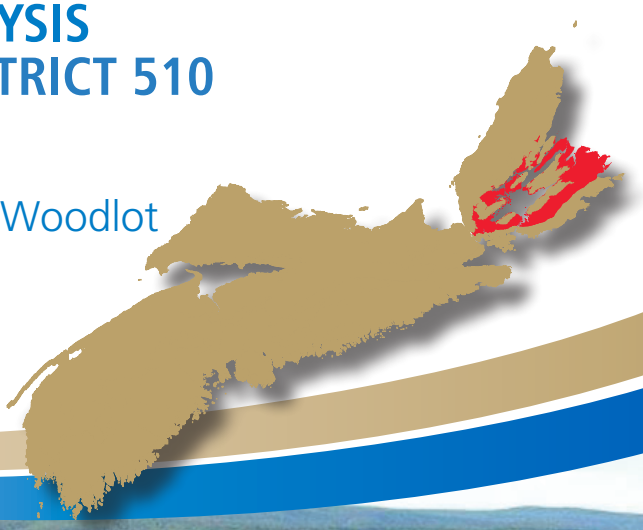
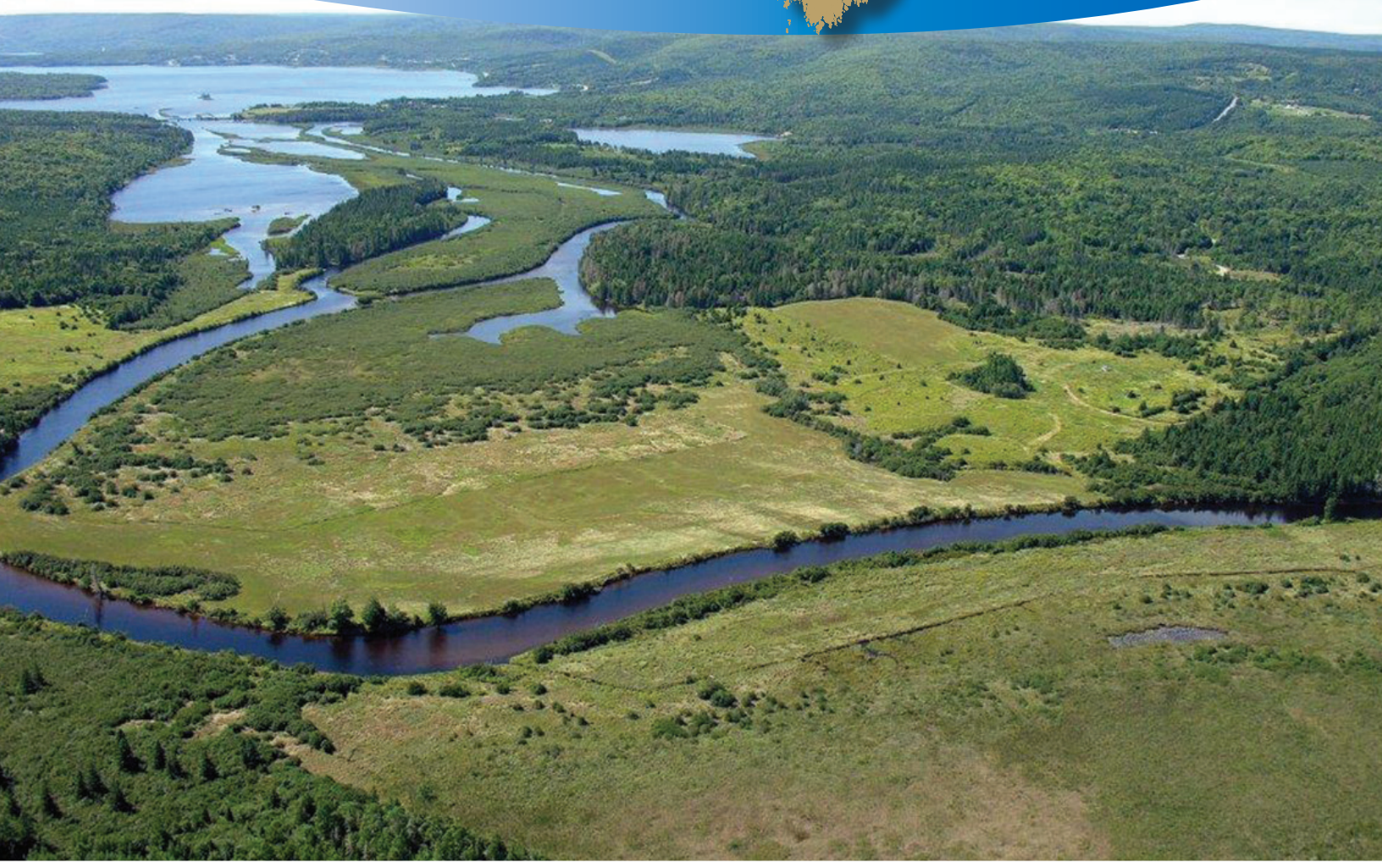
Department of Lands and Forestry

2019 Update

ECOLOGICAL LANDSCAPE ANALYSIS
BRAS D'OR LOWLANDS ECODISTRICT 510

PART 1: Overview of Ecodistrict
PART 2: Linking the Landscape to the Woodlot





ELA 2019-510

NOVA SCOTIA

Ecological Landscape Analysis, Ecodistrict 510: Bras d'Or Lowlands
2019 Update for Part 1 and 2

Prepared by the Nova Scotia Department of Lands and Forestry
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This report, one of 38 for the province, provides updated figures and tables to supplement the original Ecological Landscape Analysis documents.

Information sources and statistics (benchmark dates) include:

- Crown Lands Forest Model landbase classification (2017v.1)

Note this geodatabase includes the latest Forest Inventory Databases (FID), forest disturbance information, forest harvesting information, crown land purchases and new protected area designations. Forest harvesting, silviculture, and fire disturbance (including satellite updates) are current as of end of 2015.

As revision and peer-reviewing of Natural Disturbance Regimes mapping in Nova Scotia becomes available, any major changes will be incorporated in future updates.

Selected updated Tables and Figures

This document provides recalculated values for the following:

Table 1 (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Table 3 (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Table 5a (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Table 5b (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Development Class Targets by Elements – Only major forest elements are reported in the update. Wetlands and Valley Corridors are not reported in this update.

Table 2 was not updated as Integrated Resource Management Land Use Categories have not been updated.
Table 4 was not updated because the land capability for individual polygons has not changed since the original report. Land generally still has that same capability rating now as it did previously, regardless of any management activities at the site.

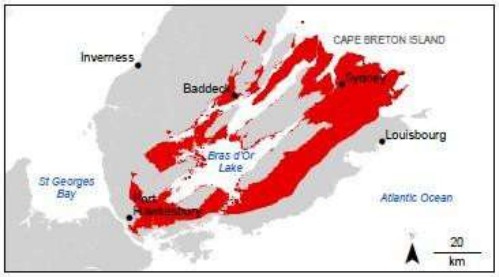
Table of Contents – Parts 1 and 2

Tables

A NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES PUBLICATION

Ecodistrict Profile

Ecological Landscape Analysis Summary
Ecodistrict 510: **Bras d'Or Lowlands**



An objective of ecosystem-based management is to manage landscapes in as close to a natural state as possible. The intent of this approach is to promote biodiversity, sustain ecological processes, and support the long-term production of goods and services. Each of the province's 38 ecodistricts is an ecological landscape with distinctive patterns of physical features. (Definitions of underlined terms are included in the print and electronic glossary.)

This Ecological Landscape Analysis (ELA) provides detailed information on the forest and timber resources of the various landscape components of Bras d'Or Lowlands Ecodistrict 510. The ELA also provides brief summaries of other land values, such as minerals, energy and geology, water resources, parks and protected areas, wildlife and wildlife habitat.

This ecodistrict occurs on Cape Breton Island and includes the lowland areas of the Bras d'Or Lake watershed, Sydney coalfield, Boularderie Island, and most of the watersheds of the Salmon and Mira rivers.

The village of Baddeck is located on the north shore of the Bras d'Or Lakes. The slopes of the Cape Breton Hills are visible in the background with Kidston Island in the foreground.

Bras d'Or Lake, an inland sea with a mixture of saltwater and freshwater, has an area of nearly 260 square kilometres in the centre of Cape Breton Island. The lake and is the signature natural feature of the ecodistrict. West Bay is a wide extension on the southwest side of the lake and East Bay is a long, tapering extension to the northeast. Bays and channels have been carved mainly from the easily erodible sediments. Thick deposits of gypsum, anhydrite – gypsum without water – and salt occur.

The Sydney coalfield contains the largest coal resource in eastern Canada. The coalfield includes the coastal area of northeastern Cape Breton and extends far out under the Atlantic Ocean toward Newfoundland.

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 Department of Natural Resources (DNR) staff. Because eagles feed mostly on fish during the nesting season, most eagle nests are located in close proximity to coastal water, though some inland waterways are also used.

The most nesting eagles of any ecodistrict in Nova Scotia are found in the Bras d'Or Lowlands Ecodistrict.

Private land ownership accounts for 73% of the ecodistrict, which has a total area of 278,997 hectares, with 20% under provincial Crown management and the remainder under other ownership.

The Bras d'Or Lowlands Ecodistrict has an abundance of parks. The DNR manages 24 properties through the provincial parks program that are either entirely or partially within the ecodistrict.

Landscapes are large areas that function as ecological systems and respond to a variety of influences. Landscapes are composed of smaller ecosystems, known as elements. These elements are described by their physical features – such as soil and landform – and ecological features – such as climax forest type. These characteristics help determine vegetation development.

Element descriptions promote an understanding of historical vegetation patterns and the effects of current disturbances. This landscape analysis identified and mapped six key landscape elements – one dominant matrix element, and five smaller patch elements – in Bras d'Or Lowlands.

The matrix **Tolerant Hardwood Drumlins and Hummocks** element, representing more than half of the ecodistrict's area, naturally supports shade-tolerant forests of long-lived species, such as sugar maple, yellow birch, and beech. The current forest has been strongly influenced by human settlement, abandonment of marginal agricultural land, considerable forestry activity, and an extensive history of fire. This has resulted in more softwood and mixedwood stands of early to mid-successional species, such as trembling aspen, red maple, grey and white birch.

Spruce Pine Hummocks is the largest patch element, representing more than one-third of the ecodistrict. Black spruce, balsam fire, white spruce, and white pine are the most common species. The other patch elements, in order of size, are **Wetlands**, **Spruce Pine Flats**, **Salt Marsh**, and **Coastal Beach**.

Forest Ecosystem Management
For Bras d'Or Lowlands Ecodistrict

The primary ecological goals of ecosystem-based management are to maintain and conserve ecosystem biodiversity, productivity, and resilience. Integration of economic, ecological, and social values within a single planning process provides opportunities for creative solutions to meet the challenges of sustainable resource management. By maintaining their integrity, ecosystems can better adapt to environmental stressors such as extended cycles of climate change, atmospheric pollution, changes in land use and vegetation cover.

This ELA provides detailed information on the resources and descriptions of various components of the landscape for Bras d'Or Lowlands Ecodistrict 510. Resources and their components include the natural elements that make up the landscape and may affect functions like connectivity – how a landscape enables or impedes movement of resources, such as water and animals – as well as conditions of forest composition, road density, and land use intensity.

Only brief summaries are presented for other land values, including minerals, energy and geology, water resources, parks and protected areas, wildlife and wildlife habitat. These summaries are included in the document to present the range of land values that must be balanced during the design stage of the land management process and are not intended to be exhaustive treatments of the respective land values. Where possible, the reader will be referred to additional sources for detailed information.

Application

The data in this ELA represent inventory based off the Forest Inventory Database (FID) current as of the end of 2015 and the Crown Land Forest Model (CLFM) current as of 2017. The update provides a reference to compare to the baseline conditions provided in the ELA 2015, which in the case of the Bras d'Or Lowlands Ecodistrict was up to 2006. These baseline measurements can be used to assess trends through comparison with present and future inventories.

The ELA supports an approach to maintaining healthy ecosystems by mimicking natural conditions. The report describes the inherent natural structure and condition of landscapes based on enduring physical features, such as elements. It goes on to show how this structure may influence ecosystem functions, such as wildlife movement and connectivity. The ELA summarizes conditions of ecosystems such as forest composition, land use intensity, and road density at the time the report was written.

Finally, the relationship between inherent structure and existing conditions is used to guide future direction. The ELA is part of an ecosystem approach that will expand to encompass other initiatives of DNR, such as The Path We Share: A Natural Resources Strategy for Nova Scotia 2011 - 2020 (http://novascotia.ca/natr/strategy/pdf/Strategy_Strategy.pdf).

The intention is to describe important ecological characteristics to consider during resource planning – the ELA is not a plan in itself.

Part 1: An Overview of Bras d'Or Lowlands – *Learning About What Makes This Ecodistrict Distinctive*

This first part of the report provides an overview of the ecodistrict for a broad readership. By reviewing several key topics, the reader will have a better understanding of the features that help give the area its character and set it apart as a distinct and unique ecodistrict.

Ecodistrict Characteristics

This ecodistrict encompasses the lowland areas around Bras d'Or Lake and the Sydney coalfield, Boularderie Island, and the Salmon River Valley on the east side of the East Bay Hills.

When compared to the climate of the surrounding uplands, this ecodistrict receives the benefit of a moderated climate due to its proximity to the large body of inland saltwater and by the shelter afforded by the surrounding uplands of the Cape Breton Hills Ecodistrict 310.

Thick deposits of gypsum, anhydrite – gypsum without water – and salt occur in the ecodistrict. The bays and channels are elongate, parallel to ridges of gypsum-dominated bedrock, with good examples of this feature near the community of Iona. Throughout the ecodistrict, cliffs of gypsum and red sandstone can be observed, especially along the shoreline of the lakes.

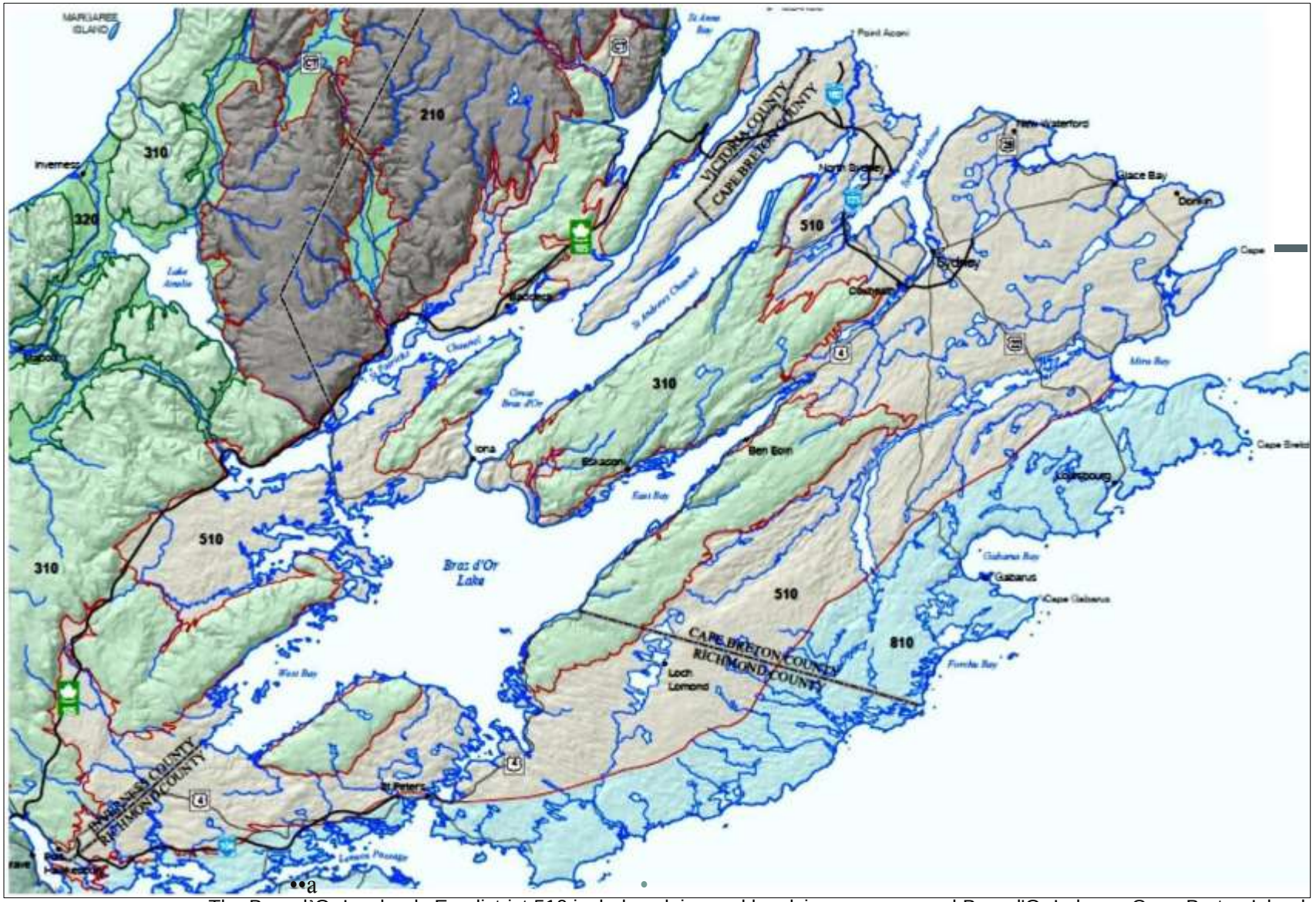
Freshwater makes up about 3% of the ecodistrict, or 5,500 hectares. The total area of this ecodistrict is 279,300 hectares, or one-third of the Northumberland / Bras d'Or Ecoregion.

Softwood covertypes currently cover just below half of the forested area and these stands are predominately made up of species composed of balsam fir, white spruce, and black spruce on the better-drained sites. On poorly drained sites, black spruce and eastern larch dominate.

Hardwood stands that are dominated by shade-tolerant hardwood species, such as yellow birch, sugar maple, beech, and scattered white ash, account for a little less than one-quarter of the forested land. Mixedwood stands account for the remaining area and generally contain species such as red maple, grey and white birch, and trembling aspen, with some yellow birch.

Much of the ecodistrict was settled in the early to mid-1800s and much of this settlement was on the tolerant hardwood sites, where the soils were better suited to farming. The poorer quality farmland began to be abandoned after World War One and this abandoned farmland reverted back to a forest of almost pure white spruce.

See map on following page for overview of the Bras d'Or Lowlands Ecodistrict, including adjacent ecodistricts, locations of area towns and villages, county boundaries, and major waterways.



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The Bras d'Or Lowlands Ecodistrict 510 includes plains and low-lying areas around Bras d'Or Lake on Cape Breton Island.
(From Ecodistricts of Nova Scotia map 2007)

Land Area

The ecodistrict is a mixture of many rural small private holdings with an industrial base in the eastern end and scattered Crown lands throughout.

Table 1 – Land Area by Ownership in the Bras d'Or Lowlands Ecodistrict*

Ownership	Area (hectares)	Percent of Total Area
Provincial Crown land	56,632	20.3
Private	204,416	73.3
Federal	724	0.3
Aboriginal	2,452	0.9
Other (Includes inland water bodies and transportation corridors)	14,773	5.3
Total	**278,997**	**100**

*Note: Figures may vary slightly from table to table because of rounding, averaging, and overlapping of categories and other factors.

The ownership pattern is indicated in Table 1. Private land ownership accounts for 73% of the area. Other ownership, in order of size, is provincial Crown, inland water bodies and transportation corridors, aboriginal, and federal.

IRM Resource Classification for Provincial Crown Lands

The Integrated Resource Management (IRM) classification for Crown lands was developed through a public consultation process during the strategic phase of IRM completed in 2002.

Table 2 provides a summary of Crown lands designated as either C1, General Resource Use; C2, Multiple and Adaptive Use (allows most uses, but special management may be required); or C3, Protected and Limited Use (such as beaches and sites of cultural and historic significance).

Table 2 – IRM Land Use Categories for Provincial Crown Lands in Ecodistrict

IRM Land Use Category	Hectares	Percent of Crown Lands
C1 – General Resource Use	29,516	57.3
C2 – Multiple and Adaptive Use	15,518	30.1
C3 – Protected and Limited Use	6,182	12
Unclassified	292	0.6
Total	**51,510**	**100**

General resource and multiple and adaptive use combined account for 87% of the Crown lands use.

Forests

Seventy-five percent of the Bras d'Or Lowlands is forested. The remaining land is wetland (8%), urban (7%), other (5%), agriculture (3%), road, trail and utility (2%), and barrens (<1%).

Softwood covertypes currently cover 41% of the forested area. These stands are predominately made up of early to mid-seral species. Hardwood stands which are dominated with late seral tolerant hardwood species account for 20% of the forest. Mixedwood stands account for 31% and generally contain early to mid-seral species. Seven percent of lands are unclassified.

Gap and frequent disturbance regimes are almost evenly split across the ecodistrict (see Part 2 for descriptions of natural disturbance regimes).

Table 3 – Area Distribution by Land Category for All Owners

Category	Hectares	Percent
Forested	208,252	74.6
Wetland	22,487	8.1
Agriculture	7,930	2.8
Barrens	2,226	0.8
Urban	18,981	6.8
Road, Trail, Utility	5,056	1.8
Other	14,065	5.0
Total	**278,997**	**100**

In the eastern end of the ecodistrict, the soils are derived from sandstones and tend to be coarse to medium-textured. In the western portion, the soils are more fine-textured and are derived from sedimentary parent materials.

The dominant species on the lowlands include black and white spruce and balsam fir. On steeper slopes, white pine can be found, while red spruce and hemlock will be found in the valley canyons, steep ravines, and along some watercourses coming off the uplands. The better-drained hills support stands of shade-tolerant hardwoods, such as sugar maple, yellow birch, and beech.

The clearing of land by early settlers and then subsequent abandonment of the fields and pastures has given rise to large areas of old field white spruce forests.

Natural disturbances include losses to blowdown in exposed areas along the lakes and the coast, along with fire and insects, most notably the spruce budworm.

Forested land dominates land use in Bras d'Or Lowlands at 75%. Agriculture accounts for 3%.

The average Land Capability (LC) of forested land in this ecodistrict is estimated to be 4.7 cubic metres per hectare per year (m^3/ha/yr), based on the ratings in Table 4. The average forest LC for the province is 4.9 m^3/ha/yr. Forested land with ratings of LC 4 or LC 5 account for over 80%.

Some areas are not suitable for trees. These non-forested areas consist mainly of rock outcrops and barren lands.

Table 4 – Area of Forested Land by Land Capability Rating

Land Capability (LC) Rating (m^3/ha/yr)*	Hectares	Percent
2 or less	1,066	0.5
3	15,220	7.7
4	56,125	28.3
5	103,541	52.2
6	20,220	10.2
7 or more	2,371	1.2
Total	**198,543**	**100**

*Based on growth potential for softwood species.

Water Resources

Water is an important provincial resource that must be considered in the context of IRM in general and specifically within individual ecosystems.

The Environmental Goals and Economic Prosperity Act, which was enacted in early 2007, has committed the province to prepare a comprehensive water strategy. This strategy will include a high-level evaluation of water resources for the entire province. In addition, detailed water resource studies have been completed for approximately 40% of the province and are available from the Nova Scotia Department of Environment. It is anticipated that the ELA, and subsequent ELA documents, will be modified once water resource information is made available. *The water strategy can be found at http://www.novascotia.ca/nse/water.strategy/docs/WaterStrategy_Water.Resources.Management.Strategy.pdf*

Water resources in the Bras d'Or Lowlands Ecodistrict total 12,222 hectares and are made up of many freshwater lakes spread across the ecodistrict. The largest freshwater lake system is the pairing of Loch Lomond and Lake Uist.

The largest river is the Mira, which the early French explorers called Lac Mira. This large river cuts across the ecodistrict and runs in an easterly direction to Mira Gut where it empties into the Atlantic Ocean.

In Cape Breton County, Forresters Lake, Grand Lake, Blacketts Lake, and Pottle Lake are found. Lakes in Richmond County include Long, MacKay, Barren Hill, Beaver and MacIntyre. Important rivers include the Baddeck, North River, River Denys, River Inhabitants, Grand, Black, and Salmon.

Bras d'Or Lake provides a border for this ecodistrict in West Bay, St. Peter's, River Denys, Grand Narrows, Whycocomagh Bay, Little Narrows, Baddeck Bay and the Great Bras d'Or Channel, as well as at the St. Andrews Channel and East Bay. To the north of the ecodistrict, the Atlantic Ocean borders the land providing a climatic influence on this coastal portion of the ecodistrict.

Frozen lakes in winter are part of a water resource in the Bras d'Or Lowlands Ecodistrict that has an area of more than 12,000 hectares.

Minerals, Energy and Geology

The Bras d'Or Lowlands Ecodistrict includes portions of the Bras d'Or and Mira-Avalon terranes. In this area, the deeper rocks are generally overlain by sedimentary rocks of the Carboniferous Period (Morien, Cumberland, Mabou, Windsor, and Horton groups). The Carboniferous strata include unmetamorphosed conglomerates, sandstones, siltstones, shales, mudstones, evaporites, carbonate, and coal.

The Sydney coalfield (Upper Carboniferous Period, Morien Group) contains the largest coal resource in eastern Canada. The coalfield includes the coastal area of northeastern Cape Breton and extends far out under the Atlantic Ocean towards Newfoundland. The coalfield contains 12 coal seams of economic interest.

Prior to 1654, when France first awarded Cape Breton mineral grants, smugglers mined coal from shoreline outcrops for shipment to New England. The first documented coal mine in North America (a French mine built around 1720) was located along the coastline at Port Morien. The mine was operated by the French military to supply fuel to their Fortress at Louisbourg.

The first recorded export of minerals from Canada occurred in 1724, when coal was exported from Cape Breton to Boston. Since then, more than 100 mines have operated in the Sydney coalfield producing over 350 million tonnes of coal. Towns such as Sydney Mines, New Waterford, Reserve Mines, Glace Bay, and Morien grew up around the coal mines. Mining activity in the Sydney

coalfield made a major historical contribution to Nova Scotia's economy, with employment peaking at over 13,600 in 1913. Coal resources and reserves of the Sydney coalfield are currently estimated at 2.3 billion and 550 million tonnes respectively.

The provincial database for abandoned mine openings lists approximately 500 openings (e.g. shafts, pits, subsidence, and collapse features) in the coalfield and undocumented openings undoubtedly exist.

Potential geohazards, such as abandoned mine openings, potential karst areas, flood risk areas, sulphide-bearing slates, and underground coal workings, can be viewed at the following web sites:
http://gis4.natr.gov.ns.ca/website/nsgeomap/viewer.htm
http://gis4.natr.gov.ns.ca/website/mrlu83/viewer.htm
Please report any additional geohazards found on Crown lands to your nearest Natural Resources office.

A sideview of a bootleg coal site, which represents a potential geohazard.

Hummocky areas such as those shown are sometimes an indication of abandoned mines that could be a source of bootleg (illegal) coal.

Coal left from a bootleg coal site.

Sand and gravel deposits in Frenchvale, Mira, Sydney River, Meadows Road, Big Baddeck, River Inhabitants, and Denys Basin have supplied the local construction industry with product. Three unconsolidated granular aggregate pits are currently operating in the Meadows Road area.

A number of clay deposits have been identified. The Eden clay deposit, the Brickyard clay deposit (Lower Mira River), and several smaller deposits have historically supplied material for local brick manufacturing. Several of the clay deposits have properties that make them attractive to the ceramic and pottery industries.

Numerous metallic and industrial mineral deposits (gypsum, limestone, dolomite, clay, barite, fluorite, celestite, copper, lead, zinc, iron, manganese) are found in the ecodistrict. Nine documented salt deposits are scattered across the southwestern portion of the ecodistrict.

There are several clusters of mineral deposits (copper, lead, zinc, molybdenum, and iron) between Gabarus Bay and the Mira River. Approximately 70 gypsum deposits are documented within the ecodistrict. Gypsum is, or has been, mined at Little Narrows, Melford, and Sugar Camp.

Approximately 30 limestone deposits are documented in the ecodistrict. Limestone quarries have operated on at least four of these deposits. Historically, steel manufacturing was a major limestone consumer. Limestone is being mined at Glen Morrison and Kelly Cove.

Limestone is mined at Kelly Cove.

Sedimentary rocks of Carboniferous age are prime targets for oil and gas exploration as they provide both source and reservoir rocks for hydrocarbons. Approximately 26 boreholes and several surface locations were reported to have hydrocarbons. The oil seeps and shows are somewhat clustered at Little Narrows, Malagawatch, and in the Sydney coalfield.

Most of the western portion of the ecodistrict is currently held under petroleum agreements. In addition to their salt and potash potential, the Windsor age salt deposits have potential as underground gas/oil storage sites. Underground gas storage cavern testing was conducted in the Port Richmond salt deposit (Cape Breton Coastal Ecodistrict 810) in the 1970s. The Sydney coalfield contains a significant coalbed methane resource.

The ecodistrict contains a number of geology/mining sites with historical, cultural and scientific significance (i.e. French and English mining sites dating back to the 1700s, abandoned mining town at Broughton, Miners Museum in Glace Bay, Fossil Museum in Sydney Mines and numerous fossil collection sites).

Parks and Recreation / Protected Areas

For the parks and protected areas within your ecodistrict, please refer to the Park and Protected Areas website (http://novascotia.ca/parksandprotectedareas/plan/interactive-map/) and the Provincial Landscape Viewer, at the following url: https://nsgi.novascotia.ca/plv/.

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The Mira River Provincial Park is one of the Crown recreational properties in the ecodistrict.

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Wildlife and Wildlife Habitat

Wildlife in the Bras d'Or Lowlands Ecodistrict includes relatively common species of plants, animals, and other organisms, along with some species that are rare and/or at risk in Nova Scotia.

Wildlife information for Bras d'Or Lowlands and other ecodistricts comes from a number of sources, including surveys, harvest statistics, hunter and trapper reports (abundance rankings), biological collections from harvested and road killed animals, and observations and reports from the public and DNR staff. Information on important sites is documented by DNR in the Significant Habitats Database and by the Atlantic Canada Conservation Data Centre in Sackville, N.B.

Old forests are recognized as providing important wildlife habitat. The provincial goal is to have a minimum 8% for old forests on provincial Crown land. Shade-tolerant hardwoods and softwoods may provide important wildlife structural components, such as cavity trees, and are encouraged across the landscape through appropriate silviculture systems.

Mammals

The mammal fauna of Cape Breton Island is somewhat less diverse than that of mainland Nova Scotia. Species common on the mainland but not present on Cape Breton Island include striped skunk, woodchuck, and porcupine. Raccoons are a relatively recent addition to the mammal fauna, having been recorded as not present in Cape Breton at least up until the late 1950s. The eastern coyote was first reported in Cape Breton in the early 1980s.

Healthy populations of moose and black bear occur on Cape Breton Island, including Bras d'Or Lowlands Ecodistrict 510, but are infrequently found south of Bras d'Or Lake and the reason for this is not well understood. The current moose population is a result of introduction of Alberta moose to Cape Breton beginning in the 1940s.

Lynx occur throughout most of Cape Breton Island. Because snowshoe hare are the primary prey or lynx, numbers fluctuate over time, roughly tracking hare density. As hare populations in the highlands decline, lynx may disperse into adjoining lowland areas, including the Bras d'Or Lowlands. Historic and current threats to lynx include forest harvesting, competition from bobcats and coyotes, and habitat loss to development, disease, and climate change.

American marten is a small carnivore of temperate and boreal forests, which feeds primarily on red squirrels, mice, voles, and snowshoe hares. The Cape Breton population of marten is very small. There has been a recent augmentation of this small population with marten from New Brunswick, but extensive loss and degradation of suitable habitat remains a concern.

The Bras d'Or Lowlands Ecodistrict has historically supported a healthy population of white-tailed deer that permits an annual harvest for recreation and food. Population levels of deer here fluctuate due to differential survivorship and productivity among years largely due to winter severity (snow depth and persistence). Harsher winters in Cape Breton cause deer to concentrate in areas of mature softwood cover to shelter from deep snow.

There are 75 deer wintering areas identified in the ecodistrict, which are typically located on sheltered slopes close to stands of mature conifers and hardwood browse for winter feed.

A small number of bat hibernacula have been documented and several gypsum caves are potentially bat hibernating areas. Surveys of summer bat roosts indicate healthy populations still remain on Cape Breton. *The recent discovery of white-nose syndrome in bats in Cape Breton is expected to result in severe declines in the coming years.*

Birds

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 DNR staff. Surveys by DNR in 2013 documented 150 nests in the annual eagle survey, most of which are located in the Bras d'Or Lowlands. Of these, at least 104 nests were active in 2013. Eagle nests are occasionally taken over by great horned owls or ospreys, which are incidentally recorded during annual surveys.

Because eagles feed mostly on fish during the nesting season, most eagle nests are located in close proximity to coastal water, though some inland waterways are also used. Nests are typically situated in large "super-canopy" trees, often along steep valleys and often associated with a stream. White pine is the most common tree species used by eagles for nesting, although other species of coniferous trees (e.g. spruce) or deciduous trees (e.g. red maple) are also used. Although a nest may be abandoned over time as individual trees become decadent, the nesting pair will usually re-locate to an adjacent tree when the old nest becomes unusable. Eagles tend to return to the same forest stands to nest year after year as long as suitable nest trees and other habitat needs are met.

While nesting eagles are sensitive to forest harvesting and other disturbance during the nesting season, they will tolerate significant disturbance as long as it is part of the normal cadence of activity in the area. New or unusual activity, however, may cause a nest to be abandoned.

Baby eagles.

The dependence of eagles on suitable stands of nest trees may be locally limiting to nesting eagles in the Bras d'Or Lowlands as forest harvesting and land clearing progresses.

Among the forest raptors that occur in the ecodistrict, goshawk is one of the species most sensitive to forest harvesting, silviculture, and other developments. Goshawks occur throughout the

ecodistrict. Since its main prey is snowshoe hare, goshawks generally nest in mature hardwood or mixedwood stands that are interspersed with younger stands which make good hare habitat.

Other common forest nesting raptors in the Bras d'Or Lowlands include ospreys, hawks, and owls.

Ospreys, which feed almost exclusively on fish, nest in softwood trees or power poles, often along sheltered coastal areas of the Bras d'Or Lake and the Atlantic coast (including coastal islands), and occasionally on freshwater lakes. Ospreys are commonly encountered during eagle surveys and nests are incidentally recorded.

A nocturnal owl survey initiated in Cape Breton in 2001 has shown a relatively high nesting density of several species in the Bras d'Or Lowlands, including great horned owl, barred owl, and northern saw-whet owl.

The coastal areas and offshore islands of the ecodistrict are important habitat for waterfowl, shorebirds, terns, herons, gulls, and seabirds, including many species which are colonial nesters.

Coastal areas provide important habitat for waterfowl.

Coastal islands and headlands, cliffs, wetlands, and beaches are used by a variety of birds for breeding, staging, and wintering. In winter, several sea ducks including common eider, greater scaup, scoters, and long-tailed ducks as well as red-breasted mergansers, goldeneye, Canada geese, and dabbling ducks – most commonly black duck and mallard – frequent the coastal waters.

The Bird Islands off Cape Dauphin (Hertford Island and Ciboux Island) comprise one of the most significant nesting areas for colonial seabirds in Nova Scotia and in 2009 were designated a Nova Scotia Wildlife Management Area.

The Bird Islands were previously designated an Important Bird Area in 1999 because they host more than 5% of the population of great cormorants in North America. About 500 pairs of great cormorants nest on the two islands, mostly on Hertford. The islands also host significant numbers of other seabirds including razorbills, puffins, guillemots, terns, and gulls.

Great blue herons nest at several colonies in the Bras d'Or Lowlands Ecodistrict and several important foraging areas are found here.

Amphibians and Reptiles

Large populations of wood turtle occur at River Denys and River Inhabitants and recent findings suggest a small population is located in Cape Breton County.

A well-established population of snapping turtle occurs at Salmon River and regular reports during egg-laying (June to July) from elsewhere in Cape Breton County suggest they are more widespread.

Four-toed salamanders have been recorded from a few locations near Baddeck and are likely more common than was previously thought.

Snapping turtles are found in the ecodistrict.

Fish

Atlantic salmon occurs in a few river systems, which also provide good brook trout habitat and support runs of smelt and gaspereau. Shad are found in a few locations and both Atlantic sturgeon and lake whitefish occur in Mira River. Striped bass are fished in both the Mira River and Bras d'Or Lake. American eel is quite common in the ecodistrict and is fished commercially in Bras d'Or Lake and elsewhere. Northern cod populations support a recreational fishery in Bras d'Or Lake. The recent illegal introduction of chain pickerel into the Blacketts Lake/Sydney River watershed during the past decade represents a significant threat to native species in this system.

Invertebrates

Seven freshwater mussel species occur in the ecodistrict. These include three rare species, yellow lamp mussel, tidewater mucket, and eastern lamp mussel. The eastern pearlshell occurs most commonly in larger waterways, such as Salmon River, Grand River, and River Inhabitants. Eastern elliptio, alewife floater, and eastern floater occur fairly commonly throughout the eocdistrict.

Yellow lamp mussel is found in Canada on only two rivers, including the Sydney River in Nova Scotia. The current population is large and apparently stable, but confined to a small area. Threats are currently limited, but the very small and discontinuous range of this species in Nova Scotia makes it vulnerable to pollution and degradation of habitat.

Bras d'Or Lowlands is home to many dragonflies and damselflies. Thanks to the efforts of a few dedicated surveyors, DNR officials are aware of at least 11 rare or uncommon species, including the extremely rare brook snaketail and Williamson's emerald.

The Maritime Butterfly Atlas, which will be completed in 2014, has stimulated considerable interest in butterflies. Seventy-one species have been recorded for Nova Scotia, many of which occur in Cape Breton. Of 15 rare or uncommon species found in the Bras d'Or Lowlands, jutta arctic, which is found in bogs, may be the most threatened species.

The Bras d'Or Lowlands Ecodistrict is home to many species of butterflies.

Plants

Bras d'Or Lake, Nova Scotia's only inland sea, renders a unique character to the surrounding landscape. The Bras d'Or Lowlands hosts a diversity of habitats reflected by a rich flora. There are several sites that harbour notable concentrations of plant species of conservation concern but many areas have not been surveyed in recent years. Many of the rare or unusual plants are associated with wetlands at River Inhabitants, River Denys, Baddeck River, Barrachois River, Loch Lomond, and Mira River. River Inhabitants, for example, hosts broad-glumed brome, stout wood reed-grass, triangular-valve dock, Canada wood nettle, alder-leaved buckthorn, climbing false buckwheat, stalked bulrush, northern bog violet, and pale jewelweed.

The diverse geology of the Bras d'Or Lowlands includes some notable areas of karst topography where limestone and gypsum protrude above the surface. The soils at these sites, such as the Little Narrows to Estmere area, support unusual plants, such as showy lady's slipper and hyssop-leaved fleabane not found elsewhere.

Black ash is recorded for a few sites in the ecodistict, including Coxheath and Malagawatch. Orangedale has historical records for brook lobelia and alder-leaved buckthorn. Whycocomagh has historical records for Canada lily and smooth sweet-cicely.

Two of the more unusual plants of the Bras d'Or Lowlands are prototype quillwort and Acadian quillwort found in cold spring-fed lakes. Quillworts are primitive plants related to ferns and do not produce seeds. Most of the world's population of rototype quillwort is found in Canada, including Pottle Lake in the Georges River area.

For more detailed and more current information on species at risk and species of conservation concern in this ecodistrict, refer to Appendix 3 and Map 6 in a separate Part 3 of this document. These species are important components of the landscape and are given priority attention in planning, management, and stewardship activities.

With much of the ecodistrict privately owned, effective wildlife management will to a great extent rely on active, informed stewardship by the many landowners. The DNR can assist private land stewardship by providing knowledge and information on various management strategies. Legislation such as the Wildlife Habitat and Watercourse Protection Regulations, the Endangered Species Act, and the Environment Act's Activities Designation Regulations address species and habitat concerns within the forest and wetland ecosystems.

Part 2: Linking the Landscape to the Woodlot – *How Woodland Owners Can Apply Landscape Concepts to Their Woodland*

This second part of the report provides information on how landscape concepts can be applied at the woodlot level. The starting point is an introduction to natural disturbances and succession to provide a foundation for better understanding forest ecosystems. The focus then shifts to elements that make up each ecodistrict and the forest groups and vegetation types at the stand level. This allows woodland owners to move between elements and stands to see how their woodland fits in with the larger landscape.

Forest Disturbances and Succession

Forest Disturbances

A disturbance can be described as an event, either natural or human-induced, that causes a change in the existing condition of an ecological system.

Disturbance pattern controls forest development classes (establishment, young, mature, multi-aged / old forest) and their distribution over area and time.

Due to the coastal location of Nova Scotia and its Maritime climate, the extent, intensity, and frequency of natural disturbances is difficult, for the most part, to predict. Prior to European settlement, natural disturbances were only curtailed by natural barriers such as water, climate, topography, and vegetation change. After about 400 years of activity by European settlers, the frequency, intensity, and magnitude of these natural processes has been affected.

New disturbances have been introduced as a result of human activity and include:

- clearing of forests for agriculture
- timber harvesting
- urbanization and development
- introduction of exotic animals, plants, and insects
- disease-causing agents, such as viruses or bacteria
- fire suppression in the forest
- changes in the chemical and physical characteristics of the atmosphere

Understanding how ecosystems respond to disturbances is critical to understanding how they function and how they can be managed. This will assist woodland owners and forest managers in:

i. assessing the potential for old forest stands and development class distributions
ii. determining appropriate patch sizes and species composition to emulate natural structures and processes

iii. prescribing the appropriate rotation age and development class structure across a forested landscape
iv. projecting future changes to the forest due to climate change and human disturbances
v. maintaining and conserving biodiversity

Natural disturbances are agents that abruptly change existing conditions and initiate secondary succession to create new ecological communities.

By adapting forest management practices to create the structures and processes that emulate natural disturbances, woodland owners and forest managers can help shape forest landscapes.

One approach that closely mimics nature is to allow ecosystems to naturally develop without active management. This approach is particularly effective on lands with long-lived tree species, such as red spruce, white pine, hemlock, sugar maple, yellow birch, and beech. One of the roles of protected areas is to allow this to occur and also provide a model to compare with managed forests.

Natural Succession

Succession refers to the changes in vegetation types (communities) following disturbance which, over time, often leads to a climax stage. Most changes follow a course of vegetation community development (seral stages) for a particular disturbance regime.

Climax vegetation refers to vegetation communities that are relatively long-lasting and self-replacing. Three types of climax vegetation can be described as follows:

Climatic climax– Vegetation types that are mainly a function of regional climate conditions; these occur on sites with average (mesic) moisture and nutrient conditions.

Disturbance climax – Vegetation types which, due to frequency of disturbance, do not progress to the climatic climax.

Edaphic climax – Vegetation types that are mainly a function of soil and site conditions (i.e. low or excess moisture, low or high fertility) which do not progress to the climatic climax.

Another Definition of Succession

Succession, as defined by Odum (1971), is an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable.

Successional development generally proceeds through a number of distinct seral stages (e.g. early, middle, late) that replace one another in a predictable sequence and which culminates in a relatively stable and self-perpetuating community condition called a climax.

– From *Part 1: Vegetation Types (2010) of Forest Ecosystem Classification for Nova Scotia* *http://www.gov.ns.ca/natr/forestry/veg-types*

Fire in Bras d'Or Lowlands 510

The incidence of fire in the Bras d'Or Lowland Ecodistrict in modern times has become less of a factor influencing the development of the forest, but fire was common in the days of early

European settlement as they were intentionally set to clear the forest for pasture land. Various industrial developments, as well as the railroad, produced frequent fires that impacted much of the natural forest, especially in the Sydney coalfield in the easternmost reaches of the ecodistrict.

Bras d'Or Lowlands – Elements Defined

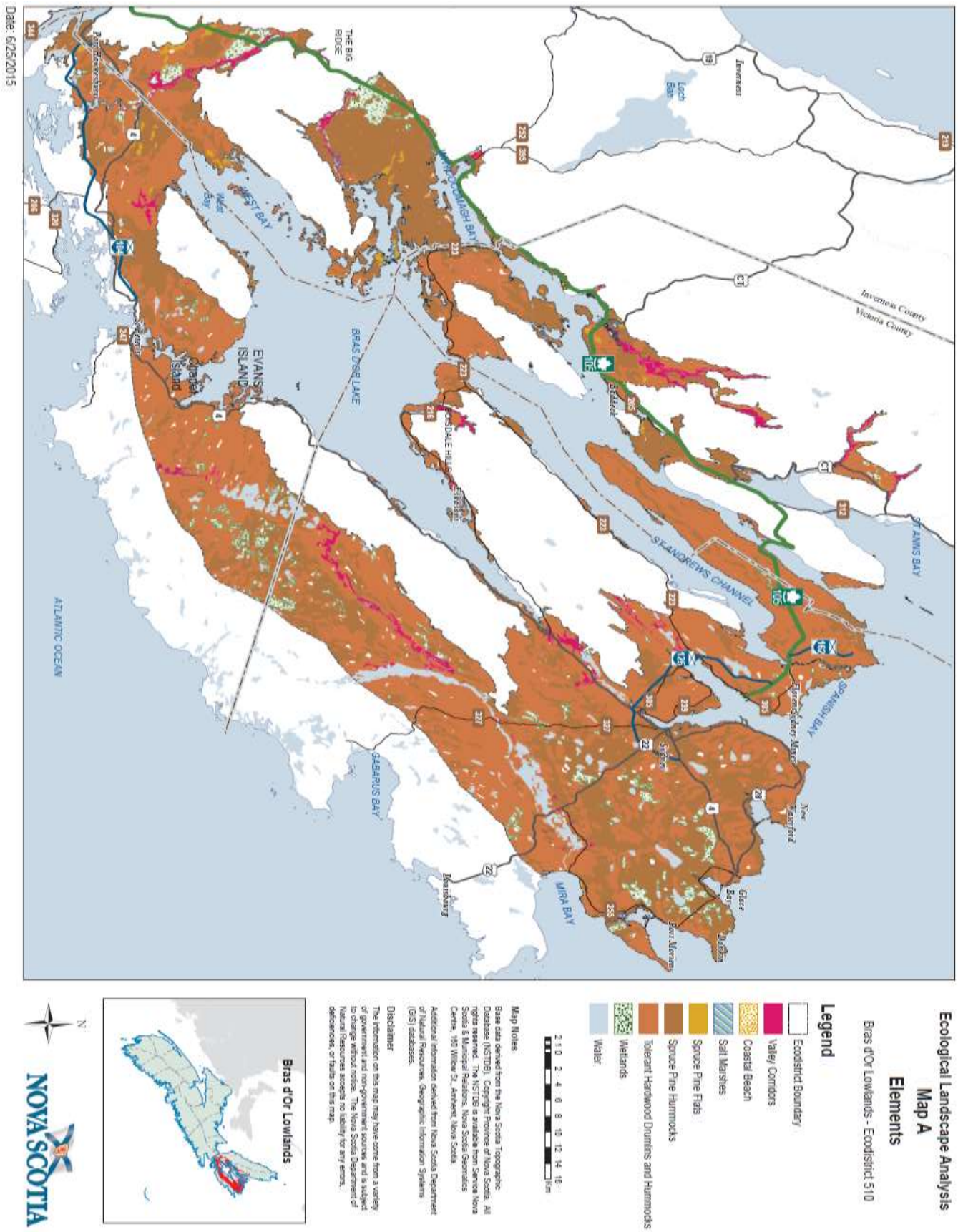
Landscapes are large areas that function as ecological systems and respond to a variety of influences. Landscapes are composed of smaller ecosystems, known as elements. These elements are described by their physical (e.g. soil, landform) and ecological features (e.g. climax forest type). These characteristics help determine vegetation development. Elements promote an understanding of historical vegetation patterns and present disturbances.

A landscape profile identified and mapped six distinctive elements in the Bras d'Or Lowlands Ecodistrict – one matrix and five patches, (Table 5a). A matrix is the dominant community type. Patches are smaller yet still distinctive community types.

The matrix **Tolerant Hardwood Drumlins and Hummocks** element, representing more than half of the ecodistrict's area, naturally supports shade-tolerant forests of long-lived species, such as sugar maple, yellow birch, and beech. The current forest has been strongly influenced by human settlement, abandonment of marginal agricultural land, considerable forestry activity and an extensive history of fire. This has resulted in more softwood and mixedwood stands of early to mid- successional species, such as trembling aspen, red maple, grey and white birch.

Spruce Pine Hummocks is the largest patch element, representing more than one-third of the ecodistrict. Black spruce, balsam fire, white spruce, and white pine are the most common species. The other patch elements, in order of size, are **Wetlands**, **Spruce Pine Flats**, **Salt Marsh**, and **Coastal Beach**.

Map of Elements in Ecodistrict



Forest Stands Within Elements

Each element contains a number of forest stands that can be classified by vegetation, soil, and ecosites. The DNR publication ***Forest Ecosystem Classification for Nova Scotia, Part I: Vegetation Types (2010)*** (http://novascotia.ca/natr/forestry/veg-types/veg-navigation.asp) is helpful in identifying forest plant communities.

Viewed online or available in print through DNR, woodland owners can learn about the characteristics of a particular forest community. Refer to Table 5a for descriptions of elements and Table 5b for forest vegetation types that are likely to be found within elements.

The fall showcases the variety of hardwood species found in the Bras d'Or Lowlands Ecodistrict.

Table 5a – Elements Within Bras d'Or Lowlands		
Element	**Size (Hectares)**	**Element Description**
Tolerant Hardwood Drumlins and Hummocks (Matrix)	149,865 56.2%	The gently rolling hummocks surrounding the Bras d'Or Lake and the drumlin-defined terrain from Loch Lomond to Marion Bridge create the conditions for this shade-tolerant hardwood matrix element. The well-drained soils are derived from sandstones and shales with textures ranging from sandy loams to clay loams. Sugar maple, red maple, yellow birch, and beech dominate on most slope positions with balsam fir and yellow birch becoming more abundant on the moist lower slopes. Where steep slopes (ravines) follow the larger streams and rivers, mixedwood forests with a strong component of hemlock and yellow birch and possibly red spruce are common in this element. With progressively poorer drainage black spruce, tamarack, and red maple dominate the forest vegetation on lower and level terrain. Where this element occurs on drumlins, forests tend to be primarily red maple and yellow birch with few sugar maple and beech. The dominant natural disturbance in the tolerant hardwood component of this element creates 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.
Spruce Pine Hummocks (Patch)	101,228 37.9%	When combined with the inherent low fertility of the substrate, derived from sandstones, siltstones and shales, the forests tend to be dominated by black spruce and scattered white pine. With progressively poorer drainage, black spruce, tamarack, and red maple dominate the forest vegetation and wetlands are embedded throughout the element. Hemlock, and sometimes red spruce, and shade-tolerant hardwoods such as sugar maple, white ash, and yellow birch are commonly found on better-drained sites, especially those of finer texture (clay loams) and enhanced nutrient levels. These late successional Acadian-like forests are typical near Ashfield and Orangedale and at Plaister Mines, perhaps owing to the underlying calcareous substrate. The imperfectly drained medium-textured (sandy loams and loams) are more common between Sydney and Glace Bay and along the Salmon River Valley. This area is more likely to be dominated by the black spruce forest with fewer occurrences of shade-tolerant species such as hemlock and sugar maple.
Wetlands (Patch)	12,026 4.5%	Wetlands are generally treeless or sparsely forested woodlands of black spruce, tamarack, and red maple often with large areas of woody shrubs such as alder, false holly, willow, and winterberry. This element is strongly associated with the alluvial deposits of sediment from annual or periodic flooding on the floodplains of the rivers Denys and Inhabitants. Two distinct forest communities occur within this portion of the element associated with floodplains: 1) forests of black spruce, balsam fir, and tamarack with scattered white pine on imperfect to poorly drained soils; and 2) late successional forests of sugar maple, elm, and white ash on well-drained alluvial soils. Smaller disjoint wetlands are often embedded within other elements, especially the Spruce Pine Flats and Spruce Pine Hummocks elements where it is usually a linear patch associated with imperfectly drained medium-textured soils along smaller streams.

Table 5a – Elements Within Bras d'Or Lowlands		
Element	**Size (Hectares)**	**Element Description**
Spruce Pine Flats (Patch)	2,460 0.9%	This patch element occurs on well to imperfectly drained, coarse to fine-textured soils on level terrain. It is often associated with the alluvial deposits of sediment from annual or periodic flooding of floodplains along rivers and major streams where it forms a linear/riparian patch. Often element will form a small irregular patch associated with a stream-lake-wetland complex that flares out on level terrain from the watercourse. Along the shores of the Bras d'Or Lake, level terrain underlain by well-drained medium-textured soils that are associated with river deltas such as the Skye and Humes rivers also supports this element. On larger rivers, such as the Middle River, soils tend to be very sandy and gravelly. Throughout the ecodistrict the element is also embedded in the Spruce Pine Hummocks element and is usually a linear patch.
Salt Marsh (Patch)	768 0.3%	Several salt marshes can be found in the Bras d'Or Lake formed due to the periodic flooding by the tide such as those at the estuaries of the Baddeck, Skye, and Middle rivers. These marshes are underlain by glacial fluvial sediments and/or peat deposits that have been salinized by the regular flooding by the tides. Atlantic and Fundy salt marshes differ in that they are formed from marine sediments deposited from tidal water flooding low-lying coastal areas. Most of the Bras d'Or salt marshes are dominated by saltwater cordgrass.
Coastal Beach (Patch)	279 0.1%	Coastal beaches are wave-dominated deposits composed of a mixture of sand, gravel and other sizes of sediments. The deposit of sand, gravel and larger particles such as boulders and cobbles occurs under a variety of circumstances leading to several types of beach landforms. Sand dunes are often associated with beaches and depending on size and distance and age support a variety of vegetation including beach grass, bayberry, and white spruce. The beaches at Glace Bay Lake and along the Atlantic coast tend to be examples of barrier beaches that have formed as a result of rising sea level and the erosion of adjacent headlands forcing a landward retreat of the beach. In Bras d'Or Lake, the beaches are created by the movement of sediments along the shore by tidal currents.
Total	**266,824***	*Area is not the same as in Table 1 because water has not been included.

Table 5b – Forest Vegetation Types[1] Within Elements in Bras d'Or Lowlands

Element	Seral Stage					
	Early	%*	Middle	%	Late	%
Spruce Pine Flats	OW2, SP10 (FP4, FP6)	29.8	SH9, SP6, SP8 (FP3)	27.0	SP5**, SP7 (FP1)**	18.0
Spruce Pine Hummocks	IH1, IH4, IH6, OW2, SP10	28.3	SH9, SP4, SP6, SP8	25.6	**SP5,** SP7	19.4
Tolerant Hardwood Drumlins and Hummocks	IH3, IH6	37.2	IH7, TH7	22.5	TH1, TH2, TH3, TH4, TH5, **TH8**	13.4
Salt Marsh	Grasslands of *Spartina spp.*					
Coastal Beach	Beach grass, Bayberry, Rose spp., White spruce					
Wetlands	WC1, WC2, WC6, WC7, WD1, WD2, WD3, WD5, WD6, WD7					

View forest groups and vegetation types at
http://novascotia.ca/natr/forestry/veg-types/veg-navigation.asp
To help with identification of vegetation types, the 14 forest groups in Nova Scotia designated by DNR are: Cedar (CE), Coastal (CO), Flood Plain (FP), Highland (HL), Intolerant Hardwood (IH), Karst (KA), Mixedwood (MW), Old Field (OF), Open Woodland (OW), Spruce Hemlock (SH), Spruce Pine (SP), Tolerant Hardwood (TH), Wet Coniferous (WC), Wet Deciduous (WD)
Bolded vegetation types indicate typical late successional community
[1] Forest Ecosystem Classification for Nova Scotia (2010)
*Percentage of element in each successional stage. Percentages may not total 100 due to unclassified lands (such as clearcuts and regenerating stands) not being included.

Photos Illustrating Vegetation Types in Elements

The following photos show some of the vegetation types expected to be found within their respective elements.

Yellow birch – White birch / Evergreen wood fern (TH7) is a mid-successional vegetation type found in the Tolerant Hardwood Drumlins and Hummocks matrix element.

Black spruce / False holly / Ladies' tresses sphagnum (SP7) is a late successional vegetation type found in the Spruce Pine Hummocks patch element.

Sugar maple – White ash / Ostrich fern – Wood goldenrod (FP1) is a late successional vegetation type found in the Spruce Pine Flats element.

Red maple – Balsam fir / Wood aster / Sphagnum (WD6) is mid-successional vegetation type found in the Wetlands element.

Landscape Composition and Objectives

Landscapes contribute to the maintenance and conservation of native biodiversity. Managing landscapes for biodiversity requires a variety of planning approaches and tools. Sustaining forest composition diversity by reflecting natural patterns of disturbance and succession is one approach that DNR is employing to try and realize this objective. DNR is developing a number of additional approaches and planning tools which will be integrated with objectives defined in the ELA protocol.

Human activities, such as forest harvesting, can have a significant impact on the structure and composition of the forested landscape. Well-planned harvesting can provide a tool to achieve landscape composition goals.

Natural Disturbance Regimes

Three natural disturbance regimes dominate natural forests:

Frequent Stand Initiating – Disturbances usually occur more frequently than the average life span of the dominant species and are of sufficient intensity to kill most of the existing mature trees, thereby promoting the establishment of a new forest within a relatively short period. Some unharmed trees often survive the disturbance in pockets and/or as scattered individuals.

Infrequent Stand Initiating – The time between stand-initiating disturbances is usually longer than the average longevity of dominant species, thereby supporting processes of canopy gap formation and understory development in mature forests.

Gap Replacement – An absence of stand-initiating disturbances supports the development of a dominant overstory that is sustained through dynamic processes of canopy gap formation, understory development, and overstory recruitment. Gap formation ranges from individual tree mortality to the replacement of a small group of trees.

In the Bras d'Or Lowland Ecodistrict, the frequent stand-initiating disturbance and the gap disturbance are the predominant natural processes shaping the diversity of forest ecosystems.

The disturbance agents on the Bras d'Or Lowland Ecodistrict associated with frequent disturbances include insects and wind and in many locations, particularly in the eastern one-third of the ecodistrict, fire has played an important role as well, especially in the past. The industrial nature of the Sydney coalfield seems to foster more fires and the resulting changes to the natural forests. That part of the province has had the most wildfires per season of any area in the province.

The forest ecosystems that arise from this disturbance type include softwood forests of white and black spruce and balsam fir and mixed stands of these species along with white and grey birch, trembling aspen, red maple, and some yellow birch.

In the portion of the ecodistrict where the gap disturbance is the predominant disturbance regime, the natural stands include mixtures of sugar maple, yellow birch, and beech along with red maple, white and grey birch, and trembling aspen.

In the eastern end of the ecodistrict, red maple seems to take the place of the sugar maple, which is more dominant in the western part of the area. White pine grows in pockets on some of the better-drained hills associated with eastern hemlock and as well, hemlock and occasionally red spruce can be found in the valleys and ravines associated with some of the streams draining the ecodistrict. Especially in the eastern end of the ecodistrict, the tolerant hardwood forest has been reduced due to settlement practices as well as fires and industrial development.

Forest Composition

Forest disturbances lead to forest renewal and the development of young forest habitats with characteristic successional patterns. Management of landscapes to conserve biodiversity requires sustaining ecologically adequate representation of natural habitat diversity, among a number of other measures and planning approaches.

At a landscape planning scale, the variety of habitats can be broadly described in terms of the composition of development classes, seral stages, and covertypes.

Development Classes describe changes in structure and process as forests age and trees grow larger. For landscape management purposes, four development classes are recognized:

- forest establishment (0 to 6 m height)
- young competing forest (7 to 11 m height)
- mature forest (> 11 m height; including multi-aged and old forest)
- multi-aged / old forest (multiple layered)

Within this simplified description there is considerable variation in the processes and structures that evolve in particular stands. When the current forest inventory is used to classify development classes, the height criterion is used. When forecasting future conditions using the Forest Model, the age criterion is preferred.

Harvesting and silviculture activities, such as planting and thinning, have been ongoing on Crown land since the 1940s.

Seral Stages describe changes in species composition of forest communities as succession progresses from domination of early seral "pioneer" species following disturbance, toward late seral communities dominated by long-lived, shade-tolerant "climax" species. Seral stage is dependent on the composition of tree species of a forest, irrespective of age. For landscape management purposes, three seral stages are recognized:

- early
- mid
- late

Early successional species are those that do well in direct sunlight and include white and grey birch, aspen, poplar, white spruce, tamarack, pin cherry, jack pine, and red pine. These species grow quickly, but are usually short-lived.

They are replaced by mid-successional species that can tolerate moderate amounts of shade, such as white ash and red oak.

Late successional species generally have a high shade tolerance and include hemlock, red spruce, sugar maple, and beech, as well as yellow birch and white pine. The species often develop slowly in shaded understories and can be long-lived and form old growth.

Covertypes descriptions further refine landscape composition by distinguishing forests of different community conditions. Management generally recognizes three forest covertypes:

- softwood (overstory cover of softwood species is 75% or more)
- hardwood (overstory cover of hardwood species is 75% or more)
- mixedwood (overstory cover of either softwood or hardwood is between 25% and 75%)

Forest Composition Objectives

Within ecodistricts, the forest composition should contain a range of conditions that sustain the inherent forest communities and dominant natural disturbance regimes. Table 6 provides target ranges for development class and seral stage composition appropriate for different disturbance regimes. These ranges have been derived from the professional judgment of DNR forest ecologists to guide composition objectives for large landscape areas.

Woodland owners can use this guidance to assess how their holdings contribute to the overall ecodistrict structure by referring to the landscape element bar charts that illustrate where deficiencies exist. For example, landowners who have a large amount of mature forest in an element where this is in short supply can recognize the contribution of their holdings to the overall health of the landscape.

Four hundred years of European settlement in the Acadian region has left insufficient natural landscape structure to confirm these ranges. Facing similar challenges, a comprehensive modeling approach was used by the Ontario Ministry of Natural Resources to support "range of variation" targets for natural disturbance regimes in the Great Lakes St. Lawrence region (http://www.ontario.ca/document/forest-management-great-lakes-and-st-lawrence-landscapes).

A full description of definitions and mapping of Nova Scotia's disturbance regimes is contained in the report "Mapping Nova Scotia's Natural Disturbance Regimes" available from the DNR website (http://novascotia.ca/natr/library/forestry/reports/NDRreport3.pdf).

Table 6 - Landscape Composition Target Ranges (by Development Class / Disturbance Regime)				
Natural Disturbance Regime	**Development Class**			
	Forest Establishment	**Young Competing Forest**	**Mature Forest (including multi-aged and old forest)**	**Multi-aged and Old Forest**
Frequent Stand Initiating	5 - 30%	5 - 30%	>40% early, mid, and late seral representation	>8%
Infrequent Stand Initiating	5 - 20%	5 - 20%	>60% most in mid and late seral stages	>16%
Gap Replacement	0 - 15%	0 - 15%	>70% most in late seral stage	>24%

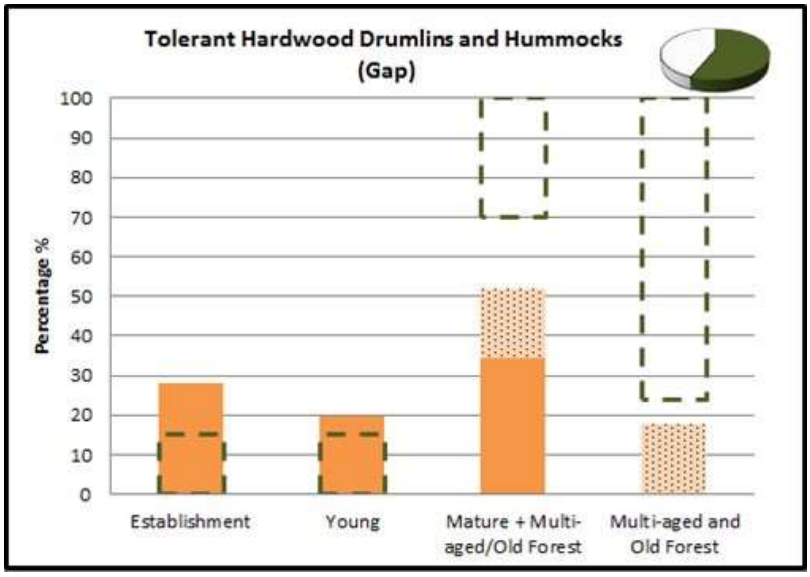
Table 6 indicates that for frequent stand-initiating disturbances, both establishment and young development class forests would typically comprise between 5 and 30% of area, while mature forest – which includes multi-aged and old forest – would cover more than 40%. Mature forest should consist of a relatively even balance of early, mid and late successional stands. At least 8% of the mature forest should be in the multi-aged and old forest class. The targets for the other disturbance regimes are shown in Table 6. Forest planning should strive to maintain composition within these targets, and identify corrective and mitigating measures when outside these ranges.

Development Class Targets by Element

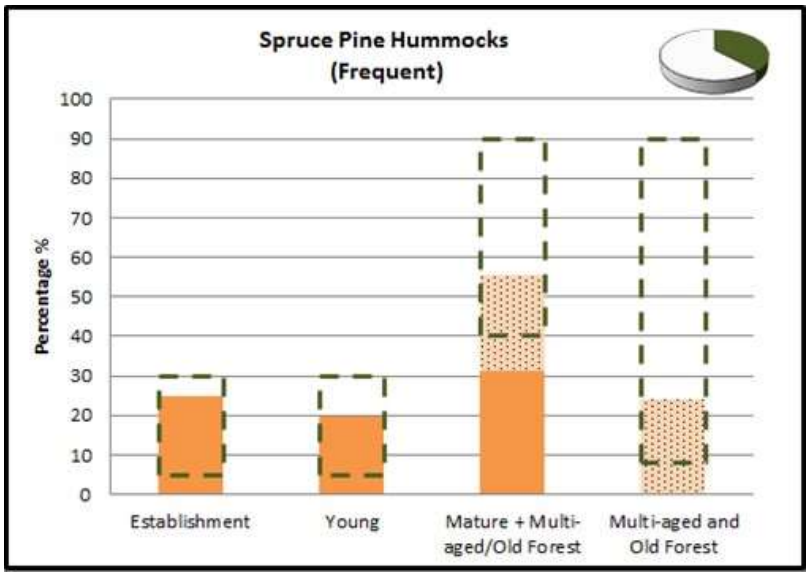
The series of charts that follow combine data on development classes for each element with desired or target percentages, based on the type of natural disturbance regime. The target percentages (from Table 6) are represented by rectangles of broken green lines. The light brown bars show the percentage of each development class at the time the original data was gathered. The dotted area in the mature class shows the amount of multi-aged and old forest area included. The coloured portion of the small pie chart in the corner of the graphic shows the relative size of the element within the ecodistrict.

All non-forest elements, (e.g. Rockland, Wetland, Beach, Urban, Marshes/Grasslands, Salt marsh) and the Valley corridor element have not been measured or included in the 2019 update.

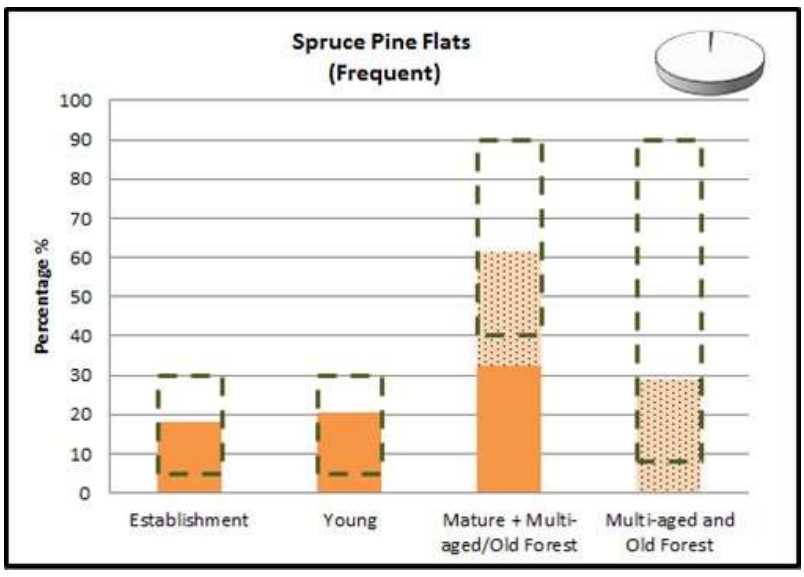
The **Tolerant Hardwood Drumlins and Hummocks** matrix element has less mature and multi-aged forest than is desired for gap natural disturbance regime ecosystems. Maintaining mature forests by delaying harvests, extending rotations through thinning and selection cutting and retaining large old trees will help restore a healthier landscape composition. Silviculture in establishment and young forests to increase growth and promote climax species will help mature forests develop.



The **Spruce Pine Hummocks** patch element has a desirable range of development classes. These frequent natural disturbance regime forests support periodic stand-initiation events that favour establishment of an even-aged forest, often with scattered surviving mature pine that provide large seed trees. The abundant establishment and young stage forest should provide silviculture opportunities.



In the small **Spruce Pine Flats** patch element, all the classes are within target ranges. This type of frequent natural disturbance regime forest supports stand-initiation events that favour establishment of an even-aged forest of mixed seral species. Natural disturbances typically retain mature surviving pine, which provides seed trees and some mature structure in developing stands.



Summary of Parts 1 and 2

This ends the first two parts of this report, which are available online to anyone who wants to view them. The intent was for the first part to provide a general overview of the ecodistrict for members of the public. The second part was designed for woodland owners to show how landscape ideas, such as elements, can be applied at the woodlot level.

The third part of the report, which includes more detailed information, maps, appendices, glossary, and literature citations, is designed for forest planners, managers, ecologists, analysts, and interested woodland owners.

Glossary A: Terms in Parts 1 and 2

Biodiversity	The diversity of plants, animals, and other living organisms, in all their forms and level of organization, including genes, species, ecosystems, and the evolutionary and functional process that link them.
Canopy	The uppermost continuous layer of branches and foliage in a stand of trees.
Climax forest community	A relatively stable and self-perpetuating forest community condition that maintains itself (more or less) until stand-level disturbance causes a return to an earlier successional stage. The final stage of natural succession for its environment.
Climax vegetation	A forest or non-forest community that represents the final stage of natural succession for its environment.
Coarse filter approach	A habitat-based approach to conserving biodiversity by maintaining a natural diversity of structures within stands, and representation of ecosystems across landscapes. The intent is to meet the habitat requirements of most native species over time. Usually combined with a fine filter approach to conserve specific rare species and ecosystems.
Composition	The proportion of biological components within a specified unit such as a stand or landscape: **Stand or Species Composition.** The proportion of each plant species in a community or stand. May be expressed as a percentage of the total number, basal area, or volume of all species in that community. **Landscape Composition.** The proportion of each community type within a landscape. Community type may be defined by vegetation type, covertype, seral stage, or development class (age).
Connectivity	The way a landscape enables or impedes movement of resources, such as water and animals.
Converted	Lands removed from a natural state (e.g. forest) and changed to other uses (e.g. agriculture, urban, settlement, road).
Corridor	Corridors are natural linear communities or elements, such as river valleys, that link parts of the ecodistrict. They are a fundamental feature of the "matrix, patch, corridor" concept of landscape structure.

Crown land and Provincial Crown land	Used in these Ecological Landscape Analysis reports to include all land under the administration and control of the Minister of Natural Resources under the Forests Act, Section 3; as well as the lands under the administration and control of the Minister of Environment under the Wilderness Areas Protection Act. Also includes Federal Parks in the accounting of protected area representation.
Covertype	Refers to the relative percentage of softwood versus hardwood species in the overstory of a stand. In this guide, covertype classes are: **Softwood:** softwood species compose 75% or more of overstory **Hardwood:** hardwood species compose 75% or more of overstory **Mixedwood:** softwood species composition is between 25% and 75%
Development class	The description of the structure of forests as they age and grow (e.g. establishment forest, young forest, mature forest, multi-aged / old forest).
Disturbance	An event, either natural or human-induced, that causes a change in the existing condition of an ecological system.
Ecodistrict	The third of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecoregions. Characterized by distinctive assemblages of relief, geology, landform and vegetation. Used to define the landscape unit for these Ecological Landscape Analysis reports.
Ecological land classification	A classification of lands from an ecological perspective based on factors such as climate, physiography, and site conditions. The Ecological Land Classification for Nova Scotia Volume 1 delineates ecosystems at five hierarchical scales: ecozone, ecoregion, ecodistrict, ecosection, and ecosite.
Ecoregion	The second level of the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecozone. Used to characterize distinctive regional climate as expressed by vegetation. There are nine ecoregions identified in Nova Scotia.
Ecosection	The fourth of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecodistricts. An ecological land unit with a repeating pattern of landform, soils, and vegetation throughout an ecodistrict.
Ecosite	The fifth of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecosections. Characterized by conditions of soil moisture and nutrient regimes. Although not mapped, the Acadian and Maritime Boreal ecosites of the province are fully described in the Forest Ecosystem Classification for Nova Scotia (2010).

Ecosystem	A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size – a log, pond, field, forest, or the Earth's biosphere – but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation, such as a forest ecosystem, old-growth ecosystem, or range ecosystem. Can also refer to units mapped in the DNR Ecological Land Classification system.
Element	A landscape ecosystem containing characteristic site conditions that support similar potential vegetation and successional processes. Elements were mapped by combining ecosections with similar climax vegetation and natural disturbance interpretations. Depending on their role in the ecosystem, elements may be described as matrix, patch or corridor.
Endangered species	A wildlife species facing imminent extirpation or extinction. A species listed as endangered under the federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal Species at Risk Act).
Even-aged	A forest, stand, or vegetation type in which relatively small age differences exist between individual trees. Typically results from stand-initiating disturbance.
Extinct species	A species that no longer exists. A species declared extinct under federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal SARA).
Extirpated species	A species that no longer exists in the wild in Nova Scotia but exists in the wild outside the province. A species declared extirpated under federal or Nova Scotia endangered species legislation (Nova Scotia Species at Risk Act or federal SARA).
Forest management	The practical application of scientific, economic, and social principles to the administration and working of a forest for specified objectives. Particularly, that branch of forestry concerned with the overall administrative, economic, legal, and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection, and forest regulation.
Frequent stand initiating	Disturbances usually occur more frequently than the average lifespan of the dominant species and are of sufficient intensity to destroy most of the existing trees, promoting a new forest within relatively short periods of time.

Gap replacement	An absence of stand-initiating disturbances supports the development of a dominant overstory that is sustained through dynamic processes of canopy gap formation, understory development, and overstory recruitment. Gap formation ranges from individual tree mortality to periodic gap formation events that are rarely of a stand-initiating intensity.
Habitat	The place where an organism lives and/or the conditions of that environment including the soil, vegetation, water and food.
Impact assessment	A study of the potential future effects of resource development on other resources and on social, economic, and/or environmental conditions.
Infrequent stand initiating	The time between stand-initiating disturbances is usually longer than the average longevity of dominant species, thereby supporting processes of canopy gap formation and understory development in mature forests.
Inherent conditions	Refers to the natural condition of ecosystems based on their enduring physical features. This is the potential condition expected in the absence of human influence.
Integrated Resource Management (IRM)	A decision-making process whereby all resources are identified, assessed, and compared before land use or resource management decisions are made. The decisions themselves, whether to approve a plan or carry out an action on the ground, may be either multiple or single use in a given area. The application of integrated resource management results in a regional mosaic of land uses and resource priorities which reflect the optimal allocation and scheduling of resource uses.
Land capability (LC)	LC values represent the maximum potential stand productivity (m^3/ha/yr) under natural conditions.
Landform	A landscape unit that denotes origin and shape, such as a floodplain, river terrace, or drumlin.
Landscape	An expanse of natural area, comprising landforms, land cover, habitats, and natural and human-made features that, taken together, form a composite. May range in scale from a few hectares to large tracts of many square kilometres in extent.
Matrix	A widespread vegetation forest community which dominates the landscape and forms the background in which other smaller scale communities (patches) occur. The most connected or continuous vegetation type within the landscape, typically the dominant element. (Matrix is a fundamental feature of the "matrix, patch, corridor" concept of landscape structure.)

Mature forest	A development class within the sequence of: 1) forest establishment, 2) young forest; 3) mature forest; and 4) multi-aged and old forest. Mature forests include multi-aged and old forest. Forests are typically taller than 11 metres, have an upper canopy fully differentiated into dominance classes, and regularly produce seed crops. Mature forests may develop over long periods, transitioning from early competitive stages where canopy gaps from tree mortality soon close, to later stages where openings persist and understories develop to produce multi-aged and old forest.
Natural disturbance	A natural force that causes significant change in forest stand structure and/or composition such as fire, wind, flood, insect damage, or disease.
Natural disturbance regimes	The patterns (frequency, intensity, and extent) of fire, insects, wind, landslides, and other natural processes in an area. Natural disturbances inherently influence the arrangement of forested ecosystems and their biodiversity on a given landscape. Three disturbance regimes recognized in Nova Scotia are: **Frequent:** Disturbances which 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 which 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 – 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.
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.

Patch	A discrete community or element nested within a surrounding landscape, which is often a matrix forest. (Patch is a fundamental feature of the "matrix, patch, corridor" concept of landscape structure.)
Reserve	An area of forest land that, by law or policy, is usually not available for resource extraction. Areas of land and water set aside for ecosystem protection, outdoor and tourism values, preservation of rare species, gene pool and wildlife protection (e.g. wilderness areas, parks).
Riparian	Refers to area adjacent to or associated with a stream, floodplain, or standing water body.
Seral stage	Any stage of succession of an ecosystem from a disturbed, unvegetated state to a climax plant community. Seral stage describes the tree species composition of a forest within the context of successional development.
Species	A group of closely related organisms that are capable of interbreeding, and which are reproductively isolated from other groups of organisms; the basic unit of biological classification.
Species at risk	Legally recognized designation for species at federal and/or provincial levels that reflects varying levels of threats to wildlife populations. The four categories of risk are extirpated, endangered, threatened, and species of special concern.
Succession	An orderly process of vegetation community development that over time involves changes in species structure and processes.
Tolerance	The ability of an organism or biological process to subsist under a given set of environmental conditions. The range of these conditions, representing its limits of tolerance, is termed its ecological amplitude. For trees, the tolerance of most practical importance is their ability to grow satisfactorily in the shade of, and in competition with, other trees.
Vulnerable species	A species of special concern due to characteristics that make it particularly sensitive to human activities or natural activities or natural events. May also be referred to as "species of special concern." A species declared vulnerable under the federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal SARA).
Wilderness area	A part of the provincial landbase designated under the Wilderness Areas Protection Act (e.g. Canso Barrens).