Department of Natural Resources

ECOLOGICAL LANDSCAPE ANALYSIS WESTERN BARRENS ECODISTRICT 770

PART 3: Landscape Analysis for Forest Ecosystem Planners

ELA 2014-770

NOVA SCOTIA

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Ecological Landscape Analysis, Ecodistrict 770: Western Barrens

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This report, one of 38 for the province, provides descriptions, maps, analysis, photos and resources of the Western Barrens Ecodistrict.

The ELAs were analyzed and written from 2005 – 2009. They provide baseline information for this period in a standardized format designed to support future data updates, forecasts and trends. The original documents are presented in three parts: Part 1 – *Learning About What Makes this Ecodistrict Distinctive* – and Part 2 – *How Woodland Owners Can Apply Landscape Concepts to Their Woodland.* Part 3 – *Landscape Analysis for Forest Planners* – will be available as a separate document.

Information sources and statistics (benchmark dates) include:

- Forest Inventory (2002) – stand volume, species composition
- Crown Lands Forest Model landbase classification (2006) – provides forest inventory update for harvesting & silviculture from satellite photography (2005), silviculture treatment records (2006) and forest age increment (2006)
- Roads & Utility network – Service Nova Scotia and Municipal Relations (2006)
- Significant Habitat and Species Database (2007)
- Atlantic Canada Data Conservation Centre (2013)

Conventions

Where major changes have occurred since the original ELA report was written, the new information will be provided in *italics,* so that the reader can see how some conditions have changed since the benchmark date of the ELA.

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This in-depth Ecological Landscape Analysis (ELA) report is a lightly edited version of the original ELA produced by the Department of Natural Resources (DNR) as an internal document to assist with Crown Land planning. The report provides information for planners, forest managers, ecologists, technicians, and woodland owners seeking detailed planning resources. In coming years DNR will continue to develop landscape planning approaches and introduce additional tools to support sustainable management and biodiversity conservation. The Department is working with stakeholders to explore novel planning approaches using these methods.

The ELA provides tools to recognize and pursue common goals for sustaining ecosystem values across all ownerships within the province's diverse landscapes. The ELA is not a plan, but instead supports planning by providing a framework of ecosystem mapping, indicators, fine-scaled features, and landscape functions that help describe landscapes as ecological systems. The report comprises the four major sections outlined below, along with theme maps and appendices containing detailed data summaries:

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Understanding the Landscape as an Ecological System

(Appendices 1, 2a, 2b; Map 2)

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, which were interpreted through analysis using the ecosection layer of the Ecological Land Classification (ELC) for Nova Scotia. Elements are described by their potential vegetation (e.g. climax forest type) and physical features (e.g. soil, landform). These characteristics help determine historical vegetation patterns and promote an understanding of present distributions and potential habitat

development. Across the province, about three dozen elements were identified in the ELAs and mapped to show their distribution across ecodistricts and ecoregions.

Elements Within Landscapes (Map 2)

A landscape profile identified and mapped five distinctive landscape elements in the Western Barrens Ecodistrict – one matrix, three patches and a corridor. A matrix is the dominant community type. Patches are smaller yet still distinctive community types. Corridors are natural linear communities, such as river valleys, that link parts of the ecodistrict.

Western Barrens is a little unusual in that the matrix element, **Pine Oak Barrens** (43%), is only a little more than 500 hectares larger than the largest patch element, **Spruce Pine Barrens** (42.4%), which basically functions as a co-matrix. In the matrix, the climax community is red oak-white pine-red pine. In the patch or co-matrix, the climax community is black spruce-white pine. In both cases, as reflected in the names, the barrens are thought to represent the naturally occurring climax condition on a large part of the ecodisrict.

The other two patch elements are **Wetlands**, usually bogs or fens, and the small **Pine Oak Hills and Hummocks**. **Valley Corridors** is the corridor element, which often follows the major rivers and interconnected lakes.

Flow – Element Interactions (Appendix 1; Map 2)

Flow phenomena are the features that move across and through landscapes. They can be energy or material, living or non-living. Diaz and Apostol (1992) suggest that the most relevant flows for landscape analysis may include water, wind, fire, animals, plants, and humans. The following flows were considered in the analysis of this ecodistrict and are described in Appendix 1: water, moose, people, furbearers (upland and aquatic), forestry, mining, and birds.

Flow occurs throughout the ecodistrict. Examples are shown in Map 2. The forested landscape of the Western Barrens today may be larger than what would occur in a natural state as fire suppression is a common management practice. This has likely had an impact on some flows in the ecodistrict.

The main purpose in describing flows, and their relationship to the elements, is to provide insight into the role of each element. This will inform understanding of each element's contribution to overall landscape function.

Maintenance of connectivity among the various flow-element interactions is one of the key management strategies for Western Barrens.

Landscape Connectivity (Appendices 2a, 2b; Map 2)

Connectivity refers to the ease or difficulty that resources, such as water, animals or even events – such as fires – can move within an area. As a basic ecological requirement, the ability to move without excessive risk is of critical importance for maintaining biodiversity at all levels, including genetic, individual, species, population, community, and ecosystem.

Connectivity takes many forms and operates at a wide range of scales. Among the structural ecosystem components that support movement, three major systems can be identified:

Matrix Ecosystems – Matrix implies large areas of broadly similar habitat in which movement is not constrained to particular routes. The slow spreading and mixing of species through the dominant community characterizes the ecosystem matrix. This "percolation" is dependent on the large patch conditions, which may be vulnerable to fragmentation. Interior habitat is often an important feature of matrix ecosystems.

Patch Ecosystems – The movement of species among patches of suitable habitat is dictated by the arrangement and size of patches and by a number of species' specific measures. Patches of suitable habitat must occur at acceptable distances over time. Some patch habitats have critical functions and must be continuously sustained, such as wetlands for migrating birds, feeding areas for deer and calving grounds for moose. Other patches may be dynamic, shifting about the landscape as ecosystems evolve. Edge and interior habitat conditions are important features of patch ecosystems, as well as natural isolation.

River corridors promote connectivity.

Linear Corridor Ecosystems – Flow along popular routes is dictated by enduring physical features, such as river valleys. Linear flow often requires continuous connection, such as rivers. Breaks in the connection serve as obstacles. It is a characteristic of continuous linear features that they often serve as connective corridors for some species and barriers for others.

Nearly three-quarters of the total Western Barrens Ecodistrict is designated a wilderness area. The area, except possibly along some of its fringes, does not have a history of forest resource extraction. The landscape will likely essentially be left to develop naturally. Movement towards a more natural state may help ensure that the integrity of the landscape in relation to connectivity will be preserved or enhanced. Consideration may have to be given to the importance of fire in this ecosystem and its role in maintaining the area in a "natural condition."

An additional concern in ecological planning is the maintenance of connectivity between conservation areas such as wilderness, old growth and ecological serves. Appendices 2a and 2b identify management strategies and practices for various features in the ecodistrict. Connectivity could be sustained by applying natural disturbance guidelines for landscape composition and recognizing natural linkage opportunities.

Links to Neighbouring Ecodistricts (Appendices 1, 2a; Map 2)

Map 2 identifies some of the linkages to neighbouring ecodistricts.

The hydrological system is an obvious connection between the Western Barrens and its surroundings. This ecodistrict contains headwaters of a number of the major river systems in the Western Ecoregion (Tusket, Clyde, Roseway, and Shelburne systems). The various ecodistricts the rivers flow into include Sable, Clare, and South Mountain. A large number of lakes, bogs and 1st to 3rd order streams dissect the landscape and form an important component of the hydrology.

People have historically, through their activities, provided a linkage with the three nearby ecodistricts. These activities have included canoeing, hunting, trapping, fishing, camp use, and ATV use. The latter two activities have been curtailed since most of the ecodistrict was designated a wilderness area.

Western Barrens was never extensively settled. The Indian Fields Fire of 1960 was the impetus for establishing a "fire road" through the ecodistrict. The establishment of Highway 203 occurred as the result of the opening of a tin mine (now closed) in 1985. This road is used by people involved in recreational activities and sometimes for transportation of forest products.

Western Barrens can perhaps be best described as extensive barrens recovering to forest. This is largely the result of considerably fewer large forest fires in the past 50 or so years.

A remnant population of mainland moose, an endangered species in Nova Scotia, is present in the Western Barrens Ecodistrict. These moose are believed to travel to adjacent ecodistricts.

Riparian corridors along Western Barrens major waterways are also largely mature and intact and continue to provide important ecological functions (temperature control, nutrients, fillers, coarse woody debris habitat). The corridors provide linkages to areas within Western Barrens as well as the adjoining South Mountain 720 and Sable 760 ecodistricts.

Landscape Indicators (Appendices 3, 6, 7, 8, 9, 10, 11; Maps 3, 4, 5, 9, 10)

Indicators provide standard measures for assessing landscape conditions. Indicators can be used to develop goals, identify priority actions, assess trends, and support the evaluation of scenarios.

Forest Composition Indicators (Appendices 8, 10; Maps 4, 9, 10)

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. A number of additional approaches and planning tools are being developed which will be integrated with objectives defined in the ELA protocol.

Human activities, such as forest harvesting, can shape the structure and composition of the forested landscape and should be planned to help support landscape composition goals.

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 class indicators 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 / Old Forest Policy)

Seral stage indicators 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 (seral score 10 to 23)
- mid (seral score 24 to 37)
- late (seral score 38 to 50)

A look-up table (see Appendix 8) assigns each species in the forest inventory a value from 1 to 5, representing its position on the successional scale. These values are applied to the species composition data in the forest inventory to calculate a seral score, which may range from 10 to

Covertype indicators 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%)

Target Ranges for Composition Indicators

Table 7 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. This guidance can be used to assess how land holdings contribute to the overall ecodistrict structure by referring to the element analysis section which summarizes the levels of these indicators.

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 7 - 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%

Forest Vegetation Types for Seral Stages in Each Element

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. Table 8 presents a description of the vegetation types likely to be found within elements, along with the current percentage of each seral stage.

Table 8 – Forest Vegetation Types[1] Within Elements in Western Barrens						
Element	**Successional Stage**					
	Early	**%***	**Middle**	**%**	**Late**	**%**
Pine Oak Barrens	OW2, OW4, OW5, IH4, MW5, SP2, SP8	3.0	IH2, IH6, MW4, SP3, SP4, SP6	48.0	SP5, **SP9**	49.0
Pine Oak Hills and Hummocks[2]	IH4, MW5, SP2, SP8	3.0	IH2, IH5, IH6, MW4, SH9, SP3, SP4, SP6	30.0	IH7, SP5, **SP9**, SH4	67.0
Spruce Pine Barrens[2]	IH4, OW2, OW4, SP2	1.0	IH6, SP3, SP6	31.0	**SP4**, **SP5**	68.0
Wetlands	FP3, WC1, WC2, WC4, WC6, WC7, WD2, WD3, WD4, WD6, SP7					

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).
[2] Vegetation types with hemlock and red spruce may be found scattered near the boundaries of the ecodistrict.
*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.

Land Use Indicators (Appendices 3, 4, 5; Maps 6, 7)

Two indices (Ecological Emphasis Index and Road Index) have been developed to measure the relative pressure that current human land use exerts on ecosystems.

Ecological Emphasis Index (Appendices 11, 12; Map 3)

A variety of land management practices occur across landscapes, ranging from natural reserve areas to highly modified urban environments. Conserving biodiversity requires a balancing of land use practices to sustain ecological integrity.

To assist in assessing land use intensities and develop appropriate practices, four levels of ecological integrity are defined based on the degree that the conservation of natural conditions is emphasized in the management practices and policies applied to the land:

- Reserve, such as parks or wilderness areas
- Extensive, which are lands managed or restored for multiple values using ecosystem-based techniques
- Intensive, optimizing resource production by management techniques that may reduce biological diversity, such as plantations; but also meet the Wildlife Habitat and Watercourses Protection Regulations (NSDNR, 2002) (http://www.gov.ns.ca/natr/wildlife/habitats/protection)
- Converted, lands altered for agriculture, roads or other human activities

All lands within the ecodistrict are assessed at the stand level and assigned one of these four ecological emphasis classes (EEC) based on past practices. These classes are mapped over all areas of the landscape using a one hectare grid. The Ecological Emphasis Index (EEI) is determined by assigning a weighting value to each class: Reserve (100), Extensive (75), Intensive (25), and Converted (0). An overall index value may be calculated for any area of interest, such as element, ecosection, ecodistrict or ecoregion, by averaging the index values within the area to provide a relative indication of land use pressure.

The overall EEI for Western Barrens is 94, indicating a high degree of "naturalness." The EEI is highest, or more natural, in the Pine Oak Hills and Hummocks, Wetlands and Spruce Pine Barrens patch elements. The EEI is lowest, or less natural, in the Pine Oak Barrens element.

DNR will evaluate how this EEI rating compares to other measures of conservation risk, developed by DNR's Wildlife Division.

Based on ELC mapping and excluding water and other non-terrestrial conditions, Western Barrens has 75,474 hectares of land (out of a total area of 79,596 hectares) used in determining EEC (Appendices 12a and 12b). Map 3 gives an indication of the location and size of the various EEC classes.

Of this EEC land, 79% of the ecodistrict falls in the reserve class. This class is divided into two categories: legal reserves and policy reserves. The legal reserves are those areas that have legal

status under IUCN (The International Union for the Conservation of Nature and Natural Resources) codes of I, II, or III, such as wilderness areas and sites of ecological significance. The second type of reserve is set aside under various provincial policies, such as the Interim Old Forest Policy. The Tobeatic Wilderness Area and Old Forest Policy contribute most of the area to the reserve class in the Western Barrens.

About 20% of the ecodistrict is included in the extensive EEC. This classification implies that land is managed for multiple values using ecosystem-based techniques that conserve biodiversity and natural ecosystem conditions and practices.

Less than 1% of area is divided among the following designations: intensive (land managed intensively to optimize resource production from sites maintained in a forested state), converted (land which has been changed to an unnatural state for human use or areas where practices have significantly degraded site productivity), and unclassified.

DNR will continue to develop and evaluate other measures of conservation risk.

Road Index (Appendices 6, 7; Map 5)

The GIS-based "Road Index" provides a standard assessment and mapping of road distributions across ecodistricts to assist planners to objectively explore options for managing road networks and assess the intersection of road affects with other features of the landscape. Density, distance, and type of linear feature (e.g. road types, power lines) are used to calculate index values that indicate relative road pressure. The index value is mapped over all areas of the landscape using a one hectare grid. The overall index may be calculated for any area of interest, such as element, ecosection, ecodistrict or ecoregion, by averaging the index values within the area to provide a relative indication of land use pressure. The index provides a numerical indicator of road influence that can be used to monitor temporal changes and compare different landscapes.

In discussing road ecology, Forman (2004) describes five distinctive landscape types in North America: city-suburb, agricultural, forestry, arid-grassland, and natural landscape. Each landscape type has a characteristic pattern of road networks with distinctive ecological effects and planning considerations (Forman & Hersperger 1996). These were adapted in Nova Scotia to classify five Road Index Benchmark Ranges associated with particular land use settings:

- Remote Landscape (RI 0 to 6): Unpopulated with few roads, trails or other linear features
- Forest Resource (RI 7 to 15: Forest access roads are the primary linear feature
- Mixed Rural (RI 16 to 24): Mixed land use of rural settlement, forestry and agriculture
- Agriculture/Suburban (RI 25 to 39): Suburban settlement and/or open agricultural fields
- Urban (RI 40 to 100): Urban environment with high building densities, roads and few tracts of undeveloped land outside municipal parks

Road, trail, and utility corridors are vital components of human land use. However, transportation systems are expensive and produce many undesirable environmental effects, such as chronic siltation, invasion routes for exotic species, fragmentation, loss of productive land, and increased human presence.

Low road density areas are important features for biodiversity conservation. Planning should consider block scheduling options, life expectancy, class requirements, decommissioning strategies, and overall landscape function, in order to develop efficient access systems designed to minimize environmental impacts.

Western Barrens has an overall Road Index (RI) value of 1.4, which falls within the remote RI class range of 0 to 6. This value denotes a landscape in an unpopulated area with very few roads or trails. Each element within the Western Barrens falls in the remote class.

Low values of RI are to be expected as Highway 203 is the only paved road crossing the ecodistrict. A dirt road from Indian Fields to Silvery Lake is essentially a four-wheel drive trail. Prior to becoming a wilderness area, old oxcart trails were used by four-wheelers and new four-wheel trails were cut to access the numerous camps in the area.

Issues in management of roads outside the wilderness protected area might include:

- For possible Crown road construction, consideration of the implications of construction on the ecological landscape. Proper planning can reduce negative effects on fragmentation, aquatic ecosystems, sensitive sites, wildlife habitat, and protected areas.
- Development of road and trail maintenance plans to ensure deterioration does not have adverse ecological effects.
- Minimizing the impact of possible road and trail construction by ensuring best management practices are used in all facets of construction.

Fine Scale Features (Appendices 3, 4, 5; Maps 6, 7)

Data on the status and location of priority species, ecological land classification, representivity analysis, and other landscape characterization themes were used to identify special occurrences, rare ecosections, and ecological representivity. These fine scale features, which occur at a sub-landscape level, may require special management practices to conserve their uncommon characteristics.

Lindenmayer and Franklin (2002) refer to the importance of identifying "midspatial-scale" features and "patch-level habitats," including: (1) aquatic ecosystems, such as streams, lakes, and ponds; (2) wildlife corridors; (3) specialized habitats, such as cliffs, caves, thermal habitats, meadows, and vernal pools; (4) biological hotspots or places of intense biological activity, such as calving sites, over wintering grounds, and spawning habitats; and (5) remnants of old forest.

Priority Species and Other Special Occurrences (Appendix 3; Map 6)

Landscapes and ecosystems comprise many species of plants, animals, and other organisms. Some of these species are given priority in planning, management, and stewardship because they are rare, and/or at risk of going extinct locally or on a larger scale. The status and location of these species are important and data are collected, compiled and assessed on an ongoing basis.

The primary species data used in this report are from the Atlantic Canada Conservation Data Centre and DNR's Significant Habitat Database. Efforts are made to ensure data are as accurate and up-to-date as possible. Lists and maps indicate what is currently known. Due diligence tied to planning, management, and stewardship may require that surveys be carried out to update information or to fill gaps in our knowledge. Priority species may require special actions in terms of forest management and other activities that alter habitat and the landscape. If more information is required, or if management specific to a priority species needs to be developed, a regional biologist, Wildlife Division staff or other species experts should be contacted.

This section includes species at risk (refer to Table 1a, Appendix 3), species of conservation concern (Table 1b, Appendix 3), other conservation features (Table 1c, Appendix 3), and heritage features (Table 1d, Appendix 3, where available). *The list of species at risk and species of conservation concern were obtained from the Atlantic Canada Conservation Data Centre (ACCDC) databases, current to 2013*.

Species at Risk

The term "species at risk" is generally used to describe those species that are, to some extent, protected under provincial or federal endangered species legislation. Usually these species are protected where they occur on provincial, federal, and private lands. In Nova Scotia, the two main pieces of endangered species legislation are the Nova Scotia Endangered Species Act (NSESA) and the federal Species at Risk Act (SARA). Species can be classified as "endangered," "threatened," "vulnerable/special concern," or as "extinct" or "extirpated." In most cases for species at risk, recovery planning and special management are in place, as well as legal protection (NSDNR 2013).

Species of Conservation Concern

The term "species of conservation concern" refers to those species that are a high priority for conservation and special attention during planning, management, and stewardship. These species may be rare and/under a variety of threats but the threats do not currently warrant species at risk designation. In some cases these species could meet the criteria for a species at risk but a formal species at risk assessment has not been done. Species of conservation concern are a priority in landscape planning because a focus on them now can prevent these species from becoming species at risk later.

Species Ranking and Coding Systems

A number of ranking and coding systems identify and convey the status of species at risk and species of conservation concern. Some of this information is provided in Appendix 3 and Map 6 and is routinely used in planning, management, and stewardship activities.

Colour-coded "traffic light" systems are used provincially and nationally. These systems use "red to orange/yellow to green" categories to indicate the most at risk species (red) to the least at risk species (green). Details of these systems are available from the Wildlife Division.

A second system commonly used is NatureServe Conservation Data Centre system. This system uses numbers from one (extremely) to five (widespread, abundant) to denote the relative rarity and conservation concern for species. At the provincial scale numbers are prefixed with "S" to indicate that this is a state/provincial level rank. Ranks at the National (N) and Global (G) levels are also available for all species. In Nova Scotia, the Atlantic Canada Conservation Data Centre (http://www.accdc.com/) works with partners to provide ranks and data on species' occurrence.

Old Forest

The Interim Old Forest Policy requires a minimum of 8% of Crown land within each ecodistrict be identified and protected. The stands are selected to provide representation of landscape elements with the best old forest and old forest restoration opportunities. This has taken place in Western Barrens, where 25,144 hectares have been located. *In 2012, DNR released an updated Old Forest Policy, containing new IRM decision-making procedures* (http://novascotia.ca/natr/library/forestry/reports/Old-Forest-Policy-2012.pdf).

Atlantic Coastal Plain Flora and Other Plants

A significant occurrence of rare species in the Western Barren Ecodistrict is plant species belonging to a group known as Atlantic Coastal Plain Flora (ACPF). These plants became established in southwestern Nova Scotia as a result of a land bridge that existed between Nova Scotia and Massachusetts 10,000 to 14,000 years ago. Sea level was likely about 110 metres lower than today, exposing a broad plain along the Atlantic coast, which is now under water. A rise in sea level from melting glaciers eventually cut off the bridge, leaving disjunctive populations of plants geographically and genetically isolated from more southern populations.

Nova Scotia has over 90 species considered to be ACPF, with over one-third of these plants found nowhere else in Canada. Eleven are listed as species at risk under the federal Species at Risk Act and the provincial NS Endangered Species Act; and 25 are listed as red (at risk) species under the NS General Status Ranks.

The Western Barrens Ecodistrict supports a number of ACPF species at risk in Nova Scotia including Long's sedge (*Carex longii*), a red-listed (at risk) species, and Southern twayblade (*Listera australis*), a small orchid found in damp woods south of Flintstone Rock. This rare plant has also been given a red (at risk) status in Nova Scotia.

Yellow-listed (sensitive) species include golden-heather (*Hudsonia ericoides*) found on dry barrens or rock outcrops; netted chainfern (*Woodwardia areolata*) on the Roseway River; hairy swamp loosestrife (*Decodon verticillatus*) at Big Pine Lake, Digby County; and humped bladderwort (*Utricularia gibba*) at West Horseshoe Lake, Shelburne County.

Other ACPF species in this ecodistrict include buttonbush (*Cephalanthus occidentalis*), humped bladderwort (*Utricularia gibba*), yellow screwstem (*Bartonia virginica*), dwarf huckleberry (*Gaylussacia bigeloviana*), and broom crowberry (*Corema conradii*), which is found on dry barrens and rock outcrops.

Most of the ACPF species in the Western Barrens Ecodistrict are also found on lakes shared with adjacent ecodistricts.

Moose

One of the most significant species at risk occurrence in the Western Barrens Ecodistrict is the Nova Scotia mainland moose, which has been designated an endangered species under the Nova Scotia Endangered Species Act. Mainland moose are genetically distinct from those on Cape Breton Island where moose populations are healthy. One of the remnant populations of moose on the mainland is in southwestern Nova Scotia, in a large area encompassing most of the Tobeatic Wilderness Area and extending southwest to Pubnico in Yarmouth County, and southeast to Liverpool in Queens County. Although moose occur at a very low density throughout the ecodistrict, they are usually observed in open barren habitat.

Moose are commonly associated with forested landscape habitats that have been altered by a disturbance regime, such as fire, wind, disease or timber harvesting. The habitat requirements of moose are largely dependent on stages of forest succession. Early succession hardwood trees and shrubs provide important browse while mature conifer cover is valuable for shelter and protection.

Prior to the introduction of forest harvesting as a disturbance regime, the availability of moose habitat in this ecodistrict would have historically been tied to natural disturbances. The natural disturbance regimes for this ecodistrict have been determined to be mainly a frequent disturbance. This would have likely meant an availability of early successional hardwoods, which are an important browse for moose.

The Forestry / Wildlife Guidelines and Standards provide minimum habitat specifications for moose on Crown land through the 8% retention for old growth, maintenance of a 20 metre minimum buffer zone along water courses and through the maintenance of reasonable age class distribution.

Additional measures to provide for specific habitat needs of moose have been identified and special management practices addressing thermal refugia, aquatic feeding sites, calving areas, and clump size are required on Crown land where appropriate.

It is important to note that as moose occur in low numbers throughout a wide range in southwestern Nova Scotia, large areas of Crown land have been designated C2 (multiple and adaptive that allows for most uses but can require special management) because of a potential need for moose considerations in forest harvesting. The intent is to ensure that considerations for moose enter into management decisions at appropriate locations. *As of July 2012, interim Mainland Moose Special Management Zones have been identified for the province. Land use practices in support of moose are mandatory on Crown lands within these zones.*

American Marten

American marten (*Martes americana*) are known to occur in the neighbouring Clare and Sable ecodistricts, but status in the Western Barrens is unknown. Formerly called pine marten, they were once more widespread throughout Nova Scotia but had declined to a few scattered populations by

1900. A reintroduction program based in Kejimkujik National Park occurred between 1987 and 1994.

In recent years, several projects undertaken by DNR's Wildlife Division have aimed at shedding some light on the current distribution, abundance, and habitat selection of marten in southwestern Nova Scotia. Although historically described as a species of mature softwood, there is evidence that they are also using mixedwood forests and younger aged softwood stands, possibly related to the relatively moderate winter weather in this part of the province. Food in the way of mice, voles, and red squirrels (*Tamiasciuris hudsonicus*) would be available to marten in these stands, but denning requirements likely have to be met within mature softwood stands. Some areas in Western Barrens likely have the capability to supply habitat, so it will be important to address marten habitat considerations in Crown land forest management decisions.

American marten in the Western Barrens would most likely be descendants of New Brunswick marten released in Kejimkujik National Park in the 1980s, but it is possible that these may have mixed with remnants of the original southwest Nova Scotia population.

The American marten has been designated a red (at risk or may be at risk) species in Nova Scotia. The Cape Breton population is also listed as endangered, but more information on the status of marten in southwest Nova Scotia is needed before mainland marten receive a possible designation under the Endangered Species Act.

Turtles

The nationally and provincially listed endangered Blanding's turtle (*Emydoidea blandingii*) is found in freshwater wetlands, lake shorelines, and shallow coves in the ecodistrict. These turtles may use adjacent terrestrial habitats for nesting. The snapping turtle (*Chelydra serpentina*) has recently been listed as vulnerable under the Nova Scotia Endangered Species Act.

Birds

The common nighthawk (*Chordeiles minor*) and the olive-sided flycatcher (*Contopus cooperi*) are both listed as threatened under the Nova Scotia Endangered Species Act. The latter prefers coniferous forest edges and openings such as meadows, rivers, bogs, and ponds.

Rare Ecosections (Appendices 3, 12b; Map 7)

The ELC for Nova Scotia (Neily et al. 2003) classifies ecosections based on similar characteristics of landform, soils, and vegetation. These are the smallest mapped unit, and they repeat within ecodistricts. Ecosections have characteristic natural disturbance regimes and climax types.

Landscape elements were identified by combining ecosections with similar characteristics. Table 9 provides explanations of ecosections and their relationship to elements. Ecosections that are rare ($\leq$ 2% of ecodistrict area) or under high land use pressure (> 75% land conversion) are identified in Appendix 3.

Table 9 – Elements, Ecosections, Disturbance Regimes, and Climax Types			
770 Western Barrens Ecodistrict			
Landscape Element and Type	**Ecosections***	**Dominant Natural Disturbance Regime**	**Dominant Climax Type**
Pine Oak Barrens (Matrix)	WCHO	Frequent	white Pine (wP), red Oak (rO)
Spruce Pine Barrens (Patch)	ICHO	Frequent	black Spruce (bS), wP
Wetlands (Patch)	WTLD ICSM	Open Seral (Frequent)	bS, red Maple (rM), tamarack (tL)
Pine Oak Hills and Hummocks (Patch)	WCKK	Frequent	wP, rO
Valley Corridors (Corridor)	Various	Various	Various

***Ecosection Explanations**: For example, in **WMHO**, **W** stands for Well-drained under Soil Drainage **M** stands for Medium textured under Soil Texture and **HO** stands for Hummocky under Topographic Pattern

Soil Drainage: **W –** Well-drained **I –** Imperfectly drained **P** – Poorly-drained **WTLD** – Wetland

Soil Texture: **C** – Coarse-textured soils (e.g. gravel) **M** – Medium-textured soils (e.g. loam) **F** – Fine-textured soils (e.g. clay)

Topographic Pattern: **SM** – Smooth or flat **KK** – Hills **HO** – Hummocky **DM** – Drumlinoid **RD** – Ridges **DS** – Canyons and steep slopes

Western Barrens contains only one ecosection that is less than 2% of the ecodistrict, WCKK (0.5%). WCKK is more prevalent in the ecoregion at 9%. The area that would, according to the ELC, support climax species associated with WCKK – red oak-white pine-red pine – occupies 21.7% and 3.2% of the ecodistrict and ecoregion respectively.

The status of the red oak-white pine-red pine community type will likely require further investigation. Provincial forest covertype GIS information, based on aerial photography, indicates that red oak or red pine (other than in plantations) do not often occur as a dominant species in forest stands within the ecodistrict. Neither are they found, even as a minor component, in a large percentage of the areas thought to have a red oak-white pine-red pine climax type.

No ecosections are more that 0.5% converted.

Similar vegetation community types also provide linkages among ecosections. ICHO ecosections in neighbouring ecodistricts (South Mountain, Clare and Sable) border Western Barrens and have the same black spruce-white pine climax types. White pine or red oak, climax species in Western Barrens is a linkage to similar climax types in Clare and South Mountain. WCKK (red oak-white pine-red pine climax) an isolated, singly occurring ecosection, may be an extension of similar small patches in the South Mountain Ecodistrict where areas are thought to have, at least in part, the same climax species.

Ecological Representivity (Appendices 4, 5)

Ecological representivity describes the degree that the range of natural ecosystem diversity (elements, ecosections) is secured within reserve systems (e.g. Parks, Wilderness, Old Growth Policy).

The overall goal is biodiversity conservation through protection of natural habitat diversity. Ecological representation is employed as a "coarse scale" ecosystem planning concept. The analysis evaluated and identified the reserve status of the ecosections and climax communities located within the ecodistrict where two levels of reserves were recognized: legally protected reserves, such as Wilderness Areas; and policy protected reserves under the Integrated Resource Management classification to include old forest, Eastern Habitat Joint Venture Sites, non-designated provincial park reserves, and non-designated sites of ecological significance.

Legally protected reserves include the Tobeatic Wilderness Area, sites of ecological significance under moratorium (Big Pine Lake, Shelburne Barrens), the Tobeatic Wildlife Management Area, and a small portion of Kejimkujik National Park.

Policy protected reserves are under the integrated resource management classification and include old forest (C2E) set aside under the Interim Provincial Old Growth Policy and operational non-designated parks and reserves (Indian Fields).

Areas under reserve in Western Barrens total in excess of 59,000 hectares (Appendices 4 and 5).

Since such a large proportion of the ecodistrict is under legal reserve, there is little concern about ecological representation in the Western Barrens, although the status of the white pine-red oak-red pine community might be assessed.

ELA Summary

Element Interpretation (All appendices and maps)

The Western Barrens Ecodistrict is located in the interior of western Nova Scotia. The topography, geology and soils are similar to the adjacent South Mountain Ecodistrict 720, which surrounds the northern portion of the ecodistrict. The southern boundary is adjacent to Sable (760) and Clare (730) ecodistricts. The location of Western Barrens in the interior of the province, away from the moderating influence of the ocean, results in summers that are hotter and drier and winters that are cooler than in adjacent ecodistricts. Elevations reach about 200 metres.

This area comprises a rolling till plain underlain by a massive granite batholith. Repeated fires in this ecodistrict have caused widespread barrens, which have been slow to regenerate tree species due to the frequency of the fires and the coarse, shallow, and infertile soils. As well, many of the soils in this ecodistrict are characterized by a massive orstein layer (locally known as hardpan) which is impervious to water movement and significantly restricts rooting depth to a few centimetres below the surface.

Much of the ecodistrict is carpeted with dense layers of ericaceous (heath-like) vegetation, including huckleberry, rhodora, and lambkill on drier sites and leatherleaf and Labrador tea on the wetter sites. The extensive root mat created by these shrubby, acid-loving plants severely restricts regeneration of softwood species and only sparse stands of white pine and black spruce occur. Scrubby red maple and white birch occur throughout the ecodistrict.

Ericaceous vegetation and large boulders are common in the Western Barrens Ecodistrict.

If fire is removed from the disturbance regime, many of the better sites may revert to the tolerant hardwood and softwood associations as characterized by the few remaining old growth examples in the ecodistrict. Freshwater lakes and rivers account for 5.2% of the ecodistrict.

A total of 3.7% has exposed bedrock, although this may seem low given the significant amount of large boulders scattered across the landscape giving the local name "flintstone theatre" to the area.

Frequent wildfires and a geological history have created an impoverished ecosystem dominated by open coniferous woodlands of stunted and scrubby trees and ericaceous woody shrubs. The near absence of tolerant 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.

Strang (1972) notes that "although fire is undoubtedly a potent factor in maintaining shrub cover, pollen analyses indicate that open woodland developed many centuries ago in response to the soil conditions and the prevailing climate. The present shrubby vegetation is thus an expression of inherent site factors as well as of the effects of burning."

Strang (1972) described the barrens as underlain by a coarse, infertile soil characterized by a massive pan layer which restricts rooting to within a few centimetres of the surface and is impervious to water movement. Since this hardpan layer is so common in the soils of the Southwest barrens, Strang hypothesized two possibilities: 1) compaction of a shallow soil layer by glaciers; or 2) percolation of dissolved humic nutrients once vegetation had been established after the glaciation.

In the Western Barrens Ecodistrict, natural disturbances appear to have occurred frequently with the dominant agent being wildfire. The poor nutritional status of the parent granite material, accumulation of acidic plant materials from the subsequent ericaceous vegetation, dryness of the soils (due to the coarse texture), and the formation of hardpans in the soil have all combined with the negative impacts of fire on this type of site to contribute to the barren and woodland conditions present on much of the Western Barrens. Based on 40 years of fire records between 1959 and 1999, the potential for a lightning-caused fire in Western Barrens is one of the highest in the province.

The occurrence of hurricanes in this ecodistrict may be comparable to other areas of the province in terms of frequency and intensity, but the impact of these hurricanes on forest composition and structure is negligible given the over-riding influence of fire.

Insect epidemics have caused minimal damage to the forests of the Western Barrens Ecodistrict with no known stand-level destroying pest. Most damage is restricted to individual trees or small patches. Populations of spruce budworm and tussock moth have caused some defoliation and mortality. Bark beetle losses are usually restricted to individual trees or small patches. Pine shoot moths and white pine weevil cause tree deformity and seldom mortality.

Pine Oak Barrens
(Matrix) (WCHO ecosection) (33,173 ha)

The well-drained coarse-textured soil of the matrix, in pre-settlement times, is thought to support two types of climax communities. The white pine-red oak-red pine species association occurred on 50% of the element. Barrens occupied the remainder.

From observations of earlier aerial photography (1955), the majority of the area at that time was either barren or semi-barren. Much of the southerly section of this element has a history of repeated burning for blueberries and wildlife habitat. Accounts from local people tell of being able to see for miles as the result of a sparse to absent tree cover.

Presently, about 25% of the element is considered to be barren. Much of the formerly barren area is slowly recovering to forest. About 75% of the element is mature or multi-aged. Softwood covertypes (57%) are dominant, usually late seral black spruce or occasionally pine or black spruce-balsam fir.

Mixed-woods are usually intolerant, early seral species with red maple most prevalent but also containing white pine, black spruce, larch, and occasionally red oak. Hardwood covertype representing 16% of the area is usually red maple, at times with scattered red oak.

Often the taller, better-developed stands in this element are located as linear types in the ditches or swales between barren-like areas where moisture in not a limiting factor. These linear areas may not have been subjected to the ravages of fire because of the moisture regime.

Earlier reports (Mailman, 1975) indicate that some excellent white pine, red spruce and red oak was found between First Bear Lake and Second Bear Lake.

A heavy cover of ericaceous vegetation is present over a large portion of the area. Scattered wetlands, as treed swamps or bogs, are distributed throughout, although this element does border some larger wetland complexes in the south.

Flows

Water (headwater, streams); wetlands (catchment, filtration, groundwater re-charge); people (recreation, hunting, trapping, canoeing, hiking); moose (habitat); upland furbearers (habitat); birds (black-capped chickadee, common yellow throat); mining (non-operable tin mine).

Composition

Western Barrens Ecodistrict 770 (based on statistics up to 2007)
Composition of Pine Oak Barrens

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	2%	24%	74% (37 Mat + 37 OF)	37%
Seral Stage	Early	Mid	Late	Unclassified
	3%	48%	49%	<1%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	57%	16%	27%	<1%

Desired Condition

A mixture of barren and semi-barren areas within a forest of varying development classes. The forest dominated by mature red oak-white pine-red pine with lesser amounts of black spruce and red maple.

Spruce Pine Barrens
(Patch) (ICHO ecosection) (32,649 ha)

Historically, this imperfectly drained, coarse-textured soil found on hummocky terrain supported a black spruce, white pine forest on about 50% of the area. The remainder of the patch was barren. Approximately 10% of this patch is still classified as barren.

Only 1% of the forest in this element is in the establishment phase. Much of the forest is mature or multi-aged (74%) and, as in the matrix, composed to the largest extent of late seral black spruce as the primary softwood covertype. White pine communities occur on some of the better-drained areas. Early to mid seral mixedwoods, with red maple being the most prevalent hardwood and occasionally red oak can be found with larch, black spruce, and white pine. Hardwood stands are usually red maple with some red oak.

Ericaceous vegetation is prevalent throughout the area. This patch is broken up by numerous waterways and wetlands which may have had an impact on curtailing the extent of past forest fires.

Flows

Water (headwater streams, wetlands within catchment, filtration, ground water recharge); people (recreation, hunting, trapping, canoeing, hiking, some ATV and snowmobile use outside wilderness area); moose (habitat); upland furbearers (habitat); forestry (harvesting at South Wallace, Aspect Lake); birds (white-throated sparrow, swamp sparrow).

Composition

Western Barrens Ecodistrict 770 (based on statistics up to 2007)

Composition of Spruce Pine Barrens

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	1%	25%	74% (32 Mat + 42 OF)	42%
Seral Stage	Early	Mid	Late	Unclassified
	1%	31%	68%	<1%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	70%	6%	24%	<1%

Desired Condition

A mixture of barrens and semi-barrens in a forest of varying development classes. With the drier forested areas featuring white pine and the wetter areas comprising black spruce.

Wetlands

(Patch) (WTLD, ICSM ecosections) (5,842 ha)

This patch is characterized by wetlands, usually bogs or fens. Dispersed throughout the wetlands is a forest whose climax should be black spruce and white pine. Presently, the forested area is largely a softwood covertype (75%), most of which is black spruce. Some pine stands occur on better-drained land. The mixedwood is largely mid seral mature or multi-aged black spruce, red maple, larch, pine combinations. Hardwood is generally intolerant, usually red maple, often occurring as fens.

The Wetlands element in Western Barrens is usually associated with the existing river/stream/lake system. The southwest corner of the ecodistrict has few wetlands. Larger wetlands are found along the Roseway River north of Back Lake, north of Bowers Lake and east of Oakland Lake. Wetlands play an important role in water collection, filtering, and ground water recharge and provide critical habitat for species at risk.

Flows

Water (wetland functions of catchment, filtering, groundwater recharge); moose (habitat, potential aquatic food source, calving sites); people (recreation, similar to matrix); furbearers (marginal mink, beaver habitat); birds (swamp sparrow).

Composition

Western Barrens Ecodistrict 770 (based on statistics up to 2007) **Composition of Wetlands**				
Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	3%	35%	62% (26 Mat + 36 OF)	36%
Seral Stage	Early	Mid	Late	Unclassified
	3%	39%	58%	<1%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	75%	6%	19%	<1%

Desired Condition

Relatively undisturbed and well-connected wetlands within a black spruce dominated forest with some white pine and red maple.

Pine Oak Hills and Hummocks

(Patch) (WCKK ecosection) (402 ha)

This small, isolated patch element is located southwest of Sand Beach Lake along the Shelburne River. A feature of this element is a well-drained coarse-textured soil on hilly terrain. The area is thought to support a climax forest of red oak, white pine and red pine.

Presently, mature softwoods form the major covertype. Black spruce is dominant. White pine stands occur in a few places but are a minor component of many stands and are often much older than the surrounding forest.

Red maple is the most common hardwood in both mixedwood and hardwood covertypes. Red maple is often found with black spruce and some white pine in mid seral mixedwood or as the major species in a hardwood covertype.

Mature and multi-aged forests account for 87% of the development classes, with only 13% in the establishment or young classes. Inventory at the time of the report showed little or no red oak and red pine. Wetlands are rare in this element.

Flows

Little known about this ecosection.

Composition

Western Barrens Ecodistrict 770 (based on statistics up to 2007) **Composition of Pine Oak Hills and Hummocks**				
Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	1%	12%	87% (55 Mat + 32 OF)	32%
Seral Stage	Early	Mid	Late	Unclassified
	3%	30%	67%	<1%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	64%	15%	21%	<1%

Desired Condition

A forest of multiple development classes featuring predominately mature red oak-white pine-red pine with some representation in earlier seral stages.

Valley Corridors

(Corridor) (Various ecosections) (4,976 ha)

Western Barrens contains a large number of streams, rivers, lakes, and wetlands. Riparian corridors that border the water are extremely important for biodiversity, ecosystem functioning, and the maintenance of habitat for species at risk. Many species utilize both aquatic and terrestrial habitats.

Riparian corridors have been delineated along the major rivers and interconnected lakes in the ecodistrict. The major river systems include the Tusket (also Napier), Shelburne, Clyde (also Bloody Creek & Davis River), and Roseway. Most of the wetland patch is connected to those identified riparian corridors on the larger rivers or to unidentified corridors on smaller streams.

Much of the identified riparian corridors pass through the imperfectly drained barrens element whose climax is black spruce-white pine or barren. The dominant species in the riparian corridor will vary according to drainage but is most likely black spruce, red maple, white pine or combinations of these. Riparian corridors have been determined for the larger waterways using Wet Areas Mapping (WAP). Actual corridor width would require field verification.

Flows

Water (major rivers, associated wetlands); people (canoeing, trapping); aquatic furbearers (mink and beaver habitat).

Composition

Western Barrens Ecodistrict 770 (based on statistics up to 2007) **Composition of Valley Corridors**				
Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	2%	19%	79% (47 Mat + 32 OF)	32%
Seral Stage	Early	Mid	Late	Unclassified
	1%	39%	60%	<1%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	55%	15%	30%	<1%

Desired Condition

Generally, a continuous strip of undisturbed vegetation of species typical of the ecosection and disturbance regime.

Ecosystem Issues and Opportunities (All appendices and maps)

Management of the forest resource in the Western Barrens Ecodistrict should focus on forest biodiversity conservation across the range of spatial scales. General principles could include maintenance of connectivity, maintenance of landscape heterogeneity, maintenance of stand structural complexity, and maintenance of the integrity of aquatic systems (Lindenmayer and Franklin 2002). Actions taken toward these principles could consider:

- Status of red oak and red pine, a climax species in much of the ecodistrict. Current GIS forestry information shows these two species as being a very minor component. Local staff believe that determining these two species from aerial photography is a difficult task and there may be more of these two species, particularly red oak, than is currently depicted.
- Fire appears to have been the dominant natural disturbance regime (NDR) in the ecodistrict. The suppression of fire and the fact that no harvesting will occur, at least in the Tobeatic Wilderness Area, may point the development of the area in a direction other than what would occur under natural conditions (the occurrence of periodic fires).
- Natural disturbances, or lack of them, will likely have an impact on the endangered mainland moose.
- Attempts have been made in the past to restore forest cover to some of the fire barrens. Red pine was planted. Success of these plantations has generally not been good. Extensive, costly site preparation to break up the orstein layer (locally known as hardpan) would be required to establish white pine or black spruce. This is not likely a feasible option.
- Cultural information, particularly aboriginal, is lacking and could be investigated.
- Local people report that decades ago trout fishing was very good in the waters of the ecodistrict. Acid rain and soils that have a low ability to buffer acidic precipitation have resulted in a decline of trout stocks. These stocks will be further impacted by the spread of introduced and highly invasive chain pickerel.

Appendix 1: Flow - Element Interactions

Element	Water	Moose	People	Furbearers (upland)	Forestry	Mining	Birds	Furbearers (aquatic)
Pine Oak Barrens Matrix (WCHO) 1. rO wP rP climax	- streams which are headwaters of rivers - wetlands within catchment, filtration, ground water recharge - soil possible catchment because of orstein layer	- thermal refugia (primarily summer) - travel ways - potential browse of hardwood	- history of hunting, trapping, ATV, snowmobile, hiking, and canoeing. - motorized travel not permitted in Tobeatic Wilderness Area	- shelter, food, denning (rocky areas)	- on edges of ecodistrict, Napier, Nepsedek accessibility issue	- tin mine (not operable) - reclamation - future mineral potential	Black capped chickadee	_____
2. Barrens Climax	- streams which are headwaters of rivers - wetlands within catchment, filtration, ground water recharge - soil possible catchment because of orstein layer			- shelter, food, denning (rocky areas)	- reforestation failed	White Rock - rare plants	- common yellowthroat	_____
Patch Spruce Pine Barrens (ICHO) 1. bS wP climax	- similar to matrix	- thermal refuge, winter and summer cover - potential browse of hardwood - travel ways	- similar to matrix	- similar to matrix	- some harvesting South Wallace, Aspect Lake	_____	- white throated sparrow	_____
2. Barrens climax	- similar to matrix	- potential browse of hardwood	- similar to matrix	- similar to matrix	_____	_____	- common yellow-throat, swamp sparrow	_____
Patch _____ Pine Oak Hills and Hummocks (WCKK) 1. rO wP rP climax	- only a few wetlands	very little known about this isolated patch element						

Appendix 1: Flow - Element Interactions

Element	Water	Moose	People	Furbearers (upland)	Forestry	Mining	Birds	Furbearers (aquatic)
Patch Wetlands (WTLD, ICSM) 1. wetlands climax	- wetland functions of catchment, filtration, groundwater recharge, flood control	- potential aquatic vegetation for food in some wetlands	- similar to matrix				- swamp sparrow, common yellow throat	- marginal mink, beaver, rabbit
2. bS wP climax	- same as above	- potential calving sites - browse	- similar to matrix				- white-throated sparrow	
3. Red maple climax	- same as above	- food source					- swamp sparrow, common yellow throat	- marginal mink, beaver, rabbit
Corridors Valley Corridors (Tusket, Shelburne, Roseway, Clyde, and Davis Rivers)	- high acidity shallow, brownish colour - wetlands associated with rivers - high water temperatures during summer	- habitat	- historically canoe use, especially in early spring during higher water levels - historically trapping and hunting	- habitat	- likely some historical harvesting along corridors near the ecodistrict westerly and easterly boundaries		- limited use by waterfowl	- habitat

Appendix 2a: Landscape Connectivity Worksheet

Feature	Structure Type (corridor, matrix, patch, island)	Importance in Ecodistrict (high, moderate, low)	Significant Cases (species, ecosections, specific rivers)	Scale and Pattern of Operation (local, landscape)	Associated Natural Disturbance Regime	Characteristic Community	Characteristic Neighbour(s)	Barriers - Impediments to Functionality	Significant Issues	Management Strategy
Pine Oak Hills and Hummocks	- patch	- low	- ecosection southwest of Sand Beach Lake	- local	- frequent	- white pine, red oak, red pine climax - currently black spruce, intolerant hardwood	- riparian corridor (Shelburne River) - matrix - ICHO	- possible isolation - possible species composition	- lack of climax species?	- maintenance of connectivity
Wetlands 1. Red maple fens	- patch	- high for nutrients and biodiversity	- connected to riparian corridors - largest concentration on Shelburne River	- landscape	- infrequent	- red maple, grasses	- watercourses - barrens - uplands	_____	- moose habitat	- maintenance of connectivity
2. Black spruce-white pine community	- patch	- high (adjacent to wetlands high biodiversity)	_____	- landscape	- open seral/frequent - fire	- black spruce	- watercourses - barrens - uplands	_____	- moose habitat	- maintenance of connectivity
3. Open fens, bogs, marshes	- patch	- high	_____	- landscape	- open seral	- peat, grass sedge, shrub	- swamps, watercourses, uplands	- fire (burning)	- moose habitat	- maintenance of connectivity
Pine Oak Barrens 1. Red oak-white pine-red pine climax	- matrix	- moderate	- WCHO	- landscape	- frequent	- climax of red oak, white pine, red pine - currently black spruce, larch, white pine, red maple	- ICHO, riparian corridors, wetlands	- fertility - species composition - ericaceous vegetation	- amount of red oak and white pine - suppression of fire as natural disturbance agent	_____

Appendix 2a: Landscape Connectivity Worksheet

Feature	Structure Type (corridor, matrix, patch, island)	Importance in Ecodistrict (high, moderate, low)	Significant Cases (species, ecosections, specific rivers)	Scale and Pattern of Operation (local, landscape)	Associated Natural Disturbance Regime	Characteristic Community	Characteristic Neighbour(s)	Barriers - Impediments to Functionality	Significant Issues	Management Strategy
2. Barrens	- matrix	- moderate	- WCHO	- landscape	- frequent	- ericaceous vegetation (i.e. crowberry, huckleberry) - currently lot of infilling with black spruce, white pine, red maple	- ICHO riparian corridors, wetlands	- infilling by natural regeneration	- suppression of fire as natural disturbance agent	_____
Spruce Pine Barrens 1. Black spruce-white pine climax	- patch	- moderate	- ICHO	- landscape	- frequent	- climax of black spruce, white pine - currently black spruce, white pine, intolerant mixedwoods	- matrix, riparian corridors, wetlands	- ericaceous vegetation	- suppression of fire as natural disturbance agent	_____
2. Barrens	- patch	- moderate	- ICHO	- landscape frequent	- frequent	- ericaceous vegetation (i.e. viburnum, kalmia, huckleberry, leatherleaf) - currently lot of infilling with black spruce, white pine, mixedwood	- matrix, riparian corridors, wetlands	- infilling by natural regeneration	- suppression of fire as natural disturbance agent	_____

Appendix 2b: Connective Management Strategies

Structure Type	Attributes	Conditions of Concern	Management Strategies
Matrix	percolation, large patch, interior habitat	fragmentation, excessive edge	1. Promote contiguous forest structure using strategies such as patch aggregation and overstory-sustaining selection cutting 2. Promote large patch structure and interior conditions 3. Mitigate large scale, long term, fragmentation of the matrix that could impede percolation 4. Manage age and structure appropriate to NDR. For gap and infrequently disturbed ecosections maintain 60% mature cover
Patch Ecosystems	patch size, nearest neighbour, edge / interior, intervening habitat condition	undesirable connections, internal composition, excessive separations, threats to key patch	1. Identify and map key patch representatives (high quality, or critical link/distance) 2. Maintain natural isolations, as well as necessary "nearest neighbour" distances 3. Identify potential metapopulation habitat dynamics (if applicable)
Linear Corridors	continuous connection	barriers, interruptions, excessive edge	1. Mitigate unnatural barriers 2. Map and manage along natural boundaries 3. Conserve "interior" conditions where appropriate through strategic management of neighbouring ecosystems 4. Sustain continuity, through management of overstory and interior structure appropriate to NDR 5. Follow habitat regulations for buffer management. Establish wider buffers with natural boundaries along major waterways

Appendix 3: Special Occurrences (Ecodistrict 770)

Table 1a: Species at Risk (species protected by endangered species legislation on all lands)

SPECIES		DESIGNATION		
Common Name	**Scientific Name**	**Provincial**	**Federal**	**COSEWIC**
BIRDS	-			
Eastern Wood-Pewee	*Contopus virens*	Vulnerable	N/A	Special Concern
Common Nighthawk	*Cordeiles minor*	Threatened	Threatened	Threatened
Barn Swallow	*Hirundo rustica*	Endangered	N/A	Threatened
FISH	-			
American Eel	*Anguilla rostrata*	N/A	N/A	Threatened
MAMMALS	-			
Moose	*Alces americanus*	Endangered	N/A	N/A
REPTILES	-			
Blanding's Turtle - Nova Scotia population	*Emydoidea blandingii*	Endangered	Endangered	Endangered
Eastern Ribbonsnake - Atlantic population	*Thamnophis sauritus pop. 3*	Threatened	Threatened	Threatened

Appendix 3: Special Occurrences (Ecodistrict 770)

Table 1b: Other Species of Conservation Concern (other species that are a priority for planning, management and stewardship action)

SPECIES		DESIGNATION	
Common Name	**Scientific Name**	**Provincial General Status Rank**	**ACCDC S-Rank***
BIRDS			
Common Loon	*Gavia immer*	May Be At Risk (Orange)	S3B,S4N
Gray Jay	*Perisoreus canadensis*	Sensitive (Yellow)	S3S4
Black-backed Woodpecker	*Picoides arcticus*	Sensitive (Yellow)	S3S4
BRYOPHYTES			
a Moss	*Thelia hirtella*	Sensitive (Yellow)	S2?
DICOTS			
Nova Scotia Agalinis	*Agalinis neoscotica*	Secure (Green)	S3
Yellow Bartonia	*Bartonia virginica*	Secure (Green)	S3
Swamp Loosestrife	*Decodon verticillatus*	Sensitive (Yellow)	S3
Pinebarren Golden Heather	*Hudsonia ericoides*	Sensitive (Yellow)	S2
Eastern Cudweed	*Pseudognaphalium obtusifolium*	Secure (Green)	S3S4
Virginia Meadow Beauty	*Rhexia virginica*	Secure (Green)	S3
Elliott's Goldenrod	*Solidago latissimifolia*	Secure (Green)	S3
FERNS AND THEIR ALLIES			
Netted Chain Fern	*Woodwardia areolata*	Sensitive (Yellow)	S2S3
INSECTS			
Mottled Darner	*Aeshna clepsydra*	Secure (Green)	S3
MAMMALS			
Southern Flying Squirrel	*Glaucomys volans*	Sensitive (Yellow)	S2S3
MONOCOTS			
Narrow-leaved Panic Grass	*Dichanthelium linearifolium*	Sensitive (Yellow) May	S2?
Downy Rattlesnake-Plantain	*Goodyera pubescens*	Be At Risk (Orange) May	S2
Southern Twayblade	*Listera australis*	Be At Risk (Orange)	S2
Canada Rice Grass	*Piptatherum canadense*	Sensitive (Yellow)	S2

*Atlantic Canada Conservation Data Centre S-Ranks, where S1: extremely rare; S2: rare; S3: uncommon; S4: usually widespread, fairly common; S5: widespread, abundant; S#S#: a range between two consecutive ranks for a species/community denotes uncertainty about the exact rarity (e.g. S1S2); Consult http://www.accdc.com/en/ranks.html for descriptions of other ranks.
Provincial General Status Ranks as assessed in 2010 (http://www.wildspecies.ca/wildspecies2010).

Appendix 3: Special Occurrences

Table 2: Comparison of Ecological Emphasis Classification Index by Ecosection (Within Ecodistrict and Ecoregion)

Ecosections that form 2% or less of the ecodistrict and/or ecoregion area or are more than 75% converted are highlighted. The table provides a sense of how unique or uncommon an ecosection and its associated climax communities are within the ecodistrict and across the ecoregion. The EEC Index value conveys an indication of relative land use pressure on the ecosection.

Ecosection	Climax Type	Ecodistrict Occurrence						Ecoregion Occurrence					
		Area of Ecosection		Area of Climax Type (1, 2, 3) *		EEC Index ecosection	% Converted	Area of Ecosection		Area of Climax Type (1, 2, 3) *		EEC Index ecosection	% Converted
		Ha	%	Ha	%			Ha	%	Ha	%		
ICHO	bS wP	34,457	43.3	19,365	24.3	97.0	0.1	270,098	16.0	419,644	24.9	75 to 79	0.0
ICSM	wetlands	3,725	4.7	0	0.0	95.0	0.4	37,858	2.2	0	0.0	76 to 79	0.0
WCHO	rO wP rP	33,639	42.3	17,242	21.7	91.0	0.5	187,670	11.1	53,643	3.2	73 to 77	0.1
WCKK	rO wP rP	423	0.5	17,242	21.7	100.0	0.0	152,022	9.0	53,643	3.2	66 to 73	0.0
WTLD	wetlands	3,230	4.1	0	0.0	99.0	0.0	87,241	5.2	0	0.0	77 to 78	0.0

*Area of Climax Type refers to the total area of the climax community in the ecodistrict and in the ecoregion.

Appendix 4: Ecological Representivity Worksheet

Ecosystem			Crown Responsibility	Legal Reserves		Policy Reserves (including unproclaimed legal reserve proposals)		Ecological Emphasis Classification "Reserve Class"					
Ecosection	Climax Type	Area (ha)	Percent of Area on Crown (%)	Crown Area (ha)	Private Area (ha)	Crown Area (ha)	Private Area (ha)	Crown		Private		Total Reserve	
								ha	% (EcoS)	ha	% (EcoS)	ha	% (EcoS)
ICHO	bS wP	34,457	98.7	30,533	0	312	0	30,845	89.5	0	0.0	30,845	89.5
WCHO	rO wP rP	33,639	96.8	22,163	0	12	0	22,175	65.9	0	0.0	22,175	65.9
XXWA		4,119	0.0	1	0	0	0	1	0.0	0	0.0	1	0.0
ICSM	wetlands	3,725	91.2	2,885	0	77	0	2,962	79.5	0	0.0	2,962	79.5
WTLD	wetlands	3,230	98.3	3,106	0	0	0	3,106	96.1	0	0.0	3,106	96.1
WCKK	rO wP rP	423	100.0	423	0	0	0	423	100.0	0	0.0	423	100.0
Total		**79,593**		**59,110**		**401**		**59,510**		**0**		**59,510**	

See Appendix 12b for full Ecological Emphasis worksheet.

Appendix 5: Ecodistrict Reserves and Protected Areas Summary

Legal Reserves			Policy Reserves (including unproclaimed legal proposals)		
Act Designation	Area by Ownership		Policy Program	Area by Ownership	
	Crown (ha)	Private (ha)		Crown (ha)	Private (ha)
Wilderness Areas	58,718	0	Operational Non Designated Parks and Reserves	74	0
Sites of Ecological Significance Under Moratorium	2,680	0	Old Forest	25,144	0
Operational Non Designated Parks and Reserves	171	0			
National Parks and Adjuncts	92	0		0	0

Source: Crown Lands Forest Model Landbase Classification
Some of these programs may occur in the same area. For example, much of the Old Forest Policy forests are located in the Wilderness Areas.

Appendix 6: Description of Road Density Index

Road, trail, and utility corridors provide the background structure for transporting people and goods and are integral components of human land use. However, transportation systems are expensive and have a wide range of negative environmental impacts including, water course siltation, habitat fragmentation, dispersal obstruction, plant and animal mortality, exotic species invasion, loss of productive land, and an overall increase in human presence (Forman & Deblinger 2000, Reed et. al. 1996, Lindenmayer & Franklin 2002).

In order to reduce conflicts with natural systems and improve transportation safety there is clearly a need to incorporate landscape ecology into the planning of transportation networks (Forman 2004, Forman & Hersperger 1996, Spellerberg 1998). The emerging science of road ecology advocates integrating spatial analysis of the transportation system with ecological landscape analysis as a fundamental step in transportation system planning (Forman 1999, Lindenmayer & Franklin 2002, Diaz & Apostol 1992).

Efficient access systems can be strategically designed to minimize environmental impacts by incorporating factors such as harvest scheduling, life expectancy, location, road class requirements, decommissioning, and mitigation measures (Lindenmayer & Franklin 2002, Forman, 2004). Selection of transportation routes should incorporate knowledge of landscape functions to improve compatibility with natural ecosystem flows and connectivity (Forman & Hersperger, 1996). Furthermore, unroaded and lightly roaded areas are important for biodiversity conservation and should be considered during planning (USDA Forest Service 1999).

The GIS based "Road Index" procedure calculates and maps the spatial influence of the transportation network. It is a management tool designed to help planners gauge the relative influence of man-made linear features within landscapes. It was designed to help integrate the transportation system into an ecological landscape analysis process. In addition to mapping, the index provides a numerical indicator of road influence that can be used to monitor temporal changes and compare different landscapes.

Main Concepts

The influence of the transportation network on the ecological landscape varies with three main factors: 1) the type of transportation feature (e.g. highway, power line, trail, etc.); 2) the density o linear features in a given area, and 3) the distance of an area from transportation features (Forman 2004, Lindenmayer & Franklin 2002, Forman & Deblinger 2000). The Road Index is a weighting of these three factors reflecting their relative influence on ecosystem function.

Road density has a well-documented influence on many factors, including wildlife movements, fragmentation, human access, hydrology, and fire patterns (Forman and Hersperger, 1996). Forman & Deblinger (2000) report great variance in road effect zones, with average cumulative effects extending 300 metres from road edges, and some impacts penetrating up to one kilometre. Consequently, Index values are determined by assessing the transportation network within a one kilometre radius. The Index algorithm is applied to a grid of one hectare squares representing the landscape in question. The calculation provides a measure of the density of the transportation network and the specific distance to the transportation features.

The resulting index values are scaled to provide a potential range of 0 to 100. For the purpose of map interpretation, these values have been grouped into benchmark ranges that reflect characteristic patterns of land use in Nova Scotia.

In Nova Scotia, as in most populated jurisdictions, transportation networks are continuously changing as new roads and utilities are constructed and unused roads and trails deteriorate. As such, any analysis of the current state of these features must be based on reasonably up-to-date data. In this province, the Geomatics Centre, administered by Service Nova Scotia and Municipal Relations, is responsible for mapping transportation features which they include in their 1:10000 topographic map series.

On a provincial level, this work is updated on a ten-year repeat cycle and includes changes to existing features and the delineation of new features. Before undertaking road analysis, the Geomatics Centre should be contacted to ensure that the most current data is used to calculate the Road Index values. This data should be further updated using Landsat satellite imagery to add significant new roads and utilities that are over 500 metres in length on lands currently with a remote or forest resource index value.

Department of Natural Resources Forestry Branch maintains a table relating the topographic series attribute coding used by the Geomatics Centre to the feature categories used in the Road Index calculations, along with ArcView programs allowing the data to be formatted correctly. An inventory of recent Landsat satellite images is also available.

Full report contained in the Ecological Landscape Analysis Guidebook (http://www.gov.ns.ca/natr/library/forestry/reports/Procedural%20Guide%20For%20Ecological%20Landscape%20Analysis.pdf).

Appendix 7: Road Density Index Worksheets

Road index values for all tables are benchmarks that will be monitored over time to evaluate trends.

Table 1: Length of Access Systems and Index Weighting for Different Road Types

Road Type	Road Index Weighting	Length (km)
Trails, tracks, abandoned roads, and railways	1	25
Utility corridors	3	2
Gravel Roads and active railways	6	55
Paved streets and roads collectors	10	17.4

Table 2: Distribution of Road Index Classes

Road Index Value		Area of Ecodistrict Affected	
Indication	Range	Hectares	Percent
Remote	0 to 6	67,559	84.9
Forest Resource	7 to 15	9,066	11.4
Mixed Rural	16 to 24	2,359	3.0
Agriculture Suburban	25 to 39	612	0.8
Total		**79,596**	**100.0**

Table 3: Road Index Values for Each Landscape Element Type

Landscape Element	Area (ha)	Road Index
Valley Corridors	4,976	4.6
Pine Oak Barrens	33,173	1.4
Spruce Pine Barrens	32,649	1.0
Pine Oak Hills and Hummocks	402	0
Wetlands	5,842	1.1
Total	**77,042***	**1.4**

*Water is excluded from this table. Rounding, overlapping, and averaging of figures may lead to small differences in tables.

Appendix 8: Development Classes and Seral Stages

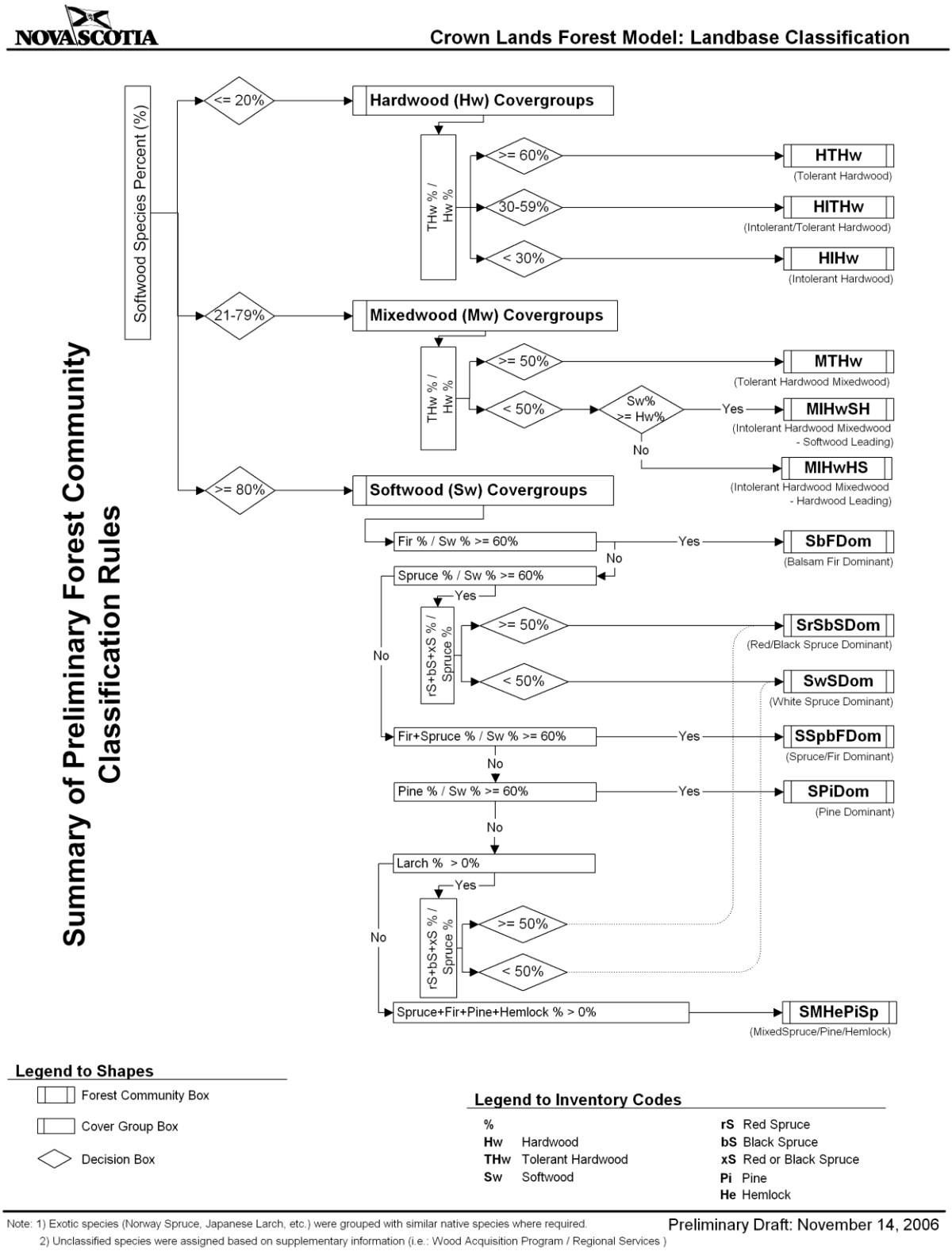
Development Class	Seral Stage
1. Forest Establishment (Height 0 to 6 m) • establishment of new growth following a stand-initiating disturbance • high diversity of forbs, shrubs, and tree regeneration, many of which are short-live shade-intolerant "pioneer" species • peak seed production by forbs and shrubs • approximate age 0 to 25 years	Early Seral Species (Score 10 to 23) • new growth dominated by pioneer tree species or unclassified regeneration Mid Seral Species (Score 24 to 37) • regeneration composed of a mixture of pioneer, mid-climax, and climax species Late Seral Species (Score 38 to 50) • regeneration dominated by climax species
2. Young Forest (Height 7 to 11 m) • young forests with developing tree canopies characterized by vigorous self-thinning and crown differentiation • early tree seed production, no understory development • approximate age 25 to 40 years	Early Seral Species (Score 10 to 23) • canopy dominated by pioneer tree species Mid Seral Species (Score 24 to 37) • canopy composed of a mixture of pioneer, mid-climax, and climax species Late Seral Species (Score 38 to 50) • canopy dominated by climax species
3. Mature Forest (Height > 11 m) • stands dominated by upper canopy with full differentiation into dominance classes • self-thinning process reduced • tree seed production prominent and regular • individual tree mortality creates canopy gaps that are soon closed by neighbouring tree growth • increased light initiates regeneration and early understory development • approximate age 40 to 125 years	Early Seral Species (Score 10 to 23) • canopy dominated by pioneer species • over maturity initiates canopy breakup and understory development Mid Seral Species (Score 24 to 37) • climax species in mixture with pioneers in the overstory • often reflecting a transition to climax domination following a period of sub-canopy development Late Seral Species (Score 38 to 50) • canopy dominated by climax species • over maturity initiates gap dynamic processes leading to multi-aged and old growth conditions
Multi-aged and old growth forest (Varying height and age and Old Growth ID) • dominant overstory exhibiting a variety of crown sizes and canopy densities • canopy gaps promote development of multi-layered understory and recruitment to overstory	Early Seral Species (Score 10 to 23) • canopy likely to break up and be replaced by developing understory Mid Seral Species (Score 24 to 37) • pioneer dominated overstory with canopy recruitment from a climax species-dominated understory Late Seral Species (Score 38 to 50) • climax species-dominated overstory maintained through gap dynamic processes

Summary of species-level seral score values by ecodistrict (Source: NSDNR - January 2014 revision)

Species		Ecodistrict																																						
Code	**Name**																																							
AS	ash	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
BA	black ash	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
BC	black cherry	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
BE	beech	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
BF	balsam fir	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	1	1
BP	balsam poplar	1	3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	3	1
BS	black spruce	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
EC	eastern cedar	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
EH	eastern hemlock	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	exotic species	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GB	grey birch	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IH	intolerant hardwood	3	2	4	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	4	3	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
IW	ironwood	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
JP	jack pine	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
LA	largetooth aspen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OH	other hardwood	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
OS	other softwood	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PC	pin cherry	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RM	red maple	3	2	4	2	2	2	2	2	4	2	5	2	2	2	2	2	2	2	2	2	5	3	2	2	2	2	2	2	2	2	2	3	2	3	3	2	2	2	2
RO	oak	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
RP	red pine	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	3	4	4	4	4	4	4	4	3	4	3	3	3	4	4	3	4	4	3	3	3	3
RS	red spruce	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
SM	sugar maple	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ST	striped maple	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
TA	aspen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TH	tolerant hardwood	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
TL	eastern larch	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
UC	unclassified	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WA	white ash	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
WB	white birch	3	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
WE	white elm	2	2	4	2	4	2	2	2	2	2	2	2	2	2	2	2	4	4	4	2	2	2	4	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2
WP	white pine	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
WS	white spruce	4	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	4	1	1
XS	red and black spruce	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
YB	yellow birch	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

A look-up table assigns each species in the forest inventory a value from 1 to 5 for its position on the successional scale. The look-up table may change by ecodistrict since climax on the coast or the Cape Breton Highlands differs from inland and lowland districts. This successional value is multiplied by the species' percent in the stand to give a stand successional score. Each stand may have up to four species, and the four percentages add to 10, so the stand successional scores range from 10 to 50. These scores are subdivided into three successional categories: 10 to 23 early, 24 to 37 mid and 38 to 50 late.

Appendix 9: Vegetation Community Classification – Forest Model



Appendix 10: Table 1: Forest Landscape Composition Worksheet (Western Barrens 770)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Pine Oak Barrens Matrix	WCHO (100.0%)	Softwood		Frequent	16,587; 50.0	Early	26	105	80	141	352	13,148; 57.3	EARLY	604; 2.6
						Mid	48	1,135	625	1,738	3,546			
						Late	49	2,173	3,362	3,656	9,239			
						Uncl	11	0	0	0	11			
		Mixedwood	rO wP rP	Frequent	16,587; 50	Early	0	49	64	18	131	6,156; 26.8	MID	10,940; 47.7
						Mid	42	1,189	1,416	1,696	4,343			
						Late	7	218	591	815	1,631			
						Uncl	52	0	0	0	52			
		Hardwood				Early	20	26	30	31	106	3,603; 15.7	LATE	11,271; 49.1
						Mid	17	536	2,134	365	3,051			
						Late	0	69	249	83.3	400			
						Uncl	46	0	0	0	46			
		Unclassified				Early	15	0	0	0	15	40; 0.2	UNCL	133; 0.6
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	25	0	0	0	25			
Total					**33,173***	**# ha**	**358**	**5,498**	**8,550**	**8,542**	**22,947**			
						%	**1.6%**	**24.0%**	**37.3%**	**37.2%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Western Barrens 770)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Spruce Pine Barrens (Patch)	ICHO (100.0%)	Softwood	bS wP	Frequent	16,324; 50.0	Early	14	148	46	89	297	18,375; 70.2	EARLY	364; 1.4
						Mid	89	1,515	522	2,163	4,289			
						Late	123	3,656	4,420	5,564	13,761			
						Uncl	27	0	0	0	27			
		Mixedwood		Frequent	16,324; 50.0	Early	0	0	18	10	28	6,250; 23.9	MID	8,119; 31.0
						Mid	7	444	1,096	1,236	2,782			
						Late	18	603	1,096	1,723	3,439			
						Uncl	1	0	0	0	1			
		Hardwood				Early	3	30	0	0	33	1,532; 5.9	LATE	17,652; 67.5
						Mid	6	144	796	102	1,048			
						Late	1	66	316	67.9	451			
						Uncl	0	0	0	0	0			
		Unclassified				Early	6	0	0	0	6	10; 0.0	UNCL	32; 0.1
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	4	0	0	0	4			
Total					**32,649***	**# ha**	**299**	**6,605**	**8,309**	**10,955**	**26,168**			
						%	**1.1%**	**25.2%**	**31.8%**	**41.9%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Western Barrens 770)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Pine Oak Hills and Hummocks	WCKK	Softwood				Early	0	5	0	4	9	221; 64.3	EARLY	9; 2.6
						Mid	0	0	0	7	7			
						Late	0	22	110	74	206			
						Uncl	0	0	0	0	0			
		Mixedwood	rO wP rP	Frequent	402; 100.0	Early	0	0	0	0	0	73; 21.2	MID	103; 29.9
						Mid	1	9	23	14	47			
						Late	4	0	12	10	27			
						Uncl	0	0	0	0	0			
		Hardwood				Early	0	0	0	0	0	50; 14.4	LATE	232; 67.5
						Mid	0	3	44	2	50			
						Late	0	0	0	0.0	0			
						Uncl	0	0	0	0	0			
		Unclassified				Early	0	0	0	0	0	0	UNCL	0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**402***	**# ha**	**5**	**40**	**189**	**111**	**344**			
						%	**1.4%**	**11.6%**	**54.8%**	**32.2%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Western Barrens 770)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Wetlands	ICSM (54.9%) WTLD (45.1%)	Softwood	bS wP	Open Seral	1810; 31.0	Early	6	48	10	12	75	2145; 75.0	EARLY	88; 3.1
						Mid	25	256	83	293	656			
						Late	50	472	384	508	1,414			
						Uncl	0	0	0	0	0			
		Mixedwood				Early	0	0	1	1	2	536; 18.7	MID	1126; 39.3
						Mid	5	116	102	126	349			
						Late	1	67	51	67	185			
						Uncl	0	0	0	0	0			
		Hardwood	rM		584; 10.0	Early	0	9	3	0	11	180; 6.3	LATE	1648; 57.6
						Mid	1	37	62	20	121			
						Late	1	4	43	0.7	49			
						Uncl	0	0	0	0	0			
		Unclassified				Early	0	0	0	0	0	0	UNCL	0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**5,842***	**# ha**	**89**	**1,008**	**738**	**1,027**	**2,862**			
						%	**3.1%**	**35.2%**	**25.8%**	**35.9%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Western Barrens 770)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Valley Corridors	ICHO (36.3%) WTLD (12.2%) ICSM (10.4%) WCHO (9.2%) WCKK (0.4%)	Softwood	bS wP	Frequent	1231; 24.7	Early	0	3	3	13	20	1118; 55.1	EARLY	20; 1.0
						Mid	23	74	27	104	228			
						Late	8	189	387	286	870			
						Uncl	0	0	0	0	0			
		Mixedwood	rO wP rP	Frequent	251; 5.0	Early	0	0	0	0	0	618; 30.4	MID	796; 39.2
						Mid	0	37	192	97	325			
						Late	0	36	127	129	293			
						Uncl	0	0	0	0	0			
		Hardwood	rM		113; 2.3	Early	0	0	0	0	0	294; 14.5	LATE	1214; 59.8
						Mid	0	16	206	21	243			
						Late	0	24	22	5.6	51			
						Uncl	0	0	0	0	0			
		Unclassified				Early	0	0	0	0	0	0	UNCL	0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**4,976***	**# ha**	**31**	**378**	**964**	**656**	**2,030**			
						%	**1.5%**	**18.6%**	**47.5%**	**32.3%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 2: Composition of Forest Communities (in Western Barrens Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Pine Oak Barrens (Matrix)	WCHO	Frequent	rO wP rP Barrens	S	SrSbSDom	9,781	42.7%	M	**Rapidly Drained** Early - bS, huckleberry Mid/Late - bS **Well Drained** Early – wB/rM, bF, rM Mid - rS Late – rS, eH, wP **Burned Areas** Early – bF, rM, wP Mid/Late – bS, rP, wP **Moist** bS, rM
				S	SPiDom	1,634	7.1%	L	
				S	SSpbFDom	1,433	6.2%	M	
				S	SMHePiSp	167	0.7%	L	
				S	SbFDom	119	0.5%	M	
				S	SwSDom	14	0.1%	E	
				M	MIHwSH	3,482	15.2%	M	
				M	MIHwHS	2,606	11.4%	E	
				M	MTHw	68	0.3%	L	
				H	HIHw	3,117	13.6%	E	
				H	HITHw	330	1.4%	M	
				H	HTHw	156	0.7%	L	
Total						**22,908**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Western Barrens Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Spruce Pine Barrens	ICHO	Frequent	bS wP Barrens	S	SrSbSDom	12,609	48.2%	L	**Well Drained** Early – wB, rM, bF Mid - rS Late - rS, eH, wP **Burned Areas** Early – wB, rM, bF, wP Mid/Late – oak, pine, bS, wP
				S	SpiDom	3,876	14.8%	L	
				S	SSpbFDom	1,429	5.5%	M	
				S	SMHePiSp	383	1.4%	L	
				S	SbFDom	75	0.3%	M	
				S	SwSDom	4	0.01%	E	
				M	MIHwSH	4,045	15.4%	M	
				M	MIHwHS	1,933	7.4%	E	
				M	MTHw	272	1%	L	
				H	HIHw	1,109	4.2%	E	
				H	HITHw	311	1.2%	M	
				H	HTHw	113	0.4%	L	
Total						26,158	**100.0%**		
*Forest Community Codes:	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant			SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H			MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood		

Appendix 10: Table 2: Composition of Forest Communities (in Western Barrens Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Pine Oak Hills and Hummocks	WCKK	Frequent	rO wP rP	S	SrSbSDom	214	62.3%	M	**Rapid** Early - rO Mid/Late - unknown **Well-drained** Early - wB, rM Mid/Late – rO, sM **Moist** Early/Mid/Late – bS, rM
				S	SpiDom	3	0.8%	L	
				S	SMHePiSp	2	0.6%	L	
				S	SspbFDom	2	0.5%	M	
				M	MIHwHS	48	14.1%	E	
				M	MIHwSH	25	7.2%	M	
				H	HIHw	50	14.4%	E	
Total						**344**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Western Barrens Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Wetlands	ICSM WTLD	Open Seral	wetlands bS wP rM	S	SrSbsDom	1,527	53.4%	L	**Moist** Early/Mid/Late - bS, rM **Wet** wetlands
				S	SPiDom	379	13.2%	L	
				S	SSpbFDom	142	5%	M	
				S	SMHePiSp	78	2.7%	L	
				S	SbFDom	19	0.6%	M	
				M	MIHwSH	363	12.7%	M	
				M	MIHwHS	139	4.8%	E	
				M	MTHw	35	1.2%	L	
				H	HIHw	133	4.6%	E	
				H	HITHw	26	0.9%	M	
				H	HTHw	22	0.8%	M	
Total						**2,862**	**100.0**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Western Barrens Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Valley Corridors	ICHO ICSM WCHO WCKK WTLD	Frequent, Open Seral	bS wP rO wP rP	S	SrSbSDom	735	36.2%	L	Corridors pass through many elements. See descriptions of successional types under corresponding ecosections in this table.
				S	SPiDom	284	14%	L	
				S	SSpbFDom	60	3%	M	
				S	SMHePiSP	37	1.8%	L	
				S	SbFDom	3	0.1%	M	
				M	MIHwSH	322	1.58%	E	
				M	MIHwHS	272	13.4%	M	
				M	MTHw	24	1.2%	L	
				H	HIHw	233	11.5%	E	
				H	HITHw	49	2.4%	M	
				H	HTHw	12	0.6%	L	
Total						**2,030**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10:
Table 3: Summary of "Potential Climax" Forest Abundance
(Based on ELC Interpretations)

Climax Type	Ecodistrict		Ecoregion	
	Hectares	Percent	Hectares	Percent
bS wP	19,365	24.3%	419,644	24.9%
rO wP rP	17,242	21.7%	53,643	3.2%
rM	696	0.9%	12,902	0.8%
Total	**37,302**	**46.9%***	**486,189**	**28.9%****

*Total does not add up to 100% because wetlands not added.
**Total does not add up to 100% because not all climax vegetation types in region are found in this ecodistrict
Source: Crown Lands Forest Model Landbase Classification.

Appendix 11: Ecological Emphasis Classes and Index Values

The classification includes all upland conditions, both forested and non-forested, under all types of administration and land use practices. It does not include water or other non-terrestrial conditions.

Ecological Emphasis Class	Conservation Factor	Description
Reserve	**1**	• Reserved lands which meet biodiversity conservation goals through preservation of natural conditions and processes. Resource management activities are not usually permitted except where required to perpetuate desired natural conditions. This class is assigned based on the types of laws and policies governing the management (for example: Wilderness, Parks, Conservation Easement, Old Forest Policy).
Extensive	**0.75**	• Lands managed for multiple values using ecosystem-based techniques that conserve biodiversity and natural ecosystem conditions and processes. • Forestry practices employ ecosystem-based prescriptions which consider natural disturbance regimes, successional trends, structure and composition. Natural regeneration is favoured to provide the next forest. Practices may include protection from fire and insects. • Management complies with the Forest Code of Practice, and excludes the use of herbicides, exotic tree species, off-site native species, genetically modified organisms, and stand conversion.
Intensive	**0.25**	• Lands managed intensively to optimize resource production from sites maintained in a native state (e.g. forested). Despite intensive practices, these lands are an important component of landscape structure and composition. • Management may eliminate or reduce the duration of some development processes, particularly mature old forest stages, and may result in non-natural succession. Practices may produce unnatural conditions such as exotic species, old field spruce, and monoculture plantations, or reduce structure and composition below ecologically desirable levels. Forests are protected from fire, insects, and competing vegetation. • Management adheres to environmental regulations and policies such as the Wildlife Habitat and Watercourse Protection Regulations, and Forest Code of Practice.
Converted	**0**	• Land converted to an unnatural state for human use, or areas where practices have significantly degraded site productivity (e.g. agriculture, urban development roads, Christmas trees, seed orchards, forest soil compaction).
Reserve	**1**	• Reserved lands which meet biodiversity conservation goals through preservation of natural conditions and processes. Resource management activities are not usually permitted except where required to perpetuate desired natural conditions. This class is assigned based on the types of laws and policies governing the management (for example: Wilderness, Parks, Conservation Easement, Old Forest Policy)

Appendix 12a: Ecological Emphasis Index Worksheet – Elements

Landscape Element	Total Land Area (ha)	Ecological Emphasis Classes					Ecological Emphasis Index	
		Reserve Area (ha)	Extensive Forest Management Area (ha)	Intensive Forest Management Area (ha)	Conversion to Non-Forest Area (ha)	Unclassified Land Use Area (ha)	Effective Area Range (ha)	EEC Index Range
Pine Oak Barrens Matrix	33,161	21,763	10,995	20	184	199	30,064 to 30,163	91
Spruce Pine Barrens	32,635	29,350	3,195	2	14	74	31,765 to 31,802	97
Wetlands	5,837	5,200	625	0	12	0	5,669	97
Valley Corridors	3,408	2,781	624	0	3	1	3,249	95
Pine Oak Hills and Hummocks	402	402	0	0	0	0	402	100
Total	**75,443**	**59,496**	**15,438**	**22**	**213**	**274**	**71,149 to 71,286**	**94**

These classes have been given a weighting percentage representing their ecological emphasis level: Reserve (100), Extensive (75), Intensive (25), and Converted (0). These percentages are applied to the area of land in each class to determine the "effective area" which is divided by "total area" to calculate the index.

The Unclassified land is too young to determine if it is being managed extensively or intensively. Therefore, an EEI range is reported based on it being all one or the other.

Water was not included as an element type. Areas were rounded to the nearest hectare.

EEI values are benchmarks that will be monitored over time.

Appendix 12b: Ecological Emphasis Index Worksheet – Ecosections

Ecosection	Total Land Area (ha)	Ecological Emphasis Classes					Ecological Emphasis Index	
		Reserve Area (ha)	Extensive Forest Management Area (ha)	Intensive Forest Management Area (ha)	Conversion to Non-Forest Area (ha)	Unclassified Land Use Area (ha)	Effective Area Range (ha)	EEC Index Range
ICHO	34,457	30,845	3,520	2	15	74	33,504 to 33,541	97
ICSM	3,725	2,962	750	0	13	0	3,525	95
WCHO	33,639	22,175	11,060	20	184	199	30,525 to 30,624	91
WCKK	423	423	0	0	0	0	423	100
WTLD	3,230	3,106	124	0	0	0	3,199	99
Total	**75,473**	**59,510**	**15,454**	**22**	**213**	**274**	**71,175 to 71,312**	**94**

For an explanation of calculations and other information to help better understand this table, please refer to the bottom of Appendix 12a.

Appendix 13:

Glossary B: Terms in Parts 1, 2, and 3

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.
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.
Coarse Woody Debris (CWD)	Dead tree stems greater than 7.5 centimetres in diameter and laying horizontally at 45 degrees or less. Provides habitat for many species and is a source of nutrients for soil development.
Commercial thinning	Silviculture treatment that "thins" out an overstocked stand by removing trees that are large enough to be sold as products, such as poles or fence posts. This treatment is carried out to improve the health and growth rate of the remaining crop trees.

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 the Ecological Landscape Analysis 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.
Ecological integrity	The quality of a natural unmanaged or managed ecosystem in which the natural ecological processes are sustained, with genetic, species and ecosystem diversity assured for the future.
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.
Ecozone	The first of five levels in the Ecological Land Classification for Nova Scotia Volume 1. Ecozones are continental ecosystems characterized by the interactions of macroclimate, soils, geographic, and physiographic features. The entire province is contained within the Acadian ecozone, one of 15 terrestrial ecozones in Canada.
Edge effect	Habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the more-or-less well-defined boundary between ecosystems, as, for example, between open areas and adjacent forest.

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.
Extensive land use	Lands managed for multiple values using ecosystem based techniques that conserve biodiversity and natural ecosystem conditions and processes.
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).
Fine filter approach	An approach to conserving biodiversity that is directed toward individual species and critical ecosystems that are typically rare or threatened. This approach is usually combined with the coarse filter approach to conserving natural ranges of habitat.
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.
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.
Intensive land use	Lands managed intensively to optimize resource production from sites maintained in a forested state.
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.
Long range management frameworks	A strategic, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource uses and values, consensus-based decision making, and resource sustainability.

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 growth. Mature forests include multi-aged and old growth. 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 growth.
Memorandum of understanding (MOU)	An agreement between ministers defining the roles and responsibilities of each ministry in relation to the other or others with respect to an issue over which the ministers have concurrent jurisdiction.
Mixed stand	A stand composed of two or more tree species.
Multiple use	A system of resource use where the resources in a given land unit serve more than one user.
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).
Precommercial thinning	A silviculture treatment to reduce the number of trees in young stands before the stems are large enough to be removed as a forest product. Provides increased growing space and species selection opportunities to improve future crop tree growth.

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.
Road deactivation	Measures taken to stabilize roads and logging trails during periods of inactivity, including the control of drainage, the removal of sidecast where necessary, and the re-establishment of vegetation for permanent deactivation
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 which 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.
Threatened species	A species that is likely to become endangered if the factors affecting its vulnerability are not reversed. A species declared as threatened under the federal or Nova Scotia species at risk legislation (NS Endangered Species Act or federal SARA).
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.
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.

Vulnerable species	A species of special concern due to characteristics that make it particularly sensitive to human 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).

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