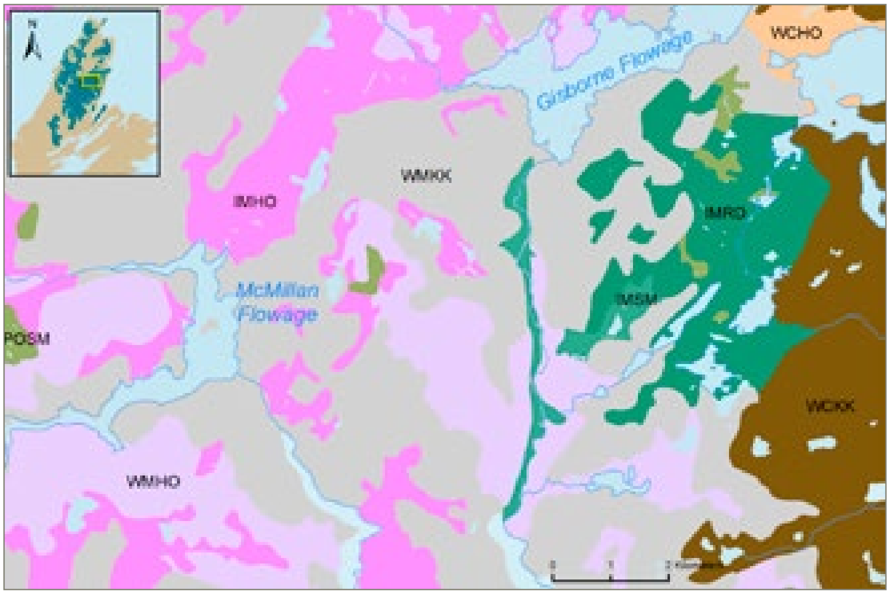
The composition and vigour of highland forests are influenced by moist, cold climate conditions and exposure, creating vegetation types with a strong boreal affinity. Closed canopy softwood forests are dominated by balsam fir with scattered white spruce (Highland Forest Group) and extend in large tracts on the zonal soils of the rolling topography. White birch follows stand-level disturbances and a few persist as remnants in mature stands of fir. Occasionally a few large (over 13 m tall and 30 cm in diameter) mountain-ash will make it into the canopy. The cool, moist climate also slows decomposition rates, resulting in sites with unusually thick duff layers. Coarse woody debris loads are among the highest of any forested ecosystem in Nova Scotia due to frequent stand-level disturbances and slow decomposition rates. The poorly developed shrub layer consists mainly of regenerating balsam fir with lesser amounts of mountain-ash.

The herb layer is often well developed and includes bunchberry (*Cornus canadensis*), wood aster (*Oclemena acuminata*), wild lily-of-the-valley (*Maianthemum canadensis*), goldthread (*Coptis trifolia*), wood-sorrel (*Oxalis montana*), sarsaparilla (*Aralia nudicaulis*), bluebead lily (*Clintonia borealis*), and a variety of ferns. Large-leaved goldenrod (*Solidago macrophylla*) is characteristic of the highland fir forest and is typically scattered throughout most stands. This matrix forest occurs on 77% of the ecodistrict. Barrens, rocklands and raised bogs are embedded in much of the highland fir forest.

Black spruce can be found on moist riparian soils as well as on shallow stony soils over bedrock. Due to significant climatic influences, this forest ecosystem is remarkably variable in terms of stand quality and site conditions. Typically it occurs on well to imperfectly drained medium textured soils derived from glacial tills. Tamarack swamps with abundant peat moss (*Sphagnum spp.*) and sedge (*Carex spp.*), occupy the wetter areas.

Another significant forest type occurs where the steep slopes of Acadian hardwood forest blend with the boreal balsam fir forest of the plateau. This transitional forest is dominated by yellow

Mixedwood forests of yellow birch and balsam fir flank the shoulder of the highlands, while fir dominated boreal forests occupy the plateau.
PHOTO: CNS (Len Wagg)



Ecodistrict 210

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMKK	52.6%	52.6%
WCKK	13.6%	66.2%
WMHO	12.9%	79.1%
IMHO	9.9%	89.1%
IMKK	3.3%	92.4%
POSM	2.1%	94.5%
IMRD	2.0%	96.4%
XXWA	1.6%	98.0%
WCDS	0.7%	98.7%
WMRD	0.4%	99.1%
WCRD	0.3%	99.4%
IMSM	0.3%	99.7%
WCHO	0.3%	100.0%

birch and balsam fir. Other associates in this forest include white spruce, heart-leaf birch, white birch and sometimes red maple.

The shrub layer includes abundant regeneration of overstory species as well as mountain maple, striped maple, and mountain-ash. Ferns can be very extensive in the understory especially in more open stands dominated by yellow birch, but typical woodland plant species such as bluebead lily (*Clintonia borealis*), wood-sorrel (*Oxalis montana*) and bunchberry (*Cornus canadensis*), along with mosses such as Schreber's (*Pleurozium schreberi*), become more plentiful in closed mixedwood conditions which blend elements of the Acadian hardwood slopes and the boreal balsam fir plateau.

This vegetation type occurs on well drained, nutrient medium to rich loams and sandy loams. In this forest two age classes are usually present, an older yellow birch cohort and a younger balsam fir cohort. The longevity of the fir is dependent on the spruce budworm cycle and the yellow birch can achieve old growth age. On similar sites a white birch yellow birch hardwood forest may also develop.

On the working forest, management practices are trying to diversify age class and reduce impacts of the next spruce budworm epidemic.
PHOTO: CNS (Len Wagg)

The main stand-level disturbance agent is spruce budworm defoliation, or in its absence, natural senescence which usually occurs at about 75 years in this ecosystem. In sheltered areas balsam fir can be expected to reach 125 years of age. Regardless of disturbance (which includes harvesting), advanced natural regeneration is a consistent part of stand renewal, leading to an even-aged late successional community. Early successional stages are dominated by pin cherry, white birch, red raspberry, mountain-ash and other woody shrubs, but these are usually quickly overtaken by balsam fir regeneration. Currently, heavy browsing by moose has shaped successional patterns in some post-budworm stands within and near the Cape Breton Highlands National Park boundary. In most of these communities, young balsam fir and hardwood saplings have been stripped out, leaving open grassland of blue joint (*Calamagrostis* canadensis) and scattered white spruce regeneration. (See **Northern Plateau (100)** for detailed description.)

Growth potential of both softwood and hardwood forests can be significantly limited by exposure to winds, snow and ice, with breakage reducing height and stem quality on hilltops and upper slopes. Wind and exposure significantly limit tree growth, with most stands less than 15 m in height.

Non Forests

The proportion of non-forested to forested vegetation across the Cape Breton Highlands is much higher than the provincial average. It supports the third largest area of heathland of any ecodistrict in the province, but most non-forested vegetation is krummholz, open peatland, and post-budworm grassland. (See **Northern Plateau (100)** for detailed description)

Krummholz is a type of stunted woody vegetation that develops in colder and/or exposed areas of the province. Although krummholz is dominated by tree species, the large majority of tree cover grows only to the height of the shrub layers, so the ecosystem is technically considered a type of shrubland.

In the Cape Breton Highlands, most krummholz is wet. The combined area of wet krummholz and treed wetland in the ecodistrict is relatively significant, however it's the size of individual wetlands of this sort that is most remarkable. On average, the largest treed wetlands (including krummholz) in Nova Scotia occur here.

Highly elevated moose population levels have created "moose pastures or meadows." These are areas where intense moose browsing has prevented regeneration of balsam fir, hardwood trees and shrubs.

PHOTO: © J.-F. Bergeron (Enviro Foto)

Ferns and blue joint grass dominate the "moose pastures."
PHOTO: DNR (Peter Neily)

One of the largest individual treed peatland in the province is also found in the Highlands, spanning more than 1400 hectares. Although far less common, wet balsam fir krummholz is found scattered in slightly enriched drainages. Wet krummholz communities in the Highlands are floristically similar to those described for the Northern Plateau ecodistrict. Krummholz and forest supports at-risk bird species like olive-sided flycatcher and the endangered Bicknell's thrush.

Aside from the krummholz, the Highlands ecodistrict also supports extensive areas of open peatland and shrub swamp. Most open peatlands are raised bogs, but sloping and ribbed fens are also prominent. Highland peatlands are boreal, characterized by species such as bakeapple (*Rubus chamaemorus*), coastal sedge (*Carex exilis*), Wiegand's sedge (*C. wiegandii*), Bartram's serviceberry (*Amelanchier bartramiana*), slender bog moss (*Sphagnum subsecundum*), and tufted clubrush (*Trichophorum caespitosum*). The Canadian wetlands classification characterizes peatlands on the Cape Breton plateau as having sub-arctic bioclimatic affinities. Shrub swamps are also common and relatively large in the Highlands. The second largest shrub swamp (220 ha) in Nova Scotia is found here.

Heathland structure and composition is outlined in the description for the **Northern Plateau (100)**. Heathlands are not markedly different between the two **Northern Cape Breton** ecodistricts **(100** and **210)**, except that the majority of heathlands in the Highlands are found on rocky summits, which suggest a stronger role for edaphic determinants.

Some heathland is interspersed with tundra-like grasslands and forblands (broad-leaved herbs). These communities have alpine and subalpine bioclimatic affinities and are limited to exposed peaks with deeper soil deposits. Initial mapping has shown that the Pollets Cove – Aspy Fault Wilderness Area, north of the national park, may support the largest tracts of these ecosystems.

Late June on the highlands – cow moose with calf
PHOTO: CNS (Len Wagg)

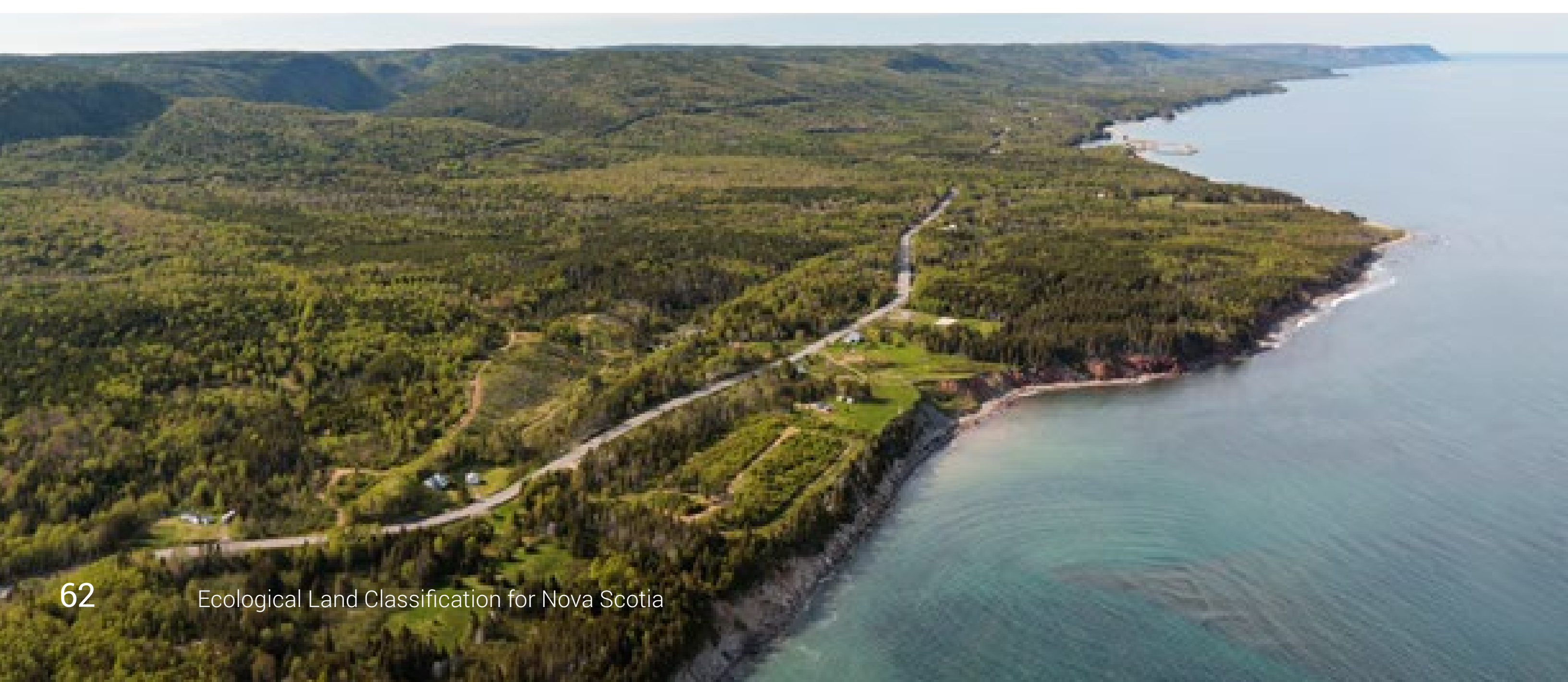
220
Victoria Lowlands

The Victoria Lowlands is the second smallest ecodistrict in Nova Scotia. It includes a narrow band of lowland running along the shore north of St. Anne's Bay, broad headlands extending from Middle Head to White Point, and lower elevations of the major river valleys (Cylburn, French, and Little Rivers) and estuaries in northern Victoria County.

This diverse terrain includes hills, coastal lowlands, outwash plains, alluvial terraces and fans, and is situated between the highland escarpment and the Atlantic Ocean. The underlying rocks are shale, limestone and sandstone characteristic of the carboniferous **Bras d'Or Lakes Lowlands (510)**. Where gypsum occurs there is karst topography with sinkholes, small caves and other features of this unique landform. The soils are primarily well drained, moderately coarse textured glacial tills. In areas where coarse sandy loams of the Hebert soil series occur, drainage can be rapid. The total area is 185 km^2 or 9% of the Cape Breton Highlands ecoregion.

Much of the ecodistrict reflects a history of land clearing and timber harvesting. Most of this occurred on the gentle terrain adjacent to the coast, and second growth forests tend to be dominated by balsam fir, white spruce, white birch, and red maple. On the hillier terrain with longer slopes, sugar maple, beech, and yellow birch prevail, along with scattered red oak, white ash, white birch, red maple, hemlock, and white pine. White pine and hemlock can be found in the ravines along the rivers and streams flowing off the plateau. Near Neil's Harbour, there are regionally rare stands of jack pine.

A narrow band of lowlands fringe the Cape Breton highlands, with Cape Smokey on the horizon. *PHOTO: CNS (Len Wagg)*



At Ingonish, the annual precipitation is about 10% higher than any other weather station in Nova Scotia. This ecodistrict contains most of the land suitable for farming in the northern part of Cape Breton Island. In areas where old fields and clearings have been abandoned, white spruce has reforested the sites. Coastal erosion is a concern for landowners.

Geology and Soils

The Victoria Lowlands ecodistrict includes the hills, lowlands, outwash plains, and fluvial terraces located between the mountainous Cape Breton highlands and Atlantic Ocean in northeastern Cape Breton. Bedrock is comprised mainly of Carboniferous period sedimentary rock (sandstone, conglomerate, shale, gypsum, and limestone).

Surficial deposits and soil parent materials are dominated by glacial tills containing igneous and metamorphic rock from the adjacent highlands, but there are also significant glaciofluvial deposits (outwash plains, kames, terraces) associated with the valley corridors in this ecodistrict. Karst topography can also be found in areas associated with near-surface gypsum and limestone bedrock.

Dominant soils are derived from stony sandy loam till high in granite and granodiorite (Gibraltar/Bayswater soils); gravelly and sandy glaciofluvial deposits (Hebert soils); and gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom soils) (**See Table 6**). There are also large areas of unsurveyed Rough Mountain Land (RML) that are likely similar to nearby Gibraltar or Thom soils.

Uncommon jack pine forests occur along the Cabot Trail near MacKinnons Cove. *PHOTO: DNR (Peter Neily)*

Gibraltar/Bayswater soils often have abundant surface stones and/or boulders. Soils near the coast are often naturally cemented with iron oxides and organic matter (Ortstein soils). Coarse-textured Hebert soils are also prone to cementation which impacts soil moisture regimes and potential rooting depth.

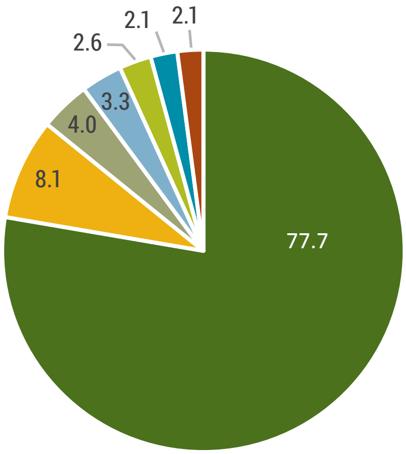
Table 6.
Summary information for dominant soils found in the Victoria Lowlands ecodistrict (220). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Gibraltar / Bayswater *	42	Glacial Till	Medium-Coarse	Well- Imperfect	ST2, ST3, ST2-G, ST3-G, ST15, ST16	Podzol
Hebert	28	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
RML *	14	Glacial Till, Colluvium, Bedrock	Medium-Coarse	Variable	ST2, ST3, ST15	Podzol, Brunisol
Thom *	6	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol

RML = Rough Mountain Land. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 220
Percentage Land Cover

Forest/Woodland	77.7
Urban/Industrial	8.1
Shrub/Heathland	4.0
Wetlands	3.3
Agriculture	2.6
Water	2.1
Sparsely Vegetated	2.1



Forests

Settlement and land use has significantly altered the natural forest of this ecodistrict and secondary forests of balsam fir, white spruce, red maple, and white birch are abundant. Before European settlement, this well-drained hummocky and hilly terrain was typically covered by shade tolerant hardwood forests of sugar maple, yellow birch, and beech (Tolerant Hardwood Forest Group). Settlement in the 1800s converted much of this area to cultivated land and pastures.

At the start of the 1920s many rural families departed their farms to live and work in urban areas. Today, the only evidence of these abandoned farmlands is rock walls, foundations, and early successional forests of white spruce, often with aspen, white birch, and balsam fir.

Where soils are moderately well to imperfectly drained (on the medium to coarse glacial tills), black spruce occurs. On the better drained soils associated with lower and middle slope positions, balsam fir, white spruce, and a component of white birch and red maple are found.

With progressively poorer drainage, black spruce, tamarack and red maple dominate the forest vegetation in association with small embedded wetlands. Early successional forests tend to have a higher component of aspen, tamarack and balsam fir, but overall regenerating forests from stand-level harvesting will also include red maple, white birch, grey birch, and pin cherry.

Natural stand-level disturbances in the Victoria Lowlands are infrequent and are usually associated with hurricanes and storms. Gap disturbances in the hardwood forest create small openings for the recruitment of younger trees, and stands will usually maintain themselves leading to uneven-aged climax forests with potential for development of old forest characteristics. Hardwood forests of this ecodistrict currently reflect two province-wide disturbance events: the beech bark canker introduction circa 1900, and the birch dieback epidemic of the 1940s. Beech is now primarily an understory species, and yellow birch is gaining prominence in the canopy. Forests of balsam fir and white spruce are susceptible to frequent spruce budworm defoliations.

North, Middle and South Aspy Rivers flow towards Dingwall and the Aspy Bay. *PHOTO: DNR (Sean Basquill)*

Northern holly fern is a rare species found growing on limestone and gypsum in rocky areas in northern and central Cape Breton. *PHOTO: DNR (Eugene Quigley)*

Floodplains in this ecodistrict are associated with smooth, level, terrain along the major rivers such as the Aspy, Ingonish and Clyburn Rivers. In addition, smaller floodplains are also found along the French, Barrachois and Little Rivers and some smaller brooks. These linear patch-level forests receive annual deposits of sediments due to flooding. Soils are coarse sandy loams, often gravelly, deposited over gravel and cobble.

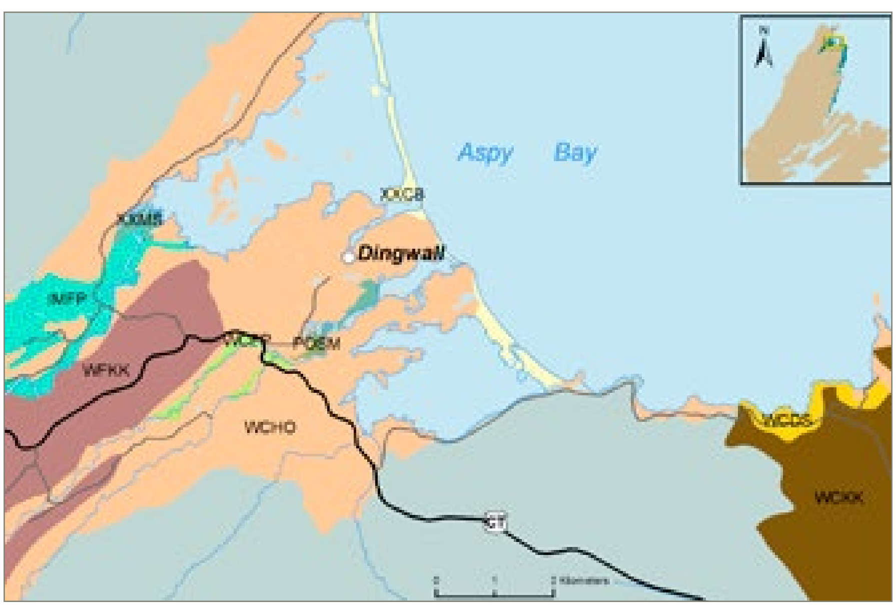
The floodplain climax forest is dominated by sugar maple and white ash. At one time it also included elm, although this species has been almost eliminated due to the Dutch elm disease. Small gap disturbances in this climax forest maintain a canopy that provides important ecological functions along these watercourses. Earlier successional forests include balsam poplar and white spruce vegetation types. Where soils are imperfectly drained, red maple and black spruce are more abundant along with willows and speckled alder. These floodplains are not known to support many rare or uncommon floodplain plants.

Scattered throughout the ecodistrict are several other forest communities. A narrow coastal climatic influence extends inland along the Atlantic shore, most notably between MacKinnon Cove and White Point, creating a coastal spruce fir forest.

Talus slopes along the Highland escarpment have early successional forest of white spruce, birch and white pine. Along watercourses steep-sided ravines give rise to mixedwood forests often dominated with red maple, yellow birch, and hemlock.

Karst topography is scattered throughout the ecodistrict, with extensive areas at North Shore (Plaster Provincial Park), Dingwall, and South Harbour. Forests on karst have late successional species such as sugar maple, yellow birch, beech, and hemlock, and have the potential for the rare plants associated with this nutrient enriched landform.

White pine can occur where soils are rockier and shallow. Red oak is widely distributed and locally common, as found at Cape North and South Harbour. Jack pine has a significant occurrence inland, from MacKinnon's Cove to Neil's Harbour. Hemlock is uncommon and usually associated with lower steep slopes along streams.



Ecodistrict 220

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCHO	38.5%	38.5%
WCKK	32.4%	70.9%
WFKK	11.6%	82.5%
WMKK	3.3%	85.8%
XXWA	2.8%	88.6%
WCFP	2.6%	91.2%
WMHO	1.8%	93.0%
IMFP	1.5%	94.6%
XXCB	1.5%	96.0%
WCDS	1.2%	97.3%
ICHO	0.9%	98.2%
ICFP	0.7%	99.0%
XXMS	0.4%	99.4%
POSM	0.3%	99.6%
ICSM	0.2%	99.9%
WCSM	0.1%	100.0%

Non Forests

Non-forested ecosystems make up a relatively small proportion of the ecodistrict, but they are a varied complex of coastal heathland and bog, karst, salt marsh, as well as some of the largest beaches and dunes in Cape Breton.

Open peatland and salt marsh occupy about 75% of the wetlands in the Victoria Lowlands. Most of the peatlands are coastal with scattered black crowberry, northeastern peat moss (*Sphagnum flavicomens*), and other coastal bog associates.

Salt marshes are found behind the large barrier beaches in Aspy Bay, and include rare northern marsh species, such as red bulrush (*Blysmus rufus*). The broad barrier beaches (North Harbour and South Harbour Beach) in Aspy Bay are among the most spectacular in Nova Scotia, and are the third largest by area of any in the province. Theses beaches and dunes are formed from eroded Windsor deposits of limestone and gypsum, providing rich sandy soil for species that are otherwise not typical of this habitat in Nova Scotia (e.g., Shepherdia (*Shepherdia canadensis*)hoary fringe moss (*Racomitrium canescens*)).

One of the most unique ecosystems in Nova Scotia is found in the Victoria Lowlands. Karst, a rugged type of topography formed by dissolving gypsum and limestone, is scattered along the coast and in the uplands around Dingwall and Cape North. The karst in this ecodistrict encircles the islands in Aspy Bay, forming dramatic coastal cliffs and deep sinkholes sometime lined with rare boreal species such as northern holly fern (*Polystichum lonchitis*). Much of the karst has been mined for gypsum but many remnant examples still exist.

The cliffs and headlands along more exposed and rugged portions of the coast are blanketed with a low-growing type of heathland dominated by black crowberry and, its rarer relative, red crowberry (*Empetrum eamesii*). The latter species, and other northern plants such as Shepherdia (*Shepherdia canadensis*), alpine bilberry (*Vaccinium uliginosum*), dwarf bilberry (*Vaccinium caespitosum*), and spurred gentian (*Halenia deflexa ssp. brentoniana*), are somewhat more common here than on other coastal heathland of Cape Breton. These heathlands are similar to the oceanic heathlands of insular Newfoundland and are largely boreal in character.

Karst topography near Dingwall, looking north to Wilkie Sugar Loaf (over 400 m at its peak) and Cape North. *PHOTO: DNR (Sean Basquill)*

300
Nova Scotia Uplands

This ecoregion is a geographically complex band of rounded summits and plateaus separated by lower elevation uplands and lowlands that extend across northern mainland Nova Scotia from Chignecto Bay to Cape Breton Island. It covers 10 928 km2 or approximately 19.8% of the province. Summits can reach 300 m in elevation and are usually bordered by steep slopes.

These uplands experience more severe winters, greater precipitation, and shorter growing seasons than surrounding lowlands, creating conditions that give rise, at least in part, to the Acadian hardwood forest of sugar maple, beech and yellow birch that dominates here.

Elevation is the strongest influence on the climate of the ecoregion, although in some areas it is modified by proximity to water bodies such as the Bras d'Or Lakes and Gulf of St. Lawrence. Lowland areas associated with river valleys and hilly topography create mesoclimatic environments where sheltered and exposed conditions can vary the local weather, especially temperature. The main climatic features are wide daily and seasonal temperature ranges, and high precipitation, especially snowfall.

The ecoregion is geologically diverse, with remnants of the Cretaceous peneplain surface (composed of metamorphic, intrusive and volcanic rocks of the Precambrian to Paleozoic eras) together with Paleozoic sedimentary rocks found in lowland areas. Several major faults also border or cut through this ecoregion, most notably the Cobequid-Chedabucto Fault and Hollow Fault.

There are relatively few lakes in this mainly upland ecoregion, but there are many rivers and streams. Fast flowing watercourses originating on the plateaus create steep-sided ravines with many waterfalls along the escarpments.

Soil parent materials in the Nova Scotia Uplands are highly variable and reflective of the large area covered by this ecoregion. Orthic Humo-Ferric[1] and Ferro-Humic Podzols dominate well drained areas underlain by medium to coarse textured material, with Gleyed subgroups associated with imperfectly drained areas. Sombric subgroups can also found on more fertile sites. Where finer

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

(top) Hardwood hills of the Eigg Mountain James River Wilderness Area; *(below)* Red-tailed hawk *PHOTOS: CNS (Len Wagg)*

textured deposits occur, Gleyed Luvisols are common. These soils grade into Luvic Gleysols on more poorly drained sites. In addition, Sombric and/or Dystric Brunisols can be found on sloped sites with "young" colluvium deposits.

The ecoregion supports Acadian Ecosites with shade tolerant hardwood forests dominant on zonal sites. Where ecosites exhibit more moisture, mixedwood forests of yellow birch, hemlock and red spruce are common. Wind and ice damage are significant limiting factors to tree growth, especially for hardwoods on crests and upper slopes, resulting in stunted forests of beech and sugar maple.

Stand-level natural disturbances are rare in these hardwood forests, so stands tend to develop uneven-aged and old growth features. However, where European colonists in the 18th and 19th centuries cleared areas of upland forests for settlement, fields and pastures, these sites, when later left unused, reforested back to white spruce stands.

310
Cape Breton Hills

The Cape Breton Hills ecodistrict provides a backdrop for the **Bras d'Or Lowlands (510)** and rivers of the **Inverness Lowlands (320)**. These hardwood covered hills and slopes are 150–300 m above sea level, with higher elevations near the apex of the steep slopes leading to the Cape Breton plateau.

Distributed throughout Cape Breton Island, this disjunct ecodistrict includes the recognizable landmarks such as the Creignish Hills, North Mountain, Kelly's Mountain, Skye Mountain (Whycocomagh), East Bay Hills, Mabou Highlands and Boisdale Hills. It also includes several lower elevation hills such as Mount Young, Washabuck/Cains Mountains and Rear Forks Baddeck.

The steep slopes of the ecodistrict are also easily observed from highways and communities in low lying areas, especially in northern Cape Breton where they descend from the plateau to the valleys of major rivers and streams such as the Southwest and Northeast Margaree, Aspy, North and Cheticamp Rivers.

The ecodistrict is influenced by the strong, cold winds of the Gulf of St. Lawrence. Temperatures are slow to warm in the spring resulting in a short growing season. The total area is 3704 km^2 (33.9% of the Nova Scotia Uplands ecoregion).

The Northeast Margaree River winds past Cape Clear.
PHOTO: DNR (Sean Basquill)

The higher steep-sloped hills are underlain with older, erosion resistant rocks. The lower more gradually sloping hills are underlain by coarse sandstone, shale and conglomerate. Areas of karst topography (typical of underlying limestone and gypsum where sinkholes are often created) are found throughout the district at lower elevations, most notably on the Iona peninsula. Most of the rivers passing through the Inverness and Bras d'Or lowlands have their headwaters originating from wetlands and a few small lakes in these hills. Freshwater accounts for only 0.4% of the ecodistrict.

Fresh, medium to rich soils support large intact Acadian forests of shade tolerant hardwoods (yellow birch, sugar maple, and beech) with stands extending from the crests to lower slopes of hills and large hummocks. Stands of black spruce and balsam fir are common on top of the larger hill complexes with level hummocky topography underlain with imperfectly drained soils. Forests of white spruce are also very common throughout the ecodistrict, especially on abandoned fields and pastures in the uplands. Deer wintering yards are common on the sheltered south facing slopes, and numerous eagle nests are found along the ravines of major streams.

The tolerant hardwood forest is shaped by gap dynamic disturbances—individual tree or small patch mortality as opposed to the stand-level disturbances common in softwood forests. Natural disturbance agents in the tolerant hardwood forests include hurricanes and wind storms, ice storms, and damage/mortality associated with freeze/thaw cycles. Frequent stand-level mortality occurs on sites supporting conifer forests of balsam fir and white spruce, which are susceptible to the spruce budworm that cycle through the forest every 30–40 years. The tussock moth and spruce bark beetles have caused stand-level mortality in fir and white spruce forests. Fire is not a significant agent in forest renewal in this ecodistrict.

Geology and Soils

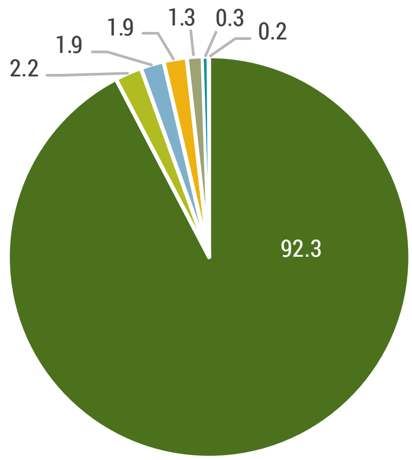
The Cape Breton Hills ecodistrict is an assemblage of discontinuous land units that more or less run in a northeast-southwest direction across the northern and central sections of the Island. This expansive area is associated with a mixed and varied geologic history that has resulted in the formation of many bedrock types. These include varieties of granite, granodiorite, rhyolite, basalt, gneiss, schist, amphibolite, marble, sandstone, siltstone, conglomerate, shale, limestone and gypsum. This diverse history, combined with a range in rock-type weatherability, has resulted in the formation of both high elevation hills with long, steep slopes, and low elevation hills with gentle slopes. Topography in the ecodistrict has also been influenced by glacial till deposits that range in thickness from less than 1 m on higher elevation slopes, up to 30 m in some lower elevation sites. Karst conditions can also be found in areas with near-surface limestone and gypsum.

Soil parent materials are dominated by stony and non-stony glacial tills along with weathered bedrock and colluvium on long, steep slopes. There

Table 7
Summary information for dominant soils found in the Cape Breton Hills ecodistrict (310). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Thom / Mira *	50	Glacial Till, Colluvium	Medium-Coarse	Well	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol, Brunisol
Woodbourne / Millbrook	13	Glacial Till	Fine-Medium	Mod. Well-Imperfect	ST2-L, ST3-L, ST6, ST5, ST12	Podzol, Luvisol
Westbrook	11	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol
RML *	9	Glacial Till, Colluvium, Bedrock	Medium-Coarse	Variable	ST2, ST3, ST15	Podzol, Brunisol

RML = Rough Mountain Land. * Stony (S) phases are common (e.g., ST2-S).



Ecodistrict 310
Percentage Land Cover

Forest/Woodland	92.3
Agriculture	2.2
Wetlands	1.9
Urban/Industrial	1.9
Shrub/Heathland	1.3
Water	0.3
Sparsely Vegetated	0.2

are also smaller areas of glaciofluvial and alluvial deposits associated with old outwash channels, kames and smaller valley corridors; some marine deposits are found near Grand Etang.

Dominant soils are derived from gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom/Mira soils); gravelly loam to clay loam till containing sandstone and shale (Woodbourne/Millbrook soils); and gravelly sandy loam to loam till high in conglomerate (Westbrook soils) (**See Table 7**). There is also a large area of unsurveyed Rough Mountain Land in the north-eastern section of the ecodistrict. Soils in these areas can vary considerably in depth, fertility and drainage depending on topography, parent material and the influence of local bedrock types.

Forests

During autumn, the iconic hardwood forests of the Cape Breton Hills are a popular tourist attraction due to their brilliant leaf colouration. These mid to late successional shade tolerant hardwood forests (Tolerant Hardwood Forest Group), typical of the Acadian Forest, occur on zonal sites of medium to rich, well drained glacial tills. They are the matrix forest condition on 83% of the ecodistrict.

Representative species include sugar maple, red maple, beech and yellow birch, with white ash and ironwood on richer soils where organic matter enrichment in the A horizon has occurred through natural mixing by soil fauna (usually with mull humus forms). Under a closed canopy, regenerating trees similar to the overstory, as well as striped maple and red maple, are abundant. The shrub layer can be extensive with mountain maple, fly-honeysuckle and beaked hazelnut. However it is the abundance and diversity of ferns and club-mosses that define the understory in this forest. In the spring, ephemeral herbs such as spring beauty (*Claytonia caroliniana*) and Dutchman's breeches (*Dicentra cucullaria*) are also common. Vernal pools (ephemeral water collection areas) and seepage areas are commonly found in these hardwood forests and are important microhabitats for distinctive assemblages of plants, animals, amphibians and insects.

Growth potential of hardwood forests can be significantly limited by exposure to winds, snow and ice, with breakage reducing height and stem

Autumn leaf colouration in the Cape Breton Hills near Margaree Valley *(PHOTO: CNS (Len Wagg))* quality on hilltops and upper slopes. However, on sheltered middle and lower slopes, height and diameter growth improves as wind exposure diminishes.

On top of several hills (including East Bay Hills, Boisedale Hills, North Mountain (at West Bay) and Sporting Mountain) the terrain is hummocky to level with imperfectly drained, coarse to medium textured soils, and a forest of black spruce, white spruce and balsam fir. Where soils are poorly drained, wet forests of black spruce, tamarack and red maple thrive. Occasionally open woodlands of black spruce and reindeer lichen occur where soils are either shallow to bedrock or extremely gravelly.

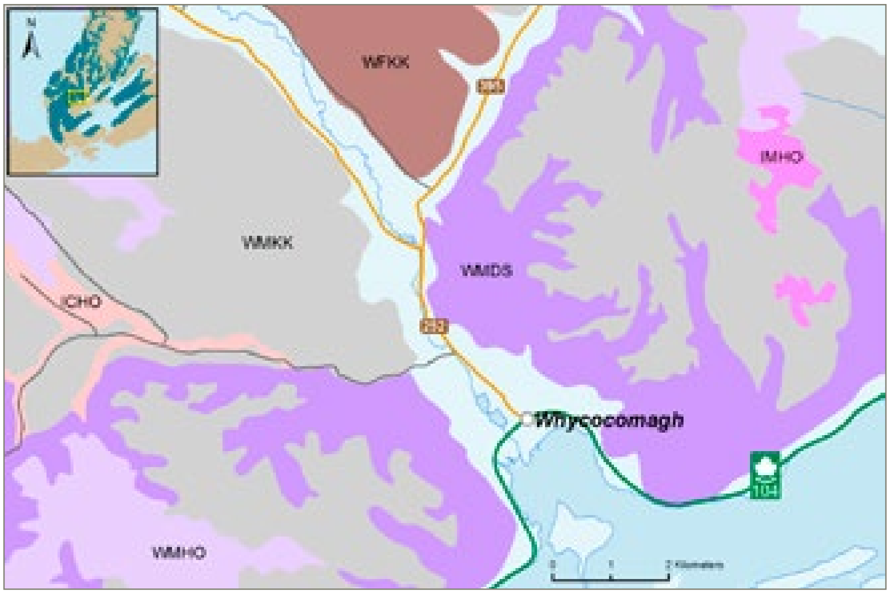
Steep-sided ravines along rivers and their tributaries in this ecodistrict have rapid to well drained soils. This supports mixed forests of shade tolerant species including hemlock, red spruce, white pine, sugar maple, yellow birch, and beech. On the riparian soils, enriched conditions support a few small floodplain forests; otherwise, forests are comprised of black spruce on the imperfectly drained soils, and balsam fir on the better drained lower slopes.

Stand-level natural disturbances in the Cape Breton Hills are rare within the dominant hardwood forest. Disturbance agents such as hurricanes, wind and ice storms, disease, and insects typically create small patch or individual tree mortality. Many of these stands will develop an uneven-aged or old growth structure, with small gap disturbances providing openings in the canopy for new growth. Evidence of blowdown and uprooting is evident in much of the hardwood forest by the abundance of pit and mound relief. Mixedwood forests in the sheltered ravines tend to be infrequently disturbed by similar agents, and can also develop uneven-aged structure. The upper elevation spruce-fir forests are more frequently subjected to stand-level disturbances caused by windthrow and insects.

Two province-wide disturbance events have significantly influenced the hardwood forests. The beech bark canker (introduced to Nova Scotia in the 1890s) has reduced the once dominant beech to a primarily understory species. Birch

Meat Cove—Nova Scotia's most northern community
(PHOTO: CNS (Len Wagg)

Ecodistrict 310



Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMDS	34.9%	34.9%
WMKK	27.9%	62.8%
WFKK	9.3%	72.1%
IMHO	8.5%	80.6%
WMHO	5.2%	85.8%
WCDS	3.7%	89.5%
WMRD	3.1%	92.6%
IFHO	2.1%	94.7%
WCKK	1.5%	96.2%
IFKK	1.2%	97.3%
WMSM	0.7%	98.0%
XXWA	0.4%	98.4%
WCHO	0.4%	98.8%
WFHO	0.4%	99.2%
POSM	0.3%	99.5%
ICHO	0.2%	99.7%
IMSM	0.1%	99.8%
IMRD	0.1%	99.9%
IFFP	< 0.1%	100.0%
IMFP	< 0.1%	100.0%
WMFP	< 0.1%	100.0%
XXCB	< 0.1%	100.0%

dieback (widespread in eastern Canada in 1932–1955) caused widespread mortality of yellow birch (up to 40%). A series of climatic events (drought and mid-winter freeze/thaw), followed by secondary agents such as fungi, are believed to have been responsible for the dieback. Yellow birch has since regained much of its natural abundance, but only a few scattered canker-free beech remain. Other insects and diseases that cause individual tree mortality include sugar maple borer in sugar maple, and chaga (birch cinder conch) in yellow birch. Wounds caused by ice storm breakage also provide avenues for a variety of fungi to enter and further weaken or kill trees.

When the Scottish settlers arrived in the early 1800s they cleared and farmed significant areas of the tolerant hardwood forest on the rolling topography in areas such as River Denys Mountain and Skye Mountain. Beginning in the 1900s many rural families left their farms to live and work in urban areas. Their abandoned fields quickly reforested to white spruce.

Today very little remains of the settlements, except rock walls, foundations and cemeteries. On the Mabou Highlands however, many of the fields have been maintained as community pastures where farmers bring their sheep and cattle to graze during the summer months.

Non Forests

The Cape Breton Hills is the largest ecodistrict in the Nova Scotia Uplands ecoregion. Mean elevation is 174 m but upper reaches of some shallow stream gullies occur just above 500 m. This wide range in elevation provides the geographic basis for an impressive variety of ecosystems and associated species. That said, the ecodistrict is one of the most extensively forested in the province. In fact the area of treeless and sparsely-treed vegetation is the lowest of any ecodistrict. Most ecosystem diversity is expressed within the forested realm, but non-forested ecosystems still include some of the province's most unique, and in some cases rare, vegetation communities.

Non-forested ecosystems in the Cape Breton Hills ecodistrict encompass a broad assortment of vegetation communities. Most are associated with coastal cliffs, steep sided canyons in the larger river valleys, heathlands on exposed coastal bluffs and upland summits, and areas with abundant exposed bedrock, shallow and/or stony surficial deposits. Some of the most interesting sites occur at northern latitudes in the stream valleys that empty into the Gulf of St. Lawrence. Cliffs and rocky gorges of the Cheticamp, Blair, Salmon, and North Aspy Rivers are among the most remarkable. Similar sites of comparable interest occur

The combined effects of elevation, coastal climatic influences, and thin soils prevent tree cover on severely exposed slopes at High Capes, northern Cape Breton Island. PHOTO: CNS (Len Wagg)

on smaller flowages and tributaries such Corney, Lockhart, Gray's Hollow, and Big Southwest Brooks. In addition to cliff flora and lichens found elsewhere in the province, several of these steep-sided outcrops host very rare arctic-alpine and boreal communities and species. Coastal cliffs, which are particularly well represented in the ecodistrict, probably support a subset of these species but many of these cliffs are inaccessible and inadequately surveyed. The total area of coastal cliffs is by far the highest of any ecodistrict in the province.

In several of the stream valleys introduced above, rocky cliff and gorges are accompanied by sometimes extensive areas of talus. Talus is a type of surficial deposit composed of usually angular fragments of rock, forming a continuous slope or basal cone of unconsolidated colluvium. If talus is inactive long enough, it may be colonized by trees. However much of the talus in the Cape Breton Hills is too steep and unstable for tree colonization. These non-forested ecosystems support unique plant communities and provide habitat for provincially rare small mammals such as the rock vole (*Microtus chorotorrhinus*) and, to a lesser extent, the Gaspé shrew (*Sorex dispar ssp. gaspensis*).

The northern part of the ecodistrict (from Pleasant Bay to Money Point) is one of the most exposed parts of the province. Bluffs, cliffs, and summits flanking the highlands are buffeted by very strong winds. The effects this has on vegetation are pronounced in the **Cape Breton Highlands (210)** and equally so in this part of the Cape Breton Hills. The presence of these conditions is due to the combined effects of latitude, elevation, and macro-scale exposure. Here, the Cape Breton Hills form the tip of a broad peninsula projecting into the mouth of the Gulf of St. Lawrence. The coast is exposed to cold waters of the Labrador Current as well as flows from the Maritime Polar Air Mass.

A unique climatic feature of Northern Cape Breton (and sometimes occurring as far south as Mabou) are the very strong wind events called "les suêtes." Les suêtes are southeasterly winds that originate over the ocean on the Atlantic side of the island, typically in the winter months. They accelerate over the plateau and can attain speeds of 200 km/hr as they descend over the western edge in this part of the ecodistrict. Les suêtes and related climatic events at the ocean-mountain interface of Cape Breton are undoubtedly a significant determinant of the subalpine and even alpine conditions expressed at upper elevations. Further information on subalpine and alpine communities is found in the descriptions for ecodistricts **100**, **210** and **220**.

320
Inverness Lowlands

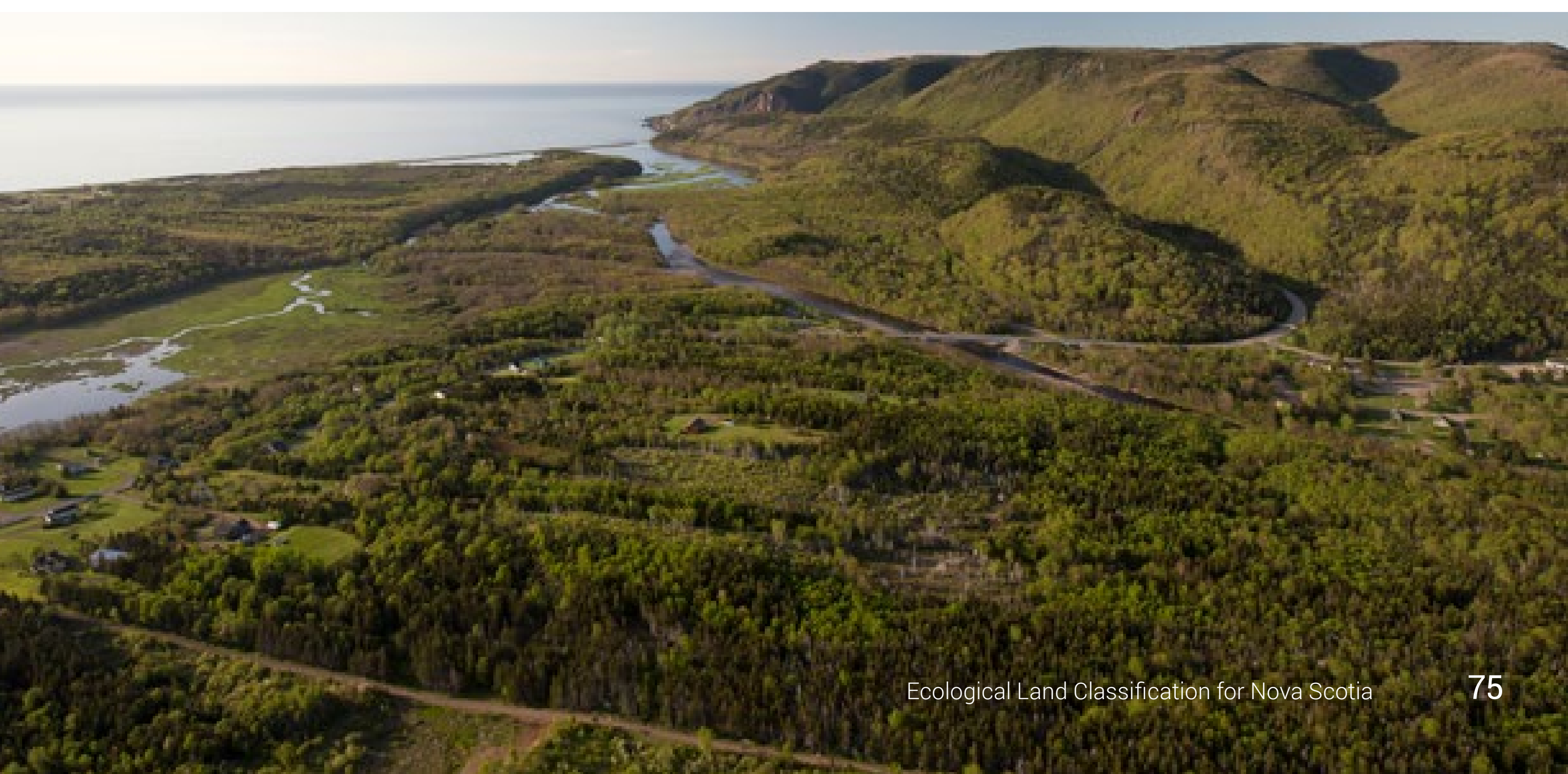
This is one of the smallest ecodistricts in the province, stretching from Pollets Cove in the north to Mull River and Whycocomagh Bay in the south. It includes the fault valleys of both the Margaree and the Middle Rivers. Its total area is 484 km^2, or 4.4% of the Nova Scotia Uplands Ecoregion.

The area tends to be somewhat sheltered by the surrounding uplands (i.e., **Cape Breton Hills, 310** and **Cape Breton Highlands, 210**), with the exception of the Cheticamp to Margaree Harbour area where a combination of topography and temperature create a unique phenomenon, locally known as "les suêtes." A suête begins with winds blowing in off the Atlantic Ocean and up the eastern slope of the Cape Breton Highlands. They then begin the steep downward descent on the western side, gathering speed as they go. The strongest officially recorded suête was logged at 233 km/hr on March 13, 1993. The Margaree Valley is known for having some of the coldest temperatures and the shortest recorded frost-free period in the province.

The underlying geology in this ecodistrict is a mixture of sedementary rocks, such as coal, sandstone, shale, gypsum and limestone. The

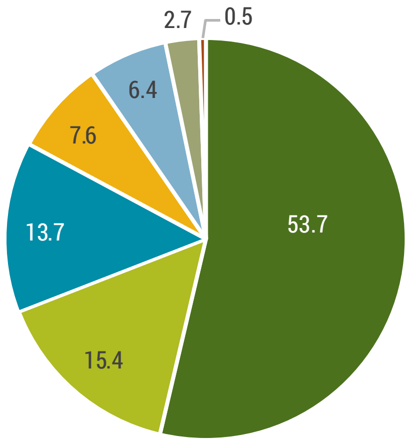
terrain is comprised of gently undulating to rolling low lying areas, much of which is suitable for farming. Most of the freshwater occurs in several rivers and Lake Ainslie. With an area of 57.4 km^2, this lake is the largest "true" (not created by hydro dams) lake in Nova Scotia. Another significant portion of the ecodistrict is comprised of freshwater wetlands, salt marshes and coastal

Cheticamp River estuary at Petit Etang *PHOTO: CNS (Len Wagg)*



Ecodistrict 320
Percentage Land Cover

Forest/Woodland	53.7
Agriculture	15.4
Water	13.7
Urban/Industrial	7.6
Wetlands	6.4
Shrub/Heathland	2.7
Sparsely Vegetated	0.5



beaches. Between Mabou and Inverness, erosion has created wide valleys with steep slopes and gorges.

The first Europeans came to the area in the 1750s to establish fishing stations along the coast. Actual settlement began about 30 years later, with Acadians settling at Cheticamp, and United Empire Loyalists coming to Mabou.

Abundant arable land and deposits of coal and gypsum at several locations led to widespread settlement of the ecodistrict. Most of the original forest has been severely disturbed, especially on the intervale lands, which account for almost 8% of the ecodistrict. On these rich floodplains sugar maple, white ash, and elm once formed the climax forest. Extensive areas of black spruce forest are found on the moist soils of this ecodistrict. Where sheltered growing conditions are provided by the hills and uplands, and where the soils are well drained on slopes, tolerant hardwood forests of sugar maple, yellow birch, and beech will occur. Old field white spruce forests are common where agricultural land has been abandoned.

The softwood forests are susceptible to spruce budworm and bark beetles. These two pests have had a significant influence on forest composition in this ecodistrict. Blowdown of the shallow-rooted spruce forests on the moist soils is common throughout the ecodistrict. Fire risk would be greatest in the softwood forests that occur on the black spruce and balsam fir ecosections of the Middle and Margaree River valleys.

The hardwood forests have also experienced significant mortality, with individual species succumbing to pathogens. In the hardwood forest, individual tree mortality is more prevalent due to species specific insects and diseases. These include the sugar maple borer, beech canker, chaga (*birch cinder conch*) in yellow birch, and Dutch elm disease in the floodplain forests.

Southwest Margaree River floodplain at Scotch Hill
PHOTO: CNS (Len Wagg)

Wounds in trees caused by ice storms and subsequent breakage provide avenues for a variety of fungi to enter and weaken trees, leading to further breakage and blowdown.

Geology and Soils

The Inverness Lowlands is a small, irregularly-shaped ecodistrict primarily made up of the valleys of seven large rivers in Inverness County and the shores of Lake Ainslie. Bedrock generally consists of Carboniferous period sedimentary rock including various conglomerates, sandstones, siltstones, shales, mudstones, limestone, gypsum and coal. More resistant sandstones and conglomerates usually form the higher ground, including the foothills and slopes that border surrounding, more elevated ecodistricts. Karst conditions can also be found in areas associated with near-surface gypsum and limestone.

Although surficial deposits and soil parent materials are dominated by glacial tills, there are also significant glaciofluvial and alluvium (floodplain) deposits associated with the valley corridors that make up this ecodistrict. Of particular note is the extensive deposit of glacial stratified sand and gravel found between Loch Ban and Inverness. During the retreat of the last glaciation (Wisconsinan), this deposit effectively dammed the Loch Ban valley, thereby contributing to the present formation of Lake Ainslie by forcing lake water to flow north by way of the Southwest Margaree River.

Dominant soils are derived from non-gravelly silt loam to clay loam till (Queens/Falmouth soils); gravelly and sandy glaciofluvial deposits (Hebert soils); non-gravelly, glaciofluvial sands (Canning soils); active floodplain deposits (Cumberland soils); and gravelly loam to clay loam till containing sandstone and shale (Woodbourne/Millbrook soils) (**See Table 8**).

Low-lying areas and extensive coverage of fine-textured till has also led to significant hydric soil development in this ecodistrict. In addition, coarse-textured Hebert and Canning soils are prone to natural cementation with iron oxides and organic matter (Ortstein soils).

Forests

Forests in this ecodistrict occur primarily on the level and hummocky terrain along rivers originating within the Cape Breton Highlands or on sites along the coastal lowlands of the Northumberland Strait. In river valleys, less fertile, well to imperfectly drained coarse textured, gravelly glaciofluvial deposits support forests of black spruce, white spruce, white pine, and balsam fir (Spruce Pine Forest Group). With progressively poorer drainage, especially where soils are finer textured, black spruce, tamarack, and red maple dominate the forest vegetation.

Table 8
Summary information for dominant soils found in the Inverness Lowlands ecodistrict (320). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Queens / Falmouth	21	Glacial Till	Fine	Mod. Well-Imperfect	ST6, ST12, ST5, ST11	Luvisol, Brunisol
Hebert	17	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Hydric *	18	Various	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Canning	7	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Cumberland	7	Alluvium	Medium-Coarse	Well	ST8, ST8-C	Regosol
Woodbourne / Millbrook	7	Glacial Till	Fine-Medium	Mod. Well-Imperfect	ST2-L, ST3-L, ST6, ST5	Podzol, Luvisol
Westbrook	6	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol

*** Hydric soils represent all poorly drained organic and mineral soil types.**

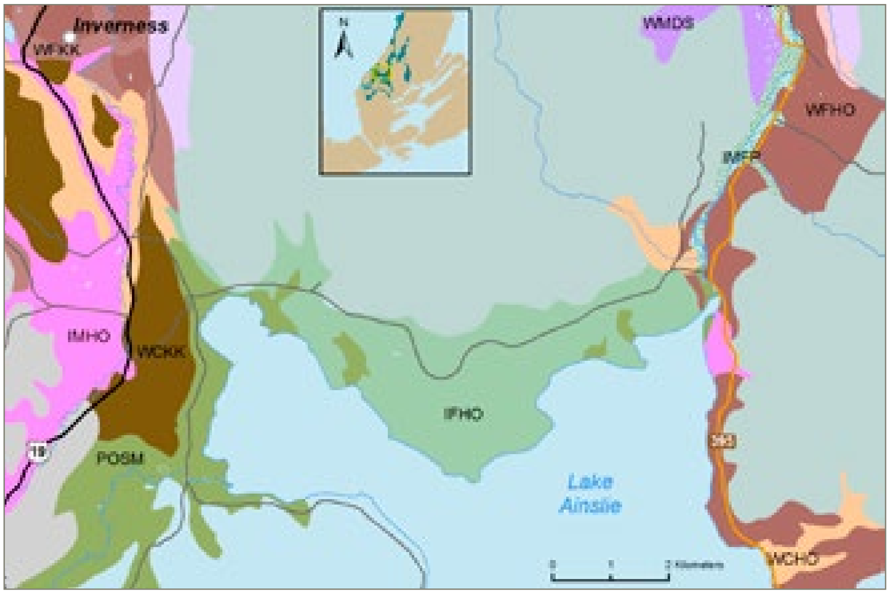
On active floodplains, alluvial deposits of sediment occur annually or periodically, enriching the site and creating conditions for a diverse mixed hardwood forest (Floodplain Forest Group) characterized by a species-rich understory of herb species and a poorly developed or non-existent bryophyte (moss) layer. Sugar maple, red maple, red oak, white ash, and balsam poplar typify the forest overstory. Seasonally active channels, such as vernal pools, marshes and stagnant pools, and old abandoned riverbeds (oxbows), are common, and provide sites for additional plant diversity.

The alluvial deposits common to floodplains are usually fresh to fresh-moist (but sometimes wetter) and rich to very rich, deep, medium to coarse textured and stone free (although gravel layers are often encountered). Rare and uncommon floodplain plants such as bloodroot (*Sanguinaria canadensis*), wild coffee (*Triosteum aurantiacum*), Canada lily (*Lilium canadense*), and black ash are found on the floodplain. Fiddlehead ferns, also known as ostrich fern (*Matteuccia struthiopteris*), are a favourite green whose unfurled frond is harvested in the early spring. Floodplains in this ecodistrict are associated with level, terrain along the major rivers such as the Middle, Southwest Margaree, Northeast Margaree and Skye, as well as along larger streams.

Forest successional dynamics and disturbance history are not well understood in the floodplain forest due to the long history of settlement and agricultural activities on these productive sites. Flooding, channelization, ice scour, insects and disease are all potential disturbance agents. Elm was once a significant part of this forest but has been wiped out in natural habitats by Dutch elm disease.

The low hills and hummocky terrain that borders the lower slopes of the Cape Breton plateau supports a mid to late successional shade tolerant Acadian hardwood forest typical (Tolerant Hardwood Forest Group). Representative species include sugar maple, beech, yellow birch, and white ash, with ironwood on the richer sites. Under these closed canopy forests the shrub layer consists of regenerating trees and shrubs such as fly-honeysuckle and beaked hazelnut. These forests also have an abundant cover of ferns and club-mosses. Natural stand-level disturbances are rare in these forests. Many of these stands will develop an uneven-aged or old growth structure with small gap disturbances providing openings

An approaching early autumn thunderstorm in the Southwest Margaree River valley near Portree *PHOTO: CNS (Len Wagg)*



Ecodistrict 320

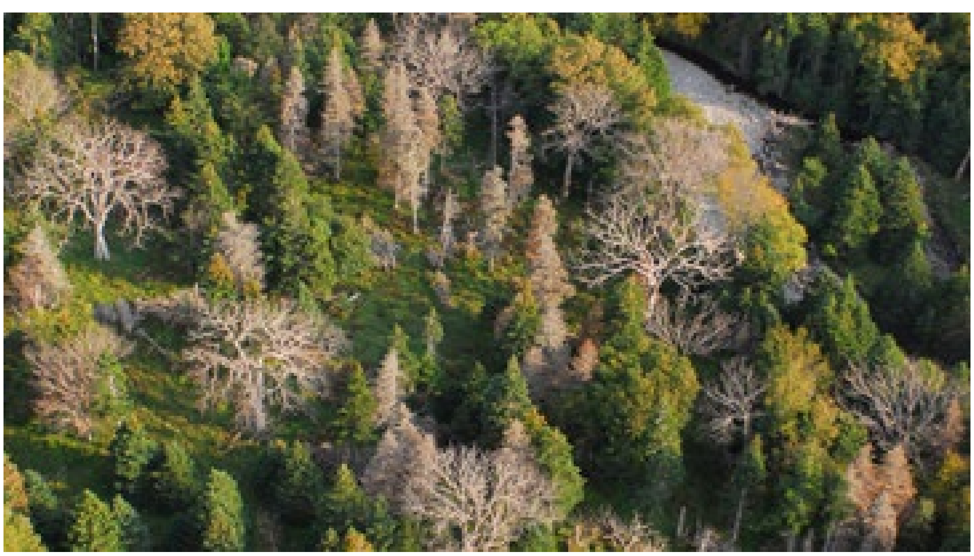
Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCHO	14.6%	14.6%
IFHO	14.0%	28.5%
XXWA	13.8%	42.4%
IMHO	10.4%	52.8%
WFHO	8.7%	61.5%
WMHO	8.1%	69.6%
IMFP	5.0%	74.6%
WMKK	4.9%	79.5%
POSM	3.6%	83.1%
WCKK	3.5%	86.6%
WFKK	2.9%	89.5%
ICFP	2.1%	91.6%
WFRD	2.0%	93.6%
ICSM	2.0%	95.6%
ICHO	1.3%	96.8%
IMSM	1.1%	98.0%
WCFP	0.6%	98.6%
WMDS	0.6%	99.2%
WFDS	0.2%	99.4%
XXMS	0.2%	99.6%
XXCB	0.2%	99.8%
IFSM	0.2%	100.0%
IFFP	< 0.1%	100.0%

in the canopy for new growth. Disturbance agents include hurricanes, ice storms, disease, and insects which typically create small patch or individual tree mortality. Evidence of blowdown and uprooting is evident in much of the hardwood forest by the abundance of pit and mound relief. Early successional species such as aspen, grey birch, white birch, red maple, and/or balsam fir will regenerate areas that have been harvested.

Another unique landform feature scattered throughout the Inverness Lowlands is the karst topography associated with Windsor era deposits of gypsum. Many rare and endangered plants such as showy lady's slipper (*Cypripedium reginae*), yellow lady's slipper (*Cypripedium parviflorum*), and black ash are found where gypsum is exposed on, or close to, the surface. Wetlands enriched with seepage from underlying gypsum deposits can also have significant populations of the above and other rare plants, with good examples along the north shore of Lake Ainslie.

On the spruce-pine upland sites, stand-level natural disturbances are frequent and result in primarily even-aged forests. Disturbances agent include fire and windthrow, as well as eastern spruce budworm if forests have a high component of balsam fir or white spruce. The spruce bark beetle has been responsible for significant mortality in old field forests of white spruce.



Expansive, leafless canopies of dead elm punctuate the floodplain forest along the Polletts Cove River.
PHOTO: © J.-F. Bergeron (Enviro Foto)

The lowlands at Inverness, looking southeast with Cabot Cliffs Golf Course in the foreground; Godfrey's Mountain can be seen in the distance PHOTO: CNS (Len Wagg)

Non Forests

The Inverness Lowlands is the only lowland ecodistrict in the Nova Scotia Uplands Ecoregion. This ecodistrict is extensively forested, fifth lowest among all ecodistricts in relative proportion of naturally unforested land. The primary reason for this biogeographic pattern is that much of the soil and climate is highly favorable for tree growth. Those non-forested ecosystems that do occur are few and often small.

Most of the non-forested ecosystems in the Inverness Lowlands are wetlands, and the vast majority are associated with Lake Ainslie, branches of the Margaree River, and the Black River. Total wetland area is relatively low, but the proportion of wetlands occupied by shallow marsh is second highest of any ecodistrict in the province. The size of individual shrub swamps is similarly remarkable. In the Inverness Lowlands, the average area of this wetland type is second highest of any ecodistrict in the province.

Some of the most botanically interesting wetlands on Cape Breton occur in the Inverness Lowlands. Lake Ainslie is the most northern known outpost of Atlantic Coastal Plain Flora in the province. These temperate plants are largely restricted to the western and the Atlantic coasts of Nova Scotia, but a number are found in the marshes, swamps and peatlands adjacent to and along the shores of Lake Ainslie. Swamp loosestrife (*Decodon verticillatus*), swamp milkweed (*Asclepias incarnata*), slender blue flag (*Iris prismatica*), and southern twayblade (*Listera australis*) are among the coastal plain species found from this area. These may co-occur with plants limited to richer wetlands. Brook lobelia (*Lobelia kalmii*), showy lady's slipper (*Cypripedium reginae*), and the very rare hoary willow (*Salix candida*) and false asphodel (*Triantha glutinosa*) are known from the wetlands around Lake Ainslie and along the Black River.

The Inverness Lowlands also contain some gypsum karst and limestone outcrops. Further information on karst is found in the **Bras d'Or Lowlands (510)** and the **Central Lowlands (630)** ecodistricts sections. Landforms associated with karst processes are generally not as diverse, extensive, or strongly expressed in the Inverness Lowlands, as they are in the two other ecodistricts mentioned above. However, there is some extensive karst along the Margaree River and on the slopes east of the Middle River. Karst communities are found on small outcrops, in sinkhole ponds and wetlands, and on the cliffs and talus scattered through these areas.

330
Pictou Antigonish Highlands

The Pictou Antigonish Highlands, includes some of the highest elevations in mainland Nova Scotia. This rolling plateau separates the **Northumberland Lowlands (530)** of Pictou County from the **St. George's Bay Lowlands (520)** of Antigonish County. To the south, the highlands border the **St. Mary's River ecodistrict (370)** along the Chedabucto fault. The elevation is generally 210–245 m above sea level and rises to 300 m at Eigg Mountain.

Complex geology is crosscut by faults trending north-south and northeast-southwest, creating many narrow valleys. The most notable fault is the Hollow Fault, which extends from Cape George to New Glasgow. The fault is marked by a 200 m escarpment which has developed as a result of differential erosion (underlying bedrock materials eroding at different rates). Much of the province's geological history can be viewed in this ecodistrict, including ancient volcanoes and the 400 million-year-old fossils at Arisaig.

The total area of this ecodistrict is 1332 km^2 (12.2% of the Nova Scotia Uplands Ecoregion), with freshwater accounting for only 0.5% or 720 hectares. Influenced by high elevations, the climate has late, cool springs, cold winters, and low annual temperatures. Part of the ecodistrict is more strongly exposed to moderating climatic influences off the Gulf of St. Lawrence.

Fresh, medium to rich soils are common on the hilly terrain. They support a zonal Acadian hardwood forest of sugar maple, beech and yellow birch which is prominent on the crests and upper slopes of hills and larger hummocks. Mixedwood tolerant forests of beech, sugar maple, yellow birch and red spruce, with scattered hemlock,

Wind turbines on the Hollow Fault escarpment near Ardness
PHOTO: CNS (Len Wagg)

grow on the steep slopes along streams and rivers flowing from the highlands. At higher elevations, softwood stands occur on more moist, level terrain.

Stand-level natural disturbances in the Cape Breton Hills are rare within the dominant hardwood forest. Disturbance agents such as hurricanes, wind and ice storms, disease, and insects typically create small patch or individual tree mortality. Many of these stands will develop an uneven-aged or old growth structure, with small gap disturbances providing openings in the canopy for new growth.

A significant portion of the Pictou Antigonish Highlands was settled and cleared for farming by Scottish settlers beginning in the late 1700s with large communities at Laggan, Browns Mountain, and on The Keppoch. However, the abandonment of these farms started shortly after the First World War and continued as the rural population moved to urban centres. As a result, most of these lands are now back in a forested condition, usually composed of white spruce and balsam fir stands.

Geology and Soils

The Pictou Antigonish Highlands ecodistrict is mainly underlain by volcanic and sedimentary rock from the Precambrian through to Silurian periods. Dominant types include basalt, rhyolite, granite, siltstone, shale and sandstone; as well as metamorphic associates (quartzite, schist and slate). This ecodistrict is also home to one of North America's best exposed sections of Silurian rock (near Arisaig) which has been studied by geologists and fossil hunters for over 150 years.

Local topography is largely controlled by the presence of faults and folds, with the southern and northwestern boundaries of the ecodistrict closely following the Chedabucto and Hollow fault lines. Within the highlands itself, narrow valleys have also formed along minor fault lines.

Soil parent materials are dominated by thin, stony, medium to coarse-textured glacial tills with frequent bedrock exposures. However, the till is thicker (up to 20 m) and less coarse around the perimeter of the highlands. Younger colluvium deposits are common on steeper slopes, while coarse glaciofluvial deposits can be found in some valley corridors.

Dominant soils are derived from gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom/Mira soils); gravelly sandy loam till high in quartzite, schist and hard sandstone (Kirkmount soils); gravelly sandy loam till with a mix of igneous and metamorphic rock (Cobequid soils); gravelly to very gravelly sandy loam to loamy sand till high in granite (Wyvern soils); and loam to silt loam till containing shaly gravel and flagstones (Barney soils) (**See Table 9**).

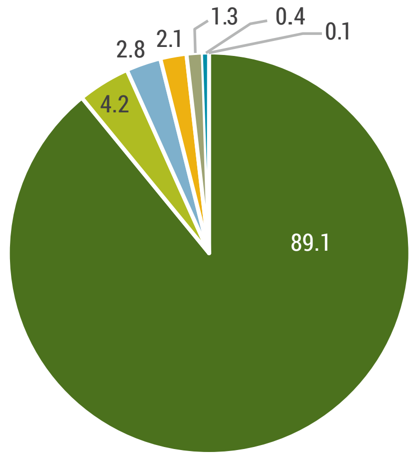
Table 9
Summary information for dominant soils found in the Pictou Antigonish Highlands ecodistrict (330). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Thom / Mira *	38	Glacial Till, Colluvium	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol, Brunisol
Kirkmount *	12	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol
Cobequid *	11	Glacial Till, Colluvium	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol, Brunisol
Wyvern*	8	Glacial Till	Coarse	Well-Rapid	ST2, ST1	Podzol
Barney	8	Glacial Till	Medium	Well-Imperfect	ST2-L, ST8, ST3-L, ST9	Podzol
Millbrook	6	Glacial Till	Fine-Medium	Imperfect	ST6, ST3-L, ST12	Podzol, Luvisol

*** Stony (S) phases are common (e.g., ST2-S).**

Forests

With large intact stands extending from hill crests to lower slopes similar to those along the Trans-Canada Highway 104 through Marshy Hope, late successional Acadian shade tolerant hardwood forests (Tolerant Hardwood Forest Group) occur on zonal sites of medium to rich, well drained glacial tills. This is the matrix forest condition on 64% of the ecodistrict. Representative species include sugar maple, beech and yellow birch, with white ash and ironwood on richer soils where organic matter enrichment in the A horizon has occurred through natural mixing by soil fauna (usually with mull humus forms). Under a closed canopy, regenerating trees similar to the overstory, as well as striped maple and red maple, are abundant. The shrub layer can be extensive with hobble-bush, fly-honeysuckle and beaked hazelnut. But it is the abundance and diversity of ferns and club-mosses that define the understory in this forest. In the spring, ephemeral herbs such as spring beauty (*Claytonia caroliniana*), dog tooth violet (*Erythonium americanum*) and Dutchman's breeches (*Dicentra cucullaria*) are also common. Vernal pools and seepage areas are commonly found in these hardwood forests. These wooded wetlands are important microhabitats for distinct communities of plants, amphibians and insects.



Ecodistrict 330 Percentage Land Cover

Forest/Woodland	89.1
Agriculture	4.2
Wetlands	2.8
Urban/Industrial	2.1
Shrub/Heathland	1.3
Water	0.4
Sparsely Vegetated	0.1

At higher elevations this forest is exposed to strong winds, snow and ice storms which can significantly influence tree growth potential. Trees can experience regular breakage (creating multiple tops, stem wounds for disease and rot entry) as well as uprooting. Evidence of tree blowdown and uprooting can be seen by the abundance of pit and mound microtopography.

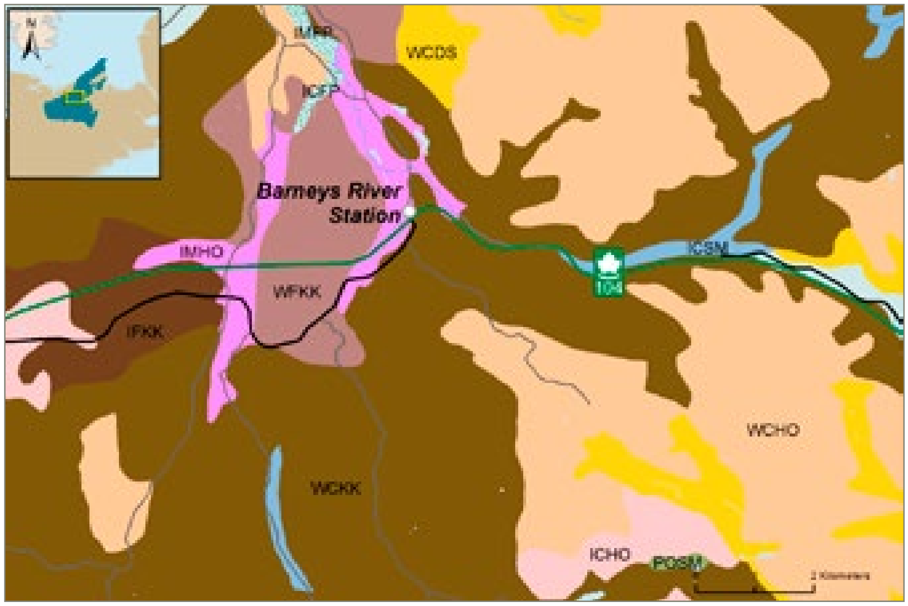
Along several rivers, including the James River, South Rights River, Rights River, Donny Brook, and Brierley Brook, steep-sided ravines support mixed forests of shade tolerant species. These include hemlock, red spruce, white pine, sugar maple, yellow birch and beech. This forest type can also be found on steep slopes and escarpments such as the Hollow Fault where red spruce and hemlock

Upland thickets of alder are flanked by spruce forests on imperfectly drained soils. *PHOTO: CNS (Len Wagg)*

Ecodistrict 330

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCKK	39.8%	39.8%
WCHO	23.0%	62.9%
WFKK	10.6%	73.5%
ICHO	7.5%	81.1%
IMHO	6.1%	87.1%
WCDS	4.6%	91.7%
IFKK	1.7%	93.4%
WMHO	1.4%	94.9%
IFHO	1.4%	96.3%
WMKK	0.8%	97.1%
WFHO	0.6%	97.8%
ICSM	0.6%	98.4%
XXWA	0.5%	98.9%
ICFP	0.5%	99.4%
WFSM	0.3%	99.7%
IMSM	0.2%	99.8%
POSM	0.1%	99.9%
WCDM	0.1%	100.0%
IMFP	< 0.1%	100.0%



are prominent on the shallow soils. The cliffs of Cape George also support a similar forest but with typically more white spruce in the canopy. Other areas of the ecodistrict with finer textured soils support a mixedwood forest with a high component of white ash—for example, the hilly terrain near Telford and Kirkmount, where the slopes are dissected with many small drainage channels.

At upper elevations the hills give way to a level or hummocky plateau-like topography with forests of red spruce and black spruce occurring on moderately-well to imperfectly drained soils. Early successional forests following stand-level disturbances caused by harvesting, windthrow, or insect defoliation include stands of red maple, white birch and balsam fir. Wet forests of black spruce, red spruce, tamarack and red maple occur on poorly drained mineral and organic soils.

A few small floodplain forests in the ecodistrict occur on smooth, level, terrain along the larger rivers and streams including the James and Moose Rivers. Gravelly soils are primarily derived from glaciofluvial outwash. However, where annual flooding deposits alluvial sediment (such as along the Barney's River and Donnybrook) soils are less gravelly and include sandy loams and loams. These linear, riparian forests support a climax floodplain forest of sugar maple, white ash and

Old field forests of white spruce, cultivated blueberries and tree plantations occupy most of the abandoned farmlands in the uplands near Brora Lake, Pictou County. *PHOTO: CNS (Len Wagg)*

A late successional, shade tolerant hardwood forest of sugar maple, yellow birch and beech is the matrix forest condition on the Pictou Antigonish Highlands.
PHOTO: CNS (Len Wagg)

elm. However, when soils are imperfectly drained, red maple and black spruce are dominant. Most of the alluvial soils in this ecodistrict that could be farmed have been converted to agriculture use.

Stand-level natural disturbances in the Pictou Antigonish Highlands are rare within the dominant hardwood forest. Disturbances agents such as hurricanes, wind and ice storms, disease and insects typically create small patch or individual tree mortality. These small gaps in the canopy allow younger trees from the understory to become part of the canopy and lead to uneven-aged or old growth stands. Two province-wide events that significantly influenced the composition of the hardwood forests were the beech bark canker (introduced in the 1890s) and the birch die-back (from 1932 to 1955). Beech, once the dominant tree of the overstory, has now been reduced to a primarily understory species with only a few scattered canopy beech remaining. Yellow birch has since recovered, and regained much of its natural abundance. Mixedwood forests in the sheltered ravines tend to be infrequently disturbed by similar agents and can also develop uneven-aged structure. The upper elevation spruce forests are more frequently subjected to stand-level disturbances caused by windthrow and insects.

Tolerant hardwood forests were cleared for farmland in the early 1800s at Brown's Mountain and The Keppoch. Later abandoned, the fields reforested naturally to stands of white spruce. Much of this old field forest has since been harvested and converted to wild blueberry production or re-planted with softwood species.

Non Forests

Shrub swamps and both shallow and emergent marshes make up most of the non-forested ecosystems in the ecodistrict. There are also some larger peatland complexes on flatter areas of the summits and gently rolling plateaus. Higher elevation wetlands contribute habitat for the endangered mainland moose, although animal numbers in this ecodistrict have had the greatest declines since the mainland population was healthy in the 1960s. Wetlands in this ecodistrict also support rare plant species including marsh harebell (*Campanula aparinoides*), Hayden's sedge (*Carex haydenii*) and rare insects such as the jutta arctic butterfly (*Oeneis jutta*) and the Maine snaketail dragonfly (*Ophiogomphus mainensis*).

The coast of the Pictou Antigonish Highlands has some of the largest beaches and cliff faces on the mainland. Most of the latter are relatively unexplored. Overall, non-forested uplands are not especially frequent or diverse in the ecodistrict.

340
Cobequid Hills

The Cobequid Hills ecodistrict is a narrow upland extending approximately 150 km in an east-west orientation between the towns of Pictou and Parrsboro. The ecodistrict is 1866 km^2 (17.1% of the Nova Scotia Uplands Ecoregion) and separates the foothills and lowland ecodistricts to its north and south.

A complex geological history includes underlying fault blocks consisting of resistant pre-Carboniferous metamorphic sediments, volcanic deposits and granites. The prominent Cobequid fault extends along the south slope from Truro to Cape Chignecto. Nuttby and Dalhousie Mountains (at 335 m above sea level) are the highest points on mainland Nova Scotia.

The Cobequid Hills encompass watersheds with north and south running streams that leave the mountains in deep, steep-walled ravines and gorges in a series of falls or cascades. Freshwater lakes and streams account for only 0.5% of the ecodistrict, with most lakes being small and shallow. However, Folly Lake, which resulted from melting glacial ice depositing gravel at both ends of an old river valley, has depths of over 30 m.

Fresh, medium to rich soils support large intact Acadian forests of shade tolerant hardwoods, with stands extending from the crests to lower slopes of hills and large hummocks. At higher elevations, softwood stands occur on more moist, level terrain, with shade tolerant mixedwood forests found along steep-sided ravines. Wind exposure, snow, and ice breakage are sometimes limiting factors to quality hardwood timber growth.

The repeating pattern of well drained hardwood hills separated by spruce/fir forests on more moist soils shows up clearly in the winter. *PHOTO: CNS (Len Wagg)*

Geology and Soils

Bedrock in the Cobequid Hills ecodistrict consists of a wide variety of igneous, sedimentary and metamorphic rocks from the Precambrian through to Carboniferous periods. Dominant types include granite, granodiorite, diorite, rhyolite, basalt, sandstone, siltstone, shale and conglomerate. Geology is also structurally complex with numerous faults and folding throughout the region. This complexity, combined with the range of weatherability of the rock type, contributes to the elevated, rolling terrain and incised valleys characteristic of this ecodistrict.

Surficial deposits and soil parent materials are dominated by thin, stony glacial tills with frequent bedrock exposures. Stony colluvium deposits are common on steeper slopes, with coarse glaciofluvial deposits also found along some valley corridors. While not extensive, these glaciofluvial deposits can be locally significant, as is the case near Folly Lake.

Dominant soils are derived from gravelly sandy loam till with a mix of igneous and metamorphic rock (Cobequid soils); gravelly to very gravelly sandy loam to loamy sand till high in granite (Wyvern soils); gravelly sandy loam to loam till high in conglomerate (Westbrook soils); gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom soils); and gravelly loam to clay loam till containing sandstone and shale (Millbrook soils) (**See Table 10**). In addition, Wyvern and Cobequid soils are often very stony with granite, quartzite and rhyolite the main rock types found.

An intact red spruce forest drapes the hummocky plateau-like topography in the Economy River Wilderness Area.

PHOTO: CNS (Len Wagg)

Forests

The forests of the Cobequid Hills are very similar to those of the **Pictou Antigonish Uplands (330)** with large intact late successional Acadian shade tolerant hardwood forests (Tolerant Hardwood Forest Group) extending from crests to lower slopes. This forest occurs on zonal sites of medium to rich, well drained glacial tills, approximately 65% of the ecodistrict. Representative species include sugar maple, beech and yellow birch, with white ash and ironwood on richer soils where organic matter enrichment in the A horizon has occurred through natural mixing by soil fauna (usually with mull humus forms).

Under a closed canopy, regenerating trees similar to the overstory (as well as striped maple and red maple) are abundant. The shrub layer can be extensive with hobble-bush, fly-honeysuckle and

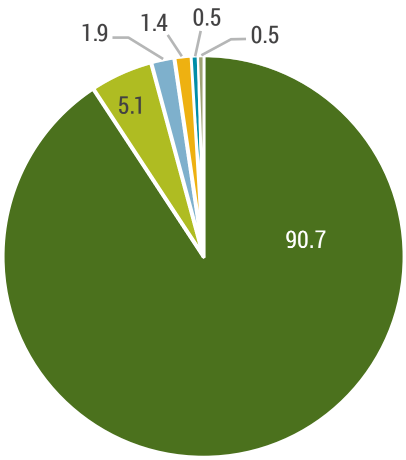
Table 10
Summary information for dominant soils found in the Cobequid Hills ecodistrict (340). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Order (SCWG 1998)
Cobequid *	35	Glacial Till, Colluvium	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol, Brunisol
Wyvern *	34	Glacial Till	Coarse	Well-Rapid	ST2, ST1	Podzol
Westbrook	11	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol
Thom	6	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol
Millbrook	5	Glacial Till	Fine-Medium	Imperfect	ST6, ST3-L, ST12	Podzol, Luvisol

*** Stony (S) phases are common (e.g., ST2-S).**

Ecodistrict 340 Percentage Land Cover

Forest/Woodland	90.7
Agriculture	5.1
Wetlands	1.9
Urban/Industrial	1.4
Water	0.5
Shrub/Heathland	0.5



beaked hazelnut. However, it is the abundance and diversity of ferns and club-mosses that define the understory in this forest. In the spring, ephemeral herbs such as spring beauty (*Claytonia caroliniana*), dog tooth violet (*Erythonium americanum*) and Dutchman's breeches (*Dicentra cucullaria*) are also common. Vernal pools and seepage areas are commonly found in these hardwood forests. These wooded wetlands are important microhabitats for distinct communities of plants, amphibians and insects.

Elevations in the Cobequids are generally higher than elsewhere in the Nova Scotia Uplands Ecoregion and therefore exposed to stronger winds. At these elevations significant physical damage can occur in the hardwood forest, which negatively influences growth potential. Trees can experience regular breakage (creating multiple tops, stem wounds for disease and rot entry) as well as uprooting. Evidence of tree blowdown and uprooting is indicated by the abundance of pit and mound microtopography.

The Cobequids are the source of many rivers flowing southerly to the Minas Basin or northeasterly to the Northumberland Strait. At the escarpment edge (particularly on those rivers flowing to the Minas Basin) are several waterfalls which are popular hiking destinations. Along these rivers are steep-sided ravines with a mixed forest of shade tolerant species including hemlock, red spruce, white pine, sugar maple, yellow birch, and beech. This forest type can also be found on steep slopes and escarpments similar to those visible from the Wentworth valley pass where red spruce and hemlock are prominent on the shallow soils.

At upper elevations the hills give way to a level or hummocky plateau-like topography with forests of red spruce and black spruce occurring on moderately-well to imperfectly drained soils. Large expanses of this forest can be found near Economy Lake and behind New Prospect. Early successional forests following stand-level disturbances caused by harvesting, windthrow, or insect defoliation include red maple, white birch, and balsam fir.

Gully Lake is typical of the many small, shallow lakes of the Cobequid Hills. PHOTO: CNS (Len Wagg)

Ecodistrict 340

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCKK	63.2%	63.2%
WCHO	13.0%	76.2%
ICHO	11.1%	87.3%
WCDS	7.5%	94.8%
ICSM	1.9%	96.7%
WFKK	1.6%	98.3%
XXWA	0.5%	98.8%
WFHO	0.5%	99.3%
IFKK	0.3%	99.6%
ICFP	0.2%	99.8%
IFHO	0.1%	99.8%
WMHO	0.1%	99.9%
WMDS	< 0.1%	99.9%
WMKK	< 0.1%	100.0%
POSM	< 0.1%	100.0%

Wet forests of black spruce, red spruce, tamarack and red maple occur on poorly drained mineral and organic soils.

Stand-level natural disturbances in the Cobequid Hills are rare within the dominant hardwood forest. Disturbances agents such as hurricanes wind and ice storms, disease and insects typically create small patch or individual tree mortality. Many of these stands will develop an uneven-aged or old growth structure with small gap disturbances providing openings in the canopy for new growth. Mixedwood forests in the sheltered ravines tend to be infrequently disturbed by similar agents and can also develop uneven-aged structure. The upper elevation spruce forests are more frequently subjected to stand-level disturbances caused by windthrow and insects.

Forests of the Cobequid Hills also reflect two province-wide disturbance events that have significantly altered hardwood forest composition. The beech bark canker that arrived in Nova Scotia in the 1890s has reduced the once dominant beech to a primarily understory species. Birch dieback, widespread in eastern Canada from 1932–1955, caused widespread mortality of yellow birch in Nova Scotia (up to 40%). A series of climatic events (drought and mid-winter freeze/thaw) followed by secondary agents such as fungi, are believed to have been responsible for the dieback. Yellow birch has since recovered and regained much of its natural abundance, but only a few scattered canopy beech remain. Other insects and diseases that cause individual tree mortality include sugar maple borer in sugar maple and chaga (birch cinder conch) (*Inonotus obliquus*) in yellow birch.

A spruce budworm epidemic in mid-1980s caused stand-level mortality in red spruce forests, most notably in the western portion of the ecodistrict. This was followed a few years later by spruce bark beetle which attacked stands stressed earlier by the budworm.

Large areas of tolerant hardwood forests were cleared for farmland in the early 1800s by Scottish settlers and later abandoned, with fields reforesting naturally to stands of white spruce. Much of this old field forest has since been harvested and converted to wild blueberry production or re-planted with softwood species.

Red trillium is a somewhat uncommon plant found in richer hardwood forests. It is not known to occur in Cape Breton.

PHOTO: DNR (Peter Neily)

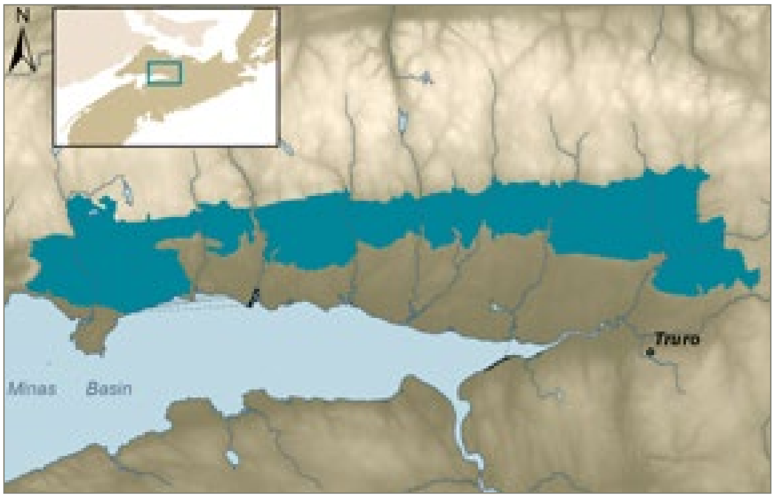
Water falls on the North River near Five Islands. *PHOTO: CNS (Len Wagg)*

Non Forests

Similar to other upland ecodistricts of Nova Scotia, the Cobequid Hills is one of the most heavily forested areas in the province. As such, non-forested ecosystems tend to be small and infrequent. Although they include the highest peak in mainland Nova Scotia, summits in the Cobequids are not high enough for krummholz or alpine conditions. Therefore, non-forested ecosystems in this ecodistrict are limited to shrubland, herbaceous (e.g., grassland) and lichen-dominated vegetation associated with either extremely wet or extremely dry sites. Latter sites include rock outcrop, talus, and small cliff ecosystems. These dry sites usually include at least sparse tree cover, and are commonly dominated by ericaceous shrubs, ground lichens (various reindeer and shield lichen species), and, less often, herb species (e.g., three-toothed cinquefoil). Some of these sites provide habitat for the long-tailed shrew (*Sorex dispar*)—one of the rarest mammals in eastern Canada. Steep cliff and outcrop ecosystems found along upper reaches of some of the major rivers include rare plants such as the smooth cliff fern (*Woodsia glabella*), fragrant wood fern (*Dryopteris fragrans*), rock whitlow grass (*Draba arabisans*), Appalachian fir club-moss (*Huperzia appalachiana*) and fir-moss (*Huperzia selago*).

Like other upland ecodistricts on the mainland, rugged topography in the Cobequid Hills limits development of larger wetland complexes. Water is shed off the rounded summits and flows down the relatively steep slopes, collecting in surrounding lowland ecodistricts. Most soils are well drained, so many wetlands are restricted to lower slopes and small slope-side seepage areas. The largest wetlands are found on the plateau, particularly in the area between Gundalow Plains in the west, and the headwaters of Bass River in the east. These two areas are the wettest uplands of Colchester County and a local stronghold for the endangered mainland moose. Poorly drained Wyvern, Millbrook, Cobequid and Hebert soils are common here, supporting the ecodistict’s largest swamps and peatlands. Sixty percent of wetlands in the Cobequid Hills are swamps. Among the swamps, treed ecosystems are relatively common, but are less frequent than shrub swamps. Swamps and peatlands are not generally rich, although localized areas may show marginally elevated pH. All peatlands in the ecodistrict are unpatterned (i.e., they do not support an alternating surface topography of ridges and troughs). Most peatlands are flat, although some bogs are raised.

350 Cobequid Slopes



The Cobequid Slopes are a series of steep to moderate grades on the south side of the **Cobequid Mountains (340)** with shoulder slopes running down to the **Minas Lowlands (620)**. Average elevation is just over 100 m. As a narrow band of rolling hills from North River in the east to Economy in the west, the southerly aspect of this ecodistrict provides significant winter habitat for white-tailed deer who venture down from higher elevations when snow accumulations there restrict movement.

The climate is moderate and relatively humid because of the ecodistrict's proximity to the Bay of Fundy. Two fault lines separate the older more resistant pre-Carboniferous rocks of the **Cobequids Hills (340)** from the late Carboniferous sandstone, shale, conglomerate and coal of the Cobequid Slopes. As the topography levels into the **Minas Lowlands (620)**, the Portapique Fault forms the southern boundary with softer Triassic era siltstone and sandstone. Wetlands and lakes are absent in this ecodistrict with all of the freshwater (0.4% of the area) located in the streams and rivers that flow through the ecodistrict on their way to the Minas Basin. Total area is 371 km^2 (3.4% of the Nova Scotia Uplands Ecoregion).

Fresh, medium to rich soils provide the zonal condition for typical species of the Acadian forest. The forests are predominantly comprised of shade tolerant species with pure and mixed stands of red spruce, sugar maple, yellow birch, beech and hemlock. On the ecosections with gentler slopes or fairly level terrain, pure stands of red spruce

Mixedwood forests of the Cobequid Slopes, near the Gerrish Valley *PHOTO: CNS (Megan Mahon)*

A newborn fawn hides in the foliage of fireweed and hemp nettle. White-tailed deer use mature conifer or mixedwood stands on warmer, generally south-facing slopes of this ecodistrict for shelter during the winter. *PHOTO: DNR (Jane Kent)*

or red spruce/yellow birch occur. For the most part, white pine is absent from the ecodistrict. Hemlock occurs on the steeper slopes along streams and rivers.

Natural disturbance agents in forests of this ecodistrict are primarily associated with climate. They include hurricanes and wind storms, ice storms, and damage/mortality associated with freeze/thaw cycles. Occasional stand-level mortality will occur due to insect and disease epidemics such as the spruce budworm, tussock moth, and birch dieback. More recently white spruce stands on abandoned agricultural lands have been impacted by spruce bark beetles.

Geology and Soils

Bedrock in the Cobequid Slopes ecodistrict is mainly comprised of Carboniferous period sedimentary rock with some older igneous intrusives. Dominant types include sandstone, siltstone, conglomerate, shale, coal, granite and granodiorite.

The Cobequid fault provides the northern boundary of the ecodistrict and separates it from the older more resistant pre-Carboniferous rocks of the **Cobequid Hills (340)**. The southern boundary follows the Portapique fault that separates this ecodistrict from the Triassic period sediments of the **Minas Lowlands (620)**.

Soil parent materials are mainly glacial tills of varying texture that reflect the sedimentary rock types found in each deposit—from fine-grained shales to coarse-grained sandstone and conglomerate. Dominant soils are derived from gravelly sandy loam till with a mix of sandstone, conglomerate and igneous rock (Folly soils); gravelly silty clay loam to clay loam till (Diligence soils); gravelly sandy loam to gravelly sand till high in conglomerate (Portapique soils); non-gravelly silt loam to clay loam till (Queens soils); gravelly sandy loam till high in sandstone (Hansford soils); and gravelly loam to clay loam till containing sandstone and shale (Millbrook soils) (**See Table 11**).

Folly and Hansford soils also frequently contain fragic horizons that restrict vertical drainage, leading to perched water tables and/or seepage flow.

Table 11
Summary information for dominant soils found in the Cobequid Slopes ecodistrict (350). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Order (SCWG 1998)
Folly *	28	Glacial Till, Colluvium	Medium-Coarse	Well-Imperfect	ST2, ST3, ST8, ST9	Podzol
Diligence	18	Glacial Till	Fine	Imperfect-Poor	ST6, ST7, ST12	Luvisol, Gleysol
Portapique	11	Glacial Till	Coarse	Well-Rapid	ST2, ST1	Podzol
Queens	11	Glacial Till	Fine	Imperfect-Poor	ST6, ST12, ST7	Luvisol, Gleysol
Hansford	8	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3	Podzol
Millbrook	5	Glacial Till	Fine-Medium	Imperfect	ST6, ST3-L, ST12	Podzol, Luvisol

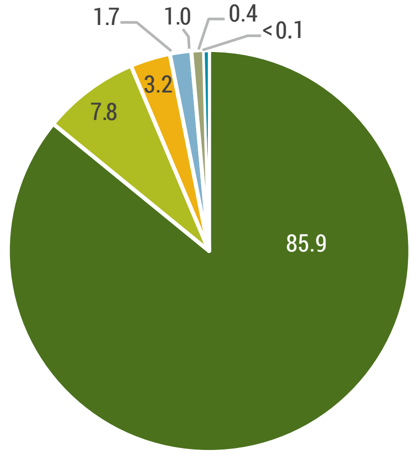
* Stony (S) phases are common (e.g., ST2-S).

Forests

South facing slopes of the Cobequid Hills support a late successional Acadian mixed forest (58% of the ecodistrict) that often serves as important deer-wintering areas. Red spruce forests (Spruce Hemlock Forest Group) occur on the middle to lower slopes of rounded hills underlain by fresh to fresh moist, coarse to medium textured glacial tills of medium fertility. Balsam fir is usually associated with earlier successional stages, but is present in all stands at some stage of development. Regenerating overstory species, herbs typical of upland softwood forests, and an extensive moss layer make up the understory.

Sugar maple, yellow birch, and beech (Tolerant Hardwood Forest Group) are dominant where soils are fresh, medium to coarse and richer. This usually occurs on upper slopes and crests, and in middle slope seepage areas where white ash and ironwood indicate nutrient enrichment. The shrub layer can be extensive with regenerating overstory species, but the understory is characterized by a diverse and abundant coverage of herbs, ferns, and club-mosses.

Elsewhere, a shade tolerant mixedwood forest (usually dominated with red spruce, hemlock and yellow birch with occasional sugar maple, beech and white pine) can be found on middle slopes and steep-sided slopes and ravines along major watercourses (such as the Chiganois, Debert and Economy Rivers). Soils are mostly well drained



Ecodistrict 350 Percentage Land Cover

Forest/Woodland	85.9
Agriculture	7.8
Urban/Industrial	3.2
Wetlands	1.7
Shrub/Heathland	1.0
Water	0.4
Sparsely Vegetated	< 0.1

with moister and richer soils at lower and toe slope positions. Very steep and/or lower slopes are usually stronger in softwood species, particularly hemlock.

Growth potential of both softwood and hardwood forests can be influenced significantly by exposure to winds, snow and ice, with breakage reducing height and stem quality on hilltops and upper slopes. However, on sheltered middle and lower slopes, height and diameter growth improves as exposure to winds diminishes.

Natural stand-level disturbances in the soft-wood and mixedwood forests are infrequent on the Cobequid Slopes. Disturbance agents include windthrow, insects and fire. Red maple and white birch colonize as early successional species following stand disturbances, often with a component of balsam fir. Mid successional stages develop as even-aged forests, with late

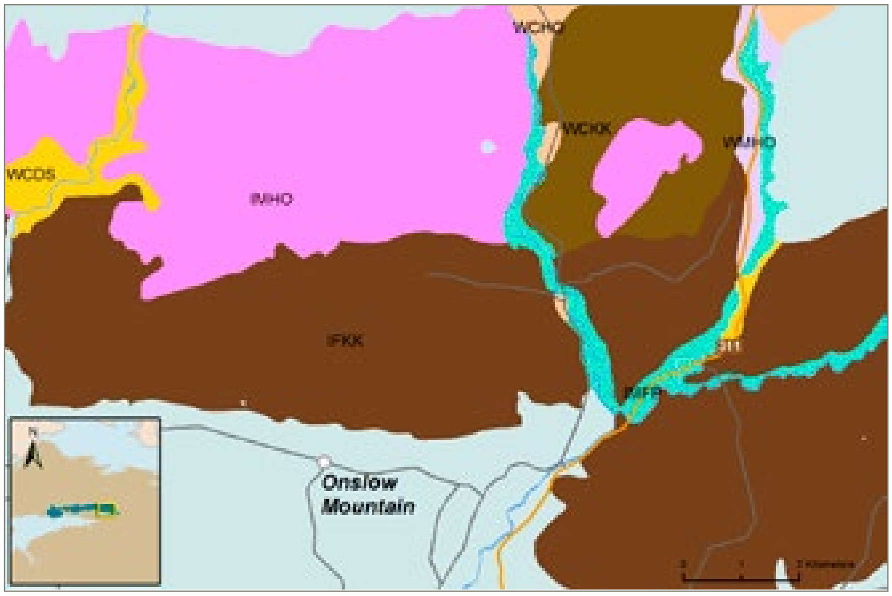
Cultivated blueberries on the lower slopes, near Pleasant Hills

PHOTO: CNS (Len Wagg)

Ecodistrict 350

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IFKK	25.4%	25.4%
WCKK	18.9%	44.3%
IMHO	18.5%	62.8%
WMHO	12.1%	74.9%
WMKK	8.8%	83.7%
IMRD	5.8%	89.5%
WCHO	3.8%	93.2%
WMDS	2.5%	95.7%
IMFP	1.5%	97.2%
WFKK	1.1%	98.3%
WCDS	1.1%	99.5%
XXWA	0.4%	99.9%
ICHO	0.1%	100.0%
XXCB	< 0.1%	100.0%



successional stages developing uneven-aged characteristics due to the longevity of the red spruce, yellow birch, sugar maple, and hemlock. As stands mature individual tree or small patches of tree mortality provide openings for the recruitment of younger trees into the canopy.

In the hardwood forests stand-level natural disturbances are rare and usually confined to individual trees and small patches. Yellow birch has recovered from the dieback event of the 1940s. However, only a few canopy-level beech remain following the beech bark canker introduction in the 1890s. Today most beech are deformed, and are present in large numbers only as part of the understory.

Other insects and diseases that cause individual tree mortality include sugar maple borer in sugar maple and chaga (birch cinder conch) in yellow birch. Wounds caused by ice storm breakage also provide avenues for a variety of fungi to enter and further weaken or kill trees. A spruce budworm epidemic in mid-1980s caused stand-level mortality in red spruce forests, most notably in the western portion of the ecodistrict. This was followed a few years later by spruce bark beetle which attacked stands stressed earlier by the budworm.

Where forests were cleared for farmland in the early 1800s and later abandoned, fields reforested naturally to stands of white spruce. Much of this old field forest has since been harvested and converted to wild blueberry production.

Non Forests

Sloped topography and generally well drained soil of the Cobequid Slopes reduces the occurrence of open wetlands. Total wetland area is very low—the second lowest of any ecodistrict in the province. Most wetlands are small slope-side seepage areas; shrub swamps, marshes, and wet meadows associated with riparian areas; and small basin wetlands along the toe slope.

The area of naturally non-forested uplands is also extremely low. Map data indicate these ecosystems are almost all taller shrublands. The ecodistrict is one of the few in the province without any mapped heathland (lower shrublands dominated by heath plants). It is likely that a good portion of the mapped, taller shrublands stands are older fallow areas, successional gray birch and cherry, and moist alder thickets. The lower reaches of some of the rivers have rocky cliffs that are not large enough to appear in map data. Some of these cliffs support relatively rare flora such as fragrant wood fern (*Dryopteris fragrans*), hyssop-leaved fleabane (*Erigeron hyssopifolius*), Drummond's rockcress (*Arabis drummondii*), and slender cliff brake (*Cryptogramma stelleri*).

360
Mulgrave Plateau

The Mulgrave Plateau is the most easterly physiographic feature of the Nova Scotia mainland, extending to the west shores of the Strait of Canso and to Chedabucto Bay. These two bodies of salt water provide a cooler and moister maritime climate, with strong coastal winds buffeting the upland forests.

The ecodistrict is a relatively flat till plain with gentle to moderate relief and a mean elevation of about 130 m. Lower elevations are largely limited to coastal areas. The Chedabucto Fault passes through this ecodistrict that is underlain by the Guysborough Group (consisting of sandstone, shale and conglomerate rocks). The Roman Valley River has exploited the fault line, creating a scarp underlain with strongly folded granite, gabbro, and related rocks. The total area of the Mulgrave Plateau ecodistrict is 1028 km^2 (9.4% of the Nova Scotia Uplands Ecoregion).

This ecodistrict is really two plateaus separated by the Chedabucto Fault, with both portions comprised of extensive areas of imperfectly drained, level to hummocky topography. The steep slopes of these elevated plateaus (approximately 200 m above sea level) are well drained and support a mixture of tolerant hardwoods and softwoods.

Soils throughout the ecodistrict are typically gravelly loams and sandy loams. However, an extensive area of imperfectly drained loams and clay loams occurs on the eastern portion of the plateau, south of West Lake.

The eastern portion of the ecodistrict (which is appreciably wetter than the western) is drained by the St. Francis Harbour River. This river flows out of Goose Harbour Lake Reservoir, which has been dammed for use as an industrial water supply in Port Hawkesbury. Two other lakes (Grant and Summers) have also been dammed for water supply for Mulgrave, while another reservoir has been created at Melford Lake for future industrial use. Freshwater covers 2.9% of the ecodistrict (3034 ha).

Low relief drumlins dot the eastern portion of the ecodistrict around Goose Harbour Lake. The Roman Valley River flows towards Chedabucto Bay via the

One of many hardwood drumlins on the Mulgrave Plateau, this one near Clam Harbour Lake *PHOTO: CNS (Len Wagg)*

Porcupine Mountain, the source of rock for the Canso Causeway (completed in 1955), continues to be a source of aggregate. *PHOTO: CNS (Len Wagg)*

Milford Haven River which, along with Guysborough Harbour, is an example of a drowned estuary (the mouth of a river submerged due to sea-level rise).

On the plateau red maple and yellow birch dominate drumlins with scattered sugar maple on lower slopes. Red spruce and hemlock are more prevalent in sheltered ravines and along streams and steep slopes. Elsewhere on the gently undulating plateau a softwood forest of balsam fir, white spruce and black spruce dominates. Where soils are deeper, better drained and slightly richer, a mixedwood forest of yellow birch, red maple, white spruce and balsam fir occurs. There are also extensive areas of shallow soils over bedrock with open woodlands of stunted black spruce, tamarack, and red maple. This ecodistrict also contains many large treeless wetlands, often bordered with wet forests of black spruce, tamarack, and red maple.

Geology and Soils

The Mulgrave Plateau ecodistrict is mainly underlain by deformed sedimentary rock from the Carboniferous period in association with older meta-sedimentary and igneous rock from the Devonian period. Rock types include shale, siltstone, sandstone, conglomerate, basalt and rhyolite. There are also several small igneous intrusions found within the ecodistrict, ranging in mineralogy from granite to gabbro. The most notable of these is Porcupine Mountain adjacent to the Strait of Canso. This area is home to one of the largest rock quarries in Canada and was the source rock used to construct the Canso Causeway.

Table 12
Summary information for dominant soils found in the Mulgrave Plateau ecodistrict (360). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Kirkhill	25	Glacial Till	Medium	Rapid-Imperfect	ST2-L, ST1, ST15-L, ST3-L, ST16-L	Podzol, Brunisol
Riverport	22	Glacial Till	Medium	Imperfect	ST3-L, ST16-L	Podzol
Thom / Mira *	21	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol
Woodbourne / Millbrook	20	Glacial Till	Fine-Medium	Mod. Well - Imperfect	ST3-L, ST6, ST2-L	Podzol, Luvisol
Hydric	8	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Halifax *	5	Glacial Till	Medium-Coarse	Well	ST2, ST2-L	Podzol

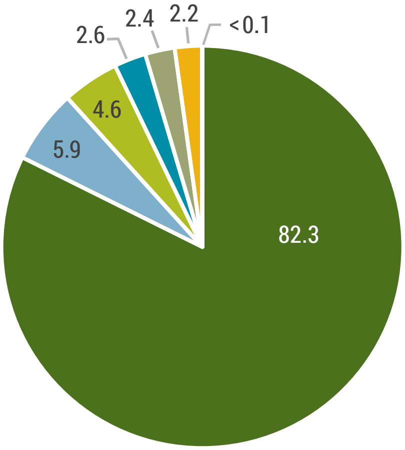
Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

At the surface, glacial till deposits on the plateau are often thin, resulting in bedrock controlled drainage that can be highly variable over short distances. Near-surface rock and relatively level terrain have also led to the formation of many hydric soils, especially in the eastern portion of the ecodistrict. However, there are also areas with thicker till deposits that are better drained (including scattered drumlin fields). Some till deposits are high in slate and/or quartzite, which were glacially transported from areas southeast of the ecodistrict where extensive quartzite and slate beds of the Meguma Group are found.

Dominant soils are derived from gravelly to very gravelly loam till high in shale (Kirkhill soils); gravelly loam till high in shales and slate (Riverport soils); gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom/Mira soils); and gravelly loam to clay loam till containing sandstone and shale (Woodbourne/Millbrook soils) (**See Table 12**).

Forests

The Mulgrave Plateau ecodistrict is defined by steep slopes and hills that create a perimeter for the level to hummocky and drumlinized terrain found here. Underlain by well to moderately well drained, fine to medium textured soils hardwood forests of sugar maple, yellow birch, red maple, and beech (Tolerant Hardwood Forest Group)



Ecodistrict 360 Percentage Land Cover

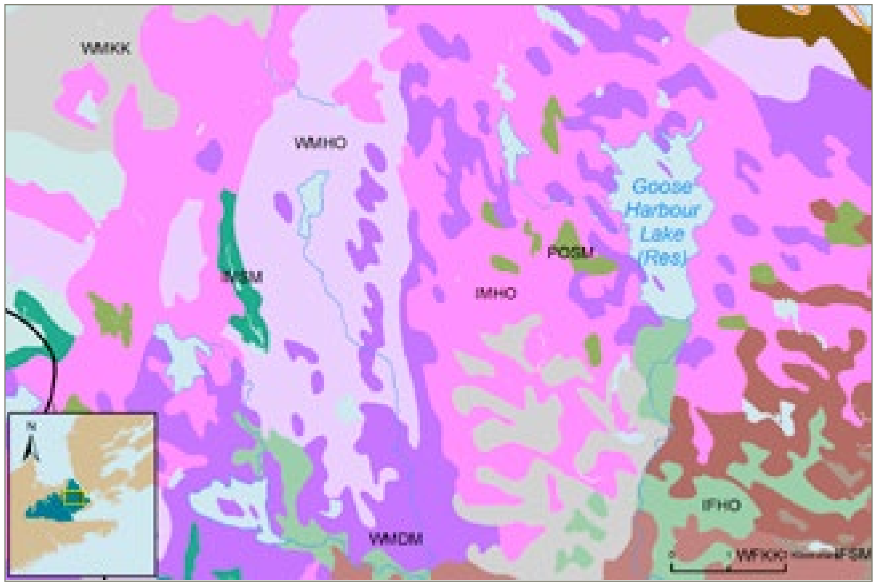
Forest/Woodland	82.3
Wetlands	5.9
Agriculture	4.6
Water	2.6
Shrub/Heathland	2.4
Urban/Industrial	2.2
Sparsely Vegetated	< 0.1

dominate the crests and upper to middle slopes (52% of the ecodistrict). Balsam fir is prominent in the understory along with striped maple, mountain maple and fly-honeysuckle. The herb layer has extensive fern cover including wood ferns (*Dryopteris spp.*) hay-scented fern (*Dennstaedtia punctilobula*) and New York fern (*Thelypteris noveboracensis*). On lower slopes red spruce, white spruce, balsam fir, yellow birch, and hemlock combine to create mixedwood forests. However on the plateau, drumlins and hummocks with similar soils and site conditions support a late successional red maple and yellow birch forest with a few scattered sugar maple and occasionally some white ash on richer soils associated with seepage sites and along toe slopes.

Pirate Harbour on the Strait of Canso *PHOTO: CNS (Len Wagg)*

Ecodistrict 360

Sample area map showing typical ecosections found in this ecodistrict



Ecosection	District %	Cumulative %
WMKK	39.1%	39.1%
IMHO	20.4%	59.6%
WFKK	10.0%	69.5%
WMHO	9.6%	79.2%
WFHO	4.9%	84.0%
WMDM	4.0%	88.0%
XXWA	2.9%	91.0%
IFHO	2.1%	93.1%
WCKK	1.9%	95.0%
WCHO	1.8%	96.8%
IMSM	1.6%	98.4%
POSM	0.8%	99.2%
WMFP	0.3%	99.5%
IFSM	0.3%	99.8%
IMFP	0.1%	99.9%
IFFP	< 0.1%	100.0%
XXMS	< 0.1%	100.0%
XXCB	< 0.1%	100.0%
WMSM	< 0.1%	100.0%

The Spruce Pine Forest Group occurs primarily on imperfectly drained hummocky terrain of the plateau and is dominated by forests of black spruce, white spruce, and balsam fir. It also occurs on level terrain associated with small streams and wetland complexes where soils are imperfectly to poorly drained, medium to fine textured, or have deep organic deposits. As soils get wetter, forests of black spruce, red maple, and tamarack are typical.

Shrubs such as speckled alder, false holly, and winterberry are common. Scattered sedges (*Carex spp.*), creeping snowberry (*Gaultheria hispidula*), and cinnamon fern (*Osmunda cinnamomea*) indicate the presence of increasing moisture; while bracken (*Pteridium aquilinum*), pink lady's slipper (*Cypripedium acaule*), and mayflower (*Epigaea repens*) indicate low nutrient status. Increasing abundance of peat moss (*Sphagnum spp.*) indicates increasing wetness of the soils. There are also several large areas in the vicinity of West and Long Lakes where soils are shallow to bedrock and open woodlands of black spruce, tamarack, and reindeer lichens (*Cladonia spp.*) are prevalent.

The Spruce Pine Forest Group is frequently disturbed by windthrow, fire and/or natural senescence which limit the potential for old growth forest development. Earlier successional forests will be of similar species composition to later stages.

A large floodplain along the Milford Haven River, and other smaller floodplains along the Salmon and Roman Valley Rivers, provide conditions for floodplain forests of sugar maple, white ash, and elm. Annual or periodic flooding along these watercourses deposits alluvial sediments which enrich the soils and produce generally smooth topography. Soils can be gravelly and medium to coarse textured and most often are imperfectly drained.

Natural disturbances in the tolerant hardwood forest create small gaps and patches in the canopy due to insects or disease, windthrow or storm breakage. As such these tolerant hardwood forests can be uneven-aged and stands can develop old forest characteristics. Stand-level disturbance is rare, and forest harvesting creates conditions favourable for early successional species such as white birch, red maple, and balsam fir.

Mixedwood forests of white spruce, balsam fir, hemlock, and yellow birch are more susceptible to stand-level disturbances, however these are infrequent and uneven-aged forests and old forests can develop over time. In the past, *(right)* Mainland moose is a provincial species at risk; *(below)* Bedrock outcrops and wetlands near West Lake, Guysborough County

PHOTOS: DNR (Reg Newell, retired DNR) moose; CNS (Len Wagg) aerial

spruce budworm and spruce bark beetle have caused significant mortality in forests dominated with balsam fir and white spruce.

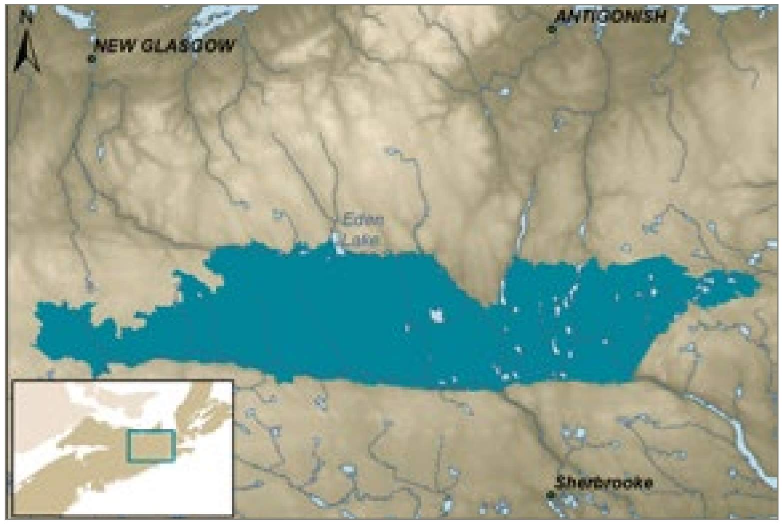
Abandoned agricultural land is quick to reforest to white spruce, but blueberries can be enhanced with management either before the sites reforest or following clear-cutting of the white spruce. Forestry has been the principle land use of this ecodistrict but large relatively intact areas still remain with limited road access.

Non Forests

Naturally non-forested ecosystems make up about 8% of the Mulgrave Plateau, with open wetlands comprising 3% and uplands making up the remainder. The largest wetlands are east and west of Goose Harbour Lake. These are open bogs and shrub swamps, which are typical throughout the ecodistrict, and make up the largest percentage of wetlands by area. Most of the peatlands are poorly surveyed for rare plant species. The majority of rare species have been found along the major watercourses, which are slightly richer than the generally acidic soils of the ecodistrict as a whole. This peninsula does however contain some small areas enriched by calcareous bedrock. It is here that some of the rare wetland plants have been found. Other species associated with open wetlands include the endangered mainland moose, wood turtle, and a number of uncommon butterflies including the green comma (*Polygonia faunus*) and question mark (*Polygonia interrogationis*).

Naturally non-forested vegetation is almost entirely composed of taller shrublands. Some of these are probably fallow areas or moist thickets beside waterways and wetlands. There is however a large complex of heathland (lower shrublands dominated by heath species) in the area east of Goose Harbour Lake. This is interspersed with peatlands and scrubby forest. Most of these heathlands are underlain by thin glacial till over acidic bedrock.

370
St. Mary's River



The St. Mary's River ecodistrict is a narrow upland (mean elevation 110 m, maximum elevation 220 m) approximately 15 km wide situated between two parallel faults. East River St. Mary's follows the Chedabucto Fault from Eden Lake and West River St. Mary's gathers its headwaters near Trafalgar and follows the St. Mary's Fault. Both rivers flow east to the confluence at Melrose and then turn to flow south to the Atlantic Ocean.

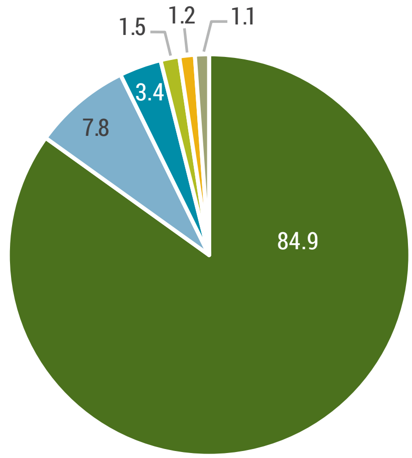
With no direct contact with coastal waters, there is a stronger continental climate here than elsewhere in the Nova Scotia Uplands Ecoregion. As such, winters are a bit colder than average for the ecoregion as a whole. The total area of the ecodistrict is 852 km^2 (7.8% of the Nova Scotia Uplands Ecoregion).

The ecodistrict is underlain by siltstones and sandstones of the Horton Group. For the most part, the topographic pattern here is hummocky with wetlands and drumlins scattered throughout. Soils are typically well to imperfectly drained, stony to gravelly sandy loams with low fertility, developed on till veneers of the Horton sandstones and shales. Freshwater totals 4.0% of the ecodistrict or 3436 hectares.

Vegetation types from the Spruce Pine Forest Group occurring on fresh to fresh-moist, nutrient poor soils (often associated with fire disturbance) dominate the ecodistrict. These forests are generally black spruce and white pine with an understory of plants that are tolerant of acidic (nutrient poor) soils.

Floodplains of the East and West branches of the St. Mary's River meet at Glenelg. *PHOTO: CNS (Len Wagg)*

Productive forests of red spruce and tolerant hardwoods are found on the drumlins and upper slopes of hills. Titus Smith who travelled the area in 1801(Hawboldt, 1955) described abundant sugar maple, black cherry and elm along the intervals of the St. Mary's River. However only a few scattered remnants of this ecosystem remain, with much of the interval lands cleared for agriculture. Historically, repeated burnings have resulted in extensive barrens in the ecodistrict (e.g., Eden Barrens and Barren Brook). Natural disturbances due to fire and windthrow are frequent, and result in even-aged stands of Spruce Pine forest group.



Ecodistrict 370 Percentage Land Cover

Forest/Woodland	84.9
Wetlands	7.8
Water	3.4
Agriculture	1.5
Urban/Industrial	1.2
Shrub/Heathland	1.1

Geology and Soils

The St. Mary's River ecodistrict is associated with a downfolded block (graben) situated between geologic faults and bordered by related escarpments. This makes the boundaries of this particular ecodistrict readily identifiable from both the air and ground. Bedrock consists mainly of Carboniferous period sedimentary rock including sandstone, shale and siltstone.

Surficial deposits are dominated by glacial tills of varying thickness (up to 30 m) along with occasional drumlin patches. There are also some floodplain (alluvium) and/or glaciofluvial deposits associated with the St. Mary's River and its major tributaries. These river channels generally coincide with fault lines found within the area. In addition, relatively level terrain has promoted the formation of many hydric soils which are found scattered throughout the ecodistrict.

Dominant soils are derived from gravelly sandy loam till high in sandstone (Shulie/Springhill soils); gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); gravelly loam to clay loam till containing sandstone and shale (Millbrook soils); and gravelly to very gravelly sandy loam till high in sandstone and arenite (Perch Lake soils) (**See Table 13**).

As with the Mulgrave Plateau, quartzite till deposits found in this ecodistrict were likely transported from areas to the south and southeast where extensive quartzite and slate beds of the Meguma Group are found.

Forests

The matrix forest found in the St. Mary's River ecodistrict is the Spruce Pine Forest Group (covering 49% of the ecodistrict).This differs from other parts of this ecoregion (300), where the matrix forest is tolerant hardwood.

Table 13
Summary information for dominant soils found in the St. Mary's River ecodistrict (370). Only soil associations or series that make up at least 5% of the land area are listed.

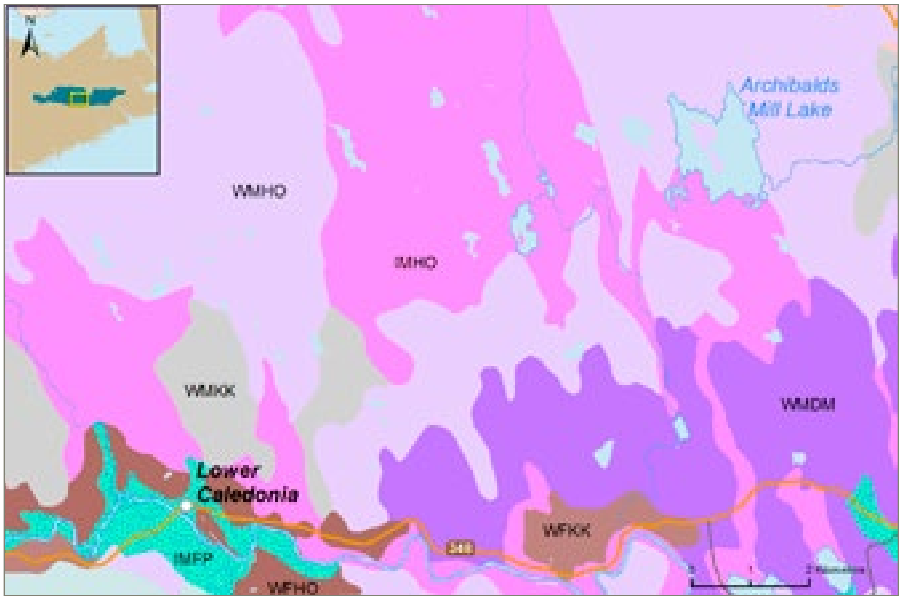
Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Shulie / Springhill	27	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3	Podzol
Halifax / Danesville *	26	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Millbrook	16	Glacial Till	Fine-Medium	Imperfect	ST6, ST3-L, ST12	Podzol, Luvisol
Perch Lake *	11	Glacial Till	Medium-Coarse	Well	ST2, ST2-L	Podzol
Hydric	8	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 370

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMHO	28.7%	28.7%
IMHO	19.2%	47.8%
WMDM	17.5%	65.4%
WMKK	12.6%	78.0%
WFHO	4.0%	82.0%
XXWA	4.0%	86.0%
WFDM	3.6%	89.6%
IMFP	1.9%	91.5%
IFHO	1.8%	93.3%
POSM	1.7%	95.0%
IMSM	1.6%	96.6%
WFKK	1.0%	97.6%
IMRD	0.7%	98.3%
WCHO	0.5%	98.8%
ICHO	0.5%	99.4%
ICFP	0.4%	99.8%
ICSM	0.2%	100.0%



This Spruce Pine forest occurs on level to hummocky terrain underlain by well to imperfectly drained soils derived from sandstones with an inherent low fertility. Black spruce and white pine dominate the canopy, with a significant understory of woody ericaceous shrubs such as lambkill, blueberry and rhodora. Herbs such as bracken (*Pteridium aquilinum*), mayflower (*Epigaea repens*), teaberry (*Gaultheria procumbens*), sarsaparilla (*Aralia nudicaulis*), and pink lady's slipper (*Cypripedium acaule*) are common. Bryophyte cover is often extensive and includes Schreber's moss (*Pleurozium schreberi*), broom moss (*Dicranum scoparium*), wavy dicranum (*Dicranum polysetum*), and stair-step moss (*Hylocomium splendens*). The presence of creeping snowberry (*Gaultheria hispidula*), cinnamon fern (*Osmunda cinnamomea*), and peat moss (*Sphagnum spp.*) indicate elevated moisture levels. Red oak and red pine are components of some stands.

With progressively poorer drainage, black spruce, tamarack, and red maple dominate the forest vegetation. Significant areas of the ecodistrict can have poorly stocked open woodlands of black spruce and white pine with a heavy ground cover of reindeer lichens.

The dominant natural disturbance is fire due to the local abundance of "fuel" in the form of pine and spruce litter and ericaceous vegetation. Soils can become quite dry in the summer months which increase the risk of wildfire. Shallow rooted forests of black spruce on moist to wet soils are also susceptible to blowdown and breakage from high winds associated with hurricanes and winter storms. The frequent disturbance of this ecosystem results in even-aged forests of black spruce, but as time increases between stand-level disturbances a supercanapy of white pine can develop.

Early successional forests include stands of red maple, white birch, grey birch, and/or pin cherry. A significant portion of this forest was planted to red pine and other softwood species following the fires of the 1950s on the Garden of Eden barrens,

Wood turtle, a federal and provincial species at risk, is found along both branches of the St. Mary's River. *PHOTO: DNR (Mark Pulsifer)* and a large more recent fire near Trafalgar in 1976. Insects and diseases have caused extensive damage to natural and planted pine forests of this ecodistrict. Both the white pine weevil and white pine blister rust have caused tree deformation and mortality. Most recently sirococcus blight (*Sirrococcus conigenus*) has caused damage to managed stands of red pine.

Floodplain forests along the East and West Branches of the St. Mary's River also make up a considerable area of the ecodistrict when compared to other upland areas. Late successional floodplain forests on rich alluvial soils yield a forest that includes sugar maple, white ash, and elm. Small gap disturbances in this climax forest maintain a canopy that provides important ecosystem functions along these major rivers. Where the watercourse has altered its route and flooding no longer occurs (to enrich the soils with alluvium), forests here are now more typical of upland communities. They include species such as red spruce, hemlock, balsam fir and yellow birch. Most of the floodplain has been cleared for farming. However, when fields are abandoned they tend to reforest to early successional forests of hawthorn, black cherry, speckled alder, and choke cherry which later succeed to red oak and red maple. Occasionally rare and endangered plants such as Canada lily (*Lilium canadense*) can be found on the less disturbed areas of the floodplain.

A zonal site condition occurs on a small area of well drained, medium rich soils associated with drumlins and hummocky terrain. Here an Acadian forest of sugar maple, red maple, and yellow birch occurs on crests and upper slopes. On middle slopes yellow birch and red spruce form mixedwoods, eventually replaced with balsam fir and red spruce on lower slopes. Where lands were cleared for agriculture then later abandoned, forests of white spruce are common. These provide an important deer wintering habitat.

(top) Twinflower, flowers in late June and is common throughout the province, but especially eastward, often forming carpets.

(below) Black spruce and white pine forests are typical on the nutrient poor soils derived from sandstones in the St. Mary's River ecodistrict. *PHOTOS: DNR (Eugene Quigley) twinflower; CNS (Len Wagg) spruce pine forest*

Red maple floodplain forests occur along both branches of the St. Mary's River. *PHOTO: DNR (Eugene Quigley)*

Non Forests

The St. Mary's River ecodistrict, outside the major river valleys, is primarily upland in character. Soils are largely favourable for tree growth and the gentle but relatively continuous relief does not promote wetland geography. Naturally non-forested uplands are limited to small stands of tall shrublands and scattered small-scale heathlands.

The most interesting non-forested ecosystems occur along the major rivers. These include shoreline outcrops, grassy meadows, shrub thickets, and low cliffs. One of the largest concentrations of wood turtles in the province occurs along the West Branch of the St. Mary's River and extends south of the ecodistrict, below its confluence with the East Branch. Wood turtles use a variety of habitats, and females in particular will sometimes travel considerable distances inland from the riparian zone. A study of fine-scale habitat selection in wood turtles along the St. Mary's River showed that among the more important habitats (independent of gender or seasonality) are riparian shrublands.

Unlike many other major rivers in the ecoregion, the waters and soils of the St. Mary's River are not especially rich. This reduces the occurrence of nutrient demanding vascular plants typical of more circumneutral riparian habitats (i.e., those with nearly neutral pH, 6.5 to 7.5). That said, some of the ledges and low cliffs along the St. Mary's River include Dudley's rush (*Juncus dudleyi*) and thyme-leaved speedwell (*Veronica serpyllifolia ssp. humifusa*), while more acidic outcrops support numerous locations of dwarf bilberry (*Vaccinium caespitosum*). Two Atlantic Coastal Plain species are known from wet meadows, moist riverbanks, and other non-forested riparian microhabitats: deer-tongue panic grass (*Dichanthelium clandestinum*) and slender blue flag (*Iris prismatica*).

The St. Mary's ecodistrict occupies the central portion of the largest moose concentration area in mainland Nova Scotia. The endangered mainland moose uses a variety of habitat types, but open wetlands are among those most frequented. Shallow water wetlands are not remarkably common, but the occurrences include some the largest in the province. In fact, one of the largest shallow water wetlands in Nova Scotia occurs in the St. Mary's ecodistrict above the west Branch of its namesake river in the Smithfield area. Across the ecodistrict, shallow water wetlands are also, on average, the largest in Nova Scotia.

380
Central Uplands

The Central Uplands is 1291 km^2 (11.8% of the Nova Scotia Uplands Ecoregion), with gently rolling uplands rising 270 m above sea level. The ecodistrict is wedged between the **Cobequid Hills (340)** and **Pictou Antigonish Highlands (330)**. This "central" positioning promotes connectivity for biodiversity throughout the province.

The headwaters of numerous rivers radiate from the ecodistrict including the Stewiacke and Calvary Rivers which make their way to the Bay of Fundy; the East, Central and West Rivers of Pictou which empty into the Northumberland Strait; and the Musquodoboit River which flows to the Atlantic.

The geology is primarily Carboniferous era sedimentary rocks that contain significant mineral resources that are influenced by an east to west fault system near the ecodistrict center. First, second and third order streams (with a trellised drainage pattern) and a few small shallow lakes cover only 0.8% of the ecodistrict. Wetlands occur on 0.4% of the ecodistrict.

Fresh to fresh-moist, medium rich soils support a red spruce/balsam fir forest. Stands of tolerant hardwoods are present on the crests and upper slopes of hills and steeper hummocks. Red spruce, yellow birch, and sugar maple form mixed stands on the finer textured soils, but following harvesting may revert to stands of balsam fir and red spruce. Hemlock develops on sheltered moist sites of lower slopes along streams and rivers,

Red spruce forests are common in the Central Uplands.
PHOTO: CNS (Len Wagg)

and white pine is scattered on the better drained, coarse textured soils. This upland extension of the St. Mary's fault block has some of the most productive red spruce forests in Nova Scotia.

In the Central Uplands stand initiating natural disturbances occur infrequently. Disturbance agents include hurricanes, fire and insects. However, the infrequency of stand-level disturbances creates climax Acadian forests of shade tolerant hardwoods and softwoods occurring as pure and mixed associations. Many of these stands develop into old growth, with gap dynamics providing breaks in the canopy and allowing for the development of uneven-aged stands and older forests.

Historically insect epidemics were unlikely to have caused extensive damage to the forests of the Central Uplands due to the mixedwood nature of the forest. Populations of spruce budworm and tussock moth have recently defoliated significant areas of the uplands—most notably in stands of balsam fir. The spruce bark beetle has also caused damage in older stands of red spruce. However, many ecologists would suggest that the recent defoliations by tussock moth, and to a certain extent the spruce budworm, have been exacerbated by forest harvesting which has increased the component of balsam fir.

Geology and Soils

Structural geology of the Central Uplands is influenced mainly by a fault system that runs east to west through the middle of the ecodistrict. Bedrock in the southern half (and parts of the north) consists mainly of Carboniferous period sedimentary rock. The northern half is mainly underlain by older Ordovician and Precambrian rock. Dominant types include sandstone, siltstone, shale, conglomerate, shale, coal, salt, gypsum, rhyolite and basalt.

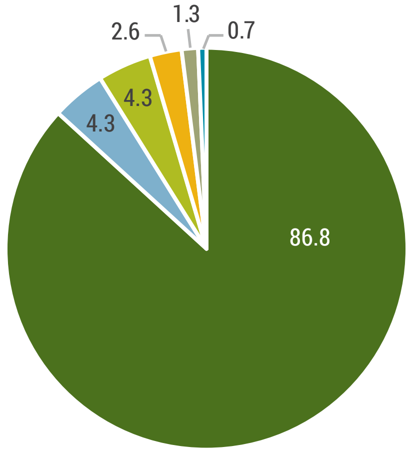
Surficial deposits are dominated by stony and non-stony glacial tills, with scattered occurrences of glaciofluvial deposits in the form of kames, eskers, outwash and valley bottom deposits. Soil parent materials are mainly glacial tills of varying texture that reflect the rock types found in each deposit—from fine-grained shales to coarse-grained sandstone and quartzite.

Dominant soils are derived from gravelly loam to clay loam till containing sandstone and shale (Woodbourne/Millbrook soils); gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom/Mira soils); gravelly to very gravelly sandy loam till high in sandstone and arenite (Perch Lake soils); non-gravelly silt loam to clay loam till (Queens soils); gravelly to very gravelly loam till high in shale (Kirkhill soils); and gravelly and sandy glaciofluvial deposits (Hebert soils) (**See Table 14**).

Table 14
Summary information for dominant soils found in the Central Uplands ecodistrict (380). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Woodbourne / Millbrook	34	Glacial Till	Fine-Medium	Mod. Well - Imperfect	ST2-L, ST3-L, ST6, ST2, ST5	Podzol, Luvisol
Thom / Mira	22	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol
Perch Lake *	11	Glacial Till	Medium-Coarse	Well	ST2, ST2-L	Podzol
Queens	10	Glacial Till	Fine	Imperfect-Poor	ST6, ST12, ST7	Luvisol, Gleysol
Kirkhill	7	Glacial Till	Medium	Rapid-Imperfect	ST2-L, ST1, ST15-L, ST3-L, ST16-L	Podzol, Brunisol
Hebert	6	Glaciofluvial	Coarse	Rapid	ST1, ST2	Podzol

*** Stony (S) phases are common (e.g., ST2-S).**



Ecodistrict 380 Percentage Land Cover

Forest/Woodland	86.8
Wetlands	4.3
Agriculture	4.3
Urban/Industrial	2.6
Shrub/Heathland	1.3
Water	0.7

Forests

The Central Uplands departs from the typical tolerant hardwood forest found throughout much of the Nova Scotia Upland Ecoregion with an Acadian softwood forest of red spruce and hemlock (Spruce Hemlock Forest Group) occurring on 47% of the hummocky terrain and gentle slopes with medium fertility. Soils are fine to medium textured and moderately well to imperfectly drained. Balsam fir is usually associated with earlier successional stages, but is present in all stands at some stage of development. Regenerating overstory species, herbs typical of upland softwood forests (e.g., bunchberry (*Cornus canadensis*), goldthread (*Coptis trifolia*), wild lily-of-the-valley (*Maianthemum* canadense)) and an extensive moss layer make up the understory. Hemlock is usually confined to ravines and steep slopes, and scattered white pine will be found on coarser and drier soils.

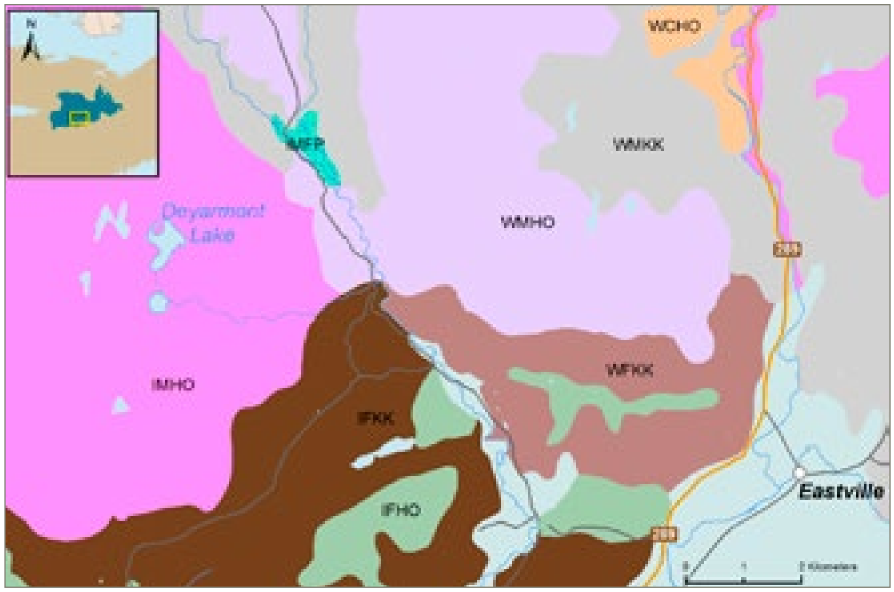
Another significant forest type is a tolerant mixedwood which occurs on almost 40% of the ecodistrict, preferring well drained medium to coarse textured soils of medium fertility. Yellow birch can always be found in these forests. It creates a mixedwood condition with sugar maple, beech, red spruce, and hemlock. The shrub layer is moderately developed and includes many regenerating trees, striped maple, and fly-honeysuckle.

The herb layer is represented by typical mixedwood flora. Ferns, club-mosses, and various flowering perennials such as starflower (*Trientalis borealis*), Indian cucumber root (*Medeola virginiana*), partridge-berry (*Mitchella repens*) and wood aster (*Oclemena acuminata*) are common.

Old growth forests of hemlock and red spruce occur on steeper slopes such as this one along the Calvary River, near Riversdale, Colchester County. *PHOTO: CNS (Len Wagg)*

Ecodistrict 380

Sample area map showing typical ecosections found in this ecodistrict



Ecosection	District %	Cumulative %
IMHO	24.6%	24.6%
WMKK	18.3%	42.9%
WMHO	14.8%	57.7%
IFKK	13.1%	70.8%
WFKK	8.8%	79.6%
IFHO	8.3%	87.8%
WFHO	2.5%	90.3%
WCKK	2.4%	92.7%
WCHO	1.9%	94.5%
ICHO	1.3%	95.8%
WMDM	0.8%	96.6%
XXWA	0.8%	97.4%
ICFP	0.7%	98.1%
IMSM	0.4%	98.5%
POSM	0.4%	98.9%
IMFP	0.3%	99.2%
WCDS	0.3%	99.5%
ICSM	0.2%	99.7%
WFDS	0.1%	99.8%
WCFP	0.1%	99.9%
IFFP	0.1%	100.0%
WMDS	< 0.1%	100.0%

Teaberry (*Gaultheria procumbens*) and bracken (*Pteridium aquilinum*) indicate sites with lesser fertility, whereas Christmas fern (*Polystichum acrostichoides*), oak fern (*Gymnocarpium dryopteris*) and northern beech fern (*Phegopteris connectilis*) indicate richness. Bryophyte development varies, with coverage directly related to relative softwood abundance in the overstory. Schreber's moss (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) are the most common species, while bazzania *(Bazzania trilobata)* abundance is more likely when coarse woody debris has accumulated on the forest floor.

Scattered elsewhere are shade tolerant hardwood forests. Larger hills support sugar maple, beech and yellow birch, along with white ash and ironwood on sites with richer soils. Associated with steep-sided slopes and ravines along watercourses, mixed forests of shade tolerant species are typical. These include hemlock, red spruce, white pine, sugar maple, yellow birch, and beech. One of the best examples is along the Calvary River at Riversdale where 125-year-old red spruces blanket the slopes to the river's edge. With progressively poorer drainage associated with level terrain, black spruce, tamarack, and red maple become more prominent.

Stand-level natural disturbances in the Central Uplands are infrequent, with windthrow and fire typical in both the softwood and mixedwood forests. Forests dominated by red spruce, hemlock, and yellow birch will develop an uneven-aged structure and old forest characteristics. Small gaps created in the stand canopy by individual tree mortality or small patches will be filled by young regeneration from the understory.

Hurricanes (windthrow), fire, insects, and harvesting are the dominant disturbance agents. Evidence of tree blowdown and uprooting is indicated by the abundance of pit and mound microtopography.

Upper elevation spruce forests are more frequently subjected to stand-level disturbances caused by windthrow, especially where trees are shallow rooted on imperfectly drained soils. Severe disturbances such as fire and hurricanes (and clear-cutting of young forests where an established layer of advanced spruce and fir regeneration has not had the chance to establish) can return ecosystems to earlier successional stages dominated by intolerant hardwoods such as red maple, white birch, and pin cherry.

Tussock moth and spruce budworm have caused extensive stand-level mortality in spruce and fir forests in this ecodistrict. Spruce bark beetle has also contributed to extensive losses in older and weakened red spruce forests.

Land clearing for agriculture and settlement has not been extensive in the ecodistrict, but a long history of forest harvesting has increased the abundance of earlier successional species such as red maple, white birch, and balsam fir.

Non Forests

The physical geography of the Central Upland is similar to a number of the ecodistricts in the Nova Scotia Uplands Ecoregion. Most of the ecodistrict is forested because soils are favourable for tree growth and the interior climate is moderate.

The Central Uplands has somewhat richer soils than ecodistrict 370 to the east. Some of the enrichment arises from underlying Windsor deposits of gypsum and limestone just inside this ecodistrict's border north of the Stewiacke River, and in its northeast corner along the East River of Pictou. Plants associated with richer soils are mostly found in forested floodplains, but some of the carboniferous outcrops and cobble plains along the rivers in these areas include bulblet bladder fern (*Cystopteris bulbifera*), woodland strawberry (*Fragaria vesca ssp. americana*), Dudley's rush (*Juncus dudleyi*), Vasey's rush (*Juncus vaseyi*), Canada tick-trefoil (*Desmodium canadense*), balsam groundsel (*Packera paupercula*), narrow false oats (*Trisetum spicatum*), and other vascular plants, most of which are provincially uncommon. Riparian thickets, wet meadows, and other non-forested habitats are also important for wood turtle, which is represented along these same rivers.

Most of the larger wetlands in this ecodistrict are associated with poorly drained soils on level terrain near North River Lake and Dickey Lake. Provincially significant wetlands occur along the Stewiacke River and in the Deyarmont and Twin Lakes areas. Forests and non-forested ecosystems in these wetland complexes support at risk species such as Canada warbler and olive-sided flycatcher.

Wetland complexes in the ecodistrict often include treed wetlands, shrub swamps, and fens. These provide a great diversity of habitat for wildlife. PHOTO: CNS (Len Wagg)

400
Eastern

Inland from the boreal-like spruce-fir coastal forest and harsher Atlantic climate, warmer summers and colder winters provide conditions for a zonal softwood forest of red spruce and hemlock.

With the highest elevation reaching 220 m above sea level, this ecoregion—the eastern extension of the Appalachian peneplain—slopes gently towards the Atlantic Ocean. Slate ridges, granite uplands, drumlin fields, wetlands, and rolling glacial till plains make up this geographically diverse ecoregion of 6425 km^2 or 11.6% of the province.

Although the Eastern ecoregion includes some climatic conditions usually associated with higher elevations and proximity to coastal influences, it has primarily an inland, lowland climate sheltered from direct marine influences. Winters in this region tend to be colder (mean -5.0° C) than in western Nova Scotia (mean -3.5° C) and mean annual precipitation ranges from 1400–1500 mm.

The ecoregion is underlain by folded Paleozoic slates and quartzites (greywacke) intruded with granites. On the till plains topography has been influenced significantly by faults and underlying quartzite strata that have been intensely folded, and covered with varying thickness of glacial tills. Granite uplands are very resistant to erosion and tend to be the highest ground in the landscape with shapeless ridges and knolls. Two prominent slate ridges, the Rawdon Hills and Wittenburg Mountain, are examples of resistant ridges from which younger sediments have been eroded away. Located on the northern boundary of the ecoregion they are surrounded by Carboniferous era lowlands. Several drumlin fields occur on the folded till plains, with elevations of 80–130 m.

Chains of lakes, streams, and stillwaters comprise a significant portion of the ecoregion. These, along with large wetlands, provide headwaters for some of the ecoregions longest rivers including the Moser, Sheet Harbour, Tangier and Liscombe. Most of the freshwater in this ecoregion is susceptible to acidification due to low buffering capacities of the thin soils derived from quartzite, slate and granite bedrock.

***Note:** During revision of the 2005 version of the Ecological Land Classification (Map DNR 2007-2), **420 Eastern Drumlins** was combined with **440 Eastern Interior** ecodistrict.*

Soil parent materials in the Eastern ecoregion are also highly variable, but are dominated by medium to coarse textured, stony glacial tills. Orthic Humo-Ferric[1] and Ferro-Humic Podzols are found in well drained areas, with Gleyed subgroups found on imperfectly drained sites. Cemented (Ortstein) subgroups are also common in coarse, granitic soils. Where finer textured deposits occur, Gleyed Luvisols are the most common soils found. Gleysols, Luvic Gleysols, Folisols, Mesisols and Humisols can all be found on poorly drained areas in this ecoregion.

The ecoregion supports the Acadian group of ecosites with shade tolerant softwood forests dominant on somewhat fresh to moist, nutrient medium zonal sites. Where ecosites exhibit better drainage and fertility (such as on drumlins) hardwood forests of yellow birch, red maple and sugar maple are more common. Black spruce forests are very typical on the large areas of azonal soil conditions due to excessive moisture, poor nutrient load, and shallow rooting potential. Fire and hurricanes are the dominant stand-level disturbances influencing forest renewal in this ecoregion. Most North Atlantic tropical storms and hurricanes form June 1 through November 30. They travel along the eastern seaboard of the United States, frequently making landfall on Nova Scotia's Atlantic coast and destroying large swaths of inland forests. Over 12 significant hurricanes have impacted this ecoregion since 1850 including Blanche (1975), Hortense (1996), and Juan (2003). If weakened by hurricane damage, older red spruce forests are often more susceptible to spruce bark beetle.

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

(above) Duck Head on Porters Lake;
(below) Liscomb River near Glencross Rips PHOTOS: CNS (Len Wagg)

410
Rawdon/ Wittenburg Hills

Two narrow hill complexes, underlain by slate bedrock and trending southwest to northeast, rise notably above the surrounding lowlands of the Stewiacke, Musquodoboit and Kennetcook Rivers in central Nova Scotia. With elevations of 180–210 m, the Rawdon Hills and Wittenburg Hills are significant landscape features. Climatically, temperatures are cooler, especially in winter, and considerably moister than in the adjacent lowlands. Total area of this ecodistrict is 615 km^2, or 9.6% of the ecoregion.

The deeply dissected hills are comprised of folded Meguma Group slate. Even small streams along their margins occupy deep channels. Sandy clay loams and clay loams occur on the side slopes of these ridges. On top of the hills, well drained soils of sandy loams and loams derived from slates and siltstones (shales) are found.

The north-facing slopes of the Wittenburg Hills supply the headwater streams for the St. Andrews River and the South Branch Stewiacke River. Streams departing the south-facing slopes feed into the Musquodoboit River. The north-facing slopes of the Rawdon Hills provide the headwater streams for the Herbert and Meander Rivers and contribute to the Kennetcook River. The Nine Mile River comes off the south-facing slopes and feeds into the Shubenacadie River. Where these rivers and larger streams leave the hills and enter the lowlands, extensive floodplains have formed; most are now used for farming. A few smaller floodplains occur in the hills and have natural forests, often with the potential for rare or endangered plants. Freshwater accounts for 0.5% or 303 ha of the ecodistrict.

Red spruce forests are very common, occurring predominantly on the hummocky terrain on top of the hills. Where soils are wetter, black spruce is dominant. Tolerant hardwood forests with sugar

Managed blueberry fields and natural slopeside forest between Benvie Mountain and Butcher Hill *PHOTO: CNS (Len Wagg)*

A slate quarry in the foreground near Glenmore *PHOTO: CNS (Len Wagg)*

maple tend to occur on the upper slopes where there are well drained, nutrient rich soils. On the middle and lower slopes where soils are enhanced with moisture and nutrients, tolerant mixed-wood forests of yellow birch and red spruce are prominent. Most of this ecodistrict is influenced by infrequent and gap disturbance regimes and has developed forest communities typical of the Acadian Forest.

Geology and Soils

Although located in different counties, the two ridges that make up the Rawdon Wittenburg Hills ecodistrict are both underlain by Ordovician period meta-sedimentary rock (mainly slate, along with schist and migmatite). These rocks are part of the Halifax Formation that, together with the Goldenville Formation, form the widely distributed Meguma Group running from Yarmouth to Canso. There are also smaller areas near the perimeter of these ridges underlain by Carboniferous period sedimentary rock (e.g., siltstone, shale, sandstone and gypsum).

The slate that dominates this ecodistrict is high in sulphide minerals (e.g., pyrite) that, when exposed and oxidized, can generate harmful acid rock drainage (ARD). Pockmarked pieces of slate found near the surface often show where pyrite crystals have been dissolved out of the rock.

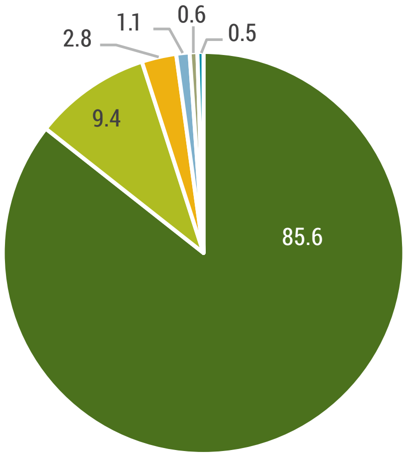
The surficial geological deposits of this ecodistrict consist mainly of gravelly glacial till that can be shallow in upper slope and ridgetop areas. Till deposits tend to be finer-textured on mid and

Table 15.
Summary information for dominant soils found in the Rawdon Wittenburg Hills ecodistrict (410). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG, 1998*)
Rawdon	37	Glacial Till	Medium	Well-Imperfect	ST2-L, ST8, ST3-L, ST9	Podzol
Queens	27	Glacial Till	Fine	Imperfect-Poor	ST6, ST12, ST7	Luvisol, Gleysol
Elmsdale	16	Glacial Till	Fine-Medium	Mod. Well	ST2-L, ST5, ST8	Podzol, Luvisol
Kirkhill	8	Glacial Till	Medium	Rapid-Imperfect	ST2-L, ST1, ST15-L, ST3-L, ST16-L	Podzol, Brunisol

Ecodistrict 410
Percentage Land Cover

Forest/Woodland	85.6
Agriculture	9.4
Urban/Industrial	2.8
Wetlands	1.1
Shrub/Heathland	0.6
Water	0.5



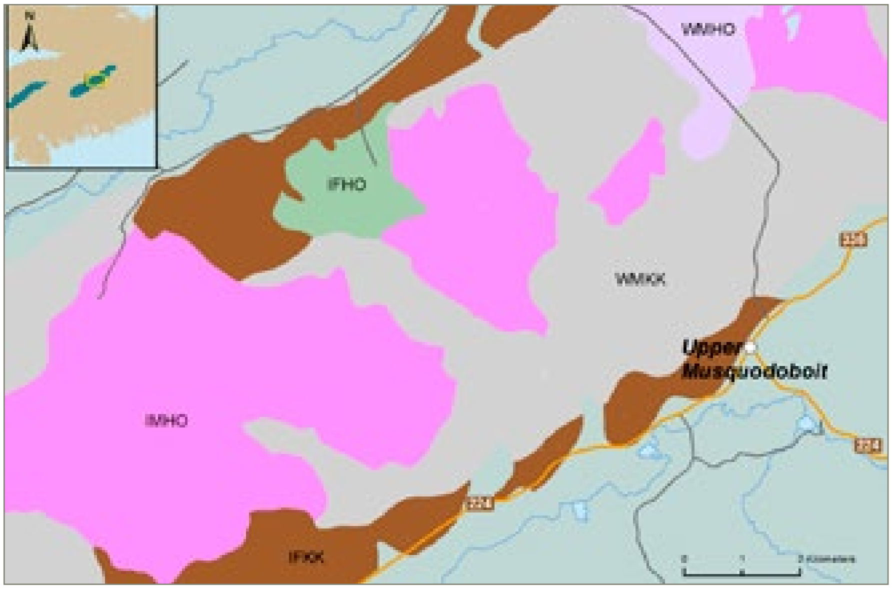
lower slope positions. Dominant soils are derived from gravelly to very gravelly loam till high in slate and siltstone (Rawdon soils); non-gravelly silt loam to clay loam till (Queens soils); gravelly loam to clay loam till with slate, shale and quartzite (Elmsdale soils); and gravelly to very gravelly loam till high in shale (Kirkhill soils) (**See Table 15, pg 113**).

Both the Rawdon and Kirkhill soils can have significant coarse fragment content (up to 75%).

Springtime in the Rawdon Hills at East Gore. *PHOTO: CNS (Len Wagg)*

Forests

The hilly slopes of this ecodistrict provide favourable conditions for an Acadian hardwood matrix forest, which occupies 71% of the landscape. Soils on upper to middle slopes of this upland terrain are well drained, gravelly sandy loams, and loams derived from slates and siltstones (shales). They support a forest of sugar maple and yellow birch with scattered beech (Tolerant Hardwood Forest Group). White ash and ironwood occur on richer soils where organic matter incorporation in the A horizon has occurred through natural mixing by soil fauna (usually with mull humus forms). Seepage areas are commonly found in these hardwood forests and are important micro-habitats for communities of plants, amphibians and other wildlife. At higher elevations this forest is exposed to strong winds, snow and ice storms which can significantly influence the potential for quality timber. Tree canopies can experience regular breakage creating multiple tops, stem wounds for disease and rot entry, and uprooting. Evidence of tree blowdown and uprooting is apparent by the abundance of pit and mound micro-topography. Scattered red spruce and white spruce are also common in the overstory while



Ecodistrict 410

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMKK	56.2%	56.2%
IMHO	18.4%	74.6%
IFKK	14.5%	89.1%
WMHO	6.1%	95.2%
IFHO	1.3%	96.5%
WMDS	1.0%	97.5%
WFKK	0.5%	98.0%
XXWA	0.5%	98.5%
IMSM	0.4%	98.9%
WCHO	0.3%	99.2%
PMHO	0.3%	99.5%
ICSM	0.3%	99.7%
WCDS	0.2%	99.9%
IMFP	0.1%	100.0%

balsam fir can be a significant understory species. The shrub layer consists mainly of regenerating trees similar to the overstory as well as woody shrubs such as striped maple, beaked hazelnut and fly-honeysuckle. Many fern species can be found in the herb layer, but typical species include hay-scented fern (*Dennstaedtia punctilobula*), New York fern (*Thelypteris noveboracensis*), northern beech fern (*Phegopteris connectilis*), evergreen wood fern (*Dryopteris intermedia*), and Christmas fern (*Polystichum acrostichoides*). On the lower slopes moderately-well drained to imperfectly drained gravelly soils support a mixedwood forest of red spruce, hemlock and yellow birch.

Associated with hummocky terrain on the higher elevations are extensive red spruce forests on moderately-well to imperfectly drained soils. Soil drainage in these areas is slow because of shallowness over the slate bedrock and/or gently sloping terrain. Where soils are deeper and better drained, mixedwood forests of red spruce, yellow birch, and sugar maple are prominent.

Along steep-sided slopes and ravines of the major watercourses leaving the hills, are mixedwood forests of shade-tolerant tree species such as sugar maple, yellow birch, red spruce, hemlock, and white pine. Hemlock are prominent on the steep lower slopes with notable hemlock stands along the upper Meander and Herbert Rivers, Thumb Hill Creek, Glen Brook, Goshen Brook and Newton Brook. Several small rich floodplain forests on smooth topography in the riparian areas along these watercourses produce the typical climax forest of sugar maple, white ash, and elm. Earlier successional species such as black cherry, white spruce, aspen and red maple are common.

Narrow bands of gypsum and anhydrite, associated with the adjacent **Valley and Central Lowlands (600)** ecoregion extend into this ecodistrict just south of Glenmore Mountain and north of the Rawdon Hills. This bedrock, and associated nutrient rich soils, is generally not characteristic of the ecodistrict but in areas where they do occur, habitat for some of the rarer plant, lichen, and vertebrate species known from this ecodistrict is provided.

Natural disturbances in the Tolerant Hardwood and Mixedwood Forest Groups are primarily due to wind, and insects and disease, creating small gaps and patches in the canopy. Beech bark canker and the birch dieback of the 1940s have impacted these forests, but only yellow birch has regained its prominence in the overstory. Hardwood forests can develop uneven-aged and old forest characteristics. Red spruce forests on moist soils that are shallow over bedrock are more susceptible to stand-level disturbances, especially windthrow, but the infrequency of natural stand-level disturbances (such as insects or windthrow) allow stands to develop as old, late successional climax forests.

Forest management and cultivated blueberry farming are significant land uses on the Rawdon/Wittenburg Hills. PHOTO: CNS PHOTO: CNS (Len Wagg)

Many of the tolerant hardwood and red spruce forests on well-drained upper slopes were cleared for farming. When these agricultural fields are abandoned, white spruce and white pine are quick to reforest the sites. Many old farmlands have been converted to high-yielding wild blueberry fields. A long history of forest harvesting across the entire ecodistrict, has also increased the abundance of earlier successional species such as red maple, white birch, and balsam fir.

Non Forests

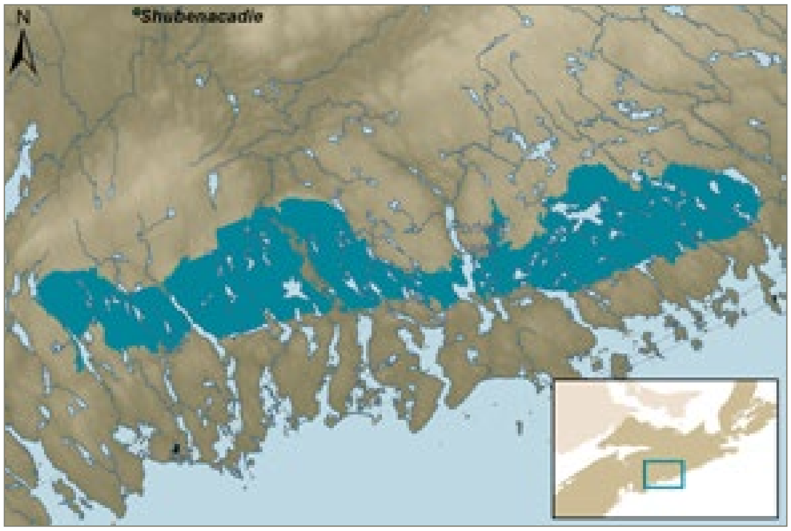
The Rawdon/Wittenburg Hills features generally well drained, moderately deep soils. These soils favour tree growth, reducing both the extent and diversity of unforested ecosystems. In fact, this is one of the most extensively treed ecodistricts in the province, and the most extensively treed in the ecoregion. The majority of the non-forest ecosystems are wetlands, but some rock outcrops and mesic to moist shrublands are scattered as small patches throughout. The more interesting ecosystems are associated with areas of karst which forms over gypsum and limestone bedrock. These include cave ecosystems, some of which have records of endangered bat species, small cliffs and outcrops, and sinkhole topography.

Wetland ecosystems are mostly shrub swamps with lesser amounts of wet meadow, shallow and emergent marsh, and peatland. The richer wetlands include populations of uncommon plant species, such as showy lady's slipper (*Cypripedium reginae*), slender spikerush (*Eleocharis nitida*) and Gmelin's water buttercup (*Ranunculus gmelinii*). Along the rivers, riparian habitats support the wood turtle, a federally and provincially listed species at risk, but this reptile is more common in lowland ecodistricts.

420 Eastern Drumlins

*Note: During revision of the 2005 version of the Ecological Land Classification (Map DNR 2007-2), **420 Eastern Drumlins** ecodistrict was combined with **440 Eastern Interior**.*

430 Eastern Granite Uplands



Stretching in a narrow ridge (80 km long by up to 13 km wide) the Eastern Granite Uplands extends just east of Waverley to Sheet Harbour and lies north of the coastal **Eastern Shore (820)** ecodistrict. This intrusion of erosion resistant bedrock rises sharply, (up to 100 m above the adjacent coastal landscape), often with steep cliffs creating a complex series of crests and valleys. This rocky ridge is dissected with narrow river gorges—the most notable being the Musquodoboit. Also of note are long narrow lakes that dissect the ecodistrict, such as Lake Charlotte and Porters Lake. Total area of this ecodistrict is 602 km^2 or 9.4% of the ecoregion.

The granite that underlies this ecodistrict is similar to the granite of the **South Mountain (720)** ecodistrict and other outcrops throughout the **Western (700)** and **Eastern (400)** ecoregions. Granite is very resistant to erosion and most of the soils derived from this type of bedrock are coarse textured and shallow. Many ecosystems in this ecodistrict have patches of exposed bedrock and are scattered with very large granite boulders. Few bogs and fens are found in this ecodistrict, but there are several notable wetlands bordering the Musquodoboit River. This ecodistrict also has one of the highest concentrations of freshwater lakes, with 11.1% coverage or 6692 hectares.

The forests of the Eastern Granite Uplands are predominantly softwood, with red spruce stands on the better drained and deeper soils associated with hummocky terrain. Elsewhere, the shallow soils give rise to forests of black spruce and white pine with scattered red pine indicating fire

Tangier Grand Lake Wilderness Area *PHOTO: CNS (Len Wagg)*

disturbances in the past. Jack pine is also found on the shallow soils of ridge tops. Only on the few scattered drumlins will any tolerant hardwoods be found. Stands of hemlock occur on the steep sided slopes of hills and hummocks alongside rivers and streams. The natural disturbance regime for the uplands is classified as frequent stand initiating. Disturbance agents are typically wind storms and hurricanes, or fire when a lack of soil moisture during summer months creates conditions favorable for forest fires.

Geology and Soils

As suggested by the name, the Eastern Granite Uplands ecodistrict is dominated by a large granitic intrusive body, exposed after millions of years of erosion. This Devonian period rock is made up of a mix of granite and granodiorite that is often directly visible as bedrock outcrop. The weather-resistant rock is now elevated above the surrounding landscape offering fine views of adjacent river valleys (e.g., from Gibraltar Hill).

Surficial deposits and soil parent materials are dominated by thin, granitic glacial till containing many surface stones (*glacial erratics*)—some the size of small buildings. Colluvium deposits can also be found on steeper slopes. In addition, there are till deposits near the boundary of this ecodistrict that contain quartzite and slate from the surrounding **Eastern Interior (440)** ecodistrict.

Dominant soils are derived from stony sandy loam to loamy sand high in granitite and granodiorite (Gibraltar/Bayswater soils); shallow and/or very stony granitic sandy loam till (Rockland soils); and gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils) (**See Table 16**). Restricted drainage by near-surface bedrock has also promoted the formation of many hydric soils which are found scattered throughout this ecodistrict.

Forests

The underlying granite till and bedrock imparts little nutrient enrichment to the soils, therefore, softwood forests, which are more adaptable to acidic conditions, cover most of the ecodistrict. On upland slopes, coarse, well drained soils support a matrix forest (43% of the ecodistrict) of red spruce, hemlock and white pine (Spruce Hemlock Forest Group). Regenerating balsam fir and red spruce are prominent in the shrub layer, along with ericaceous species such as lambkill and blueberry. Overall coverage and diversity of typical woodland flora is low, with bracken (*Pteridium aquilinum*) the most prominent species. Bazzania (*Bazzania trilobata*) and Schreber's moss (*Pleurozium schreberi*) are typically extensive on the forest floor. Hemlock is usually found on soils with higher moisture and nutrient content associated with lower slope positions.

Due to the coarse textured and generally shallow soils, black spruce and white pine (Spruce Pine Forest Group) are prominent on drier and nutrient poor sites, with occasional red pine, jack pine and red oak. White pine often forms a super canopy overtopping black spruce.

Ericaceous shrubs dominate the shrub layer (mainly lambkill and blueberry) with wild raisin and huckleberry also common. Herb coverage and diversity are low, favouring species that tolerate

Table 16
Summary information for dominant soils found in the Eastern Granite Uplands ecodistrict (430). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Gibraltar /Bayswater *	73	Glacial Till, Colluvium	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol
Rockland *	15	Glacial Till, Bedrock	Medium-Coarse	Rapid-Imperfect	ST15, ST16, ST15-G, ST16-G, ST2, ST3	Podzol
Halifax / Danesville *	10	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Hydric	5	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST4-G	Organic, Gleysol

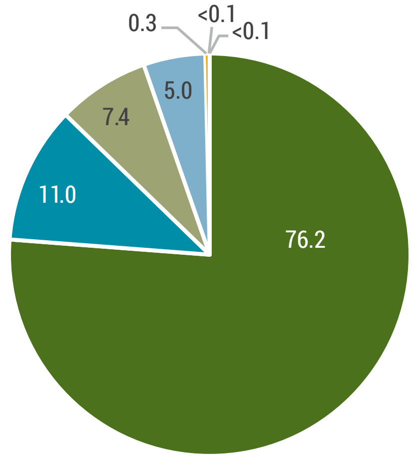
Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

acidic soils (e.g., bracken (*Pteridium aquilinum*), teaberry (*Gaultheria procumbens*), mayflower (*Epigaea repens*) and bunchberry (*Cornus canadensis*)). On level terrain with progressively poorer drainage, black spruce, red maple and tamarack dominate the forest vegetation.

In the Eastern Granite Uplands the inherently poor soil fertility can significantly limit softwood growth potential. A slight improvement in soil fertility enhances conditions favourable for red spruce and hemlock. However, marginal sites often result in the development of a black and red spruce hybrid, which can make it difficult to distinguish between these two species.

Open woodlands of jack pine, red pine and black spruce with scattered red oak, occur on the curvilinear ridging caused by the folding of the underlying granitic bedrock. Most sites have numerous large granite boulders scattered throughout, with large expanses of exposed bedrock. Soils in these areas are typically coarse textured, shallow and dry, and support a significant understory of woody ericaceous shrubs. Most of these sites have been impoverished by repeated wildfires, however, modern fire suppression and prevention has allowed these sites to reforest to higher stocking levels than may have been historically present.

Near Mooseland and East Taylor Bay Lake, richer, well drained soils on drumlins support a forest of sugar maple, red maple, yellow birch, and beech. On the moister lower slopes, balsam fir, red spruce and yellow birch are more abundant.



Ecodistrict 430 Percentage Land Cover

Forest/Woodland	76.2
Water	11.0
Shrub/Heathland	7.4
Wetlands	5.0
Urban/Industrial	0.3
Agriculture	<0.1
Sparsely Vegetated	<0.1

Natural disturbances in Eastern Granite Uplands forests are frequent. Disturbance agents (such as fire, hurricanes, wind and ice storms, and insects) typically create stand-level mortality.

During a hurricane event, although stand-level destruction (i.e., windthrow) can be partial, the remaining trees are left weakened, and will often fall in subsequent years during less severe storms. Stands on shallow and/or imperfectly drained soils are most susceptible.

Red spruce stands will develop uneven-aged structures the longer the interval between disturbances. Old growth forest is possible, especially in sheltered sites.

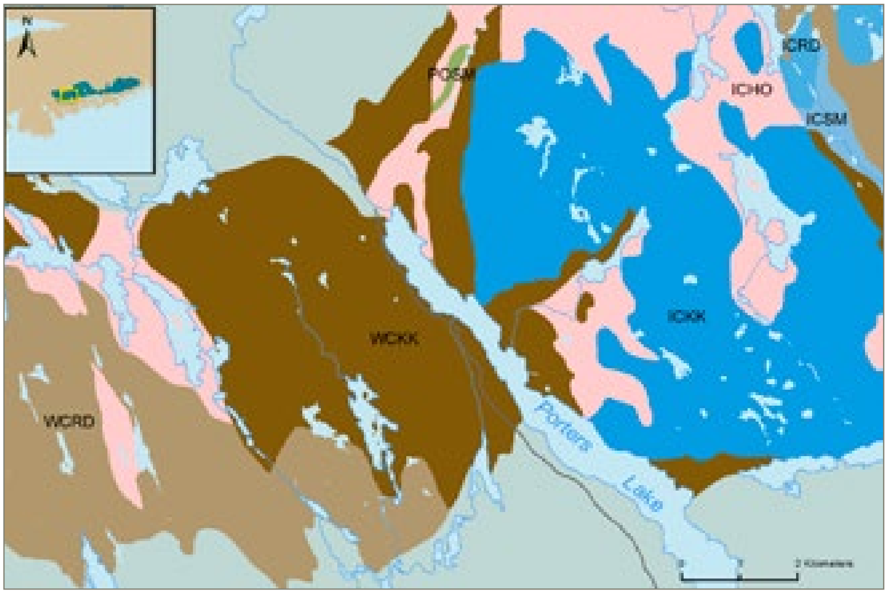
In the Spruce Pine forest, fires are more common due to the local abundance of "fuel" in the form of spruce and pine litter and ericaceous vegetation. Fires of severe intensity can have a significant negative impact on site productivity, especially those sites with high coverage of stones and boulders, or those with shallow soils over bedrock.

A large granite outcrop and cliff at Paces Lake *PHOTO: CNS (Len Wagg)*

Ecodistrict 430

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCKK	26.5%	26.5%
ICHO	16.2%	42.8%
WCRD	14.1%	56.9%
ICKK	11.2%	68.2%
XXWA	11.1%	79.3%
ICRD	7.1%	86.3%
WCHO	6.5%	92.9%
IMHO	3.0%	95.9%
WCDM	1.2%	97.0%
ICSM	0.9%	97.9%
WFDM	0.8%	98.7%
POSM	0.7%	99.4%
WMKK	0.6%	100.0%



Non Forests

The rugged topography of the Eastern Granite Uplands generally promotes extensive forest cover and reduces the potential for open wetlands. That said, the area of naturally unforested ecosystems (includes both wetlands and uplands) is the highest in the ecoregion, encompassing about 10.5% of the terrestrial landscape. (This excludes water bodies and other aquatic areas.)

Most naturally unforested ecosystems in the Eastern Granite Uplands are shrublands. While shrublands may be stands of alder, cherry, grey birch, or other taller shrub species, unforested ecosystems in the ecodistrict are mostly dominated by "heathland" vegetation (a specific type of low-growing shrubland). The relative proportion of the Eastern Granite Uplands occupied by heathland is actually the fourth highest of any ecodistrict in the province.

Heathland vegetation shows remarkable variation throughout the province and among microhabitats. In Eastern Granite Uplands, many of the summits are characterized by thin stony soils, and sometimes have extensive areas of exposed acidic bedrock. These sites are almost always occupied by open heathland or sparsely treed woodland. On all but the driest sites, the heathlands may be dominated by black crowberry, common juniper, various blueberry species (usually lowbush blueberry), and or huckleberries. On the driest sites, the heathland may feature extensive areas of ground lichen and broom crowberry. Broom crowberry is a temperate shrub globally limited to the eastern seaboard of North America, from New Jersey to the Magdalen Islands. Nova Scotia is the only jurisdiction in its global range where the species is not a conservation concern. Rocky summits along the ridge running east of the Musquodoboit River support broom crowberry communities and rare species such as mountain sandwort (*Minuartia groenlandica*). These broom crowberry communities are inland outliers of what is usually considered coastal vegetation.

A small wetland breaks the forest near Oak Lake.
PHOTO: CNS (Len Wagg)

440
Eastern Interior

This is the largest ecodistrict in the province—stretching from Pockwock Lake (Halifax County) in the west to Chedabucto Bay (Guysborough County) in the east. This expansive tract of upland topography is a rolling till-plain comprised of generally gravelly and stony soils. Bedrock ridging is highly visible where glacial tills have left a thin to non-existent veneer. Where the till is deeper, the ridged topography is masked, and thick softwood forests occur. While the highest summits reach 220 m, mean elevation is only 95 m, similar to some lowland areas. Changes in topography are relatively gradual, as topography follows the gentle rise and fall of underlying bedrock and glacial deposits.

This ecodistrict has three distinct concentrations of drumlins which can be identified roughly by the watersheds of the three rivers that flow through them: Sackville River, Tangier River, and Moser River. Although drumlins are scattered elsewhere in the eastern ecodistrict, these three areas represent the highest concentrations. Formed by glacial ice movement, the drumlins are orientated north-south indicating the route of the glaciers toward the Atlantic Ocean. Total area of the ecodistrict is 4575 km^2, about 71.2% of the ecoregion.

A diverse wetland complex near Shoaly Lake, west of the Boggy Lake Wilderness Area *PHOTO: CNS (Len Wagg)*

The ecodistrict is underlain by resistant Meguma Group quartzite/greywacke and slate. The thickness of the till is quite variable across the ecodistrict, ranging from 1–10 m but averaging less than 3 m. Much of the ecodistrict has been scraped clean by glaciers, exposing large areas of bedrock. This situation can be found on ridged terrain near Seloam Lake and the Head Lakes in the Liscombe Game Sanctuary.

Numerous irregular shaped lakes are found throughout this ecodistrict and have a tendency to be dystrophic, meaning the water is acidic and brown-colored due to high levels of dissolved humus. Conductivity is low in the lakes and streams but one of the largest populations of sea-run brook trout in the province is found in the Moser River.

The composition of the forests in this ecodistrict strongly reflects the depth of the soil profile. On shallow soils, repeated fires have impoverished soils and reduced forest cover to scrub hardwoods (such as red maple, white birch, grey birch, and red oak with scattered white pine and black spruce) underlain by a dense layer of ericaceous vegetation. However, on deeper, well drained soils, stands of red spruce are found. On crests and upper slopes of hills, drumlins and some hummocks, stands of tolerant hardwood occur. Both beech and hemlock occur on these deeper, well drained soils, but their presence is seldom a high percentage in any stand. On the imperfectly and poorly drained soils, black spruce, tamarack and red maple dominate stand composition. Frequent stand-level disturbances are due to fires and hurricanes.

Geology and Soils

The extensive Eastern Interior ecodistrict is mainly underlain by meta-sedimentary rock from the Cambrian and Ordovician periods (quartzite, slate and greywacke, along with schist and migmatite). These rocks are part of the Halifax and Goldenville Formations that together make up the widely distributed Meguma Group that runs from Yarmouth to Canso. There are also smaller areas near the northeast and northwest boundaries of the ecodistrict underlain by Carboniferous period sedimentary rock including sandstone, siltstone, shale and gypsum. Some intrusions of Devonian period granite and granodiorite can also be found.

The Goldenville Formation contains most of the gold deposits found in Nova Scotia. There are many old and new mining operations scattered across the ecodistrict—from Montague Gold Mines in the west, to Moose River in the interior, to Goldboro in the east.

Surficial deposits and soil parent materials are dominated by quartzite and slate tills of variable thickness. However, drumlin formations are also common, with higher concentrations found from Eastern Passage to Long Lake and between Lake Charlotte and Country Harbour. These landforms are generally finer-textured than surrounding till deposits.

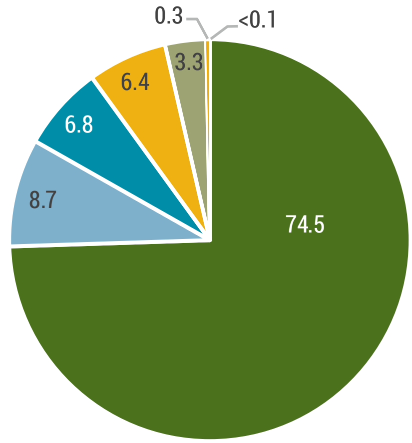
Dominant soils are derived from gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); gravelly sandy clay loam till containing shale, sandstone and mudstone (Wolfville/Hantsport soils); shallow and/or

Table 17
Summary information for dominant soils found in the Eastern Interior ecodistrict (440). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Halifax / Danesville *	61	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Wolfville / Hantsport	12	Glacial Till	Fine-Medium	Mod. Well-Imperfect	ST2-L, ST5, ST8, ST3-L, ST6, ST9	Podzol, Luvisol
Hydric	12	Organic, Glacial Till	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Rockland *	8	Glacial Till, Bedrock	Medium-Coarse	Rapid-Imperfect	ST15, ST16, ST2, ST3	Podzol
Bridgewater / Riverport	13	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

very stony sandy loam till high in quartzite (Rockland soils); and gravelly loam to silt loam till high in slate (Bridgewater/Riverport soils) (**See Table 17**). Gentle terrain and bedrock controlled drainage has also promoted the formation of many hydric soils across the ecodistrict.



Ecodistrict 440 Percentage Land Cover

Forest/Woodlands	74.5
Wetlands	8.7
Water	6.8
Urban/Industrial	6.4
Shrub/Heathland	3.3
Agriculture	0.3
Sparsely Vegetated	<0.1

Forests

The Eastern Interior ecodistrict has several significant forest ecosystems: an azonal climax black spruce forest (Spruce Pine Forest Group) that is widely dispersed on dry to moist, nutrient poor soils (28%); a zonal softwood/mixedwood forest of red spruce, hemlock and yellow birch and red maple (Spruce Hemlock Forest Group) on fresh to fresh-moist, nutrient medium soils (50%); and a zonal Tolerant Hardwood forest of sugar maple, yellow birch and red maple) on fresh, nutrient medium to rich soils (10%).

On imperfectly drained hummocky to level terrain, even-aged forests of black spruce, white pine and hybrid red/black spruce occur, with a significant understory of woody ericaceous shrubs. White pine often forms a super canopy overtopping black spruce. Elsewhere in the ecodistrict, large areas have exposed curvilinear bedrock ridging, locally called "whalebacks." **(See photo, below)** Here the rapidly drained soils on ridge tops support a poorly stocked forest of black spruce, white and jack pine, with an understory of ericaceous shrubs and reindeer lichens (*Cladonia spp.*). Between the ridges soils are moist to wet, and black spruce, red maple, tamarack, false holly, winterberry and speckled alder are prominent. The spruce-pine forest also occurs as a broad linear patch along larger streams and rivers such as the Twelve Mile Stream and Ecum Secum River or large flats (Bruce Plain) associated with the headwaters and wetlands of streams and rivers. Embedded within this ecosystem are wet open woodlands where stocking of tree species can be very poor.

A slightly impoverished Acadian forest of red spruce and white pine occurs as a large patch forest ecosystem primarily on hummocky terrain, with well drained soils derived from slates and quartzite tills. Hemlock is associated with lower slopes and with steep slopes following watercourses. Near Devon (and where soils have higher clay content) mixedwood forests of yellow birch, red spruce, and hemlock are dominant.

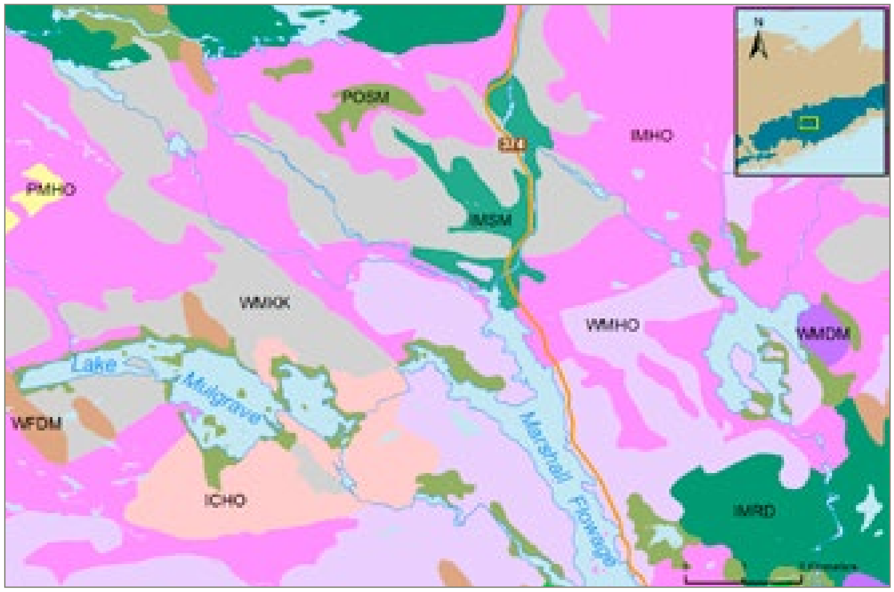
Late successional Acadian forests of shade tolerant hardwoods are dominated by yellow birch (with red maple and sugar maple) and occur on drumlin and hilly topography as a small to large patch-sized forests. These fertile sites, many with humus enriched soil profiles, are underlain by

Exposed bedrock ridging in the Clattenburgh Brook Wilderness Area

PHOTO: CNS (Len Wagg)

Ecodistrict 440

Sample area map showing typical ecosections found in this ecodistrict



Ecosection	District %	Cumulative %
IMHO	22.8%	22.8%
WMKK	17.6%	40.4%
IMRD	13.6%	54.0%
WMHO	8.3%	62.2%
XXWA	7.1%	69.4%
WFDM	6.1%	75.5%
WMRD	4.5%	80.0%
WMDM	3.8%	83.8%
POSM	3.6%	87.4%
IMSM	2.4%	89.9%
WFKK	2.3%	92.1%
WCKK	1.5%	93.6%
ICHO	1.3%	94.9%
IFHO	1.3%	96.2%
WFHO	1.2%	97.5%
XXUR	1.0%	98.4%
WCHO	0.5%	98.9%
IMKK	0.3%	99.2%
IFRD	0.2%	99.4%
PMHO	0.2%	99.6%
IMFP	0.1%	99.7%
ICSM	0.1%	99.8%
IFSM	0.1%	99.8%
WFRD	< 0.1%	99.9%
PMRD	< 0.1%	99.9%
WMSM	< 0.1%	100.0%
ICFP	< 0.1%	100.0%
XXMS	< 0.1%	100.0%
XXCB	< 0.1%	100.0%

well drained medium to fine textured soils. Mixedwood forests of balsam fir, red spruce and yellow birch become more abundant on the moister middle and lower slopes.

The Eastern Interior ecodistrict is subjected to natural disturbance agents including fire, hurricanes, insects and natural senescence. In the Spruce Pine Forest Group disturbances tend to be more frequent, often resulting in even-aged forests and limiting opportunities for old growth forest development. Earlier successional forests have similar tree species composition as later stages. Due to the local abundance of “fuel” in the form of pine and spruce litter as well as ericaceous vegetation, fires of severe intensity can have a significant negative impact on site productivity, especially those sites with high coverage of stones and boulders or with shallow soils over bedrock. Where soils are shallow to bedrock, or have been impoverished by repeated wildfires, low stocked woodlands of black spruce and white pine are more dominant. Historically these sites were frequently disturbed by fire, resulting in extensive areas of low stocking and/or barrens. Fire suppression efforts are now encouraging natural regeneration. Imperfectly and poorly drained soils and the shallow rooting of black spruce make these sites sensitive to windthrow. The Spruce Hemlock and Tolerant Hardwood Forest Groups are less susceptible to windthrow due to deeper rooting. The longevity of the dominant species and infrequent occurrence of stand-level disturbances can lead to the development of uneven-aged forests and old growth features. These late successional forests experience smaller gap disturbances in the canopy caused by individual tree mortality. Older red spruce forests are susceptible to outbreaks of the spruce bark beetle.

Early successional forests (following stand-level disturbances such as fire and harvesting) include shade intolerant hardwoods such as red maple and white birch. Balsam fir is also an early successional component following stand-level disturbance in red spruce forests.

Mayflower, Nova Scotia’s provincial flower

PHOTO: DNR (Peter Neily)

This ecodistrict has been used extensively for timber products and recent silviculture has enhanced forest production on a significant portion of the landbase. Seasonal forest access roads have increased entry points throughout the ecodistrict, however there are also large roadless expanses, many of which have been placed into Wilderness Areas (i.e. Alder Ground, Liscomb River, Ship Harbour, Long Lake and Devils Jaw).

Non Forests

Similar to other ecodistricts in the Eastern ecoregion, the Eastern Interior is largely forested. However, unlike the others, wet ecosystems occupy a relatively large proportion of the landscape. These include both treed and unforested wetlands, as well as aquatic ecosystems. The area of lakes, rivers, and ponds in the Eastern Interior makes up 10% of all inland waters in the province—the third highest proportion of any ecodistrict in Nova Scotia.

Open wetlands are primarily shrub swamps and open peatlands. Most of the larger peatlands are unpatterned bogs, including flat, raised, and sloping surface expressions. Larger fens are much less common and tend to be flat and unpatterned. These open peatlands cover an area equivalent to 12% of all the peatlands in the province. This is the second highest proportion of provincial peatland area of any ecodistrict in Nova Scotia.

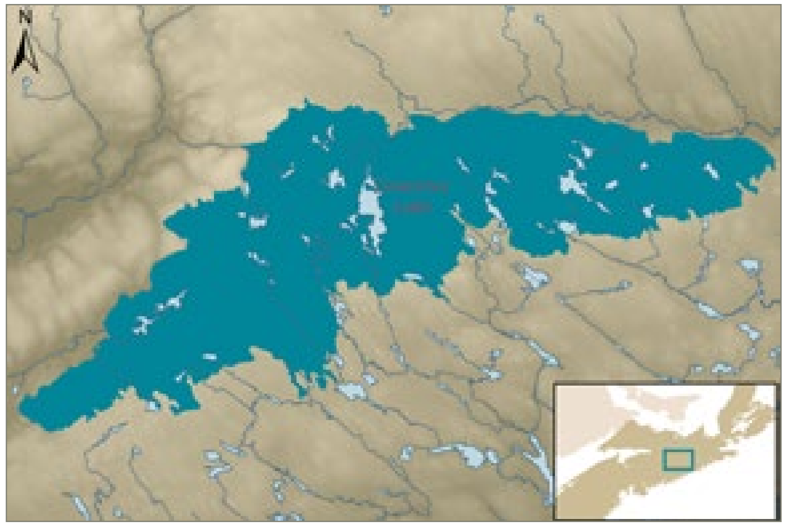
The remainder of wetlands are mostly shrub swamps, including taller (e.g., speckled alder, winterberry, and willow) and shorter shrub species (e.g., sweet gale, leather-leaf, glossy rose).

The amount of shrub swamp found here is also remarkable. Twelve percent of all shrub swamp in Nova Scotia is found in this ecodistrict—the highest proportion of any ecodistrict in the province.

Open uplands are largely low heathlands composed of lambkill, Rhodora, huckleberry species and blueberry species. Low dwarf-heath may be dominated by either black crowberry or broom crowberry, as detailed in the description for **Eastern Granite Uplands (430)**. Black crowberry heathland communities are more typical of the coast.

A concentrically patterned dome bog in Big Bog Wilderness Area near Ross Lake *PHOTO: CNS (Len Wagg)*

450
Governor Lake



Located in the center of the eastern mainland Nova Scotia, Governor Lake ecodistrict is an upland landscape underlain by granite bedrock. To the north, the ecodistrict drops sharply to West River St. Mary's, however on the other three sides its rise is less abrupt from the shales and quartzites of the **Eastern Interior (440)** ecodistrict. At its highest point, the ecodistrict is 200 m above sea level. The area has hot summers, cold winters and a very short frost free period. It covers 633 km^2, which is 9.9% of the ecoregion.

The ecodistrict is underlain by intruding Meguma Group granite—similar to that found in **South Mountain (720)** and **Eastern Granite Uplands (430)**—which is very resistant to erosion. The terrain is thinly covered by coarse granitic till with many large granite boulders, especially on hummocky and hilly terrain between Lower Rocky Lake and Big Liscomb Lake. Soils are typically coarse textured, well drained, gravelly sandy loams. Glacial activity has created drumlins and eskers, which can be found scattered throughout the ecodistrict. Freshwater lakes, streams (e.g., Ten-, Twelve-, Fifteen-, and Seventeen-Mile Stream), and rivers account for almost 6% of the area.

On the well-drained upper slopes and crests of hills and drumlins, tolerant hardwood forests dominate, with yellow birch and red maple and lesser amounts of sugar maple and beech.

Governor Lake, northern Halifax County *PHOTO: CNS (Len Wagg)*

Yellow birch with diameters over 1 m are common. Elsewhere, softwood forests dominate the ecodistrict with stands of red spruce and scattered hemlock. Isolated pockets of white pine are found on the coarse shallow soils of ridges associated with black spruce and ericaceous vegetation. The ecodistrict is prone to wildfire due to the dryness of the soils, and to windthrow due to the shallowness of those soils.

Geology and Soils

Geologically, the Governor Lake ecodistrict is in many ways a hybrid of the **Eastern Granite Uplands (430)** and **Eastern Interior (440)** ecodistricts. Bedrock is a mix of Meguma Group meta-sedimentary rocks (quartzite, slate, schist, greywacke); Devonian period intrusives (granite and granodiorite); plus metamorphic rocks related to the Devonian intrusives (paragneiss and schist).

Surficial deposits are also mixed, with granite, quartzite and slate dominated tills all present. These deposits are of variable thickness—from less than 1 m up to 20 m. As with the **Eastern Granite Uplands (430)**, granitic surface boulders are common here, but there are also drumlin formations similar to those found in the **Eastern Interior (440)**. In addition, several small glacio-fluival deposits can be found, such as those between Loon Lake and Caledonia.

Dominant soils are derived from gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); stony sandy loam to loamy sand high in granitite and granodiorite (Gibraltar/Bayswater soils); and gravelly loam to silt loam till high in slate (Bridgewater/Riverport soils) (**See Table 18**). Hummocky terrain and bedrock controlled drainage has also promoted the formation of many hydric soil pockets across the ecodistrict.

Forests

Even though the underlying granite bedrock and soil fertility is similar to the **Eastern Granite Uplands (430)**, more of this ecodistrict (69%) supports a zonal late successional Acadian forest of red spruce and white pine (Spruce Hemlock Forest Group) on well to moderately-well drained slopes. Nonetheless, the inherent lower fertility of these soils also allows for a significant presence of white pine, black spruce, and the red/black spruce hybrid. Yellow birch becomes a prominent overstory component on moist lower slopes. Regenerating balsam fir and red spruce are prominent in the shrub layer, along with ericaceous species such as lambkill and blueberry. Overall coverage and diversity of typical woodland flora is low, with bracken (*Pteridium aquilinum*) the most prominent. Bazzania (*Bazzania trilobata*) and Schreber's moss (*Pleurozium schreberi*) are typically extensive on the forest floor. Hemlock is found on soils with higher moisture and nutrient content. This soil condition is usually associated with lower slope positions, but is relatively uncommon in the ecodistrict. Balsam fir is an early successional component of most stands.

On hilly topography and drumlins (found south and east of Governor Lake and near Otter Lake) upper slopes with richer soils are mainly associated with tolerant hardwood (yellow birch with red maple

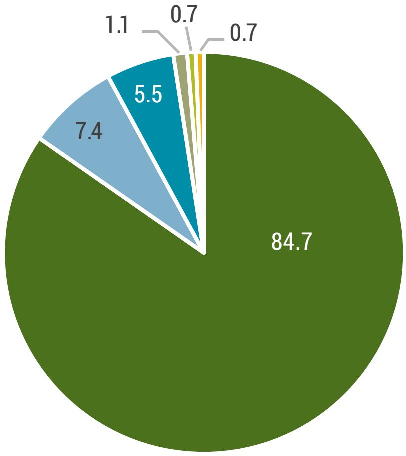
Table 18
Summary information for dominant soils found in the Governor Lake ecodistrict (450). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Halifax / Danesville *	41	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Gibraltar / Bayswater *	33	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol
Bridgewater / Riverport	13	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol
Hydric	9	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4	Organic, Gleysol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 450 Percentage Land Cover

Forest/Woodland	84.7
Wetlands	7.4
Water	5.5
Shrub/Heathland	1.1
Agriculture	0.7
Urban/Industrial	0.7



and sugar maple). Balsam fir, red spruce and yellow birch are more abundant on moister lower slopes.

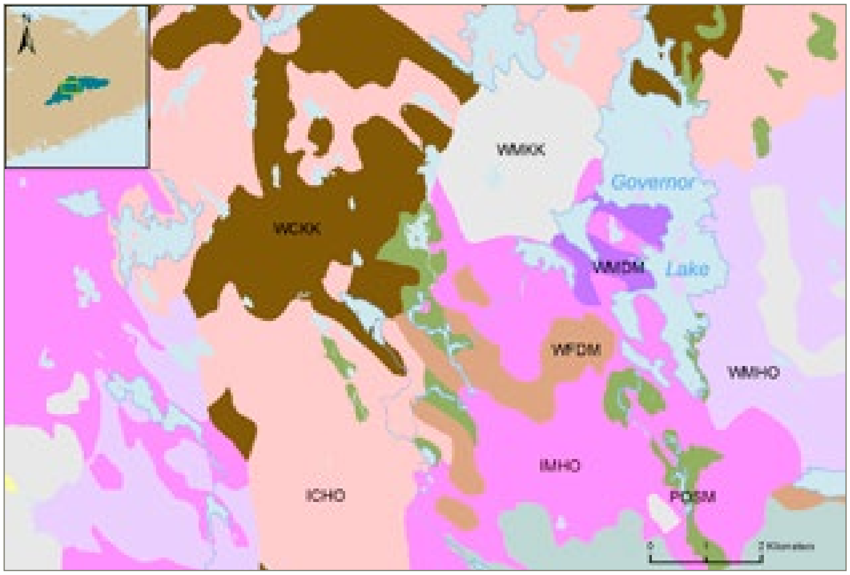
Elsewhere in the ecodistrict small open woodlands of black spruce and white pine with thick ericaceous cover and reindeer lichen (*Cladonia spp.*) occur on nutrient poor soils shallow to bedrock.

The Governor Lake ecodistrict is subjected to similar natural disturbance agents as often occur in the Eastern ecoregion including fire, hurricanes and insects. However, red spruce and white pine tend to be deeper rooted than black spruce and are therefore less susceptible to windthrow. Red spruce and white pine longevity can lead to development of uneven-aged forests and old growth features and occasionally white pine will form a super-canopy over red spruce. These stands experience smaller gap disturbances in the canopy caused by individual tree mortality. Red spruce are very tolerant of understory shade, responding well to release after decades of suppression, whereas white pine, which has only intermediate shade tolerance, requires release at a young age. Older red spruce forests are susceptible to the spruce bark beetle, especially when weakened by hurricanes. The Abraham Lake Nature Reserve, with a large component of old red spruce has sustained substantial mortality due to the spruce bark beetle in recent years.

Early successional stages that are dominated by red maple, white birch, and pin cherry can be by-passed, if at the time of disturbance, advanced red spruce, balsam fir, and white pine regeneration is retained. (This could happen after a stand-level disturbance such as windthrow or harvesting). Black spruce, a shallow rooting species, is susceptible to windthrow on imperfectly drained sites and soils shallow to bedrock.

This ecodistrict has been used extensively for timber products, and silviculture has increased forest production on significant areas. Seasonal forest access roads have enhanced transportation throughout the ecodistrict.

Red spruce mortality caused by the native spruce bark beetle, in the Abraham Lake Nature Reserve *PHOTO: CNS (Len Wagg)*



Ecodistrict 450

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	26.0%	26.0%
WCKK	17.0%	43.0%
WMKK	15.7%	58.7%
ICHO	11.2%	69.9%
WMHO	10.8%	80.7%
XXWA	5.7%	86.5%
POSM	2.8%	89.3%
WCHO	2.8%	92.0%
WFDM	1.7%	93.8%
WMDM	1.7%	95.5%
WFKK	1.5%	97.1%
IMRD	1.4%	98.4%
IMSM	0.8%	99.2%
ICSM	0.4%	99.7%
PMHO	0.3%	100.0%

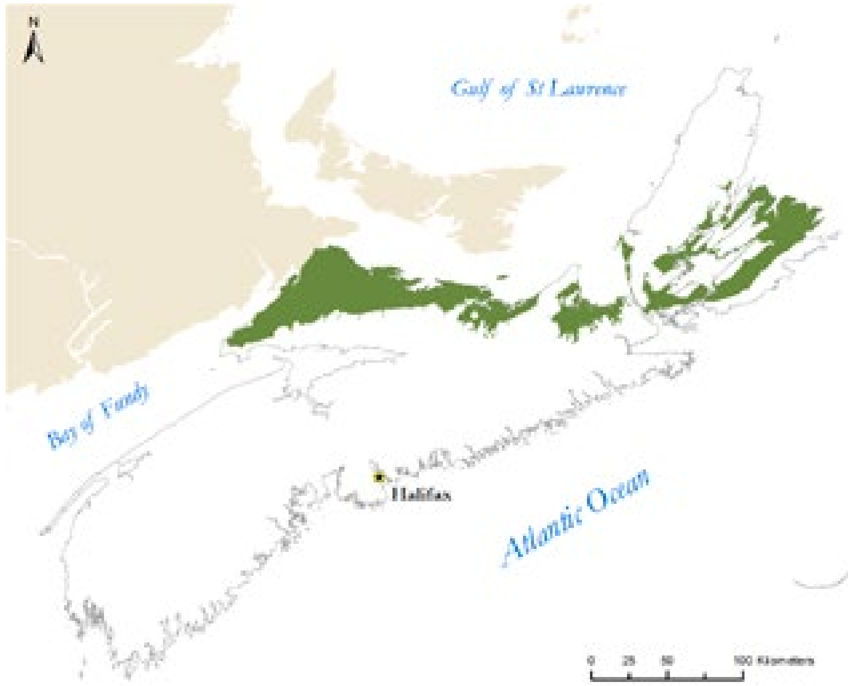
Non Forests

Governor Lake ecodistrict is characterized by relatively well drained soils and gradual changes in topography. Conditions are favourable for upland forests, and while treed swamps and peatlands are well represented, open wetlands and open uplands are relatively uncommon.

The shrublands and sparse rocky vegetation which characterize much of the ecoregion, especially the **Eastern Interior (440)**, are also much scarcer here. The generally acidic bedrock, the absence of major rivers, and the remoteness of this landscape, has limited interest in botanical and ecological exploration. As such, few rare plant records exist for the ecodistrict and those that do are largely from forest vegetation. The same pattern exists for lichen and zoological records. Aquatic and wetland birds, such as the American bittern, spotted sandpiper, and greater yellowlegs, among other bird species, have shown up consistently in breeding surveys.

The majority of open wetlands in the ecodistrict are bogs and shrub swamps. In the areas on either side of the ecodistrict's namesake lake, however, there are some larger unpatterned fens. Little is known about these unsurveyed wetlands.

Lakeside wet meadow, Tait Lake, Halifax County *PHOTO: DNR (Sean Basquill)*



500

Northumberland/ Bras d'Or

This ecoregion covers all lands north of the **Cobequid Hills (340)** on mainland Nova Scotia. Along the Northumberland Strait—from the New Brunswick border to the Strait of Canso—all lowlands are also included. On Cape Breton Island, it includes the lowlands surrounding the Bras d'Or Lakes and St. George's Bay; the watersheds of the River Inhabitants, Salmon River and Mira River; and the Sydney coalfields.

The majority of the ecoregion is 25–50 m above sea level, however elevations up to 150 m are found along the rolling hills of Antigonish County. These lowlands have deep soils on Carboniferous sedimentary rocks and cover 8407 km^2 or approximately 15.2% of the province.

The Northumberland/Bras d'Or ecoregion is warmed by its proximity to the more temperate waters of the Northumberland Strait and the Bras d'Or Lakes, compared to either the Atlantic or Bay of Fundy, which are adjacent to other ecoregions.

The Northumberland Strait warms considerably in late August, with a typical surface temperature of 18° Celsius. This contrast between air and water temperatures is enough to cause on-shore sea breezes, and to delay the onset of frost for a few weeks in the fall.

The Northumberland Shore area experiences some of the province's warmest summer temperatures, but is also one of the colder areas in winter. The **Bras d'Or Lowlands (510)** also experience rather cool winters, while summer temperatures are considerably cooler than those along the Strait. The mean annual precipitation ranges between 1100–1400 mm, with drier areas found along the Northumberland Strait.

Erodible Carboniferous sandstone, shale, limestone and gypsum underlay the ecoregion. Where the bedrock is limestone and gypsum, karst topography is common and creates some of the province's most unique ecosystems.

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

Overall, there are few lakes in this lowland ecoregion and most freshwater occurs in the abundant wetlands. Due to the level terrain and heavy soils, extensive swamps and peat bogs have formed. Many wetlands in the ecoregion have dammed reservoirs (impoundments) for waterfowl habitat. Beaver-influenced wetlands are common throughout. Wide floodplains are associated with the major rivers and larger streams.

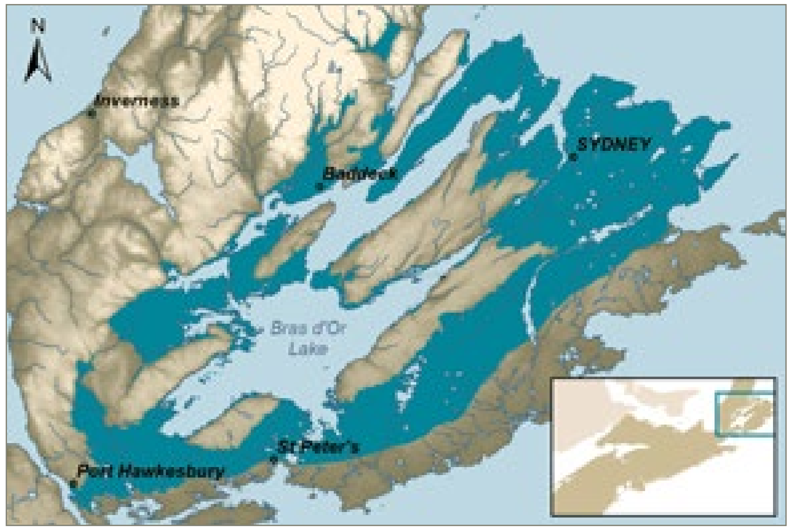
Most of the soils in the Northumberland / Bras d'Or ecoregion have developed from relatively deep, non-stony glacial till deposits. However, low relief, massive subsoils and frequent fragipan development have created large areas of imperfectly to poorly drained soils. Where these soils are fine textured, Gleyed Luvisols[1] and Luvic Gleysols are most common. In medium to coarse textured soils, Gleyed Humo-Ferric and Ferro-Humic Podzols are dominant (along with Fragic variants). These grade into Gleysols, Humic Gleysols, and various Organic soils under poorly drained conditions. Better drained areas in the ecoregion are mainly associated with Orthic Humo-Ferric and Ferro-Humic Podzols.

Extensive areas of azonal soils give rise to forests of black spruce and pine throughout the ecoregion. Dry, warm summers contribute to soil moisture deficits in parts of the ecoregion underlain by deep, coarse textured soils, shallow soils over bedrock, and/or fine textured soils over compacted impervious glacial tills. Fire adapted species, such as jack pine, red pine and black spruce are common.

The Acadian forest of shade tolerant species occurs on zonal ecosites with forests of yellow birch, hemlock and red spruce. On hillier topography, where slopes improve drainage, tolerant hardwoods are found, especially along the Bras d'Or Lake. Floodplains associated with the larger rivers used to support forests of elm, sugar maple and white ash, but many of these areas have been cleared for settlement, making this forest type now rare. Stand-level natural disturbances due to fire and windthrow from hurricanes are more frequent here than in other ecoregions, so stands tend to develop even-aged features. However, where European settlers in the 1800s cleared large areas of forests for settlement, fields and pastures, some have now reforested back to the Old Field Forest Group of white spruce, tamarack and aspen stands.

Big Merigomish Island, Pictou County
PHOTO: CNS (Len Wagg)

510 Bras d'Or Lowlands



This ecodistrict, located on Cape Breton Island, includes the lowland areas of the Bras d'Or Lake watershed, Sydney coalfield, Boularderie Island, and most of the watersheds of the Salmon River and Mira River. The Bras d'Or Lake, an inland sea with a mixture of saltwater and freshwater, covers nearly 260 km^2 in the center of Cape Breton Island, with West Bay being a wide extension on the southwest side and the long tapering East Bay extending 40 km in a northeasterly direction. Freshwater (excluding the Bras d'Or Lakes) makes up 4.4% of the ecodistrict or 12224 hectares. Total area is 2802 km^2 or about 33.3% of the ecoregion.

The Sydney coalfield contains the largest coal resource in Eastern Canada. The coalfield includes the coast of northeastern Cape Breton and extends far out under the Atlantic Ocean toward Newfoundland. The bays and channels of the Bras d'Or Lakes have been carved mainly from the easily erodible Windsor sediments. Locally, thick deposits of gypsum, anhydrite, and salt occur. The bays and channels are narrow, and parallel to ridges of gypsum dominated bedrock. Good examples of this feature are found near the community of Iona. Throughout the ecodistrict, white gypsum cliffs and red sandstone can be observed, especially along the shoreline of the lakes.

Where the underlying gypsum bedrock is expressed at the surface with sinkholes and/or karst topography, unique forest communities can occur—often

Baddeck River near Harris Pool, before entering into Nyanza Bay on the Bras d'Or Lakes *PHOTO: DNR (Bob Gusett, retired DNR)*

with rare plants, such as yellow lady's slipper (*Cypripedium parviflorum*), swamp milkweed, and shepherdia (*Sheperdia canadensis*).

The eastern half of the district is covered predominately with shallow, stony, moderately coarse-textured glacial till derived from the underlying sandstones. The western half of the ecodistrict is dominated by imperfectly drained, loam to clay loam soils.

The Bras d'Or Lowlands ecodistrict has more nesting eagles than any other ecodistrict in the province, with 216 nesting areas recorded over the years by Nova Scotia Department of Natural Resources staff. Because eagles feed mostly on fish during the nesting season, most eagle nests are located close to the shoreline, though some inland waterways are also used.

Fresh, nutrient medium soils support Acadian forests of shade tolerant hardwoods on hummocky to hilly terrain or drumlins. On level to hummocky terrain with moist nutrient poor soils, black spruce, white spruce and balsam fir are prominent (with tamarack and red maple becoming more prevalent as soils gets wetter). On steeper slopes, white pine can be found, while red spruce (a rarity in the district) and hemlock will be found in the valley canyons, steep ravines, and along some watercourses coming off the uplands.

The clearing of land by early settlers and later abandonment of those fields and pastures has given rise to large areas of old field forests of white spruce and tamarack. Natural disturbances include losses to blowdown in exposed areas along the lakes and coast, as well as fire and spruce budworm.

The current forest has been strongly influenced by human settlement and later abandonment, followed by forest harvesting. These conditions have resulted in more softwood and hardwood stands of early successional species such as white spruce, trembling aspen, red maple, white birch and grey birch.

Geology and Soils

The Bras d'Or Lowlands ecodistrict runs the length of Cape Breton Island and encompasses lowland areas around Bras d'Or Lake, the Sydney coalfield and Boularderie Island, as well as several watersheds associated with the Salmon and Mira Rivers.

Bedrock generally consists of Carboniferous period sedimentary rock including various conglomerates, sandstones, siltstones, shales, mudstones, coal, limestone, gypsum and salt. Extensive coal deposits in the area have been mined for centuries and there are numerous (more than 500) mapped and unmapped mine openings of various sizes found within the ecodistrict (mainly in the east). Indeed, this ecodistrict contains many geology/mining sites with historical, cultural and scientific significance dating back to the 1700s.

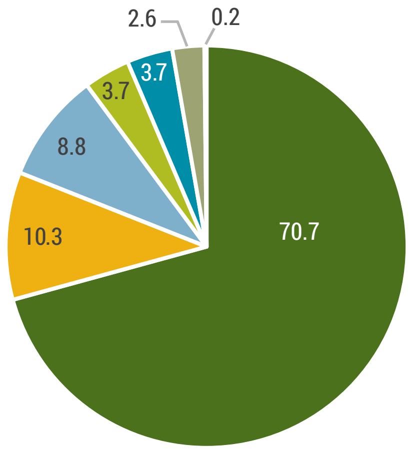
Table 19
Summary information for dominant soils found in the Bras d'Or Lowlands ecodistrict (510). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Shulie / Springhill *	28	Glacial Till, Colluvium	Medium-Coarse	Well-Imperfect	ST2, ST3	Podzol
Hydric	21	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Thom / Mira *	14	Glacial Till, Colluvium	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol
Woodbourne / Millbrook	14	Glacial Till	Fine-Medium	Mod. Well- Imperfect	ST2-L, ST3-L, ST6, ST5, ST12	Podzol, Luvisol
Queens / Falmouth	9	Glacial Till	Fine	Mod. Well- Imperfect	ST6, ST12, ST5, ST11	Luvisol, Brunisol
Westbrook	6	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 510 Percentage Land Cover

Forest/Woodland	70.7
Urban/Industrial	10.3
Wetlands	8.8
Agriculture	3.7
Water	3.7
Shrub/Heathland	2.6
Sparsely Vegetated	0.2



Soil parent materials are mainly glacial tills of varying texture that reflect the sedimentary rock types found in each deposit. Karst conditions can also be found in areas associated with near-surface gypsum and/or limestone.

Dominant soils are derived from gravelly sandy loam till high in sandstone (Shulie/Springhill soils); gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom/Mira soils); gravelly loam to clay loam till containing sandstone and shale (Woodbourne/Millbrook soils); non-gravelly silt loam to clay loam till (Queens/Falmouth soils); and gravelly sandy loam to loam till high in conglomerate (Westbrook soils) (**See Table 19**).

Low-lying areas and the presence of fine-textured tills has also led to significant hydric soil development in this ecodistrict.

Forests

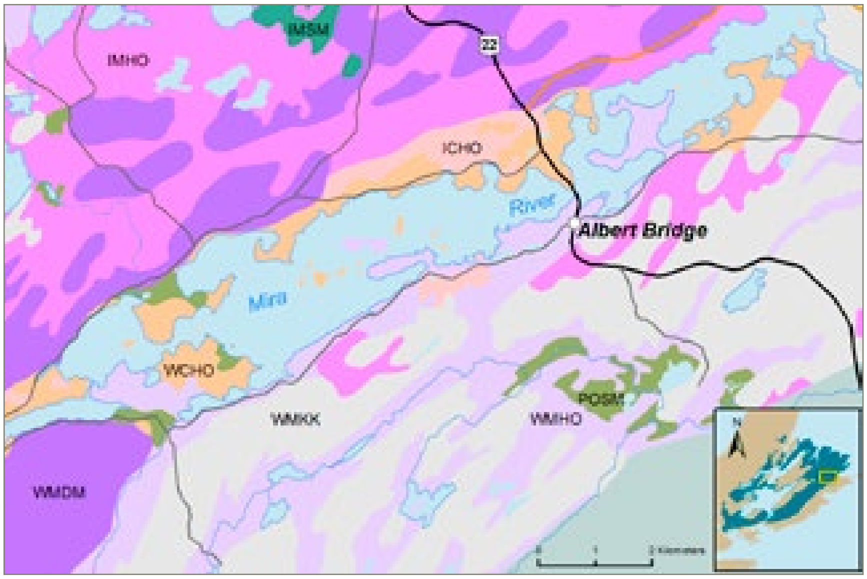
A matrix-scale Acadian hardwood forest occurs on the zonal sites (56% of the ecodistrict) of gently rolling hummocks and hills surrounding the Bras d'Or Lake, and on drumlinized terrain on the eastern side of the island.

The typical shade tolerant hardwood forest (Tolerant Hardwood Forest Group) includes sugar maple, red maple, yellow birch, and beech and occurs on fresh, nutrient medium soils of hillier terrain with steeper slopes—similar to the conditions on Boularderie Island. Closed canopy forests extend from crests to lower slopes with an abundant understory of regenerating trees similar to those making up the overstory (e.g., striped maple and red maple). Vernal pools (ephemeral water collection areas) are commonly found biodiversity features, while seepage areas support even more diverse hardwood forests with white ash, ironwood and (occasionally) rare plants.

The understory includes hobble-bush, fly-honeysuckle and beaked hazelnut, and extensive coverage of various ferns and club-mosses. In the spring, ephemeral herbs such as spring beauty (*Claytonia caroliniana*) and Dutchman's breeches (*Dicentra cucullaria*) are also common.

Where this forest occurs on drumlins, fresh to fresh-moist, nutrient medium soils carry a stronger component of red maple and yellow birch, with sugar maple confined to richer sites.

The lowlands are quite narrow along East Bay at Ben Eoin.
PHOTO: CNS (Len Wagg)



Ecodistrict 510

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	18.3%	18.3%
WMKK	17.0%	35.3%
IFHO	10.4%	45.7%
WMDM	9.8%	55.5%
WMHO	8.2%	63.7%
WFKK	5.7%	69.4%
IFKK	4.6%	74.0%
XXWA	4.4%	78.4%
WMRD	3.3%	81.7%
POSM	3.1%	84.8%
WCHO	3.0%	87.8%
WFHO	3.0%	90.9%
IMRD	1.8%	92.7%
IFRD	1.3%	94.0%
IMDM	1.3%	95.3%
ICHO	1.1%	96.4%
IMSM	0.8%	97.2%
IFSM	0.5%	97.8%
IMFP	0.5%	98.2%
WFDM	0.3%	98.5%
WFRD	0.3%	98.8%
WCFP	0.2%	99.0%
ICSM	0.2%	99.2%
WCRD	0.2%	99.3%
WCKK	0.1%	99.5%
XXCB	0.1%	99.6%
WCDM	0.1%	99.7%
XXMS	0.1%	99.8%
WMFP	0.1%	99.9%
WMSM	0.1%	100.0%
ICFP	< 0.1%	100.0%
IFFP	< 0.1%	100.0%

Most of these stands have a minor component of balsam fir and/or white spruce and softwood regeneration tends to be dominant in the understory.

Other shrubs include, mountain maple and fly-honeysuckle, along with striped maple. The herb layer has extensive fern cover including wood ferns (*Dryopteris species*), hay-scented fern (*Dennstaedtia punctilobula*) and New York fern (*Thelypteris noveboracensis*). Other common plants include bunchberry (*Cornus canadensis*), wood-sorrel (*Oxalis montana*) and gold thread (*Coptis trifolia*).

The dominant natural disturbance agents in the tolerant hardwood forest (i.e., insects or disease, windthrow or storm breakage) create small gaps and patches in the canopy. Evidence of blowdown and uprooting is evident in much of the hardwood forest by the abundance of pit and mound relief. As such these tolerant hardwood forests can be uneven-aged and stands can develop old forest characteristics. Stand-level

Looking south towards Benacadie Point *PHOTO: CNS (Len Wagg)*

disturbance is rare and forest harvesting creates conditions for early successional species such as white and grey birch, red maple, aspens, and balsam fir. The beech bark canker that arrived in Nova Scotia in the 1890s has reduced the once dominant beech to a primarily understory species with only a few scattered uninfected trees surviving. Yellow birch has regained much of its natural abundance following the birch dieback event of the 1940s. Other insects and diseases that cause individual tree mortality include sugar maple borer and chaga (birch cinder conch). Wounds caused by ice storm breakage also provide avenues for a variety of fungi to enter and further weaken or kill trees.

Large areas of black spruce forests occur on hummocky terrain with moist to moist wet, nutrient poor soils. Balsam fir, tamarack and white pine are associated with these slow growing forests. As the abundance of sedges (*Carex species*), creeping snowberry (*Gaultheria hispidula*), cinnamon fern (*Osmuna cinnamomea*) and peat moss (*Sphagnum species*) increases, so do the soil moisture levels. With progressively poorer drainage black spruce, tamarack and red maple dominate the canopy, and wetlands are embedded throughout the forest. Natural stand-level disturbances due to windthrow, insects, or senescence (old age) are frequent, and result in primarily even-aged forests with little potential for old growth forests. Associated with the upper River Inhabitants and River Denys are extensive black spruce–tamarack forests on inactive alluvial and glacial fluvial deposits. Regeneration following stand-level disturbances and harvesting tends to be of similar species to the previous stand, but aspen, white birch, red maple and grey birch can occur on better drained sites.

Late successional floodplain forests of sugar maple, elm, and white ash occur on fresh, nutrient rich soils derived from active alluvial deposits. In the understory are choke cherry, speckled alder, alternate-leaved dogwood, and regenerating overstory tree species. Rich floodplain plants include bloodroot (*Sanguinaria Canadensis*), ostrich (fiddlehead) fern (*Matteuccia struthiopteris*), nodding trillium (*Trillium cernuum*) and wood goldenrod (*Solidago flexicaulis*). Most of the well-drained alluvial soils in this element have been cleared of forest for agriculture, and when abandoned they reforest to speckled alder, choke cherry and willow species, followed by white spruce, tamarack, red maple and white ash.

Massive gypsum sinkhole with high cliffs at Plaster Ponds
PHOTO: DNR (Sean Basquill)

Occasionally Acadian softwood forests of red spruce, hemlock and white pine (with a component of yellow birch) are found scattered throughout the ecodistrict. These late successional forests are typical on finer textured soils near Ashfield, Orangedale, and Plaster Mines.

Much of the forest along the Bras d'Or Lake was cleared for farming in the 1800s. When fields are abandoned, white spruce, tamarack and aspens are quick to reforest the sites. A long history of forest harvesting has also increased the abundance of earlier successional species such as red maple, balsam fir, aspens, and white birch. Much of the arable floodplain along the Baddeck, Denys and Inhabitants Rivers has been converted for agriculture use.

Non Forests

The Bras d'Or Lowlands includes some of the richest wetlands in Nova Scotia. The prevalence of calcareous bedrock (e.g., limestone and gypsum) in the ecodistrict serves to increase pH and the availability of nutrients in the soil, which are essential for plant growth.

Richer wetlands are associated with areas of karst (defined below) and larger tracts of poorly drained land overlying calcareous bedrock. These wetlands are mostly shrub swamps and fens. Richer freshwater marshes are also frequent along the edges of karst ponds.

These wetlands support rare bryophytes (e.g., giant spear moss (*Calliergon giganteum*), tufted fen moss (*Paludella squarrosa*), hooked scorpium moss (*Scorpidium scorpioides*)) and vascular plants (e.g., Boreal aster (*Symphyotrichum boreale*), brook lobelia (*Lobelia kalmia*), Gmelin's water buttercup (*Ranunculus gmelinii*), hidden-scaled sedge (*Carex cryptolepis*), limestone meadow sedge (*Carex granularis*), woodland rush (*Juncus subcaudatus var. planisepalus*), and showy lady's-slipper (*Cypripedium reginae*)).

Most of the calcareous wetlands occur in the western and southwestern parts of the ecodistrict where Windsor Group bedrock is more extensive. The eastern part of the ecodistrict is not as rich but is known for its population of New Jersey rush (*Juncus caesariensis*), a rare Atlantic Coastal Plain plant only found in wetlands in this part of the province. New Jersey rush is found mostly in the **Cape Breton Coastal (810)** ecodistrict, with only scattered occurrences in parts of the Bras d'Or Lowlands.

The most remarkable open upland ecosystems in the ecodistrict are associated with karst. Karst is a rugged type of landform created as soluble rocks dissolve in ground and surface water. In Nova Scotia, most karst is found in areas underlain by gypsum. Karst landforms include uniquely shaped cliffs, talus, caves, sinkholes, and disappearing streams, among other features.

The kind of karst in Nova Scotia is only found in Atlantic Canada; most of it in this province with small outliers in Newfoundland and New Brunswick.

Karst is scattered throughout Nova Scotia in areas underlain by Windsor Deposits, and to a lesser extent other calcareous bedrock formations. The most dramatic and undisturbed (e.g., by mining activities, farming, and non-native plants) karst is found in the Bras d'Or Lowlands. Additional information on Nova Scotia karst is included in the description for the **Central Lowlands (630)**.

Stream channel through grassy marsh at Big Marsh, near Upper River Denys *PHOTO: DNR (Sean Basquill)*

520
St. George's Bay

A gently rolling topography of low elevation, rounded hills wrap around St. George's Bay extending inland to the **Mulgrave Plateau (360)** ecodistrict on the mainland and the **Cape Breton Hills (310)** ecodistrict on the island. Including most of Antigonish County and incorporating the Judique lowlands of Inverness County, this area has been used extensively for farming.

Elevations are between 30–60 m above sea level although there is a consistent rise inland from the coast to an elevation of 150 m. Much of this elevation is on gently rolling hills that have been cleared and used for agriculture.

Freshwater in lakes and streams account for less than 1% (800 ha) of the ecodistrict. Most lakes are small and shallow. The largest, Gaspereaux Lake, supports a significant bald eagle population. Total area is 894 km^2 or about 10.6% of the ecoregion.

Underlying the ecodistrict are Lower Carboniferous sedimentary rocks of sandstone, shale and limestone. In some areas, gypsum outcrops and associated karst topography can be seen (e.g., the cliffs along St. George's Bay north of Antigonish). Adjacent to the major rivers are deposits of alluvium and ice-contact stratified sand and gravel. The soils of the ecodistrict are dominated by moderately-well and imperfectly drained gravelly loams and gravelly clay loams. Well drained sandy loams are predominant along the coast, with rapidly drained, gravelly sandy loams on the outwash plains of the major rivers. The alluvial soils are usually moderately-well drained silty, clay loams.

Karst topography at Plaster Cove looking south to Lower South River *PHOTO: CNS (Len Wagg)*

The ecodistrict contains several significant wildlife habitats and species at risk. For example, the barrier sand beaches bordering the Northumberland Strait provide nesting and rearing habitat for the endangered piping plover. The sand dune system at Pomquet Beach Provincial Park is a unique feature along the shore and is an example of a prograding beach-dune complex with marine deposited sand ridges over-topped by wind-blown sand.

The area's extensive agricultural history has modified most of the natural forest that would have occurred on the zonal sites. Abandoned agricultural lands have reverted to stands of white spruce, aspen, red maple and white birch. In Antigonish County alone there are more than 10 000 hectares of forests where white spruce comprises at least 30% of the cover. This indicates a history of disturbance, most likely clearing for agriculture. It is speculated that the presettlement forests included tolerant hardwood stands of sugar maple, yellow birch and beech on the upper slopes, with tolerant softwoods such as red spruce and hemlock becoming more abundant on the lower slopes. White spruce may also have been a significant component of both tolerant hardwood and softwood forests. On level to hummocky terrain with imperfect drainage, forests are dominated with black spruce and tamarack. Where the underlying gypsum bedrock is expressed at the surface with sinkholes and/or karst topography, unique forest communities can occur—often with rare and endangered plants. These karst forests can occur in most forest communities and are usually underlain with fine textured (clay) soils.

Geology and Soils

As implied by its name, the St. George's Bay ecodistrict wraps around St. George's Bay, then rises in elevation as it moves inland to meet the **Mulgrave Plateau (360)** and **Pictou Antigonish Highlands (330)** ecodistricts. Bedrock generally consists of Carboniferous and Devonian period sedimentary rock including various conglomerates, sandstones, siltstones, shales, mudstones, limestone and gypsum. More erosion-resistant sandstones and conglomerates generally form the higher ground, including foothill areas that adjoin surrounding ecodistricts.

Local topography is influenced by the variable thickness of glacial till deposits (up to 30 m), as well as karst conditions found with near-surface gypsum and limestone. There are also significant glaciofluvial deposits (outwash plains, kames, terraces) associated with valley corridors within this ecodistrict.

Dominant soils are derived from gravelly loam to clay loam till containing sandstone and shale (Millbrook and Woodbourne soils); non-gravelly silt loam to clay loam till (Queens soils); gravelly sandy loam till high in sandstone (Merigomish soils); and very gravelly and/or sandy glaciofluvial deposits (Hebert soils) (**See Table 20**).

Low-lying areas and the presence of fine-textured tills has also led to significant hydric soil development in this ecodistrict.

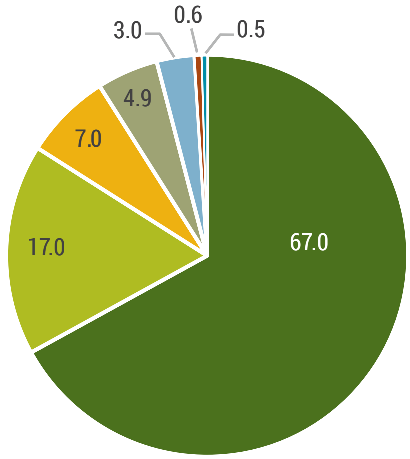
Table 20
Summary information for dominant soils found in the St. George's Bay ecodistrict (520). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Millbrook	28	Glacial Till	Fine-Medium	Imperfect	ST6, ST3-L, ST12	Podzol, Luvisol
Queens	22	Glacial Till	Fine	Imperfect-Poor	ST6, ST12, ST7	Luvisol, Gleysol
Woodbourne	18	Glacial Till	Fine-Medium	Mod. Well	ST2-L, ST5, ST8	Podzol, Luvisol
Merigomish	8	Glacial Till	Medium-Coarse	Well- Imperfect	ST2, ST3, ST8, ST9	Podzol
Hebert	5	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Hydric *	5	Various	Various	Poor-Very Poor	ST14, ST7, ST4	Organic, Gleysol

*** Hydric soils represent all poorly drained organic and mineral soil types.**

Ecodistrict 520
Percentage Land Cover

Forest/Woodland	67.0
Agriculture	17.0
Urban/Industrial	7.0
Shrub/Heathland	4.9
Wetlands	3.0
Sparsely Vegetated	0.6
Water	0.5



Forests

The gently rolling hummocks and hills surrounding St. George's Bay create the conditions for a matrix forest of tolerant hardwood (Tolerant Hardwood Forest Group) on 60% of the landscape. Moderately-well drained fine textured soils on crests, upper and middle slopes support a forest of sugar maple, yellow birch, beech and white ash. Scattered ironwood is typical in the lower canopy or high shrub layer which is usually dominated by regenerating hardwood, balsam fir and striped maple, with less prominent amounts of alternate-leaved dogwood, hobble-bush and beaked hazelnut. Herb coverage is diverse and may include several rich site indicators including white baneberry (*Actaea pachypoda*), Christmas fern (*Polystichum acrostichoides*), oak fern (*Gymnocarpium dryopteris*), lady fern (*Athyrium filix-femina*), shining clubmoss (*Huperzia lucidula*) and northern beech fern (*Phegopteris connectilis*). The bryophyte layer is poorly developed, with moss cover generally restricted to tree trunks, stones and downed woody material.

Other significant forests in the ecodistrict include yellow birch-dominated mixedwoods on middle and lower slopes with lesser amounts of white spruce and balsam fir. Along steep slopes of larger streams and rivers, forests of yellow birch, hemlock and red spruce are possible. Large patches of black spruce occur on moist nutrient poor soils. As soils get wetter, tamarack and red maple forests become more prevalent, and open wetlands are embedded throughout.

Along major rivers such as the South, West, and Pomquet and some larger streams, a typical floodplain forest of sugar maple and white ash occurs with a diverse understory of rich-site plants including ostrich (*fiddlehead*) fern (*Matteuccia struthiopteris*), lady fern (*Athyrium filix-femina*), nodding trillium (Trillium *cernuum*), wood goldenrod (*Solidago flexicaulis*) and Jack-in-the-pulpit (*Arisaema triphyllum*). Dutch elm disease has decimated elm from floodplain ecosystems although a few scattered individuals (usually young trees) may be found. Earlier successional forests include balsam poplar, red maple and white spruce. On wet floodplain soils, tamarack, red maple, willows and speckled alder become more abundant.

Natural stand-level disturbances are rare within the dominant hardwood forest, with wind and insects or disease as the major disturbance agents. They primarily create small gaps and patches in the canopy that allow the recruitment of younger trees into the overstory. Stands will develop uneven-aged features and depending on the frequency of stand-level disturbance events, eventually progress to old growth. Elsewhere moist to wet soils restrict rooting of black spruce forests, making them very susceptible to windthrow. Mature old field white spruce forests are susceptible to spruce bark beetle. Trees usually start to succumb to this insect at age 60 or

Trembling aspen is an early successional tree species that reforests sites after stand level disturbances such as clearcut harvesting and fire. PHOTO: DNR (Peter Neily)

less. Tamarack stands are susceptible to defoliation by the larch sawfly and larch casebearer. The spruce budworm and tussock moth have also been destructive agents in white spruce and balsam fir forests.

Due to extensive land clearing by settlers for agriculture and the subsequent abandonment of a significant portion of this farmland in the mid 1900s, much of the ecodistrict became forested with old field forests of white spruce and tamarack. When these old field forests were harvested, many regenerated with aspen, white birch, red maple, grey birch, pin cherry and balsam fir. Furthermore, a long history of forest harvesting in hardwood and mixedwood forests has also increased the abundance of these earlier successional species. Balsam fir can be a component in second generation old field forests that have slowly deteriorated and created canopy openings that encourage fir regeneration. On the floodplains, arable soils that have been cultivated tend to reforest to early successional species including white spruce and red maple once they are no longer farmed or pastured.

Non Forests

Unforested ecosystems of note include upland shrublands, coastal beaches, and dunes. Along the major river valleys, shrub swamps, shallow marshes, and shallow-water emergent wetlands are well developed. Some of these rivers flow over calcareous Windsor and Lower Mabou bedrock, elevating the pH of riparian wetlands, shrublands, and associated waterbodies.

The ecodistrict also supports most of the karst found on the Northumberland shore of mainland Nova Scotia, including steep crumbling cliffs, sinkholes, pinnacles, caves and vertical shafts, and other karst features. Karst biodiversity and geomorphology is discussed more extensively in the description the **Central Lowlands (630)**.

The most remarkable ecosystem features of St. George's Bay are its beaches and dunes. The easily eroded Carboniferous bedrock of the ecodistrict (sandstones, siltstone, gypsum, and marine dolostone) has contributed to the abundant sediment supply evident along this coastline. The ecodistrict has some of the largest beach-dune complexes in Nova Scotia. Average beach size is fifth largest in the province (not including Sable Island). Similarly, total dune area is fourth highest among ecodistricts, while average and maximum dune size is second highest among ecodistricts (again, not including Sable Island).

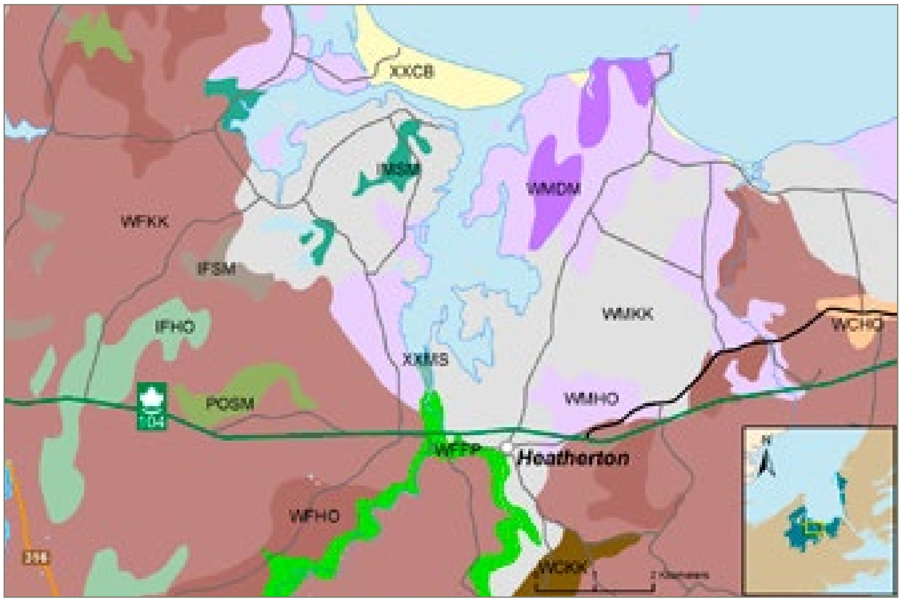
(top) Beach pea, a common seashore plant on the sand beaches of St. George's Bay; *(below)* Ridges of the large prograding dune complex at Pomquet Beach Provincial Park.

Photo: Beach Pea DNR (Sean Basquill); Aerial PHOTO: CNS (Len Wagg)

Ecodistrict 520

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WFKK	41.9%	41.9%
IFHO	10.4%	52.2%
WFHO	9.3%	61.5%
IFKK	8.0%	69.5%
WMHO	5.4%	74.9%
WMKK	5.0%	79.9%
WCHO	4.0%	83.9%
IFFP	3.8%	87.7%
WCKK	3.3%	91.1%
IFSM	2.0%	93.1%
ICHO	1.7%	94.9%
WFFP	1.5%	96.4%
XXWA	0.9%	97.3%
XXCB	0.6%	97.9%
IMHO	0.5%	98.3%
WMDS	0.3%	98.6%
POSM	0.2%	98.9%
WMDM	0.2%	99.1%
XXMS	0.2%	99.3%
WCSM	0.2%	99.5%
WCRD	0.2%	99.7%
IMSM	0.1%	99.8%
WCFP	0.1%	99.9%
PFHO	0.1%	100.0%
IMFP	< 0.1%	100.0%

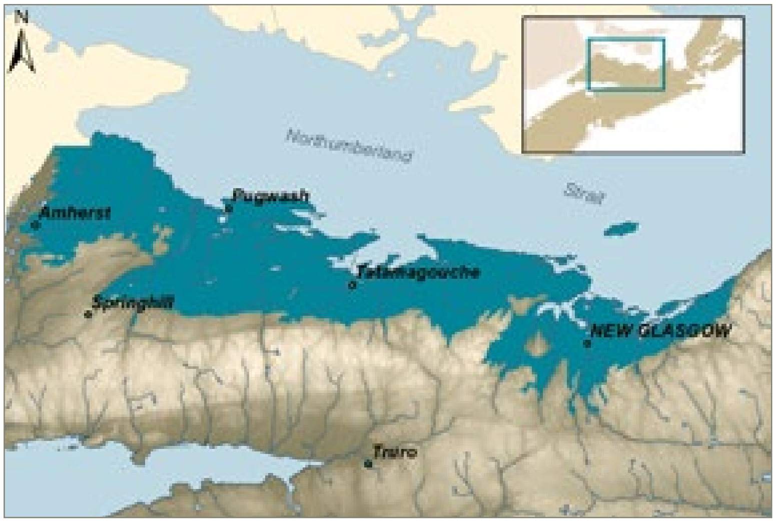


The beach-dune complex at Pomquet Provincial Park is the largest and most strongly expressed "prograding" system in Nova Scotia—meaning its shoreline shifts toward the sea due to the on-going deposit of sediment. This is in contrast to other beach-dune complexes, which tend to be "transgressive"—meaning they move inland over time (depending on wind energy and available sediments).

Pomquet dunes include relatively extensive areas of dune heath, dune meadow, and dune woodland. Interdunal wetlands and ponds—features that are uncommon in dunes elsewhere in Nova Scotia—are also present. Pomquet is the only location in Nova Scotia where broom crowberry (*Corema conradii*) forms dune heath. Similar dune heath vegetation is found on the large barrier islands along Prince Edward Island's northern shore, and on the tombolo dunes of the Magdalen Islands.

Forests, fields and farms intertwine on the gently rolling landscape of the St. George's Bay Lowland. PHOTO: CNS (Len Wagg)

530 Northumberland Lowlands



A broad lowland extends along the Northumberland Strait stretching from the New Brunswick border to eastern Pictou County, covering 2866 km^2 or 34.1% of ecoregion 500. This long linear landscape is characterized by favourable agricultural soils, relatively mild climate, and gentle relief. The ecodistrict has a significant moisture deficit during the growing season, second only to the Annapolis Valley. Soils with gentle slope, shallow to bedrock or compacted till, low clay content and high evapo-transpiration, contribute to these moisture deficits. Elevations on this low plain seldom exceed 50 m above sea level, with higher points of 100 m on Wallace Ridge and Streets Ridge.

The surficial till is derived from Carboniferous sedimentary rocks; the most prominent are the fine red sandstones, siltstones and shales which are conspicuous on the cliffs along the Northumberland shore. Scattered through the ecodistrict are occurrences of gypsum and salt. The most notable karst topography is near Oxford where many of the smaller sinkholes are filled with water. Scattered throughout the ecodistrict are deposits of coal, gypsum and salt. Quarrying of building stone has been an important industry since the 1800s. The famous Wallace Quarries supplied sandstone for some of the most important buildings in Canada, including Province House in Halifax, Confederation Building in Charlottetown, and the Parliament Buildings in Ottawa.

Of all the watersheds in the ecodistrict, only the Nappan River flows westward to the Cumberland Basin. The remaining watersheds drain north to the Northumberland Strait. Freshwater in lakes and rivers comprises only 4485 hectares (1.5%)

Patches of drift ice remain close to shore in late March on the Northumberland Strait near Heather Beach Provincial Park.
PHOTO: CNS (Len Wagg)

Great blue heron are commonly seen in the marshlands and estuaries along the Northumberland Strait.
PHOTO: Len Wagg

of the ecodistrict. The beaches and coastal flats are important feeding areas for shorebirds, particularly in the spring and fall as they migrate to and from their northern breeding areas.

Fresh-moist to moist, medium to poor soils support softwood forests of red spruce, hemlock, white pine and black spruce on the gentle undulating terrain. Fire origin forests of jack pine, red pine and black spruce are common near Oxford, Springhill and Thomson Station. Following disturbance, either by natural causes or forest harvesting, sites are usually invaded by early successional species such as balsam fir, red maple, white birch, grey birch, and both trembling and large-tooth aspen. Eastern white cedar is found scattered throughout the ecodistrict (most notably near Oxford and Pugwash) on poorly and imperfectly drained soils. Abandoned farmland typically reforests to speckled alders and willows, followed by forests of white spruce, tamarack and aspens.

Geology and Soils

The Northumberland Lowlands ecodistrict encompasses an expanse of low-lying ground adjacent to the Northumberland Strait, running from the New Brunswick border to northeast Pictou County. Bedrock is dominated by Carboniferous period sandstone, siltstone, and shales (mainly red in colour). Sandstone beds are particularly common, with long-established quarries in and around the Wallace area having provided stone for some of the most important buildings in Canada. Coal, salt and gypsum deposits are also extensive enough to support local mining operations.

Surficial deposits and soil parent materials are dominated by glacial tills of varying texture that reflect the range in sedimentary rock types found in the area. Dominant soils are derived from non-gravelly silt loam to clay loam till (Queens soils); non-gravelly sandy loam till derived mainly from red and grey sandstone and shale; (Pugwash and Debert soils); and gravelly sandy loam till derived from red and grey sandstone (Hansford soils) (**See Table 21**).

Debert and Pugwash soils often contain fragipan horizons near the surface that restrict vertical drainage and/or potential rooting. Restricted drainage from fragipan horizons and/or compact subsoils, together with gentle relief, has also led to significant hydric soil development in this ecodistrict.

Table 21
Summary information for dominant soils found in the Northumberland Lowlands ecodistrict (530). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG, 1998 *)
Queens	23	Glacial Till	Fine	Imperfect-Poor	ST6, ST12, ST7	Luvisol, Gleysol
Pugwash	20	Glacial Till	Medium-Coarse	Well-Mod. Well	ST2	Podzol
Debert	18	Glacial Till	Medium-Coarse	Imperfect	ST3, ST16	Podzol
Hydric *	16	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST7, ST4	Organic, Gleysol
Hansford	7	Glacial Till	Medium-Coarse	Well-Rapid	ST2, ST1	Podzol

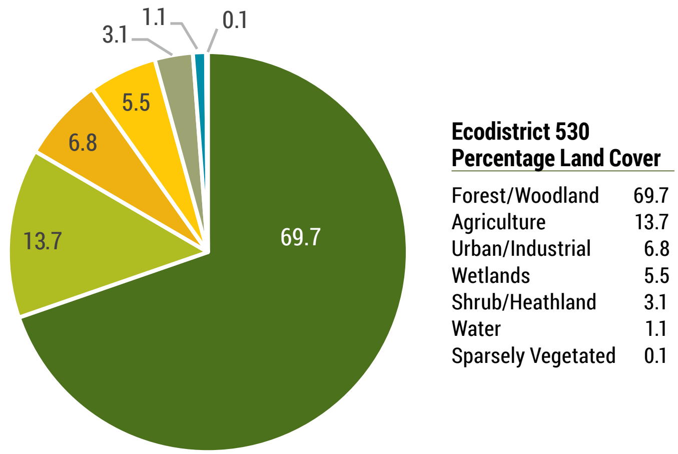
*** Hydric soils represent all poorly drained organic and mineral soil types.**

Forests

The Northumberland Lowlands is dominated by a coniferous forest, with black and red spruce the most common species. The matrix-level forest ecosystem, occurring on almost half the ecodistrict, is black spruce and pine (Spruce Pine Forest Group); an ecosystem often developing after fire. Crown closure can vary within and between different forest types of this group.

Black spruce, white pine, red pine and jack pine are the main overstory species, with scattered red oak. Soil conditions range from dry to moist but all have low nutrient status reflected by the presence of plants tolerant of acidic (nutrient poor) soils. These plants include members of the ericaceous (heath) family such as rhodora, lambkill, blueberry species, teaberry (*Gaultheria procumbens*), and mayflower (*Epigaea repens*). Pink lady's slipper (*Cypripedium acaule*), bunchberry (*Cornus canadensis*) and bracken (*Pteridium aquilinum*) are also typical.

Bryophyte/lichen coverage is usually moderate to extensive and includes Schreber's moss (*Pleurozium schreberi*) and broom moss (*Dicranum scoparium*).



Reindeer lichens (*Cladonia spp.*) can be abundant on drier sites and peat moss (*Sphagnum spp.*) on moister sites. With progressively poorer drainage, black spruce, tamarack and red maple become the dominant forest vegetation, with treed wetlands embedded throughout the ecodistrict.

Red spruce, often with a component of white spruce and occasionally hemlock, occupy the higher, better drained ground of the hummocky terrain and can be a large patch-level forest. On sites with marginal soil fertility, spruce often have a hybridized appearance with traits of both black and red spruce expressed. Hemlock is often found with these hybridized spruces.

Hemlock forests are also common on the steep ravine-like slopes of several major rivers including River John and Wallace River. Well drained upper slopes and hilltops support shade tolerant hardwoods (and mixedwoods) but these stands are rare. Eastern white cedar is found at only a few sites, most notably near Oxford and Pugwash on seepage and imperfectly to poorly drained soils along watercourses. Old growth forests are rare, and if found, are usually associated with steep slopes along rivers.

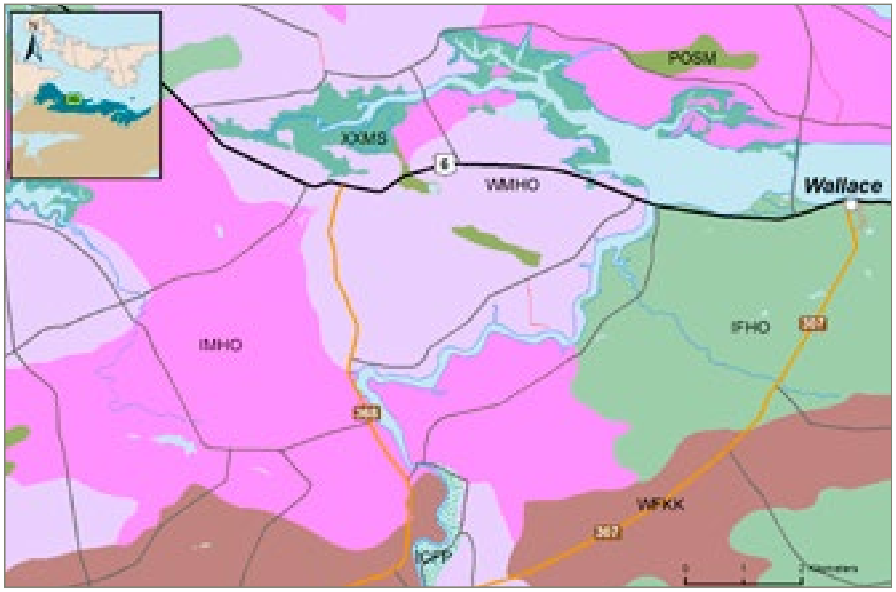
With an abundance of rivers and large streams floodplain forest are very common in the Northumberland Lowlands. A typical mature floodplain forest includes sugar maple and white ash with a diverse understory of rich-site plants including ostrich (fiddlehead) fern (*Matteuccia struthiopteris*),

Beaver ponds significantly contribute to ecosystem richness and biodiversity. This photo shows a history of beaver dams (three old dams are visible). Beavers are abundant in the Northumberland Lowlands. *PHOTO: CNS (Len Wagg)*

Ecodistrict 530

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	35.5%	35.5%
WMHO	16.2%	51.7%
IFHO	13.1%	64.7%
WFKK	6.0%	70.7%
WMKK	4.4%	75.1%
IFRD	3.9%	79.0%
IMRD	3.8%	82.9%
ICHO	2.7%	85.6%
WCHO	2.4%	87.9%
WCKK	1.7%	89.6%
XXWA	1.5%	91.1%
WFRD	0.9%	92.0%
IFKK	0.8%	92.9%
IFSM	0.8%	93.6%
IMSM	0.8%	94.4%
IFDM	0.7%	95.1%
ICFP	0.7%	95.9%
POSM	0.6%	96.5%
XXMS	0.6%	97.1%
WFHO	0.6%	97.6%
IMDM	0.5%	98.1%
WCSM	0.5%	98.6%
WMRD	0.4%	99.0%
IMFP	0.3%	99.3%
WCFP	0.2%	99.5%
ICSM	0.2%	99.8%
IFFP	0.1%	99.9%
XXCB	0.1%	100.0%
WCDS	< 0.1%	100.0%



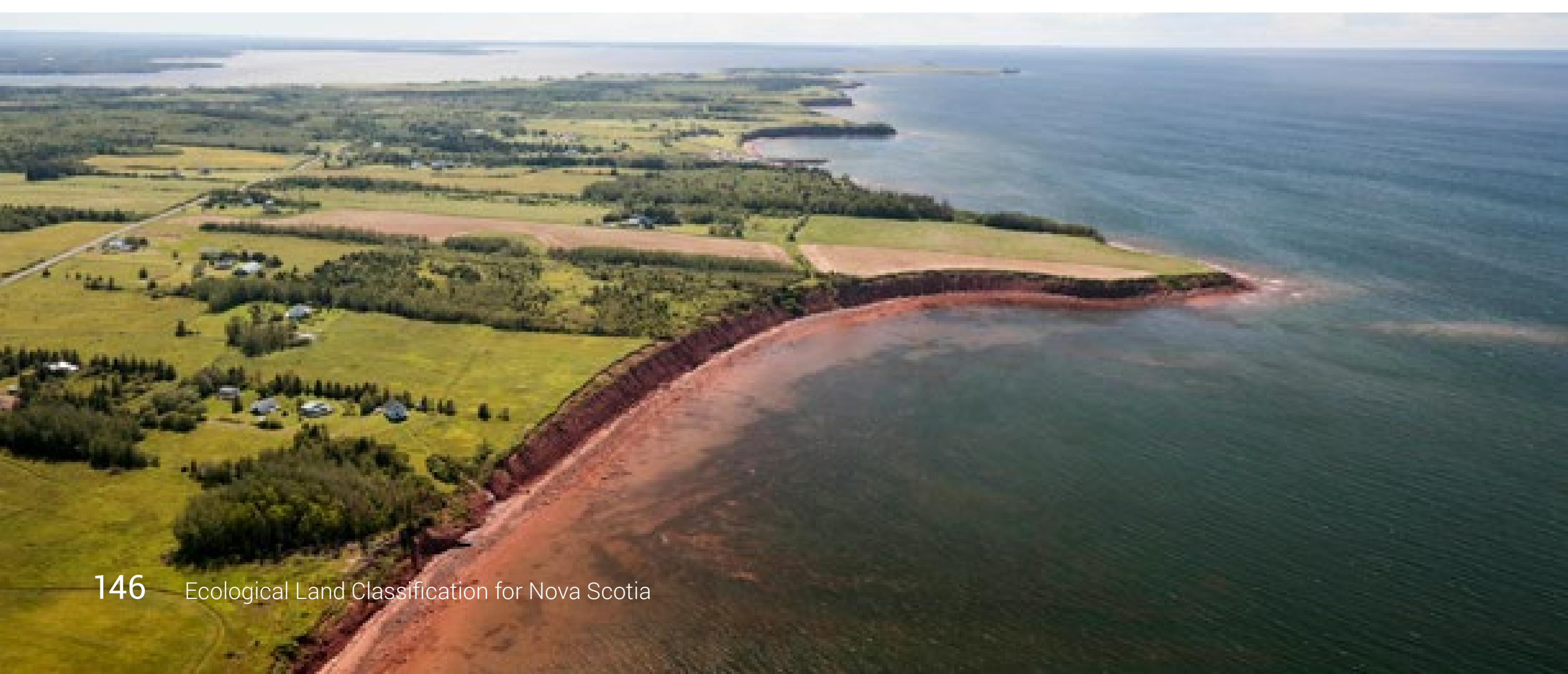
bloodroot (*Sanguinaria Canadensis*), lady fern (*Athyrium filix-femina*), nodding trillium (*Trillium cernuum*), wood goldenrod (*Solidago flexicaulis*) and Jack-in-the-pulpit (*Arisaema triphyllum*). Dutch elm disease has decimated elm from this ecosystem although a few scattered individuals (usually young trees) can be found. Earlier successional forests include red maple, black cherry, and white spruce. As the soils get progressively wetter, tamarack, red maple, willows and speckled alder become more abundant. Many of the sites disturbed by farming and later abandoned have introduced species such as hawthorn and wild apple.

Frequent stand-level disturbances caused by fire and windthrow, when combined with low site fertility and moist soils, create the conditions for predominantly even-aged forests of black spruce and pine. In most cases these disturbed forests regenerate to similar species.

Soil moisture deficits and the flammable nature of the ericaceous shrubs and spruce-pine litter enhance the possibility of fire. The occurrence of "fire species" such as jack pine and red pine does not occur consistently throughout the ecodistrict on similar soils. Jack pine forests are localized near Oxford along the railroad where their abundance may have been enhanced by wildfires

Red sandstone and shale cliffs at Cape John

PHOTO: CNS (Len Wagg)



Wallace Bay National Wildlife Area. This large complex of terrestrial and marine ecosystems provides important habitat for migrant and nesting waterfowl. PHOTO: CNS (Len Wagg)

started from train locomotives in the late 1800s. Red pine forests are less common, but the species can be found as individuals throughout the ecodistrict.

Early successional forests of trembling aspen, large-tooth aspen, red maple, white birch, pin cherry and grey birch often occur after red spruce forests and old field forests of white spruce are harvested. Beaver-flooded forests are common throughout this lowland ecodistrict due to its many small streams and wetlands.

Due to the extensive clearing of land by settlers for agriculture and the subsequent abandonment of much of this farmland in the mid-1900s, a significant portion of the ecodistrict became forested with old field forests of white spruce, tamarack, aspen and alders. When these old field forests are harvested, many regenerated with early successional species like trembling and large-tooth aspen, white birch, red maple, grey birch, pin cherry and balsam fir. Furthermore, a long history of forest harvesting has also increased the abundance of these earlier successional species.

Non Forests

Similar to **St. George's Bay (520)**, this ecodistrict's easily-eroded Carboniferous bedrock (sandstone, siltstone, shale, conglomerate, coal) has contributed to the abundant sediment that forms the beaches and dunes along this part of the Northumberland Coast.

Over 20% of all the dunes in Nova Scotia (excluding Sable Island) are found in this ecodistrict, including some of largest dune complexes found province-wide. These larger dunes often have multiple ridges and frequently occur on barriers attached to islands at one end.

Dune vegetation is not especially remarkable, although some dunes include provincially uncommon lichen communities. At Merigomish, the only known provincial occurrence of the wooly hudsonia (*Hudsonia tomentosa*) dune community is found. (Wooly hudsonia is widespread in New Brunswick and Prince Edward Island but is not well expressed in Nova Scotia.)

The Northumberland Lowlands is dissected by numerous rivers flowing to the Gulf of Saint Lawrence. Most of them form estuaries with extensive eel grass beds and submerged marine flats. The area of submerged estuarine flats is second highest of any ecodistrict in the province.

The Northumberland Lowlands rivers are also among the most nutrient-rich in Nova Scotia. Several of them flow over moderately calcareous bedrock in their upper reaches, picking up dissolved minerals and cations important for plant growth. The result is that these rivers support a number of rare riparian plant species promoted by less acidic water and richer water-deposited soils. Elevated nutrient availability is expressed in the vegetation communities of riparian shrub swamps, forests and marshes.

Non-forested vegetation is relatively abundant in the Northumberland Lowlands. Most of it is open wetland and tall shrublands. Wetlands are dominated by shrub swamp and salt marsh. Brackish marshes and muddy shorelines in the River Philip estuary include disjunct occurrences of Eastern lilaeopsis (*Lilaeopsis chinensis*), an at-risk Atlantic Coastal Plain plant species.

540
Cumberland Hills

A narrow band of rounded hills flows along the north facing slopes of the **Cobequid Hills (340)** and extends westward stopping short of Cape Chignecto. The ecodistrict bulges northerly at Springhill towards Amherst and Leicester Ridge. Elevations seldom exceed 150 m above sea level, although there are some higher points (over 180 m) near Springhill and Fenwick. The ecodistrict is 910 km^2 or about 10.8% of the ecoregion. It separates the **Cobequid Hills (340)** from the lowlands of the **Northumberland (530)** and **Chignecto Ridges (560)** ecodistricts. The bedrock geology is generally late Carboniferous strata, which are predominantly sandstones, shales, conglomerates and coal. The Springhill coalfield was one of the province's most important past coal mining districts.

Leicester Ridge divides two watersheds: Little River flows east to the River Philip and the Northumberland Strait, while Little Forks River drains westward to the Maccan River and the Bay of Fundy. Most freshwater occurs in wetlands, streams and rivers, with only a few scattered lakes (the largest being Newville, Welton and Shulie). In total, freshwater accounts for only 0.4% of the ecodistrict, with most lakes being small and shallow.

Fresh to fresh-moist, medium to rich soils support large intact Acadian forests of shade tolerant hardwoods and softwoods. Typically upper slopes are favoured by sugar maple and yellow birch, with red spruce occupying slightly moisture soils where the terrain is level to hummocky or lower slope. Wind exposure, snow accumulation, and ice breakage are sometimes limiting factors to height growth in both softwood and hardwood forests on upper elevations.

Red spruce forests and blueberry fields dominate the Cumberland Hills landscape at Smith's Pond, Rodney.
PHOTO: CNS (Len Wagg)

Fly agaric (also known as Fly amanita), with its telltale small, white to yellow pyramid-shaped warts, is a commonly found forest mushroom. PHOTO: DNR (Jane Kent)

Where forests were cleared for farmland in the early 1800s and later abandoned in the early 1900s, fields reforested naturally to stands of white spruce. Much of this old field forest has since been harvested and converted to wild blueberry production. The largest producer of frozen blueberries in the world is located in the ecodistrict.

Geology and Soils

The Cumberland Hills ecodistrict flanks the northern edge of the Cobequid Mountains and is underlain by Carboniferous period sedimentary rock including sandstone, siltstone, shale, conglomerate and coal. The Springhill coalfield, historically one of the Province's most important coal mining districts, is also part of this formation. This area still contains significant deposits of deep coal, as well as smaller blocks of high quality coal accessible by surface mining.

Surficial deposits are comprised of medium to coarse textured glacial till of varying thickness and lithology (physical characteristics related to bedrock age and origin). Dominant soils are derived from gravelly sandy loam to loam till high in conglomerate (Westbrook soils); gravelly sandy loam till high in grey sandstone and conglomerate (Rodney soils); gravelly sandy loam till high in grey sandstone (Shulie/Springhill soils); and non-gravelly sandy loam till derived mainly from red and grey sandstone and shale (Pugwash soils) (**See Table 22**).

Shulie soils are sometimes shallow to bedrock, while Pugwash soils often contain fragipan horizons that restrict vertical drainage and potential rooting depth. The presence of fragipan horizons, near-surface bedrock and/or compact subsoils have also led to significant hydric soil development in this ecodistrict.

Forests

A late successional tolerant mixedwood (Mixedwood Forest Group) Acadian forest covers over half of this ecodistrict. This matrix-level forest has an overstory co-dominated by red spruce and yellow birch, with lesser amounts of mostly shade-tolerant trees (e.g. sugar maple, hemlock, beech, white ash, balsam fir). It commonly occurs on gravelly, well drained medium to coarse textured soils of medium to rich fertility on middle slopes.

The shrub layer is moderately developed and includes striped maple and fly-honeysuckle and the advanced regeneration of overstory tree species.

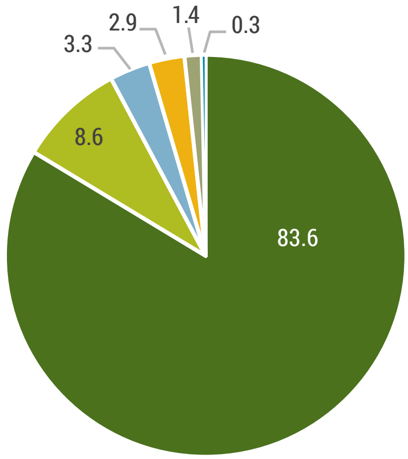
Table 22
Summary information for dominant soils found in the Cumberland Hills ecodistrict (540). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Westbrook	32	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST2-L, ST8, ST3, ST3-L, ST9	Podzol
Rodney	24	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3	Podzol
Shulie / Springhill *	15	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST15, ST16	Podzol
Hydric	9	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Pugwash	6	Glacial Till	Medium-Coarse	Well-Moderately Well	ST2	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 540 Percentage Land Cover

Forest/Woodland	83.6
Agriculture	8.6
Wetlands	3.3
Urban/Industrial	2.9
Shrub/Heathland	1.4
Water	0.3



Several fern species and club-mosses are common in the well-developed herb layer, including evergreen wood fern (*Dryopteris intermedia*), New York fern (*Thelypteris noveboracensis*) and hay-scented fern (*Dennstaedtia punctilobula*). Typical mixedwood flora present includes Indian cucumber root (*Medeola virginiana*), wood-sorrel (*Oxalis montana*), rose twisted stalk (*Streptopus roseus*), partridgeberry (*Mitchella repens*), and wood aster (*Oclemena acuminata*). Herb layer species can also indicate relative site conditions, with hay-scented fern (*Dennstaedtia punctilobula*) found on drier, poorer sites, and Christmas fern (*Polystichum acrostichoides*), northern beech fern (*Phegopteris connectilis*) and shining club-moss (*Huperzia lucidula*) found on moister, richer sites. Bryophyte development varies, with coverage directly related to relative softwood abundance in the overstory—with Schreber's moss (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) the most common, and bazzania (*Bazzania trilobata*) when coarse woody debris has accumulated on the forest floor.

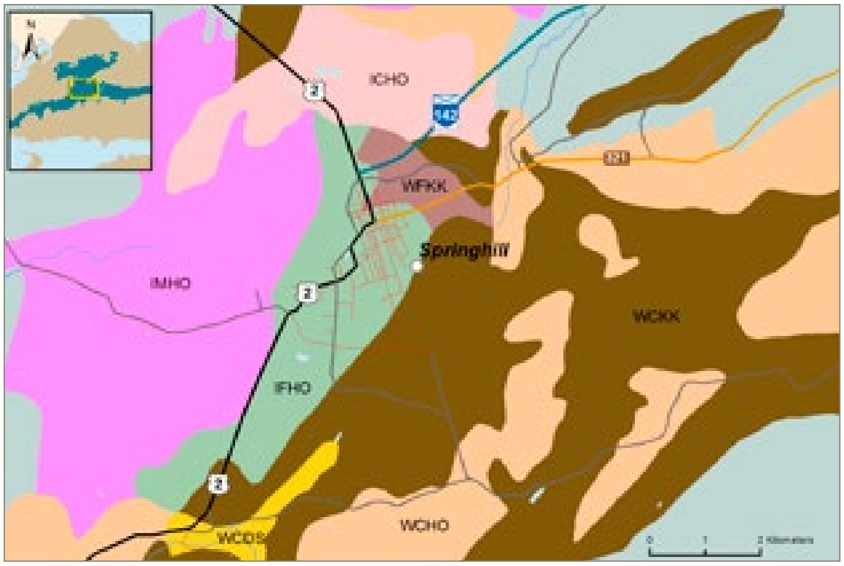
Sugar maple, yellow birch and beech occupy upper slopes giving way to red spruce on moderately-well to imperfectly drained soils on level to hummocky terrain at upper elevations. Often there are seepage sites along slopes where soils are wetter and richer. The occurrence of plants and trees such as Northern beech fern (*Phegopteris connectilis*), lady fern (*Athryium felix-femina*), white ash and ironwood indicate this enriched condition. Hemlock occurs on steeper slopes of ravines as well as on lower slopes, as these locations are cooler and have higher moisture and nutrient content.

In mixedwood forests earlier successional species following stand-level disturbances include red maple, aspens, white and grey birch and balsam fir. Often a remnant population of red spruce is left following both harvesting and natural disturbances.

Due to the longevity of the dominant species and infrequent cycle of stand-level disturbances, uneven-aged forests and old growth features can develop. The growth potential of hardwood forests can be significantly limited by exposure to winds, snow accumulation and ice storms, with breakage reducing height and stem quality on hilltops and upper slopes. Evidence of blowdown and uprooting

Mature stands of red spruce usually have a significant understory of advanced regeneration. *PHOTO: DNR (Peter Neily)*

Ecodistrict 540



Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCKK	39.3%	39.3%
WCHO	20.2%	59.5%
WMKK	11.5%	71.0%
ICHO	11.0%	82.0%
IMHO	7.0%	89.0%
IMSM	2.1%	91.2%
WMHO	1.9%	93.1%
IFHO	1.7%	94.8%
IMFP	1.6%	96.4%
WCDS	1.1%	97.5%
WFHO	0.6%	98.0%
IFSM	0.5%	98.5%
XXWA	0.4%	98.9%
WFKK	0.4%	99.2%
POSM	0.3%	99.5%
ICFP	0.3%	99.8%
ICSM	0.1%	100.0%
WCSM	< 0.1%	100.0%

is evident in much of the forest by the abundance of pit and mound relief. The upper elevation spruce forests are more frequently subjected to stand-level disturbances caused by windthrow and insects. Beech bark canker, birch dieback, sugar maple borer, chaga (birch cinder conch) have all been significant disturbance agents in the tolerant hardwood forest. Wounds caused by ice storm breakage also provide avenues for a variety of fungi to enter and further weaken or kill trees.

Larger patch-level forests in the ecodistrict include a fire origin forest of black spruce, jack pine and red pine near Chase Lake. This Spruce Pine forest occurs on coarse, dry, nutrient poor soils under hummocky terrain typically with a significant understory of woody ericaceous shrubs, bracken (*Pteridium aquilinum*) and reindeer lichens (*Cladonia spp.*).

The lower elevation Cumberland Hills near West Brook (foreground), with the higher Cobequid Hills (340) in the distance.

Sugar maple stands in the Cumberland Hills are often used for maple syrup production like this one near Fenwick. *PHOTO: CNS (Len Wagg)*

Another patch-level forest is associated with the floodplains of larger rivers and streams including the Halfway, Philip and Hebert Rivers. Here a climax forest of sugar maple, white ash and elm grows on well to moderately-well drained alluvial soils. Earlier successional species such as black cherry, white spruce, aspen and red maple are common. Also common throughout the ecodistrict are wet forest complexes of black spruce, tamarack and red maple, with woody shrubs (such as speckled alder, false holly, willow and winterberry) on poorly drained glacial tills and peat. These site conditions are usually associated with the upper headwaters of rivers, e.g. Black River.

After the richer alluvial soils of floodplains, the next best soils to be claimed for farming by early settlers were under tolerant hardwood and mixedwood forests. When this farmland was abandoned, white spruce quickly reforested the fields. These old field forests were later harvested, and the residual blueberry component of the understory was enhanced through cultivation practices such as burning. Some of the oldest cultivated wild blueberry fields in the province occur in the Cumberland Hills at communities such as Wyndham Hill and Rodney.

Non Forests

The ecodistrict is heavily forested with less than 4% of total area occupied by unforested wetlands and uplands. Lakes, ponds, and rivers cover less than 1% of the landscape.

Consistent with most ecodistricts in this region, the non-forested ecosystems of the Cumberland Hills are mostly wetlands and taller shrublands. Shrub swamps, open peatlands, and to a lesser extent shallow marshes are typical wetland types.

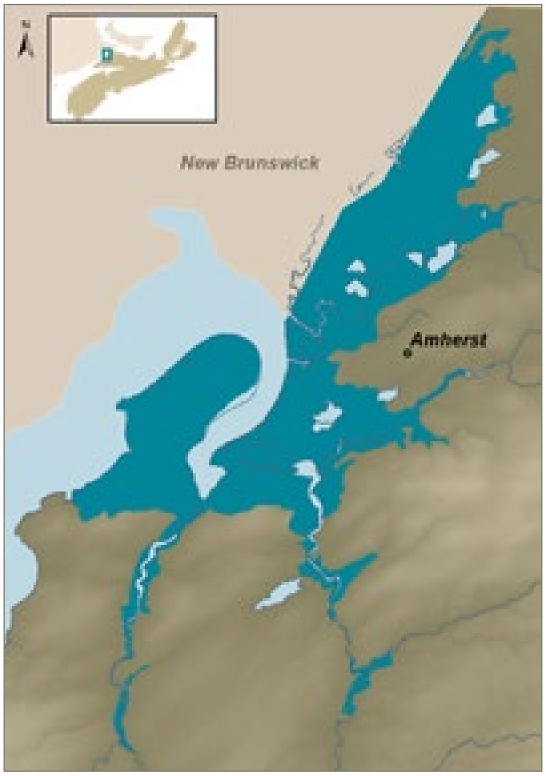
These habitats may be occupied by the endangered mainland moose (*Alces americana*). Moose in the northern part of the mainland are concentrated in nearby ecodistricts (**340** and **910**) but are also relatively common in ecodistricts **540** and **560**. Wood turtles (*Glyptemys insculpta*) are also present along some of the rivers, as are rare freshwater mussels such as the triangle floater (*Alasmidonta undulata*), tidewater mucket (*Leptodea ochracea*), eastern lampmussel (*Lampsilis radiata*), and the brook floater (*Alasmidonta varicosa*).

550
Cumberland Marshes

One of the smallest and most distinctive eco-districts in the province, Cumberland Marshes provides a natural boundary between Nova Scotia and New Brunswick at the Isthmus of Chignecto. The marshes are part of a larger wetland complex shared with New Brunswick (where it is called the Tantramar Marshes).

The level terrain—much of it underlain by tidal sediments deposited from the Bay of Fundy—supported development of very extensive salt marshes of cordgrass (*Spartina spp.*). The early 17th century Acadian settlers constructed dykes to keep out the saltwater to allow farming of these fertile lands. On-going dyke construction and maintenance has continued to reduce the area of natural salt marshes.

The ecodistrict receives strong winds and experiences cooler temperatures than elsewhere in the ecoregion due to its location at the end of the Bay of Fundy (Chignecto Bay). Freshwater lakes and rivers (1516 ha) makes up 8% of the ecodistrict. The Missaguash and La Planche Rivers drain the marshes into Cumberland Basin. Total area of the Cumberland Marshes is 190 km^2 or about 2.3% of the ecoregion.



Wet and poorly drained soils occurs on 53% of the ecodistrict. This total includes re-claimed marshlands and grasslands (34%), natural salt marshes (6%), and wetlands (13%) , most of which

Forested islands amidst open peatland on the Missaquash Bog, near Goose Lake. *PHOTO: CNS (Len Wagg)* are treeless peatlands. Organic deposits on these peatlands are about 1 m thick and have formed in low lying depressions. Elsewhere mineral soils are predominantly imperfectly to poorly drained and include silty clay loams reclaimed from the salt marshes and sandy loam glacial tills.

The highest point of relief in the ecodistrict is the Fort Lawrence Ridge which supports a shade tolerant mixedwood forest. Forested sites adjacent to the dykelands, marshes and wetlands are forested with black, red or hybrid spruce, red maple, and tamarack.

Cumberland Marshes is one of the most important areas in the province for migratory waterfowl due to the valuable habitat offered by the abundant marshlands, coastal tidal flats and freshwater lakes. Enhancement of this habitat has been ongoing through the work of agencies such as Ducks Unlimited and the Canadian Wildlife Service.

Geology and Soils

The Cumberland Marshes ecodistrict is underlain by Carboniferous period sedimentary rock including sandstone, siltstone, shale, conglomerate and mudstone. However, it is the reclaimed marshland associated with the tidal flats around Chignecto Bay that most strongly characterizes this ecodistrict. Historically, most of this area was salt marsh, but from the early to mid-1700s Acadian settlers built dykes to “reclaim” the lands for agricultural use. The dyking system kept saltwater out at high tide, but allowed freshwater to drain at low tide. Eventually, enough residual salts were leached out of the soil to provide valuable agricultural land. This reclaimed soil has been appropriately classed as the Acadia soil series.

In addition to marine alluvium and wetlands, surficial geology in the Cumberland Marshes is comprised of medium to coarse textured glacial till high in sandstone. Dominant soils are derived from non-gravelly, fine to very fine textured marine alluvium (Acadia soils); non-gravelly sandy loam till derived mainly from red and grey sandstone and shale (Pugwash and Debert soils); and non-gravelly sandy loam till high in micaceous red sandstone (Tormentine soils) (**See Table 23**).

Low elevation, gentle relief, and the presence of compact or massive subsoils have also led to significant hydric soil development in this ecodistrict, including large areas of organic wetland.

Forests

Softwood forests in the Cumberland Marshes occur as small to large patch-level forests surrounded by the predominant open conditions of the marshes and grasslands, dykeland and treeless wetlands. These forests tend to occur on gently undulating to hummocky terrain underlain with compact subsoils that resist penetration of water and tree roots. During summer, the surface layers of these soils commonly dry out for considerable periods.

Red spruce, black spruce, balsam fir and the hybrid spruce (red and black cross) are dominant with an extensive understory of ericaceous shrubs. On the flatter terrain between hummocks the soils are poorly drained and support a forest of black spruce, red maple, and tamarack with

Table 23
Summary information for dominant soils found in the Cumberland Marshes ecodistrict (550). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG, 1998 *)
Acadia	39	Marine, Alluvium, Organic	Fine	Imperfect-Poor	ST12, ST13	Regosol
Hydric *	31	Various	Various	Poor-Very Poor	ST14, ST7, ST4	Organic, Gleysol
Debert	13	Glacial Till	Medium-Coarse	Imperfect	ST3, ST16	Podzol
Pugwash	7	Glacial Till	Medium-Coarse	Well-Mod. Well	ST2	Podzol
Tormentine	6	Glacial Till	Medium-Coarse	Well	ST2	Podzol

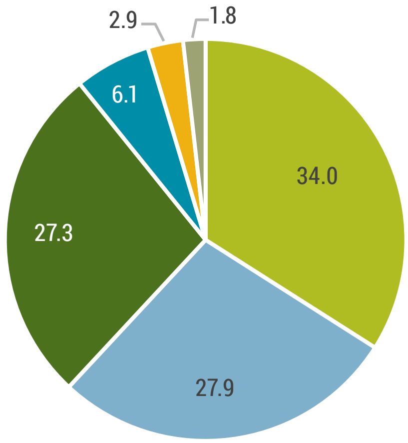
*** Hydric soils represent all poorly drained organic and mineral soil types (excluding Acadia).**

woody understory shrubs such as false holly, winterberry and speckled alder. Black ash has been found on these wetter soils. Following frequent stand-level natural disturbances (such as fire, windstorm or insect defoliation) early successional forests may include shade intolerant hardwoods such as red maple, white birch, grey birch and aspen, with a component of balsam fir.

The Fort Lawrence Ridge, an area of undulating to gentle rolling topography is underlain by well and imperfectly drained fine to medium textured sandy loams. These productive soils have been extensively used for agriculture. The forests tend to be comprised of both shade-tolerant hardwood and softwood species such as red spruce and balsam fir. With progressively poorer drainage on the lower slopes and flat terrain, black spruce becomes more prevalent.

Early and mid-successional forests are typically composed of red maple, white birch, aspen and balsam fir. Even with the increased exposure to winds (due to the ecodistrict's location at the end of the Bay of Fundy) stand-level disturbances are infrequent in this ecodistrict, and gap disturbances create uneven-aged stand structures in mature forests.

Due to the shallow rooting of trees on the moist to wet soils found here, forest stands are frequently disturbed by windthrow. Therefore, the potential for old growth forest development is low.



Ecodistrict 550 Percentage Land Cover

Agriculture	34.0
Wetlands	27.9
Forest/Woodland	27.3
Water	6.1
Urban/Industrial	2.9
Shrub/Heathland	1.8

Non Forests

The rivers of the Cumberland Marshes have played an important role in soil and vegetation development in the ecodistrict. Acadia soils, which characterize the dyked land prominent in the Cumberland Marshes, were deposited by seawater flowing upstream twice a day during high tide.

The extreme tidal amplitude of the Bay of Fundy reverses the flow of water in these rivers and floods their banks with seawater suspended with silt and clay. The result is a massive plain of poorly drained mineral soil, interspersed with tidal creeks, agricultural ditches, and a massive system of dykes. The dykes were first built by Acadians in the 1600s and 1700s. Today the dykes are considerably higher and bigger, maintained by modern machinery and engineering.

Dykes along the River Hebert have been used since the early 1700s to reclaim salt marsh for agriculture. *PHOTO: CNS (Len Wagg)*

Wind turbines on the Cumberland Marshes along the Trans-Canada Highway north of Amherst, take advantage of the near constant winds that channel through this lowland area from the Cumberland Basin and Bay of Fundy. PHOTO: CNS (Len Wagg)

Compared to the area of dyked marsh, little natural salt marsh is left on the Cumberland Marshes. A ribbon is still found on the seaward side of the dykes, and in the John Lusby Marsh, a National Wildlife Area managed by Environment Canada.

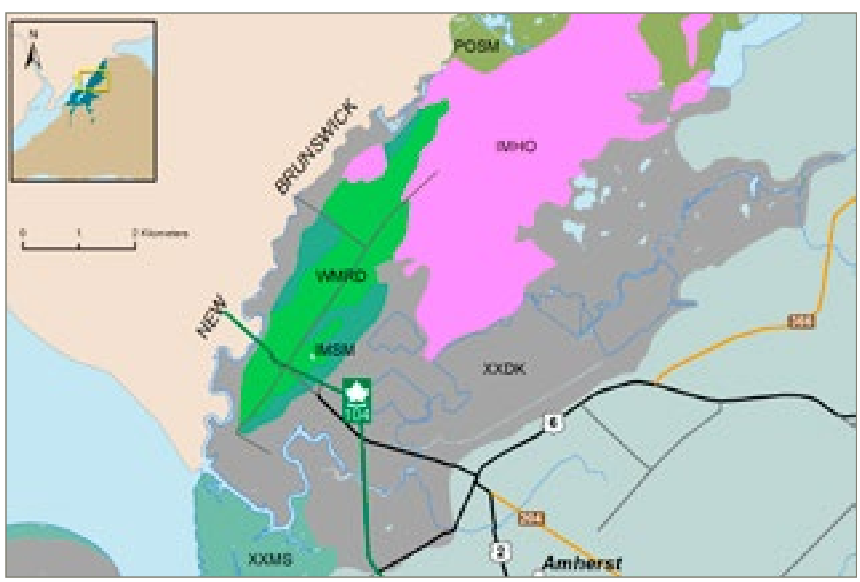
Most of the dyked land is characterized by a mix of brackish marsh and pasture species. Along some of the muddy river banks, salt marsh and shoreline, are species such as glassworts (*Salicornia spp.*), seaside plantain (*Plantago maritima*), and sea lavender (*Limonium carolinianum*). The most comprehensive description of salt and dyked marshes in the border regions is W.F. Ganong's treatise from 1903. Today salt marsh communities on the Cumberland Marsh are largely the same as Ganong's descriptions.

The Cumberland Marshes ecodistrict also features open peatland and shrub swamps. Mean and maximum peatland size across the ecodistrict is one of the highest reported for the province. Similarly, total relative area of peatlands (as a percentage of all wetlands) is remarkably high, ranking fifth highest among ecodistricts. Some of the peatlands support rare and or otherwise interesting plant species such as skunk cabbage (*Symplocarpus foetidus*), russet cottongrass (*Eriophorum russeolum*), and creeping sedge (*Carex chordorrhiza*).

Ecodistrict 550

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
XXDK	39.7%	39.7%
IMHO	26.0%	65.6%
POSM	10.9%	76.5%
XXWA	8.0%	84.5%
XXMS	6.0%	90.5%
IMSM	4.5%	95.0%
WMRD	2.9%	97.9%
WMHO	2.0%	100.0%
IFSM	< 0.1%	100.0%



560
Chignecto Ridges

Occupying most of northern Cumberland County, this ecodistrict is a plain tilting towards Chignecto Bay, with elevations that seldom exceed 120 m above sea level. The Bay of Fundy marks its western boundary, and although there is a moderate coastal influence on forest composition and growth, this effect does not extend very far inland.

Geological folding of the underlying strata into concentric ridges (made of grey sandstones, siltstones and shale) can be found throughout the ecodistrict. An interesting glacial landform on the west side of the River Hebert is the Boar's Back esker, a 20 km, long, narrow and meandering ridge of sand and gravel (3–6 m high) created by deposits from meltwater flowing beneath a glacier. Travellers drive a road constructed on this esker as they pass through the Chignecto Game Sanctuary. Small freshwater lakes and rivers make up 0.8% of the ecodistrict. Chignecto Ridges covers 745 km^2 or about 8.9% of the ecoregion.

Softwood forests of red and black spruce on hummocky terrain create the matrix forest condition in the ecodistrict. Patch forests of shade tolerant hardwood occur on richer, well drained upper slopes and crests. Elsewhere large patch forests of jack pine, black spruce, red maple and white birch occupy nutrient poor soils on ridged topography. Here glacial activity has resulted in thin soils and exposed bedrock. Repeated wildfires have further impoverished the soils.

Chignecto Ridges contains almost all of the Chignecto Game Sanctuary. This large sanctuary was established in 1937, partly to protect moose. Mainland moose are listed as endangered under the Nova Scotia Endangered Species Act and have been reported in low numbers throughout the area. Most of the game sanctuary became part of the Kelley River Wilderness Area in 2012.

Forests and wetlands reflect the curvilinear ridging of the underlying bedrock south of Joggins in the Chignecto Game Sanctuary. *PHOTO: CNS (Len Wagg)*

Underlying this ecodistrict are coal-bearing Carboniferous strata, with coal seams at Joggins, Springhill, River Hebert and Maccan. The strata include coarse and fine grained sandstones, which are exposed at the surface in some locations (Chignecto Game Sanctuary) and overlain by sandy tills to the east of the River Hebert. For the most part this ecodistrict is characterized by shallow, imperfectly drained soils derived from sandstones. In many of the soil landscapes, drainage is influenced by the haphazard arrangement of the bedrock which creates a pattern of imperfectly and poorly drained soils.

The Joggins Fossil Cliffs, located along the Chignecto Bay at Joggins, is a UNESCO (United Nations Educational, Scientific and Cultural Organization) World Heritage Site known for its world-class fossils. (Calder, 2012)

Geology and Soils

The Chignecto Ridges ecodistrict is underlain by Carboniferous period sedimentary rock including sandstone, siltstone, shale, conglomerate, mudstone and coal. The ecodistrict gets its name from the conspicuous ridging of near-surface folded bedrock—mainly hard sandstone. This ridging is clearly visible on aerial photos and satellite images. The ecodistrict is also home to the world famous Joggins Fossil Cliffs adjacent to Chignecto Bay. Many fine examples of "Coal Age" fossils have been discovered within these sedimentary cliffs as they are continually exposed by tidal action.

Surficial deposits are comprised of medium to coarse textured glacial till of varying thickness and lithology. Dominant soils are derived from gravelly sandy loam till high in grey sandstone (Shulie/Springhill soils); gravelly sandy loam till high in grey sandstone and conglomerate (Rodney soils); and non-gravelly sandy loam till derived mainly from red and grey sandstone and shale (Debert soils) (**See Table 24**).

Shulie soils are also associated with ridged areas and are therefore often shallow to bedrock. The presence of near-surface bedrock and/or compact subsoils has also led to significant hydric soil development in this ecodistrict, especially in low lying areas between ridges.

Forests

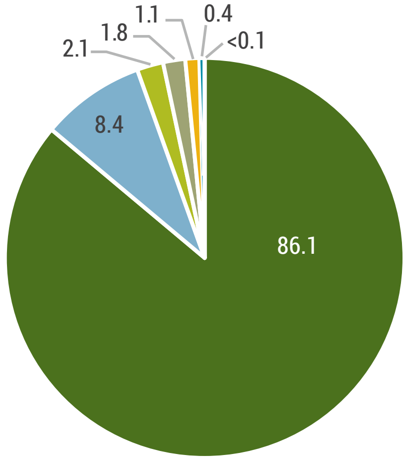
A mixed softwood forest of red spruce and black spruce reflects fresh-moist to moist nutrient poor soils on 72% of the ecodistrict. Hybridization of red and black spruce is common and creates difficulty in distinguishing these two species. Regenerating balsam fir and red spruce are prominent in the understory along with ericaceous shrubs. Overall herb coverage and diversity is low, with bracken (*Pteridium aquilinum*) prevalent. The forest floor is typically moss, with Schreber's moss (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) common, and peat mosses (*Sphagnum spp.*) indicative of moist sites. Late successional Acadian softwood forests with red spruce and hemlock are scattered throughout on zonal sites. Level terrain between hummocks is usually imperfectly drained and supports a forest of black spruce and white pine. Following stand-level disturbances such as fire, hurricane, insect defoliation and harvesting, early successional forests may include shade intolerant hardwoods such as red maple, white birch, grey birch and aspen.

Table 24
Summary information for dominant soils found in the Chignecto Ridges ecodistrict (560). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Shulie *	44	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST15	Podzol
Hydric	22	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Rodney	15	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3	Podzol
Springhill *	10	Glacial Till	Medium-Coarse	Imperfect	ST3, ST16	Podzol
Debert	5	Glacial Till	Medium-Coarse	Imperfect	ST3, ST16	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

On medium to coarse, fresh to moist, nutrient poor soils, and where soils are often shallow to bedrock, jack pine, red pine and white pine are common, along with black spruce and a thick understory of ericaceous shrubs. The shrub layer is usually densely occupied by black spruce regeneration (usually from vegetative layering) and ericaceous species such as lambkill, lowbush blueberry and rhodora (presence of rhodora is particularly indicative of low site fertility). Herb layer diversity is low and dominated by bracken and teaberry. Schreber's moss dominates the bryophyte layer, with patches of reindeer lichens in more open areas.



Ecodistrict 560 Percentage Land Cover

Forest/Woodland	86.1
Wetlands	8.4
Agriculture	2.1
Shrub/Heathland	1.8
Urban/Industrial	1.1
Water	0.4
Sparsely Vegetated	< 0.1

The dominant natural disturbance in the Spruce Pine forests has been wildfire due to the local abundance of "fuel" in the form of pine and spruce litter and ericaceous vegetation. Severe intensity fires can have a significant negative impact on site productivity, especially those sites where soils are shallow over bedrock. Historically these sites were frequently disturbed by fire resulting in extensive areas of poorly stocked forests and/or barrens. Suppression efforts are now encouraging natural infill. Old growth forests are uncommon.

As soil drainage gets progressively poorer, wet forests of red maple, tamarack and black spruce with speckled alder, false holly, winterberry, and other woody shrubs are common. Often embedded within this forest are wet open woodlands where stocking of tree species can be very low. This forest type is frequently disturbed by windthrow, fire and/or natural senescence, all of which limit the potential for old growth forest development. Earlier successional forests are composed of similar species to later stages.

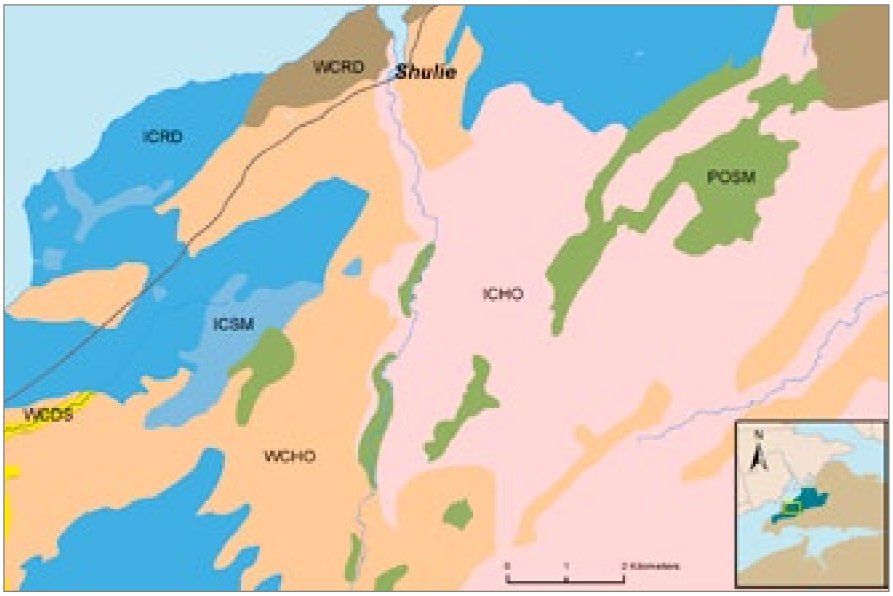
A few mixedwood forest stands comprised of shade-tolerant tree species (such as sugar maple, yellow birch, beech, red spruce, hemlock and white pine) are found on long slopes and steep-sided ravines along watercourses where soils are well drained. Natural disturbances are primarily small gaps created in the stand canopy by individual tree

The rock layers in the fossil cliffs at Joggins include sandstone, siltstone, limestone, shale and coal. *PHOTO: CNS (Len Wagg)*

Ecodistrict 560

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
ICHO	44.7%	44.7%
WCHO	21.7%	66.4%
ICRD	12.6%	79.0%
WCRD	7.4%	86.4%
IFHO	3.3%	89.8%
POSM	2.5%	92.3%
IMHO	2.2%	94.4%
WCKK	1.5%	95.9%
IMFP	1.2%	97.1%
XXWA	0.8%	97.9%
ICSM	0.6%	98.5%
IMSM	0.5%	99.0%
WCDS	0.4%	99.4%
IFFP	0.3%	99.7%
XXMS	0.1%	99.8%
WCFP	0.1%	99.9%
WFDS	0.1%	100.0%



mortality or by windthrow. Stands can develop old forest characteristics. A few small floodplains occur along several rivers flowing into the Bay of Fundy, but the forests have been cleared for farmland and typical floodplain forests are rare.

Non Forests

The Chignecto Ridges is a largely forested ecodistrict with about 7% of the landscape unfavourable for tree growth. It has very few lakes, and those that do occur total very little area. Less than 1% of the ecodistrict is occupied by lakes and ponds; the fifth lowest proportion in the province. Open wetlands contribute about 75% of the area of treeless land, while upland shrublands make up the difference. Wetlands are mostly flat unpatterned bogs; fens are uncommon. These acidic wetlands do not support many uncommon plants or lichens. Wiegand's sedge (*Carex wiegandii*) is one of the few exceptions. These same wetlands, and surrounding conifer forest, provide important habitat for the endangered mainland moose (*Alces americanus*).

Open uplands in the ecodistrict include the northern most provincial occurrences of broom crowberry—a small woody plant. It forms low heathland on sandy deposits and rocky outcrops. Small patches of this type of globally uncommon heathland are found in the Chignecto Ridges. Broom crowberry is discussed in more detail in the description for the **Annapolis Valley (610)** ecodistrict.

Herbaceous fen south of Harrison Lake *PHOTO: DNR (Eugene Quigley)*

600

Valley and Central Lowlands

These lowlands are largely sheltered from direct coastal climatic influences, promoting warmer summer temperatures which are more favourable for agriculture. With an area of 4065 km^2 (7.4% of the province) the ecoregion includes the Annapolis Valley, watersheds of the Minas Basin, and the Musquodoboit Valley. Elevation seldom exceeds 50 m above sea level; with only a few areas above 100 m.

Most of the extensive salt marsh along tidal rivers in this part of Nova Scotia has been dyked and converted to farmland. Seaward of some of the larger dykelands are extensive mud flats and estuaries, such as along the Minas Basin which supports remarkably large flocks of migratory shorebirds. Inland, there is little surface water and most lakes are shallow, and associated with larger peat bogs in Hants County. Most floodplains have been extensively used for agriculture, and only a few remnant floodplain forests remain.

Excluding the slightly cooler temperatures along the Minas Basin, shelter from the climatic influences of the Bay of Fundy is provided by the North and South Mountains in the Annapolis Valley and by uplands along major river valleys (including the Nine Mile, Shubenacadie, Stewiacke and Musquodoboit). This gives the ecoregion relatively early springs and hotter summers, a long growing season, and a significantly larger number of growing degree days—making it the most favoured agricultural zone in the province. Mean annual precipitation ranges from 1100 to 1300 mm, and summer moisture deficits can be expected.

Red Triassic sandstones underlie the Annapolis Valley as well as a narrow fringe of lowlands along the Minas Basin. Elsewhere, Carboniferous shale, sandstones, gypsum and limestone underlie central lowland watersheds. Where areas are underlain by gypsum and limestone, karst topography and sinkholes can be expected.

Deep glacial tills, glaciofluvial deposits and alluvium are the main soil parent materials in the Valley and Central Lowlands ecoregion. Orthic Humo-Ferric[1] and Ferro-Humic Podzols dominate

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

Heavy rains have caused flooding along the Stewiacke River at Middle Stewiacke.
PHOTO: CNS (Len Wagg)

well drained areas, with cemented (Ortstein) subgroups also common in soils derived from sandy glaciofluvial deposits (especially in the Annapolis Valley). Elsewhere, fine textured, imperfectly to poorly drained Gleyed Luvisols and Luvic Gleysols are common. On active floodplains and dyked marshlands, Orthic and Gleyed Humic Regosols are the main soils found.

Zonal sites throughout the ecoregion support an Acadian softwood forest (Spruce Hemlock Forest Group) of red spruce, hemlock and white pine with yellow birch and red maple increasing on moister fine textured soils. The Spruce Pine Forest Group occupies the poorer soils with extensive forests of black spruce, red and white pine and red oak. These forests can occur on rapidly drained coarse textured sands or imperfectly to poorly drained soils typical of level to gently hummocky terrain.

Natural disturbances in the forest have included hurricanes and fire. Softwood forests on moist soils frequently experience stand-level windthrow. Due to significant soil moisture deficits in the summer, fire can be a frequent stand-level disturbance. Second growth, early successional forests of aspen, red maple, grey and white birch, that establishes on abandoned agricultural lands and after timber harvesting constitutes a large portion of the forested landscape.

610
Annapolis Valley

The Annapolis Valley ecodistrict is a warm, broad plain. Seldom exceeding 11 km in width, it extends over 140 km—from Boot Island (in the Minas Basin) to a point just west of Digby (in the gut of St. Mary's Bay). Encompassing the Annapolis, Cornwallis, Pereaux, Canard, Habitant, and Gaspereau Rivers, "the Valley," as it's typically called, is flanked by the North and South Mountains, both of which shelter the ecodistrict from stronger oceanic influences of the Bay of Fundy.

Ecodistrict 610 is generally flat—sloping northeast to the Minas Basin along the Cornwallis River, and southwest along the Annapolis River to the Annapolis Basin. Both of these major rivers have headwaters in the Caribou Bog area, near Berwick, which rises to about 50 m above sea level. These rivers and their tributaries are significantly influenced by the high Bay of Fundy tides that force saltwater upstream twice daily—creating tidal wetlands as the waters come in, and exposing extensive mudflats as they retreat. The flattest areas of the Valley are sandy glaciofluvial outwash plains, largely concentrated in Kings County, while the remainder of the ecodistrict shows gentle relief across a variety of other glacial deposits. Small knolls, ridges, and additional (sometimes interesting) landforms are scattered throughout. One such landform is the Wolfville Ridge which forms the northern margin of the Gaspereau Valley, a small disjunct watershed included in ecodistrict 610.

This is the most heavily and intensely farmed ecodistrict in the province. Warm climatic conditions, deep relatively stone-free soil, and an abundant groundwater supply are the primary reasons farming is so prosperous in the Annapolis Valley. Soils are mainly derived from the underlying sandstone, but basalt fragments scraped off

A mosaic of field and forests at Lakeville, Kings County
PHOTO: CNS (Len Wagg)

Blue cohosh is a relatively rare flowering plant found only in the richest floodplain forests. (Nictaux River, Annapolis County)
PHOTO: DNR (Peter Neily)

the North Mountain during glaciation enriched the soil, particularly below the north mountain toe slope. On the south side, a few rivers originating on the South Mountain (e.g., Nictaux, Fales, and South) flow over slate, which also has higher nutrient availability than the more abundant sandstone of the valley floor.

Freshwater, which occupies 1.8% of the ecodistrict, is primarily restricted to streams and rivers and a few small ponds and lakes. Total area of the ecodistrict is 928 km^2 or about 22.8% of the ecoregion.

The ecodistrict has the longest history of permanent European settlement in the province. Colonialism in Canada originated in 1605 at Port Royal, a French fortification and one of the oldest permanent settlements in North America. Early French Acadians built numerous dykes to increase farmable land. Many dykes still border tidal portions of the Valley's major rivers, strongly shaping the ecology of the landscapes within which they fall.

Dykelands in the Annapolis Valley ecodistrict are the second most extensive in the province, totaling 6471 ha, (The largest area is found in the **Cumberland Marshes (550)**, spanning 7529 ha.) An especially large tract of dykeland lies north of the historic Acadian village of Grand Pré. This area of dykeland, now recognized as a UNESCO World Heritage Site, is the "Grand Prairie" after which the village is named.

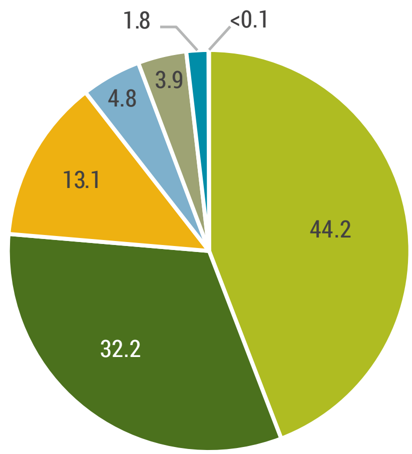
Late successional forests of red spruce, white pine, and hemlock on zonal sites are rare in the Valley, since most of this arable land has been cleared for agriculture. Black spruce and red maple forests are still prevalent on the wet soils unsuitable for farming. White pine, red pine and red oak are common on dry, coarse sandy soils. Elsewhere, early successional forests of aspen, red maple, white ash, grey and white birch occur on farmlands that have reverted back to forest cover. Along the rivers the rich alluvial soils once supported a riparian hardwood forest of elm,

Table 25
Summary information for dominant soils found in the Annapolis Valley ecodistrict (610). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Hydric *	19	Various	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Cornwallis	12	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Kentville	8	Glacial Till	Medium-Coarse	Imperfect	ST3, ST9, ST3-L	Podzol
Middleton	7	Glacial Till	Fine	Mod. Well-Imperfect	ST11, ST12, ST5, ST6	Luvisol
Nictaux	7	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Woodville	6	Glacial Till	Medium-Coarse	Well	ST2, ST8, ST2-L	Podzol
Somerset	5	Glacial Till	Coarse	Well-Rapid	ST1, ST2, ST15	Podzol
Berwick	5	Glacial Till	Medium-Coarse	Well	ST2, ST8, ST2-L	Podzol

*** Hydric soils represent all poorly drained organic and mineral soil types including Acadia soils.**

sugar maple, white ash, black cherry, and black ash, but most of this forest has been cleared for farming. Fire and windthrow are the most prevalent natural disturbances associated with the various forest communities.



Ecodistrict 610
Percentage Land Cover

Agriculture	44.2
Forest/Woodland	32.2
Urban/Industrial	13.1
Wetlands	4.8
Shrub/Heathland	3.9
Water	1.8
Sparsely Vegetated	<0.1

Geology and Soils

The Annapolis Valley ecodistrict is mainly underlain by soft Triassic period sedimentary rock including siltstone, sandstone, shale, mudstone and conglomerate. This easily erodible bedrock provided much of the material found in surficial deposits that dominate the valley floor today. These include glacial till deposits of variable texture; sandy and/or gravelly glaciofluvial deposits (outwash plains, kames and eskers); fine-textured glacio-lacustrine deposits; and glacio-marine deposits of variable texture. There are also significant alluvial deposits associated with floodplains and estuaries of the Annapolis and Cornwallis Rivers.

A variety of poorly drained soils make up the largest single soil group in the ecodistrict. This includes fine-textured Acadia soils that have been dyked and artificially drained to allow their use for agriculture. Other dominant soils are derived from non-gravelly, glaciofluvial sands (Cornwallis soils); gravelly loam to sandy loam water-worked till containing basalt (Kentville soils); gravelly clay loam till containing basalt (Middleton soils); gravelly and sandy glaciofluvial deposits (Nictaux soils); gravelly sandy loam till containing sand-stone (Woodville soils); sandy, water-worked till (Somerset soils); and gravelly sandy loam till with sandstone, shale and basalt (Berwick soils). **(See Table 25)**.

Coarse-textured Cornwallis, Nictaux and Somerset soils are all prone to natural cementation with iron oxides and organic matter (Ortstein soils).

Forests

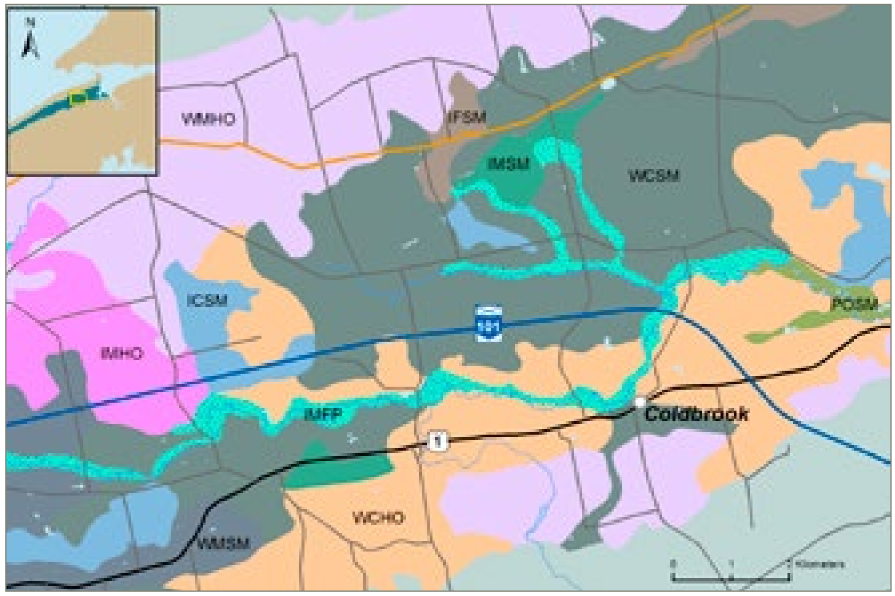
Vegetation Types of the Spruce Hemlock Forest Group occur on hummocky terrain associated with moderately well drained, nutrient medium soils derived from glacial tills. Red spruce, white pine and hemlock (32% of the ecodistrict) occupy this zonal site condition with occasional yellow birch, sugar maple, ironwood and white ash, especially where soils are finer textured, moister and richer. The shrub layer is primarily regenerating overstory species along with balsam fir and red maple. Herb density is usually low, but species richness can be relatively high with typical woodland flora such as bluebead lily (*Clintonia borealis*), wild lily-of-the-valley (*Maianthemum canadense*), partridge-berry

Climax sugar maple floodplain forest on the Annapolis River between lower Middleton and Brickton, Annapolis County
PHOTO: DNR (Peter Neily)

Ecodistrict 610

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMHO	17.9%	17.9%
WCSM	14.8%	32.7%
WCHO	11.9%	44.6%
IMHO	7.1%	51.7%
XXDK	7.0%	58.6%
WMSM	6.7%	65.4%
WFHO	5.9%	71.3%
IFHO	5.8%	77.1%
ICSM	5.3%	82.4%
IFSM	4.2%	86.6%
ICFP	3.3%	89.9%
IMSM	2.5%	92.4%
XXWA	1.8%	94.2%
ICHO	1.4%	95.6%
WMKK	1.2%	96.8%
POSM	1.1%	97.9%
XXMS	0.8%	98.7%
IMFP	0.7%	99.5%
WFSM	0.5%	100.0%
WFKK	< 0.1%	100.0%



(*Mitchella repens*), star-flower (*Trientalis borealis*) and painted trillium (*Trillium undulatum*). Schreber's moss (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) are the main bryophytes on the forest floor.

Early successional forests following stand-level disturbances such as clearcutting, fire and windthrow may include red maple, white birch, grey birch, large-tooth and trembling aspens with balsam fir and red oak. Old forest characteristics can develop over time.

Red pine, white pine and red oak from Spruce Pine Forest Group are dominant on coarse, rapidly drained sands that have been deposited by glacial melt waters. Roughly occurring in a narrow band down the middle of the Valley from Wolfville to Bridgetown, this forest can be viewed along Highway 101 and Highway 1.

Understory plants in this forest group are indicative of dry, nutrient poor (acidic) soils. They include ericaceous species such as lambkill, blueberry and huckleberry, along with witch-hazel and sweet fern. Herb cover usually includes bracken (*Pteridium aquilinum*), mayflower (*Epigaea repens*) and teaberry (*Gaultheria procumbens*). A pine needle carpet is typical and on drier sites; reindeer lichens (*Cladonia spp.*) can be abundant.

The inherently low fertility and droughty nature of these sandy soils supports a late successional white pine – red oak ecosystem. Earlier successional forests will include red pine, aspen and red maple. Occurrences of natural populations of jack pine are unique and uncommon.

Small stands of floodplain forest types can be found in unfarmed areas along the Cornwallis and Annapolis Rivers and major tributaries. These patches of forest provide rich habitat conditions for a variety of species and help form an important wildlife corridor. Most of the climax forest of sugar maple, red oak, white ash and elm has been replaced with farmland—only a few remnant stands remain.

Abandoned farmland on floodplains reforests to early successional forests of white ash, black cherry, chokecherry, alders, willows and hawthorn. Red oak and red maple will follow as mid-successional forests. Eastern white cedar, a species at risk in Nova Scotia, can be found along the Annapolis River and its tributaries.

Natural disturbance agents in ecodistrict 610 are primarily associated with hurricanes, windstorms and fires. Where soils are sandy, coarse and dry, fire has played a role in the origin of the pine and oak forests that characteristically occupy these sites (Roland 1946). The flammable nature of the pine and spruce litter and the understory ericaceous vegetation make Spruce Pine Forest Group susceptible to fire during droughty years. However, fire suppression has reduced the occurrence of wildfires, and without intense crown fire, these forests will develop a structure of super canopy white pine over black spruce. The presence of red oak is also enhanced by fire. Insect defoliation has not been a significant factor in forest disturbance although forest tent caterpillars have defoliated aspen stands in the past. The loss of elm on the floodplain forests due to Dutch elm disease has impacted the floodplain forest ecosystem.

Elsewhere in the Valley, slow growing forests of black spruce, red maple and tamarack dominate poorly drained sites. Usually on level terrain and underlain by fine textured soils (clay loams) or deep organic soils on depressional terrain, these slow growing forests have understories of alders, willows, false holly, winterberry, spiraea, and other woody shrubs. Windthrow is common due to the shallow rooting of the spruce. Earlier successional forests may be of similar species, but aspens, white birch and grey birch are common.

Very few patches of original forest or unaltered land remain due to the agricultural potential of the land. When farmland is abandoned it reverts to forests of aspen, red maple, grey and white birch, white pine and white spruce, with tamarack on the moist sites.

Non Forests

Most of the Valley is farmed, forested, or developed for residential, commercial, and/or industrial use. However, it still supports a number of interesting biodiversity features. The dykelands at Grand Pré and nearby along the Cornwallis River are the two largest drained salt marshes in Nova Scotia. Natural salt marshes on the water side of these dykes support the easternmost populations of big-leaved marsh-elder (*Iva frutescens ssp. oraria*), a nationally rare salt scrub species found only in Nova Scotia. Floodplains of the Cornwallis and Annapolis Rivers host rare vascular plants, including some found nowhere else, or in very few other places in the province (e.g., false nettle (*Boehmeria cylindrica*), and silver maple (*Acer saccharinum*)). The majority of these and other rare plants are associated with flooded forests, but some are also found in wet meadows, marshes, and banks along rivers (e.g., bog willow (*Salix pedicellaris*), false mermaidweed (*Floerkea proserpinacoides*), and common scouring-rush (E*quisetum hyemale var. affine*)).

The most unique non-forested or sparsely-treed ecosystems in the Valley are found on its sand plains and the wetlands embedded within them.

Peat mining on Caribou Bog, west of Berwick, Kings County
PHOTO: DNR (Sean Basquill)

Remnant sand heathland (sometimes called *barrens*) near Kingston. These rare, globally unique ecosystems are under threat from land use pressures. PHOTO: DNR (Sean Basquill)

Ecodistrict 610 has extensive glaciofluvial sand plains just west of Kentville and in the area between Berwick and Lawrencetown. The sand plains co-occur with kames, eskers, and terraces, all of which share similar glaciofluvial origins. Today, naturally unforested upland areas support a low-growing heathland dominated by broom crowberry (*Corema conradii*), one of the few examples of Atlantic Coastal Plain Flora inhabiting upland habitat in Nova Scotia.

While broom crowberry heathlands are found on sand plains elsewhere in Nova Scotia, the examples in the Valley are particularly well developed and extensive. The plains also support golden heather (*Hudsonia ericoides*) and rockrose (*Crocanthemum candense*, formerly *Helianthemum canadense*), two other provincially rare upland coastal plain plants.

It has been estimated that pre-settlement area of the heathland encompassed approximately 200 km^2 but today less than 3% of the original ecosystem remains (Carbyn et al 2006).

Residential development, invasive species, and suppression of fire as a natural disturbance are threats to the existence of this vegetation association.

Sand plains in the Annapolis Valley are peppered with shrub swamps and bogs, including some with very deep peat accumulations. Three of the largest bogs have been mined and two such operations are still active. The smaller shallower bogs are similar to "pocosins," a type of evergreen bog found in sand barrens of New Jersey, the Carolinas, and Florida. Similar to pocosins, the shallow Annapolis Valley bogs often dry out in the summer making them prone to fire and promoting the occurrence of species capable of tolerating such harsh conditions. Another interesting feature of Annapolis Valley peat bogs is the presence of low sand dunes snaking across their surfaces. These unique landforms are the only inland dunes documented in the province. Little is known about their ecology and geomorphology, but they have been reported by geologists for almost 50 years.

620
Minas Lowlands

The Minas Lowlands wraps around the coast of Cobequid Bay, from Tennecape on the Noel Shore to Lower Economy in Colchester County. This ecodistrict is fairly narrow until it approaches the end of Cobequid Bay at Truro, where it widens and extends inland following the valleys of the Salmon and North Rivers. The Minas Lowlands is one of the smallest ecodistricts in the province, with mean elevations of 30 m and higher inland slopes rising to about to about 150 m in the foothills above the Folly and Debert Rivers.

Several other major rivers pass through the ecodistrict, including the Shubenacadie, Chiganois, Great Village, Portapique, Bass and Economy.

The Minas Lowlands is characterized by gentle relief, and despite its proximity to the Bay of Fundy, it is somewhat sheltered from stronger oceanic climatic influences.

Although slightly cooler than Ecodistrict **610**, many of the crops associated with the Annapolis Valley, such as corn and strawberries, are productive and profitable. There are only a few lakes in the Minas Lowlands, with most of the freshwater resource (2% of the area) occurring in streams and rivers. Total area of the ecodistrict is 437 km^2 or about 10.7% of the ecoregion.

Ecodistrict 620 is underlain by Triassic red siltstones and sandstones. There are thick glacial fluvial deposits of sand and gravel along the rivers at the end of Cobequid Bay. These have been quarried extensively for aggregates, especially along

Low tide as the Debert River empties into the Minas Basin, surrounded by dyked farmland. Natural salt marsh fringes the bay side of the dykes. *PHOTO: CNS (Len Wagg)* the North, Debert and Folly Rivers. Extensive tidal flats occur on both sides of the bay, created by the twice daily erosional and depositional actions of the tides of the Bay of Fundy. Since European settlement in the 17th century, the construction of dykes has been used to claim farmland from the tidal salt marshes which surround the bay.

Softwood forests dominate the landscape, with only a few well-drained hills with soils suitable for sugar maple, yellow birch, and beech. Red spruce, hemlock and white pine occur on well drained soils, especially along steep-sided slopes of streams and rivers. Most soils are imperfectly to poorly drained, supporting forests of black spruce and scattered with white pine. Near Debert, deep, dry, coarse sandy soils yield red pine and white pine. A few remnant floodplain forests of red maple, sugar maple, white ash and elm may be found on the heavily farmed alluvial soils along major rivers.

Fire and hurricane have been the predominant natural disturbances with occasional stand-level mortality by spruce budworm and tussock moth. Windthrow and breakage caused by Hurricane Juan in 2003 was extensive in this ecodistrict, especially where soils were imperfectly and poorly drained. A warm and sheltered climate has enhanced agricultural opportunities on almost all soil types, and a significant portion of the ecodistrict has been converted to farmland.

Geology and Soils

The Minas Lowlands ecodistrict is mainly underlain by soft Triassic period sedimentary rock, but also contains some older Carboniferous period rock. Dominant bedrock types include sandstone, siltstone, shale and conglomerate (mostly red). As in **Annapolis Valley (610)**, this easily erodible bedrock provided much of the material found in surficial deposits that dominate the ecodistrict today. This includes extensive coverage of sandy and/or gravelly glaciofluvial deposits (outwash plains, kames, eskers, etc.) that are regularly exploited as aggregate sources. There are also significant alluvial deposits along the many rivers running through this ecodistrict.

Dominant soils are derived from gravelly sandy loam till containing sandstone (Woodville soils); non-gravelly, sandy glaciofluvial outwash (Truro soils); gravelly and sandy glaciofluvial deposits (Hebert soils); and active floodplain deposits (Cumberland soils). (**See Table 26**)

Coarse-textured Truro and Hebert soils are prone to natural cementation with iron oxides and organic matter (Ortstein soils). Low-lying areas and gentle relief have also promoted significant hydric soil development in this ecodistrict.

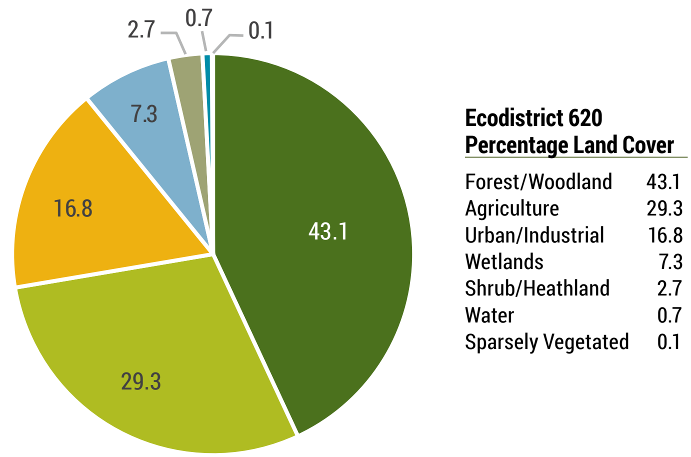
A deep, well drained, soil profile supports a pure stand of red pine at Debert, Colchester County.

Forests

The gentle terrain surrounding Cobequid Bay supports a forest dominated by black spruce and pine on sites that tend to be poor and imperfectly drained. Better drained conditions, especially on steep slopes along streams and rivers, support red spruce and yellow birch with sugar maple, beech and hemlock often present. Hybridization of black and red spruce is typical on marginal sites throughout the ecodistrict. White pine often forms a super canopy overtopping black spruce.

An extensive moss coverage is common in Spruce-Pine forests with Schreber's (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) very common. Where soils are moist, various species of peat mosses (*Sphagnum spp.*) also occur. Herbs on these moist sites include cinnamon fern (*Osmunda cinnamomea*), creeping snowberry (*Gaultheria hispidula*), interrupted fern (*Osmunda claytoniana*), New York fern (*Thelypteris noveboracensis*) and three seeded sedge (*Carex trisperma*). The shrub layer is generally occupied by ericaceous plants such as blueberry and lambkill, and other woody shrubs such as false holly and wild raisin.

Near Debert on dry, sandy, nutrient very poor soils which experience a significant moisture deficit during the summer, red pine, white pine and jack pine are common. Sparsely treed heathland is interspersed with closed canopy pine and black spruce forests and is characterized by high broom crowberry and reindeer lichen (*Cladonia spp.*) cover.



With progressively poorer drainage, black spruce, tamarack and red maple dominate the forest with an understory of various woody shrubs (e.g., Labrador tea, rhodora and false holly) and abundant ground cover of peat mosses (*Sphagnum spp.*) and sedges (*Carex spp.*).

Along the floodplains of the larger rivers and streams, annual deposits of alluvium create rich soils for forests of sugar maple, white ash and elm. Much of the elm has been decimated by the Dutch elm disease, with only a few trees left on the landscape. Fiddlehead (ostrich) ferns (*Matteuccia struthiopteris*) are abundant on these floodplains.

Black spruce, a shallow-rooting species; is even more so on moist soils, making this forest very susceptible to hurricane and storm damage. Following stand-level disturbances such as windthrow and harvesting, early successional forests are similar to the original forest but may

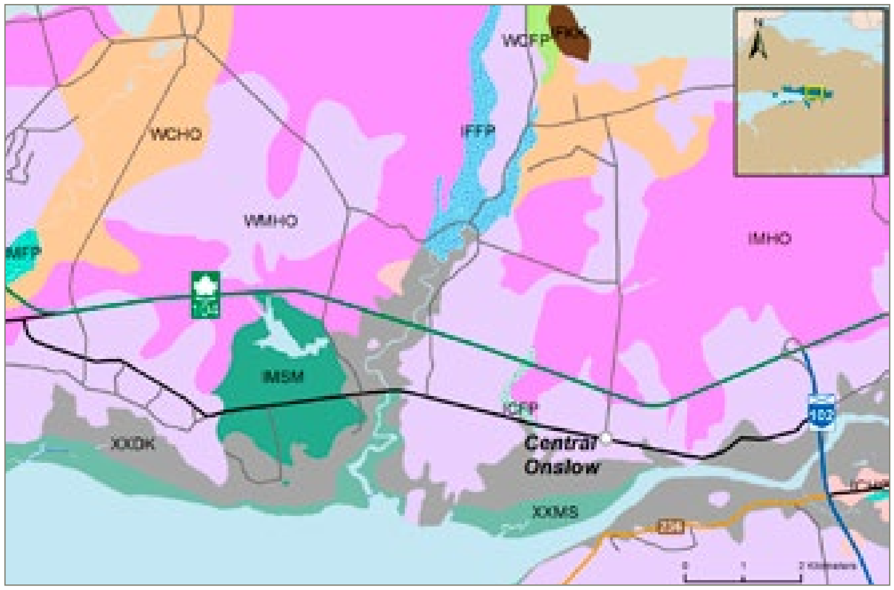
Table 26
Summary information for dominant soils found in the Minas Lowlands ecodistrict (620). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Woodville	29	Glacial Till	Medium-Coarse	Well	ST2, ST8, ST2-L	Podzol
Truro	24	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Hebert	13	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Hydric *	13	Various	Various	Poor-Very Poor	ST14, ST4	Organic, Gleysol
Cumberland	7	Alluvium	Medium-Coarse	Well	ST8, ST8-C	Regosol

* Hydric soils represent all poorly drained organic and mineral soil types.

Ecodistrict 620

Sample area map showing typical ecosections found in this ecodistrict



Ecosection	District %	Cumulative %
WMHO	34.5%	34.5%
IMHO	24.5%	59.0%
WCHO	9.5%	68.5%
XXDK	7.2%	75.7%
IMFP	4.3%	80.0%
IFHO	4.1%	84.1%
XXMS	3.0%	87.1%
IMSM	2.9%	90.0%
WMKK	2.5%	92.4%
ICHO	2.0%	94.5%
XXWA	2.0%	96.4%
IFFP	1.3%	97.8%
WMSM	0.5%	98.3%
POSM	0.4%	98.8%
IFSM	0.4%	99.1%
WCFP	0.2%	99.4%
WMDS	0.2%	99.6%
IFKK	0.2%	99.8%
ICSM	0.1%	99.9%
ICFP	0.1%	100.0%
WMRD	< 0.1%	100.0%
XXCB	< 0.1%	100.0%

include red maple, white birch, grey birch and aspens, and a heavy cover of ericaceous shrubs and bracken (*Pteridium aquilinum*).

Pine forests on dry sites are typically regenerated by a few residual trees that have survived high intensity fires. However, with fire suppression, red and jack pine will eventually succumb to senescence and be gradually replaced by black spruce and white pine. Both pine and black spruce forests tend to be even-aged. White pine often forms a super canopy over younger black spruce forests.

Non Forests

About 10% of the ecodistrict is naturally non-forested (excludes agricultural areas such as dykelands), which is slightly higher than the provincial average. Prior to salt marsh dyking by the early Acadians, a higher relative proportion would have been naturally non-forested. The ecodistrict includes about 2300 ha of dykeland, which is lower than the areas found in ecodistricts **610** and **550**, but still significant. Just over 6% of the ecodistrict is dykeland, including a remarkably large area within Truro town boundaries.

The Debert River near Little Dyke in winter

PHOTO: CNS (Len Wagg)

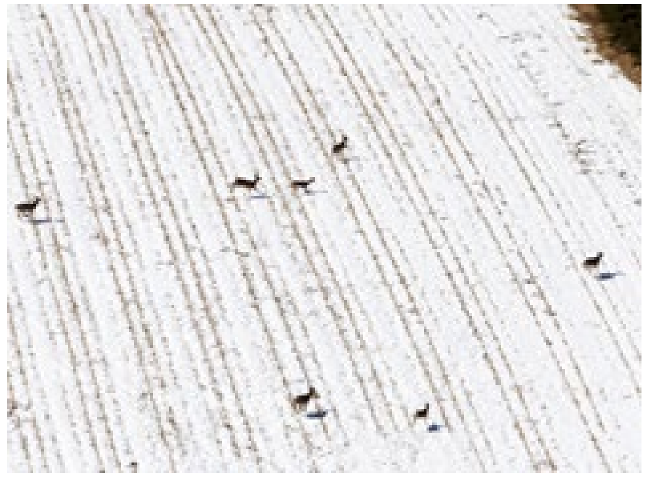
Despite dyking on the banks of the major rivers and along the north shore of Cobequid Bay, salt marshes are still relatively frequent and abundant. In fact, the area of salt marshes in the Minas Lowlands make up the second largest proportion of total land area of any ecodistrict in the province, after the **Tusket Islands (840)**.

Salt marshes are the most common wetland in the ecodistrict and characterize most of the non-forested ecosystems. The salt marshes exhibit zonation patterns similar to others in the inner and outer Bay of Fundy.

An interesting feature of the marshes on the north shore of Cobequid Bay is they are known to support foraging deer and moose moving down from the **Cobequid Slopes (350)** in summer.

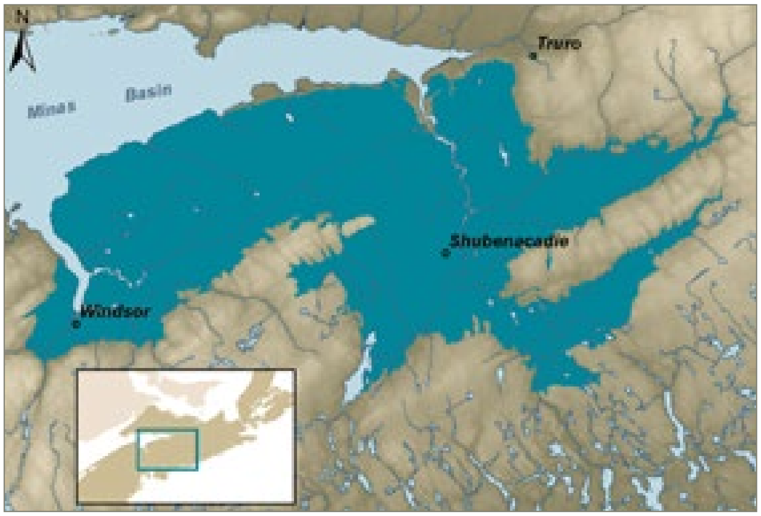
The Minas Lowlands is also known for its extensive estuarine flats. This is part of the Bay of Fundy with the highest tides, resulting in the largest tidal flats on the Nova Scotia side of the bay. The flats are muddy—derived from silt and clay suspended in turbid tidal waters.

The beaches, mud flats, and shoreline features provide important habitat for a number of shorebirds. These include American golden-plover (*Pluvialis dominica*), semipalmated plover (*Charadrius semipalmatus*), killdeer (Charadrius *vociferous*), greater yellowlegs (*Tringa melanoleuca*), willet (*Tringa semipalmata*), spotted sandpiper (*Actitis macularius*), red knot (*Calidris canutus rufa*), semipalmated sandpiper (*Calidris pusilla*), and least sandpiper (*Calidris minutilla*).



(above) Deer foraging in a harvested cornfield in late March; *(below)* Looking west from Highland Village towards Economy Point (with Economy Mountain, then Green Mountain, in the background)
PHOTOS: CNS (Len Wagg)

630
Central Lowlands



The Central Lowlands encompasses much of eastern Hants and southern Colchester counties in central Nova Scotia. It incorporates the floodplains and gently rolling terrain of the major river valleys, including the Kennetcook, Shubenacadie, Musquodoboit, Stewiacke, and St. Croix—all of which are significantly influenced by the daily Bay of Fundy tides, except the Musquodoboit River, which drains to the Atlantic Ocean.

Mean and maximum elevations are slightly higher here than in ecodistricts **610** and **620**, mostly because this ecodistrict includes some foothills of the Rawdon Hills; a small upland area (Creelman Hill) near Maitland; and a sparsely populated upland west of Hilden. Overall, most of the ecodistrict is fairly level, with hummocky to undulating topography, and elevations seldom exceeding 90 m above sea level.

The climate of Central Lowlands is conducive to farming and the area has been extensively used for dairy and beef production, as well as growing forage, corn and soybeans. Total area is 2700 km^2 or about 66.4% of the ecoregion.

This ecodistrict is underlain by Carboniferous era shale, limestone, sandstone and gypsum. Karst topography is common on areas underlain by gypsum. Glacial outwash deposits, some of which have been quarried for aggregate, are abundant, especially alongside the rivers. However, most of the ecodistrict has deep, reddish-brown, fine

Dyked farmland along the Shubenacadie River, south of the confluence with the Stewiacke River *PHOTO: CNS (Len Wagg)* textured soils comprised of loams, silts and clays. Drainage is restricted on most soils due to glacial compaction, higher clay content, and/or the effects of generally flat topography.

Large peatlands are dominant on level terrain in the watersheds of the Walton, Cogmagun and Tom Cod Rivers. Adjacent to these peatlands are extensive areas of imperfect to poorly drained forests underlain by a relatively impermeable clay loam till. A few freshwater lakes dot the ecodistrict but when added to the streams and rivers, total freshwater area is only 3964 ha or 1.5% of the ecodistrict.

Forest cover in this ecodistrict is influenced by predominantly moist soils, many of which are fine textured, and support coniferous forests of black and red spruce, white pine, hemlock, and earlier successional forests of white birch, red maple, and aspen. Many soil types are prone to summer moisture deficits, which may promote fires and fire-adapted ecosystems of black spruce, red pine and white pine. On better drained hills late successional climax forests of mixed Acadian Forest species such as yellow birch, red spruce, hemlock, sugar maple, and to a lesser extent beech, will occur. Pure stands of tolerant hardwood species are uncommon. Hemlock is found predominantly on steeper slopes near streams and rivers. On sites where soils are derived from glacial outwash till, white pine will occupy these coarser soils. An unusual association is the occurrence of red pine with black spruce on imperfectly and poorly drained clay soils north of the Kennetcook River. Alluvial soils along major rivers have been used extensively for farming with the result that natural riparian floodplain forests of elm, white and black ash, and sugar maple are now rare. However, several examples of these forests can be found along the Meander, Herbert, and Kennetcook rivers. Rare and uncommon plants such as showy lady's slipper (*Cypripedium reginae*), blue cohosh (*Caulophyllum thalictroides*), and bloodroot (*Sanguinaria canadensis*) are common in these scattered remnants.

Much of the ecodistrict is underlain by calcareous bedrock (limestone, gypsum, and anhydrite), and forests of hemlock, white pine, red oak, and tolerant hardwood species are typical. These sites may support rare and uncommon plants such as ram's head lady's slipper (*Cypripedium arietinum*), yellow lady's slipper (*Cypripedium parviflorum*), Bulblet bladder fern (*Cystopteris bulbifera*), leatherwood (*Dirca palustris*) and shepherdia (*Shepherdia canadensis*).

Abandoned farmland in the ecodistrict tends to reforest with a variety of species including white spruce, white pine, tamarack, and occasionally white ash, red maple, aspen, and white birch.

Geology and Soils

The Central Lowlands ecodistrict is mainly underlain by Carboniferous period sedimentary rock including sandstone, siltstone, shale, mudstone, gypsum, limestone and salt. Gypsum deposits are particularly extensive, supporting major mining operations around both Windsor and East Milford.

Although surficial deposits and soil parent materials are dominated by glacial tills, there are also significant alluvium (floodplain) and glaciofluvial

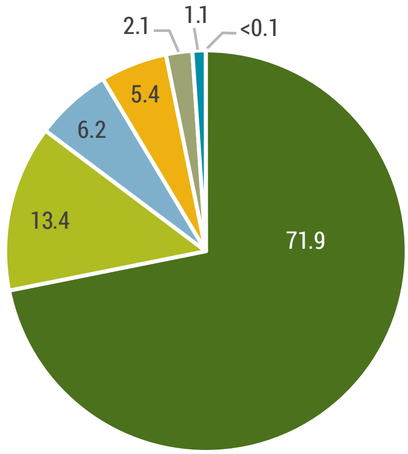
Table 27
Summary information for dominant soils found in the Central Lowlands ecodistrict (630). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Queens / Falmouth	56	Glacial Till	Fine	Mod. Well- Imperfect	ST6, ST12, ST5, ST11	Luvisol, Brunisol
Wolfville / Hantsport	12	Glacial Till	Fine-Medium	Mod. Well-Imperfect	ST2-L, ST5, ST8, ST3-L, ST6, ST9	Podzol, Luvisol
Hansford	9	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3	Podzol
Hydric *	8	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST7, ST4	Organic, Gleysol
Stewiacke	5	Alluvium	Fine-Medium	Mod. Well-Poor	ST9, ST12, ST13	Regosol, Gleysol

*** Hydric soils represent all poorly drained organic and mineral soil types.**

Ecodistrict 630
Percentage Land Cover

Forest/Woodland	71.9
Agriculture	13.4
Wetlands	6.2
Urban/Industrial	5.4
Shrub/Heathland	2.1
Water	1.1
Sparsely Vegetated	<0.1



deposits adjacent to the many rivers and within the valley corridors found in this ecodistrict. Karst conditions are also prominent in areas associated with near-surface gypsum.

Dominant soils are derived from non-gravelly silt loam to clay loam till (Queens/Falmouth soils); gravelly sandy clay loam till containing shale, sandstone and mudstone (Wolfville/Hantsport soils); gravelly sandy till derived from red and grey sandstone (Hansford soils); and recent or active floodplain deposits (Stewiacke soils). (**See Table 27**).

Hansford soils sometimes contain fragipan horizons that restrict vertical drainage and/or potential rooting. Low-lying areas and extensive coverage of fine-textured till have also led to significant hydric soil development in this ecodistrict.

Forests

Spruce Pine, shade tolerant Mixedwoods, and Spruce Hemlock Forest Groups make up the majority of forests found in the Central Lowlands. At one time, floodplain forests of sugar maple, ash and elm were common on the rich alluvial soils along the major rivers but much of this land is now extensively farmed.

Spruce Pine vegetation types occur on moderately well to imperfectly drained soils where drainage is slowed by impermeable soils and level terrain. These forests can be found in the upper reaches of the Cogmagun and Walton Rivers and on old alluvial soils associated with large floodplains of the Stewiacke, Musquodoboit and Shubenacadie Rivers. Mixed throughout this ecosite condition are dry, coarse soils where forests of red pine, white pine, jack pine and red oak are present. Where soils are poorly drained, a wet forest of red maple, black spruce, tamarack, alders, false holly, winterberry, and other woody shrubs, is prominent. Stand-level disturbances caused by windthrow of shallow-rooting black spruce are frequent and these forests seldom achieve old growth status. Pine and oak forests, with an understory of thick ericaceous shrubs, reestablish on sites following wildfires.

An Acadian mixedwood forest (Mixedwood Forest Group) prefers the deep, well to moderately well drained fine textured soils of the rolling hills of the Shubenacadie, Musquodoboit and Stewiacke valleys. Late successional mixedwood forest are dominated by sugar maple, yellow birch and beech on upper slopes leading to increasing abundance of red spruce, balsam fir and hemlock on middle and lower slopes. Often there are seepage sites along the slope where soils are wetter and richer, with plants and trees such as white ash indicating this improved condition. Earlier successional species follow after stand-level disturbances and include red maple, aspens, white and grey birch and balsam fir. Natural stand-level disturbances are infrequent, however, small canopy gaps or patches created by individual tree mortality or windthrow permit development of uneven-aged forests and old growth features. Much of this forest has been converted to other uses including agriculture, however, abandoned farmland will reforest to white spruce, tamarack and occasionally aspen.

Tidal Bore adventurers on the Shubenacadie River
PHOTO: CNS (Len Wagg)

Ecodistrict 630

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IFHO	20.5%	20.5%
IFKK	16.3%	36.8%
WFHO	10.1%	47.0%
IFRD	9.2%	56.1%
WFKK	6.7%	62.8%
IMHO	6.2%	69.0%
IFSM	3.8%	72.8%
IMRD	3.1%	75.9%
WMKK	2.9%	78.8%
IMSM	2.8%	81.6%
POSM	2.7%	84.3%
WMHO	2.5%	86.7%
IFFP	2.3%	89.0%
ICHO	1.5%	90.6%
PFHO	1.5%	92.0%
XXWA	1.5%	93.5%
XXDK	1.4%	94.9%
IMFP	1.4%	96.3%
WFRD	1.2%	97.6%
WCHO	0.7%	98.2%
WMRD	0.5%	98.7%
WCKK	0.4%	99.1%
XXMS	0.2%	99.3%
ICSM	0.2%	99.5%
ICFP	0.2%	99.7%
IFDM	0.1%	99.8%
WCSM	0.1%	99.9%
WFDM	0.1%	99.9%
WFSM	0.1%	100.0%

At one time floodplain forests of white ash, sugar maple and elm dominated extensive areas along major river valleys of the Central Lowlands. As these areas were also preferred agricultural lands, most of this forest has been converted to fields, pasture and croplands. However, when this floodplain farmland is abandoned, early successional forests can include black cherry, chokecherry, red maple and willows, followed by white spruce, tamarack and white pine. Where sites are no longer annually enriched with alluvial deposits, they slowly change into upland sites and begin to support treed communities dominated by hemlock, red spruce, yellow birch and white pine. Wherever soils are poorly drained—such as in depressions and swales (old flow channels)— black spruce, willows, cherries and red maple dominate the forest vegetation. Floodplains in this ecodistrict provide a rich variety of wildlife habitats and offer an important travel corridor.

A complex of treed and open wetlands near Anthony Lake, Hants County *PHOTO: CNS (Len Wagg)*

Gypsum cliff along the St. Croix River, near Sweets Corner, Hants County *PHOTO: DNR (Sean Basquill)*

Natural disturbance agents in the ecodistrict are primarily hurricanes and fire. Windthrow is typical on most sites but more pronounced in forests on moist and wet soils. Summer moisture deficits lead to dry, volatile conditions in the spruce pine forest, especially when a thick understory of ericaeous shrubs is present. Special management considerations may have to be made to maintain red pine in the ecosystem while practicing fire suppression. Spruce budworm, balsam wooly adelgid, spruce bark beetle, and tussock moth have had localized impacts on the forests of this ecodistrict.

Non Forests

The Central Lowlands is largely underlain by a geological bedrock formation called the Windsor Group. Over 300 million years ago, a large portion of Nova Scotia was inundated with saltwater from the Windsor Sea, which extended through Nova Scotia and up to Newfoundland.

The Windsor Sea's coverage of Nova Scotia was irregular, alternating between periods of high and low sea levels. When the ocean was shallow, the water evaporated, leaving behind mineral deposits, which were subsequently rehydrated during high water. This cyclical process resulted in the formation of concentrated minerals called evaporites.

The Windsor Group is characterized by a number of evaporites, including limestone (which can also form through other means), gypsum, and anhydrite. The latter two are the most common Windsor Group rocks in Nova Scotia, showing strong expression in the Central Lowlands and **Bras d'Or Lowlands (510)**, with more minor occurrences in a number of other ecodistricts.

Evaporites are soluble in water. Over time, these rocks dissolve above and below ground, resulting in a kind of Swiss cheese topography called karst. Karst is a rugged type of landform with distinct hydrological and geomorphic processes. It is characterized by caves, conical depressions, steep cliffs and pinnacles, vertical shafts, disappearing streams, and by underground aquifers and springs, among other unique attributes. Nova Scotia supports abundant and markedly variable karst including some landforms, and finer karst features, which are nationally if not globally significant.

Nova Scotia's karst landscapes give rise to important ecosystems and rare species populations. They provide habitat for numerous provincially, and in some cases nationally, rare vascular plant, bryophyte, and lichen species. Important

Rams head lady's slipper is a species at risk in Nova Scotia, and one of the rarest orchids in the province. It is known in only six locations
Photo: DNR (Reg Newell, retired DNR)

hibernacula for all of Nova Scotia's endangered cave-dwelling bat species are also found in karst. Rare invertebrate assemblages, including species groups restricted to subterranean watercourses and vertebrate dung heaps, are supported in Nova Scotia karst caves. Karst forest, and non-forested karst cliff, talus, and rocky outcrop ecosystems are extremely rare outside Nova Scotia.

In Nova Scotia, karst usually forms in landscapes underlain by gypsum, and less often over limestone or dolomite. The closer these bedrock types are to the surface, the more likely karst will form and the stronger the expression. Other important karst determinants include: bedrock age, origin, and homogeneity; soil drainage potential; and, the hydrology of surface and ground water. Karst is very well expressed in the Central Lowlands. Gypsum karst cliffs, pinnacles, and ponds are even visible from some of the major highways.

Open or non-forested karst also supports numerous unique and rare species such as: fragile tortella moss (*Tortella fragilis*), hyssop-leaved fleabane (*Erigeron hyssopifolius*), bulblet fern (*Cystopteris bulbifera*), balsam groundsel (*Packera paupercula*), ebony sedge (*Carex eburnea*), goldenleaf campylium moss (*Campylium chrysophyllum*), verdigris tufa-moss (*Gymnostomum aeruginosum*), and woodland strawberry (*Fragaria vesca*) among others.

Karst pond and wetland species featured in the Central Lowlands are similar to those described in **Bras d'Or Lowlands (510)** in this guide.

A bend in the Stewiacke River at Eastville. Colchester County, is broken by side channels crossing the floodplain *PHOTO: CNS (Len Wagg)*

700
Western

The Western ecoregion is characterized by a milder climate than the rest of Nova Scotia. This eastern portion of the Appalachian peneplain slopes gently southeast towards the Atlantic Ocean. Typical elevations of 275 m above sea level occur along the northern boundary. White pine, hemlock and red oak are more prominent here than elsewhere in the province. Slate ridges, granite uplands and till plains, drumlin fields, and extensive wetlands and barrens make up this ecoregion, which covers 16 870 km^2, or 30.5% of the province.

No part of the ecoregion is more than 60 km from the Atlantic Ocean or Bay of Fundy. This causes significant temperature and precipitation fluctuations between inland and near-coastal locations. Prevailing westerly winds direct warmer temperatures inland from the Gulf of Maine, with colder Atlantic temperatures buffered by the **Atlantic Coastal (800)** ecoregion. Overall, the ecoregion has early springs, warm summers and milder winters, with mean annual precipitation of 1300–1500 mm.

The Western ecoregion is underlain by folded Paleozoic slates and quartzites (greywacke) in the southwest. An elevated and larger portion is underlain by an extensive granitic batholith arcing northerly from Yarmouth to Halifax. Many areas of the ecoregion are covered by stony, discontinuous veneers and blankets of coarse, gravelly glacial tills.

Some of Nova Scotia's longest rivers originate from the uplands of the South Mountain, including the LaHave, Mersey and Medway. Chains of lakes, streams, and stillwaters are abundant. Much of the freshwater is susceptible to acidification due to the low buffering capacities of the thin soils and tills derived from the underlying quartzite, slate and granite bedrock. Surface water is less acidic in drumlin areas.

Soils in the Western ecoregion are dominated by stony, medium to coarse textured glacial tills high in granite and/or quartzite. Orthic Humo-Ferric[1] and Ferro-Humic Podzols are the main soils found in well drained areas, with Gleyed subgroups associated with imperfectly drained sites. Cemented (Ortstein) subgroups are also common in coarse, granitic soils. In addition, Sombric Podzols are often found in drumlin landscapes that are more loamy and higher in fertility.

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1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

The Spruce Hemlock Forest Group occurs on fresh to fresh-moist, nutrient medium zonal sites. Slightly richer sites such as drumlins provide conditions for shade tolerant hardwood and mixedwood forests of sugar maple, beech, yellow birch, red spruce and hemlock. Black spruce occurs where there is excessive soil moisture, low nutrient availability, or shallow soils. White pine, red pine and red oak are found where soils are drier and nutrient poorer.

Although balsam fir occurs in most of the forest types, its dominance within stands has been reduced by the damaging effects of the balsam woolly adelgid, a gout-causing forest pest introduced from Europe circa 1910.

Extensive heathlands—characterized by a dense growth of ericaceous (heath) plants such as lambkill, huckleberry, rhodora, blueberry, bearberry and broom crowberry—are prominent in the western portion of the ecoregion. Large tracts of poorly stocked woodlands are also abundant with slow growing black spruce, pine and red oak. These barrens and woodlands are a product of inherently low site fertility and impoverishment by repeated fires, both natural and human caused. The ecoregion is also home to extensive wetlands, many of which are next to stillwaters of slow moving rivers and streams.

Stand-level natural disturbances include fire and windthrow from hurricanes. Fire occurs due to the droughty sandy soils and a volatile fuel load of ericaceous woody shrubs and conifer forests.

Based on provincial fire records between 1959 and 1999[2], 141 lightning caused fires were recorded in the Western ecoregion, with almost half occurring in the **South Mountain (720)** ecodistrict. Fire suppression has significantly reduced the amount of area burnt by wildfire here over the past century, resulting in gradual restocking of forest species on the barren lands.

Windthrow from hurricanes can be significant in this ecoregion, especially on sites with shallow or imperfectly drained soils. However, old growth forests of pine, hemlock and spruce can also be found, indicating the infrequency of catastrophic stand disturbances on zonal sites.

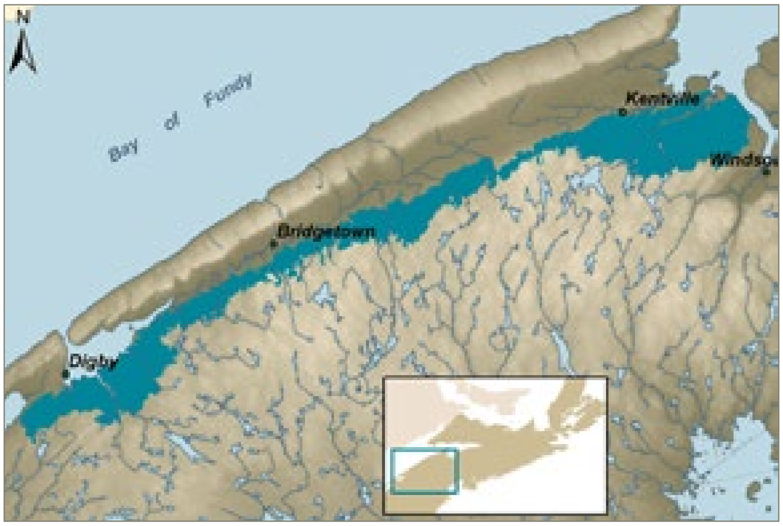
A notable and more recent impact on terrestrial and freshwater ecosystems is the deposition of airborne pollutants originating from long range transport of industrial emissions along the eastern seaboard. Large areas of the Western ecoregion do not have the soil buffering capacity to neutralize these acidic deposits, therefore freshwater acidity has increased in many rivers and lakes over the past several decades.

Historically, this region's extensive system of rivers and lakes was used to access and transport timber resources from inland areas. Today, there are still significant portions of the ecoregion with few or no roads. Abandoned agricultural lands tend to reforest to white pine and white spruce.

2 Nova Scotia Department of Natural Resources, Forest Protection Division

Shrub fen and treed swamps, interspersed with upland white pine forest, along the Shelburne River, a Canadian Heritage River. *PHOTO: CNS (Len Wagg)*

710
Valley Slope



The Valley Slope is a long, narrow ecodistrict of foothills along the north-westerly facing slope of the South Mountain. It is bounded by the **Annapolis Valley (610)** and **South Mountain (720)** ecodistricts and extends west to east from the Acacia Valley in Digby County to Mount Denson in Hants County.

With a climate warmed by westerly exposure, and situated far enough inland that cold Bay of Fundy temperatures do not impact local climate, these sheltered and often fertile slopes have been used extensively for apple orchards, vineyards and mixed farming.

Between Annapolis Royal and Middleton, granites constitute the bedrock and soils are coarse to moderately coarse, well drained and commonly gravelly, with large granite surface stones. However, slate, schist and quartzite underlie the slopes further east, with well drained, moderately coarse to fine textured soils. Freshwater lakes and streams account for only 0.5% of the ecodistrict, the lowest coverage in the ecoregion. Total area is 885 km^2 or about 5.2% of the ecoregion.

On well drained upper slopes, tolerant hardwoods are the climax forest, with sugar maple, beech and yellow birch. Lower slopes with deep moist soils, and on the shaded steep slopes of ravines, a climax forest of hemlock, red spruce, and white pine is prominent, with good examples at Kentville Ravine, and between Bridgetown and Digby. Red pine and red oak may form part of the forest on lower slopes adjacent to the **Annapolis Valley (610)** ecodistrict.

Natural disturbance agents causing stand-level disturbances are infrequent and primarily associated with windthrow from storms and hurricanes. The beech bark canker, introduced in the 1890s, has reduced the beech to an understory species, although scattered disease-free individuals are not uncommon.

View to the south, narrow forested valley at Acaciaville, Digby County *PHOTO: CNS (Len Wagg)*

Climatic climax hemlock forest, Kentville Ravine *PHOTO: DNR (Peter Neily)*

Geology and Soils

Bedrock in the eastern section of this long, narrow ecodistrict is mainly comprised of Meguma Group rock (slate, greywacke/ quartzite and schist), while the western section is mainly underlain by Devonian period granite and granodiorite.

Surficial deposits and soil parent materials are dominated by glacial till of variable thickness, especially in upper slope positions. Colluvium deposits are also common on steeper slopes, with coarse glaciofluvial deposits found along some valley corridors. Till lithology is influenced by local bedrock, but also by sedimentary and igneous material transported from the **Annapolis Valley (610)** and **North Mountain (920)** areas.

Dominant soils are derived from gravelly loam till high in shale (Morristown soils); gravelly sandy clay loam till containing shale, sandstone and mudstone (Wolfville/Hantsport soils); gravelly loam to silt loam till high in slate (Bridgewater/ Riverport soils); stony sandy loam to loamy sand till high in granitite and granodiorite (Gibraltar/ Bayswater soils); and sandy loam till containing granite, quartzite and basalt (Bridgetown soils) (**See Table 28**).

Gibraltar, Bridgetown and Morristown soils are sometimes shallow to bedrock.

Forests

Late successional Acadian softwood forests are prominent on zonal sites of medium to fine textured, moderately well drained soils (72% of the ecodistrict). Vegetation types from the Spruce Hemlock Forest Group include red spruce, hemlock and white pine on northwesterly facing slopes of the South Mountain. Regenerating overstory species, herbs typical of upland softwood forests, and an extensive moss layer make up the understory. Mid-successional stages are usually even-aged, whereas late successional stages can develop uneven-aged characteristics due the longevity of hemlock and red spruce.

On a few of the longer slopes where soil moisture and nutrients combine to increase the site richness (e.g., terraces and lower slopes), forests of

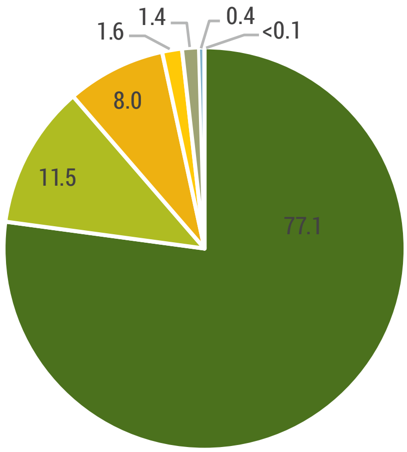
Table 28
Summary information for dominant soils found in the Valley Slope ecodistrict (710). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Morristown	31	Glacial Till, Colluvium	Medium	Well	ST2, ST2-L, ST8	Podzol
Wolfville / Hantsport	21	Glacial Till	Fine-Medium	Mod. Well-Imperfect	ST2-L, ST5, ST8, ST3-L, ST6, ST9	Podzol, Luvisol
Bridgewater / Riverport	13	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol
Gibraltar / Bayswater *	13	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol
Bridgetown *	9	Glacial Till, Colluvium	Medium-Coarse	Well	ST2, ST2-L, ST2-G, ST8	Podzol

*** Stony (S) phases are common (e.g., ST2-S).**

Ecodistrict 710
Percentage Land Cover

Forest/Woodland	77.1
Agriculture	11.5
Urban/Industrial	8.0
Shrub/Heathland	1.6
Wetlands	1.4
Water	0.4
Sparsely Vegetated	<0.1



shade-tolerant hardwood species such as sugar maple, yellow birch, beech and white ash are prominent. Moister conditions will increase the presence of yellow birch, hemlock and red spruce. Red maple is a canopy component on most sites.

Steep-sided ravines following rivers and streams leaving the South Mountain have rapid to well drained soils and support mixed forests of hemlock, red spruce, white pine, sugar maple, yellow birch and beech. However, very steep and/or lower slopes usually have a stronger component of hemlock. Where soils are shallow to bedrock, red spruce and hemlock occur, and are noticeable on escarpments and crests.

At a few locations (e.g., near Nictaux), deep glaciofluvial deposits have created coarse (sandy), excessively drained and inherently poorer soils, which provide favourable conditions for white pine, red pine and red oak forests.

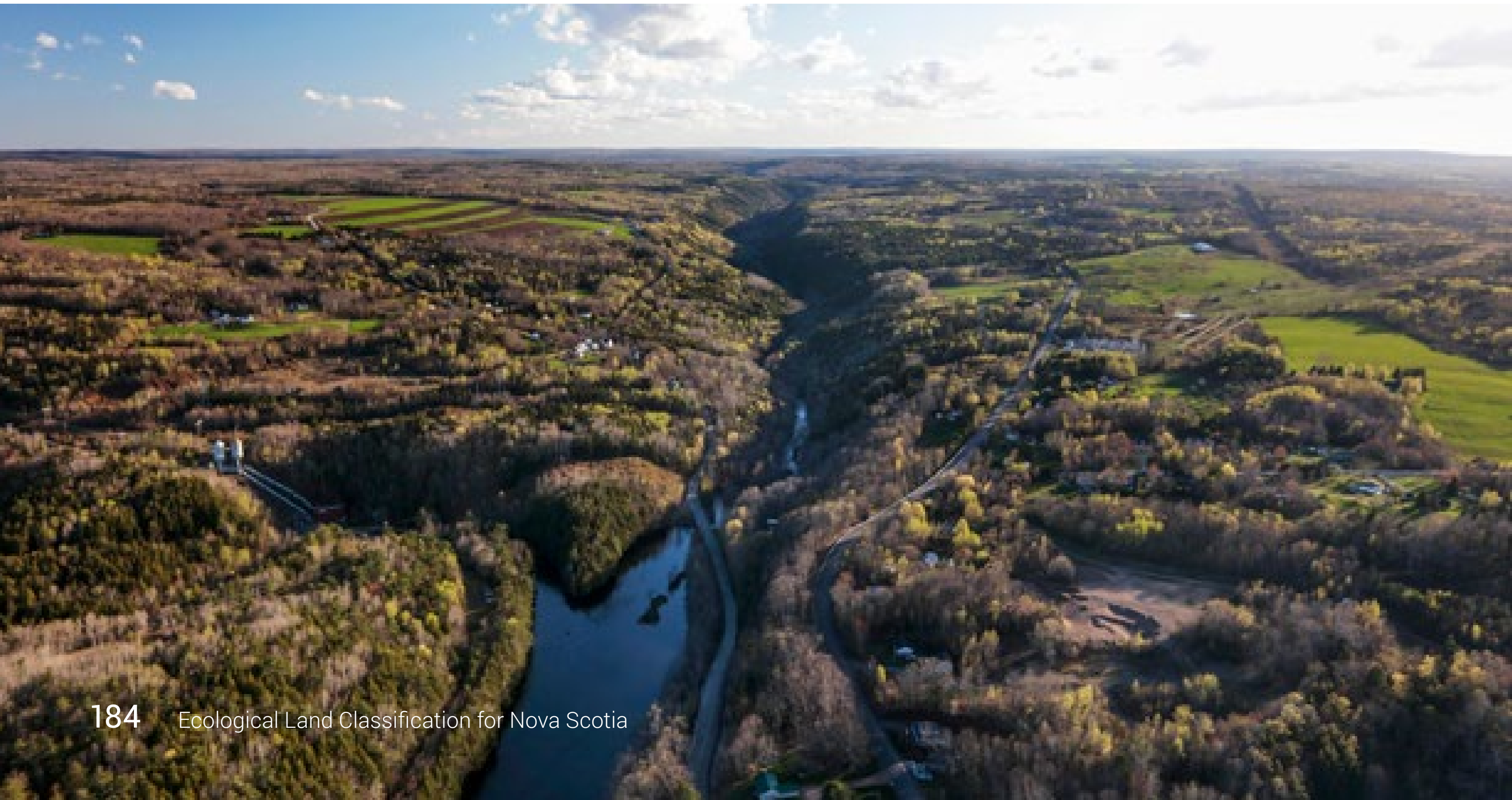
Stand-level natural disturbances from hurricanes and fire are infrequent within the Spruce Hemlock Forest Group, and stands may develop an uneven-aged or old growth structure with small gap disturbances providing openings in the canopy for new growth.

Mixedwood forests in the sheltered ravines tend to be infrequently disturbed by similar agents and can also develop uneven-aged structure.

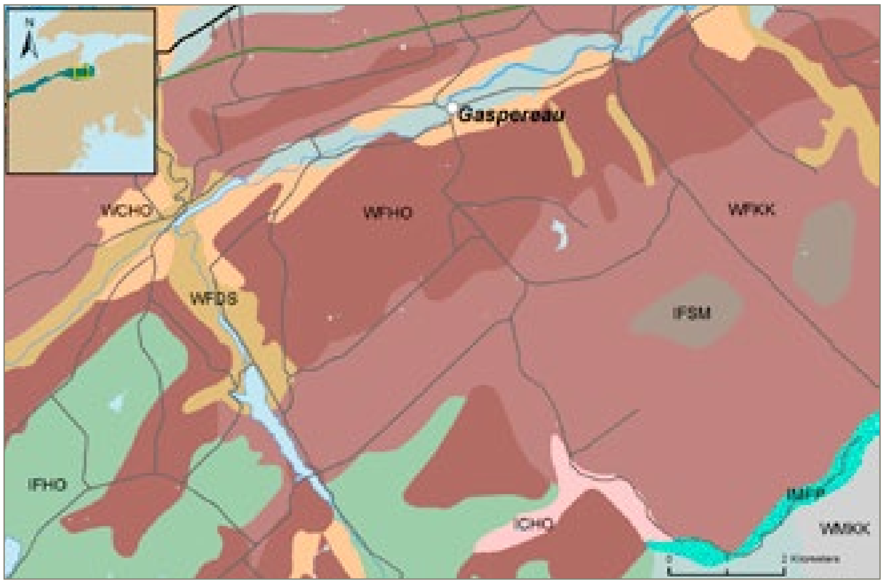
Effects of natural disturbances in shade tolerant hardwood forests are primarily small canopy gaps caused by individual tree mortality or small patches created by windthrow. Beech in this forest has been reduced to a lower canopy species due to the beech bark canker.

Much of the arable land in this ecodistrict has been cleared for orchards, forage, and field crops. If agricultural lands are abandoned, they revert to forests of white spruce and aspen.

The Gaspereau River canyon cuts through the South Mountain slopes *PHOTO: CNS (Len Wagg)*



Ecodistrict 710



Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WFKK	31.5%	31.5%
WFHO	14.9%	46.4%
WMHO	13.4%	59.8%
WCKK	11.2%	71.0%
WMKK	7.6%	78.6%
WCHO	5.3%	83.9%
IFHO	5.1%	89.1%
WMDS	3.1%	92.1%
WFDS	2.7%	94.9%
IMHO	1.3%	96.1%
IFSM	0.8%	96.9%
WCDS	0.7%	97.6%
ICHO	0.5%	98.1%
XXWA	0.5%	98.6%
POSM	0.4%	99.0%
IMFP	0.3%	99.3%
WMSM	0.3%	99.6%
WCRD	0.2%	99.8%
ICSM	0.1%	99.9%
WFSM	0.1%	100.0%
XXMS	< 0.1%	100.0%

Non Forests

The Valley Slope ecodistrict descends from 270 m on the edge of the **South Mountain (720)** to sea level on the valley floor. Mean elevation is about 130 m. The Valley Slope is one of the more rugged ecodistricts on the mainland, with somewhat more subdued relief than either the **Parrsboro Shore (910)** or **Cobequid Hills (340)** ecodistricts.

The Valley Slope is the fifth most extensively forested ecodistrict in Nova Scotia. Soils are favourable for tree growth, and sparsely treed woodlands are scarce. Approximately 2.8% of the ecodistrict is non-forested, which is about evenly divided between wetland and upland. Water bodies (lakes, ponds, rivers and streams) are also uncommon, occupying less area than in any other ecodistrict in the Western ecoregion.

Open peatlands (includes bogs and fens) and shrub swamps are the typical wetlands in the Valley Slope ecodistrict, and individual wetlands are on average among the smallest in the province. The ecodistrict supports moist shrublands around the periphery of many wetlands. Low growing heathland and lichen-dominated ground vegetation is restricted to rock outcrops and some of the sand deposits that extend up from the Annapolis Valley floor onto the slope of South Mountain.

A mix of orchards, fields and forests near Coldbrook, Kings County *PHOTO: CNS (Len Wagg)*

720
South Mountain

The South Mountain ecodistrict is a rugged upland of pine and spruce dominated forests, shallow and coarse textured soils, granite boulders, and bedrock exposures. Characterized by abundant lakes, rivers and wetlands, this ecodistrict extends 150 km in a long arc from east of the Sissiboo River to Panuke Lake, and 75 km north to south. It includes the highest elevations in western Nova Scotia at about 289 m, with a mean elevation of 175 m above sea level. Headwaters of some of Nova Scotia's longest rivers originate here, including the Medway, Mersey, LaHave, Jordan and Roseway.

The climate consists of warm, early springs and warm, dry summers which, when combined with the coarse, shallow soils, creates soil moisture deficits during the growing season. Winters are moderately mild, although if snow is going to accumulate in western Nova Scotia, it is most likely on the higher elevations.

The South Mountain is the second largest ecodistrict in the province and the largest in the Western ecoregion with a total area of 4552 km^2 or 27% of the ecoregion.

Sloping towards the Atlantic Ocean, this boulder-strewn landscape has stony, dry, shallow, coarse textured soils derived from granitic till of inherently low fertility. Approximately 5.5% of the ecodistrict has exposed bedrock outcrops. This is due in part to the absence (or shallowness) of glacial till and because of repeated wildfires that have prevented accumulation of organic matter.

White pine and rocky lakes are iconic of the South Mountain ecodistrict. *PHOTO: CNS (Len Wagg)*

Drumlins—all with coarse, gravelly soils—are numerous near Fisher Lake and scattered throughout the ecodistrict. Lakes and rivers are abundant and approximately 7.5% or 342 km^2 of the ecodistrict is comprised of freshwater. More than 15% of all inland freshwater in Nova Scotia is found in this ecodistrict.

The Acadian softwood forest—primarily eastern hemlock, red spruce, and white pine—occurs as a late successional forest on the zonal sites with fresh to fresh-moist soils of medium fertility. Scattered throughout the ecodistrict, on the richer sites, will be climax Acadian hardwood forests of sugar maple, yellow birch and beech, particularly on drumlins and the upper slopes of long hills. Red oak, red pine and white pine are commonly found where soils are dryer, very coarse and less fertile, and where fire has been a disturbance.

Wildfire, hurricanes and a long history of forest harvesting have influenced the current forests of this ecodistrict. Repeated fires in some areas have impoverished sites and created open woodlands. However, fire suppression efforts over the past 100 years have allowed forests to redevelop on some of these sites. Typically natural disturbances are infrequent and spruce hemlock forests can develop an uneven-aged or old growth structure.

Two introduced forests pests—balsam wooly adelgid and beech bark canker—have reduced balsam fir and beech to primarily an understory component in most of the forest stands where they occur.

Abandoned farmland on drumlins tends to reforest with white pine.

Geology and Soils

Geology within the South Mountain ecodistrict is dominated by the South Mountain Batholith—a massive granitoid formation that underlies much of western Nova Scotia. This batholith is the largest of its kind within the Appalachian orogenic belt—the mountain range that runs through northeastern North America.

Surficial deposits are mainly comprised of stony, granitic glacial till that is often shallow to bedrock. Almost the entire ecodistrict is mapped as Gibraltar/Bayswater soils which are derived from this parent material. Surface stoniness in these soils is usually high and sometimes excessive. Gibraltar/Bayswater soils are also prone to natural cementation by iron oxides and organic matter (Ortstein soils).(**See Table 29**).

Hummocky terrain, shallow soil and bedrock-controlled drainage have also led to the formation of many hydric soils in this ecodistrict. These soils are often associated with pocket wetlands (mainly treed swamps) found in low-lying areas adjacent to well drained uplands.

Forests

Forests in the South Mountain ecodistrict have been strongly influenced by several factors including a long history of forest harvesting and uncontrolled wildfires. White pine is a typical component of most stands regardless of site conditions. Red oak is also prevalent. Growth potential of all forests in this ecodistrict is greatly influenced by the granite till and surface stoniness.

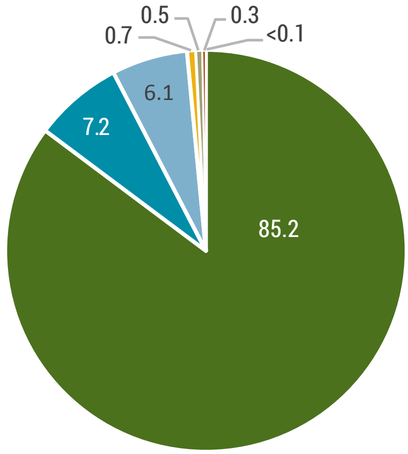
Table 29
Summary information for dominant soils found in the South Mountain ecodistrict (720). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Gibraltar / Bayswater *	80	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol
Hydric	10	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST4G	Organic, Gleysol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 720
Percentage Land Cover

Forest/Woodland	85.2
Water	7.2
Wetlands	6.1
Urban/Industrial	0.7
Shrub/Heathland	0.5
Agriculture	0.3
Sparsely Vegetated	<0.1



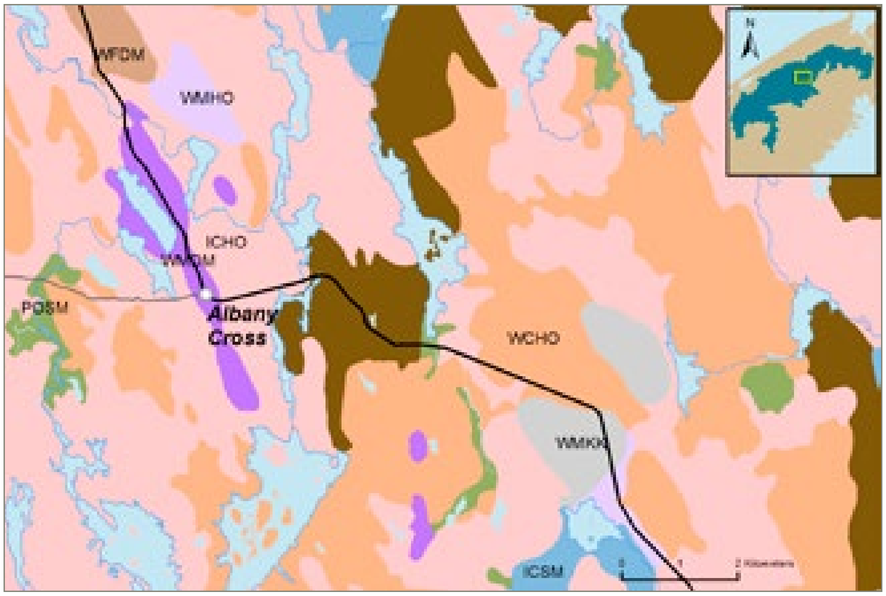
The Spruce Hemlock Forest Group is typical on well to moderately well drained soils of medium fertility. Red spruce, white pine and hemlock will occupy most slope positions where these conditions exist. Balsam fir is usually associated with earlier successional stages, but is often present in all stands at some stage of development.

The shrub layer is mainly regenerating overstory species, but lambkill and blueberry are common on poorer sites. Typical woodland flora includes bunchberry (*Cornus canadensis*), wild lily-of-the-valley (*Maianthemum canadense*), bluebead lily (*Clintonia borealis*), sarsaparilla (*Aralia nudicaulis*) and starflower (*Trientalis borealis*), with bracken (*Pteridium aquilinum*) also found on poorer sites. Schreber's (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) create an extensive moss layer in most stands, and where there is an abundance of decaying wood, Bazzania (*Bazzania trilobata*) is also common. Mid-successional stages are usually even-aged whereas late successional stages can develop uneven-aged characteristics due to the longevity of red spruce and hemlock.

There are extensive areas in the ecodistrict of imperfectly drained sandy soils or shallow soils on bedrock ridges and outcrops. These soils have low inherent fertility and the Spruce Pine Forest Group dominates with black spruce, pine (white and red) and red oak. Shade intolerant hardwoods such as largetooth aspen, red maple and white birch will follow stand-level disturbances. White pine often forms a super canopy over black spruce.

Spruce Pine vegetation types will be found on a range of slope positions. The understory is dominated by a variety of shrubs and herbs tolerant of acidic (nutrient poor) soils. Ericaceous shrubs (e.g. lambkill, blueberry, huckleberry), witch-hazel and black spruce regeneration (often through layering), are typical. Bracken (*Pteridium aquilinum*) and teaberry (*Gaultheria procumbens*) are common along with prince's pine (*Chimaphila umbellata*) and round-leaved pyrola (*Pyrola americana*).

Forests and wetlands on the South Mountain, east of New Albany, Annapolis County PHOTO: CNS (Len Wagg)



Ecodistrict 720

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
ICHO	40.2%	40.2%
WCHO	22.0%	62.2%
WCKK	15.4%	77.6%
XXWA	7.5%	85.2%
ICSM	5.1%	90.3%
POSM	3.4%	93.7%
WCDM	1.6%	95.3%
WMDM	1.1%	96.4%
IMHO	0.8%	97.2%
WMHO	0.8%	98.0%
WMKK	0.5%	98.5%
WCRD	0.4%	98.9%
WFDM	0.2%	99.1%
ICRD	0.2%	99.3%
WCSM	0.1%	99.5%
IMDM	0.1%	99.6%
ICKK	0.1%	99.7%
WCDS	0.1%	99.8%
IMSM	0.1%	99.9%
WFHO	< 0.1%	99.9%
ICFP	< 0.1%	100.0%
IMFP	< 0.1%	100.0%

The Tolerant Hardwood Forest Group is not abundant in this ecodistrict and occurs primarily on drumlins and on a few crests and upper slopes. Drumlins are small elongated hills of unsorted glacial tills that have well drained productive soils. Sugar maple, yellow birch, red maple, beech and red oak are representative species. Regenerating tree species, striped maple, and a dense layer of several fern species create the understory.

Shrublands of leather leaf, rhodora, lambkill and Labrador tea are found next to slow moving water and streams. These shrub land areas have poorly drained organic and mineral soils with water levels at or near the surface. Fens of red maple are also typical along these stillwaters. On upland sites with poor soil drainage, black spruce, tamarack and red maple dominate the forest vegetation.

Stand-level natural disturbances are infrequent on zonal sites, and late successional softwood and hardwood forests can develop uneven-aged or old growth structure with small gap disturbances creating canopy openings for new growth.

Depending on the type and severity of natural disturbances agents such as hurricanes, wind and fire, regeneration can revert to earlier successional stages dominated by red maple and white birch. Or, if natural regeneration is saved, stands will more quickly revert back to late successional species.

On edaphic sites where moisture and fertility are limiting factors, forests are typically more susceptible to stand-level disturbances and develop even-aged stand structure. Fire in this ecodistrict is aggravated by dry summer conditions and the local abundance of "fuel" in the form of ericaceous vegetation and spruce/pine litter in the understory. Where sites have been repeatedly burned and impoverished, barrens of woody ericaceous shrubs, scrubby black spruce, white pine, red oak and red maple with reindeer lichens (*Cladonia spp*.) are typical.

A small pond slowly filling in with peat and other water loving plants *PHOTO: CNS (Len Wagg)*

Big Molly Upsim Lake, one of many lakes on the South Mountain that are being used for hydroelectricity generation. Damming has increased water levels and flooded forested areas which are now part of the flowage area. *PHOTO: CNS (Len Wagg)*

Non Forests

Most non-forested ecosystems are wetland. Open uplands are limited to small rocky outcrops and cliffs adjacent to rounded summits, boulder plains left after glaciation, outwash deposits, and the tops of sandy eskers and kames. Rock bluffs are characterized by low growing heathland or ground lichens. These lichen dominated ecosystems can be quite striking with extensive areas of snow lichen (*Stereocaulon spp.*), reindeer lichen (*Cladonia spp.*), and rock tripe (*Umbilicaria spp.*).

The heathlands in the South Mountain ecodistrict often show evidence of historic fire. However it is not possible to conclusively determine how recent these fires were without using carbon dating.

Heathlands tend to be dominated by lambkill, huckleberry, broom crowberry, and low bush blueberry. It is uncommon to find large heathlands, and the area of many appear to be decreasing due to tree encroachment.

Similar to most of the other ecodistricts in this ecoregion, shrub swamps and open peatlands occupy the majority of wetland area. Some of the ecodistrict's more interesting open wetland species are its Atlantic Coastal Plain Flora, which include rare and provincially and/or nationally endangered species.

Although Atlantic Coastal Plain Flora are more common in other parts of the Western ecoregion, they are still relatively well represented here. In the South Mountain ecodistrict, plymouth gentian (*Sabatia kennedyana*), slender blue flag (*Iris prismatica*), smooth alder (*Alnus serrulata*), and swamp loosestrife (*Decodon verticillatus*) are some of the more rare coastal plain flora documented from lakes shores and open peatlands.

730 Clare

The Clare ecodistrict, a heavily drumlinized till plain, rises slowly from the shores of St. Mary's Bay and extends inland to the uplands of the South Mountain granite batholith. Similar to **Rossignol (750)** and **Sable (760)**, Clare ecodistrict is really a lowland with little relief and relatively homogenous landform diversity. Elevation is on average only 50 m, rising to about 160 m above sea level in the interior. Extending from Digby to Yarmouth, this northwestern corner of the Western ecoregion includes inland and coastal habitats and covers 1916 km^2 or about 11.4% of the ecoregion.

Early, mild springs followed by cool summers and mild winters typify the climate of the ecodistrict. Approximately 1300–1400 mm of precipitation is received annually. The Clare ecodistrict also has the longest growing season in the province, with 210 growing degree days (5°C basis).

Underlain by greywacke, slate, quartzite and schists, the soils are predominantly well-drained, stony, sandy loams. Imperfectly drained soils are found on level terrain between drumlins and hummocks, as well as in those areas where internal drainage has been restricted due to glacial soil compaction. The ecodistrict is heavily covered with lakes and rivers (9.6% of its area is freshwater).

The narrow properties at Meteghan reflect the early ownership system of Acadian settlers, which provided access to the shore of St. Mary's Bay. *PHOTO: CNS (Len Wagg)*

Skunk cabbage is our first plant to flower in the spring. This unique species produces enough heat to melt through the snow, revealing its flower to early insect pollinators. *PHOTO: DNR (Eugene Quigley)*

Zonal sites support productive forests of shade tolerant species such as hemlock, red spruce, beech, sugar maple and yellow birch, with white ash and ironwood on the most fertile sites. As the soils get progressively wetter on the level terrain, the proportion of black spruce and tamarack increases until red maple dominates the forested wetlands. Natural disturbances in the forest are infrequent and usually associated with hurricanes, storms, and occasionally fires.

In Clare much of the landscape reflects the ownership system of early Acadian settlers, whereby land grants provided access to the coast. When land was passed on through family inheritance, these lots were often subdivided and re-subdivided maintaining coastal access but creating narrow properties often less than 100 m in width. This ownership pattern significantly altered the forest landscape by fragmenting the forest into many small patches due to harvesting practices and road building.

Geology and Soils

The Clare ecodistrict is mainly underlain by Cambrian and Ordovician period Meguma Group rock (slate, greywacke/quartzite and schist), but there is also a smaller zone of younger Silurian period rock that includes basalt and rhyolite.

The landscape is a drumlinized till plain comprised of numerous low drumlins (generally under 20 m) with variable texture and stoniness depending on parent material attributes. Drainage patterns are also highly correlated with slope position in this landscape, with imperfectly to poorly drained areas found between well drained drumlin slopes.

Dominant soils are derived from gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); gravelly loam to silt loam till high in slate (Bridgewater/Riverport soils); gravelly sandy loam till high in mica and hornblende schist (Yarmouth/Deerfield soils); and gravelly sandy loam to loam till high in schist and quartzite (Mersey/Liverpool). (**See Table 30**).

Compact subsoils and low lying areas found between drumlins has also led to significant hydric soil development in this ecodistrict.

Table 30
Summary information for dominant soils found in the Clare ecodistrict (730). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Halifax / Danesville *	49	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Bridgewater / Riverport	17	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol
Hydric	16	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Yarmouth / Deerfield	9	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L, ST8, ST9	Podzol
Mersey / Liverpool	7	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L, ST8, ST9	Podzol

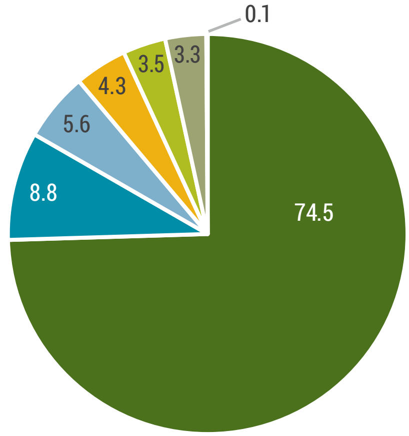
Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Forests

Late successional mixedwood forests of shade tolerant Acadian forest species such as sugar maple, beech, yellow birch, red spruce and hemlock occur on hummocky topography and drumlins 75% of the ecodistrict).

The abundance of various tree species is dictated by slope position which strongly influences soil moisture and nutrient levels. Yellow birch and softwood most typically occurs on lower slopes, and ironwood and white ash are most likely where soils are enriched. Red oak and red maple may also be stand components.

Under a closed canopy the shrub layer can be moderately developed, and includes mainly regenerating tree species, striped maple and fly-honeysuckle. Several fern species are present in the well-developed herb layer, including evergreen wood fern (*Dryopteris intermedia*). Various clubmosses, wood-sorrel (*Oxalis montana*), wood aster (*Oclemena acuminate*), and rose twisted stalk (*Streptopus lanceolatus*) are common. Early and mid-successional forests following stand-level disturbances will have red maple, white pine, red spruce, white birch, aspen, balsam fir and red oak.



Ecodistrict 730 Percentage Land Cover

Forest/Woodland	74.5
Water	8.8
Wetlands	5.6
Urban/Industrial	4.3
Agriculture	3.5
Shrub/Heathland	3.3
Sparsely Vegetated	0.1

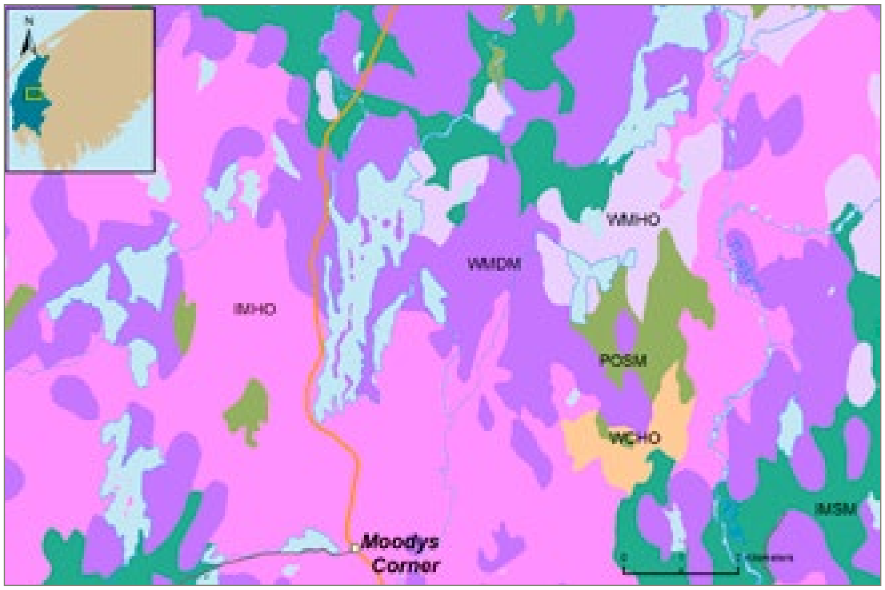
Elsewhere, forests of black spruce, tamarack and red maple on imperfectly to poorly drained soils, along with large areas of shrubby wetlands, occupy much of the flat topography of the ecodistrict. Although Spruce Pine forests may occur on a variety of terrain and site conditions, soils are generally nutrient poor and moisture is a limiting factor—either too much or too little. Many of the soils along St. Mary's Bay have originated from wave washed gravels and marine sediments.
A significant understory of woody ericaceous shrubs is typical under these Spruce Pine forests. As soil drainage gets progressively poorer, black spruce, tamarack and red maple increase with cedar locally. Where the soils tend to be droughty, a typical pine / oak forest with ericaceous understory vegetation is common.

(left) Tolerant hardwood forest on a drumlin near Lake George; *(right)* Cedar, a provincial species-at-risk, at Little Tedford Lake, Yarmouth County PHOTO: DNR (Peter Neily)

Ecodistrict 730

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	34.8%	34.8%
WMDM	25.8%	60.7%
WMHO	14.4%	75.1%
XXWA	9.6%	84.7%
IMSM	6.8%	91.6%
POSM	3.8%	95.4%
WMKK	1.3%	96.7%
WCHO	1.3%	98.0%
ICHO	0.7%	98.7%
IMDM	0.4%	99.1%
WMDS	0.4%	99.5%
ICSM	0.3%	99.8%
XXMS	0.1%	99.9%
XXCB	0.1%	100.0%



Natural disturbances are infrequent in Clare. Stands on zonal sites comprised of species with longevity and shade tolerance can develop old forest characteristics when small gaps are created in the canopy by individual tree mortality or by windthrow. If these forests are harvested early, successional forests of red maple, white birch, aspen, red oak and balsam fir will follow. Historically much of this forest was cleared and converted to other land uses, however, when abandoned, the lands tend to revert to forests of white spruce, tamarack, aspen and occasionally red spruce.

The dominant natural disturbances are windthrow (due to the shallow rooting of black spruce on moist to wet soils), and fire (where soils are dry during the summer and fuel loads include pine and spruce litter and ericaceous shrubs). However, wildfires caused by lightning are infrequent due to the moist and humid climate and the frequent occurrence of fog in the summer.

Tidal sand flats and beach at Mavilette Beach Provincial Park
PHOTO: CNS (Len Wagg)

Salt marsh along the road to Cape St. Mary's *PHOTO: CNS (Len Wagg)*

Non Forests

Clare is the only ecodistrict in the Western ecoregion with an extensive coastline. Its coast is sheltered from the harsher climatic conditions typical of the Atlantic and Fundy coasts. As a result, a number of the ecosystems more prevalent on other coasts are absent or poorly developed in this ecodistrict. There are some exceptions to this pattern, however. The shoreline from Bear Cove Point to Cape Saint Mary's is more exposed and has a narrow ribbon of coastal forest, stunted shrubland, and low growing coastal heath. There are also a number of beaches and dunes found in the Clare ecodistrict. Among those of note are Port Maitland, Mavillette, and Bartlett's Beaches. The dunes behind the latter two beaches are somewhat low and show disturbance by past and present human activities. In general, the dune-beach complexes here are typical of many of the smaller systems in the province.

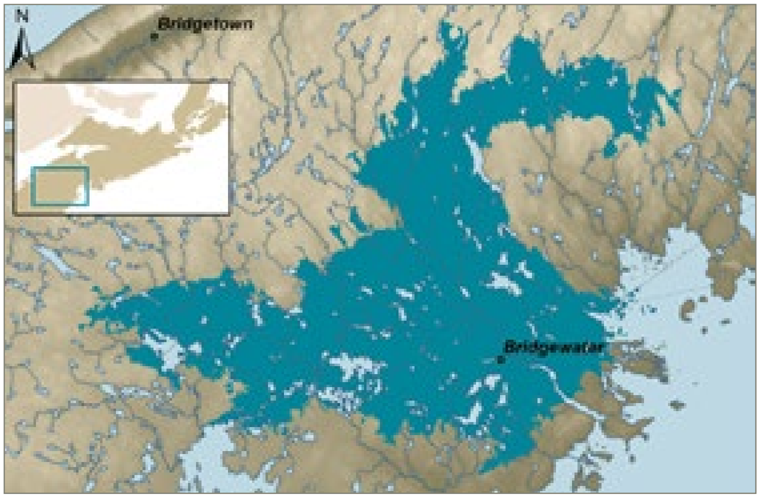
About 7.5% of the ecodistrict is non-forested (excludes water bodies), which is slightly less than the provincial average. About two thirds of that is wetland and the remainder is taller shrubland. Although shallow water wetlands and shallow marshes make up more area in Clare than in other ecodistricts in this ecoregion, most open wetlands here are shrub swamps and peatlands.

Wetlands of the Clare ecodistrict host more Atlantic Coastal Plain Flora than almost any other ecodistrict in Nova Scotia (second after **LaHave Drumlins (740)** ecodistrict). Atlantic Coastal Plain Flora are a group of temperate vascular plants with affinity to the Atlantic Coastal Plain, a physiographic region that extends along the eastern seaboard from Texas to Massachusetts. Nova Scotia is not part of the Atlantic Coastal Plain, although that physiographic region does extend under the ocean off the province's Atlantic shore.

A number of Atlantic Coastal Plain plants reach the northern limit of their North American range in western Nova Scotia. They are disconnected from the true coastal plain and from the main part of continental populations.

Atlantic Coastal Plain Flora occur in a variety of habitats, but they are most strongly expressed along lakeshores, in peatlands and marshes, and in shrub and treed swamps. These coastal plain flora do exceptionally well in this part of Nova Scotia because water bodies and wetlands are prevalent, and because the climate is generally mild.

740
LaHave Drumlins



The LaHave Drumlins is a broad ecological landscape extending from sheltered areas of Mahone Bay north to the interior of Kings County. It extends into the western edge of Hants and Halifax Counties all the way to the northwestern boundary of Kejimkujik National Park. This drumlinized till plain is considered one of the best drumlin landscapes in eastern North America—with drumlins formed as a classic streamlined, teardrop-shaped deposit of glacial till, with the tapered or narrow end pointing in the direction of glacial movement. The drumlins rise roughly 40–50 m, punctuating the landscape with unique ecosystems from the surrounding matrix forest.

Sloping southeasterly towards the Atlantic Ocean, this area of Nova Scotia has a pleasant climate with early, warm springs and a long growing season, followed by a relatively mild winter. The area receives approximately 1400–1500 mm of precipitation annually. Total area is 2751 km^2 or about 16.3% of the ecoregion.

Soils throughout the ecodistrict are generally derived from a slate-based parent material with a few areas underlain by granite. Much of the soils between the drumlins tend to be shallow and imperfectly drained, with slate bedrock just below the surface. The soils on drumlins are unsorted glacial tills. They tend to be well drained and deeper, and have been used extensively for farming and settlement. Aside from a few interior uplands, mean elevation in LaHave Drumlins is just over 110 m with some uplands rising to about 250 m, similar to the highest summits of the **South Mountain (710)** ecodistrict. Total freshwater area in the ecodistrict is 27 631 ha or 10% of its total.

LaHave Drumlins is dominated by coniferous forests, with tolerant hardwoods on the upper slopes of drumlins and well-drained hills. Sugar maple, red oak and beech are also found on the valley floors of the major waterways.

Titus Smith, during his western tour in 1802, (Hawdoldt, 1955) reported elm in the LaHave River valley—the first they had seen since leaving Halifax.

A well-developed drumlin field punctuates the landscape at Westfield, Queens County *PHOTO: CNS (Len Wagg)*

Hemlock, red spruce and white pine occur on side slopes of the drumlins and on moist soils of lower slopes. Forests of black spruce, white pine and red maple are dominant on imperfectly drained soils.

After disturbance, balsam fir is an early component of the coniferous forest in this ecodistrict and has been developed as a significant commercial resource as a preferred species for Christmas tree cultivation.

Geology and Soils

As suggested by its name, the LaHave Drumlins ecodistrict is characterized by its many, well developed drumlins. Beneath these till deposits lies mainly Meguma Group rock (slate, greywacke/quartzite and schist), with Halifax Formation slate particularly prominent. There are also smaller areas in the northeastern section of the ecodistrict underlain by Devonian period granitoid rock (part of the South Mountain Batholith).

Drumlin deposits tend to be less stony and finer-textured than surrounding till—a result of increased slate content in these deposits. Indeed it is the abundance of easily sheared slate bedrock in this ecodistrict that provided much of the material for drumlin development.

Dominant soils are derived from gravelly loam to silt loam till high in slate (Bridgewater/ Riverport soils); gravelly sandy clay loam till containing shale, sandstone and mudstone (Wolfville/Hantsport soils); gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); and stony sandy loam till high in granite, quartzite and slate (Gibraltar/Farmville soils). (**See Table 31**).

Although all soil series can be associated with drumlin formations, Bridgewater and Wolfville are the most common drumlin soils.

Forests

Drumlin or drumlin-like landforms (46% of the ecodistrict) provide fresh, medium to rich soils for development of a late successional Acadian forest of red spruce, hemlock, white pine, yellow birch, beech, and sugar maple.

The composition of the glacial till also influences the dominance of the overstory species, with some stands exhibiting climax hardwood while others have climax mixedwood or softwood vegetation types. A similar forest dominated by shade tolerant softwood species occurs on well drained hummocky terrain (26% of the ecodistrict).

Often crests and upper slope positions are preferred by hardwood species, with red spruce, white pine and hemlock becoming more dominant on lower slope positions and on slopes adjacent to rivers and lakes.

Shrub layers include regenerating trees, striped maple and fly-honeysuckle. Typical woodland flora include ferns, club-mosses and various flowering perennials such as bluebead lily (*Clintonia borealis*), starflower (*Trientalis borealis*), Indian cucumber root (*Medeola virginiana*), partridge-berry (*Mitchella repens*) and wood aster (*Oclemena acuminate*). Red oak and red maple often occur in the overstory.

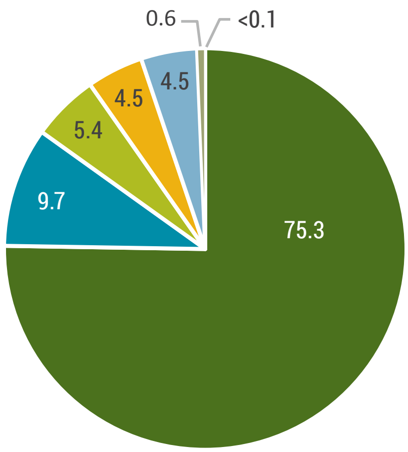
Table 31
Summary information for dominant soils found in the La Have Drumlins ecodistrict (740). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Bridgewater / Riverport	47	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol
Wolfville / Hantsport	25	Glacial Till	Fine-Medium	Mod. Well-Imperfect	ST2-L, ST5, ST8, ST3-L, ST6, ST9	Podzol, Luvisol
Halifax / Danesville *	9	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Gibraltar / Farmville *	7	Glacial Till	Medium-Coarse	Well	ST2, ST2-G	Podzol
Hydric	6	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 740
Percentage Land Cover

Forest/Woodland	75.3
Water	9.7
Agriculture	5.4
Urban/Industrial	4.5
Wetlands	4.5
Shrub/Heathland	0.6
Sparsely Vegetated	<0.1



Stand-level natural disturbances are infrequent on drumlins. Small gaps in the canopy created by individual tree or small patch level mortality provide conditions suitable for development of uneven-aged and old growth forests. Following harvesting, white pine, balsam fir and red maple generally increase in abundance.

Historically drumlins have been extensively used for settlement and farming, and natural late successional forests are uncommon. Abandoned agricultural lands typically revert to forests of white pine and occasionally white spruce. When these old field forests are harvested, balsam fir regeneration is extensive and many are used for Christmas tree cultivation.

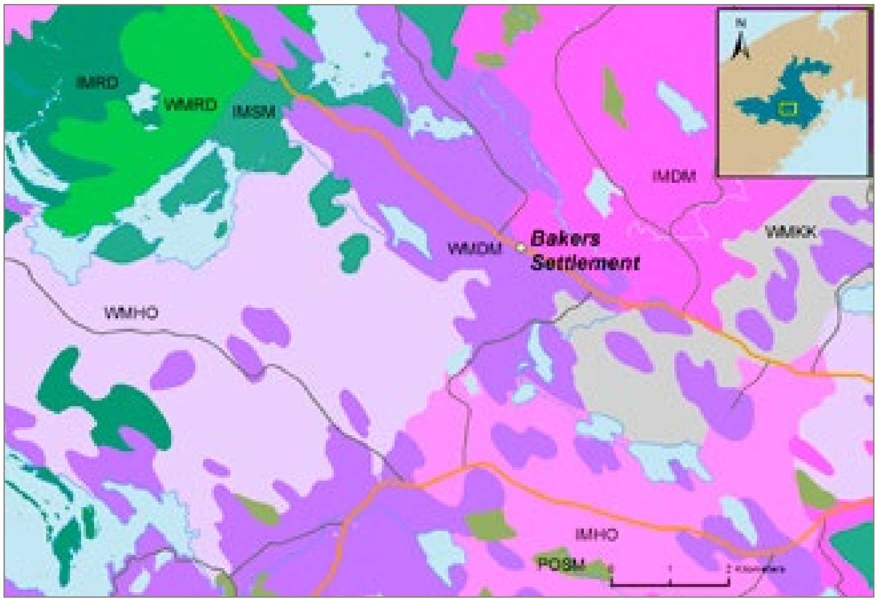
(top) Many drumlin forests have been converted to intensively managed Christmas tree plantations, like this one at Pleasant River, Queens County; *(below)* Due to settlement and farming, forested drumlins are uncommon. These at Gludogan Lake show the typical hardwood forest on the crest and upper slopes grading to mixedwood and softwood forests on lower slopes. *Photos: CNS (Len Wagg)*

The islands of Mahone Bay are drumlins with similar soils. Although surrounded by cold, salty, ocean waters, they support a comparable mixed-wood forest. Evidence of this forest is scarce due to land use pressures, although one study (SRES 2002) found local stands of red spruce and white pine with scattered sugar maple, yellow birch and hemlock—indicating that these islands are afforded some protection from the Atlantic Ocean.

Vegetation types of the Spruce Pine Forest Group occur throughout the ecodistrict on well drained, medium textured soils of inherently lower soil fertility underlying ridged terrain with exposed bedrock and boulders.

These forests are primarily composed of black spruce, red maple and white pine. Drier and less fertile soils, often coarse and/or shallow to bedrock, support red oak, white pine and red pine. A dense understory of ericaceous vegetation creates both regeneration problems for tree species and a potential fire hazard.

Ecodistrict 740



Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMDM	25.7%	25.7%
WFDM	12.5%	38.2%
IMSM	11.6%	49.8%
XXWA	10.0%	59.8%
IMHO	8.4%	68.2%
WMHO	8.4%	76.7%
WFHO	6.7%	83.3%
IMDM	5.7%	89.1%
POSM	2.3%	91.4%
IMRD	2.0%	93.4%
WMKK	1.9%	95.2%
WMRD	1.2%	96.4%
IFHO	1.1%	97.6%
WCHO	0.6%	98.2%
IFSM	0.6%	98.8%
ICRD	0.5%	99.3%
ICSM	0.5%	99.8%
ICFP	0.2%	100.0%
IMFP	< 0.1%	100.0%
XXCB	< 0.1%	100.0%
WMFP	< 0.1%	100.0%

Red oak is also a minor constituent in many early successional forest types following disturbance from harvesting or fire. Red oak is associated with aspen, white birch and red maple on drier sites.

On level terrain, with imperfectly to poorly drained shallow soils over bedrock, forests of black spruce, white pine and red pine are typical. As soil drainage gets progressively poorer, wet forests of red maple, tamarack, alders, false holly, winterberry, and other woody shrubs are common.

Often embedded in this forest are wet open woodlands. Where soils are less fertile, shallow to bedrock or have been impoverished by repeated wildfires, open black spruce woodlands with ericaceous vegetation and bracken (*Pteridium aquilinum*) are dominant.

Windthrow from hurricanes, fire and/or senescence are common stand replacing natural disturbances in the Spruce Pine Forest Group, limiting the potential for old growth forest development. Earlier successional forests include similar species, as well as white birch and aspen. Due to the local abundance of "fuel" in the form of pine/spruce litter and ericaceous vegetation, intense fires are possible, although fire suppression efforts have reduced this hazard.

Hardwood forests starting their spring flush on drumlins at Upper Gully Lake, Lunenburg County (north of Forties). *PHOTO: CNS (Len Wagg)*

Marsh and shrub fens with treed swamps surround a small pond near New Canada, Lunenburg County *PHOTO: CNS (Len Wagg)*

Non Forests

This is the most heavily forested ecodistrict in the Western ecoregion, with upland soil and climatic conditions generally very favourable for tree growth.

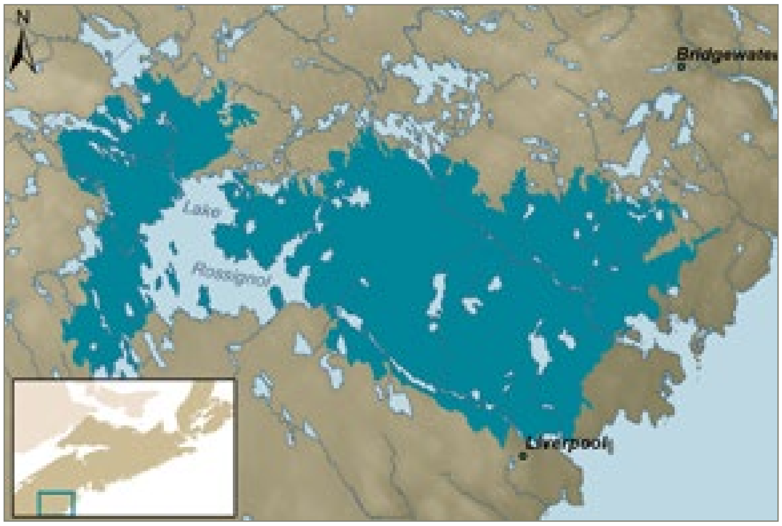
The ecodistrict is also remarkable for its aquatic and non-forested ecosystems. Lakes are very common in the LaHave Drumlins. Approximately 10% is occupied by inland water bodies, including lakes, ponds and rivers. (This is the third highest proportion of any ecodistrict in the province.) More than 10% of all the inland water in the province is found here. Individual water bodies are also among the largest in Nova Scotia. These include Kejimkujik, Ponhook, Molega, and Sherbrooke Lakes.

LaHave Drumlins is underlain by slates and greywacke, and by more minor extents of other bedrock types typical of the Western Ecoregion. Slate fragments embedded in the soil increase the nutrient potential of water and soil in the LaHave Drumlins. This increased potential is expressed in the abundance of vascular flora, and in the types of ecosystems found throughout, particularly the wetlands.

Wetlands of the LaHave Drumlins support exceptionally dense concentrations of Atlantic Coastal Plain Flora (**See Ecodistrict 730, for detailed description**). Marshes, gravelly and peaty shorelines, shrub swamps, and peatlands are the wetland types supporting most of these plants. They include shrubs such as smooth alder (*Alnus serrulata*), buttonbush (*Cephalanthus occidentalis*) and sweet pepperbush (*Clethra alnifolia*), and herbaceous species like golden crest (*Lophiola aurea*), water pennywort (*Hydrocotyle umbellate*) and redroot (*Lachnanthes caroliniana*). More Atlantic Coastal Plain Flora species are found in this ecodistrict than in any other.

Along some of the major rivers (e.g., LaHave), richer conditions support more extensive and diverse floodplains than are otherwise typical of the ecoregion. Nutrient demanding riverine plants as well as some that are range-restricted are found in the ecodistrict. These include silky willow (*Salix sericea*), wavy-leaved aster (*Symphyotrichum undulatum*), sweet wood reed grass (*Cinna arundinacea*), and false nettle (*Boehmeria cylindrical*)—found here in both forested and non-forested areas.

750 Rossignol



The Rossignol ecodistrict is largely made up of low hills and drumlin-like ridges. It includes Nova Scotia's largest inland water body—Lake Rossignol (sometimes called the Rossignol Reservoir). This expansive reservoir was created in 1929 when the Bowater Mersey Paper Company dammed the Mersey River to create electricity for its pulp mill. *(Note: the Bras d'Or Lakes are considered an inland sea because they are brackish).*

Rivers, lakes and streams constitute 18.3% (21 584 hectares) of the ecodistrict. The Mersey and Medway River watersheds, with their origins in the granite areas to the north (**South Mountain 720** ecodistrict), account for most of the area.

This part of western Nova Scotia (along with the **Sable** and **Clare** ecodistricts) has the earliest and warmest springs in the province. Approximately 1470 mm of precipitation fall annually (approx. 496 mm between May and September) but the ecodistrict still experiences a high summer moisture deficit. The whole of Rossignol ecodistrict could be considered a lowland since mean elevations are only about 75 m and the highest point is only 160 m above sea level. Total ecodistrict area is 1179 km^2, or about 7% of the ecoregion.

Soils tend to be moderately coarse, stony and shallow, making them unsuitable for agriculture. Quartzite and slate underlie these soils which are

Loon Lake, in Kejimkujik National Park and Historic Site, is part of the Mersey River watershed *PHOTO: DNR (Sean Basquill)*

Shelburne River below Sand Lake
PHOTO: CNS (Len Wagg)

derived from glacial till. Peatlands are common in the depressions of the undulating topography.

Even though it is one of the more humid areas in the province, forests in this ecodistrict are vulnerable to fire because of moisture deficits associated with sandy soils in the summer months. Wind damage to the forests occurs frequently (Rowe, 1972) and past hurricanes have caused considerable blowdown. Fires are common, but the effects have not been severe enough to cause the extensive barrens more common further to the southwest.

On lower slopes and better drained sites between hills, the climax forest is hemlock, red spruce and white pine. Black spruce becomes dominant on imperfectly drained sites, and treeless bogs are found on the wettest sites.

Shade tolerant hardwood forests occur on drumlins and larger hills with scattered white ash, hemlock, white pine and red spruce. On sites that have been frequently disturbed by fire red oak is fairly common. Once a dominant species in the hardwood forest canopy, beech has been reduced to an understory species due to mortality and growth defects caused by the beech canker.

Geology and Soils

The Rossignol ecodistrict is underlain by Halifax and Goldenville Formation (Meguma Group) rock comprised of greywacke/quartzite, slate, schist and migmatite. The Goldenville Formation contains most of the gold deposits found in Nova Scotia and there are two recognized gold districts within the Rossignol – the Mill Village Gold District and the Fifteen Mile Brook Gold District. Both areas have produced gold in the past and are still targets for exploration.

Surficial deposits and soil parent materials are dominated by quartzite and slate tills of variable thickness producing an overall hummocky to rolling terrain. Dominant soils are derived from gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils) and gravelly loam to silt loam till high in slate (Bridgewater/ Riverport soils) (**See Table 32**).

Halifax/Danesville soils are often very stony and occasionally shallow to bedrock. Variable topography and massive subsoils have also led to the formation of many hydric soils in this ecodistrict. These soils are often associated with pocket wetlands (mainly treed swamps) found in low-lying areas adjacent to well drained uplands.

Table 32
Summary information for dominant soils found in the Rossignol ecodistrict (750). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Halifax / Danesville *	60	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Bridgewater / Riverport	29	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol
Hydric	6	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4	Organic, Gleysol

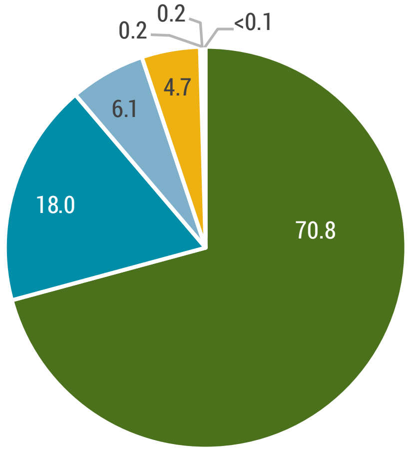
Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Forests

A late successional Acadian softwood forest of red spruce, hemlock and white pine (Spruce Hemlock Forest Group) occurs on zonal sites (50% of the ecodistrict) of fresh to fresh-moist soils of medium fertility, occurring on lower slopes of hills and hummocks, drumlins and drumlin-like flutes (linear ridges of glacial till).

Balsam fir is usually associated in all stands at some stage of development. These stands are composed of regenerating overstory species, typical woodland flora of upland softwood forests (e.g., bunchberry (*Cornus canadensis*), sarsaparilla (*Aralia nudicaulis*), wild lily-of-the-valley (*Maianthemum canadense*)), and an extensive moss layer as the understory. White pine, black spruce, and ericaceous shrubs (e.g., lambkill, huckleberry and blueberry) become more abundant on poorer sites.

Natural disturbance agents include hurricanes, wind, fire, disease and insects. Late successional forests develop an uneven-aged or old growth structure between infrequent stand-level disturbance events. This is due to the longevity of the major species. Evidence of blowdown and uprooting is expressed through pit and mound relief of the forest floor.



Ecodistrict 750 Percentage Land Cover

Forest/Woodland	70.8
Water	18.0
Wetlands	6.1
Urban/Industrial	4.7
Agriculture	0.2
Shrub/Heathland	0.2
Sparsely Vegetated	<0.1

Dry, shallow and less fertile soils occur on ridged bedrock terrain, and forests and woodlands of the Spruce Pine Forest Group are typical (i.e., white pine, red pine and black spruce). White pine often forms a super canopy over other species, especially black spruce. Red maple and red oak occur in mixedwoods with white pine and black spruce, but may also form hardwood stands on their own, depending on the severity of past disturbance.

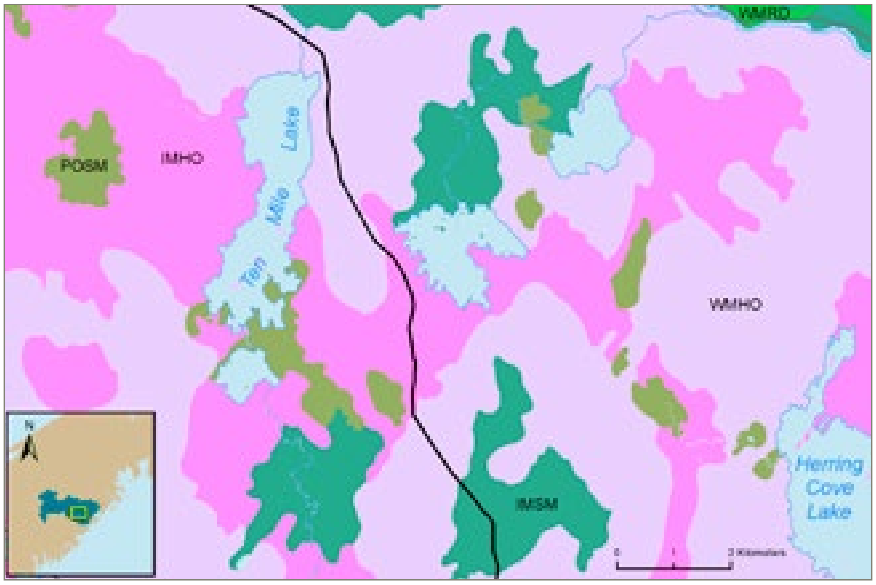
With progressively moister soils, black spruce, tamarack and red maple dominate the forest vegetation, with alders, false holly, winterberry, and other woody shrubs more common on wetter sites. Wet open woodlands are often embedded in this forest setting. Fire was a prominent natural disturbance in this forest due to the combustible

Extensive white pine forests blanket the landscape around Lake Rossignol, the largest lake in Nova Scotia, although its size is due to hydroelectric dams on the Mersey River PHOTO: CNS (Len Wagg)

Ecodistrict 750

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMHO	42.9%	42.9%
XXWA	18.3%	61.2%
IMSM	12.6%	73.8%
IMHO	10.8%	84.6%
POSM	5.6%	90.3%
IMDM	5.5%	95.7%
WMDM	2.1%	97.8%
WMRD	1.6%	99.4%
IMRD	0.3%	99.7%
ICSM	0.3%	100.0%



nature of the spruce-pine litter and ericaeous vegetation. Repeated fires on these sites can reduce soil fertility and delay stocking of forest species. Early successional forests include red maple, white birch, aspen and red oak.

Shade tolerant hardwood and mixedwood forests occur on productive and well drained soils characteristic of drumlins and lower slopes along watercourses. Sugar maple, beech, yellow birch and hemlock are typical, with abundant red oak and red maple in the canopy.

Drumlins and other sites with arable soils have been extensively used for settlement and farming. Abandoned agricultural lands tend to revert to forests of white pine and occasionally white spruce.

The ecodistrict has a long history of forest harvesting. Logs were once floated in the spring to mills along the Mersey and Medway Rivers.

White and red pines along with red and black spruce are dominant species in the forests of the Rossignol ecodistrict.

PHOTO: CNS (Len Wagg)

Extensive areas of shrub wetlands occupy level terrain along many of the lakes and slow moving streams and rivers of this ecodistrict.
PHOTO: CNS (Len Wagg)

Non Forests

Lake Rossignol, prior to flooding for the reservoir in 1920s, was occupied by three large lakes and numerous small lakes, all separated by low-lying land. Today Lake Rossignol and the lower reaches of the Mersey and Medway Rivers are some of the most recognized and ecologically important features of the ecodistrict.

The Rossignol ecodistrict is heavily forested with only about 5% of all land (excludes water bodies) occupied by non-forested ecosystems. These non-forested ecosystems are almost all wetlands. In fact, the relative percentage of the land base occupied by non-forested upland is the lowest of any ecodistrict in the province. Wetlands are predominantly peatland—most are raised and flat unpatterned bogs. Unlike other areas in the province, shrub swamps are not well represented here.

The ecodistrict includes populations of some of Nova Scotia's most range-limited animal species, notably the Blanding's turtle (*Emydoidea blandingii*) and eastern ribbon snake (*Thamnophis sauritus*). High concentrations of Atlantic Coastal Plain Flora (ACPF) also occur in the ecodistrict. Long's bulrush (*Scirpus longii*), redtop panic grass (*Panicum rigidulum* var. *pubescens*), redroot (*Lachnanthes caroliniana*), and golden crest (*Lophiola aurea*) populations are well represented.

Eastern ribbonsnake is a species at risk in Nova Scotia *PHOTO: DNR (Peter Neily)*

760
Sable

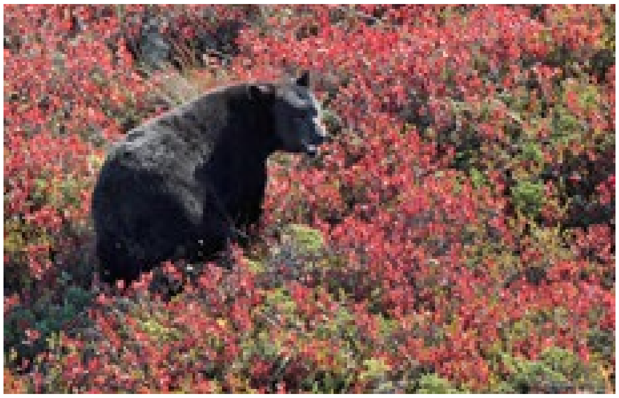
In southwestern Nova Scotia a lower elevation plain with relatively subdued relief and an abundance of poorly drained soils, bogs and other types of wetlands defines the Sable ecodistrict—second largest in the Western ecoregion and fourth largest in the province.

Characterized by gentle hills, hummocks and extensive poorly drained flats (e.g. Dunraven Bog), mean elevation is about 60 m above sea level and rises to 135 m north of Tidney River Wilderness Area. Near shallow lakes and sluggish rivers, wetlands are common, along with bogs, fens and swamps. The largest concentration of peatlands in Nova Scotia is found in the Sable.

Gravelly eskers run along the Clyde and Barrington Rivers, and are also prominent glacial landforms elsewhere. The dominant bedrock of quartzites and slates is overlain by shallow, rocky, coarse to moderately coarse textured, imperfectly to poorly drained soils. Well-drained sites can be somewhat dry during the growing season.

Extending inland are coastal inlets and harbours from the Atlantic Ocean (such as Port Joli, Port l'Hebert, Sable River, Jordan Bay and Shelburne Harbour) that help cool localized areas—although summers are still typically very warm. Freshwater in lakes and rivers accounts for 5.8% of the total area of the ecodistrict. Total area is 2945 km^2 or about 17.6% of the ecoregion.

Heathland southwest of Little Pubnico Lake *PHOTO: CNS (Len Wagg)*



Black bear getting ready for winter by feeding on the heathlands' abundant huckleberries *PHOTO: CNS (Len Wagg)*

On well-drained hills and hummocks with coarse textured soils, a climax forest of red oak, white and red pine occurs. Red spruce, hemlock and white pine characterize forests where soils are less coarse. About one-quarter of the ecodistrict is either treeless bog, or supports a stunted black spruce forest. Better drained hummocks in peaty areas support a forest of white pine and black spruce.

About half of the ecodistrict is covered by imperfectly drained, moderately coarse soils. These ecosections have a climax forest of black spruce, with white pine on upper slopes of hills and better drained microsites. Poorly drained sites support a forest of stunted black spruce. A total of 2.2% of the ecodistrict is exposed bedrock.

Poor inherent fertility of the parent material, years of organic accumulation of acidic plant materials from ericaceous vegetation, dry soils (due to their coarse texture), and cemented soil layers, have all combined with the impacts of fire to contribute to barren and woodland conditions throughout the ecodistrict. Fires and hurricanes have been significant natural disturbances on the landscape.

Geology and Soils

The Sable ecodistrict is mainly underlain by Meguma Group rock (slate, greywacke/quartzite and schist) along with Devonian period granite, granodiorite and tonalite in the southwestern section.

Another distinctive geologic feature in this ecodistrict is the Shelburne dyke. This Jurassic period formation (mainly gabbro) is the most prominent dyke in Nova Scotia running through the Sable and all the way up to Sambro Island—a distance of about 200 km.

The landscape is mainly flat or of very gentle relief, which has promoted the development of many bogs and fens. Several of these wetlands are hundreds of hectares in size, with the Dunraven Bog (Queens County) and Quinn's Meadow (Shelburne County) being prominent examples.

Aside from hydric (wetland) soils, other dominant soils are derived from gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); gravelly sandy loam to loam till high in schist and quartzite (Mersey/Liverpool); and stony sandy loam to loamy sand till high in granite and granodiorite (Gibraltar/Bayswater soils) (**See Table 33**).

Halifax and Gibraltar association soils are often very stony and occasionally shallow to bedrock. Coarse Gibraltar/Bayswater soils are also prone to natural cementation by iron oxides and organic matter (Ortstein soils).

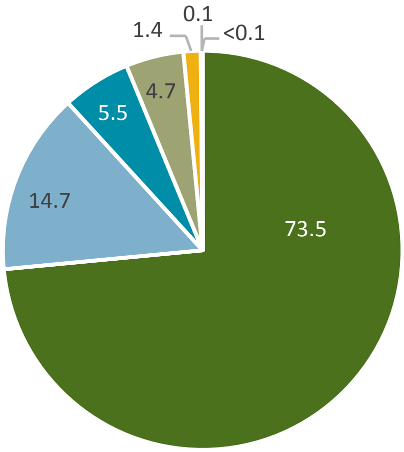
Table 33
Summary information for dominant soils found in the Sable ecodistrict (760). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Halifax / Danesville *	44	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Hydric	19	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4	Organic, Gleysol
Mersey / Liverpool	17	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Gibraltar / Bayswater *	13	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 760
Percentage Land Cover

Forest/Woodland	73.5
Wetlands	14.7
Water	5.5
Shrub/Heathland	4.7
Urban/Industrial	1.4
Agriculture	0.1
Sparsely Vegetated	<0.1



Forests

Spruce Pine forest occurs on 54% of the Sable ecodistrict, with large intact poorly-stocked forests of black spruce, red pine, white pine and red oak. These are nutrient poor ecosystems often associated with fire disturbance. There is usually a significant understory of woody shrubs dominated by ericaceous species such as lambkill, blueberry, rhodora and huckleberry, along with black spruce regeneration (often through layering). Bracken (*Pteridium aquilinum*) and teaberry (*Gaultheria procumbens*) are almost always present in the herb layer. White pine and red oak mixedwood forests are more commonly found on very dry coarse textured soils derived from granite till. Red maple, white pine and black spruce mixedwoods are also common on a greater variety of site conditions.

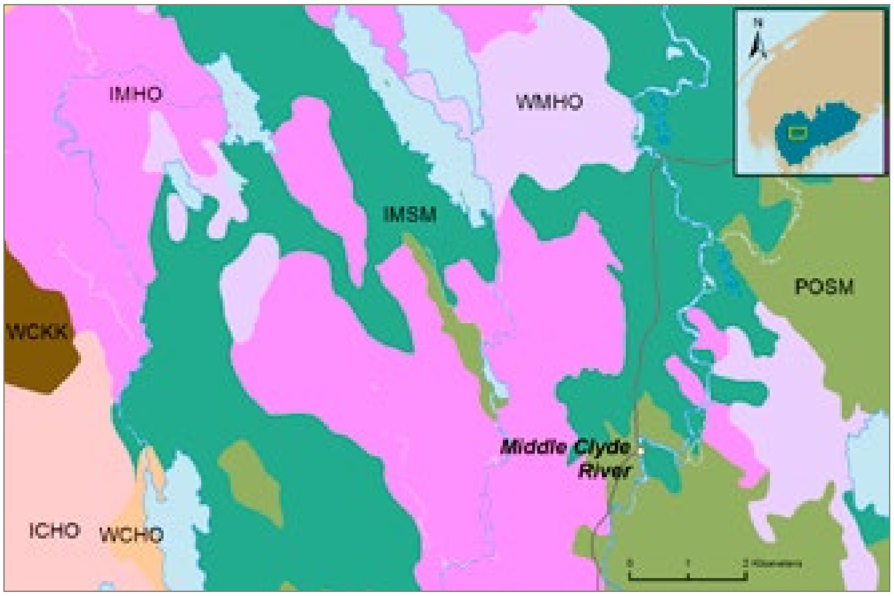
Any of these forest types can occur on a range of slope positions, with moisture availability the main factor determining species composition. White pine may occur as pure forests on the drier sites and often forms a super canopy over red maple and black spruce.

The zonal climax forest, Spruce Hemlock, is expressed sparingly in Sable, with only a few locations supporting the Acadian softwood forest (red spruce and hemlock). This occurs primarily in the northern portion of the ecodistrict and on drumlins along the Roseway River. Soils on these sites are well drained, medium textured, usually derived from quartzite and slates, and inherently more fertile than those derived from granite tills.

With progressively poorer drainage, black spruce, tamarack and red maple dominate the forest vegetation. Where balsam fir occurs, it has usually been deformed by the balsam wooly adelgid. It remains in the understory, often with large stem diameters, reduced heights due to stem breakage, and advanced bole decay.

The dominant natural disturbance in the Sable ecodistrict is fire due to the local abundance of "fuel" in the form of pine/spruce litter and dense ericaceous vegetation. Intense fires can significantly decrease site productivity, especially those sites with a high coverage of stones and boulders.

Red oak (large, shiny canopies) dominate many of the hardwood forests in this ecodistrict (near First Lake, Yarmouth/Shelburne county line) *PHOTO: CNS (Len Wagg)*



Ecodistrict 760

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	38.4%	38.4%
POSM	15.4%	53.8%
WMHO	10.9%	64.7%
IMSM	9.9%	74.6%
PMHO	6.9%	81.5%
ICHO	6.2%	87.7%
XXWA	5.8%	93.5%
WCHO	2.7%	96.2%
ICSM	1.5%	97.7%
WMDM	1.0%	98.6%
IMDM	0.8%	99.5%
WCKK	0.5%	100.0%
XXMS	< 0.1%	100.0%

Early successional forests may include red maple, white birch, aspen and red oak. Where soils are shallow to bedrock or have been impoverished by repeated wildfires, low stocked woodlands of black spruce and pine and barrens are dominant.

Stand-level disturbances from fire were historically frequent, as were less intense understory fires which helped maintain red oak and white pine in the canopy. Today, fire suppression efforts have caused natural infill to occur on many of the poorly-forested areas. The occurrence of hurricanes in this ecodistrict is comparable to elsewhere in Nova Scotia, however their impact on forest composition and structure has been lessened due to a more frequent fire history.

Insect epidemics are not known to cause stand-level destruction in the Sable ecodistrict—most damage is restricted to individual trees or small patches. The introduction of the balsam woolly adelgid in the early 1900s has significantly impacted balsam fir and reduced the species to a lesser component in most stands. Bark beetle losses are usually restricted to individual trees or small patches. Pine shoot moths, white pine weevil and white pine blister rust cause tree deformity but seldom mortality.

Streamside fen and upland mixedwood stands near Eagle Lake (Queens County) *PHOTO: CNS (Len Wagg)*

Black Georges Savannah, a large heathland-wetland complex
PHOTO: CNS (Len Wagg)

Non Forests

The Sable ecodistrict has the highest concentration of open (treeless or sparsely treed) wetlands in the province, and the highest relative proportion of open peatland of any ecodistrict.

Over 11% of the ecodistrict is occupied by non-forested ecosystems, including some of the largest wetland complexes in Nova Scotia.

One such complex is Dunraven Bog, a large peatland in the headwaters of the Sable River. Dunraven is a remarkably intact unpatterned bog with areas of both raised and flat topography. Embedded in the larger bog complex are some low shrub fens.

Dunraven and many of the other wetlands in the ecodistrict support very significant concentrations of Atlantic Coastal Plain Flora (See the **Clare (730)** ecodistrict for a description). Sweet pepper bush (*Clethra alnifolia*), tubercled spikerush (*Eleocharis tuberculosa*), and thread-leaved sundew (*Drosera filiformis*) are among the notable examples in this ecodistrict. The latter species is limited to five peatlands in two ecodistricts in Nova Scotia. It is found nowhere else in Canada.

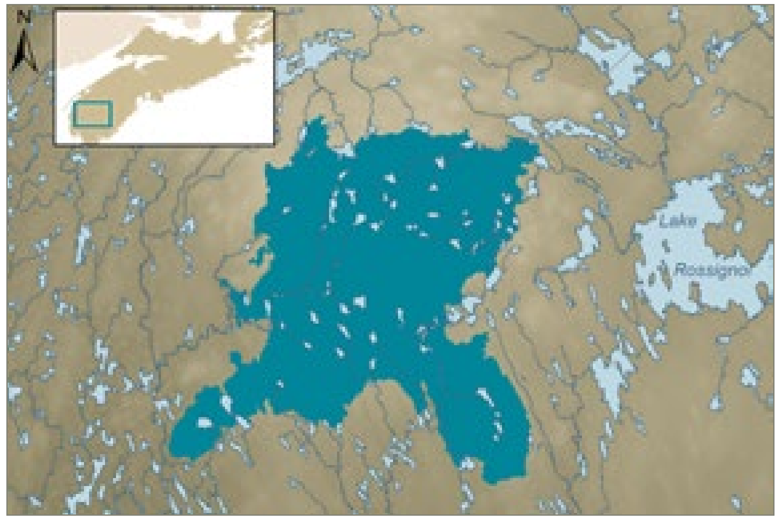
The Sable ecodistrict has large areas of low shrubland, sometimes called "barrens." As the shrublands are dominated by heath species (plants from the *Ericaceae* family), they are also called "heathlands."

The type of low shrubland common in the Sable ecodistrict is described in more detail in the non-forest description for the **Western Barrens (770)**.

Eleven percent of all the low shrubland in Nova Scotia is found in the Sable ecodistrict. These heathlands are well frequented by the endangered mainland moose. Mainland moose occur in several separate population concentration areas across Nova Scotia, including one that extends across parts of every ecodistrict in the Western ecoregion.

Thread-leaved sundew, one of several Atlantic Coastal Plain Flora species in this ecodistrict that are at risk and are legally protected. For more information, refer to *A Field Guide to Forest Biodiversity Stewardship* (NS Department of Natural Resources, Report FOR 2017-1)

770
Western Barrens



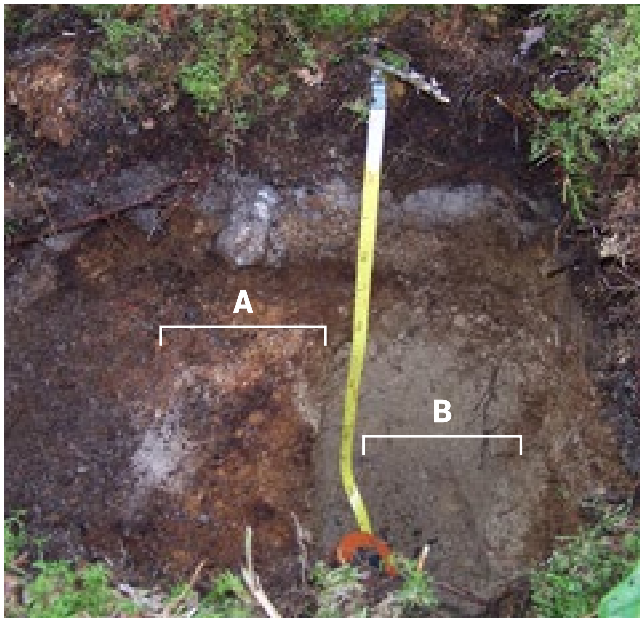
The Western Barrens is a relatively small ecodistrict in the interior of the Western ecoregion. This is a remote part of Nova Scotia with few roads and very little past or present industrial activity. Limited access and a high percentage of protected area have safeguarded many of this ecodistrict's biodiversity features.

The Western Barrens is situated inland, away from the moderating influence of the ocean. Summers are hotter and drier and winters are cooler than elsewhere in the ecoregion. The topography, geology and glacial tills are similar to the adjacent **South Mountain (720)**, but typical vegetation types in the Western Barrens are different due to past wildfires and soils that are very acidic and further limited by ortstein layers in the subsoil. Forests are typically open coniferous woodlands of stunted and scrubby trees with an abundance of ericaceous shrubs.

The near absence of zonal climax species such as red spruce, hemlock, sugar maple and beech attest to the poor growing conditions. Open woodlands of white pine, black spruce, red oak and red maple are dominant. Occasionally well-stocked stands of white pine are found on the deeper, well drained soils of eskers.

Boulder strewn lakes (such as Buckshot and Granite) and rocky headwater streams of the Tusket and Shelburne Rivers account for 4.9% of the ecodistrict. Much of the landscape is covered with excessively large granite boulders and 3.7% of the area has exposed bedrock. Total area is 796 km^2 or about 4.7% of the ecoregion.

West of Duck Pond Lake, Digby County *PHOTO: CNS (Len Wagg)*



Cemented horizons (ortsteins) are common in the soils of the Western Barrens. These rusty coloured layers (A) may be many centimetres thick over loose, sandy subsoil (B).

PHOTO: DNR (Peter Neily)

Generally the Western Barrens have been considered a product of frequent fires, many of them human caused, with related soil impoverishment resulting in slow regeneration to tree species. However, Strang (1972) noted that while fire is undoubtedly a potent factor in maintaining shrub cover, pollen analyses indicate that open woodland conditions developed many centuries ago in response to poor soil conditions and prevailing climate, and that current vegetation is an expression of inherent site factors as well as frequent burning.

The barrens have very coarse, shallow, infertile soils often with a cemented ortstein layer (locally known as hardpan), which can significantly restrict rooting and water movement. In addition, dense layers of ericaceous vegetation have thick root mats that can severely restrict regeneration of softwood species. However, since the beginning of fire suppression efforts in the early 1900s, many barrens have slowly started to reforest to black spruce, white pine, and red oak.

Geology and Soils

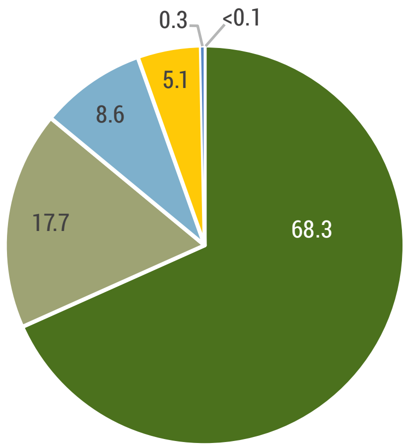
Like the **South Mountain (720)**, the Western Barrens is mainly underlain by the South Mountain Batholith—a massive granitoid formation that underlies much of western Nova Scotia. However, Meguma Group rock (mainly greywacke/quartzite and slate) is also found in the southeastern tip and western edge of the ecodistrict. Associated with these western contact areas is the Southwest Nova Scotia Tin Domain, mainly exploited through the East Kemptville tin mine. Operating in the 1980s and 1990s, this was the first and only primary tin mine in North America.

Surficial deposits are mainly comprised of stony, granitic glacial till that is often shallow to bedrock. Almost the entire ecodistrict is mapped as Gibraltar/Bayswater soils which are derived from this parent material. Surface stoniness in these soils is usually high and sometimes excessive. Gibraltar/Bayswater soils are also prone to natural cementation by iron oxides and organic matter, and these ortstein soils are particularly common in this ecodistrict. Affected horizons can show various degrees of cementation, with fully developed examples requiring a pick or rock hammer to break through. (**See Table 34**)

Table 34
Summary information for dominant soils found in the Western Barrens ecodistrict (770). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Gibraltar / Bayswater *	85	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1, ST15, ST15-G, ST16, ST16-G	Podzol
Hydric	11	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST4-G	Organic, Gleysol
Halifax / Danesville *	5	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).



Ecodistrict 770 Percentage Land Cover

Forest/Woodland	68.3
Shrub/Heathland	17.7
Wetlands	8.6
Water	5.1
Urban/Industrial	0.3
Agriculture	<0.1

Hummocky terrain, shallow soil and bedrock-controlled drainage have also led to the formation of many hydric soils. These soils are often associated with pocket wetlands (mainly treed swamps) found in low-lying areas adjacent to well drained uplands.

Forests

Nearly half of this ecodistrict is barrens and open woodlands on coarse textured soils derived from granite tills with low nutrient availability.

Where soils are well drained (e.g., on upper slopes and glaciofluvial deposits), white pine, red oak and red maple are abundant. Where soils are shallow over bedrock or a cemented layer, black spruce are more often prominent. Balsam fir can occur where soils are slightly enriched by seepage flows. On moist soils, black spruce and red maple are typical, with tamarack found on the wettest sites.

All forests and woodlands have a significant understory of ericaceous shrubs such as lambkill, rhodora, huckleberry, and blueberry along with false holly and wild raisin. As soils get wetter, Labrador tea, winterberry and false holly increase in abundance. Bracken (*Pteridium aquilinum*) and various species of reindeer lichens (*Cladonia spp.*) can be extensive in open conditions.

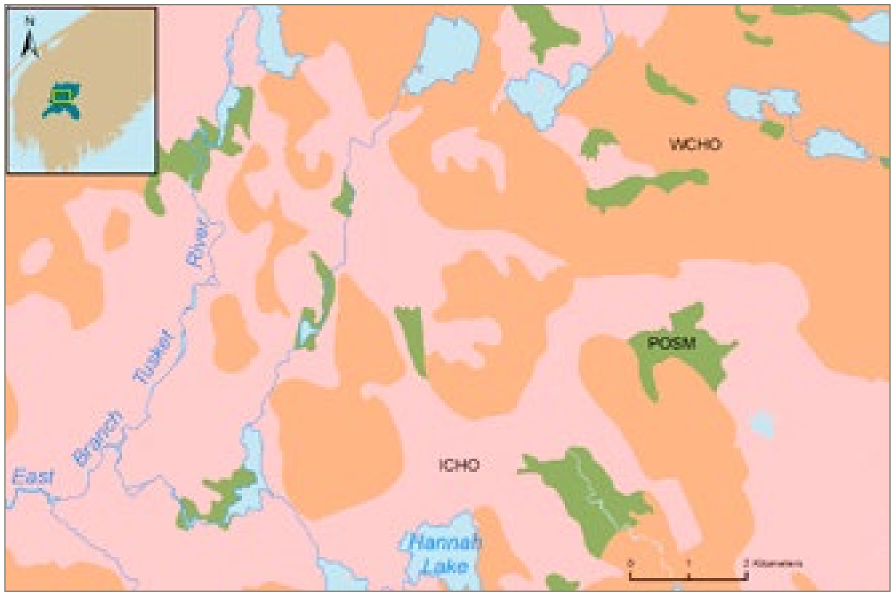
The phytotoxicity (toxic to plants) of ericaceous litter, and the thick root mats created by these species, restricts establishment of black spruce seedlings, except where seedbeds of mineral soil are provided (e.g., after fire). Instead, most black spruce is regenerated by vegetative layering. Early successional forests can include red maple, white birch, large-tooth aspen and red oak.

Black spruce woodland with lichen and broom crowberry ground cover. *PHOTO: DNR (Sean Basquill)*

Ecodistrict 770

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
ICHO	43.3%	43.3%
WCHO	42.3%	85.5%
XXWA	5.2%	90.7%
ICSM	4.7%	95.4%
POSM	4.1%	99.5%
WCKK	0.5%	100.0%



Wildfire has historically been the dominant stand-level natural disturbance over much of the ecodistrict. Summer moisture deficits on the coarse textured soils and easily combustible ericaceous shrubs have contributed to (and helped perpetuate) the dominant barren and woodland conditions present today. Other stand-level disturbance agents include hurricane, insects and disease. European pine shoot moth, white pine weevil, and white pine blister rust can cause tree deformity (but seldom mortality).

Barrens and woodland forests continue to dominate this landscape although fire suppression efforts over the past century have allowed a recovery to forested conditions on many sites. Very little human land use has occurred in this ecodistrict and road access is negligible.

Shrub fens are common along slow moving large streams and rivers in this ecodistrict. *PHOTO: CNS (Len Wagg)*

Non Forests

The Western Barrens is one of the flattest and most topographically homogenous ecodistricts in the province. Geological and edaphic (soil-related) factors coupled with a long history of fire have strongly shaped the ecology of this landscape.

Over 15% of the Western Barrens ecodistrict is occupied by non-forested terrestrial ecosystems, and 8% is non-forested upland. Most non-forested land is low shrubland. In fact the relative area of low shrubland is the highest outside the **Northern Plateau (100)** ecoregion and the **Eastern Shore (820)** ecodistrict. Trees and even tall shrubs have primarily been excluded from this low-growing vegetation by shallow rooting potential (mostly because of the cemented soil layers) and by extreme soil moisture and nutrient limitations.

Fire is thought to have killed off a lot of the forest that would have grown here based on local climate, but the influence of fire is largely historical.

The “barrens” of the Western Barrens are mostly composed of three major “heathland” communities. Heathland is a type of shrubland dominated by plants from the *Ericaceae* family. The heathland communities are arranged on the landscape according to moisture availability (from the soil) and successional history.

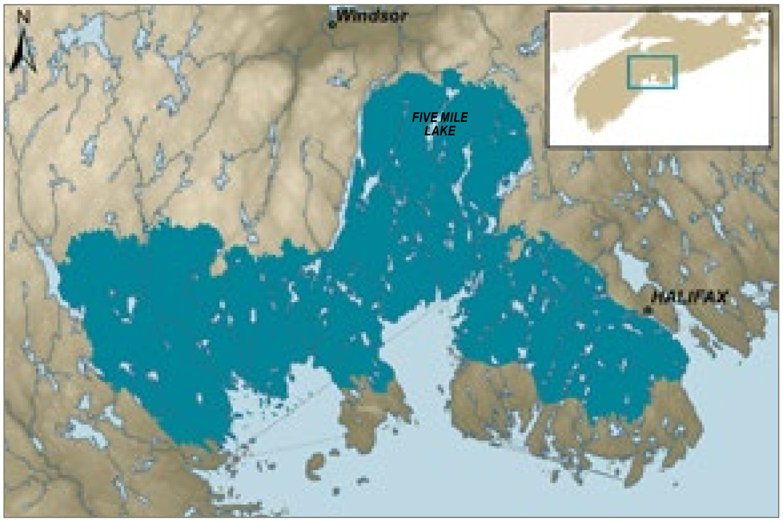
On the tops of hummocks, and in areas with excessive stoniness or impenetrable ortstein, heathland is dominated by broom crowberry and ground lichens. Over time, broom crowberry can be overtaken by other types of heathland and even stunted trees, provided soil conditions are suitable for these larger woody species.

On mid-slope and lower slope positions, and on better drained flats, heathland is usually dominated by huckleberry, with lesser amounts of chokeberry, and inkberry. Excessive stoniness or thick cemented layers can exclude this type of heathland from these slope positions, however.

The third major type of heathland is composed of shrub species found in moist to wet areas, including rhodora, dwarf huckleberry, and lambkill, among other characteristic shrubs.

Peatland, rocky heathland and white pine dominated forests define the landscape of the western barrens. *PHOTO: CNS (Len Wagg)*

780 St. Margaret's Bay



The St. Margaret's Bay ecodistrict encompasses much of the Chebucto peninsula and western Halifax County, extends inland to Hants County, and includes portions of eastern Lunenburg County.

Geologically, it is very similar to the **South Mountain (720)** ecodistrict, being the eastern portion of a granitic batholith which is part of the larger Atlantic uplands. (This upland tilts southerly to make contact with the sheltered oceanic coastlines of St. Margaret's Bay and Mahone Bay.) However St. Margaret's Bay ecodistrict has a moister climate, influenced by its proximity to cooler coastal waters which increases local rain and fog, thereby increasing soil moisture levels. This also reduces summer droughtiness compared to the **South Mountain (720)** where pine and oak are more common.

Mean elevation is 100 m above sea level. Elevations here rise from sea level to near 175 m west of Five Mile Lake.

The predominant soils are well drained sandy loams that have developed on granitic till and are very similar to soils found in the **South Mountain (720)** ecodistrict. For the most part the soils are shallow and stony and the landscape is dotted with large granite boulders (glacial erratics). Soils on this parent material tend to be coarse to moderately coarse, well drained and commonly gravelly with abundant surface stones. This limits both timber harvesting machine operability and stocking levels of trees.

Matrix forests of red spruce blanket the landscape adjacent to Island Lake, Halifax County. *PHOTO: CNS (Len Wagg)*

The areas north of Big Indian Lake, surrounding Five Mile Lake, and near Big Black Lake, exhibit thin or discontinuous till on glacially scoured basins and knobs. Here the topography is flat to rolling, with ridges of exposed bedrock. The topography has an irregular arrangement of low rounded hills and hummocks with pronounced ridges, especially where the soil is thin and/or the bedrock is exposed. Dispersed throughout this chaotic topography are small streams and rivers, bogs and swamps, and several large lakes. The largest river, Gold River, drains the western portion of the ecodistrict. The Pockwock Lake watershed, a significant water supply source for the municipality of Halifax, is within the ecodistrict. Approximately 7.4% or 13 650 ha of the ecodistrict is comprised of lakes and rivers. Total ecodistrict area is 1847 km^2 or about 10.9% of the ecoregion.

The dominant vegetation of the St. Margaret's Bay ecodistrict is a red spruce forest which occupies all slope positions throughout the area. Hemlock will be found on the lower and toe slopes near watercourses. White pine and black spruce, overtopping a heavy cover of ericaceous shrubs, is found on soils that are shallow to bedrock, coarse textured, and drier. Black spruce occupies the poorly drained soils associated with the lower level ecosites. Occasionally, stands of tolerant hardwood are found on the deeper well drained soils of larger hills.

The additional moisture from frequent rains and fog during spring and summer may also reduce the possibility of fires as compared to the drier **South Mountain (720)** ecodistrict where red and white pine, white birch and red oak (indicators of a fire history), are more prevalent. The added moisture during the growing season also assists in the re-establishment of red spruce forests after natural or human disturbances.

Hurricanes have played a significant role in shaping the forests of this ecodistrict, most likely due to its geographic position near the Atlantic Coast and at the end of two major coastal bays.

Geology and Soils

The St. Margaret's Bay ecodistrict is mainly underlain by the southeastern most portion of the South Mountain Batholith—a massive granitoid formation underlying much of western Nova Scotia. However, Meguma Group rock (mainly greywacke/quartzite and slate) is also found in the southwest section of the ecodistrict.

Surficial deposits are mainly stony, granitic glacial till that is often shallow to bedrock. Almost the entire ecodistrict is mapped as Gibraltar/Bayswater soils which are derived from this parent material. Larger areas that are excessively stony and/or shallow are mapped as Rockland soils. Gibraltar/Bayswater soils are prone to natural cementation by iron oxides and organic matter, but these ortstein soils are less common here than in the **Western Barrens (770)**.(**See Table 35**)

Although not easily mapped, this ecodistrict contains the same kind of pocket wetlands found in other ecodistricts, with similar terrain and soil parent materials. This is especially true in Rockland areas where drainage conditions often vary over short distances.

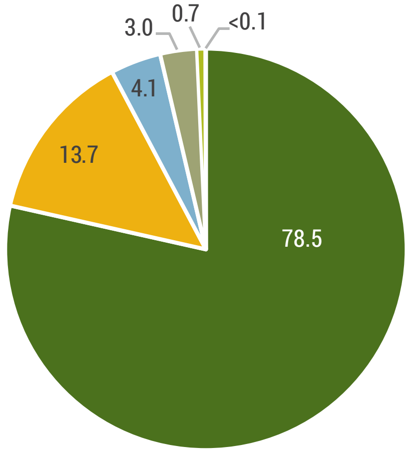
Table 35
Summary information for dominant soils found in the St. Margaret's Bay ecodistrict (780). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Gibraltar / Bayswater *	77	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol
Rockland *	15	Glacial Till, Bedrock	Coarse	Rapid-Imperfect	ST15, ST16, ST15-G, ST16-G, ST2, ST3	Podzol

*** Stony (S) phases are common (e.g., ST2-S).**

Ecodistrict 780
Percentage Land Cover

Forest/Woodland	78.5
Urban/Industrial	13.7
Wetlands	4.1
Shrub/Heathland	3.0
Agriculture	0.7
Sparsely Vegetated	< 0.1



Forests

Forests in this ecodistrict and in **South Mountain (720)** are on similar soils and geology, but here they are shaped by cooler temperatures and higher humidity and soil moisture.

On zonal sites (62% of ecodistrict) expansive stands of Acadian softwood forests of red spruce with hemlock, white pine and yellow birch (Spruce Hemlock Forest Group) occur on hilly and hummocky terrain. Soils are well to rapidly drained, coarse to medium textured soils derived from granite till.

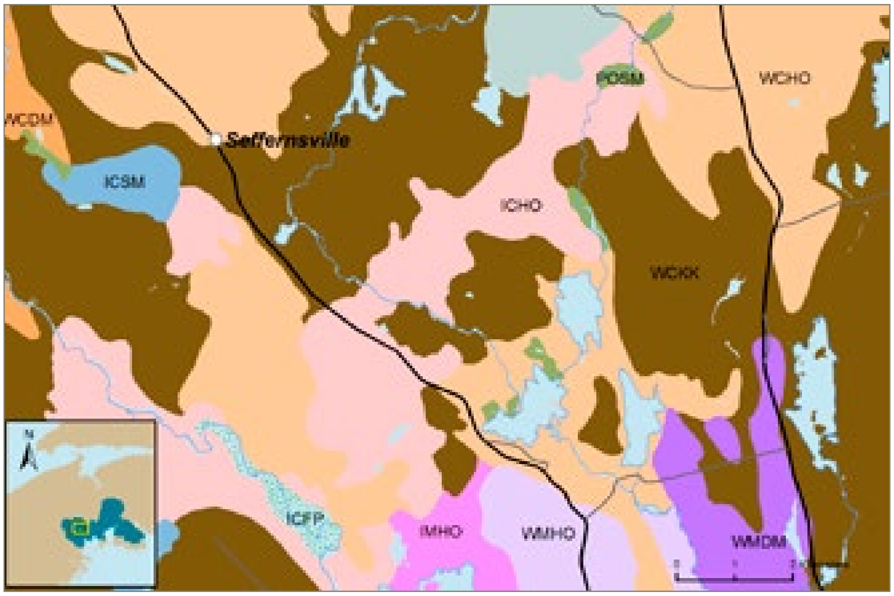
A shrub layer, primarily of advanced regeneration of overstory species, includes balsam fir and red maple. Herb coverage is usually low, but species richness can be relatively high including typical woodland flora such as wild lily-of-the-valley (*Maianthemum canadense*), bluebead lily (*Clintonia borealis*), partridge-berry (*Mitchella repens*), starflower (*Trientalis borealis*) and painted trillium (*Trillium undulatum*). Schreber's moss (*Pleurozium schreberi*) and stair-step moss (*Hylocomium splendens*) are the main bryophytes, with bazzania (*Bazzania trilobata*) very abundant on decaying coarse woody debris.

Spruce Pine Forest Group vegetation types occur as small to large patch forests on very coarse to coarse textured, nutrient poor soils derived from granite tills. These forests can occur on a wide range of soil moisture conditions, but are usually associated with imperfectly drained soils on lower slopes and level terrain. They are also common where soils are shallow to bedrock. Black spruce and white pine (with scattered red pine, red maple and sometimes red oak) comprise the overstory. White pine often forms a super canopy over red maple and black spruce.

The shrub layer may be densely occupied by ericaceous species such as lambkill, huckleberry and blueberry, along with wild raisin and black spruce regeneration from vegetative layering. Ericaceous vegetation can negatively reduce regeneration of trees and can be a volatile fuel source during dry periods.

As soil drainage gets progressively poorer, wet forests of red maple, alders, false holly, winterberry, and other woody shrubs are common. Often embedded within this element are open woodlands where tree growth and density are

White pine and red spruce occur on the well-drained, stony soils, with small treed wetlands of black spruce interspersed. Looking south towards Mahone Bay from Long Lake, Lunenburg County *PHOTO: CNS (Len Wagg)*



Ecodistrict 780

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WCKK	37.9%	37.9%
WCHO	20.1%	58.0%
ICHO	17.5%	75.5%
XXWA	7.4%	82.9%
WMHO	3.1%	86.0%
ICRD	2.7%	88.7%
WCDM	1.9%	90.6%
ICSM	1.7%	92.3%
POSM	1.5%	93.8%
WMDM	1.2%	95.0%
IMSM	1.2%	96.2%
WFDM	1.1%	97.3%
ICKK	1.0%	98.3%
IMHO	0.8%	99.1%
WCRD	0.4%	99.5%
WFKK	0.2%	99.7%
WMKK	0.2%	99.9%
ICFP	0.1%	100.0%
XXCB	< 0.1%	100.0%

limited by low fertility, moisture extremes, thin soils and/or exposed bedrock. Many areas that have shallow soils, exposed bedrock or are excessively stony have been impoverished by repeated wildfires resulting in poorly stocked woodlands of black spruce and pine.

Uncommon and scattered in a few locales are tolerant hardwoods (Tolerant Hardwood Forest Group) such as sugar maple, yellow birch and beech on those richer, well drained soils found on upper slopes and drumlins. Elsewhere red maple and red oak often occur in mixedwoods with white pine and black spruce but may form hardwood stands depending on the stand-level disturbance.

Hurricanes have been a significant force influencing the forests of St. Margaret's Bay ecodistrict. In 1801 Titus Smith (Hawboldt, 1955) describes traversing an area north of the bay with "miles of country where nearly all the trees had been blown down in the Great Storm of September 25, 1798." Hurricanes Carol (1953) and Edna (1954) impacted this ecodistrict, destroying large tracts of forests (approximately 1.6 million m^3) with uprooting and breakage. Other infrequent forest disturbances include fire, and outbreaks of insect species such as spruce bark beetle and balsam wooly adelgid.

Pockwock Lake, looking west between Moose Cove and Sandy Cove

PHOTO: CNS (Len Wagg)

Pennal Brook wetland, southwest of Beech Hill, Lunenburg County
PHOTO: CNS (Len Wagg)

Due to the longevity of red spruce, white pine and hemlock forests, uneven-aged and old forest characteristics can develop. The Spruce Pine Forests tend to be more susceptible to frequent stand disturbances and are typically even-aged. Natural senescence is common in these poorer forests. Following harvesting, regenerating areas may have more white pine, balsam fir, white birch and red maple. Many of the early successional vegetation types (red maple, white birch, grey birch, balsam fir) can be by-passed if harvesting or natural disturbance occurs when there is a well-stocked and/or established layer of advanced shade tolerant regeneration (i.e., red spruce, hemlock, balsam fir).

The islands in Mahone Bay included in this ecodistrict are well drained drumlins and most have been converted from forest to other land uses. However a few examples of late successional forest conditions are present (i.e., red spruce, white pine, and scattered sugar maple, yellow birch and hemlock) (SRES, 2002). This indicates these islands are afforded some protection from the Atlantic Ocean.

Non Forests

Non-forested ecosystems occupy about 5.5% of the terrestrial landscape, which is about half the provincial average. Some of the more interesting non-forested ecosystems are the heathlands on the Chebucto and, to a lesser extent, the Aspotogan peninsulas. This heathland is characterized by mixtures of broom crowberry, black crowberry, red crowberry (*Empetrum eamesii*), common juniper, huckleberry, and a variety of other shrubs and ground lichens. Taller shrubs such as bayberry and downy alder are also common. Some heathland have scattered jack pine trees, usually in areas with high levels of exposed bedrock. The heathlands support some rarer species such as mountain sandwort (*Minuartia groenlandica*) and Golden heather (*Hudsonia ericoides*).

The St. Margaret's Bay ecodistrict is part of an important population concentration area for endangered mainland moose. Moose are mostly found on the Chebucto peninsula, but occasionally wander out towards St. Margaret's Bay and are even infrequently found in the broader Waverley/Fall River area. This large mammal utilizes wet forests, upland hardwood forest, denser conifer forests, open wetlands, and open heathlands among its preferred habitat types.

800 Atlantic Coastal

The Atlantic Coastal ecoregion is a narrow strip of land extending southwest to northeast, from Yarmouth to Scatarie Island, and including St. Paul and Sable Islands. It seldom exceeds 5 km in width, except along Cape Breton where coastal influences extend almost 10 km inland. Total area of the ecoregion is 4695 km^2 (8.5% of Nova Scotia).

The Atlantic Coastal ecoregion has a maritime climate. The background features of this coastal climate are controlled by the southwest-flowing Nova Scotia current (Davis and Browne, 1986). Air flows and onshore winds elevate humidity, increase exposure, lower "effective" growing season temperatures and moderate annual temperatures.

Proximity to cold waters of the Atlantic Ocean gives rise to short, cool summers and relatively mild, wet winters. Annual precipitation is 1400–1500 mm, the bulk of which falls as rain. The ecoregion is exposed to high winds, high humidity, salt spray, and fog during the summer and fall, and experiences slow spring warm-up and a frost-free period that is the longest in the Maritime Provinces (Webb and Marshall, 1999). A moderated coastal climate is found where the coastline configuration of inland bays and coves, offshore islands, estuaries and leeward slopes of hilly topography (rising uplands) are afforded protection from the winds.

Extending the entire length of Nova Scotia the ecoregion captures the complex geological and surficial history of the province. The Atlantic coast has been submerging with rising sea levels over the last 10,000 years. This slow sinking has resulted in a highly irregular coastline with drowned estuaries and headlands, fringed with islands.

The underlying geology is primarily comprised of granite, quartzite or slate on most of the mainland, with sedimentary rocks along Chedabucto Bay. Older Precambrian volcanic and metamorphic rocks underlie the flat low-lying Atlantic coast of Cape Breton Island.

The coastal ecoregion is dissected by many fault-controlled river and lake systems that drain into the ocean. Freshwater lakes are plentiful on the granite landscapes but elsewhere are less common, often shallow and typically associated with bogs. Brackish lakes and ponds (locally referred to as *barrachois ponds*) are common behind barrier beaches.

(left) Rocky shoreline and coastal conifer forest, south of Villagedale along Barrington Bay; *(below)* The rugged Atlantic coastline on eastern Cape Breton Island. PHOTOS: CNS (Len Wagg)

Shallow, medium to coarse textured glacial tills (often stony) are the main soil parent materials in the Atlantic Coastal ecoregion. Orthic[1], Gleyed, Ortstein and Gleyed Ortstein Humo-Ferric and Ferro-Humic Podzols are all common, usually with thick forest floor horizons. Cool and moist climatic conditions have also favoured the development of many poorly drained organic soils (Fibrisols, Mesisols, Humisols) and, on occasion, some upland Organic soils (Folisols). Poorly drained Gleysols are also common.

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

The main features of the Atlantic Coastal forest are a long frost-free period and a long growing period, combined with cool summer temperatures, low evapotranspiration rates due to an elevated humidity and fog, salt spray, and exposure to wind. This bioclimate gives rise to Maritime Boreal ecosites represented by a boreal-like forest dominated by balsam fir, white spruce and black spruce on zonal sites. Red maple and white birch become more dominant in the overstory on sheltered sites and farther inland. White spruce is most common on exposed sites such as coastal islands and headlands.

A suite of plants may be used to indicate coastal influence, including heart-leaf birch (*Betula papyrifera* var. *cordifolia*), mountain-ash, downy alder, bayberry and foxberry (*Vaccinium vitis-idaea*). In addition, the absence of Acadian forest species such as red spruce, hemlock, sugar maple and beech are similarly indicative of the ecoregion's boreal-like climate. Forest cover across the ecoregion is relatively low, ranging from **Sable Island (850)** which has no forest, to the **Cape Breton Coastal (810)** ecodistrict which is the most heavily forested.

Balsam fir wave forest on the slopes of St Paul Island, the most northern location in Nova Scotia
PHOTO: DNR (Sean Basquill)

The Atlantic Coastal softwood forest is mainly found on fresh to fresh-moist, nutrient poor to medium soils that are often stony and of glacial origin. However, this cool, humid coastal climate increases moisture availability during the growing season, resulting in plants and plant associations that inland are more typical of moist to wet sites. For example, several moss and fern species that are generally indicative of poor soil drainage, are common here on well to moderately well drained soils owing to the thick, moist forest floor that occurs in this climatic zone.

Growth potential of softwood forests can be significantly limited by exposure to winds, snow and ice, with breakage reducing height and stem quality and affording opportunities for insects and fungi to further deteriorate tree quality. However, on sheltered middle and lower slopes, height and diameter growth improves as exposure to winds diminishes.

Hurricanes and strong winds can be attributed as the cause of most stand-level disturbances in coastal forests (e.g., windthrow and stem breakage). Other disturbance agents include winter storms, salt spray, spruce budworm, larch sawfly, spruce bark beetles, fungal species, dwarf mistletoe, and to a lesser extent fire.

These frequent small patch and stand-level disturbances usually remove the overstory and release a layer of advanced regeneration to create similar stands of even-aged structure and composition. As this moist climate is conducive to the establishment of coniferous regeneration, most stands will already have established an abundance of advanced regeneration (Neily et al, 2004) ready to reforest sites immediately after a stand-level disturbance.

Uneven-aged and old growth forests are rare due to the frequency of disturbance and the longevity of the dominant trees. In the absence of physical disturbance, natural senescence in both softwood and hardwood species limits stand age to 100 to 125 years.

The ecoregion provides an extensive variety of marine and coastal habitat types including salt marshes, beaches, dune systems, rocky shores, headlands, barrens, mud flats and off-shore islands. These habitats are prime breeding grounds and feeding areas for a broad range of migratory and resident bird species.

810 Cape Breton Coastal

The Cape Breton Coastal ecodistrict flanks the exposed Atlantic Shore of Cape Breton Island and extends northeasterly from the north shore of Chedabucto Bay to Scatarie Island. This long, narrow ecological landscape includes a variety of coastal features and adjacent low lying inland areas. Elevations are generally low, rising to about 130 m in the interior behind the Fortress of Louisbourg. The total area of the ecodistrict is 1178 km^2 or about 25.1% of the ecoregion.

Some of the largest islands in the ecoregion occur here (e.g., Scatarie Island, Isle Madame). St. Paul, the second most remote island in Nova Scotia (after Sable Island) is also in the ecodistrict.

Strong winds, abundant fog and rain, and lower summer temperatures characterize the generally cool climate, making the Cape Breton Coastal ecodistrict usually the coldest part of Nova Scotia's entire coast. These coastal influences also extend farther inland, on average, than in any other ecodistrict in the province.

A Maritime Boreal coastal forest of white spruce, balsam fir and black spruce dominates the ecodistrict, and extends several kilometers inland. Balsam fir wave forests are strongly expressed on the exposed coastal slopes, especially on St. Paul Island. In sheltered areas and on drumlins, white pine and tolerant hardwood species will occasionally be found. However, red maple and white birch dominate the hardwood component of most coastal forests. Throughout the ecodistrict small patches of jack pine and scattered red oak occur.

Rocky coastal outcrops, cobble beach and salt marsh at Belfry Head, Fourchu Bay *PHOTO: CNS (Len Wagg)*

Sedimentary rocks underlay the Chedabucto north shore, Isle Madame, and northeasterly to Loch Lomond. However, from Point Michaud to Scatarie Island, igneous rock, as well as metamorphic sediments (slate and quartzite), are found beneath a deep deposit of glacial till composed of sand and gravels, with the underlying bedrock visible only along the coast.

Most of the ecodistrict is covered with a thick stony glacial till plain broken by low drumlins, surface boulders, and oval hills. Finer textured, well to imperfectly drained soils occur along Chedabucto Bay and extend to St. Peter's. However, coarse textured, better drained soils, especially on drumlins and elevated glacial deposits continue to Scatarie Island. Several large areas of coarse textured, imperfectly drained soils are found around the Bays of Forchu and Gabarus. Poorly drained coarse soils occur at Little Lorraine.

Lakes and rivers are significant within this ecodistrict, occupying 7745 ha (6.6% of the ecodistrict).

Since the construction of the Canso Causeway in 1953, there has been no movement of spring ice from the Gulf of St. Lawrence through the Strait of Canso. Currents here may have flowed at 4260 to 8460 m^3/second (upwards of 20 knots/hour) from St. George's Bay (Fothergill, 1954). Spring ice still comes through Cabot Strait from the Gulf of St. Lawrence and is blown against the Cape Breton coast. However the impact of this reduced influx of offshore ice in the spring has yet to be determined. Before the causeway, ice remained offshore well into May.

Geology and Soils

The Cape Breton Coastal ecodistrict runs along the entire east coast of Cape Breton and covers a range of geologic conditions. The northeastern portion is mainly underlain by Late Precambrian period rock (basalt, rhyolite, slate, quartzite and sandstone), while the southeast portion is associated with Carboniferous period sedimentary rock (mainly sandstone, siltstone and conglomerate). There are also intrusions of Cambrian period granite and granodiorite in central sections of the ecodistrict.

Surficial deposits are dominated by glacial till up to 30 m in depth, along with several drumlin formations in the central section of the ecodistrict between Isle Madame and Gabarus Bay.

Dominant soils are derived from gravelly sandy loam till containing hard sedimentary and metamorphic rock (Thom/Mira soils); gravelly loam to clay loam till containing sandstone and shale (Woodbourne/Millbrook soils); and stony sandy loam till high in granite and granodiorite (Gibraltar/Bayswater soils) (**See Table 36**). Drumlin formations are mainly associated with finer textured Woodbourne/Millbrook soils.

Variable topography, low elevations and abundant moisture have also led to significant hydric soil development in this ecodistrict.

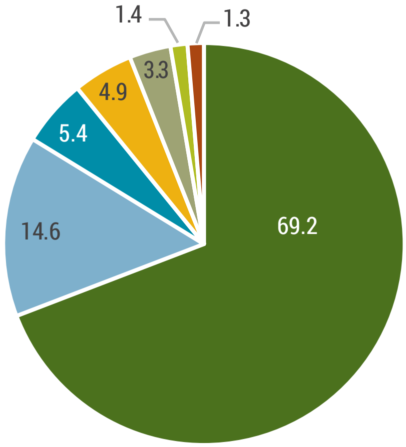
Table 36
Summary information for dominant soils found in the Cape Breton Coastal ecodistrict (810). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Thom / Mira *	56	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST3, ST3-L	Podzol
Hydric	24	Glacial Till, Organic	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Woodbourne / Millbrook	11	Glacial Till	Fine-Medium	Mod. Well- Imperfect	ST2-L, ST3-L, ST6, ST5, ST8, ST12	Podzol, Luvisol
Gibraltar / Bayswater *	5	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

Ecodistrict 810 Percentage Land Cover

Forest/Woodland	69.2
Wetlands	14.6
Water	5.4
Urban/Industrial	4.9
Shrub/Heathland	3.3
Agriculture	1.4
Sparsely Vegetated	1.3



Forests

A boreal-like matrix forest of balsam fir, white spruce and black spruce blankets zonal sites (48% of the ecodistrict) on a variety of topography features such as hummocks, drumlins, flats, ridges, and low level hills. Red maple and white birch reach into the upper forest canopy farther inland and/or on sheltered sites often creating mixedwood forests with balsam fir. White pine may also occur as a minor component of stands in sheltered locations. Earlier successional forests will have red maple and white birch but these species are quickly over-topped by the fir and spruce.

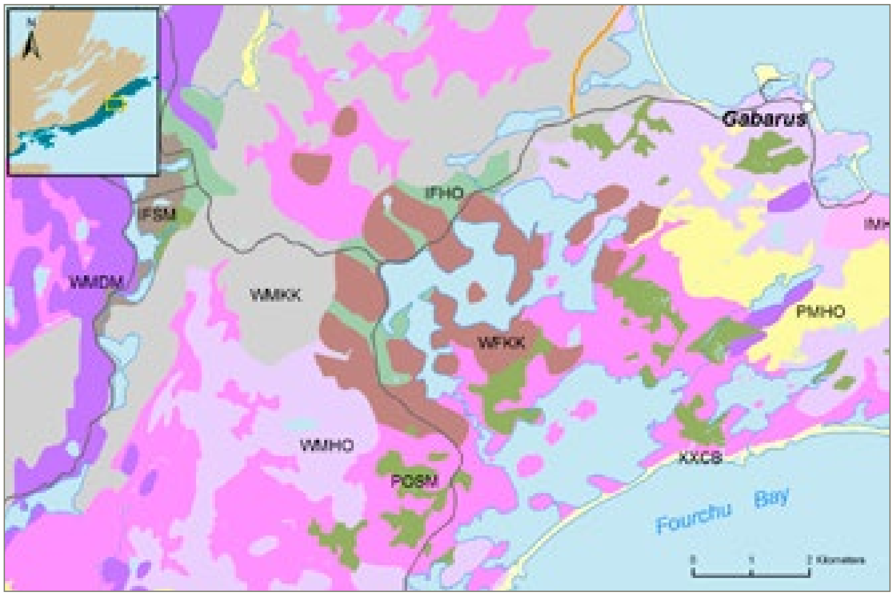
Soils are well to imperfectly drained, fine to medium textured glacial tills. These boreal-like forests have dense canopies and well-developed bryophyte layers. On more exposed sites, trees may be stunted and wind shorn. In extreme circumstances krummholz canopy structures can form. Rare, small stands of jack pine are scattered along the coast from Janvrin Island to Baleine.

A small patch hardwood vegetation type (comprised of yellow birch, white birch and red maple) occurs on sheltered crests and upper slopes of drumlins, hummocks and ridges. Examples are found between St. Esprit and Framboise. Balsam fir, birch and red maple mixedwoods favour middle slopes and may transition to a hardwood forest depending on disturbance and successional stage.

As soil drainage gets progressively poorer, wet forests of red maple, black spruce, tamarack, alders, false holly, winterberry, and ericaceous woody shrubs occur, usually on the lower slopes and flats. Often embedded within this forest are wet open woodlands, bogs, swamps, fens, and seasonally flooded flats. Much of the eastern portion of the ecodistrict is comprised of flat and raised bogs, fens and salt marshes. On sites with wet mineral soils, black spruce is the predominant tree species.

The most common disturbance agents in this ecodistrict are coastal winds and storms. Frequent, stand-level disturbances due to windthrow, insects, disease or natural senescence create opportunity for the release of advanced

Coastal conifer forests and low relief drumlins at Gabarus Wilderness Area. Patches of young forest occur where previous forests succumbed to blowdown. *PHOTO: CNS (Len Wagg)*



Ecodistrict 810

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	23.7%	23.7%
WMKK	15.6%	39.3%
WFKK	12.9%	52.2%
WMDM	10.0%	62.3%
WMHO	7.6%	69.9%
XXWA	6.6%	76.5%
IFHO	5.6%	82.0%
IMDM	5.3%	87.3%
WFHO	2.9%	90.2%
PMHO	2.4%	92.6%
POSM	2.3%	94.9%
IFRD	1.3%	96.2%
XXCB	1.0%	97.2%
WMRD	0.7%	97.9%
WFRD	0.5%	98.3%
IFSM	0.4%	98.8%
WCKK	0.3%	99.1%
PFHO	0.3%	99.3%
IMKK	0.2%	99.5%
WFDM	0.2%	99.7%
IMRD	0.1%	99.8%
WCHO	0.1%	99.9%
IMSM	< 0.1%	100.0%
WCRD	< 0.1%	100.0%
XXMS	< 0.1%	100.0%

fir regeneration—quickly starting another forest. These same agents also limit the potential for old forest development. Bentley and Smith (1956) suggests that the coastal fir/spruce forest, subjected to abundant moisture, cool temperatures, and extreme exposure, is susceptible to fungal attack and resulting vulnerability to windfall, and therefore balsam fir seldom exceed 70 years of age. The level of physical disturbance can vary, with both small and large patches of windthrow and breakage common.

Loucks (1962) reported that fires in the Atlantic Coastal ecoregion have been common, but they appear to have been started by European settlers to extend pasture land. He also states that the presence of jack pine in several places suggests that the constant winds of the coastal zone may create drought conditions that are conducive to wildfire.

Wherever forests have been cleared for settlement and later abandoned, forests of white spruce and tamarack are common.

(left) A coastal peatland complex near Landing Cove, with Fortress Louisburg in the distance; *(right)* The road from Janvrin Island to Isle Madame *Photos: CNS (Len Wagg)*

Barrier beaches forming a cuspate spit at Winging Point, Gabarus Wilderness Area *PHOTO: CNS (Len Wagg)*

Non Forests

Most of the ecodistrict is covered with a thick stony till plain punctuated by low drumlins, surface boulders, and oval hills. Bedrock outcrops are mostly limited to the immediate coast. About 14% of the ecodistrict is non-forested which is above the provincial average but lower than other ecodistricts in the Atlantic Coastal ecoregion.

The shoreline is low-lying and highly crenulated, supporting a variety of coastal landforms. On Isle Madame and the surrounding smaller islands, the complex shoreline includes a few estuaries, small salt marshes, and scattered pocket beaches. Beyond Isle Madame, the shore from Point Michaud to Blackrock Point (just past Louisbourg), is characterized by low cliffs, beaches, and numerous brackish ponds. There are extensive areas of coastal heathland seaward of Framboise Intervale, Forchu, and Gabarus Wilderness Area. Some of these heathlands are broken by undisturbed coastal grasslands which are relatively rare in Nova Scotia. Some spectacular dune complexes are found at Point Michaud and Framboise beaches.

Northward towards Scatarie Island, the shore and near-shore areas are rockier—low cliffs are the dominant coastal landform. Aside from Sable Island, Scatarie Island is the eastern most point in Nova Scotia, jutting out into the Atlantic off Main-à-Dieu. Scatarie is covered in stunted coastal forest and extensive areas of heathland and coastal peatland. A number of rare, boreal oceanic species are represented in this part of the ecodistrict. The offshore and lower intertidal zone of the ecodistrict is very rocky and beaches are small.

The total area of beaches in the Cape Breton Coastal ecodistrict is third highest in the province (after ecodistricts **820** and **830**). Many of these are cobble or rocky beaches that support plant communities different from those on sand beaches and dunes.

Coastal cliffs are also prevalent in this ecodistrict, second in total area, after the **Cape Breton Hills (310)**. Similarly, the area of coastal islands is also second highest in this case, after the **Eastern Shore (820)**. These coastal features provide provincially significant habitat for great cormorant, whimbrel, black-legged kittiwake, black guillemot, common eider, and other coastal bird species.

820
Eastern Shore

The Eastern Shore is a rugged and topographically complex ecodistrict extending from Chedabucto Bay (Guysborough County) to St. Margaret's Bay (Halifax County). This long, narrow ecodistrict encompasses a wide range of landforms, geology, soils and ecosystem conditions. It is highly exposed, and prone to strong winds and extended periods of fog and cooler weather.

The Eastern Shore is the coldest coastline on the mainland. Across its more exposed headlands and summits, the landscape supports boreal and near boreal conditions. While shelter is provided behind the numerous islands scattered along the seaboard and deeper inlets, these sheltered bays still may be iced-in during the winter months. The climate is distinguished by high precipitation and low summer temperatures. Spring warm up is slow, but the frost free period is long.

In the west the ecodistrict is several kilometers narrower than in the east where coastal influences extend inward to encompass the entire Chedabucto peninsula with a moderating effect on the leeward side. For most of the ecodistrict the influence of the ocean extends inland until topography restricts further penetration (approximately the 60 m contour). The effect of headlands, offshore islands, and coastal peninsulas (e.g., Liscomb Point), also influence the extension of coastal influence inland.

Barrens underlain by granite correspond with vast expanses of exposed glacially scoured bedrock. Thin glacial tills create bookends at either end of the ecodistrict, while in between greywackes, quartzites, and slates comprise the bedrock geology. The Eastern Shore ecodistrict has a variety of coastal landforms including sandy beaches, sand dunes, offshore islands, and headlands.

Coastal peatland and conifer forests at Snow Island, East Quoddy

PHOTO: CNS (Len Wagg)

(top) Borgle's Island (looking west) showing the linear relief of the underlying bedrock; *(below)* Coastal heathlands and rock outcrops at Clam Pond, east of Peggy's Cove. PHOTOS: DNR (Bob Guscott, retired DNR)

Lakes comprise a significant portion of the ecodistrict with 9728 ha (5.7%) covered in freshwater. Approximately 21.6% of the land area (36 350 hectares) is comprised of exposed bedrock (and/or bedrock sparsley covered by lichens and mosses)—by far the greatest area of any ecodistrict. The total area of the ecodistrict is 1716 km^2 or about 36.6% of the ecoregion.

A high diversity of landforms promotes coastal forest diversity along the Eastern Shore, with vegetation types expressing strong boreal affinities, indicative of Maritime Boreal ecosites.

The coastal forests are primarily dominated by balsam fir and black spruce, with a lesser component of white spruce. Red maple and white birch will occupy an intermediate canopy position and only express dominance farther inland and/or on sheltered sites.

White spruce is typically found on abandoned farmland and/or exposed headlands, often forming krummholz.

Insect defoliation has not been a significant factor in forest disturbance, although the balsam wooly adelgid has damaged and caused mortality in balsam fir forests throughout the ecodistrict. Other insect outbreaks have occurred sporadically including tussock moth, spruce bark beetle, and hemlock looper.

Table 37
Summary information for dominant soils found in the Eastern Shore ecodistrict (820). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Halifax / Danesville *	43	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Rockland*	24	Glacial Till, Bedrock	Medium-Coarse	Rapid-Imperfect	ST15, ST16, ST2, ST3, ST15-G, ST16-G	Podzol
Gibraltar / Bayswater *	15	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol
Hydric	14	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4, ST4-G	Organic, Gleysol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

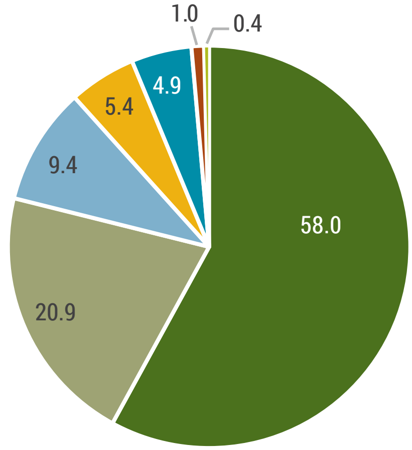
Geology and Soils

Although the Eastern Shore ecodistrict runs from St. Margaret's Bay to Canso, bedrock geology is relatively consistent, comprised mainly of Meguma Group rock (greywacke/quartzite, slate, schist and migmatite), with pockets of Devonian period granite/granodiorite around Halifax and Canso.

Surficial deposits and soil parent materials are dominated by stony glacial tills that are often shallow to bedrock. Surface stoniness in these soils is usually high, and sometimes excessive. Scattered drumlin formations can also be found.

Dominant soils are derived from gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); shallow and/or very stony sandy loam till (Rockland soils); and stony sandy loam to loamy sand till high in granite and granodiorite (Gibraltar/Bayswater soils) (**See Table 37**). Coarse Gibraltar/Bayswater soils are prone to natural cementation by iron oxides and organic matter (Ortstein soils).

Hummocky terrain, shallow soils and abundant moisture have also led to significant hydric soil development in this ecodistrict. These soils are often associated with pocket wetlands found in low-lying areas adjacent to well drained uplands.



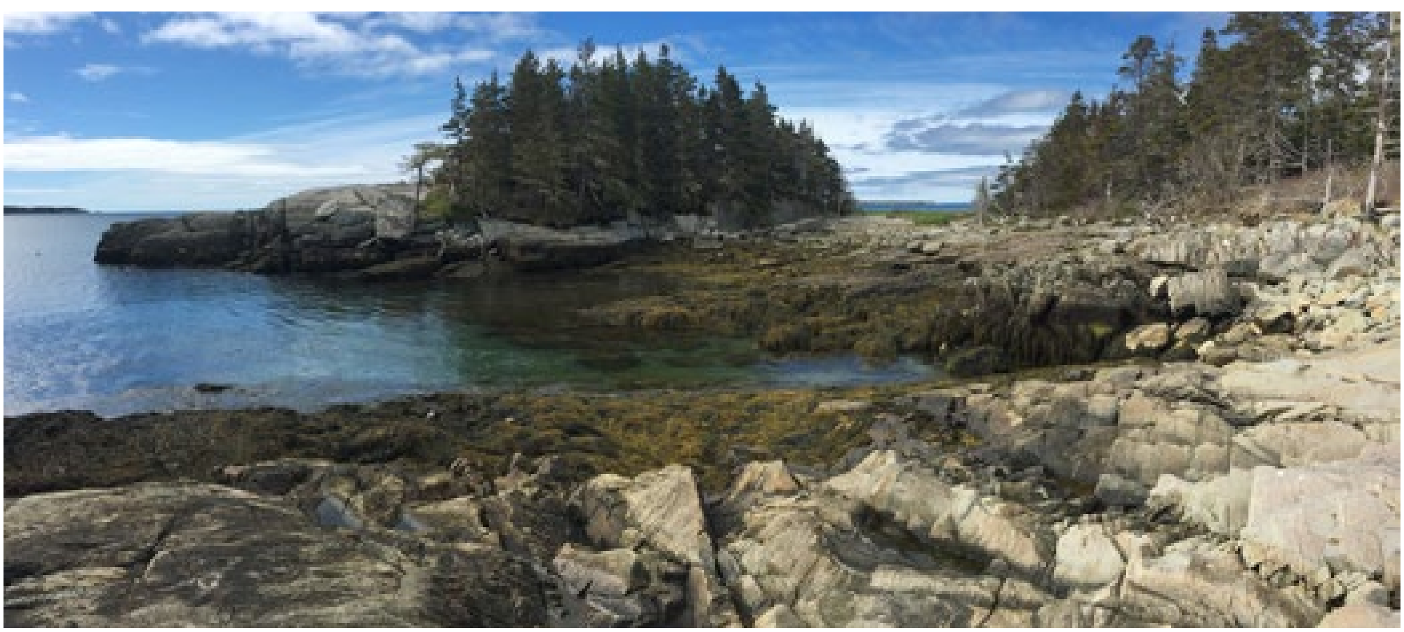
Ecodistrict 820 Percentage Land Cover

Forest/Woodland	58.0
Shrub/Heathland	20.9
Wetlands	9.4
Urban/Industrial	5.4
Water	4.9
Sparsely Vegetated	1.0
Agriculture	0.4

Forests

The composition of the zonal softwood forest is dominated by balsam fir with lesser amounts of white spruce and black spruce and occurs on 25% of the ecodistrict. Scattered red maple and white birch (if present) are typically in the lower canopy or suppressed. Regenerating balsam fir with lambkill, false holly and mountain-ash make up the shrub layer. Herb diversity is low with bunchberry (*Cornus canadensis*), twinflower (*Linnaea borealis*), foxberry (*Vaccinium vitis-idaea*) and wild lily-of-the-valley (*Maianthemum canadense*) common. Schreber's moss (*Pleurozium schreberi*) and bazzania (*Bazzania trilobata*) dominate the extensive bryophyte layer, along with stair-step moss (*Hylocomium splendens*), broom moss (*Dicranum scoparium*) and plume moss (Ptilium *crista-castrensis*).

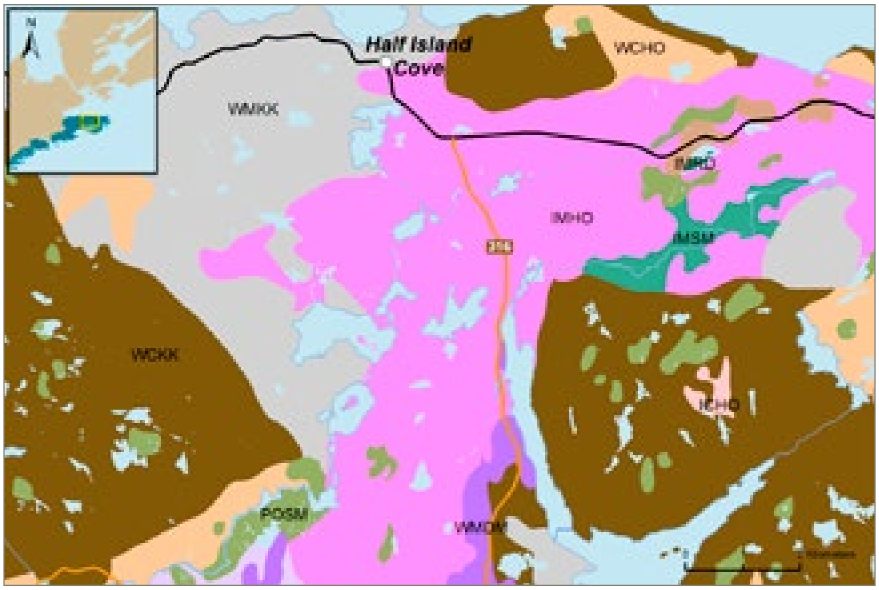
White spruce and balsam fir coastal forests extend to the shoreline at Burnt Point. Meguma Group bedrock (quartzite and grewacke) is exposed at low tide. *PHOTO: DNR (Carrie Drake)*



Ecodistrict 820

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	20.5%	20.5%
WCKK	16.4%	36.9%
WMKK	15.6%	52.6%
WCHO	8.5%	61.0%
IMRD	5.9%	66.9%
XXWA	5.7%	72.6%
WMRD	4.4%	77.0%
ICHO	4.3%	81.2%
WMDM	3.8%	85.0%
WCRD	3.6%	88.5%
WMHO	3.0%	91.5%
POSM	2.6%	94.1%
WFDM	2.5%	96.6%
WCDM	0.9%	97.5%
IMKK	0.5%	98.0%
XXCB	0.5%	98.5%
IMSM	0.4%	98.9%
WFHO	0.4%	99.3%
IFHO	0.3%	99.6%
PMHO	0.2%	99.8%
XXMS	0.1%	99.9%
ICKK	0.1%	100.0%



This matrix forest occurs on a variety of topography features such as hummocks, drumlins, flats, ridges and low level hills with moderately well-drained to imperfectly drained coarse to medium textured soils. On soils with lower nutrient availability balsam fir will form dense stands with small diameters.

Sheltered drumlins and low hills, extending along inland harbours with well drained, medium to rich soils, provide favourable conditions for patch-level hardwood and mixedwood forests of yellow and white birch. Red maple, balsam fir and white spruce are also possible.

The shrub layer is dominated by regenerating balsam fir and woody shrubs such as wild raisin, lambkill and mountain-ash. Herb diversity is low—bunchberry (*Cornus canadensis*), goldthread (*Coptis trifolia*), sarsaparilla (*Aralia nudicaulis*), wood-sorrel (*Oxalis montana*) and bracken (*Pteridium aquilinum*) are common. The moss layer is relatively well developed for a hardwood forest, with Schreber's (*Pleurozium schreberi*) and hypnum moss (*Hypnum imponens*) typical.

On very exposed headlands and shorelines, strong winds, salt spray and harsher climatic conditions often create a severely stunted canopy structure (especially in white spruce) called "krummholz."

(left) Prolific advanced balsam fir regeneration will soon replace the mature overstory as it deteriorates due to natural causes;
(right) Coastal conifer forest near DeBaie's Cove PHOTOS: DNR (Peter Neily) fir; CNS (Len Wagg) coastal

Under open conditions, black crowberry and common juniper grow in large patches between stunted and branchy white spruce.

Throughout the ecodistrict, on bedrock-ridged terrain where fresh to moist and nutritionally poor soils occur, forests of black spruce and balsam fir are dominant. Open woodlands of stunted black spruce are interspersed where soils are very shallow over bedrock. A windswept version of this forest repeats on many of the off-shore islands, especially between Clam Harbour and Ecum Secum.

Wet forests are embedded in both matrix and large patch forests, and as soil drainage gets progressively poorer, wet forests of red maple, black spruce and tamarack with alders, false holly, winterberry, and ericaceous woody shrubs (e.g., huckleberry, Labrador tea and rhodora) are common. This patch-level forest occurs primarily on imperfectly drained soils of medium texture (sandy loams) on flat terrain sometimes associated with lakes and watercourses. Embedded within this forest are wet open woodlands, bogs, swamps, fens and seasonally flooded flats. Forests of slow growing black spruce are typical.

All forests along the eastern shore are frequently disturbed by windthrow due to strong coastal winds and hurricanes, insects and disease. These agents plus natural senescence limit the potential for traditional concepts of old growth forest development. Forests are typically even-aged and stand renewal following stand-level disturbance is rapid owing to the advanced regeneration of fir and spruce in the understory. In the absence of physical disturbance, natural senescence in both softwood and hardwood species limits stand age to 100 to 125 years. The scale of canopy disturbance can be variable, with both small and large patches of windthrow and breakage common.

The large rock barrens near Peggy's Cove and Canso are covered with scattered black spruce, tamarack and jack pine, with a dense ericaceous (heath) shrub layer. The presence of jack pine in several locations suggests that constant winds of the coastal zone may create drought conditions that are conducive to jack pine seeding and germination with or without fires.

Wherever lands have been cleared for settlement and later abandoned, forests of white spruce and tamarack are common. Much of the forest on the drumlins in this ecodistrict has been cleared, especially near Halifax.

Clam Harbour Provincial Park is one of several coastal parks in this ecodistrict. The annual sandcastle competition held here attracts thousands of visitors and participants. An eroding coastal drumlin is visible in the background. *PHOTO: DNR (Carrie Drake)*

Coastal heathland, exposed bedrock and stunted forest at Jamieson Lake, Bonnett Lake Barrens Wilderness Area *PHOTO: CNS (Len Wagg)*

Non Forests

Over 27% of the ecodistrict is non-forested—the second highest area among ecodistricts in the province, and the highest on the mainland. This ecodistrict contains vast expanses of exposed glacially scoured granite bedrock and thin glacial tills. These are particularly common on the Canso peninsula, the shoreline of the Chebucto peninsula, and on several of the numerous Eastern Shore islands. Elsewhere in the ecodistrict, a flat to gently rolling till-plain is the dominant surficial deposit.

Most of these non-forested ecosystems are upland, dominated by heath species (plants from the *Ericaceae* family) growing on thin glacial soils, upland organic deposits (called folisols), and or rock outcrops. Often called heathlands or barrens, these low growing shrubby areas occupy a larger proportion of non-forested ecosystem area than in any other ecodistrict in the province. They are particularly well expressed in the Bennett Lake and Canso Coastal Barrens Wilderness Areas. Here globally rare broom crowberry coastal heathland is found scattered in larger areas dominated by huckleberries (*Gaylussacia baccata* and *G. bigeloviana*), velvet-leaf blueberry, lambkill, cinnamon fern (*Osmunda cinnamonia*), alders, and black crowberry. On exposed bedrock, the subarctic hoary rock-moss (*Racomitrium lanuginosum*) may form extensive mats.

The ecodistrict is also characterized by numerous beaches and dunes. Most of these are found between Halifax Harbour and Clam Bay, but there are also a few closer to Canso (including notable examples in Tor Bay). Outside of **Sable Island (850)**, total beach and dune areas in this ecodistrict are respectively the second and third highest in the province.

Most of the dunes do not extend far inland, but some are broader with well-developed secondary and tertiary dune communities.

One of the most significant features of the ecodistrict is the numerous islands found scattered along the coast. There are almost 3000 islands along the Eastern Shore—most are concentrated between Clam Bay and Liscomb Harbour. Many of the islands are non-forested, covered in a myriad of low growing trees, dense shrubland, and in some cases dense areas of lichen or peatland. These islands provide important habitat for common eider, harlequin duck, double-crested cormorant, and other coastal bird species.

830
South Shore

The South Shore ecodistrict extends about 180 km from the Halifax peninsula, west to Pubnico Harbour, and extends inland at some locations approximately 10 km.

The coastline is irregular, with many bays, inlets, headlands and islands. It largely reflects the geology and landforms of adjacent inland ecodistricts where granite, slate and quartzite bedrock extend to the coast.

The topography of low hills and hummocks, extensive flats and scattered drumlins follows the coastline. Mean elevation is just over 20 m. Coastal barrens and headlands can be extensive throughout, particularly in the western portion. Coarse, sandy beaches are common, along with small scattered salt marshes. This ecodistrict excludes the inner islands of Mahone Bay, which for the most part are within the **LaHave Drumlins (740)** ecodistrict.

A homogenous softwood forest of black spruce, white spruce and fir drapes most of the coastal area, with mixedwood forests more common inland. Total area of the ecodistrict is 1352 km^2 or about 28.8% of the ecoregion.

This coastal forest has more diversity than elsewhere in the Atlantic Coastal ecoregion and this may be attributed to warm on-shore temperatures in western Nova Scotia and the mixing of warmer waters of the Gulf Stream with the Nova Scotia Current. Nonetheless, the South Shore ecodistrict is cooler in summer and milder in winter than the adjacent inland ecodistricts, and further distinguished by frequent periods of fog.

Vegetation types have boreal affinity and are considered indicative of Maritime Boreal ecosites. Scattered red maple and white birch are typically subordinates in the dominant softwood forest of black spruce, white spruce and balsam fir, but these hardwoods achieve greater prominence

A conifer forest of white spruce, black spruce and balsam fir hug the coastline along Barrington Bay. *PHOTO: CNS (Len Wagg)*

Armallaria root rot (Honey mushrooms) is a serious forest disease causing tree death and forest dieback. These armallaria mushrooms can be commonly found in coastal forests of balsam fir and white spruce.
PHOTO: DNR (Bruce Stewart)

farther from the coast and on sheltered sites. Red oak and white pine are also more common in this ecodistrict than elsewhere in the ecoregion.

The coastal headlands receive the brunt of the Atlantic winds, which creates severely stunted forests of black and white spruce. However, once the impact of this exposure is diminished—either by shelter or distance from the coast—other tree species (red spruce, white pine, red oak and yellow birch) are found. The absence of red spruce, except for the most sheltered locations in the ecodistrict, is an indicator of the Atlantic Ocean's influence on climate and vegetation.

Natural disturbance agents in the South Shore ecodistrict are primarily hurricanes and storms due to its proximity to the Atlantic Ocean. Much of the forest is on imperfectly drained soils, which makes them prone to blowdown. Once blowdown starts, it can quickly expand small patches into larger areas. Forests in this ecodistrict have been heavily impacted by human activity.

Geology and Soils

Like the **Eastern Shore (820)**, the South Shore ecodistrict is mainly underlain by Meguma Group rock, in particular Halifax Formation slate. Halifax slate is high in sulphide minerals (e.g., pyrite) that, when exposed and oxidized, can generate harmful acid rock drainage (ARD). This rock is also a major source of arsenic (arsenopyrite) that can contaminate drinking water.

Surficial deposits and soil parent materials are dominated by stony glacial tills that are often shallow to bedrock. Surface stoniness in these soils is usually high and sometimes excessive. Scattered drumlin formations can also be found—associated with the abundance of slate in the area. These landforms are generally finer-textured and less stony than surrounding till deposits.

Dominant soils are derived from gravelly sandy loam till containing a mix of quartzite, slate, granite and schist (Port Hebert/Lydgate soils); gravelly sandy loam till high in quartzite and slate (Halifax/Danesville soils); gravelly loam to silt loam till high in slate (Bridgewater/Riverport soils); and shallow and/or very stony sandy loam till (Rockland soils) (**See Table 38**).

Port Hebert/Lydgate soils are almost always cemented by iron oxides and organic matter to

Table 38
Summary information for dominant soils found in the South Shore ecodistrict (830). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Port Hebert / Lydgate *	33	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST15, ST3, ST16, ST15-G, ST16-G	Podzol
Hydric	30	Glacial Till, Organic	Medium-Coarse	Poor-Very Poor	ST14, ST4	Organic, Gleysol
Halifax / Danesville *	14	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Bridgewater / Riverport	14	Glacial Till	Medium	Well-Imperfect	ST2-L, ST2, ST8, ST3-L, ST3, ST9	Podzol
Rockland*	5	Glacial Till, Bedrock	Medium-Coarse	Rapid-Imperfect	ST15, ST16, ST2, ST3, ST15-G, ST16-G	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

(left) Coastal conifer forests tend to have a significant layer of regeneration in the understory, ready to start the next forest after the overstory is destroyed by winter storms and/or hurricanes. (Lower Sandy Point, Shelburne County); *(right)* Well drained soil profile, partially cemented with iron oxides and organic matter (Port Hebert Soil Series) Photos: DNR (Peter Neily)

varying degrees (Ortstein soils). Although not mapped as such, these soils likely also occur in the **Eastern Shore (820)** ecodistrict since both areas have similar parent materials and climate. Bridgewater soils are mainly associated with drumlin formations.

Variable topography, low elevations and abundant moisture have also led to significant hydric soil development in this ecodistrict.

Forests

Forests of white spruce, balsam fir and black spruce are typical on zonal sites. They occur on 43% of ecodistrict. Soils have developed from glacial tills and are well to moderately well drained of poor to medium fertility. These soils are generally medium to coarse textured and often stony.

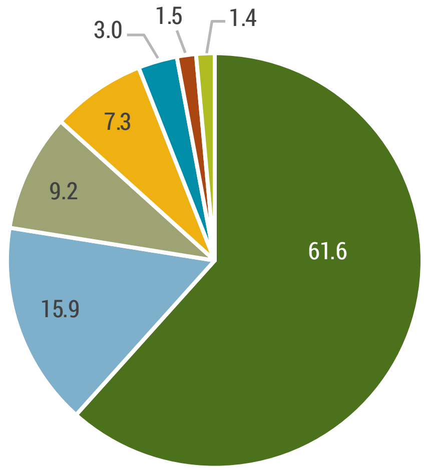
Where balsam fir is dominant, the shrub layer is typically regenerating fir with scattered lambkill, false holly and mountain-ash. Herb layer diversity is low, with bunchberry (*Cornus canadensis*), twinflower (*Linnaea borealis*), sarsaparilla (*Aralia nudicaulis*), foxberry (*Vaccinium vitis-idaea*) and wild lily-of-the-valley (*Maianthemum canadense*). Schreber's moss (*Pleurozium schreberi*) and bazzania (*Bazzania trilobata*) dominate the extensive bryophyte layer, along with stair-step moss (*Hylocomium splendens*), broom moss (*Dicranum scoparium*) and plume moss (*Ptilium crista-castrensis*).

This matrix-level forest occurs on a variety of topography features such as hummocks, drumlins, flats, ridges and low level hills. High winds and exposure limit tree height. Embedded within this forest are barrens, wet open woodlands, bogs, swamps and fens. Coastal black spruce flats with wetland inclusions often occur as a linear feature on imperfectly to poorly drained, nutrient poor soils associated with lakes, stillwaters and watercourses. The slow growing black spruce occurs with red maple, tamarack, alders, false holly, winterberry. Ericaceous woody shrubs (such as huckleberries) are more common on the wettest sites.

A small patch-level forest of jack pine and black spruce occurs on ridged terrain (e.g., at Blandford and Peggy's Cove). Here, soils are shallow to bedrock and coarse textured—with a shrubby cover of huckleberry, common juniper, rhodora and other ericaceous species. Elsewhere on similar conditions (e.g., offshore islands and exposed headlands), tree cover is usually a few scattered black spruce, tamarack, white spruce, and red maple. On headlands, white spruce is more prominent, often as krummholz.

Ecodistrict 830
Percentage Land Cover

Forest/Woodland	61.6
Wetlands	15.9
Shrub/Heathland	9.2
Urban/Industrial	7.3
Water	3.0
Sparsely Vegetated	1.5
Agriculture	1.4



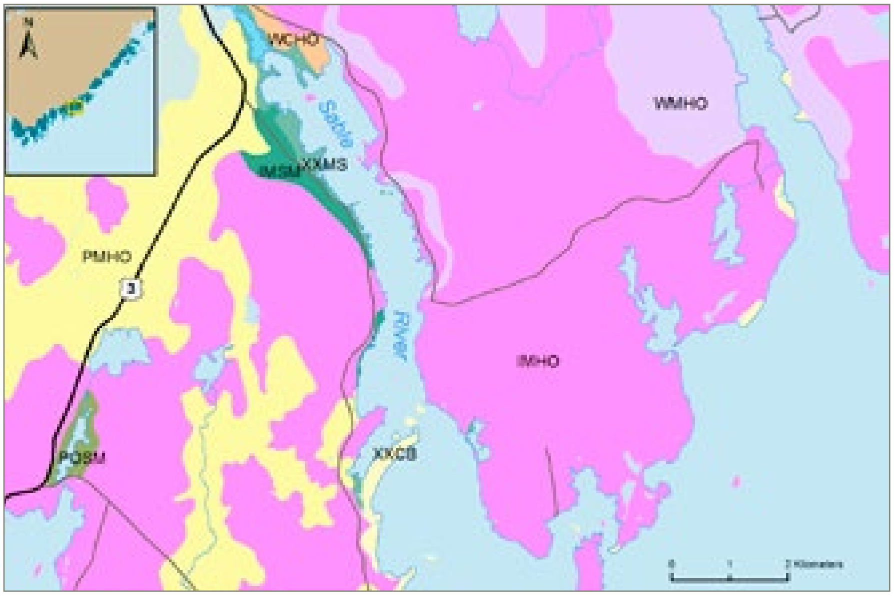
Inland locations with deep, well drained soils, produce a patch-level forest of black spruce, white pine and red oak, which is often associated with glaciofluvial tills along major rivers such as the Clyde and Sable Rivers. Some of the more productive forests occur on this site, especially on sheltered areas with loamy soils, allowing white pine and red oak to become more prominent overstory species.

Understory vegetation includes several woody shrubs (including blueberry), lambkill, and huckleberry), which can be extensive where stands are only partially stocked. Coastal mixedwood forests occur on the fresh, nutrient medium to rich soils found on sheltered drumlins and inland hummocky terrain. These are primarily found in coastal Lunenburg County. The overstory is dominated by white birch and red maple with a strong component of balsam fir and white spruce. Yellow birch, white pine and red spruce are possible on the more sheltered sites. The shrub layer often has considerable fir regeneration along with wild raisin, lambkill, blueberry, false holly, and mountain-ash (which can sometimes attain an overstory height with a significant canopy). Herbs include wood-sorrel (Oxalis *montana*), twinflower (*Linnaea borealis*), bunchberry (*Cornus canadensis*), goldthread (*Coptis trifolia*) and creeping snowberry (*Gaultheria hispidula*).

This coastal forest is frequently disturbed by windthrow, insects and/or natural senescence. Stands are typically even-aged, and reforestation is quick following a stand-level disturbance due to the advanced regeneration of fir and spruce in the understory.

Earlier successional forests support red maple and white birch, but these species are quickly over-topped by the spruce. Species composition and frequency of disturbance limit old growth potential in these coastal forests.

Relict sand dune perched on top of glacial till at Carter’s Beach, Queens County *PHOTO: DNR (Sean Basquill)*



Ecodistrict 830

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	41.2%	41.2%
PMHO	12.6%	53.7%
WMHO	12.3%	66.0%
IMSM	5.7%	71.7%
POSM	4.4%	76.1%
WMDM	4.1%	80.2%
XXWA	3.5%	83.7%
WMRD	2.7%	86.4%
IMRD	2.6%	88.9%
WCKK	1.9%	90.9%
WFDM	1.5%	92.4%
WCHO	1.3%	93.8%
WMSM	1.2%	95.0%
WMKK	1.2%	96.1%
XXCB	1.1%	97.2%
IMKK	0.9%	98.0%
ICHO	0.9%	98.9%
XXMS	0.8%	99.7%
ICSM	0.3%	100.0%

Insect defoliation has not been a significant factor in forest disturbance, although the balsam woolly adelgid is currently damaging and causing mortality in balsam fir.

The poor nature of many soils in this coastal ecodistrict, especially in the western portion and on many ridged ecosections near Lunenburg (e.g., Heckmans Island), has created ecosystems that are vulnerable to fire. Barrens and poorly stocked spruce forests are especially at risk due to the local abundance of "fuel' in the form of ericaceous shrubs and needle litter.

While naturally-ignited forest fires are not a likely cause of disturbance here (due to the moist climate), the potential for significant burns is possible if ignition were to occur inland on drier sites, and was pushed by winds to the coastal region.

On dry sites with shallow soils, relatively constant coastal winds may create a drought condition that is conducive to wildfire. Fires have been common in the past but they appear to have been started by European settlers to extend pasture land and/or create conditions for game and blueberries. Wherever forests have been cleared for settlement and later abandoned, forests of white spruce are common, with white pine and red oak more common farther inland.

Non Forests

Similar to other ecodistricts in the Atlantic Coastal ecoregion, the South Shore has a high relative proportion of non-forested ecosystems. Just over half of these, by area, are open wetland. Salt marshes are common but most of the open wetlands are peatland and shrub swamp.

Some of the salt marsh complexes in the western end of the ecodistrict support nationally unique plant communities. These open wetlands are on the landward side of active salt marshes and within the influence of higher tides and storm surges. They are characterized by species like Olney's bulrush (*Schoenoplectus americanus*) and beaked spikerush (*Eleocharis rostellata*). The communities are described in more detail in the description for the **Tusket Islands (840)** ecodistrict.

Another unique species found in some South Shore wetlands is the thread-leaved sundew (*Drosera filiformis*), a plant that occurs nowhere else in Canada. The thread-leaved sundew is known to occur in only four peatland complexes, three of which are in this ecodistrict.

The South Shore is famous for its white sand beaches, many of which are backed by dunes. The area of beaches and dunes in the South Shore is higher than in any other ecodistrict in Nova Scotia.

Cobble woodlands are known at only five beaches in Nova Scotia, but likely occur at a few more. *PHOTO: DNR (Sean Basquill)*

East Point Island, Lunenburg Bay
PHOTO: DNR (Bob Guscott, retired DNR)

Dunes here are composed of fine-grained sand reworked from beaches and glacial till. Unlike beaches and dunes on the **Eastern Shore (820)**, eroding drumlins provide very little of the sediment.

This is the only part of the province (outside of Sable Island) where dunes are found landward of a "shoreline beach." Elsewhere, beaches and dunes are usually on barrier spits or barrier islands. Most of the dunes in the South Shore have a single ridge with a steep seaward ramp. These landforms are dominated by marram grass (*Ammophila breviligulata*) and other herbaceous species. In less active parts of the dunes, shrubs (e.g., bayberry, Virginia rose) and eventually trees replace marram grass as part of dune vegetation succession. Protected interdunal areas may support wetlands called *slacks*. These low lying ecosystems are characterized by large cranberry (*Vaccinium macrocarpon*) and Baltic rush (*Juncus balticus*), among other species. Drier interdunal areas may be occupied by heathland or ground lichens, although these communities are less common in the South Shore.

840
Tusket Islands

The Tusket Islands is one of the most topographically and ecologically distinct landscapes in Nova Scotia. This small ecodistrict at the western end of the province encompasses over 800 offshore islands—roughly 8% of all the islands in Nova Scotia. This is remarkable considering the ecodistrict makes up less than 1% of provincial area.

The ecodistrict, which seldom exceeds 10 km in width, is characterized by a submerged coastline with tidal rivers and inlets (e.g., Chebogue River), numerous islands, long narrow peninsulas, and extensive salt marshes. At its widest, it extends inland approximately 13 km (near Ellenwood Lake Provincial Park).

The Tusket Islands ecodistrict extends along the Gulf of Maine coast from Pubnico to Yarmouth Harbour. This area shares the same topography and geology as the adjacent **Clare (730)** and **Sable (760)** ecodistricts, but is influenced by a cooler and more moist coastal climate.

Overall, the moderating effect of the Gulf of Maine gives this area the mildest winters in the province, and a frost-free period for over half the year—

longer than any other place in Eastern Canada (Environment Canada). Yarmouth's average January temperature is –2.7 °C, the warmest of any mainland station in the Maritimes. However, summers are cool and fog is common.

Coastal forests fringe the extensive estuarine salt marshes of the Tusket Islands *PHOTO: CNS (Len Wagg)*

The bedrock of the Tusket Islands is mostly quartzite and slate. However, there is an intrusion of granite near Wedgeport. Soils are derived largely from glacial till with a moderately coarse texture.

Total salt marsh area is very high, comprising approximately 3839 ha or 9.2% of the ecodistrict. Total area of the ecodistrict is 418 km^2 or about 8.9% of the ecoregion.

In the 17th century, Nicolas Denys described this area: "…a great bay in which there are many islands called the Isles of Tousquet. They are covered with fine and good woods [pines, firs of three sorts, birches, black birches, beeches, aspens, maples, ashes and oaks]. Many meadows occur on the islands, where abounds all kinds of geese, cranes, ducks, …and so many other kinds of birds that it is astonishing." (Ganong, 1908)

Boreal-like forests of black spruce (with white spruce and balsam fir) are prominent on the most exposed headlands and outer islands. Farther inland and on the interior islands of Lobster Bay (which are more sheltered), conditions are suitable for other species such as red spruce, white pine, red oak and shade tolerant hardwoods. The presence of these Acadian forest species here and extending up the Bay of Fundy coast (into Maine, New Brunswick and into Chignecto Bay) suggests that the coastal influence of the Gulf of Maine is more moderate than that of the open Atlantic Ocean.

Forests in this ecodistrict have been heavily impacted by human activity, usually associated with settlement, pasturing, and the fishing industry.

This ecodistrict is also home to many species of the Atlantic Coastal Plain Flora. Over 90 species of the coastal plain flora grow in Nova Scotia, and many are endangered.

Natural disturbance agents in this ecodistrict are primarily hurricanes and storms due to its proximity to the Atlantic Ocean. Much of the forest is on imperfectly drained soils, which makes them prone to blowdown. Once blowdown starts, it can quickly expand small patches into larger areas.

Insect defoliation has not been a significant factor, although the balsam wooly adelgid is currently damaging and causing mortality in balsam fir forests throughout the ecodistrict. Naturally-ignited forest fires are not a likely cause of disturbance in this ecodistrict.

Geology and Soils

The Tusket Islands ecodistrict is underlain by Meguma Group rock (greywacke/quartzite, slate, schist and migmatite) along with a Carboniferous period intrusion of granite/granodiorite in the Wedgeport area.

Surficial deposits and soil parent materials are dominated by gravelly glacial tills, but there are also significant glaciofluvial deposits and salt

Table 39
Summary information for dominant soils found in the Tusket Islands ecodistrict (840). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Hydric	36	Various	Various	Poor-Very Poor	ST14, ST4	Organic, Gleysol
Mersey / Liverpool	24	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L, ST8, ST9	Podzol
Halifax / Danesville *	14	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L	Podzol
Yarmouth / Deerfield	13	Glacial Till	Medium-Coarse	Well-Imperfect	ST2, ST3, ST2-L, ST3-L, ST8, ST9	Podzol
Medway	9	Glaciofluvial	Coarse	Well-Rapid	ST2, ST1	Podzol
Gibraltar / Bayswater *	5	Glacial Till	Coarse	Well-Imperfect	ST2, ST2-G, ST3, ST3-G, ST1	Podzol

Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

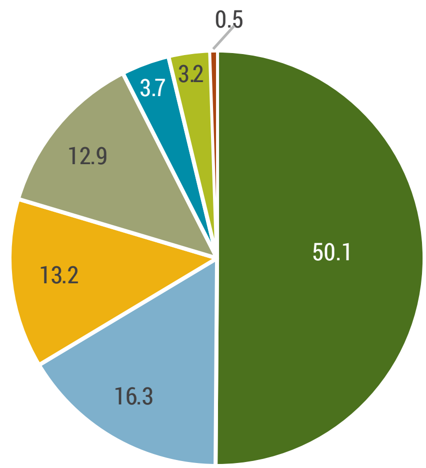
marsh organic deposits in the many estuaries found in this ecodistrict. Scattered drumlin formations can also be found.

In addition to saltmarsh organic and other hydric soils associated with low lying areas, dominant soils are derived from gravelly sandy loam to loam till high in schist and quartzite (Mersey/ Liverpool soils); gravelly sandy loam till high in quartzite and slate (Halifax/ Danesville soils); gravelly sandy loam till high in mica and hornblende schist (Yarmouth/ Deerfield soils); very gravelly glacio-fluvial deposits high in quartzite (Medway soils); and stony sandy loam to loamy sand till high in granite and granodiorite (Gibraltar/Bayswater soils) (**See Table 39**).

Coarse, gravelly Medway and Gibraltar/ Bayswater soils are prone to cementation by iron oxides and organic matter (Ortstein soils).

Forests

A typical coastal coniferous forest dominated by balsam fir, white and black spruce occurs on the headlands and islands where they are subjected to significant exposure from high winds, salt spray and fog. This forest occurs on moderately well-drained to imperfectly drained coarse to medium textured soils on hummocky terrain.



Ecodistrict 840
Percentage Land Cover

Forest/Woodland	50.1
Wetlands	16.3
Urban/Industrial	13.2
Shrub/Heathland	12.9
Water	3.7
Agriculture	3.2
Sparsely Vegetated	0.5

A little farther inland, sheltered from direct coastal exposure but on similar soils, red spruce takes over, occurring on drumlins or hummocks often as islands or long narrow peninsulas in Lobster Bay. An occasional white pine may occur in the canopy but hemlock is absent.

Although this forest is frequently disturbed by windthrow, insects and/or natural senescence old growth forest development is possible, given the longevity of red spruce.

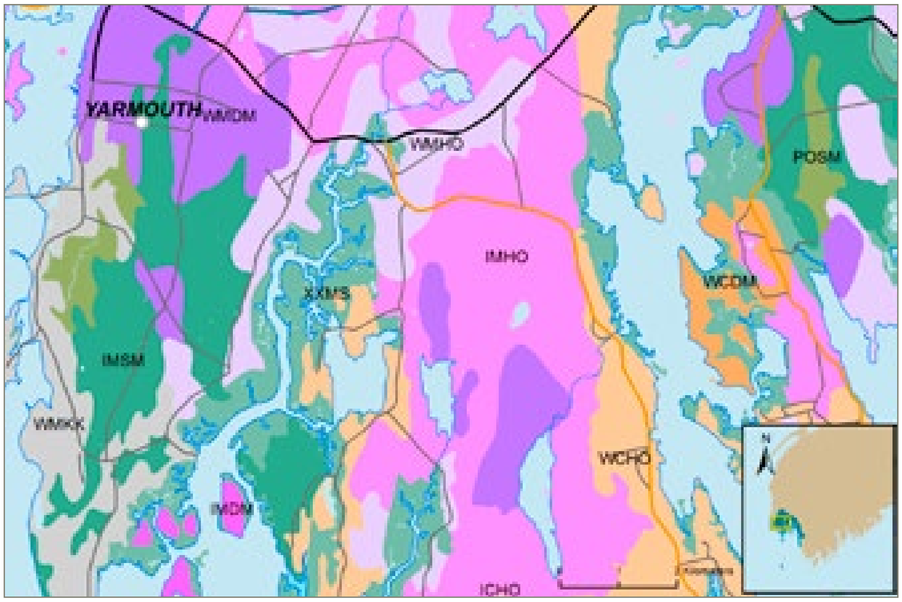
Earlier successional forests will have red maple and white birch, but these species are quickly over-topped by spruce. Embedded within these

Tucker Island in Lobster Bay *PHOTO: CNS (Len Wagg)*

Ecodistrict 840

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
IMHO	26.2%	26.2%
WMHO	17.4%	43.6%
WCHO	11.8%	55.5%
WMDM	9.8%	65.3%
IMSM	9.6%	74.9%
XXMS	9.2%	84.0%
XXWA	4.5%	88.6%
POSM	3.3%	91.9%
WMKK	2.8%	94.7%
ICHO	1.5%	96.2%
IMDM	1.4%	97.7%
ICSM	1.3%	98.9%
WCDM	0.6%	99.5%
PMHO	0.3%	99.8%
XXCB	0.2%	100.0%



spruce dominated forests which occupy 40% of the ecodistrict are wet open woodlands, bogs, swamps and fens.

Big Tusket Island and the many smaller islands surrounding it (as well as those at the mouth of the Chebogue River) are dominated by black spruce, white spruce and some balsam fir. These forests are frequently renewed by windthrow and the overstories seldom attain a multi-aged condition. Tree height is severely restricted on the islands and krummholz may occur.

On bedrock-ridged terrain at Cape Forchu and nearby Kelly's Cove soils are well drained sandy loams supporting a climax forest of black spruce and white spruce, with very few red maple or white birch in the canopy. In all cases these stands are directly influenced by the coastal climate. Krummholz white spruce occurs on the most exposed headlands. There are very few wetlands embedded within this forest but there are adjacent salt

Tidal channels crisscross the estuarine marsh at Indian Bay, Yarmouth County. *PHOTO: CNS (Len Wagg)*

The salt marsh at Abram's River is punctuated by numerous pools and pannes. Salt marsh pannes are shallow sparsely-vegetated depressions which provide unique microhabitat for a variety of plants and marine invertebrates. This particular marsh supports some very rare plant species. *PHOTO: CNS (Len Wagg)*

marshes. This forest is frequently disturbed by windthrow and/or natural senescence, which limit the potential for old growth forest development.

Farther inland, hardwood species form part of the canopy. On warmer and better drained sites, coastal hardwood forests of red maple, white and yellow birch and red oak are possible.

As soil drainage gets progressively poorer, wet forests of red maple, black spruce and tamarack with alders, false holly, winterberry, and ericaceous woody shrubs such as huckleberries and inkberry, are common.

All coastal forests are frequently disturbed by windthrow, insects and/or natural senescence. All these factors limit the potential for old growth forest development. Typically following stand-level disturbances, coastal forests will quickly regenerate to a similar forest community from the abundant younger trees and other vegetation in the understory. Earlier successional forests on inland sites have red maple and white birch, but these species are quickly over-topped by spruce.

Wherever forests have been cleared for settlement and later abandoned, forests of white spruce are common.

Non Forests

The marine and near-marine environment along this stretch of the Atlantic Coast is unique. The shoreline substrate is predominantly mud with lesser amounts of sand and gravel. Marine and estuarine flats, including eelgrass beds, are well-developed—having the highest area of any ecodistrict in the province. Supratidal (above the usual high tide mark) macroalgae (seaweed) species diversity and abundance is very high in the intertidal zone. It is here in the offshore that the relatively low tidal range of the Atlantic Coast transitions to the higher tides typical of the Bay of Fundy. This change in tidal regime creates a persistent upwelling which causes warmer than average yearly water temperatures and high biological productivity in the outer part of Lobster Bay.

The inlets and estuaries sandwiched between peninsulas of the Tusket Islands ecodistrict are called drowned valleys, or fjards. Fjards are similar to fjords, but they tend to be shorter, wider, and shallower. Fjards are created when

Salt scrub (in foreground) is found along the upper edge of coastal marshes along the Tusket River near Muise's Point. PHOTO: CNS (Len Wagg)

coastlines are submerged by sea-level rise and/or coastal subsidence. Nova Scotia has been slowly subsiding since the last glaciers receded. This has flooded river valleys and inlets on the Atlantic Coast. The effects are particularly pronounced and visible in the Tusket Islands ecodistrict.

The long fjards in this area are highly protected from wave and winds typical of the Atlantic Coastal ecoregion, which has allowed extensive development of more sensitive ecosystems like salt marshes.

Salt marshes make up over 55% of all wetland area—the highest proportion of any ecodistrict in the province. These marshes, along with adjacent landward wetlands and the transition zones to uplands, include numerous rare plants, some of which are found nowhere else in Canada (e.g., saltmarsh agalinis (*Agalinis maritima*), eastern lilaeopsis (*Lilaeopsis chinensis*), eastern baccharis (*Baccharis halimifolia*), and big-leaved marsh-elder (*Iva frutescens* ssp. *oraria*)).

On the landward side of many salt marshes is a unique kind of supratidal fen. These seaside peatlands are above daily tidal flooding but are inundated by higher seasonal tides and storm surges. They have slightly brackish soils and are dominated by rare species such as Olney's bulrush (*Schoenoplectus americanus*) and beaked spikerush (*Eleocharis rostellata*).

In some areas, salt marshes or supratidal fens grade into a salt scrub transition zone restricted to this part of Canada. The salt scrub is found as a narrow band between upland and wetland ecosystems. Big-leaved marsh-elder (*Iva frutescens* ssp. *oraria*), a pioneer woody shrub, and eastern baccharis (*Baccharis halimifolia*) are characteristic species of Nova Scotia salt scrub.

850
Sable Island

This section authored by Zoe Lucas

Sable Island is a long, narrow, bow-shaped island of sand, situated far offshore, near the outer margin of the continental shelf. Although the island is part of Nova Scotia, it is distinguished from the rest of the province by its remote location, and by a number of unique features.

The island's landscape is dominated by one of the largest dune systems in Atlantic Canada. Other notable features include an extensive freshwater lens; the world's largest breeding colony of grey seals (*Halichoerus grypus*); a population of feral horses; and numerous rare and/or endemic species of flora and fauna. Sable Island is a distinct biogeographic entity within the province, and having a surface area of roughly 30 km^2, is the smallest ecodistrict in Nova Scotia.

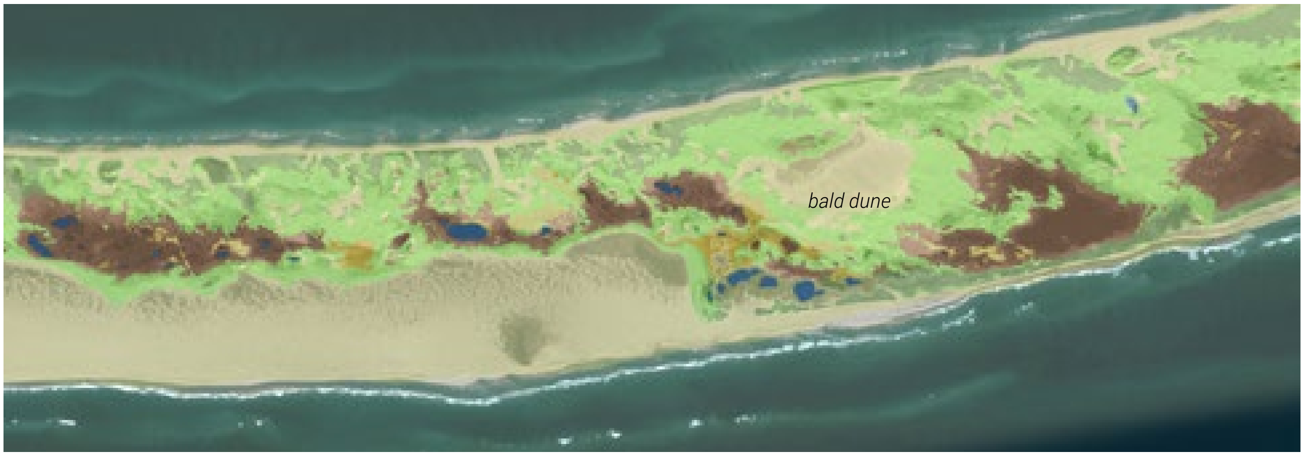
Sable Island is located in the northwestern Atlantic Ocean close to the edge of the Scotian Shelf—the part of the continental shelf off Nova Scotia. The island's western tip is approximately 156 km from the nearest landfall, a point just south of the Canso Coastal Barrens Wilderness Area, Guysborough County.

The island is oriented roughly east–west, and measures approximately 49 km long and up to 1.3 km wide (S. O'Grady, Parks Canada, 2015, pers. comm.). However, the island's dimensions vary, as its perimeter (the north and south shorelines, and the east and west tips) is subjected to seasonal and long-term changes in patterns of sand deposition and erosion. Also, severe weather events can have short- and/or long-term impacts on the island's size and shape. These changes are sometimes dramatic.

The island's climate is Maritime Temperate, and relatively moderate compared with that of the rest of Nova Scotia (Meteorological Service of

Looking towards East Spit, Sable Island. PHOTO: CNS (Len Wagg)

Vegetation cover types of the Central Core portion of Sable Island. *SOURCE: Colville et al, 2016*



Typical landcovers found in this ecodistrict are shown in this sample area map.

Ecosection	District %	Cumulative %
XXCB	98.8%	98.8%
XXWA	1.2%	100.0%

Canada, 1999). The climate is strongly affected by variable influences of ocean circulation patterns on the Scotian Shelf around Sable Island.

The relatively cool, fresh water from the Gulf of St. Lawrence flows through the Cabot Strait, and part of the flow turns southward and becomes the Nova Scotia Current on the Scotian Shelf, where it eventually mixes with the cold Labrador Current from the north, and with warmer eddies off the Gulf Stream from the south. The overall effect is a general increase in temperature from the mainland coast outward to the continental slope, and from the northeast to the southwest (Byrne et al., 2014).

Compared with the rest of the province, the island has milder temperatures, a smaller proportion of precipitation received as snow, and more frequent cloud cover and fog. However, winds are generally stronger on Sable Island. The island, being in a remote oceanic location, is exposed to wind, heavy seas and fog from all directions. This distinguishes Sable Island from more familiar sandy “barrier” islands which, being much closer to the mainland, tend to have a relatively sheltered ‘side’ and an exposed ‘side’. The island’s topography reflects the wind regime, and the predominant storm pattern is apparent in the orientation of landforms on the island.

The landscape of Sable Island consists of highly dynamic beaches, complex vegetated dune systems, inland areas of low, undulating terrain, huge bald dunes, and brackish and freshwater ponds. Most of these ponds are the surface exposures of a large, precipitation-fed, freshwater lens that underlies the island.

Roughly 50% of the island’s surface area is vegetated (Colville et al., 2016). During the last four centuries, introductions of livestock and cultivation of crops have influenced the island’s landforms and the composition of vegetation communities. Two centuries ago, the island was primarily known as a hazard to navigation, one of several locations along the northeast coast of North America that earned the name “Graveyard of the Atlantic.” In 1801 the Government of Nova Scotia set up the lifesaving stations—the Sable Island Humane Establishment—which operated until 1958. The human impact on the island was greatest during this period, with farming, constructions, roads, and introductions of non-native flora and fauna.

Roughly 185 plant species are presently found in distinctive plant communities comprised of herbs and low shrubs. Although about 40 of the plant species on Sable Island are non-native, few of these thrive on the island, and most occur in areas where buildings and other structures provide some protection from wind and blowing sand. Much of the island's native flora is typical of mainland Nova Scotia and northeastern North America. A number of the native plants have a restricted distribution beyond Sable Island, and a dozen, such as the long-bracted green orchid (*Coeloglossum viride var. virescens*), have a relatively high conservation status rank (≤S3).

Overall, plant community development is restricted to mostly coastal grasslands and low shrub-heath. There are extensive colonies of sea-beach sandwort (*Honckenya peploides*) on the east and west ends of the island, and the outer dunes are dominated by marram grass (*Ammophila breviligulata*) and beach pea (*Lathyrus maritimus*). Inland areas feature shrub-heath and cranberry communities that are dominated by black crowberry, bayberry, creeping and common juniper, Virginia rose and/or large cranberry. In addition there are richly vegetated freshwater pond and wetland communities, and in the moist terrain of dune slacks, and areas near freshwater ponds, cranberry is abundant. The habitats of the island support a rich biodiversity, and a number of endemic and restricted plants and animals have been recorded (Catling et al., 1984, 2009; Gibbs, 2010; Mazerolle, 2015).

The fauna of Sable Island is comprised of invertebrates, fishes, birds, horses, and seals. The horses (and humans) are the only terrestrial mammals. There are no reptiles or amphibians. The invertebrate fauna—including spiders, mites, beetles, flies, ants, wasps, grasshoppers, earthworms, and leeches—account for a large proportion of the biodiversity of Sable Island. Over 600 terrestrial invertebrates have been identified, along with 27 freshwater species. However, much of the currently cited species list is based on work done in the 1970s and 1980s. Recent collections have identified more than 100 species not previously recorded on the island, including some species new to science, such as the Sable Island sweat bee (*Lasioglossum sablense)* (Gibbs, 2010).

In December 2013, the island became a national park under the Canada National Parks Act. The designation of the Sable Island National Park Reserve recognizes the island's significant ecological values and unique features. Sable Island is part of the Halifax Regional Municipality.

Dunes provide the only major topographic relief on Sable Island. The horses occur in small groups, called bands. *Photo: Len Wagg*

Geomorphology

Sable Island, composed almost entirely of sand, is the emergent portion of a much larger sand deposit, the Sable Island Bank. During the most recent glacial period, the maximum extent of ice cover occurred at various times between 11,000 and 25,000 years BP*, and the ice had extended to the edge of the continental shelf off Nova Scotia. A series of banks were formed of reworked outwash sediments deposited by large paleo-rivers during glacial and early postglacial times.

Although the Sable Island, Middle, and Banquereau Banks were first exposed by glacial retreat around 12,000 years BP, sea-level rise in the region submerged Banquereau and Middle Banks, and by 8,000 years BP the above-water area of Sable Island Bank had diminished.

By 6,000 years BP the Sable Island Bank was mostly submerged, with only the island itself above water in what is roughly its present day form. With its on-going aggradation (vertical build-up of deposits), the central portion of the island has kept pace with sea-level rise, maintaining a relatively constant elevation with respect to mean sea level. However, the length and width of the island have diminished (Byrne et al., 2014).

Sable Island is subject to dynamic processes causing ongoing and often dramatic morphological changes that can occur overnight, or over a few days, months and years. Wind strength and direction, storm types and frequency, wave conditions, ocean circulation, and sea level changes, and the varying interactions between these processes, affect the physical and biological state of the island's terrestrial environment. However, essential to the long-term persistence and evolution of the above-water portion of Sable Island is the sediment (sand) budget around and on the island—the movement of sand to and from the island, between the beaches and the surrounding near- and offshore seafloor (Dalrymple and Hoogendorn, 1997). Little is known about the rates and directions of sand transport over the seafloor, however, clarification of the extent and movement of these sand sources is essential to understanding short- and long-term developments in the island's present and long-term structure.

* BP = Before Present.
The above dates are in radio carbon years (where "present" is 1950).

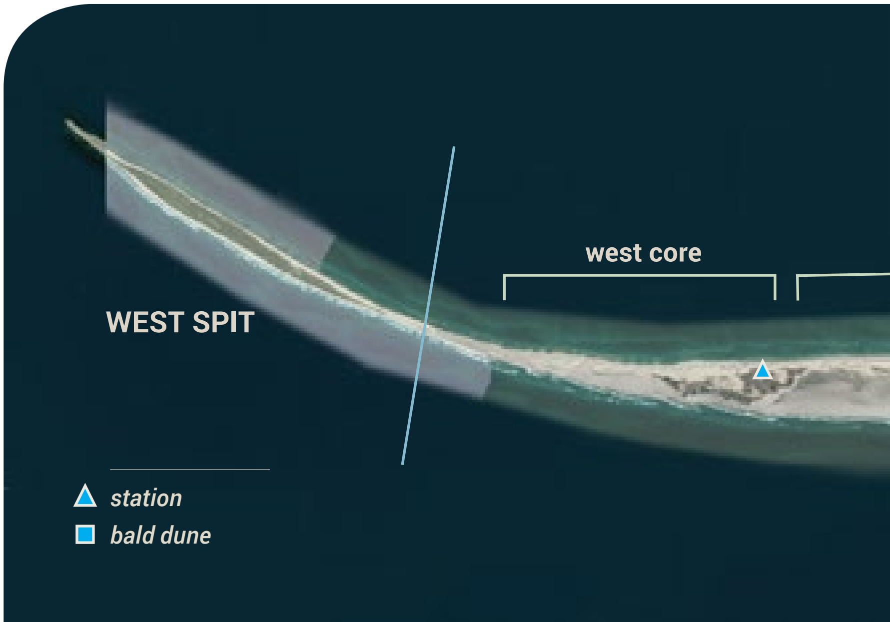
Landscape – Physiographic Regions and Morphology

Sable Island is long and narrow, crescent-shaped, and concave to the north. Being roughly oriented west-east, it can be described as having north and south shorelines (sides), and west and east tips (ends).

The north and south shorelines converge at the east and west tips. The north beach is generally narrower than the south, and the beach profiles undergo normal seasonal changes, being steeply inclined in winter and gently inclined in summer.

Along the north and south sides, dune ridges generally provide some shelter for inland areas of relatively stable terrain, complex vegetation communities and freshwater ponds. In these habitats, with increased vegetation coverage there is less sand movement, leading to a more stable environment and promoting the development of organic soils. Although vegetation change is ongoing, it occurs at a relatively slow rate, and such areas are referred to as "fixed" dunes. The outer dune ridges are discontinuous in places, particularly along the south beach.

Figure 1
Composite aerial photo showing the five sections (east and west spits, west, central and east cores) *SOURCE: Colville et al, 2016*



The island is widest in its central portion (about 1.3 km across). Along the south side, the beach widens at two locations forming vast, flat stretches of sand. The largest is the Sandy Plain.

In all areas of the island the sandy terrain is particularly vulnerable to the scouring and eroding effects of wind and water, but these forces are also responsible for sand deposition and dune development. Aerial photos of the island show a general northwest to southeast orientation of dune migration and blowouts, reflecting the predominant high winds. Overall, the prevailing westerly winds move sand toward the east along the length of the island, and thus dune elevation generally increases from west to east. The highest dune—just over 30 m—occurs near the eastern end of the island (AGRG, 2011). The width of the vegetated dune belt changes along the length of the island, reflecting variations in the width of both the beaches and the island itself.

The dunes on Sable Island are a complex mix of forms, both vegetated and unvegetated, and can be classified on the basis of process and morphology, as well as vegetation. The many types of dunes on the island range from small-scale ripples and ridges, to large, complex, well-vegetated dunes, and huge, unvegetated hills of sand. The latter, which for many decades have been called "bald dunes," may be similar to landforms referred to as the "naked sand hills" in historical descriptions of the island's landscape (MacDonald, 1884).

The primary process of dune development involves wind action (aeolian forces) and the movement of sand over the surface. Features such as sand ripples, migrating ridges, and sand strings develop as the wind moves over a large, open stretch of sand, such as a beach or dry washover surface. Ripples also develop in unvegetated hollows between established ridges where the wind is accelerated. Wind ripples are flat in comparison to their length and are made up of fine- to medium-grained sand (0.125 to 0.5 mm). More complex, unvegetated, aeolian deposits occur where moving sand encounters an obstacle and sand is deposited on or in the lee of the obstacle. The obstacle can be anything from a single plant to a pre-existing dune ridge. A variety of dune features formed this way include aprons, ramps, precipitation ridges, and shadow dunes.

In describing the topography of Sable Island, most sources divide the island into sections based on landform and/or vegetation features, however, the basis for the definition and number of sections, and the level of detail, varies. Here the island's geographic features are described in three sections—the East Spit, West Spit, and the Main Body (core) comprised of three parts, the West, Centre and East. **(See Figure 1)**

The East and West Spits

The two spits extend outward beyond the east and west ends of the older dune ridges. The spits terminate in tips that are unvegetated and exposed to both the full force of winds from all directions and frequent ocean overwash. The above-water portion of both spits reach outwards as submerged bars and shoals (Byrne and McCann, 1995).

The vegetated dunes on the spits are recent formations and are small in comparison to dunes elsewhere on the island. Many are hummocks that have developed around beach plants (such as seabeach sandwort (*Honckenya peploides*) or sea rocket (*Cakile edentula*)) that are able to withstand the harsh conditions in such exposed areas. Others have formed in the lee of non-plant material.

Generally, these hummocks began as small shadow dunes—a common dune form on the island. These dunes generally develop in open locations where the wind speed and direction are more variable, and develop best in the lee of semi-permeable materials or objects that interrupt the wind flow in both the horizontal and vertical planes, causing sand grains to stop moving and accumulate. A single plant or a patch of vegetation, as well as a dead crab, a tangle of seaweed, driftwood, seal bones, a piece of plastic litter, and snarls of netting and rope can initiate dune development.

The base of a shadow dune forms in an area extending downwind from the edges of an obstacle. The size and shape of a shadow dune depends on the dimensions of the obstacle and the angle of repose of the sand. The core region of the accumulated sand diminishes in size with increasing distance from the obstacle. Shadow dunes become vegetated dunes where they develop around vegetation and the sand accumulation and vegetation growth continue. Also, where beach debris initiates a shadow dune, vegetation develops from seeds and/or plant fragments that get caught up in the accumulating pile of sand.

On the West and East Spits, the hummock dunes are subjected to periodic flooding by ocean overwash during storms. The hummock shape can withstand inundation better than a continuous ridge because the breaks between hummocks allow the movement of wind and water around and between the forms. In contrast, a single ridge must absorb the wind and wave energy and in so doing may be eroded.

Among the most geomorphologically dynamic changes observed on Sable Island are the lengths of the spits—during the past three decades, losses and gains ranging from several to more than 10 km have been recorded. Small islands have occurred at both the east and west ends. These have been formed by accumulations of sand that have aggraded until a section of the submerged bar has developed an isolated above-water surface. Also, these small islands have been the result of a cut forming across the spit that separates the tip, or

Sable Island is widest in the middle, where ponds, wetlands, and a variety of dune landforms are well developed
PHOTO: DNR (Sean Basquill)

Ipswich sparrow, a federally and provincially listed species at risk which breeds exclusively on Sable Island *Photo: Zoe Lucas*; (below) The grey seal is the most common seal on Sable Island *PHOTO: DNR (Sean Basquill)*

a larger section, from the rest of the spit. During the past four decades this has happened several times at both the east and west ends. There are historical accounts of similar formations. In 1913, for example, a small island off the east end was reported by the captain of a Gloucester fishing schooner (New York Times, 1913).

Although the West and East Spits are similar in exposure and shape, they are very different in dune morphology and vegetation. Forty years ago the vegetated terrain on both spits was comprised mostly of low hummocks of sandwort with scattered patches of beach grass and sea rocket that waxed and waned in extent.

However since that time, the hummock dunes on the West Spit joined together and became low-lying but extensive 'fields' of seabeach sandwort. As sand continued to collect around the thriving sandwort, the vegetated terrain increased in elevation, and provided suitable habitat for dune-building species such as marram grass, developing into foredunes with elevations of 7 m and 9 m along the south and north sides of the spit (AGRG, 2011). The West Spit dune system includes some unusual forms comprised of entirely of sandwort. These occur at the western end of the spit and have reached elevations of 4 to 6 m (Basquill, 2015).

The development of a richly vegetated and continuous dune system on the West Spit has been one of the more dramatic changes on Sable Island. There is, however, a narrow neck on the eastern area of the West Spit that is relatively unvegetated. Lacking the vigorous dune development that has occurred on the rest of the spit, this section is subject to ocean overwash from both sides, and during storms the rush of water has on several occasions scoured a cut across the spit, separating most of the spit from the rest of the island. However, with changing wind and wave conditions, these cuts have healed as sand was carried in and filled the gap.

There has been less vegetated dune development on the East Spit. Dunes are largely comprised of low, hummocky formations, some isolated and some coalesced into broader patches. These dunes are generally dominated by sandwort, with a minor component of marram grass. Sea rocket is

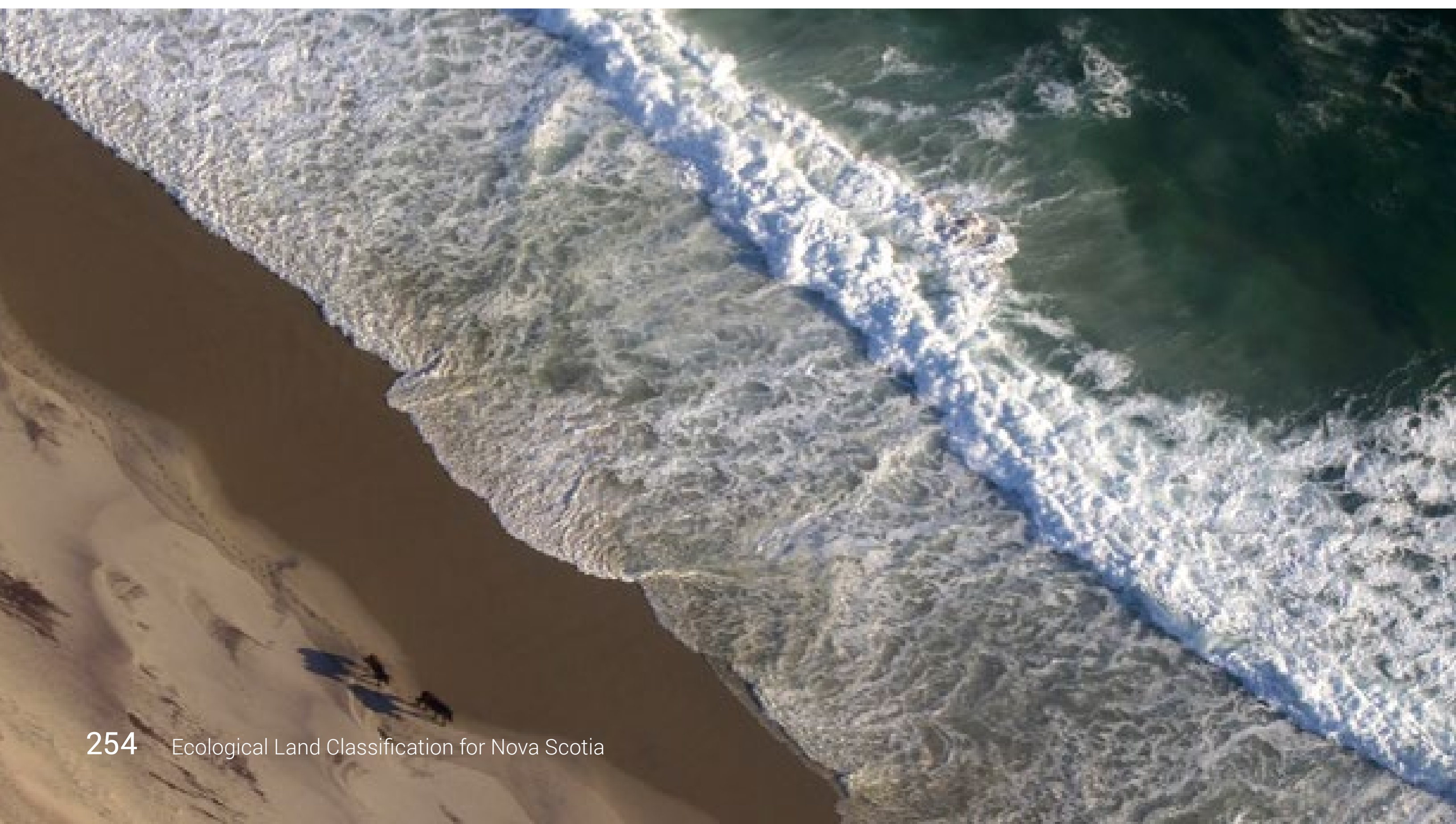
common on the beach. Many washover flats and cuts separate the areas of sandwort vegetation, and ocean flooding commonly sweeps across the spit from the north and south sides during storms.

The Main Body – West, Centre, and East Cores

The most developed vegetated dunes and highest terrain occupy the central two-thirds of the island—the island's Main Body or Core. Compared with the West and East Spits, this area is morphologically far more complex, and is not uniform in dimensions and landform characteristics. It can be roughly divided into three areas: the **West Core** (includes the westernmost ponds, and the Sable Island Station); the **Central Core** (an area dominated by the Sandy Plain); and, the **East Core** (the area having the most extensive and complex cover of dunes on the island, including the bald dunes). (**See Figure 1)**

The prominent dunes on the island are the discontinuous, high, foredune ridge along the north beach, and the parabolic dunes (both active and relict) that are most developed in the East Core.

Wave actions constantly change the shoreline of Sable Island.
PHOTO: Len Wagg



Along the length of the island, the dune ridge near north beach is an established foredune with a wave-trimmed seaward scarp which is undergoing slow retreat. From west to east, there are marked differences in its continuity, morphology, and structure. The pattern of higher northern ridges and lower southern dune ridges, with an intervening central zone of low relief continues along the island, although it is masked by other features and transverse blowouts.

Parabolic dunes are migratory and frequently evolve from blowouts in the foredune ridge. When the force of the wind is concentrated in one area, or when the vegetation cover is broken at a particular location, the dune ridge may become locally eroded, and a deflation basin (a blowout caused by erosion of sand) may develop. Blowouts, common on Sable Island, are often large, and cut southward through the north beach dune ridge. Deflation may continue downwind, developing into a parabolic dune or precipitation ridge. Sand is transported along the blowout to the crest of the dune and spills over to the steep, bow-shaped, leeside slope.

Parabolic dunes are usually U-shaped, open to the dominant wind, and have trailing arms that are stabilized by vegetation. These arms point

Fresh water ponds are found scattered across Sable Island. Most, like this one, are fringed with marsh vegetation. *Photo: Zoe Lucas*

towards the dominant wind direction. When deflation ceases, a blowout may begin to fill with wind-blown sand, and if the infill becomes vegetated, the break in the ridge may heal. Blowouts may occur in any vegetation type, but the marram communities are particularly susceptible to damage and erosion.

A remnant dune is one which remains after the sand around it has been eroded. It may erode completely, or if it is in a sheltered location, it is possible that the remnant dune would not be completely destroyed by the wind and sand deposition may occur, burying the remnant and preserving it as the core of a new dune.

West Core

This section of the island, from the western extension of the dune ridge to the Sable Island Station, is comprised of north and south dune ridges, the westernmost pond system, remnants of the old main station, the West Light area, and the Station.

The topography is further complicated by the presence, on the south side, of a broad flat beach—similar to, but far smaller than, the Sandy Plain **(See Figure 1)**.

A belt of outer dunes, dominated by marram grass, separates north and south beaches. Within the dune belt there is a northern ridge about 10 m high, a central hollow, and a southern ridge 6–7 m high (AGRG, 2011).

The central hollow of the West Core dune belt is wider in the eastern part, and contains a series of interconnected freshwater and brackish ponds and areas of heath. There was a notable change over time in the size and shape of the dunes that separated the pond complex from the south beach. In the 1970s, the dunes had been breached, allowing storm overwash into the system. Subsequent terrain restoration programs provided protection for the ponds. However, since the 1990s, continuing erosion of the southern foredune ridge has exposed most of the West Light freshwater wetland complex to saltwater intrusion. This is the most notable ecological aspect of dune change because it strongly impacted critical habitats of many plant and animal species.

Central Core

The Centre, a 9 km long area extending from the Sable Island Station eastward to Old No.3 lifesaving station, is comprised of a narrow and severely dissected dune belt (about 200–400 m wide) and a vast south beach. The topography is complex, with a mix of developing and older dunes, having the highest elevation (to 15–18 m) along the north side. Inland of the north foredune ridge are small freshwater ponds, areas of heath, and fixed dunes, separated by transverse ridges and bounded on the south by a low, discontinuous dune line. This narrow dune belt separates the north beach from the 600–1000 m-wide south beach—the Sandy Plain—a highly conspicuous feature of the island's landscape. The Sandy Plain, once occupied in part by Wallace Lake, is frequently flooded during storms. However, when the Plain is dry, very large wind ripples can develop across its unvegetated surface. These ripples may be as much as a metre in elevation, and spaced 5 to 10 m apart (G. Forbes, Meteorological Service of Canada, pers. com., 2016). These large ripples often have finer ripples superimposed on their surface.

Among the more dramatic long-term changes on Sable Island has been the disappearance of Wallace Lake. The brackish lake had been located in the position once occupied by an extensive lagoon (shown in the earliest maps of the island). When the openings between the lagoon and the ocean closed, the lagoon became a lake. The dunes that once existed on the south beach between Wallace Lake and the ocean were part of the southern dune ridge, and it had been fairly continuous. However, by the early 1950s, the ridge was eroding and represented by a series of discrete, vegetated, remnant dunes. These continued to erode, and by the mid-1990s had entirely disappeared. In the meantime, Wallace Lake was slowly infilled by sand carried in by ocean overwash and blown in by wind. As shown in the first aerial photos taken in the 1950s, the lake was 8 km long. During the mid-1970s, the infilling caused the lake to become three separate parts—West, Middle, and East Wallace. Thirty years later only West Wallace remained and was reduced to about 2 km in length. By 2012 it had been filled by sand, leaving only a broad, moist flat where the last of the lake had been.

The area of the former lagoon and the former Wallace Lake had long been dominated by the erosion that caused the disappearance of the southern dune ridge, and the infilling of the lagoon/lake bodies. However, in the early 1990s, small hummocks began to develop on the Sandy Plain. These hummocks started as shadow dunes in the lee of scattered debris and small patches of beach grass and sandwort. During the past decade, these dunes have continued to increase in number and distribution on the Sandy Plain, and as they increase in size some have coalesced (merged), suggesting that although the Sandy Plain still floods with storm-driven ocean overwash, the area is in a phase of dune development.

East Core

This section, is 13 km long, has narrow beaches along both its north and south shorelines, and contains the most well developed and extensive dune systems on the island. The north and south dune ridges are higher (up to 30 m and 22 m, respectively, AGRG 2011) and more substantial, and the width of the dune belt greater, than elsewhere on the island.

Blowouts through the north ridge extend well inland, and large parabolic dunes migrating across the island separate stretches of low-lying, undulating, fixed dune terrain and heath communities.

Beach grass near Bald Dune
Photo: Zoe Lucas

Freshwater ponds are critical to the survival of the wild horses on Sable Island. *PHOTO: DNR (Sean Basquill)*

Although difficult to see at ground level, the complex topography and processes of this dune belt are recognizable in aerial photographs. Blowouts in the northern dune ridge, the axes (direction of advance) of the parabolic dunes, and ridges that are remnants of earlier parabolic forms, are aligned to the east-southeast. There is considerable variety in the form of parabolic dunes on Sable Island, and several of them include a large unvegetated dome dune within the arc behind the advancing dune face. These bald dunes are among the most visible and familiar features of the East Core dune belt. The most dramatic of these forms is "Bald Dune," roughly circular and about 24 m high (AGRG, 2011). It is located in the western end of the East Core region and extends halfway across the island. The bare sand surface of the dune is textured with wind ripples, including large-granule ripples, which reflect the current wind directions and velocities. To the southeast of Bald Dune, the advancing front of the parabola is depositing new sand over low, hilly terrain covered by grass, forbs, and heath.

Freshwater

The freshwater reservoir on Sable Island is the result of precipitation (rain and snowmelt) that runs down through the sand and accumulates in an aquifer that overlies the salt water table.

Groundwater occurs in the unconfined sands (watertable) as a lens of freshwater that gently slopes from the central areas of the island toward its northern and southern shores. Measurements taken in 1973 found that the thickness of the aquifer ranged from 1 to 36 m. More recent studies indicate that in some areas of the island the aquifer's thickness could exceed 60 m (Kennedy et al., 2014).

The freshwater lens is probably not continuous across the island (i.e., between the north and south sides of the island). Where breaches in the outer dune ridges and areas of low elevation permit seawater incursions and overwash during storms, the flooding could result in slugs of vertically infiltrating salt water.

The freshwater lens is relatively stable east of the Sandy Plain where the area of vegetated terrain is wider and is more protected to the north and south by dune ridges. Due to its close proximity to the surface and the high permeability of the sandy soil, the freshwater lens is highly vulnerable to contamination from the soil surface, such as a fuel spill.

There are about 20 freshwater ponds (and many seasonal pools) in low areas where the freshwater aquifer erupts at the surface. Many decades ago freshwater ponds were more common, but now they are located only on the western half of the island, between 43.932°N, 60.028°W and 43.934°N, 59.886°W. The westernmost is Mummichog Pond, named for the small killifish (*Fundulus heteroclitus*) which is abundant in many of the island's ponds; the easternmost is Iris Pond, named for the stands of blue-flag (*Iris versicolor*) that were once common there.

While some of the island's freshwater ponds are isolated, many are part of freshwater complexes comprised of ponds, pondshore and transition zones, and dune slack wetlands (Slacks are depressions that can occur between dunes). These are highly diverse communities that provide important habitats for birds, fish, plants, and invertebrates on the island, and thus provide essential habitat for a large portion of the island's biodiversity (particularly plants and invertebrates).

The number and size of the freshwater ponds has been diminishing because of incursions of storm-driven seawater through breaches in the foredune ridges, and also because of infilling by windblown sand. Ponds exposed to ocean overwash diminish even more rapidly in size as sediments are also carried in by flooding. Most brackish ponds on the island are remnants of freshwater ponds that have been flooded by salt water.

Near the sites of West Light and the Old No. 3 lifesaving station, where erosion of the south beach dune ridges exposed the ponds to overwash and infilling, sand flats have replaced what were once richly vegetated and interconnected freshwater pond systems. However, these flats are subjected to continuing sand deposition, and are enriched by inputs of ocean-derived nutrients (e.g., materials ranging from sea foam that can contains high concentrations of dissolved organic matter, to seaweed and the remains of marine animals such as invertebrates, fish and birds). Sandwort and sea rocket, growing from seeds and plant fragments, and small hummock dunes developing around these plants and the driftline debris accumulated on the washover areas, are providing habitat for new communities of marram grass (*Ammophila breviligulata*), seaside goldenrod (*Solidago sempervirens*), and other species.

Geology and Soils

The soils of Sable Island are derived from modern marine and wind deposited sediments. Much of the soil is composed of sand and loamy sand reworked by the dynamic geomorphic processes which characterize the island. These processes and their role in shaping soil, hydrological, and biodiversity features of Sable Island are the primary criteria that differentiate the island from other ecodistricts in Nova Scotia. The Sable Island ecodistrict is the largest and most diverse beach-dune complex in the province.

The most detailed description of the depositional history of Sable Island sediments is provided in McCann and Byrne (1989), where dune stratification sequences of Atlantic Canada are outlined. McCann and Byrne (1989) consider Sable Island a unique depositional setting in the region and propose a stratification model to explain the geomorphic and vegetation factors influencing depositional strata. While they do not differentiate soil horizons, their description of organic materials, sand particle size, and modes of deposition among strata provides an excellent basis from which to understand Sable Island soils.

The different soils of Sable Island largely result from how stable they are, their degree of saturation, and the extent to which organic materials have been incorporated into surface horizons. All of the soils are young. Even older soil horizons buried by sand and subsequently exposed in eroding dune faces have been dated within a few hundred years of present (Terasmae and Mott, 1971). A study of Sable Island soils has not been conducted but components of other research have included a soils component (e.g., Basquill, 2015). Below a general overview of soil conditions on Sable Island is provided.

Vegetated dunes, beaches, and wetlands of Sable Island are the only environments showing evidence of soil development. Unvegetated parts of the beaches, and new blow-outs and erosional features of the dunes, are composed entirely of unweathered sand without a noticeable component of finer soil particles. Dune communities dominated by marram grass and other herbaceous species are sometimes called mobile dunes because they are dynamic and less stable than older fixed dunes. Here new sand is actively deposited on the surface, organic surface layers are absent, and A horizons can be difficult to discern. These soils are called regosols (SCWG, 1998). In more sheltered and generally older parts of marram grass dune communities, vegetation is denser and the development of an A horizon is more apparent. Undecomposed dead organic material may be found scattered through surface horizons, but aside from litter, organic surface deposits do not usually occur.

The same kind of soil is found at the eastern and western ends of Sable Island where sea sandwort covers extensive areas of older beach deposits and low rolling dune plains. These areas appear to more often contain buried Ah and buried organic deposits alluding to the effects of storms and more rapid changes in island morphology. Seaward of the main foredunes on Sable Island, similar buried organic horizons and organic-streaked mineral horizons can be found in surface horizons (≤1 m) of remnant dune hummocks.

More stable vegetation is characteristic of fixed dunes; these are less mobile and generally older. Upland fixed dune communities are characterized by shrub species such as bayberry, black crowberry, common juniper, and a variety of other species. Fixed upland dunes also feature regosolic soils, although particularly old areas may feature brunisolic soil, when an incipient B horizon at least 5 cm thick is present. Fixed dune regosols have a more consistently recognizable A horizon frequently overtopped by a thin sometimes discontinuous layer of humus. Humus layers tend to be classified as mors, although some moders have been identified.

The most variable and complex soils on Sable Island appear to be associated with its wetlands. Sable Island's wetlands occur in and around its numerous ponds, and in deeper inactive hollows or interdunal depressions called slacks. Dune slacks may also support moist upland communities that have soil that is transitional in character between the fixed dune soils described earlier and wetland soils described below.

Sable Island's ponds, wetlands, and deeper dune slacks occur where the fresh water table is at or near the surface of the rooting zone for most of the growing season. Soils of these areas are characterized by saturated surface horizons and thin to moderate accumulations of humus. Mineral horizons in the rooting zone have redox features such as gleying, organic staining and streaking, depleted matrix colours, and faint to distinct redox concentrations (mottling). Identifying these features in sand and loamy sand is sometimes challenging, because soil pits often fill with water and because redox features in saturated sand and loamy sand are often faint (U.S. Army Corps of Engineers, 2011).

Bald dune is the highest point on Sable Island, and a unique geomorphological landform. *PHOTO: Zoe Lucas*

Vegetation

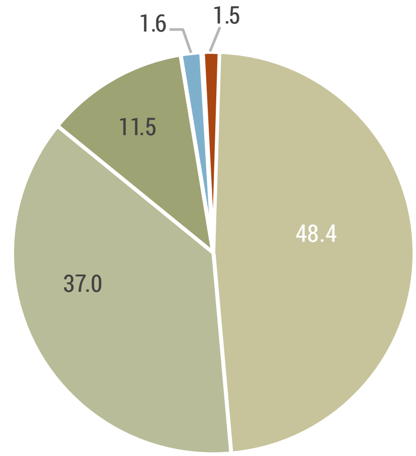
The relationship between the island's landforms, soils, and vegetation communities is complex.

Dune forms occur and erode partly in response to changing vegetation types and quality of cover, while the composition and stability of vegetation communities are a function of processes of erosion and sand deposition in a local area.

While a total of 230 species of vascular plants have been recorded on Sable Island (of which 34% are introduced species to North America), there are presently approximately 185 species on the island.

A number of native plants (16 species) have been extirpated during the past century, but a larger number of alien plants (30 species) have been extirpated, mostly because of habitat changes associated with the cessation of agricultural activities during the past five or more decades. Periods of high wind, salt spray, and blowing sand limit the growth of trees and shrubs. Since the early 1900s there have been several attempts to introduce trees, but none have been successful. A lone survivor of one such effort is a solitary Scots pine (*Pinus sylvestris*). Over 50 years old and less than a meter in height, the tree has persisted on a gentle and relatively sheltered slope near a freshwater pond.

Vegetation communities on Sable Island can be roughly divided into four overall types with an approximate coverage as follows **(See chart)**:



Vegetation Communities[1] and Approximate Coverage[2]

Grassland	37.0%
Shrub-heath	11.5%
Sandwort	1.6%
Freshwater & associated wetlands	1.5%

(The remaining 48.4 % would be non-vegetated/sand)

The sandwort community develops on unconsolidated sand, in beach areas that are frequently exposed to ocean overwash. It has a low community-level biodiversity with marram grass (*Ammophila breviligulata*) and sea rocket (*Cakile edentula*) among the few plants usually found growing in stands of Seabeach sandwort (*Honckenya peploides*). While the sandwort communities can develop into dune habitats that become dominated by marram grass, beach pea (Lathyrus maritimus), and seaside goldenrod (Solidago sempervirens), on Sable Island, particularly on the West Spit, dunes formed and vegetated entirely by sandwort occur.

Grasslands occur as marram-forb communities and sparse grasslands. The former is a rich community that occurs throughout the island, most frequently on foredunes (particularly inland slopes) and in exposed inland fields where there is a high

1 Vegetation communities of Sable Island were surveyed in 2015 (Basquill 2015) as part of an effort to classify beach and dune ecosystems of Nova Scotia.

2 Coverage figures (Colville et al., 2016). The above figures (proportion of island surface covered by each community type, and the characterization of community types are approximate due to differing interpretations and results of various surveys.

Sandwort, also known as seaside sandplant, is a small spreading plant that helps bind the sand along the beaches and spits. *Photo: Zoe Lucas* rate of sand deposition. Marram grass (*Ammophila breviligulata*) and beach pea (*Lathyrus maritimus*) are the dominant species, with yarrow (*Achillea millefoliu*m), seaside goldenrod (*Solidago sempervirens*), New York aster (*Symphyotrichum novi-belgii*), Virginia rose, red fescue (*Festuca rubra*), and Kentucky bluegrass (*Poa pratensis*) often abundant. The sparse grassland community ranges from a species-poor type comprised of marram grass with lesser amounts of beach pea, seaside goldenrod (*Solidago sempervirens*) and several other species, to a more species-rich type featuring marram grass, red fescue, pearly everlasting (Anapha*lis margaritacea*), strawberry (*Fragaria virginiana*), Virginia rose, and bayberry. This community, more often inland, is characterized by a reduced input of new sand and nutrients.

The shrub-heath community includes the more widespread mesic (moderately moist) shrub-heath, and the wetter cranberry communities in fixed dune areas. Both types are species rich, and prominent species in the shrub-heath community are black crowberry, creeping juniper and common juniper, bayberry, Virginia rose, and lowbush blueberry, with a large number of associated species, including lichens and mosses. Prominent species in the cranberry heath are cranberry and rush (*Juncus balticus*), with bayberry, aster species, lance-leaved violet (*Viola lanceolata*) and grass pink (*Calopogon tuberosus*), and many less abundant associates such as bog club-moss (*Lycopodiella inundata*) and bryophytes, particularly *Sphagnum*.

The freshwater ponds and associated wetlands represent a very small proportion of the island's total area, but they support a disproportionate share of the island's vascular plant diversity (Mazerolle, 2015).

Several plant species that are rare elsewhere in the province are common on Sable Island. Examples are cinnamon-spot pondweed (*Potamogetan oblongus*) and bulbous rush (*Juncus bulbosus*). Mazerolle *(2015)* notes that for many of the island's plant species, natural recruitment from mainland populations is very limited or impossible, and thus, regardless of their status on the mainland, all species known to be rare or uncommon on the island could be considered of conservation concern. Examples are cinnamon fern (*Osmunda cinnamomea*) and branched bartonia (*Bartonia paniculata*).

Many pondshore plant communities are heavily impacted by the island's horse population, particularly where the horses congregate to graze, drink, and socialize. Some of these areas are heavily grazed and trampled. The prevalence of ruderal (pioneer plants on disturbed lands) exotic species such as white clover (*Trifolium repens*), tiny allseed (*Radiola linoides*) and fall dandelion (*Leontodon autumnalis*) around many of the ponds is likely a result of horse activity (Mazerolle, 2015).

Nutrient enrichment from horse feces and urine, and from the corpses and feces generated by the greatly increased breeding population of grey seals on the island (Bowen et al., 2003), may also have an impact on aquatic and pondshore plant communities.

Also, as noted above (See "**Freshwater**" section), during the past 100 years, saltwater incursions and infilling by windblown sand have eliminated large portions of these habitats, concentrating impacts among the remaining freshwater areas.

Final Note

The landforms and natural history of Sable Island have been observed, studied, and documented since the 1800s. With early attempts to settle the island and the long-term operation of the Sable Island Humane Establishment, there was a practical interest in the island's climate, landscape, flora, and fauna.

However, beyond those early concerns about mapping sand bars, harvesting seals, farming, and maintaining lighthouses, the island has long been recognized as a special place with unique natural values and considerable scientific importance. Geological and hydrological studies, topography and land cover mapping, research on the island's nesting bird species, seal populations, and horses, and surveys of vegetation and invertebrates—and hundreds of reports and scientific publications—continue to expand our knowledge and understanding of Sable Island. In all these fields, and in many others, there is still so much more to learn.

Zoe Lucas has spent over 40 years researching the ecology and environment of Sable Island. Her work has included studies with the famed wild horses, shark predation of seals, native plants, migratory birds, and monitoring the impacts of the offshore oil and gas industry.

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900
Fundy Shore

This small, narrow ecoregion of 1432 km^2 (2.6% of Nova Scotia) wraps around the north shore of the Bay of Fundy from Cape Chignecto to Five Islands, crossing over to Cape Split and continuing west to Brier Island. The ecoregion is influenced by both its geological history and proximity to cold Bay of Fundy waters. However, because the Bay coast is more sheltered than Nova Scotia's southern coast (which is exposed directly to the Atlantic Ocean), Fundy Shore forests reflect features of both the boreal-like forest along the Atlantic Ocean and the temperate Acadian forests.

Two hundred million years ago lava flowed up through rifts created by the movement of drifting continental plates. This lava cooled and became basalt that underlies the entire North Mountain, with small outliers on the north shore of the Minas channel from Cape d'Or to Portapique Mountain. The topography in the ecoregion can be quite variable, with sharply dissected slopes coming down to the Bay or gently undulating to rolling coastal plains of glacial outwash and erodible red Triassic sandstones skirting the shores. Elevations rise up to 225 m along the North Mountain and 245 m above sea level at Economy Mountain.

The cooler waters of the Bay of Fundy have a significant influence on the climate of the adjacent coasts. High tides averaging 10 m prevent coastal waters from freezing but also prevent the warming of the surface layers in the summer. The arrival of spring is prolonged in the ecoregion and summer temperatures are cool, with winters somewhat milder than the interior of the province. Total annual precipitation is 1200-1400 mm, with summer and fall fog frequent along the shores. Compared to the **Atlantic Coastal (800)** ecoregion, there is less exposure to winds and salt spray from ocean swells.

Freshwater occurs in a few, small and shallow spring-fed lakes on the North Mountain with short streams flowing to the Bay of Fundy. Several longer rivers and streams flow through the **Parrsboro Shore (910)** ecodistrict.

Basalt cliffs of the North Mountain reach the Bay of Fundy near Morden, Kings County. *PHOTO: CNS (Len Wagg)*

Well drained, gravelly, medium to coarse textured glacial tills high in basalt are the main parent materials found in the Fundy Shore ecoregion. These soils are often shallow, but also of relatively high fertility. Orthic[1] and Sombric Ferro-Humic and Humo-Ferric Podzols dominate well drained areas, along with Gleyed subgroups (or variants) on imperfectly drained sites. Poorly drained areas are generally associated with richer mineral and organic soils (i.e., Humic Gleysols, Mesisols and Humisols).

The ecoregion supports the Acadian group of ecosites with shade tolerant mixedwood forests dominant on zonal sites. Yellow birch, red spruce, and hemlock forests are common, with sugar maple and beech forests on crests and upper slopes. A narrow band of coastal white spruce and red spruce forest (usually less than 1 km) is found along the shore on exposed headlands, islands and steep coastal facing slopes (e.g., on Brier and Long Islands, Cape Split and Cape Chignecto).

Stand-level natural disturbances are uncommon and forests typically develop uneven-aged and old growth features. Wind and ice damage limit hardwood on crests and upper slopes and insects can cause mortality in the softwood forest. Much of the forest is now second growth early successional forest owing to the large areas that were once cleared and farmed, but have since been abandoned or removed from agricultural use. This old farmland and many areas of the gravelly coastal plain are now used for the cultivation of wild blueberries.

1 All classification terms are from: Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Publication 1646, Agriculture and Agri-Food Canada. NRC Research Press, Ottawa.

910
Parrsboro Shore

This ecodistrict follows the north shore of the Minas Basin from Economy Mountain westerly to Sand River on Chignecto Bay. It is a narrow, rugged landscape where elevations are not so extreme but topography changes over very short distances. Undulating lowlands and steep rolling hills seldom exceed 125 m above sea level. Rivers and streams flowing from the Cobequid Mountains dissect the terrain. The ecodistrict covers an area of 442 km^2 which is 31% of the Fundy Shore ecoregion. Several smooth glacial outwash plains of gravelly soils are interspersed within this topography with examples at Parrsboro and Advocate.

The beaches and cliffs along this part of the Fundy shore are a popular destination for rock hounds and fossil hunters. Amethyst, agate, jasper, stilbite, and chalcedony are among the most sought after rocks and minerals. Some very import fossils discoveries have been made along this coast including bones and scales from dinosaurs and prehistoric fish. Collecting is limited by provincial laws and regulations.

Local climate in this ecodistrict is significantly affected by proximity to cold waters of the Bay of Fundy. Summer temperatures are cool and fog is a common occurrence.

The ecodistrict has three major faults running its length, with a series of minor faults scattered throughout. This has created a varied landscape with resistant basalts and erodible sandstones side by side.

Most of the freshwater in the ecodistrict occurs primarily in fast flowing narrow streams and rivers. Total freshwater area is 285 hectares, less than 1% of the ecodistrict.

Gently rolling hills and cultivated wild blueberry fields at MacAloney's Lake, just north of Parrsboro. *PHOTO: CNS (Megan Mahon)*

The 'Coal Age' beds of the Parrsboro Formation, here at West Bay. They were originally flat-lying, but now stand on end—a testimony to the intense tectonic events that transpired along the Cobequid fault as the 'supercontinent' Pangea assembled during the Coal Age. *PHOTO: CNS (Len Wagg)*

Fresh, medium to rich soils support large intact Acadian forests of shade tolerant hardwoods and softwoods on the rolling topography. Where the terrain is gently sloped or level, forests of black spruce, tamarack and red maple are more prevalent on moister soils. Tolerant mixedwood forests are found along steep-sided ravines. Coastal forests of white spruce skirt the headlands along the Minas Basin and Chignecto Bay but quickly revert to tolerant hardwoods and softwoods a short distance from the shore.

Natural disturbance agents include windthrow, snow and ice breakage, and insect defoliation. Stand-level disturbances are infrequent and old growth forests may develop with an uneven-age structure. The yellow birch dieback of the 1940s has been a significant disturbance agent in the Fundy hardwood forest.

Geology and Soils

The Parrsboro Shore ecodistrict is associated with the Cobequid-Chedabucto fault system, with major faults running east-west and minor faults running north-south. Regular fault movement in the past has resulted in varied geology within the region, with Carboniferous period sedimentary rock (sandstone, shale, conglomerate and siltstone) interspersed with basalt. Lowland areas are underlain by softer sedimentary rock, but where this rock was capped by more weather-resistant basalt, high steep-sided hills have formed (e.g., Economy Mountain).

Surficial deposits, dominated by glacial till, are thinner and more stony on long slopes. There are also significant glaciofluvial deposits in the many valleys leading to the Minas Basin outwash plains around Parrsboro and Advocate.

Dominant soils are derived from gravelly to very gravelly loam till high in shale (Kirkhill soils); gravelly silty clay loam to clay loam till (Diligence soils); gravelly sandy loam till with a mix of igneous and metamorphic rock (Cobequid soils); gravelly and sandy glaciofluvial deposits (Hebert soils); gravelly sandy loam to loam till high in basalt (Rossway soils); and gravelly sandy loam till high in sandstone (Shulie soils) (**See Table 40**).

Table 40.
Summary information for dominant soils found in the Parrsboro Shore ecodistrict (910). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Kirkhill	33	Glacial Till	Medium	Well-Rapid	ST2-L, ST1, ST15-L	Podzol, Brunisol
Diligence	13	Glacial Till	Fine	Imperfect-Poor	ST6, ST7, ST12	Luvisol, Gleysol
Cobequid *	12	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol
Hebert	11	Glaciofluvial	Coarse	Rapid	ST1, ST2, ST15	Podzol
Hydric	11	Various	Various	Poor-Very Poor	ST14, ST4, ST7	Organic, Gleysol
Rossway	7	Glacial Till	Medium-Coarse	Well-Rapid	ST8, ST2-L, ST15-L, ST17	Podzol, Brunisol
Shulie	7	Glacial Till	Medium-Coarse	Well	ST2, ST2-L, ST8	Podzol, Brunisol

Richer ST8 and ST17 soils with mull humus forms are mainly associated with tolerant hardwood and mixedwood sites. Hydric soils represent all poorly drained organic and mineral soil types. * Stony (S) phases are common (e.g., ST2-S).

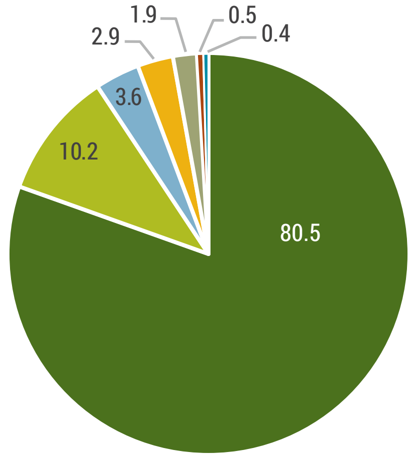
Both the Kirkhill and Rossway soils are often shallow to bedrock. Shallow soils, varied topography, and the presence of clay in some deposits has also led to significant hydric soil development in the ecodistrict.

Forests

An Acadian forest of shade tolerant hardwood and softwood occurs on hilly zonal sites (38% of ecodistrict). Sugar maple, yellow birch, and beech occur on upper slopes, but as soil moisture increases downslope, or where the slope terraces, yellow birch and red maple become more common in a mixedwood with red spruce. On lower slopes, softwood forests become dominant, comprised of red spruce and balsam fir.

Similar terrain and site conditions along exposed coastal slopes of Cape Chignecto do not support the tolerant hardwoods. In these areas coastal red spruce forests occupy upper to lower slopes, with white spruce and heartleaf birch on the thinly defined, severely exposed headland.

Steep-sided ravines along streams and rivers leaving the higher elevations of Cape Chignecto and the Cobequid Mountains have well to rapidly drained, coarse textured soils. Red spruce is the dominant softwood with white pine and hemlock, occasionally yellow birch, and a few occurrences of sugar maple and beech.



Ecodistrict 910 Percentage Land Cover

Forest/Woodland	80.5
Agriculture	10.2
Wetlands	3.6
Urban/Industrial	2.9
Shrub/Heathland	1.9
Sparsely Vegetated	0.5
Water	0.4

The Parrsboro Shore has large expanses of flatter and gentle terrain where variable soil conditions create forest complexes of red spruce, balsam fir, hybrid spruce and black spruce.

Surrounding the communities of Parrsboro, Port Greville and Diligent River, soils are coarse gravelly deposits laid down at the end of the last glaciation by torrential meltwaters—with the main deposits in the valleys leaving the Cobequid Mountains and extending onto the coastal plains.

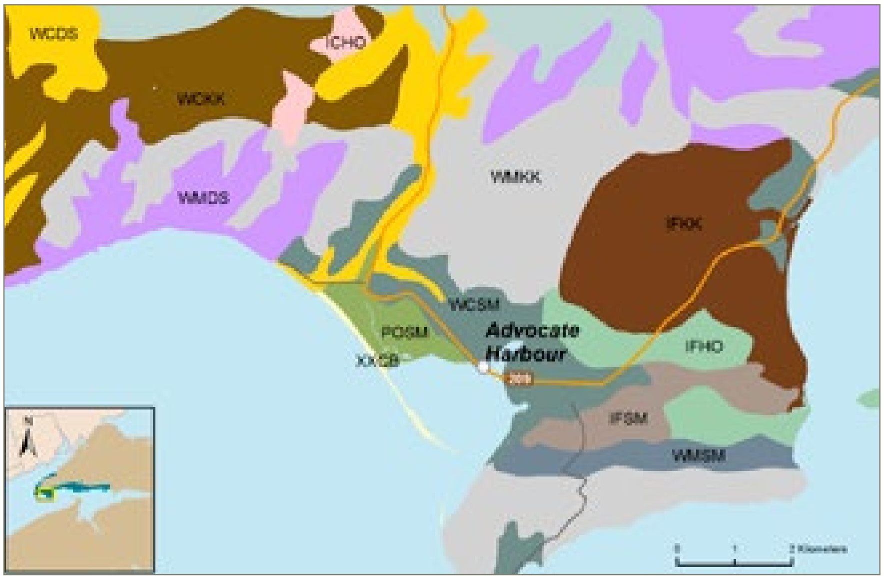
In between these areas of coarse gravelly soils are imperfectly to poorly drained fine textured silty-clay loams. Red spruce and balsam fir prefer

Cape Chignecto splits the Bay of Fundy, with the Cumberland Basin to the north and the Minas Basin to the south *PHOTO: CNS (Len Wagg)*

Ecodistrict 910

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMKK	29.0%	29.0%
WCKK	13.6%	42.6%
WMDS	8.4%	51.0%
IFKK	6.5%	57.5%
WCHO	6.3%	63.8%
IFHO	6.2%	70.0%
WCSM	5.7%	75.7%
WCRD	4.5%	80.3%
WCDS	4.1%	84.4%
ICHO	4.1%	88.5%
WFKK	3.9%	92.4%
IFSM	2.3%	94.6%
ICSM	1.9%	96.5%
POSM	0.8%	97.3%
XXWA	0.6%	98.0%
WMHO	0.6%	98.5%
WMSM	0.6%	99.1%
IMHO	0.5%	99.5%
XXMS	0.4%	99.9%
XXCB	0.1%	100.0%



the better drained sites, but as drainage gets progressively poorer, hybrid spruce, black spruce, tamarack and red maple become more prevalent.

Wetlands are numerous throughout the ecodistrict. Where these occur, forested conditions include red maple and tamarack, with black spruce, alders, willows, false holly, winterberry and wild raisin.

Natural stand-level disturbances are infrequent along the Parrsboro Shore with windthrow, winter storms, and insects/disease the main agents. Many disturbances are small gaps created in the stand canopy by individual tree mortality or small patches created by windthrow, especially in the tolerant hardwood stands. These forests are likely to develop uneven-aged and old forest characteristics.

Early successional forests following stand-level renewal from natural disturbances or harvesting may include red maple, white birch, grey birch, aspen, balsam fir and white spruce. However, on moist soils, stand-level disturbances caused by storms and hurricanes are frequent, owing to the shallow rooting of spruce and fir. As a result, these stands are unlikely to develop old forest characteristics

Low tide at Five Islands *PHOTO: CNS (Megan Mahon)*

Cape Sharp — the resistant basalt headlands and islands of the Bay of Fundy and entire **North Mountain (920)** are the product of the largest outpouring of lava in Earth history. This monumental event attended the breakup of the 'supercontinent' Pangea at the end of the Triassic Period, some 200 million years ago. In the background is Black Rocks, location of the tidal energy technology test site and *Fundy Ocean Research Centre for Energy* (FORCE). *PHOTO: CNS (Len Wagg)*

A spruce budworm epidemic in mid-1980s caused significant defoliation and mortality in red spruce forests. Damage was exacerbated a few years later by spruce bark beetle which attacked stands stressed earlier by the budworm. Spruce bark beetle continues to be a threat to older forests.

Non Forests

The Parrsboro Shore is heavily forested with less than 5% of the terrestrial landscape occupied by non-forested ecosystems. About half of these are wetland. Open wetlands are mostly shrub swamps and salt marshes. Salt marshes are largely restricted to protected coves in the Five Islands area, and the estuaries of rivers draining down from the Cobequids. Peatlands and swamps at the western end of the plateau provide important habitat for the endangered mainland moose, which is locally concentrated in parts of the ecodistrict.

Some of the most interesting non-forested habitats in the ecodistrict occur on coastal cliffs and headlands. These exposed sites support a number of rare, or at least uncommon, alpine and subarctic species including: Drummond's rockcress (*Arabis drummondii*), western hairy rockcress (*Arabis hirsuta* var. *pycnocarpa*), rock whitlow-grass (*Draba arabisans*), field locoweed (*Oxytropis campestris* var. *johannensis*), Laurentian primose (*Primula laurentiana*), and white mountain saxifrage (*Saxifraga paniculata* ssp. *neogaea*). Nesting peregrine falcon (*Falco peregrinus*) are frequently seen on these same Fundy cliffs.

920
North Mountain

The North Mountain, with a maximum elevation of 240 m above sea level, is a narrow upland underlain by volcanic basalt. It is situated parallel to the south shoreline of the Bay of Fundy. Starting at Cape Split it stretches to the southwest for about 200 km, ending at Brier Island. The Annapolis River enters into the Bay of Fundy at Digby Gut, through a break in this upland ecodistrict. It breaks again at Long Island and Brier Island. The ecodistrict is 990 km^2, or 69% of the Fundy Shore ecoregion.

The ecodistrict shelters the adjacent **Annapolis Valley (610)** from the cooler Fundy climate. The south facing slope of the North Mountain can be steep in places, with escarpment-like features at several locations. Small steep-sided valleys, locally known as vaults, dissect the slope. On the Bay of Fundy side, the slopes are longer and more gradual, but usually end with vertical cliffs at the coastline (e.g., at Cape Split, Margaretsville and Keatings Sand Beach). Freshwater lakes and streams account for 373 ha or 0.4% of the ecodistrict, with most lakes being small, shallow and spring-fed.

The coastal climatic effect on forests is more noticeable on Digby Neck, resulting in fewer hardwoods in the forest composition starting near Trout Cove and Centreville. Eventually, except in sheltered areas, the forest is predominantly white and black spruce, mountain-ash, and stunted white birch. Elsewhere, the coastal influence extends inland only slightly from the Bay of Fundy shore.

A mix of forests, fields and abandoned farmland blanket the North Mountain, which gently slopes toward the Bay of Fundy here at Victoria Harbour. *PHOTO: CNS (Len Wagg)*

Minerals such as magnesium and calcium found in basalt are important for plant growth, and have shaped the types of ecosystems found here.

Acadian forests of shade tolerant hardwoods and softwoods occur on the Fundy facing slopes underlain with fresh to fresh-moist, medium to rich soils. The Annapolis Valley facing slopes are dominated by shade tolerant hardwood on fresh, medium to rich soils. Stand-level natural disturbances are rare to infrequent, creating opportunities for uneven-aged and old growth forests. Wind exposure, snow, and ice breakage are limiting factors to quality hardwood growth.

Much of the ecodistrict has been harvested, and mixtures of intolerant hardwood species, white spruce and balsam fir (with scattered occurrences of red spruce and hemlock) now dominate the forest. Extensive areas on the north facing slopes were cleared for farming, especially forage, but much of this area has reforested to early successional forests.

Geology and Soils

The North Mountain ecodistrict is a narrow ridge, almost entirely underlain by 200 million-year-old basalt from the Jurassic period (the youngest rock in Nova Scotia). This rock is up to 300 m thick and was laid down in approximately 17 different flow events (lava bubbled up and spilled out of cracks formed during tectonic movements). The basalt also has a variety of semi-precious rock and mineral inclusions (e.g., jasper, calcite, agate and amethyst) that are popular with rock collectors. The area near Scots Bay, one of the few areas not underlain by basalt, is also frequented by rock collectors looking for chert, agate and stromatolites. Surficial deposits are dominated by glacial till high in basalt that is often shallow to bedrock in upper slope positions. Significant colluvium deposits are also common on middle and lower slope positions.

Dominant soils are derived from gravelly sandy loam to loam till high in basalt (Rossway/Roxville soils); cobbly sandy loam to loam till/colluvium high in basalt (Glenmont soils); and gravelly clay loam till/colluvium containing basalt (Middleton soils) (**See Table 41**).

The Rossway/Roxville soils are often shallow to bedrock, which can impact drainage conditions over short distances.

Forests

Late successional Acadian hardwood and mixedwood forests occur on zonal sites (73% of the ecodistrict). Large intact stands of sugar maple, yellow birch and beech occur along the crest of the North Mountain and steeper south-facing slopes. On the more gently north facing slopes extending to the Bay of Fundy, mixedwood forests are prevalent at middle and lower slopes. Typically, mixedwood forests include sugar maple, yellow birch, red spruce and hemlock as dominant overstory species, accompanied by red maple, beech, ironwood, white ash, white spruce, white birch and balsam fir.

The shrub layer includes regenerating hardwood, balsam fir and striped maple, with less prominent amounts of alternate-leaved dogwood, hobble-bush and beaked hazelnut. Herb coverage is

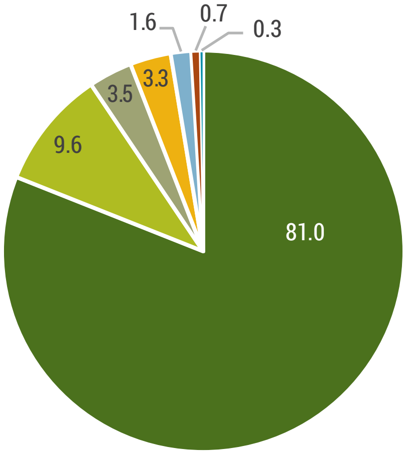
Table 41.
Summary information for dominant soils found in the North Mountain ecodistrict (920). Only soil associations or series that make up at least 5% of the land area are listed.

Dominant Soils (CANSIS 2013)	% Area	Parent Material	Dominant Texture	Dominant Drainage	Common FEC Soil Types	Soil Orders (SCWG 1998)
Rossway / Roxville	75	Glacial Till	Medium-Coarse	Rapid-Imperfect	ST8, ST2-L, ST15-L, ST17, ST9, ST3-L, ST16-L, ST18	Podzol, Brunisol
Glenmont *	8	Glacial Till	Medium-Coarse	Well	ST8, ST2-L, ST2, ST8-C	Podzol, Brunisol
Middleton	7	Glacial Till	Fine	Mod. Well-Imperfect	ST11, ST12, ST5, ST6	Luvisol, Podzol

Richer ST8, ST9, ST11, ST12, ST17 and ST18 soils with mull humus forms are mainly associated with tolerant hardwood and mixedwood sites.
*** Stony (S) phases are common (e.g., ST2-LS).**

Ecodistrict 920 Percentage Land Cover

Forest/Woodland	81.0
Agriculture	9.6
Shrub/Heathland	3.5
Urban/Industrial	3.3
Wetlands	1.6
Sparsely Vegetated	0.7
Water	0.3



diverse and may include several rich site indicators including Christmas fern (*Polystichum acrostichoides*), oak fern (*Gymnocarpium dryopteris*), lady fern (*Athyrium filix-femina*), shining club-moss (*Huperzia lucidula*) and northern beech fern. Other herbs include the ephemerals—spring beauty (*Claytonia caroliniana*) and Dutchman's breeches (*Dicentra cucullaria*)—as well as purple trillium (*Trillium erectum*), Indian cucumber root (*Medeola virginiana*), and false Solomon's seal (*Maianthemum racemosum*).

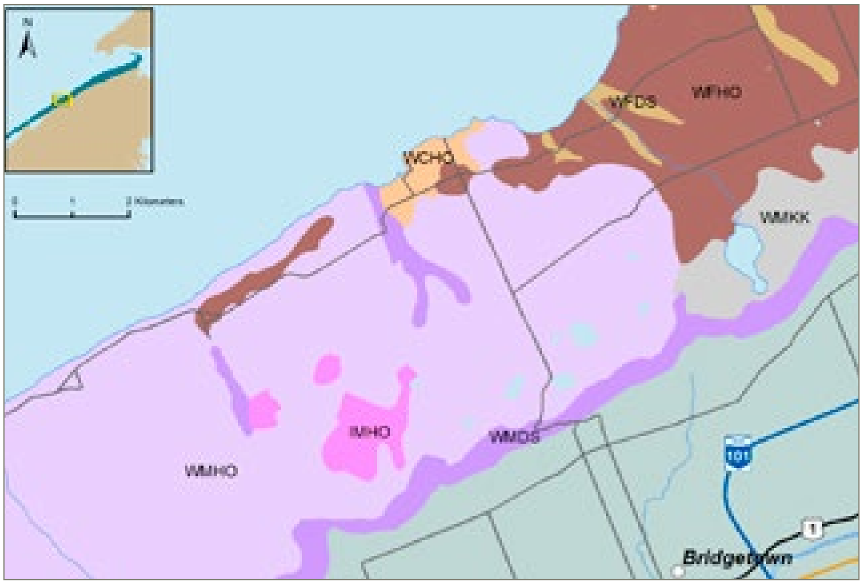
In mixedwood forests red spruce and yellow birch are dominant, with lesser amounts of sugar maple, white ash and red maple. Pure forests of beech are common on exposed hilltops where soils are often drier, coarse textured and shallow to bedrock (a few scattered white pine is also possible).

Embedded on the long north-facing slope, on level to gentle terrain, are a few sites of imperfectly drained soils supporting a forest of red and black spruce. These sites contain a diverse understory including ground hemlock, cedar, and several herbs indicative of richer soils.

Growth potential of hardwood forests can be significantly limited by exposure to winds, snow and ice, with breakage reducing height and stem quality on crests and upper slopes. However, on sheltered middle and lower slopes, height and diameter growth improves as exposure to winds diminishes. Vernal pools (ephemeral water collection areas) are common, while seepage areas support even more diverse hardwood forests of white ash, ironwood and (occasionally) rare plants (e.g., wild leek (*Allium tricoccum*).

The North Mountain escarpment is quite noticeable when travelling in the Annapolis Valley. It appears as a narrow, linear hardwood forest near the crest, with visible rock outcrops. Soils are shallow over bedrock and/or colluvium and excessively well drained. Talus deposits occur at a few locations. The underlying basalt bedrock enhances the soil's fertility, which is reflected by the abundance of rich-site loving plants (e.g., white ash and ironwood) along with beech, sugar maple and yellow birch.

The North Mountain escarpment, north of Lakeville, Kings County
PHOTO: CNS (Len Wagg)



Ecodistrict 920

Sample area map showing typical ecosections found in this ecodistrict

Ecosection	District %	Cumulative %
WMHO	56.3%	56.3%
WMKK	15.6%	71.9%
WMDS	9.9%	81.8%
WFHO	7.6%	89.4%
IMHO	5.2%	94.5%
WCHO	1.5%	96.1%
IMSM	1.4%	97.4%
WFDS	0.6%	98.0%
WCKK	0.5%	98.6%
POSM	0.5%	99.1%
XXWA	0.4%	99.5%
IFSM	0.3%	99.8%
WCDS	0.1%	99.9%
WCSM	0.1%	100.0%

Along the Bay of Fundy shoreline a narrow, coastal-like forest dominated by white spruce and balsam fir occurs. It extends inland only a few hundred metres, except on Digby Neck where it extends over 1 km inland. Red spruce stands occur in a few areas where well drained, coarse textured soils lie over wave-washed stratified gravel derived mainly from basaltic material. Yellow birch and red maple also occur in mixedwoods with red spruce.

Stand-level natural disturbances on the North Mountain ecodistrict are rare within the dominant hardwood forest, but natural disturbances agents include hurricanes, wind and ice storms, disease and insects. These disturbances typically create small patch or individual tree mortality. Affected stands will then develop an uneven-aged or old growth structure with small gap disturbances providing openings in the canopy for new growth. Evidence of blowdown and uprooting is evident in much of the hardwood forest by the abundance of pit and mound relief.

The role of beech in this forest has been significantly altered by the beech canker (introduced circa 1900), which reduced the once dominant beech to a primarily understory species. Still,

Columnar basalt on Long Island, Digby County

PHOTO: DNR (Sean Basquill)

some of the least diseased and best developed beech forests in Nova Scotia are found in this ecodistrict.

A birch dieback epidemic in the 1940s also caused widespread mortality, affecting yellow birch across Nova Scotia. On the North Mountain this species has since regained much of its natural abundance.

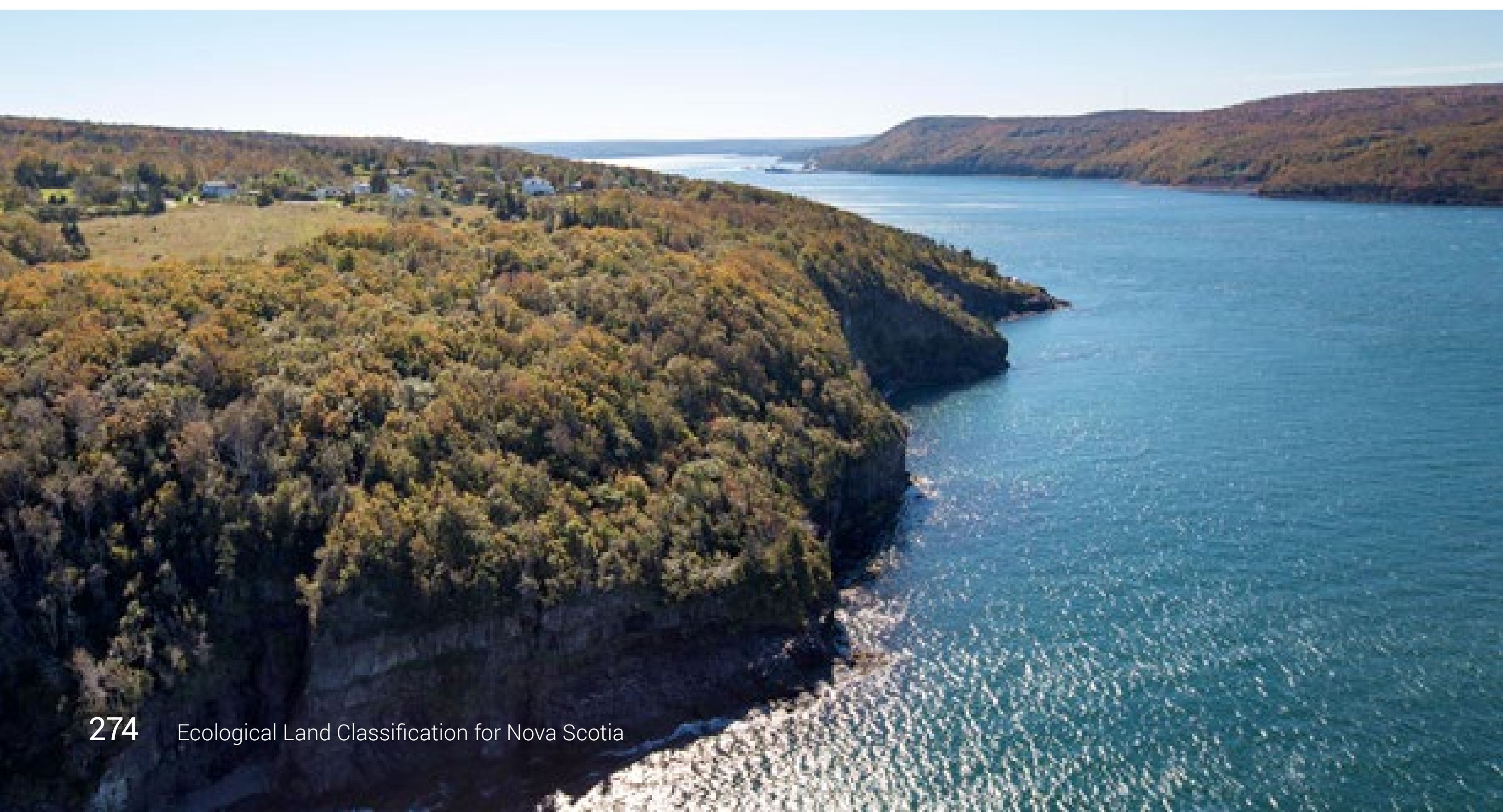
Other insects and diseases that cause individual tree mortality include maple borer in sugar maple and cinder conk in yellow birch. Wounds caused by ice storm breakage also provide avenues for a variety of fungi to enter and further weaken or kill trees.

Starting in the 1700s, large areas of tolerant hardwood forests in this ecodistrict were cleared for farmland. After the farmland was abandoned, the fields reforested to stands of white spruce.

Non Forests

The North Mountain is mostly forested. Non-forested ecosystems of note include talus slopes and cliffs along the south facing escarpment. Talus is often occupied by sometimes sparse vegetation composed of: marginal wood fern (*Dryopteris marginalis*), fibrous-root sedge (*Carex communis*), western poison ivy (*Toxicodendron rydbergii*), and small trees. On the cliffs, maiden-hair spleenwort (*Asplenium trichomanes*) and rusty woodsia (*Woodsia ilvensis*) are more common. The Fundy side of the ecodistrict has some of the same non-forested habitat and alpine/sub-arctic plants documented in the description for ecodistrict **910 (Parrsboro Shore)**. Peregrine falcons (*Falco peregrinus*) are known to use these sea cliffs for nesting habitat.

Wetlands are not especially common in the ecodistrict. Soils are generally well drained and the steep topography tends to shed most surface water. However at the western end of the ridge, topographic gradients are more subdued which promotes wetland formation. The western tip of Digby neck and both Long and Brier Islands support a relatively high wetland density. Most of these are freshwater marshes and peatland. In some of the peatlands, a globally rare flower grows profusely. Eastern mountain avens (*Geum peckii*) is only found in two places in the world—the western tip of the North Mountain ecodistrict and an alpine summit in New Hampshire. Brier and Long Island also support coastal heathland and rocky coastal headlands both of which are more common in Atlantic coastal ecodistricts.



The Annapolis River exits through Digby Gut, a break in the North Mountain's volcanic foundation. *PHOTO: CNS (Len Wagg)*

APPENDICES

MacEacherns Lake in the Pictou Antigonish Highlands (330)

PHOTO: CNS (Len Wagg)

Appendix 1
Species List: Scientific and common names

Plants

Vascular Plants

Adder's-tongue	*Ophioglossum pusillum*
Agrimony	*Agrimonia spp.*
Alder	*Alnus spp.*
Alder-leaved buckthorn	*Rhamnus alnifolia*
Allegheny hawkweed	*Hieracium paniculatum*
Alpine bilberry	*Vaccinium uliginosum*
Alternate-leaved dogwood	*Cornus alternifolia*
Anise-root	*Osmorhiza longistylis*
Appalachian fir club-moss	*Huperzia appalachiana*
Arrowleaved violet	*Viola sagittata*
Bakeapple	*Rubus chamaemorus*
Balsam fir	*Abies balsamea*
Balsam groundsel	*Packera paupercula*
Balsam poplar	*Populus balsamifera*
Baltic rush	*Juncus balticus*
Bartonia	*Bartonia paniculata*
Bartram's serviceberry	*Amelanchier bartramiana*
Bayberry	*Morella pensylvanica*
Beach grass	*Ammophila breviligulata*
Beach pea	*Lathyrus japonicus*
Beaked hazelnut	*Corylus cornuta*
Beaked spikerush	*Eleocharis rostellata*
Bearberry	*Arctostaphylos uva-ursi*
Bedstraw	*Galuim spp.*
Beech	*Fagus grandifolia*
Beech-drops	*Epifagus virginiana*
Bellwort	*Uvularia sessilifolia*
Bent-grass	*Agrostis spp.*
Big-leaved marsh-elder	*Iva frutescens ssp. oraria*
Bittersweet	*Solanum dulcamara*
Black ash	*Fraxinus nigra*
Black cherry	*Prunus serotina*
Black chokeberry	*Aronia melanocarpa*
Black crowberry	*Empetrum nigrum*
Black snakeroot	*Sanicula marilandica*
Black spruce	*Picea mariana*
Bladder sedge	*Carex intumescens*
Bloodroot	*Sanguinaria canadensis*
Blue cohosh	*Caulophyllum thalictroides*
Blue flag	*Iris versicolor*
Blue joint	*Calamagrostis canadensis*
Bluebead lily	*Clintonia borealis*
Blueberry	*Vaccinium spp.*
Blunt-leaved bedstraw	*Galium obtusum*
Boreal aster	*Symphyotrichum boreale*
Bog birch	*Betula pumila*
Bog club-moss	*Lycopodiella inundata*
Bog-goldenrod	*Solidago uliginosa*
Bog willow	*Salix pedicellaris*
Bracken	*Pteridium aquilinum*
Braun's holly fern	*Polystichum braunii*
Bristle stalked sedge	*Carex leptalea*
Bristly black currant	*Ribes lacustre*
Bristly club-moss	*Lycopodium annotinum*
Brome-like sedge	*Carex bromoides*
Brook lobelia	*Lobelia kalmii*
Broom crowberry	*Corema conradii*
Brownish sedge	*Carex brunnescens*
Bugleweed	*Lycopus uniflorus*
Bulblet bladder fern	*Cystopteris bulbifera*
Bulbous rush	*Juncus bulbosus*
Bunchberry	*Cornus canadensis*
Bush-honeysuckle	*Diervilla lonicera*
Buttonbush	*Cephalanthus occidentalis*
Button sedge	*Carex bullata*
Calico aster	*Aster lateriflorus*
Canada burnet	*Sanguisorba canadensis*
Canada bluegrass	*Poa compressa*
Canada goldenrod	*Solidago canadensis*
Canada lily	*Lilium canadense*
Canada mountain-ricegrass	*Oryzopsis canadensis*
Canada tick-trefoil	*Desmodium canadense*
Canada wood-nettle	*Laportea canadensis*
Cancer root	*Conopholis americana*
Case's ladies'-tresses	*Spiranthes casei*
Catbriar	*Smilax rotundifolia*
Checkered rattlesnake plantain	*Goodyera tesselata*
Cherry	*Prunus spp.*
Choke cherry	*Prunus virginiana*
Chokeberry	*Photinia spp.*
Christmas fern	*Polystichum acrostichoides*
Cinnamon fern	*Osmunda cinnamomea*
Cinnamon-spot pondweed	*Potamogetan oblongus*
Cinquefoil	*Potentilla simplex*
Club-moss	*Lycopodiaceae*
Coastal sedge	*Carex exilis*
Cordgrass	*Spartina spp.*
Coltsfoot	*Tussilago farfara*
Common blackberry	*Rubus allegheniensis*
Common hair grass	*Deschampsia flexuosa*
Common juniper	*Juniperus communis*
Common speedwell	*Veronica officinalis*
Common woodrush	*Luzula multiflora*
Cotton-grass	*Eriophorum spp.*
Cow-parsnip	*Heracleum lanatum*
Cow-wheat	*Melampyrum lineare*
Cranberry	*Vaccinium oxycoccus*
Creeping bent-grass	*Agrostis stolonifera*
Creeping buttercup	*Ranunculus repens*
Creeping juniper	*Juniperus horizontalis*
Creeping rattlesnake plantain	*Goodyera repens*
Creeping sedge	*Carex chordorrhiza*
Creeping snowberry	*Gaultheria hispidula*
Crested wood fern	*Dryopteris cristata*
Cut-leaved avens	*Geum laciniatum*
Dandelion	*Taraxacum officinale*
Deer-tongue panic grass	*Dichanthelium clandestinum*

Dewey's sedge	*Carex deweyana*
Dog tooth violet	*Erythronium americanum*
Downy alder	*Alnus viridis*
Downy rattlesnake plantain	*Goodyera pubescens*
Drooping wood sedge	*Carex arctata*
Drummond's rockcress	*Arabis drummondii*
Dudley's rush	*Juncus dudleyi*
Dutchman's breeches	*Dicentra cucullaria*
Dwarf bilberry	*Vaccinium caespitosum*
Dwarf huckleberry	*Gaylussacia bigeloviana*
Dwarf mistletoe	*Arceuthobium pusillum*
Dwarf raspberry	*Rubus pubescens*
Early leaf brome grass	*Bromus latigumis*
Eastern baccharis	*Baccharis halimifolia*
Eastern lilaeopsis	*Lilaeopsis chinensis*
Eastern mountain avens	*Geum peckii*
Eastern spreading wood fern	*Dryopteris campyloptera*
Eastern white cedar	*Thuja occidentalis*
Ebony sedge	*Carex eburnea*
Eelgrass	*Zostera marina*
Elliott's goldenrod	*Solidage elliottii*
Elm (American)	*Ulmus americana*
Evening primrose	*Oenothera biennis*
Evergreen wood fern	*Dryopteris intermedia*
Fall dandelion	*Leontodon autumnalis*
False holly	*Nemopanthus mucronatus*
False asphodel	*Triantha glutinosa*
False holly	*Nemopanthus mucronatus*
False mermaidweed	*Floerkea proserpinacoides*
False nettle	*Boehmeria cylindrica*
False Solomon's seal	*Maianthemum racemosum*
False violet	*Dalibarda repens*
Fibrous-root sedge	*Carex communis*
Field locoweed	*Oxytropis campestris var. johannensis*
Field horsetail	*Equisetum arvense*
Fir club-moss	*Huperzia selago*
Fireweed	*Epilobium angustifolium*
Fly-honeysuckle	*Lonicera canadensis*
Foamflower	*Tiarella cordifolia*
Fowl manna grass	*Glyceria striata*
Fowl meadow grass	*Poa palustris*
Foxberry	*Vaccinium vitis-idaea*
Fragrant wood fern	*Dryopteris fragrans*
Fringed sedge	*Carex crinita*
Giant rattlesnake plantain	*Goodyera oblongifolia*
Gmelin's water buttercup	*Ranunculus gmelinii*
Grape fern	*Botrychium spp.*
Glasswort	*Salicornia spp.*
Glossy rose	*Rosa nitida*
Golden crest	*Lophiola aurea*
Golden heather	*Hudsonia ericoides*
Golden ragwort	*Senecio aureus*
Goldenrods	*Solidago spp.*
Goldthread	*Coptis trifolia*
Gooseberry family	*Ribes spp.*
Graceful sedge	*Carex gracillima*
Grass pink	*Calopogon tuberosus*
Grey birch	*Betula populifolia*

Ground cedar	*Diphasiastrum tristachyum*
Ground hemlock (Yew)	*Taxus canadensis*
Ground juniper	*Juniperus communis*
Ground pine	*Lycopodium obscurum*
Hair fescue	*Festuca filiformis*
Hairy sedge	*Carex hirtifolia*
Hairy sweet cicely	*Osmorhiza claytoni*
Hare-bell	*Campanula rotundifolia*
Hawkweeds	*Hieracium spp.*
Hawthorn	*Crataegus spp.*
Hay-scented fern	*Dennstaedtia punctilobula*
Hayden's sedge	*Carex haydenii*
Heart-leaf birch	*Betula papyrifera var. cordifolia*
Heart-leaved aster	*Aster cordifolius*
Helliborine	*Epipactis helleborine*
Hemlock (Eastern)	*Tsuga canadensis*
Hemp-nettle	*Galeopsis tetrahit*
Herb-Robert	*Geranium robertianum*
Hidden-scaled sedge	*Carex cryptolepis*
Hickey's club-moss	*Lycopodium hickey*
Highbush blueberry	*Vaccinium corymbosum*
Highbush cranberry	*Viburnum opulus*
Hoary willow	*Salix candida*
Hobble-bush	*Viburnum lantanoides*
Hooked agrimony	*Agrimonia gryposepala*
Horse-gentian	*Triosteum aurantiacum*
Huckleberry	*Gaylussacia baccata*
Hudsonia	*Hudsonia ericoides*
Hybrid spruce	*Picea mariana x Picea rubens*
Hyssop-leaved fleabane	*Erigeron hyssopifolius*
Indian cucumber root	*Medeola virginiana*
Indian pipe	*Monotropa uniflora*
Inkberry	*Ilex glabra*
Interrupted fern	*Osmunda claytoniana*
Ironwood	*Ostrya virginiana*
Jack pine	*Pinus banksiana*
Jack-in-the-pulpit	*Arisaema triphyllum*
Jewelweed	*Impatiens capensis*
Kentucky bluegrass	*Poa pratensis*
Labrador tea	*Ledum groenlandicum*
Lady fern	*Athyrium filix-femina*
Lambkill	*Kalmia angustifolia*
Lance-leaved grapefern	*Botrychium lanceolatum*
Lance-leaved violet	*Viola lanceolata*
Large cranberry	*Vaccinium macrocarpon*
Large enchanter's nightshade	*Circaea lutetiana*
Large-leaved goldenrod	*Solidago macrophylla*
Large-tooth aspen	*Populus grandidentata*
Laurentian primrose	*Primula laurentiana*
Large-leaved aster	*Aster macrophyllus*
Large-leaved goldenrod	*Solidago macrophylla*
Large-tooth aspen	*Populus grandidentata*
Late goldenrod	*Solidago gigantea*
Leather-leaf	*Chamaedaphne calyculata*
Leatherwood	*Dirca palustris*
Lions paw	*Prenanthes trifoliolata*
Little grapefern	*Botrychium simplex*
Limestone meadow sedge	*Carex granularis*
Live-forever	*Sedum telephium*

Long-bracted green orchid	*Coeloglossum viride*
Long-stalked sedge	*Carex pedunculata*
Long's bulrush	*Scirpus longii*
Loosetrife	*Lysimachia terrestris*
Lowbush blueberry	*Vaccinium angustifolium*
Maidenhair spleenwort	*Asplenium trichomanes*
Male fern	*Dryopteris felix-mas*
Manna-grass	*Glyceria spp.*
Marginal wood fern	*Dryopteris marginalis*
Marram grass	*Ammophila breviligulata*
Marsh harebell	*Campanula aparinoides*
Marsh fern	*Thelypteris palustris*
Massachusetts fern	*Thelypteris simulata*
Mayflower	*Epigaea repens*
Meadow hawkweed	*Hieracium caespitosum*
Meadow horsetail	*Equisetum palustre*
Meadow-rue	*Thalictrum pubescens*
Meadow-sweet	*Spiraea alba*
Millet grass	*Milium effusum*
Mitrewort	*Mitella nuda*
Mountain maple	*Acer spicatum*
Mountain sandwort	*Minuartia groenlandica*
Mountain-ash	*Sorbus americana*
Mouse eared hawkweed	*Hieracium pilosella*
Narrow false oats	*Trisetum spicatum*
Narrow-leaved cottongrass	*Eriophorum angustifolium*
New England sedge	*Carex novae-angliae*
New Jersey rush	*Juncus caesariensis*
New York aster	*Symphyotrichum novi-belgii*
New York fern	*Thelypteris noveboracensis*
Nodding trillium	*Trillium cernuum*
Northern beech fern	*Phegopteris connectilis*
Northern blueberry	*Vaccinium boreale*
Northern holly fern	*Polystichum lonchitis*
Northern long sedge	*Carex folliculata*
Northern wild licorice	*Galium kamtschaticum*
Oak fern	*Gymnocarpium dryopteris*
Old-field goldenrod	*Solidago nemoralis*
Olney's bulrush	*Schoenoplectus americanus*
Ostrich fern	*Matteuccia struthiopteris*
Ox-eye daisy	*Chrysanthemum leucanthemum*
Painted trillium	*Trillium undulatum*
Pale laurel	*Kalmia polifolia*
Partridge-berry	*Mitchella repens*
Pearly everlasting	*Anaphalis margaritacea*
Philadelphia panic grass	*Panicum philadelph*
Pickering's reed grass	*Calamagrostis pickeringii*
Pin cherry	*Prunus pensylvanica*
Pine barren goldenheather	*Hudsonia ericoides*
Pine-sap	*Monotropa hypopithys*
Pink lady's slipper	*Cypripedium acaule*
Pitcher-plant	*Sarracenia purpurea*
Plymouth gentian	*Sabatia kennedyana*
Poison ivy	*Toxicodendron radicans*
Poverty grass	*Danthonia spicata*
Princes'-pine	*Chimaphila umbellata*
Purple trillium (Red)	*Trillium erectum*
Ram's head lady's slipper	*Cypripedium arietinum*
Rattlesnake fern	*Botrychium virginianum*
Red baneberry	*Actaea rubra*
Red bulrush	*Blysmus rufus*
Red chokeberry	*Aronia arbutifolia*
Red crowberry	*Empetrum eamesii*
Red fescue	*Festuca rubra*
Red maple	*Acer rubrum*
Red oak	*Quercus rubra*
Red pine	*Pinus resinosa*
Red raspberry	*Rubus idaeus*
Red spruce	*Picea rubens*
Red-berried elder	*Sambucus racemosa*
Red-osier dogwood	*Cornus sericea*
Redroot	*Lachnanthes caroliana*
Redtop panic grass	*Panicum rigidulum var. pubescens*
Rhodora	*Rhododendron canadense*
Ribless woodland sedge	*Carex leptonervia*
Rice grass	*Oryzopsis asperifolia*
Rock polypody	*Polypodium virginianum*
Rock whitlow grass	*Draba arabisans*
Rockrose	*Helianthemum canadense*
Rose pogonia	*Pogonia ophioglossides*
Rose twisted stalk	*Streptopus lanceolatus*
Roses	*Rosa spp.*
Rough aster	*Aster radula*
Rough bedstraw	*Galium asprellum*
Rough goldenrod	*Solidago rugosa*
Rough hawkweed	*Hieracium scabrum*
Round-leaved dogwood	*Cornus rugosa*
Round-leaved pyrola	*Pyrola americana*
Round-leaved sundew	*Drosera rotundifolia*
Royal fern	*Osmunda regalis*
Running club-moss	*Lycopodium clavatum*
Rushes	*Juncus spp.*
Russet cottongrass	*Eriophorum russeolum*
Rusty woodsia	*Woodsia ilvensis*
Sarsaparilla	*Aralia nudicaulis*
Saltmarsh agalinis	*Agalinis maritima*
Scotch pine	*Pinus sylvestris*
Scouring-rush	*Equisetum hyemale var. affine*
Seabeach sandwort	*Honckenya peploides*
Sea lavender	*Limonium carolinianum*
Sea rocket	*Cakile edentula*
Seaside goldenrod	*Solidago sempervirens*
Seaside plantain	*Plantago maritima*
Sedges	*Carex spp.*
Sensitive fern	*Onoclea sensibilis*
Serviceberry	*Amelanchier spp.*
Sheep-sorrel	*Rumex acetosella*
Shepherdia	*Shepherdia canadensis*
Shining club-moss	*Huperzia lucidula*
Shinleaf	*Pyrola elliptica*
Short husk	*Brachyelytrum erectum*
Showy lady's slipper	*Cypripedium reginae*
Silver maple	*Acer saccharinum*
Silky willow	*Salix sericea*
Silver poplar	*Populus alba*
Silvery spleenwort	*Deparia acrostichoides*
Skunk cabbage	*Symplocarpus foetidus*
Slender blue flag	*Iris prismatica*

Slender cliff brake	*Cryptogramma stelleri*
Slender spikerush	*Eleocharis nitida*
Small bedstraw	*Galium tinctorium*
Small cranberry	*Vaccinium oxycoccus*
Small enchanter's nightshade	*Circaea alpina*
Small flowered wood rush	*Luzula parviflora*
Smooth cliff fern	*Woodsia glabella*
Smooth alder	*Alnus serrulata*
Smooth serviceberry	*Amelanchier laevis*
Soft leaved sedge	*Carex disperma*
Solomon's seal	*Polygonatum pubesens*
Southern twayblade	*Listera australis*
Speckled alder	*Alnus incana*
Spinulose wood fern	*Dryopteris carthusiana*
Spreading sedge	*Carex projecta*
Spiraea	*Spiraea spp.*
Spurred gentian	*Halenia deflexa ssp. brentoniana*
Squash berry	*Viburnum edule*
Spring beauty	*Claytonia caroliniana*
Staghorn sumac	*Rhus typhina*
Starflower	*Trientalis borealis*
Stiff sedge	*Carex stricta*
Stinking Willie	*Senecio jacobaea*
Strawberry	*Fragaria virginiana*
Striped maple	*Acer pensylvanicum*
Sugar maple	*Acer saccharum*
Swamp loosestrife	*Decodon verticillatus*
Swamp milkweed	*Asclepias incarnata*
Sweet cicely	*Osmorhiza spp.*
Sweet gale	*Myrica gale*
Sweet pepperbush	*Clethra alnifolia*
Sweet wood reed grass	*Cinna arundinacea*
Sweet-scented bedstraw	*Galium triflorum*
Sweetfern	*Comptonia peregrina*
Tall buttercup	*Ranunculus acris*
Tall white aster	*Aster umbellatus*
Tamarack	*Larix laricina*
Teaberry	*Gaultheria procumbens*
Thimbleweed	*Anemone virginiana*
Thread-leaved sundew	*Drosera filiformis*
Three seeded sedge	*Carex trisperma*
Three-leaved false Solomon's seal	*Smilacina trifolia*
Thyme-leaved speedwell	*Veronica serpyllifolia ssp. humifusa*
Three-toothed cinquefoil	*Sibbaldiopsis tridentata*
Trailing blackberry	*Rubus hispidus*
Tiny allseed	*Radiola linoides*
Trembling aspen	*Populus tremuloides*
Tubercled spikerush	*Eleocharis tuberculosa*
Tufted clubrush	*Trichophorum caespitosum*
Twinflower	*Linnaea borealis*
Umbel-like sedge	*Carex umbellata*
Vasey's rush	*Juncus vaseyi*
Velvet-leaf blueberry	*Vaccinium myrtilloides*
Violets	*Viola spp.*
Virginia chain fern	*Woodwardia virginica*
Virginia rose	*Rosa virginiana*
Virgins bower	*Clematis virginiana*
Water-horehound	*Lycopus americanus*
Water pennywort	*Hydrocotyle umbellata*
Wavy-leaved aster	*Symphyotrichum undulatum*
Western hairy rockcress	*Arabis hirsuta var. pycnocarpa*
Western poison ivy	*Toxicodendron rydbergii*
White ash	*Fraxinus americana*
White avens	*Geum canadense*
White baneberry	*Actaea pachypoda*
White birch	*Betula papyrifera*
White clover	*Trifolium repens*
White goldenrod	*Solidage bicolor*
White lettuce	*Prenanthes altissima*
White panicle aster	*Aster lanceolatus*
White mountain saxifrage	*Saxifraga paniculata ssp. neogaea*
White pine	*Pinus strobus*
White spruce	*Picea glauca*
White twisted stock	*Streptopus amplexifolius*
White-haired panic grass	*Panicum villosissimum*
Wiegand's sedge	*Carex wiegandii*
Wiegand's wild rye	*Elymus wiegandii*
Wild apple	*Pyrus Malus*
Wild carrot	*Daucus carota*
Wild coffee	*Triosteum aurantiacum*
Wild leek	*Allium tricoccum*
Wild lily-of-the-valley	*Maianthemum canadense*
Wild raisin	*Viburnum nudum*
Wild red currant	*Ribes triste*
Wild rose	*Rosa carolina*
Wild rye grass	*Elymus virginicus*
Willows	*Salix spp.*
Winterberry	*Ilex verticillata*
Wood aster	*Oclemena acuminata*
Wood ferns	*Dryopteris spp.*
Witch-hazel	*Hamamelis virginiana*
Wood aster	*Aster acuminatus*
Wood goldenrod	*Solidago flexicaulis*
Wood nettle	*Laportea canadensis*
Wood reed	*Cinna latifolia*
Wood-sorrel	*Oxalis montana*
Woodland horsetail	*Equisetum sylvaticum*
Woodland rush	*Juncus subcaudatus var. planisepalus*
Woodland strawberry	*Fragaria vesca*
Wooly hudsonia	*Hudsonia tomentosa*
Yarrow	*Achillea millefolium*
Yellow birch	*Betula alleghaniensis*
Yellow hawkweed	*Hieracium x floribundum*
Yellow lady's slipper	*Cypripedium parviflorum*
Yellow violet	*Viola pubescens*
Yellow-green sedge	*Carex flava*

Non-Vascular Plants

Bryophytes

Atrichum moss	*Atrichum spp.*
Bazzania	*Bazzania trilobata*
Blunt-leaved Sphagnum	*Sphagnum palustre*
Brachythecium moss	*Brachythecium spp.*
Brittle stem Sphagnum	*Sphagnum wulfinum*

Broom moss	*Dicranum scoparium*
Brown fat-leaved Sphagnum	*Sphagnum papillosum*
Common green Sphagnum	*Sphagnum girgensohnii*
Dicranums	*Dicranum spp.*
Fern moss	*Thuidium delicatulum*
Fine Sphagnum	*Sphagnum angustifolium*
Flat topped Sphagnum	*Sphagnum fallax*
Fragile tortella moss	*Tortella fragilis*
Giant spear moss	*Calliergon giganteum*
Goldenleaf campylium moss	*Campylium chrysophyllum*
Goose neck moss	*Rhytidiadelphus loreus*
Greater broom moss	*Dicranum majus*
Hair-cap moss	*Polytrichum commune*
Hoary fringe moss	*Racomitrium canescens*
Hoary rock-moss	*Racomitrium lanuginosum*
Hooked scorpium moss	*Scorpidium scorpioides*
Hypnum moss	*Hypnum imponens*
Juniper polytrichum	*Polytrichum juniperinum*
Ladies' tresses	*Sphagnum capillifolium*
Mniums	*Mnium spp.*
Naugehyde liverwort	*Ptilidium pulcherrimum*
Northeastern peat moss	*Sphagnum flavicomens*
Pale fat-leaved Sphagnum	*Sphagnum centrale*
Peat moss	*Sphagnum spp.*
Pin cushion moss	*Leucobryum glaucum*
Plume moss	*Ptilium crista-castrensis*
Prickly Sphagnum	*Sphagnum squarrosum*
Red fat-leaved Sphagnum	*Sphagnum magellanicum*
Rhizomniums	*Rhizomnium spp.*
Rhytidiadelphus moss	*Rhytidiadelphus spp.*
Russ's Sphagnum	*Sphagnum russowii*
Schreber's moss	*Pleurozium schreberi*
Shaded wood moss	*Hylocomium umbratum*
Shaggy moss	*Rhytidiadelphus triquetrus*
Slender bog moss	*Sphagnum subsecundum*
Sphagnum moss	*Sphagnum spp.*
Sphagnum tenellum	*Sphagnum tenellum*
Stair-step moss	*Hylocomium splendens*
Torrey's Sphagnum	*Sphagnum torreyanum*
Tufted Fen Moss	*Paludella squarrosa*
Verdigris tufa-moss	*Gymnostomum aeruginosum*
Wavy dicranum	*Dicranum polysetum*

Lichens

Arctic kidney lichen	*Nephroma arcticum*
Boreal felt lichen	*Erioderma pedicellatum*
Coral lichen	*Sphaerophorus globosus*
Cup lichens	*Cladonia spp.*
Dixie reindeer lichen	*Cladina subtenuis*
Green reindeer lichen	*Cladina arbuscula*
Grey reindeer lichen	*Cladina rangiferina*
Lesser green reindeer lichen	*Cladina mitis*
Methuselah's beard lichen	*Usnea longissima*
Old man's beard	*Usnea spp.*
Reindeer lichen (moss)	*Cladonia spp.*
Rock tripe	*Umbilicaria spp.*
Shield lichen	*Parmelia spp. and Punctelia spp.*
Snow lichen	*Stereocaulon spp.*
Star-tipped reindeer lichen	*Cladina stellaris*

Animals

Birds

American bittern	*Botaurus lentiginosus*
American golden-plover	*Pluvialis dominica*
American goldfinch	*Spinus tristis*
American kestrel	*Falco sparverius*
American redstart	*Setophaga ruticilla*
Bald eagle	*Haliaeetus leucocephalus*
Barred owl	*Strix varia*
Bicknell's thrush	*Catharus bicknelli*
Black and white warbler	*Mniotilta varia*
Black-backed woodpecker	*Picoides arcticus*
Black-crowned night heron	*Nycticorax nycticorax*
Black-legged kittiwake	*Rissa tridactyla*
Black guillemot	*Cepphus grylle*
Blackpoll warbler	*Dendroica striata*
Black-throated blue warbler	*Dendroica caerulescens*
Blue jay	*Cyanocitta cristata*
Boreal chickadee	*Poecile hudsonicus*
Canada warbler	*Wilsonia canadensis*
Chestnut-sided warbler	*Dendroica pensylvanica*
Chickadees	*Poecile spp.*
Common eider	*Somateria mollissima*
Common redpoll	*Acanthis flammea*
Common yellowthroat	*Geothlypis trichas*
Crossbills	*Loxia spp.*
Crow	*Corvus brachyrhynchos*
Double-crested cormorant	*Phalacrocorax auritus*
Evening grosbeak	*Coccothraustes vespertinus*
Finches	*Carpodacus spp.*
Fox sparrow	*Passerella iliaca*
Grey catbird	*Dumetella carolinensis*
Grey jay	*Perisoreus canadensis*
Great blue heron	*Ardea herodias*
Great cormorant	*Phalacrocorax carbo*
Great crested flycatcher	*Myiarchus crinitus*
Great-horned owl	*Bubo virginianus*
Greater yellowlegs	*Tringa melanoleuca*
Harlequin duck	*Histrionicus histrionicus*
Ipswitch sparrow	*Passerculus sandwichensis princeps*
Killdeer	*Charadrius vociferous*
Kinglets	*Regulus spp.*
Least sandpiper	*Calidris minutilla*
Lincoln's sparrow	*Melospiza lincolnii*
Mourning warbler	*Oporornis philadelphia*
Northern goshawk	*Accipiter gentilis*
Northern oriole	*Icterus galbula*
Northern parula warbler	*Parula americana*
Northern waterthrush	*Seiurus noveboracensis*
Nuthatches	*Sitta spp.*
Olive-sided flycatcher	*Contopus cooperi*
Osprey	*Pandion haliaetus*
Ovenbird	*Seiurus aurocapilla*
Peregrine falcon	*Falco peregrinus*
Pileated woodpecker	*Dryocopus pileatus*
Pine siskin	*Spinus pinus*

Piping plover	*Charadrius melodus melodus*
Purple finch	*Carpodacus purpureus*
Raven	*Corvus corax*
Red crossbill	*Loxia curvirostra*
Red knot	*Calidris canutus rufa*
Red-tailed hawk	*Buteo jamaicensis*
Ruby-throated hummingbird	*Archilochus colubris*
Ruffed grouse	*Bonasa umbellus*
Rusty blackbird	*Euphagus carolinus*
Semipalmated plover	*Charadrius semipalmatus*
Semipalmated sandpiper	*Calidris pusilla*
Sharp-shinned hawk	*Accipiter striatus*
Sharp-tailed sparrow	*Ammodramus caudacutus*
Solitary vireo	*Vireo solitarius*
Spotted sandpiper	*Actitis macularius*
Spruce grouse	*Falcipennis canadensis*
Swamp sparrow	*Melospiza georgiana*
Veery	*Catharus fuscescens*
Vesper sparrow	*Pooecetes gramineus*
Whimbrel	*Numenius phaeopus*
White-winged crossbill	*Loxia leucoptera*
Willet	*Tringa semipalmata*
Wilson's warbler	*Wilsonia pusilla*
Wood thrush	*Hylocichla mustelina*
Woodcock	*Scolopax minor*
Yellow warbler	*Dendroica petechia*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Yellow-rumped warbler	*Dendroica coronata*

Amphibians and Reptiles

Blanding's turtle	*Emydoidea blandingii*
Blue-spotted salamander	*Ambystoma laterale*
Four-toed salamander	*Hemidactylium scutatum*
Red-backed salamander	*Plethodon cinereus*
Eastern ribbonsnake	*Thamnophis sauritus*
Wood frog	*Rana sylvatica*
Wood turtle	*Glyptermys insculpta*
Yellow-spotted salamander	*Ambystoma maculatum*

Invertebrates

Balsam woolly adelgid	*Adelges piceae*
European pine shoot moth	*Rhyacionia buoliana*
Forest tent caterpillar	*Malacosoma disstria*
Green comma	*Polygonia faunus*
Hemlock looper	*Lambdina fiscellaria*
Jutta arctic butterfly	*Oeneis jutta*
Larch casebearer	*Coleophora laricella*
Larch sawfly	*Pristiphora erichsonii*
Maine snaketail dragonfly	*Ophiogomphus mainensis*
Question mark	*Polygonia interrogationis*
Sable Island sweat bee	*Lasioglossum sablense*
Spruce bark beetle	*Dendroctonus rufipennis*
Spruce budworm	*Choristoneura fumiferana*
Sugar Maple borer	*Glycobius speciosus*
Tent caterpillar	*Malacosoma disstria*
Tussock moth	*Orgyia leucostigma*
White pine weevil	*Pissodes strobi*

Fish and Molluscs

Killifish	*Fundulus heteroclitus*
Brook floater	*Alasmidonta varicosa*
Eastern lampmussel	*Lampsilis radiata*
Tidewater mucket	*Leptodea ochracea*
Triangle floater	*Alasmidonta undulata*

Mammals

American marten	*Martes americana*
Bear	*Ursus americanus*
Beaver	*Castor canadensis*
Canadian lynx	*Lynx canadensis*
Coyote	*Canis latrans*
Deer	*Odocoileus virginianus*
Fisher	*Martes pennanti*
Gaspé shrew	*Sorex dispar* ssp.gaspensis
Grey seal	*Halichoerus grypus*
Horse	*Equus ferus caballus*
Long-tailed shrew	*Sorex dispar*
Mink	*Neovison vison*
Moose (Mainland)	*Alces alces americanus*
Muskrat	*Ondatra zibethicus*
Northern flying squirrel	*Glaucomys sabrinus*
Otter	*Lontra canadensis*
Porcupine	*Erethizon dorsatum*
Red fox	*Vulpes vulpes*
Red squirrel	*Tamiasciurus hudsonicus*
Rock vole	*Microtus chrotorrhinus*
Snowshoe hare	*Lepus americanus*
Southern flying squirrel	*Glaucomys volans*
Star-nosed mole	*Condylura cristata*
Water shrew	*Sorex palustris*
Woodland caribou	*Rangifer tarandus*

Fungi

Beech bark canker	*Neonectria faginata*
Beech scale disease	*Nectria ditissima*
Birch cinder conch (Chaga)	*Inonotus obliquus*
Black knot fungus	*Apiosporina morbosa*
Black trumpet mushrooms	*Craterellus fallax*
Boletes	*Boletaceae spp.*
Chanterelles	*Cantharellus cibarius*
Dutch elm disease	*Ophiostoma ulmi*
False Morrel	*Gyromitra spp.*
Fly agaric (fly amanita)	*Amanita muscaria*
Hemlock varnish shelf	*Ganoderma tsugae*
Hollow foot suillus	*Suillus cavipes*
Honey mushooms	*Armillaria spp.*
Hypoxylon canker	*Hypoxylon mammatum*
Larch slippery jack	*Suillus grevillei*
Maitake (Hen-of-the-woods)	*Grifola frondosa*
Pine mushrooms	*Tricholoma magnivelare*
Saffron milkcap	*Lactarius deliciousus*
Shoestring root rot	*Armillaria solidipes*
Sirococcus blight	*Sirrococcus conigenus*
Violet-toothed polypore	*Trichaptum biforme*
White pine blister rust	*Cronartium ribicola*

Appendix 2
Forest Ecosystem Classification (FEC) Units

Summary of Forest Groups, Vegetation Types (VTs) and variants within the provincial (FEC) system

Forest Group	Forest Group Code	Number of VTs	Number of Variants
Cedar Forest	CE	2	1
Coastal Forest	CO	7	1
Floodplain Forest	FP	6	1
Highland Forest	HL	4	1
Intolerant Hardwood Forest	IH	7	3
Karst Forest	KA	2	0
Mixedwood Forest	MW	5	1
Old Field Forest	OF	5	0
Open Woodland	OW	6	0
Spruce Hemlock Forest	SH	10	1
Spruce Pine Forest	SP	10	5
Tolerant Hardwood Forest	TH	8	4
Wet Coniferous Forest	WC	8	3
Wet Deciduous Forest	WD	8	1
Total	**14**	**88**	**22**

Vegetation types (VTs) and their associated ecosite groups

VT Code	VT Name	AC *	MB *
CE1	Eastern white cedar / Speckled alder / Cinnamon fern / Sphagnum	X	
CE1a	(Poison ivy variant)	X	
CE2	Eastern white cedar – Balsam fir / Stair-step moss	X	
CO1	Black spruce – Balsam fir / Foxberry / Plume moss		X
CO2	White spruce – Balsam fir / Foxberry / Twinflower		X
CO2a	(Black crowberry Headland variant)		X
CO3	Red spruce / Mountain-ash / Foxberry		X
CO4	Balsam fir / Foxberry – Twinflower		X
CO5	White birch – Balsam fir / Foxberry – Wood aster		X
CO6	Red maple – Birch / Bunchberry – Sarsaparilla		X
CO7	White spruce / Bayberry		X

DEFINITIONS

Acadian Ecosite Group contains 17 ecosites representing a full range of forest site conditions. Zonal sites are associated with climax forest containing mainly shade tolerant and shade-intermediate species such as red spruce, hemlock, white pine, sugar maple, yellow birch, beech, white ash and red maple.

Maritime Boreal Ecosite Group includes 11 ecosites representing a range of forest site conditions. Exposure and climate differentiates the maritime Boreal group from the Acadian group. Zonal climax forests contain mainly balsam fir, white spruce, black spruce, red maple and white birch.

Refer to **Forest Ecosystem Classification for Nova Scotia (2010)** for further information. The NS FEC is available on-line at: novascotia.ca/natr/forestry/veg-types

* **AC = Acadian**
MB = Maritime Boreal

VT Code	VT Name	AC	MB
FP1	Sugar maple – White ash / Ostrich fern – Wood goldenrod	X	
FP2	Red maple – Red oak / Bellwort – Nodding trillium	X	
FP2a	(Sugar maple variant)	X	
FP3	Red maple / Sensitive fern – Rough goldenrod	X	
FP4	Balsam poplar – White spruce / Ostrich fern – Cow-parsnip	X	
FP5	Black cherry – Red maple / Rough goldenrod – Jack-in-the-pulpit	X	
FP6	White spruce / Wood goldenrod / Shaggy moss	X	
HL1	Balsam fir / Mountain-ash / Large-leaved goldenrod		X
HL1a	(White birch / Wood sorrel variant)		X
HL2	White spruce / Wood aster		X
HL3	Yellow birch – Balsam fir / Eastern spreading wood fern – Wood sorrel		X
HL4	Birch / Wood fern – Wood sorrel		X
IH1	Large-tooth aspen / Lambkill / Bracken	X	
IH1a	(Red oak variant)	X	
IH2	Red oak – Red maple / Witch-hazel	X	
IH2a	(Red oak variant)	X	
IH3	Large-tooth aspen / Christmas fern – New York fern	X	
IH4	Trembling aspen / Wild raisin / Bunchberry	X	
IH5	Trembling aspen – White ash / Beaked hazelnut / Christmas fern	X	
IH6	White birch – Red maple / Sarsaparilla – Bracken	X	
IH6a	(Aspen variant)	X	
IH7	Red maple / Hay-scented fern – Wood sorrel	X	
KA1	Hemlock / Christmas fern – White lettuce – Wood goldenrod	X	
KA2	Sugar maple / Christmas fern – Rattlesnake fern – Bulblet bladder fern	X	
MW1	Red spruce – Yellow birch / Evergreen wood fern	X	
MW2	Red spruce – Red maple – White birch / Goldthread	X	
MW2a	(Aspen variant)	X	
MW3	Hemlock – Yellow birch / Evergreen wood fern	X	
MW4	Balsam fir – Red maple / Wood sorrel – Goldthread	X	
MW5	White birch – Balsam fir / Starflower	X	
OF1	White spruce / Aster – Goldenrod / Shaggy moss	X	X
OF2	Tamarack / Speckled alder / Rough goldenrod / Shaggy moss	X	X
OF3	White pine – Balsam fir / Shinleaf – Pine-sap	X	
OF4	Balsam fir – White spruce / Evergreen wood fern – Wood aster	X	X

VT Code	VT Name	AC	MB
OF5	Trembling aspen – Grey birch / Rough goldenrod – Strawberry	X	
OW1	Jack pine / Huckleberry / Black crowberry / Reindeer lichen	X	X
OW2	Black spruce / Lambkill / Reindeer lichen	X	X
OW3	Red spruce / Red-berried elder / Rock polypody	X	
OW4	Red pine – White pine / Broom crowberry / Grey reindeer lichen	X	
OW5	Red oak / Huckleberry / Cow-wheat – Rice grass / Reindeer lichen	X	
OW6	White birch – Red oak – White ash / Marginal wood fern – Herb-Robert	X	
SH1	Hemlock / Pin cushion moss / Needle carpet	X	
SH2	Hemlock – White pine / Sarsaparilla	X	
SH3	Red spruce – Hemlock / Wild lily-of-the-valley	X	
SH4	Red spruce – White pine / Lambkill / Bracken	X	
SH4a	(Red spruce variant)	X	
SH5	Red spruce – Balsam fir / Schreber's moss	X	
SH6	Red spruce – Balsam fir / Stair-step moss – Sphagnum	X	
SH7	White spruce – Red spruce / Blueberry / Schreber's moss	X	
SH8	Balsam fir / Wood fern / Schreber's moss	X	
SH9	Balsam fir – Black spruce / Blueberry	X	
SH10	White spruce – Balsam fir / Broom moss	X	
SP1	Jack pine / Bracken – Teaberry	X	X
SP1a	(Black spruce variant)	X	X
SP2	Red pine / Blueberry / Bracken	X	
SP2a	(Black spruce variant)	X	
SP3	Red pine – White pine / Bracken – Mayflower	X	
SP3a	(Black spruce variant)	X	
SP4	White pine / Blueberry / Bracken	X	X
SP4a	(Black spruce variant)	X	X
SP4b	(Huckleberry variant)	X	X
SP5	Black spruce / Lambkill / Bracken	X	X
SP6	Black spruce – Red maple / Bracken – Sarsaparilla	X	X
SP7	Black spruce / False holly / Ladies' tresses sphagnum	X	X
SP8	Black spruce – Aspen / Bracken – Sarsaparilla	X	
SP9	Red oak – White pine / Teaberry	X	
SP10	Tamarack / Wild raisin / Schreber's moss	X	
TH1	Sugar maple / Hay-scented fern	X	

VT Code	VT Name	AC	MB
TH1a	(Beech variant)	X	
TH1b	(Yellow birch variant)	X	
TH2	Sugar maple / New York fern – Northern beech fern	X	
TH2a	(Yellow birch variant)	X	
TH3	Sugar maple – White ash / Christmas fern	X	
TH4	Sugar maple – White ash / Silvery spleenwort – Baneberry	X	
TH5	Beech / Sarsaparllla / Leaf litter	X	
TH6	Red oak – Yellow birch / Striped maple	X	
TH7	Yellow birch – White birch / Evergreen wood fern	X	
TH8	Red maple – Yellow birch / Striped maple	X	
TH8a	(White ash variant)	X	
WC1	Black spruce / Cinnamon fern / Sphagnum	X	X
WC2	Black spruce / Lambkill – Labrador tea / Sphagnum	X	X
WC2a	(Huckleberry – Inkberry variant)	X	X
WC3	Jack pine – Black spruce / Rhodora / Sphagnum	X	X
WC3a	(Black spruce variant)	X	X
WC4	Red pine – Black spruce / Huckleberry – Rhodora / Sphagnum	X	
WC5	Red spruce – Balsam fir / Cinnamon fern / Sphagnum	X	X
WC6	Balsam fir / Cinnamon fern – Three seeded sedge / Sphagnum	X	X
WC7	Tamarack – Black spruce / Lambkill / Sphagnum	X	X
WC7a	(Huckleberry – Inkberry variant)	X	X
WC8	Hemlock / Cinnamon fern – Sensitive fern / Sphagnum	X	
WD1	White ash / Sensitive fern – Christmas fern	X	
WD2	Red maple / Cinnamon fern / Sphagnum	X	X
WD3	Red maple / Sensitive fern – Lady fern / Sphagnum	X	X
WD4	Red maple / Poison ivy / Sphagnum	X	X
WD4a	(Huckleberry – Inkberry variant)	X	X
WD5	Trembling aspen / Beaked hazelnut / Interrupted fern / Sphagnum	X	
WD6	Red maple – Balsam fir / Wood aster / Sphagnum	X	X
WD7	Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum	X	
WD8	Red spruce – Red maple / Wood sorrel – Sensitive fern / Sphagnum	X	

Appendix 3
Glossary

A

Abiotic – describing the non-living components of the planet (ecosystem) such as soils, rocks, water, air, light, and nutrients (Dunster and Dunster 1996)

Acadian Forest – broadly defined as that area where red spruce is characteristic, along with eastern hemlock, eastern white pine, sugar maple, yellow birch, and beech

Acadian ecosite group - See pages 22, 23.

Acid soils – soils that have an inherently low pH and low nutrient content due to the nature of the parent materials they are derived from

Advanced regeneration – trees of variable age found in the understory shrub layer which are in a position to grow into the canopy when overstory competition has been removed by disturbance or natural mortality

Aeolian – See **Parent material**.

Alluvium – See **Parent material**.

Alpine – an area where trees are excluded by extreme climatic conditions found at higher elevation. See also **Subalpine**.

Aspect – the direction of a downhill slope expressed in degrees or as a compass point

Atlantic Coastal Plain Flora (ACPF) – a group of 90 species of taxonomically unrelated wetland plants that inhabit lake and river shores, bogs, fens and estuaries and which are found primarily in southwestern Nova Scotia. The distribution of this group of plants extends down the eastern coast of the USA with isolated populations in Nova Scotia and along the Great Lakes.

Azonal – the opposite of zonal. Also see **Edaphic**.

B

Barrachois ponds – See page 221.

Barrens – See **Heathlands**.

Barrier beaches – See **Beaches**.

Beaches – wave-dominated deposits composed of a mixture of sand, gravel and other sizes of sediments. Sand beaches often contain a significant gravel element at the higher levels. Very large particles in the boulder/cobble range are generally found close to their source, usually an eroding glacial-till cliff. (Davis and Browne 1996).

Barrier beach – a narrow, elongate sand ridge rising slightly above the high-tide level and extending generally parallel with the shoreline, but separated from it by a brackish pond (lagoon) or marsh. Rising sea level forces a landward retreat of barrier beaches due to erosion of the beach and the adjacent headlands which anchor the extremities of the barrier beaches. As a result of this continuing landward migration, all these beaches undergo a constant cycle of erosion, failure and rebuilding.

Spit – Spits are created by the movement of sediments along the shore by waves and/or tidal currents. At points where there is an abrupt change of shoreline orientation or the currents diminish, sediment is deposited. Beaches on spits are uncommon although one of the best is at St. Anns Bay (Englishtown) (Davis and Browne 1996).

Bedrock – Solid rock that underlies gravel, soil, or other surficial material. Also, see **Parent material**.

Bioclimatic affinities – the close relationship between particular biodiversity components and climatic factors or regions. Some species and ecosystems have affinity to regions characterized on the basis of both climate and component biodiversity.

Biodiversity – the variety and interconnectedness of all life, including plants, animals, and other organisms, the genes they contain, and the systems and processes that link them

Biogeographic – relating to the spatial distribution of biodiversity across **Ecological Land Classification** or jurisdictional (county, provincial, etc.) units

Biogeographic pattern – repeating or well defined patterns in the spatial distribution of biodiversity across **Ecological Land Classification** or jurisdictional (county, provincial, etc.) units

Biophysical – the physical and biological components of the environment

Biotic – pertaining to life (Cauboue et al. 1996). Any living aspect of the planet (ecosystem) (Dunster and Dunster 1996)

Bog – a type of wetland characterized by the accumulation of Sphagnum moss as peat. The bog surface, which is raised or level (flat) with the surrounding terrain, is virtually unaffected by surface runoff or groundwater from the surrounding terrain. Generally the water table is at or slightly below the bog surface. Precipitation, fog, and snow melt are the primary water sources (ombrotrophic). Bogs may be treed (black spruce and tamarack) or treeless (open).

Boreal forest – a large region characterized by a distinctly cold climate and mostly coniferous tree species such as balsam fir, jack pine, white and black spruce (in Canada)

Boreal–like – forest vegetation that shares many characteristics with boreal forests but lacks key diagnostic features (e.g. understory plants or successional stages). For example, some black spruce forest vegetation types are dominated by a boreal tree (i.e. black spruce) but have temperate species in their understories.

Boreal oceanic – a cold, humid ocean region. Some species and ecosystems are affiliated with such environments.

Brackish – water with a salt content between that of fresh and sea water

Brunisol – soils that have sufficient development to be excluded as a Regosol, but lack the degree or kind of horizon development specified for other soil groups (Cauboue et al. 1996). See **Soil horizon** and **Regosol**.

Bryophytes – mosses, hornworts and liverworts

C

Canopy – the uppermost continuous layer of branches and foliage in a stand of trees

Cemented soils – See **Fragipan** and **Ortstein**.

Climatic climax forest – See **Zonal climax forest**.

Climax forest association – a relatively stable and self-perpetuating community condition which maintains itself (more or less) until stand–level disturbance causes a return to an earlier successional stage.

Coarse woody debris – typically sound or rotting logs, stumps, or large branches that are laying horizontally at 45 degrees or less.

Co–dominant – See **Crown class**.

Coarse soils – See **Soil texture**.

Colluvium – See **Parent material**.

Covertype – refers to the relative percentage of softwood versus hardwood species in the overstory of a stand.

Softwood Overstory – coverage of softwood species is 75% or more.

Hardwood Overstory – coverage of hardwood species is 75% or more.

Mixedwood Overstory coverage of softwood and hardwood species is between 25% and 75%.

Crown class – groups of trees in a forest with crowns of similar development and occupying a similar position in the canopy (Dunster and Dunster 1996). Three crown classes are defined:

Dominant – trees with crowns extending above the general level of the main canopy, receiving full light from above and partial light from the sides

Co–dominant – trees with crowns forming the general level of the main canopy, receiving full light from above and comparatively little light from the sides

Intermediate – trees with crowns extending into the lower portion of the main canopy, but shorter in height than co-dominants. These trees receive little direct light from above and none from the sides.

D

Disturbance – a discreet force that causes significant change in structure and/or composition of a forest (Dunster and Dunster 1996). Also see **Natural disturbance**.

Dominant – See **Crown class**.

Drumlin – an elongated, oval hill composed of glacial till, built under the margin of a glacier and shaped by its flow. The long axis of the hill is parallel to the direction of ice flow (Donohoe and Grantham 1989).

Duff layer – See **Forest floor**.

Dykeland – areas converted from salt marsh through drainage ditches and dykes

E

Ecoclimatic – climate as an ecological factor

Ecodistrict – a subdivision of ecoregion and the third level within the Nova Scotia ecological land classification system. It is based on distinct assemblages of relief, geology and landform. See pages 15, 19.

Ecological – relating to or concerned with the relation of living organisms to one another and to their physical surroundings

Ecological land classification (ELC) – a classification of lands from an ecological perspective based on factors such as climate, physiography and site conditions. ELC is a framework used to delineate ecosystems at different landscape scales and includes five levels: **ecozone**, **ecoregion**, **ecodistrict**, **ecosection** and **ecosite**.

Ecoregion – the second level in the Nova Scotia **ecological land classification** system used to characterize a distinctive regional climate as expressed by vegetation. There are nine ecoregions identified in Nova Scotia.

Ecosection – a subdivision of **ecodistrict** and the fourth level in the Nova Scotia **ecological land classification** system. It is based on enduring physical features: **soil drainage**, **soil texture**, topographic pattern and sometimes landform. See pages 15, 19.

Ecosite – a unit that represent **ecosystems** that have developed under a variety of conditions and influences, but that have similar moisture and nutrient regimes. Ecosite is found in both the landscape-level **ecological land classification** and the stand-level forest ecosystem classification systems. See pages 15, 19.

Ecosite Group – represents **ecoregion** and **ecodistrict** units with similar climate conditions, which can be grouped for Forest Ecosystem Classification purposes. Two ecosite groups are identified: the **Acadian group** and **Maritime Boreal** group.

Ecosystem – a complex system of living organisms (plants, animals, fungi, and microorganisms), their environment (soil, water, air, and nutrients), and the interacting processes among them

Ecozone – this unit is the most general level of an **ecological land classification**. It is characterized by large continuous areas of similar macroclimate, physiographic and geologic features and vegetation. Nova Scotia is represented by one ecozone. See pages 15, 18.

Edaphic – refers to the influence of soil and site conditions on plant growth. In this guide, edaphic is used to express the dominance of site over climate in vegetation development.

Edaphic climax forest – results when a forest community cannot progress to the zonal climax due to local extremes in site conditions

Edatopic grid – a two-dimensional diagram used to plot ecosystems (and subsequently ecosites) with respect to their relative moisture and nutrient regimes

Endemic – native or restricted to a certain area (pertaining to plants and animals)

Ephemeral – typically used to describe things found in nature that last for brief periods of time. For example, spring ephemeral plants; ephemeral streams formed by snowmelt. See also Spring ephemerals.

Ericaceous – plants in or related to the heath family (*Ericaceae*) usually found on acidic (nutrient poor) soils including *Kalmia spp.*, *Vaccinium spp.* and *Rhododendron spp.* (Dunster and Dunster 1996)

Escarpment – a steep slope or cliff (scarp) that is usually of great lateral extent compared to its height. It can be the result of faulting, erosion or volcanic activity.

Esker – a linear to meandering ridge consisting of sorted sand and gravel deposits created by water flowing beneath a glacier (Cauboue et al. 1996)

Estuary – the lower portion of a river or stream where ocean salt water and fresh water mixing occurs. It is a semi-enclosed body of water subject to tidal conditions.

Estuarine flat – a type of wetland that can be vegetated (salt marsh) or unvegetated (mud flat or tidal flat) and is found between the open salt water of the bays and the uplands of the coast. It is alternately covered and uncovered by the tide, and consists of unconsolidated sediment (mostly mud and sand).

Evapotranspiration – the loss of water through plant transpiration and ground surface evaporation (Cauboue et al. 1996)

Even–aged – describes a forest, stand, or vegetation type in which relatively small age differences exist between individual trees

Exposure – the relative openness of a site to weather conditions, particularly wind and sun. Exposure can affect moisture conditions on a site and severely Impact the height growth of trees. Exposure is assigned using topographical features at the landscape scale and does not include conditions created by edge effect (disturbances) either natural or man-made.

F

Fault – a fracture or fracture zone along which there has been displacement parallel to the fracture. The displacement may be a few centimetres or many kilometres (Donohoe and Grantham 1989).

Fjards – See page 245–246.

Fen – a type of wetland. Fen are ground or surface water-fed peatlands saturated with water and typically dominated by sedges and Sphagnum mosses. Groundwater and surface water movement (nutrient enriched) is a common characteristic that distinguishes fens from **bogs**. The vegetation in fens is more diverse than in bogs and closely related to the depth of the water table and water chemistry.

Fibrisol – See **Organic soils**.

Fine soils – See **Soil texture**.

Floodplain – the flat or level area adjacent to a stream or river that is annually or periodically flooded and enriched by sediment

Fluvial – a general term to describe stream or river processes that involve the transport and deposition of sediment (Dunster and Dunster 1996). In this guide, fluvial refers to all flowing water deposits, regardless of age or time since deposition.

Folisol – See **Organic soils**.

Forest – sites which can (and normally do) support a minimum of 30% crown closure by trees

Forest Ecosystem Classification (FEC) – a classification of stand-level forest ecosystems based on vegetation, soil and site attributes. A FEC allows users to recognize similar ecosystem units on the ground and to develop a common understanding of these units. The classification can be used to support an ecosystem-based approach to the planning and management of forest ecosystems.

Forest floor – a general term encompassing the layer of undecomposed organic matter (leaves, twigs and plant remains in various stages of decomposition) lying on top of the mineral soil (Dunster and Dunster 1996). Often referred to as the **duff layer**.

Forest group – are groups of forest vegetation types with similar species composition, site conditions and successional pathways. They are a unit of classification in the Nova Scotia Forest Ecosystem Classification. See Appendix 2 for a complete list of Forest Groups and Vegetation Types.

Fragipan soils – soils with a loamy, subsurface horizon with high density and low organic matter that acts cemented when dry (fragic)

Frequent natural disturbance – See **Natural disturbance regime**.

Freshwater lens – it arises when rainwater seeps down through a sand (or soil) surface and then gathers over a layer of seawater

G

Gap disturbance – See **Natural disturbance regime**.

Glacial till – See **Parent material**.

Glaciofluvial – See **Parent material**.

Gleyed – a soil condition achieved when soils are under water saturation and prolonged anaerobic conditions. It is a condition generally associated with high water tables or saturation over a relatively impermeable layer (Cauboue et al. 1996).

Gleysol – 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. (Cauboue et al. 1996).

Graben – a portion of the Earth's crust bounded on at least two sides by faults that have dropped downward in relation to adjacent portions.

Ground water – that part of subsurface water that is in the zone of saturation, including underground streams (AGI 1984).

H

Hardwood – See **Covertype**.

Heathlands (barrens) – a type of shrubland ecosystem characterized by acidic soils, well to moderate drainage, and vegetation dominated by plants from the heath (*Ericacaea*) family. In Nova Scotia, they are often called barrens.

Humisol – See **Organic soils**.

Hummocky – a series of small rounded hills with a gentle slope usually 15% or less. See page 21 for more information on topographic patterns.

Humus form – a system for describing and classifying organic (forest floor) horizons. Common humus forms include (derived from Green et al. 1993):

Mor – Organic horizons (generally derived from acidic plant material) which have decomposition and horizon features dominated by fungal processes. There is no mixing of organic material into surface mineral soil.

Moder – Similar to mor humus forms in appearance, but more zoologically active (less fungi). There is only minor (if any) mixing of organic material into surface mineral soil.

Mull – Humus form with high zoological activity characterized by significant incorporation of humus into surface mineral soil forming an Ah horizon.

Hybrid spruce – in Nova Scotia, a natural cross between red spruce and black spruce displaying features of both.

Hydric soil – a soil that has formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils are generally associated with wetlands.

Hydrophytic – preferring wet growing conditions, i.e. a plant that grows in water or wet (poorly drained) soils.

I

Imperfectly drained – See **Soil drainage class**.

Infrequent natural disturbance – see **Natural disturbance regime**.

Igneous rock – rock formed by cooling and crystallization from a molten or partially molten state. Major varieties include plutonic and volcanic (Dunster and Dunster 1996).

Intermediate – in reference to shade tolerance, a condition between intolerant and tolerant. (Also, see Crown class.)

Intertidal zone – is the area that is above water at low tide and under water at high tide

Intolerant – refers to shade tolerance and defines a condition whereby trees are not capable of successfully growing beneath the shading canopy of other or similar species.

Intrusion – coarse-grained, igneous rock that was intruded (forced) into pre-existing rock. See also **Plutonic rocks**.

K

Kames – a conical hill or irregular ridge of sand and gravel that was deposited (meltwater-transported) in contact with glacier ice (Cauboue et al. 1996).

Karst – Karst is a rugged and irregular type of landform with distinctive hydrological and geological processes, and unique topography. It arises from the dissolution (dissolving) of water soluble rocks like gypsum, limestone, and dolomite. Karst is characterized by caves and chambers, conical depressions (sinkholes), crumbling cliffs and pinnacles, vertical shafts, disappearing streams, and by underground aquifers and springs.

Krummholz – vegetation (usually dominated by trees) stunted by harsh climatic influences, such as wind and cold temperatures. It is common at higher elevations and along more exposed coastlines. Krummholz can occur on a variety of soil moisture and nutrient regimes (ecosites).

L

Lacustrine – See **Parent material**.

Landscape – an expanse of land with landforms, land cover, habitats, and natural features which are repeated in similar form and that, taken together, form a composite (Dunster and Dunster 1996)

Land system – an area of land having a reoccurring pattern of landforms, soils and hence vegetation. The area of a system is variable and depends on the complexity of terrain conditions.

Land systems are defined by the following criteria: topographic pattern, slope class, relief class, landform, soil drainage class, soil texture class, surface stoniness, parent rock type, bedrock exposure.

Layering – a form of vegetative reproduction where a branch buried in the forest floor develops roots and becomes independent of the parent tree (Dunster and Dunster 1996)

Les suêtes – See pages 74, 75.

Lithology – physical characteristics related to bedrock

Luvisol – soil that is characterized by a soil horizon from which minerals have been leached and having B horizons in which silicate clay has accumulated (Cauboue et al. 1996). See **Soil horizon**.

M

Mafic – pertaining to a rock rich in magnesium and iron-bearing minerals (Donohoe and Grantham 1989). For example, igneous rocks such as basalt and gabbro, are referred to as mafic.

Marine – See **Parent material**.

Maritime boreal forest – a region or ecosystem that is characterized by cold humid oceanic conditions. Vegetation found in these areas may be boreal or cold temperate.

Marshes – a shallow-water wetland with water levels that fluctuate daily, seasonally or annually, occasionally drying up and exposing sediments. Marshes receive their water from the surrounding watershed as surface runoff, stream inflow, precipitation, storm surges, groundwater discharge, and tidal action (salt marshes). High nutrient levels give rise to high vascular plant activity and high decomposition rates at the end of the growing season. Most marshes usually accumulate little organic matter, but wetter more stable and permanently saturated marshes can accumulate organic depths around 50 cm. Emergent aquatic plants such as rushes, reeds, grasses and sedges, floating and submerged aquatic plants, and other plants such as mosses, liverworts, and macroscopic algae are typical of marshes.

Matrix forest – a widespread forest community which dominates the landscape and forms the background in which other smaller scale communities (patches) occur (Thompson 2002).

Medium soils – See **Soil texture**.

Mesic – describes sites with average moisture conditions for a given climate (Cauboue et al. 1996)

Mesisol – See **Organic soils**.

Mesoclimatic – localized modification of the climate due to slope (exposed to sheltered) and aspect

Metamorphic rock - rock forms derived from existing rocks, but differing from them due to natural geological forces, such as heat and pressure. The original materials could be igneous, sedimentary, or other metamorphic rocks, but the new metamorphic rocks have different physical, chemical, and mineralogical properties (Dunster and Dunster 1996).

Microtopography – the expression of mound and pit surface terrain within a forest stand—the main cause being the uprooting and subsequent decay of trees

Mixedwood – See **Covertype**.

Moder – See **Humus form**.

Moderately Well drained – See **Soil drainage class**.

Moisture regime – represents average moisture in the soil available for plant growth. It is assessed by integrating moisture supply (as related to climate) with soil drainage and moisture holding capacities.

Moose meadows – See page 53.

Mor – See **Humus form**.

Mud flat – See **Estuarine flat**.

Mull – See **Humus form**.

N

Natural disturbance – a natural force that causes significant change in forest stand structure and/or composition (e.g. fire, wind, flood, insect damage or disease)

Natural disturbance regime – the frequency and type of natural disturbances that influence the arrangement of forested ecosystems and their biodiversity on a given landscape. Three disturbance regimes recognized in Nova Scotia are:

Frequent – disturbances that result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even-age. The time interval between stand initiating events typically occurs more frequently than the longevity of the climax species that would occupy the site—therefore, evidence of gap dynamics and understory recruitment is usually absent. This regime results in the establishment and perpetuation of early to mid successional vegetation types.

Infrequent – stand initiating disturbances that result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even-age but the time interval between disturbance events is normally longer than the average longevity of the dominant species, thereby allowing gap dynamics and understory recruitment to evolve and become evident (eventually creating uneven-aged stands). This regime generally leads to the establishment and/or perpetuation of mid to late successional vegetation types.

Gap replacement – stand initiating disturbances are rare. Instead, disturbances are characterized by gap and small patch mortality, followed by understory recruitment, resulting in stands with multiple age classes. This regime generally leads to the establishment and/or perpetuation of late successional vegetation types.

Nutrient regime – the relative availability of nutrients in the soil for plant growth. Determination of nutrient regime requires consideration and integration of several environmental features including forest floor humus form, soil type, seepage class, and ground water characteristics.

O

Old growth – climax forests in the late stage of natural succession, the shifting mosaic phase, marked by mature canopy processes of gap formation and recruitment from a developed understory. Typical characteristics include a multi-layered canopy of climax species containing large old trees, decadent wolf trees and abundant snags and coarse woody debris. In Nova Scotia stands older than 125 years are classed as old growth.

Ombrotrophic – See **Bogs.**

Open woodland – upland sites where natural disturbances (e.g. frequent fires) and/or site conditions (e.g. sandy soils, excessive surface stoniness, bedrock exposures) generally limit the establishment of trees to less than 30% crown closure

Organic – a substance derived from living organisms or their products (Dunster and Dunster 1996). Also see Parent material.

Organic soils – are divided into four great groups. Three of these (Fibrisols, Mesisols, Humisols) represent organic soils from hydrophytic vegetation (wetland) and are separated on the basis of degree of decomposition of the organic matter. These soils are commonly saturated throughout the year. The fourth (Folisols) represents organic soils formed in upland organic materials and are soils that are only briefly saturated with water. (SCWG 1998)

Organic/Bedrock – See **Parent material**.

Ortstein soils – soils with naturally cemented B horizons that restrict rooting depth and/or drainage. Ortstein soils are usually associated with well to rapidly drained, coarse textured, acid soils. Cementation is mainly from concentrated iron oxide minerals leached from the A horizon above.

Outwash - materials washed from a glacier by flowing water and laid down as stratified sorted beds of sand and/or gravel (Cauboue et al. 1996)

Overstory – trees that occupy the dominant, co-dominant and intermediate canopy positions. Also, see **Crown class**.

P

Parabolic dune – in Nova Scotia, parabolic dunes are only found on Sable Island. They are "U" shaped dunes formed when strong winds eliminate vegetation and create a blow-out or hollow through the side of a foredune (the first linear dune along a beach). Over time, sand movement in the hollow creates a curved ridge, which advances landward, with trailing arms anchored by remnant vegetation.

Parent material – the unconsolidated and more or less chemically unweathered material from which a soil develops by soil formation (pedogenic) processes (Cauboue et al. 1996). Parent material types found in Nova Scotia include (adapted from ECSS 1983):

Aeolian – material deposited by wind action. Aeolian deposits are usually high in silt and/or fine sand and may show internal structures such as cross-bedding.

Alluvium – sediments deposited by streams and rivers (floodplains, deltas, etc.). These deposits are younger than glacial deposits and may or may not contain rock (gravel/cobbles).

Colluvium – deposits of sand, silt, clay, organic matter and/or rock that have reached their position by gravity-induced movement.

Glacial Till – unstratified deposits of sand, silt, clay and rock that have been released from glacier ice. Some glacial deposits also have recognizable landform features such as drumlins.

Glaciofluvial – deposits which were partly or wholly stratified by glacial meltwater. Glaciofluvial deposits are often high in sand and/or gravel.

Lacustrine – sediments deposited in quiet waters (lakes and ponds) which may or may not have been directly associated with glaciers. These deposits tend to be high in silt and clay and generally do not contain rock.

Marine – sediments deposited in salt or brackish water or through shoreline processes. Marine deposits are generally stratified, of variable texture, and may contain shells and gravel.

Organic – built-up plant debris that does not easily decompose because of high moisture and low soil temperatures

Organic/Bedrock – combination of upland organic over weathered, near-surface bedrock

Till/Bedrock – combination of thin glacial till over weathered, near-surface bedrock

Patch forest – a discrete forest community nested within a matrix forest. Both large and small patches are associated with ecological processes or environmental conditions, but small patches usually have several processes and conditions come together in a very precise way (Thompson 2002).

Peatlands – a type of wetland featuring poor drainage; water at or near the surface for most of the growing season; at least 40 cm of organic matter; and vegetation composed of hydrophytic plants (saturation-tolerant). See **Bogs** and **Fens**.

Peneplain – a rugged area that was high at one time, but has since been eroded to a low, gently rolling surface resembling a plain (Cauboue et al. 1996)

Perched water table – a water table that is 'perched' or elevated above a layer or lens of Impermeable soil such as clay (Dunster and Dunster 1996)

Physiographic – refers to landscape level relief, structural geology and elevation

Pit and mound – See **Microtopography**.

Plutonic rocks – coarse-grained rocks, usually of igneous origin, that have formed deep within the Earth, but may also include the associated metamorphic rocks (Dunster and Dunster 1996). The principal plutonic rocks are granite, diorite and gabbro. See also **Intrusion**.

Pocket beaches – a small beach, often found enclosed at the back of a rounded cove

Podzol – soil that is characterized by a soil horizon (from which minerals have been leached) and where these minerals (iron, aluminum and/or organic carbon) have accumulated in the B horizon (Cauboue et al. 1996). See **Soil horizon**.

Poorly drained – See **Soil drainage class**.

Prograding dune – See page 141–142.

R

Rapid drainage – See **Soil drainage class**.

Redox features – visible evidence of chemical (reduction-oxidation) reactions in microbially active soils under prolonged anaerobic conditions (Richardson and Vepraskas 2001)

Regosol – soils characterized by minimal profile differentiation due to youthfulness of the site or cold climate (Cauboue et al. 1996)

Riparian – the terrain, vegetation, or simply position adjacent to or associated with a stream, floodplain, or standing waterbody (Cauboue et al. 1996)

Rockiness – the surface area with exposed bedrock

S

Salt marshes – a type of wetland that is flooded regularly by tidal water, or influenced by salt spray or seepage, such that the water and/or soil is saline or brackish. Tidal channels and/or ponds may be present. Salt-water cordgrass (*Spartina alternifolia)* and other saline tolerant grasses and sedges often dominate low marshes, which are flooded regularly. High marshes are often flooded only during extreme tides and are typically dominated by salt meadow cordgrass (*Spartina patens)*.

Scarp – See **Escarpment**.

Sedimentary rock – rock formed from materials deposited from suspension or precipitated from solution and usually consolidated. The principal sedimentary rocks are sandstones, shales limestones, gypsum, and conglomerates (Dunster and Dunster 1996).

Seepage – lateral subsurface water flow (includes precipitation and spring sources)

Senescence – generally, the process of aging in mature individuals (trees), typical toward the end of an organism's life (Dunster and Dunster 1996)

Sheltered – locations on the landscape which are afforded some wind protection from one or more directions. It is best illustrated by lower slopes of deep valleys where protection is provided on all sides. See also **Exposure**.

Shrubland – a vegetated land cover type dominated by woody shrub species and/or by trees severely stunted by limiting site conditions. Examples include stands dominated by alders, willows, ericaceous species, and/or other woody shrubs.

Sinkhole – a funnel-shaped depression common in karst topography caused by the dissolving of underlying limestone or gypsum bedrock

Slacks – a low lying are between dune ridges or domes, usually characterized by moist to wet soils and related vegetation

Slope Gradient – describes the percentage of vertical rise relative to horizontal distance. Zero percent slope describes a level site and 100% slope equates to a 45 degree angle.

Slope classes are:	**Level** 0-3%	**Gentle** 4-15%
Moderate 16-30%	**Steep** 31-60%	**Extreme** >60%.

Slope Position – the relative topographic position of a site within the landscape. Position classes include; crest, upper, middle, lower, toe, depression and level.

Softwood – See **Covertype**.

Soil drainage class – soil drainage reflects the length of time it takes water to be removed from a soil in relation to supply

Rapid – Water is removed from the soil rapidly in relation to supply.

Well – Water is removed from the soil readily, but not rapidly.

Moderately Well – Water is removed from the soil somewhat slowly in relation to supply.

Imperfect – Water is removed from the soil sufficiently slowly In relation to supply to keep the soil wet for a significant part of the growing season.

Poorly – Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time (when not frozen).

Very Poor – Water is removed from the soil so slowly that the water table remains at or near the surface for the greater part of the time (when the soil is not frozen).

Soil horizon – a layer or zone of soil or soil materials lying approximately parallel to the land surface with physical, chemical, and biological properties or characteristics that are distinct from the adjacent, genetically related layers (Dunster and Dunster 1996).

A horizon — a mineral soil horizon formed at or near the surface of the soil, generally immediately beneath the forest floor. It is usually formed by (derived from SCWG 1998):

- leaching or loss of iron and aluminum, clay and organic matter to form an Ae horizon
- natural accumulation of partially decomposed organic matter to form an Ah horizon
- a combination of leaching and natural organic matter accumulation to form an Ahe horizon

B horizon — a mineral soil horizon characterized by enrichment of material lost from the A horizon above and/or through transformations (chemical reactions) within the horizon itself (derived from SCWG 1998)

C horizon — a mineral soil horizon relatively unaffected by the formation processes active in the A and B horizons above (derived from SCWG 1998)

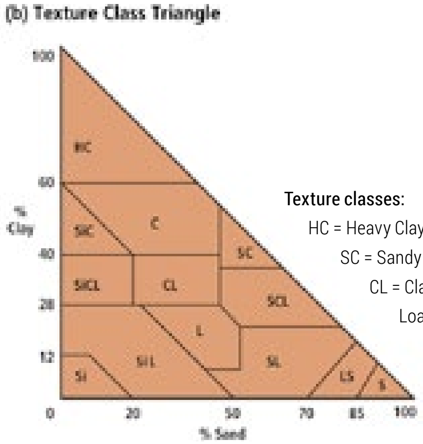
Soil texture – the percentage of sand, silt and clay in a soil. In general, fine textured soils are relatively high in clay, medium textured soils are relatively high in silt, and coarse textured soils are relatively high in sand. The soil texture triangle shows relative clay and sand percentages by class unit (% silt is inferred by knowing other values).

Soil types – are soils differentiated based on texture, drainage, fertility and depth; all of which influence site productivity and other natural resource management Interpretations

Texture class triangle

The figure shows relative clay and sand percentages by class unit (% silt is inferred by knowing other values). In general, fine textured soils are higher in clay, medium textured soils are higher in silt, and coarse textured soils are higher in sand.

(b) Texture Class Triangle



Texture classes:
HC = Heavy Clay, SiC = Silty Clay, C = Clay, SC = Sandy Clay, SiCL = Silty Clay Loam, CL = Clay Loam, SCL = Sandy Clay Loam, Si = Silt, SiL = Silt Loam, L = Loam, SL = Sandy Loam, LS = Loamy Sand, S = Sand

Sparsely vegetated – a land cover type used to map upland areas with sparse (usually less than 10% plant cover) vegetation cover, or those upland areas that are naturally devoid of vegetation. Examples include: coastal beaches, dunes, talus and cliffs.

Spits – See **Beaches**.

Spring ephemerals – any of various species of wildflowers (e.g. spring beauty, dog tooth violet, Dutchman's breeches), that bloom in the early spring for only a few weeks and then quickly die-back.

Stand – in the case of forests, a group of trees in a specific area that are sufficiently uniform in composition, age, arrangement and condition to be distinguishable from adjacent forest areas (Dunster and Dunster 1996)

Stoniness – refers to the presence of exposed stones and boulders (minimum 25 cm in diameter or length)

Subalpine – an area where tree growth is stunted by extreme climatic conditions found at higher elevations. The term **Krummholz** is often used to describe stands of trees in these environments (or similar coastal environments). Subalpine conditions are usually downslope from alpine conditions.

Subarctic – a region with conditions transitional between boreal and arctic ecosystems and climate. The term is sometimes used to characterize species and ecosystems with affinities to this region of Canada.

Succession – an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable (Odum 1971).

Successional development – plant community development that proceeds through a number of distinct successional stages (e.g. early, middle, late). The stages replace one another in a predictable sequence.

Super canopy – a canopy position above the normal overstory/canopy layer

Supratidal zone – the area above the usual high tide mark on coastlines and estuaries, that may be splashed but is not submerged by ocean water

Swamp – a treed or tall shrub dominated wetland that is influenced by ground water, either on mineral or organic soils and water tables typically at or below the surface. They may be seasonally flooded and are generally not as wet as **marshes**, **fens** and open **bogs**. They are common along portions of floodplains and riparian areas of rivers and streams. In shrub swamps, shrubs occupy more than half of the habitat, with sedges as the typical ground cover. Grasses, sedges or rushes commonly occupy open areas. In wooded swamps, trees dominate, but there are usually several other levels of vegetation, including shrubs, ferns and a variety of herbaceous plants.

T

Talus – a form of colluvium deposit, characterized by excessive surface stoniness, usually found at the base of steep slopes or cliffs (Dunster and Dunster 1996)

Talus slopes – a slope of about 35 degrees (the natural angle of rest for non-cohesive rock fragments) and underlain by talus (Dunster and Dunster 1996)

Temperate – having a climate intermediate between tropical and polar; moderate or mild in temperature; having four seasons. An area south of the boreal region characterized by southern species (especially trees) and climatic conditions

Terraces – relatively level benches that are created and occur adjacent to streams or rivers. These features are formed during a period of fluvial stability followed by a period of downcutting by a stream (Cauboue et al. 1996).

Tidal flat – See **Estuarine flat**.

Till/Bedrock – See **Parent material**.

Tolerant – refers to shade tolerance and defines a condition whereby trees are capable of successful growth and reproduction beneath the shading canopy of other or similar species

Tombolo dunes – a dune found on a tombolo (a landform composed of an island connected to the mainland by a narrow extension, often a beach).

U

Understory – refers to vegetation growing below the overstory grouped into three categories:

Shrub layer: Woody stemmed species and regenerating trees usually less than 2 m in height, but occasionally taller

Herb layer: Dwarf woody plants plus ferns, club-mosses and other herbaceous plants

Bryophytes and Lichens: Mosses, hornworts, liverworts and lichens

Uneven–aged – describes a forest, stand, or vegetation type in which intermingling trees differ markedly in age

Upland - an area that is not a wetland. See **Wetland.**

V

Volcanic rock – rocks that have formed from the deep-seated, igneous processes causing magma and its associated gases to rise up through the Earth's crust and be extruded onto the surface and into the atmosphere, sometimes with great force and violence (Dunster and Dunster 1996). The principal volcanic rocks are basalt, andesite and rhyolite.

Vegetation Type – recurring and identifiable forest plant communities that reflect differences in site conditions, disturbance regimes and/or successional stage. They are a unit of classification in the Nova Scotia Forest Ecosystem Classification. See Appendix 2 for a complete list of Vegetation Types.

Vernal Pool – a seasonal body of standing water that typically forms in the spring from melting snow and other runoff, dries out in the hotter months of summer, and often refills in the autumn

Very poorly drained – See **Soil drainage class**.

W

Wave forest – a wave-like pattern of dead and living trees found on highly exposed sites. It is created by wind damage and subsequent mortality.

Well drained – See **Soil drainage class**.

Wetland – land that either periodically or permanently has a water table at, near or above the land's surface, or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions. This includes **swamps**, **fens**, **marshes** and **bogs**.

Windthrow – a disturbance where a tree (or trees) has been uprooted by the wind. Over time, windthrow leads to the development of mound and pit microtopography. Windthrow is synonymous with blowdown.

Woodland – See **Open woodland**.

Z

Zonal climax forest – results when a forest community reflects regional climate norms and is not unduly affected by local extremes in soil and site conditions

Zonal site – a site with conditions that could potentially support the establishment of a **zonal climax forest**

Appendix 4
References

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