



PORT HAWKESBURY PAPER STRATEGIC LONG-TERM PLAN

APPENDIX B DATA PACKAGE REPORT

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SUPERINTENDENT, CERTIFICATION ENVIRONMENT OUTREACH

EXECUTIVE SUMMARY

In December 2020, Port Hawkesbury Paper (PHP) and the Nova Scotia Department of Natural Resources & Renewables (NSDNRR) initiated a joint wood supply analysis for the eastern Crown landbase and PHP's Crown license area under the Forest Utilization License Agreement (FULA). The main goal of the study was to establish an updated sustainable harvest level that took new forest management guidelines from the 2018 Forestry Review (FR) process into account including a new TRIAD management model for Crown forests. The analysis' findings would also be in support of PHP's Forest Utilization License Agreement's impending renewal.

The initial base model was built on the NSDNRR 2016 Strategic Forest Analysis model. Six significant improvements to the functionality and structure of the base model were developed (herein called v6 base model). Numerous other alternate management scenarios were examined as part of the overall analysis, but only 15 were chosen to be reported as alternatives to the base model and sensitivity analysis for the final revision 6 model assumptions.

The timber supply analysis is also in support of an updated Sustainable Forest Management Long-term Plan from the 2015 plan. This report has been created to outline the information and assumptions that will be utilised to determine a sustainable harvest level for PHP's next 100-year timber supply.

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1 INTRODUCTION

Port Hawkesbury Paper (PHP) and the Nova Scotia Department of Natural Resources & Renewables (NSDNRR) initiated a joint project in 2021 to complete a new timber supply analysis for PHP's forest management area (FMA) in Eastern Nova Scotia, Canada. A timber supply analysis in support of PHP's 100-year SFMLTP (2015-2115) was completed in 2014, which set the spruce/fir annual allowable cut (AAC) at approximately 394,000 tonnes/year. To support the renegotiation of the Crown license agreement between PHP and NSDNRR (FULA), which is set to expire in 2022, the 2021 analysis was started to determine an updated sustainable harvest level for PHP FULA lands. This updated analysis will also feed into an updated Sustainable Forest Management Long-term Plan for PHP (100-year period from 2022 to 2122).

Additionally, new forest management strategies were created in response to the 2018 provincial forestry review process, and these strategies eventually affect sustainable harvest levels for Nova Scotia. In a perfect world, the new policies would already be in place, but many are still in the early stages with no firm release date. Given this, the analysis method will use interim guidance where available, and any results must be interpreted with consideration for the inherent uncertainty.

The idea of TRIAD management, which consists of three separate zones: Protected, Ecological Matrix (EM), and High Production Forestry (HPF), is a key component of the new strategy. The TRIAD model is a direct commitment of the Nova Scotia government for implementation on public land (Nova Scotia Government, February 2020). The protected zone for this analysis is the current status of existing and proposed protected areas. The analysis considers various zoning scenarios because the EM and HPF zones have not yet been established. The guidance from the December 2020 Draft Silvicultural Guide for the Ecological Matrix served as the basis for the EM management techniques (SGEM).

To identify a province-wide wood harvest that considers recent changes in forest policy, senior management within the Department of Natural Resources (DNR) launched the Nova Scotia Strategic Forest Analysis (SFA) in July 2016. A balanced approach that addresses wood harvest, forest wildlife habitat, and forest ecosystem objectives was the goal of the SFA. The base model with assumptions from the 2016 strategic forest analysis forms the basis for the base scenario used in this new timber supply analysis for PHP.

The team for the 2021 strategic analysis consisted of NSDNRR, PHP, and a consultant with Remsoft, the developer of the Woodstock Optimization Studio software used in this analysis:

- Joel Taylor, Forest Resources Superintendent – PHP
- Kari Easthouse, Consultant – Remsoft
- James Steenberg – Resource Analyst – NSDNRR
- Mark Hudson – Resource Analyst - NSDNRR
- Jamie Ring – Resource Analyst - NSDNRR
- Rob O'Keefe – Supervisor, Resource Analyst - NSDNRR

Existing FULA Agreement and FSC certification standards that the licensee is already required to follow were interspersed with the new management policies. A comparison of the spruce/fir harvest (000's gmt/yr) from the 2012 FULA agreement, the 2016 strategic forest analysis, and the 2021 eastern Crown area preferred scenario is shown in Figure 1 below.

Much of this summary report on the analysis' data package is based on NSDNRR's 2016 Strategic Forest Analysis (SFA) (NSDNRR, 2017) for the eastern Crown landbase and NSDNRR's Timber Supply Analysis Summary Report (NSDNRR, 2021). This Appendix should be viewed in conjunction with PHP's Timber Supply Analysis Appendix as part of its Sustainable Forest Management Long-term Plan. Data for this updated timber supply analysis were provided by various departments of the provincial government and PHP's own forest management data.

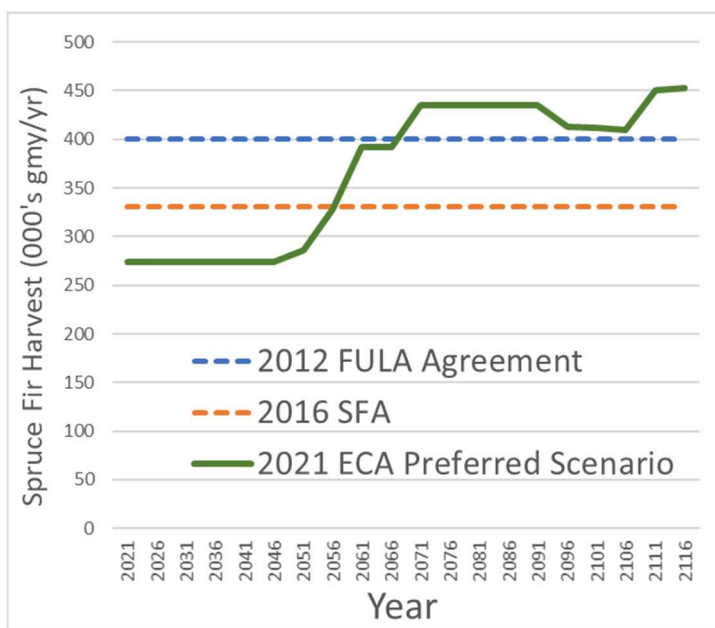


Figure 1. Comparison of Wood Supply Estimates for PHP FULA Lands

2 LAND BASE INFORMATION AND DATA

2.1 Landbase Classification

The beginning area-based inventory for the strategic timber analysis is provided by the landbase categorization data (version 2016.2). The inventory of forested land in the province is contained in the spatially explicit integrated information database known as the Crown Lands Forest Modeling (CLFM) landbase classification (Figure 2). The primary data sources are the Nova Scotia Forest Inventory, the Nova Scotia Ecological Land Classification, parks and protected areas layer, the layer for ownership, and the layer for integrated resource management (IRM) on Crown land. Table 1 below summarises the landbase for PHP Crown FULA lands.

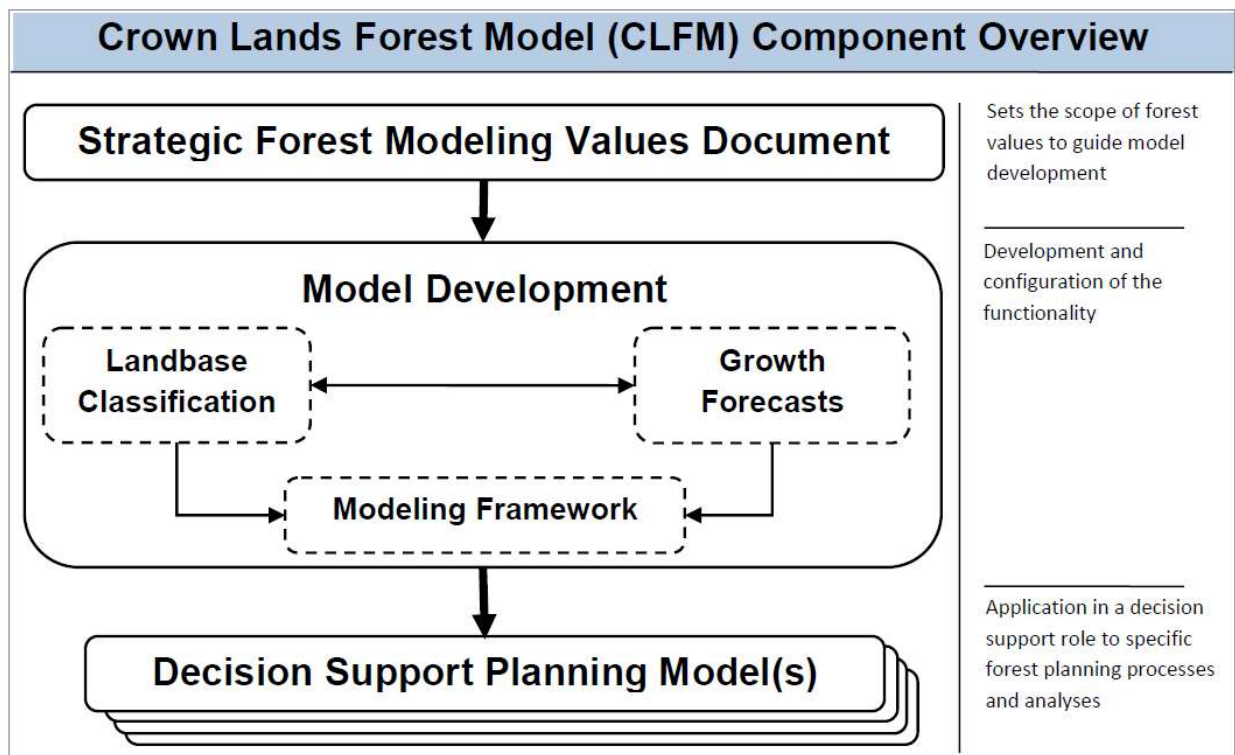


Figure 2. Crown Lands Forest Modeling (CLFM) Overview

The CLFM was used as the base model for the new PHP/NSDNRR 2021 model analysis. As necessary, data input layers were modified or updated to reflect any changes that may have occurred from the CLFM model in 2016-17 to 2021.

2.2 Landbase Netdown and Data Summary

The landbase netdown process begins with the land base's gross area and gradually reduces it in accordance with certain classification criteria. Area is systematically eliminated by the netdown in order to create a base for a productive forest with timber harvesting. The area reduced under each netdown category, as well as the present and projected productive forest with timber harvesting, are shown in Table 1.

As landbase layers are overlaid, attributes are coded to allow for partitioning of results based on forest and non-forest values. The total land area includes all area, crown wilderness area and non-forested land are removed to create the forested landbase. After removing permanent exclusions (off limits to forest management prescriptions), the remainder is the working landbase which contributes to wood supply. The working landbase is largely occupied by special management lands, which dictate treatment prescription details (NSDNR, 2021b). Any specific PHP management objective is also included in the netdown (e.g. PHP's watershed areas for Margaree and St. Mary's River).

Table 1. Landbase Summary & Netdown for PHP License Area

Analysis Unit: Eastern Crown: PHP License Area					
Landbase Category					Area(ha)¹
1 Total Land Area					510,342
1.a	Non-Forested Land	83,004			
2 Forested Landbase (FLB)					427,338
		[gTLB]	[gFLB]	[nFLB]	
2.a.1	Existing Protected Area	44,046	37,655	37,655	
2.a.2	Proposed Protected Area	28,440	22,672	22,672	
2.b.1	DNR Lynx Habitat Buffers	24,296	23,840	18,904	
2.b.2	DNR Moose Habitat Buffers	12,653	12,199	10,857	
2.b.3	Coastal Plains Flora Buffers	136	132	103	
2.b.4	Boreal Felt Lichen Buffers	6,809	5,157	3,966	
2.b.5	Other Special Site Habitat	1,166	858	562	
2.c	DNR Old Growth Policy	40,707	40,587	9,207	
2.d	Inoperable/Subjective Removals	36,777	34,260	19,545	
2.e	Other Regional Harvest Exclusions	2,235	2,179	1,396	
2.f	Aboriginal Offered Lands	100	99	6	
2.g.1	Regulation Watercourse Buffers (20m)	32,936	32,031	12,039	
2.g.2	Main River Watercourse Buffers (100m) (Crown)	103	102	64	
2.g.3	Non-Watercourse Open Bog Buffers (20m) (Crown)	1,932	1,897	522	
2.h	Sensitive Forest Groups (Crown)	5,428	5,378	5,378	
2.i	Draft IPCA (Crown)	6,655	5,917	2,986	
2 FLB Exclusions Sub-Total				145,861	

3 Working Landbase (WLB)		[gTLB]	[gFLB]	[nFLB]	[nWLB]	281,477
3.a.1	Non-Watercourse Treed Bog Buffers (20m) (Crown)	10,590	10,456	4,839	4,839	
3.b.1	Marten Patches	23,163	21,267	9,271	9,232	
3.b.2	Deer Wintering Areas	21,581	17,531	10,761	10,591	
3.b.3	Mainland Moose Concentration Areas	199,237	164,334	121,116	110,772	
3.b.4	Wood Turtle Habitat	4,418	3,892	2,332	295	
3.b.5	BFL Habitat buffers 200-500m	27,281	21,565	13,705	6,968	
3.b.6	BFL Bicknell's Thrush Habitat Areas	68,006	52,998	34,728	33,491	
3.c	Rare Ecosections	25,156	17,812	10,962	3,430	
3.d	Protected Areas 100m Buffer	12,573	10,862	8,373	2,403	
3.e	Corridors	44,559	36,717	21,465	6,309	
3.f	PHP Watershed (Margaree/St. Mary's)	90,599	79,844	58,802	8,073	
3.g	IRM - C2 Areas	267,547	224,939	129,115	40,934	
3 WLB Restrictions Sub-Total					237,338	
4 WLB No Restrictions						44,139
						NSCLFM Landbase2021v1a
¹ All area statistics exclude water						
² TLB, FLB and WLB were prefaced with 'g' indicating total intersect area and 'n' indicating intersect area after previous						

The above table uses the following area statistics for exclusion category description (NSDNRR, 2021b):

- **gTLB: Gross Total Landbase:** This category reports the total landbase area contained inside the whole exclusion category, excluding any overlap with other exclusion categories. The gTLB statistic does not include any inland water body area.
- **gFLB: Gross Forested Landbase:** Only the forested area that falls within the exclusion category's boundaries is reported in this area statistic. What is or is not regarded to be forested is determined using data from the forest inventory. The [fornon] and [species] attributes from the photo-interpreted forest inventory are used to form the rules for classifying forested landbases. A stand is regarded as being a part of the forested landbase if it has a valid [species] label or, in the absence of a [species] label, a [fornon] code indicating the potential to become a forest stand in the future. The loss of land for roads and trails that were not included in the main forest inventory is one exception.
- **nFLB: Net Forested Landbase:** The forested area inside the exclusion category's boundaries that hasn't already been taken into consideration by earlier exclusion categories is reported by this area statistic. Since there is no double counting in the nFLB area, these areas can be added to get accurate totals.
- **nWLB: Potential Working Landbase:** The forested area inside the exclusion category's boundaries that does not overlap with any other exclusion categories is reported by this area statistic. The nWLB offers a way to evaluate potential benefits to the working landbase that come with eliminating any particular exclusion category. Since they are category-specific, it is impossible to sum them up without first addressing any overlap between newly released categories.

Figure 3 shows the distribution of these categories within the forest management area by total land area available.

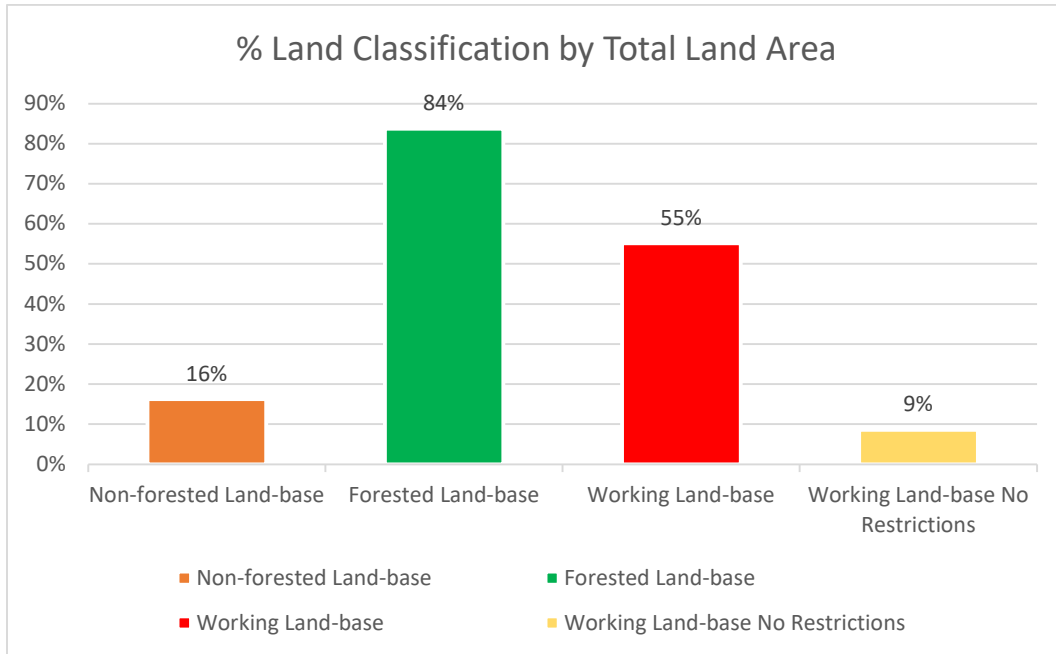


Figure 3. Percent Land Classification by Total Land Area - FULA

Even though the strategic forest model makes use of the complete forested landbase (FLB), only a fraction of this, known as the "working landbase," is available for scheduling forest management operations (WLB). The complete FLB is not included in the working landbase due to numerous operational and policy requirements (i.e., protected areas, old forest policy, wildlife habitat buffers, watercourse buffers, inoperable stands, etc.).

2.3 Non-Forested Landbase

The only data used to create the non-forested landbase exclusion category comes from the base forest inventory. This class, which draws heavily from the attribute field of the forest inventory [fornon], is substantially aggregated. There is no overlap in the classification because each classification is based on the attributes of the forest inventory. Figure 4 below provides an overview of the non-forest classification process. Areas classified as ocean, inland water, roads/trails, non-forested vegetation, naturally non-vegetated, anthropogenic non-vegetated, and anthropogenic vegetated are not included in the forested landbase.

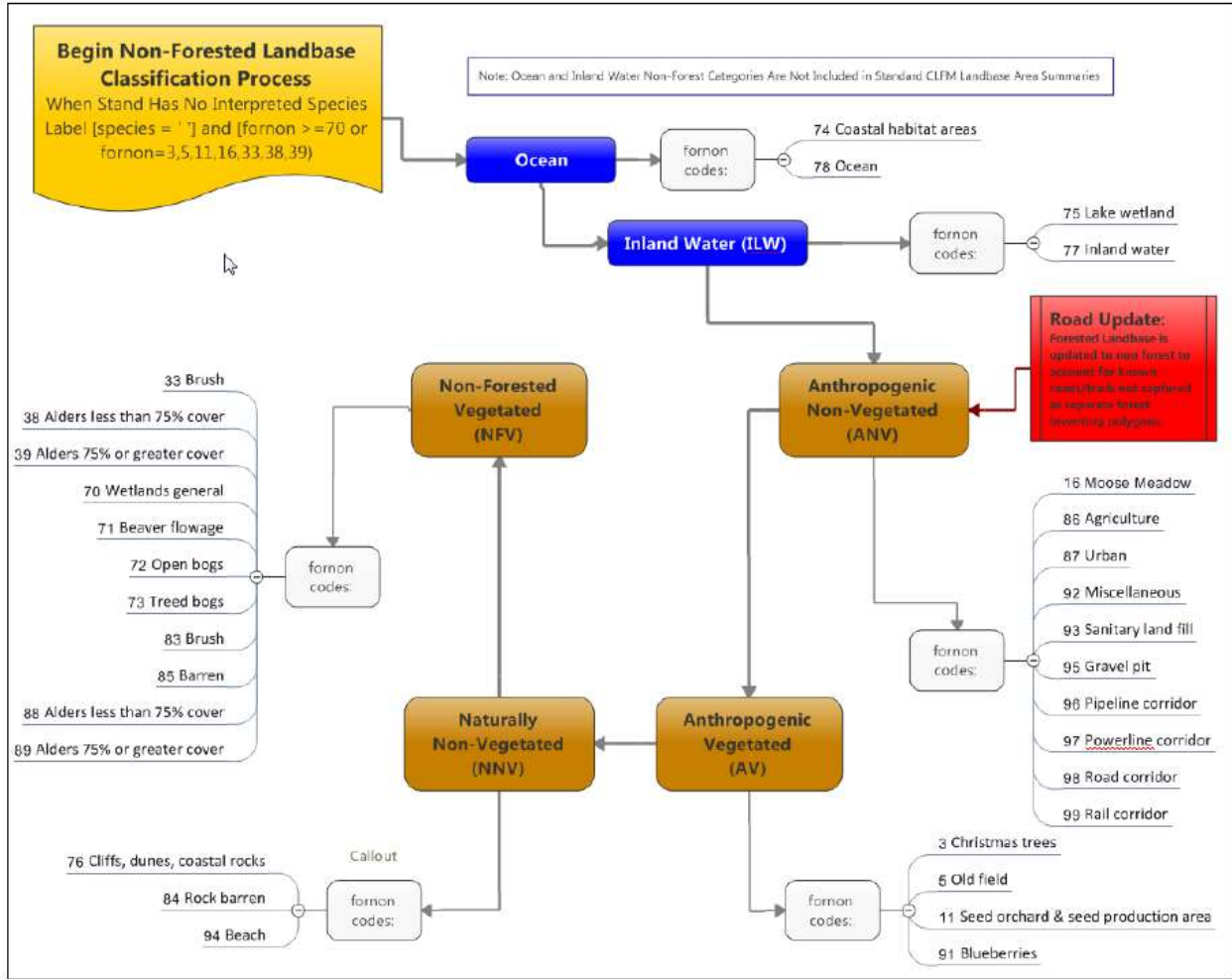


Figure 4. Non-forested Landbase Classification Rule Set (NSDNRR, 2017)

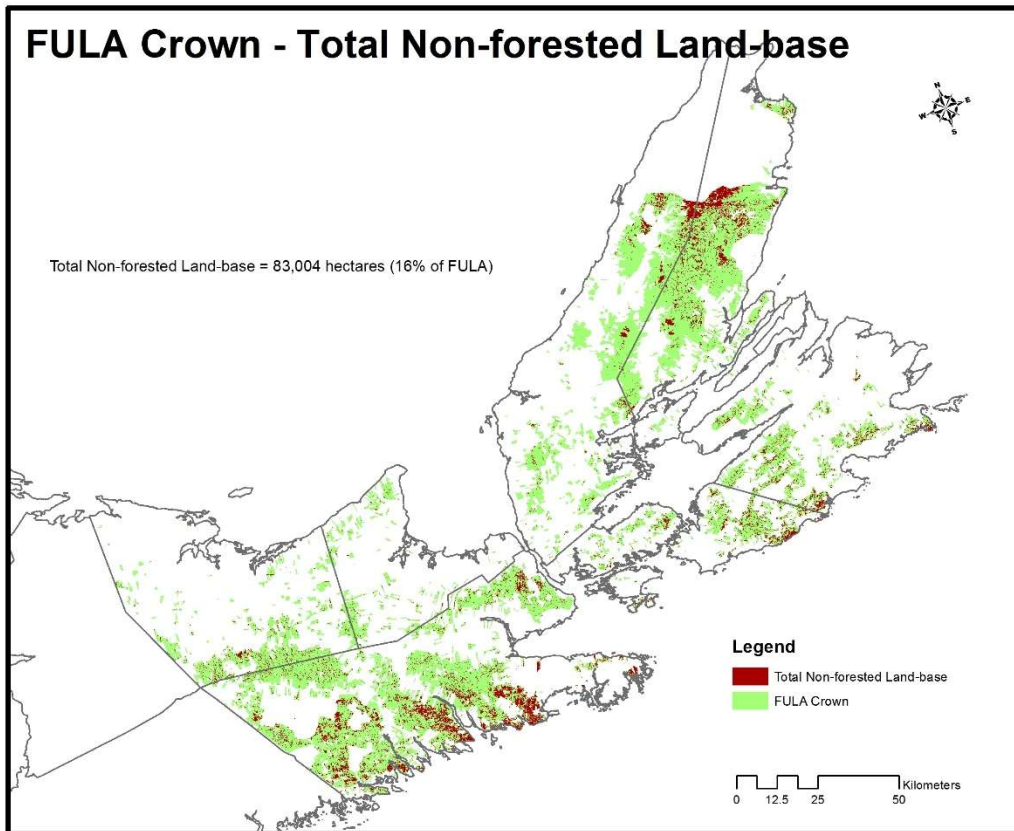


Figure 5. Total Non-forested Landbase on FULA Crown

2.4 Forested Landbase

2.4.1 Protected – Existing and Proposed

The provincial parks and protected areas (PPA) layer serves as the foundation for the existing and prospective protected areas exclusion categories. Both the specified areas that have already been identified and the prospective regions inside the PPA layer that have not yet been designated fall under this exclusion category. It is possible to enhance the working landbase available for forest management planning if any of the proposed areas are ultimately removed from protected status. Any area freed would have to pass through the following exclusion classes, which will temper any net working landbase gains, with protection being the first exclusion class.

All other exclusion categories overlapped with the planned and existing protected area exclusions. The categories old forest policy, inoperable/subjective removals, other regional harvest exclusions, and 20 m watercourse buffers were among the prominent overlap categories. Understanding overlap with other exclusions improves our comprehension of the entire impact of the working landbase.

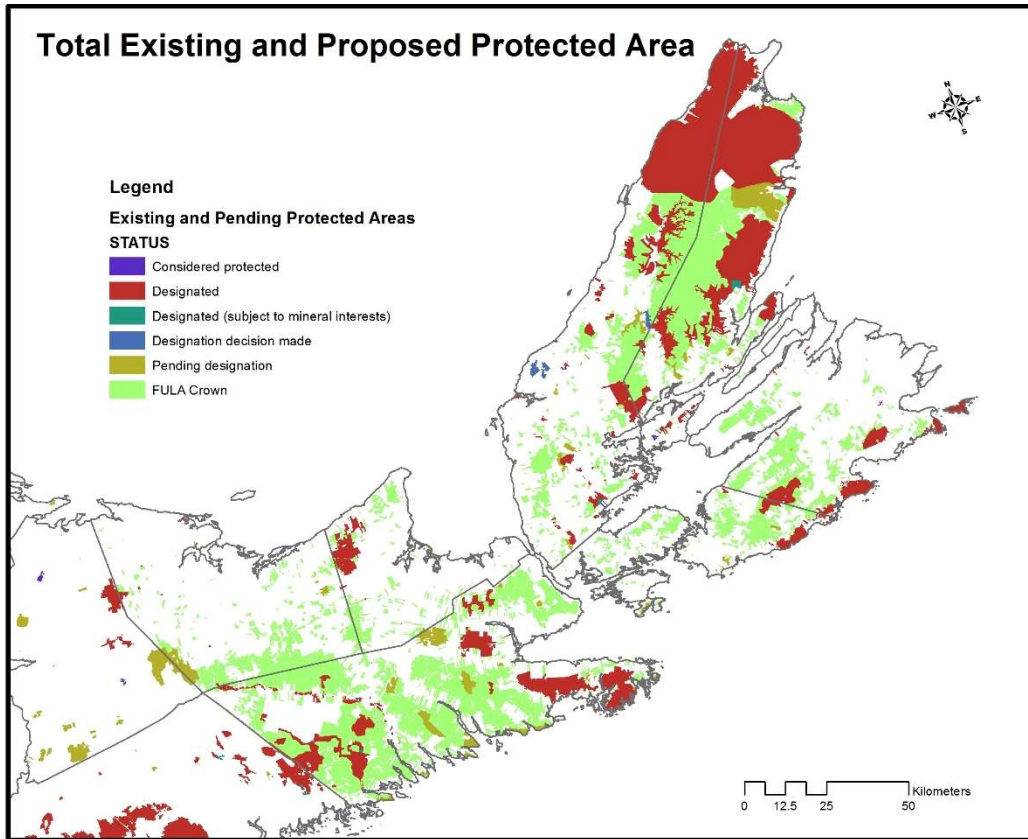


Figure 6. Total Existing and Proposed Protected Area

2.4.2 Wildlife Conservation Buffers

This exclusion category includes five threatened or endangered wildlife species that are subject to particular management procedures that typically bar the area from any type of conventional forest management or harvesting activity (Table 2). The NSDNR Wildlife Division served as the main resource for instructions and information needed to include these areas in the analysis. While some buffer layers were established inside the resource analysis group based on buffering rules provided by Wildlife Division, certain buffer layers were directly provided by the Wildlife Division.

This exclusion category's requirement that it only apply to Crown land is a key feature. The habitat buffers frequently crossed into private property, but they didn't serve as a barrier to that property. All of the habitat buffers are built upon NSDNR's management guidelines, and there is no legal need that they be implemented on private property. A summary of each of the layers in this category that make up the wildlife conservation buffers exclusion group is given in Table 2.

Table 2. Wildlife Conservation Buffers Summary

Wildlife Conservation Buffer Layer	Buffer Width	Buffer Feature	Data Source
Canada Lynx	100 m	Wetlands	January 2012, NSDNRR Wildlife Division
Mainland Moose	20 m	Watercourses	Base Forest Inventory
Atlantic Coastal Plain Flora	100 m	Area Locations	June 2015, NSDNRR Wildlife Division
Boreal Felt Lichen	200 m	Point Locations	2021, MTRI
Other Special Sites	N/A	N/A	PHP

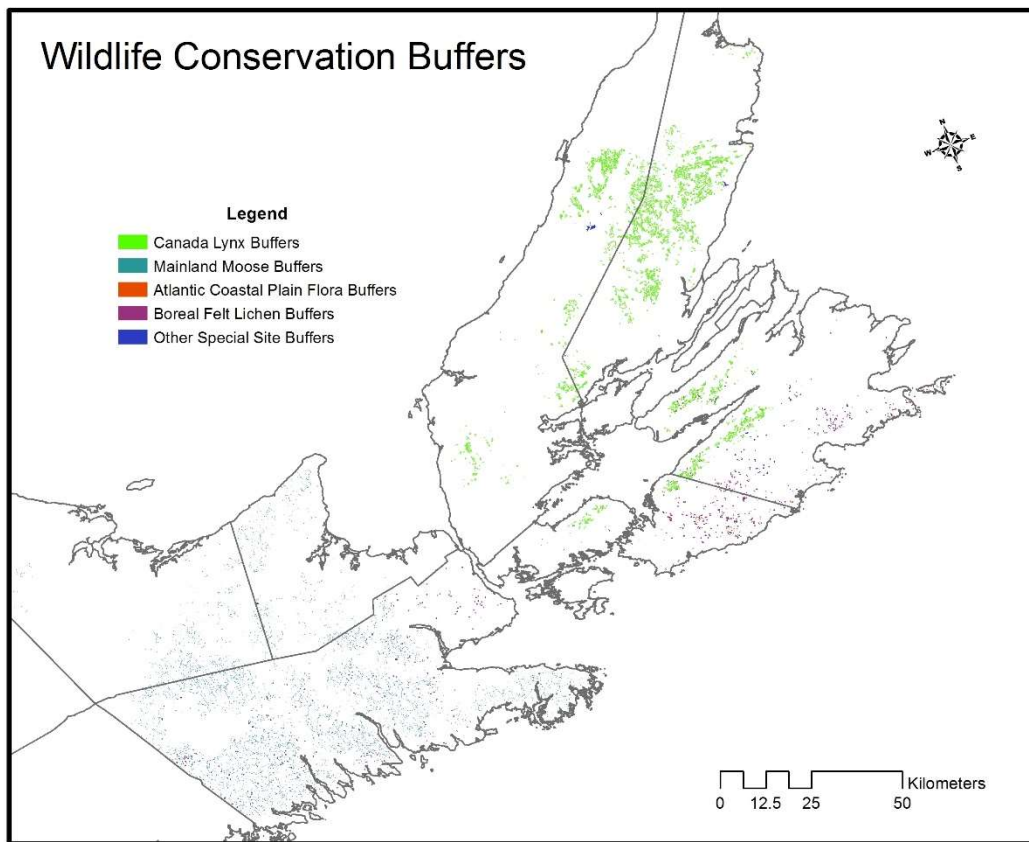


Figure 7. Wildlife Conservation Buffers

2.4.3 Old Forest Policy

The NSDNRR old forest policy exclusion layer was originally developed in 2007. Since then, additional areas of known old growth stands have been added. In 2018, the NSDNRR initiated a new old-growth forest protocol for the assessment of mature climax hardwood stands greater than 11 meters height based on forest inventory data. Since that time, an additional 3,235 hectares of old-growth areas have been identified and protected on PHP's Crown license area.

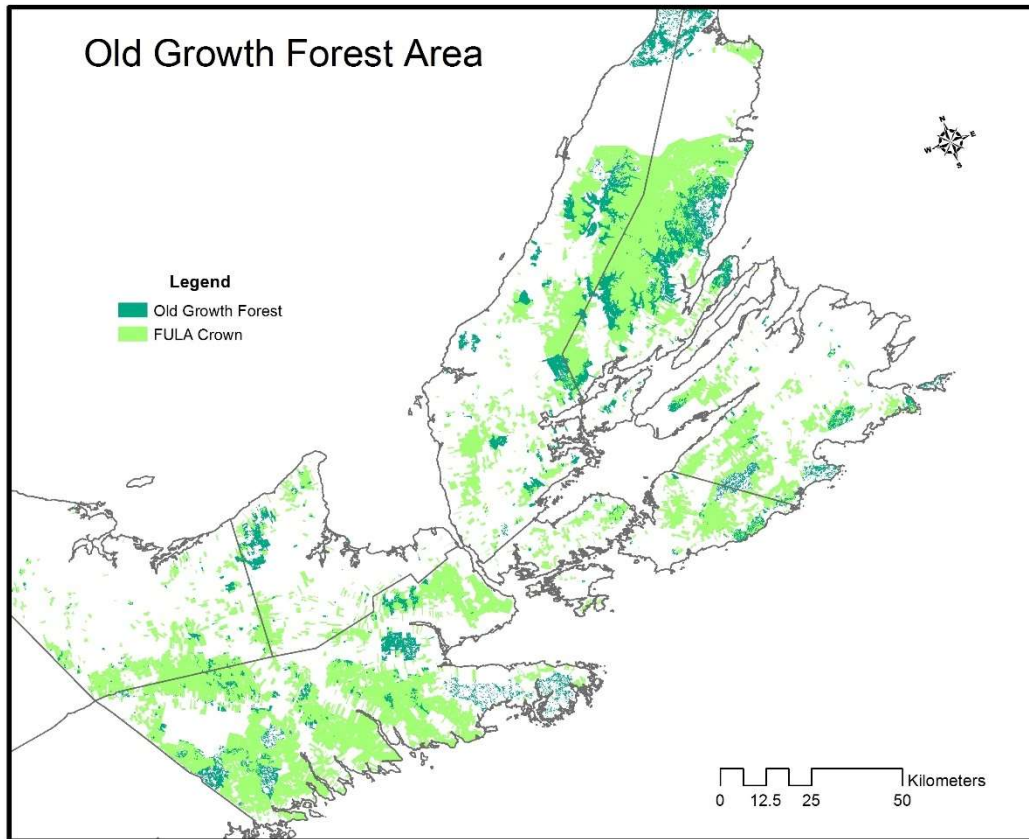


Figure 8. Old Growth Forest Area

2.4.4 Inoperable/Subjective Removals

Three sub-classifications are combined to create the inoperable/subjective removal exclusion classification:

1. Low Site Productivity
2. Lake Islands or Offshore Islands
3. Steep Slopes

While the steep slopes classification was created using a different method, the low site and island classifications were directly obtained from the forest inventory data.

The low site class pulls any forested stands classed as having a softwood land capability (LC) rating of $\leq 2 \text{ m}^3/\text{ha}/\text{yr}$. The lake islands were directly extracted from the base forest inventory by removing all stands with the inventory code [Indclass]=96, which is used to identify lake islands by picture interpretation [Indclass=96]. The offshore islands were obtained using a different examination of the spatial data from the forest inventory for land encircled by ocean.

The provincial digital elevation model (DEM) provides the foundation for the steep slopes layer. To remove slopes greater than 30%, a slope raster was made using this DEM.

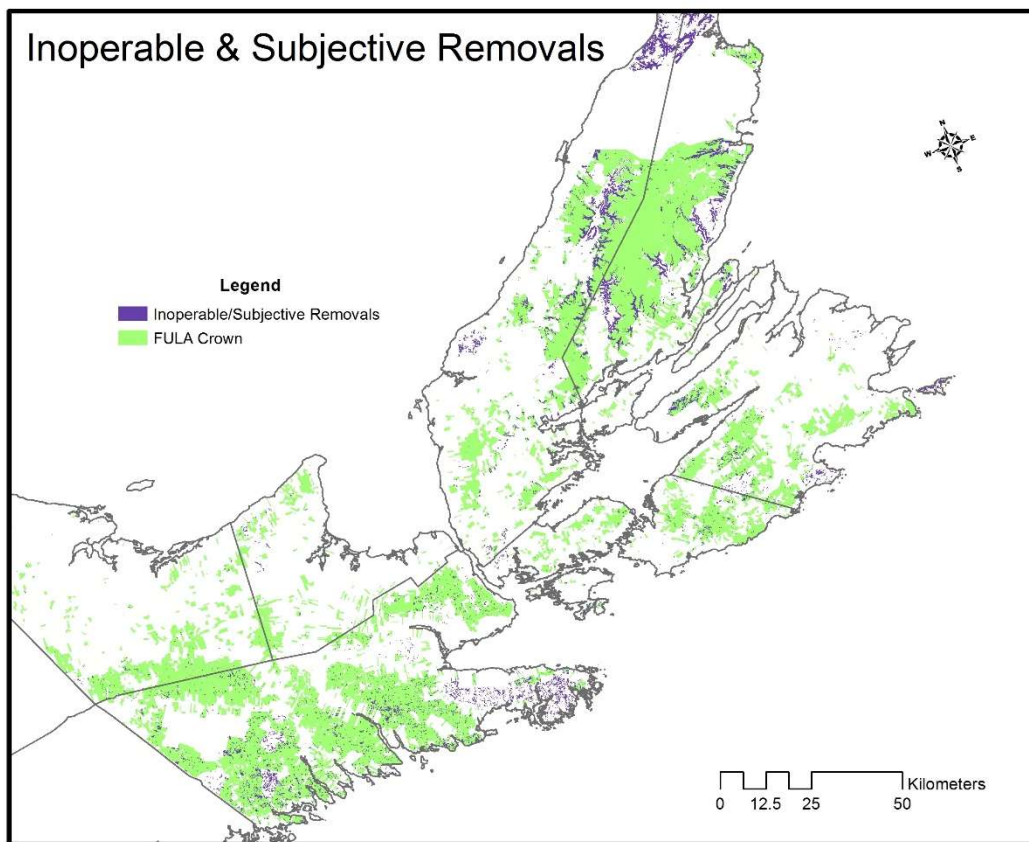


Figure 9. Inoperable & Subjective Removals

2.4.5 Other Regional Harvest Exclusions

Crown areas excluded due to incompatible harvest planning or other landuses are part of this exclusion layer. Areas that were reviewed by NSDNRR staff during the original development of FULA in 2012 were coded into three categories:

Code 3 - Not Crown Land (some require the ownership layer to be fixed)

Code 4 - Not recommended for License - various constraints

Code 5 - Lands with constraints that should be reviewed for the License (may include lands under Park Reserve or Recreation lands, but would also include land with other constraints)

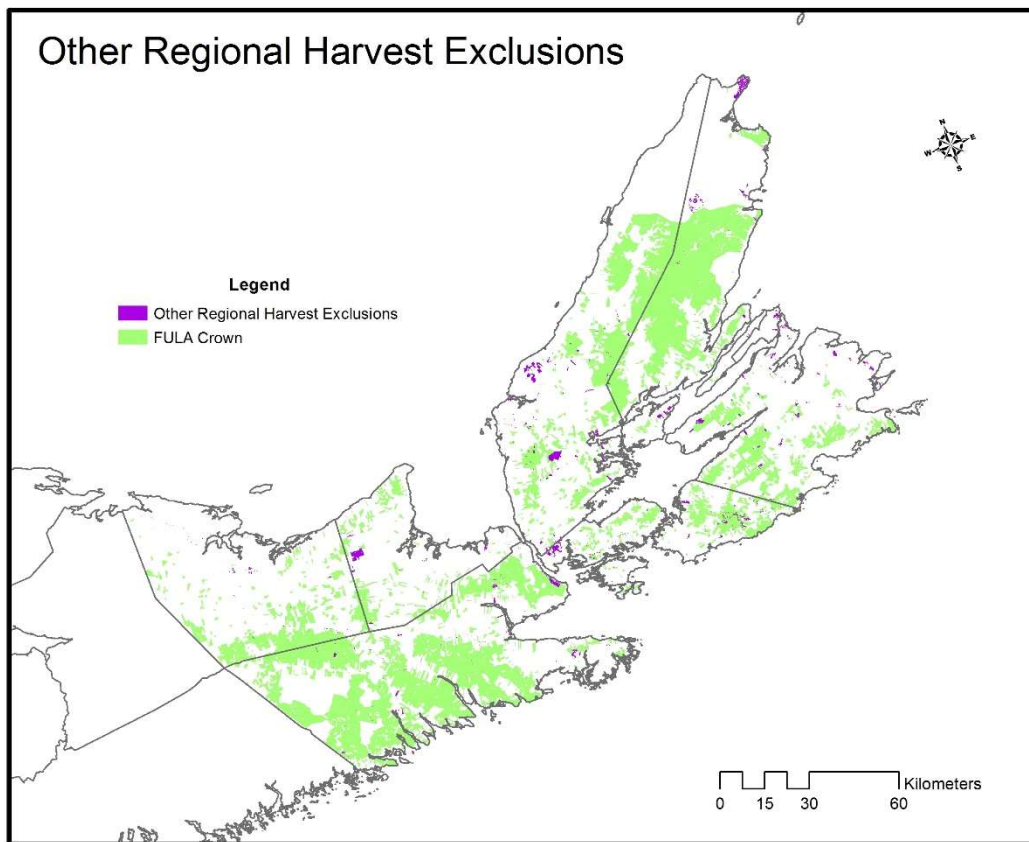


Figure 10. Other Regional Harvest Exclusions

2.4.6 Aboriginal Offered Lands

In order to retain Crown land that was allocated for Aboriginal discussions, there is a layer called "aboriginal committed lands" (ACL). This contrasts with the Mi'kmaw Forestry Initiative (MFI) lands, which are not excluded and are handled similarly to any other region subject to a Crown licence. The region services staff's manual block identification was the main source for this layer. Since some of this data crossed MFI lands, any overlap areas were eliminated to give the MFI status precedence.

By directly linking to more current data in the Crown lands layer managed by the Lands Services Branch, the upcoming modification of the CLFM landbase will more effectively handle this exclusion category. The 2016 SFA's stakeholder engagement phase recognised this as a need that has not yet been fully closed.

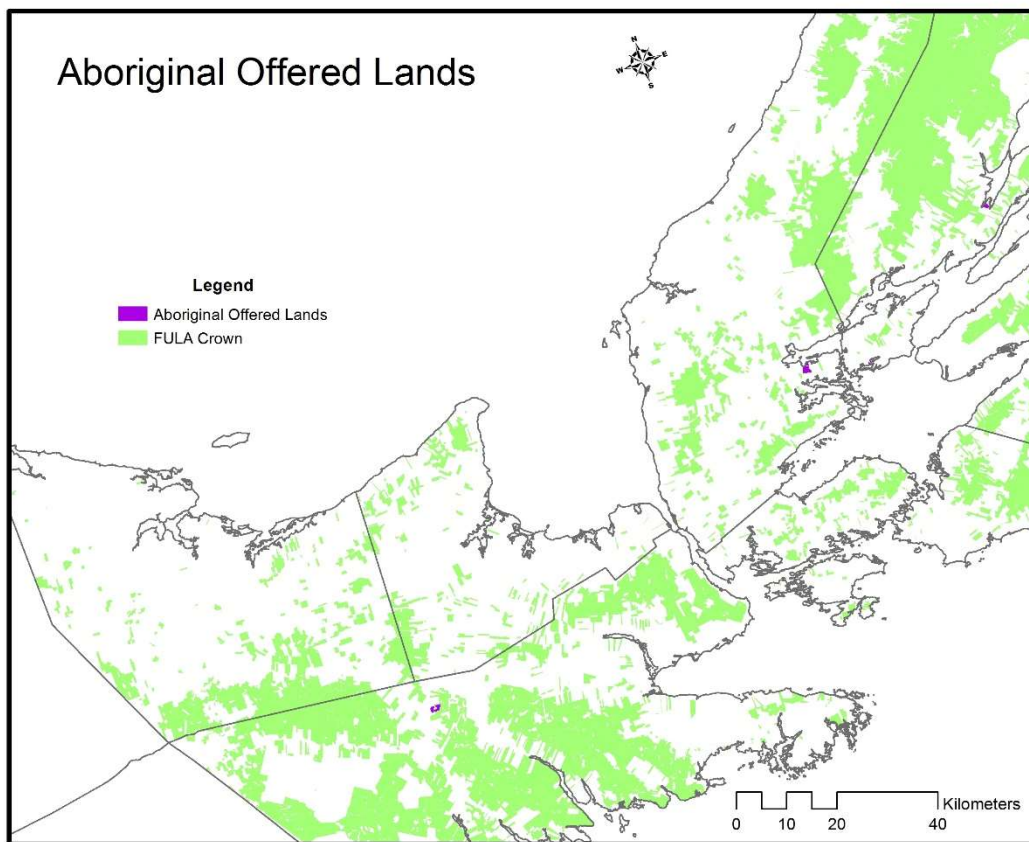


Figure 11. Aboriginal Offered Lands

2.4.7 Watercourse and Open Bog Buffers

The working landbase no longer includes watercourse buffers in the model. The overall model findings were not significantly affected by this decision to simplify or increase model efficiency. A certain amount of partial harvest is allowed under the legislation protecting wildlife habitat and watercourses, but it was determined at the strategic planning level that it would have little impact on projections of total harvest. The watercourse buffers were thus handled similarly to other wooded landbase exclusion layers.

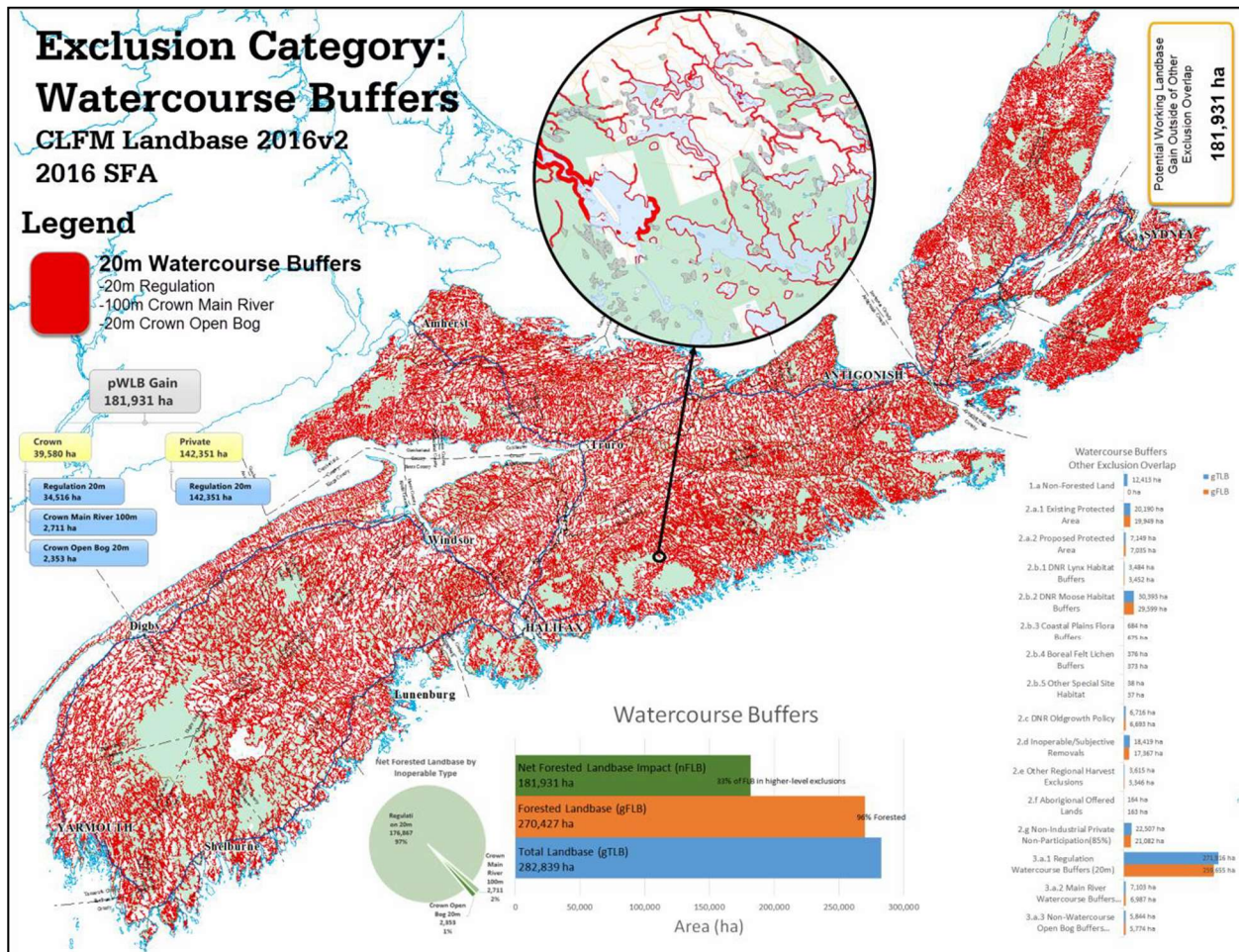


Figure 12. Watercourse Buffer Exclusions

2.4.8 Sensitive Forest Groups

In the ecological matrix zone, where biodiversity priorities and timber production are both applicable and coupled, the Nova Scotia Silvicultural Guide for the Ecological Matrix (SGEM) makes recommendations for acceptable silviculture practises (Lahey, 2018). The manual is applicable to Crown land, more specifically to land located in the Triad system's ecological matrix zone.

SGEM does not recommend harvesting in the six forest categories that are located in delicate ecosystems. These are:

- Karst
- Cedar
- Flood Plain
- Cleared woodlands
- Wet Deciduous
- Wet Coniferous

These locations are well-known for their high levels of biodiversity, the existence of species that are threatened and therefore legally protected by the Nova Scotia Endangered Species Act, and/or the fragility of their ecosystems.

Examples of well-known biodiversity hotspots are Flood Plain, Wet Coniferous, and Wet Deciduous forest types, where many species spend their whole lives. Numerous aquatic and terrestrial species, including rare and listed species-at-risk plants, lichens, turtles, birds, and both large and small mammals, are supported by these forest groupings.

As they control water flow, supply filtration, replenish groundwater, reduce flooding, disperse organic matter and nutrients, and offer cooler areas for species to hide during the hot summer months, they also perform crucial ecosystem functions. Due to rising water levels and soil erosion after harvest, wet deciduous and coniferous forest types could change into another forest or wetland type (Dube and Plamondon, 1995; Roy et al., 1999; Marcotte et al., 2008).

2.4.9 Draft Indigenous Protected & Conserved Areas

Indigenous governments play the key role in protecting and conserving ecosystems through Indigenous laws, governance, and knowledge systems in Indigenous Protected and Conserved Areas (IPCAs), which are lands and bodies of water.

Canada started a process in 2015 to identify and safeguard 17% of its lands for ecological and historical importance. The establishment of IPCA's around the nation was investigated by the Indigenous Circle of Experts (ICE), which was a part of that process. Through the Unama'ki Institute of Natural Resources (UINR), the Mi'kmaq took part in this process. It was acknowledged that reconciliation is necessary not only between different societal segments, but also more generally between people and the environment.

In terms of governance and management goals, IPCAs differ. However, they typically have three things in common:

- Indigenous Peoples lead IPCAs.
- IPCAs are an ongoing dedication to conservation.
- IPCAs strengthen Indigenous People's rights and obligations

Work between PHP and UINR began in early 2021 to develop a process for identifying IPCA's. At the time of the 2021 model analysis, there was an area of 6,655 hectares identified as an IPCA near the Eskasoni First Nation. This area was included in the analysis as a restricted forest landbase with no management allowed to occur. The below map shows the current IPCA boundary as of November 2022.

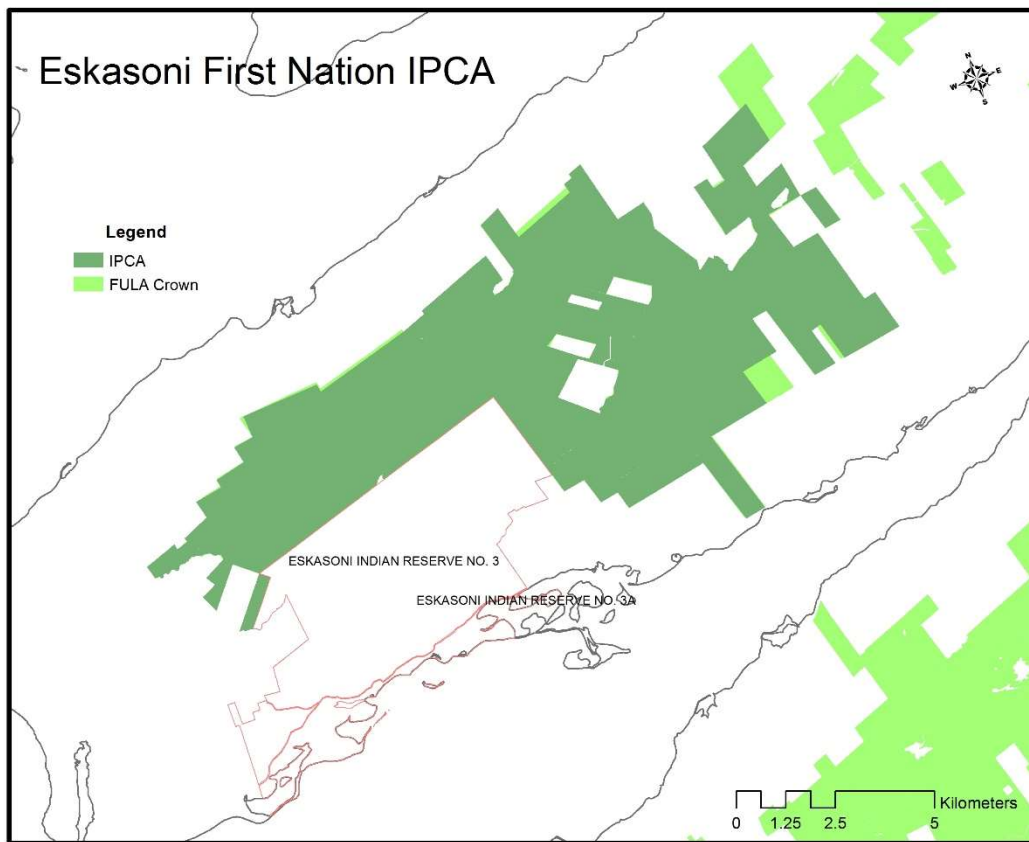


Figure 13. Indigenous Protected & Conserved Area, Eskasoni First Nations

2.5 Working Landbase

2.5.1 Treed Bog Buffers

The treed bog buffers (20 meters wide) were not included in the final class of watercourse buffer exclusions. Treed bog buffers were once taken under consideration for inclusion on the Crown, but regional staff ultimately decided against it. This choice was motivated by the ambiguity around the beginning and end of the treed bog, which is typically thought to be arbitrary and challenging to identify on the ground while conducting operations. Therefore, management activities are allowed to occur in treed bog buffers.

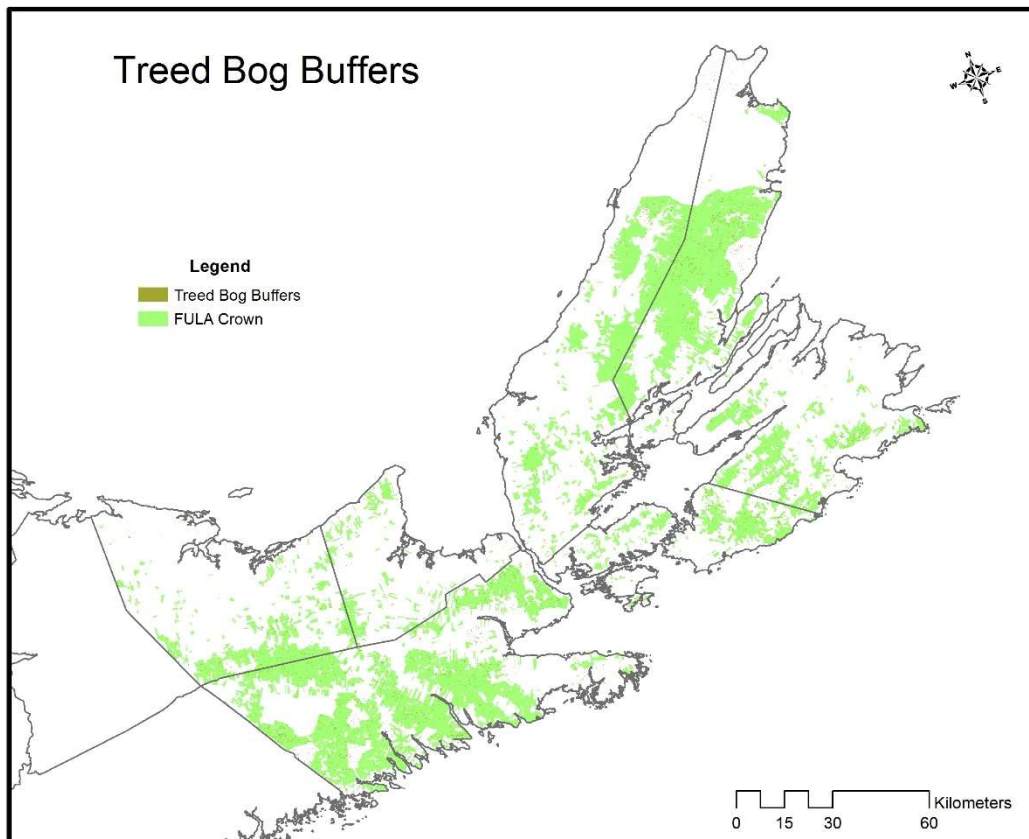


Figure 14. Treed Bog Buffers

2.5.2 Marten Patches

The habitat subcommittee of the marten recovery plan, which defined two sets of marten habitat patches known as the 2019 patches and the 2030 patches, is the source of the data for the marten patches. The patches, which together make up slightly over 29,000 acres of forested land, are completely in Cape Breton. The marten objectives are only used on Crown land for modelling. For different reasons (such as protected areas, buffers, etc.), a significant percentage (68%) of the forested patch area is removed from the working landbase, leaving 32% or 9,000ha of working forest. This subject is paired with theme 10 (forest management state) to identify existing managed stands (plantations and pre-commercial thinning's) within the marten patch area for the purpose of setting objectives. Only 2,300 hectares, or 26%, of the 9,000 ha of working forest, are in a controlled state. In the modelling process, the remaining 74% behaves like non-working landbase.

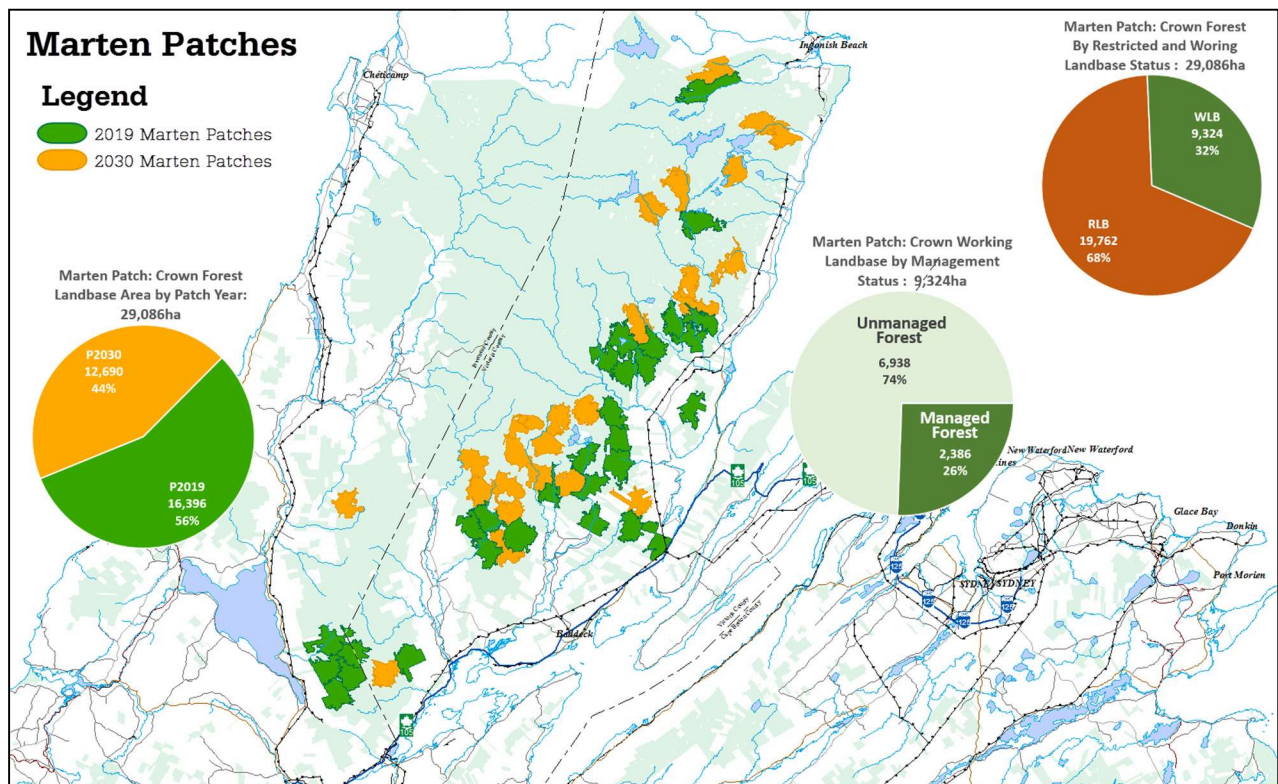


Figure 15. Marten Patches, Cape Breton Highlands

2.5.3 Deer Wintering Areas

Source information for the deer wintering area (DWA) is taken from the wildlife division's "Significant Habitats" database. The DWA model objectives were solely used for the DWAs' Crown land area, similar to the moose objectives. About 27% of the total forested landbase inside the DWAs is made up of Crown land.

When there is more than approximately 20 cm of snow in Nova Scotia, deer mostly travel to wintering regions, start to yard, and are severely constrained in their movement by 50 cm of snow. In eastern Cape Breton, deer show a preference for low-elevation areas (highlands are colder, have longer winters, and get more snow), seek locations with big overstory trees, lots of understory growth, close proximity to tall softwood canopy, and no second story below the main canopy, and avoid north-facing slopes.

The management of deer yards must adopt an adaptable strategy due to regional variations in winter severity. Special management practices as outlined by NSDNRR (https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_White-tailed_Deer.pdf) were built into the 2021 model where feasible.

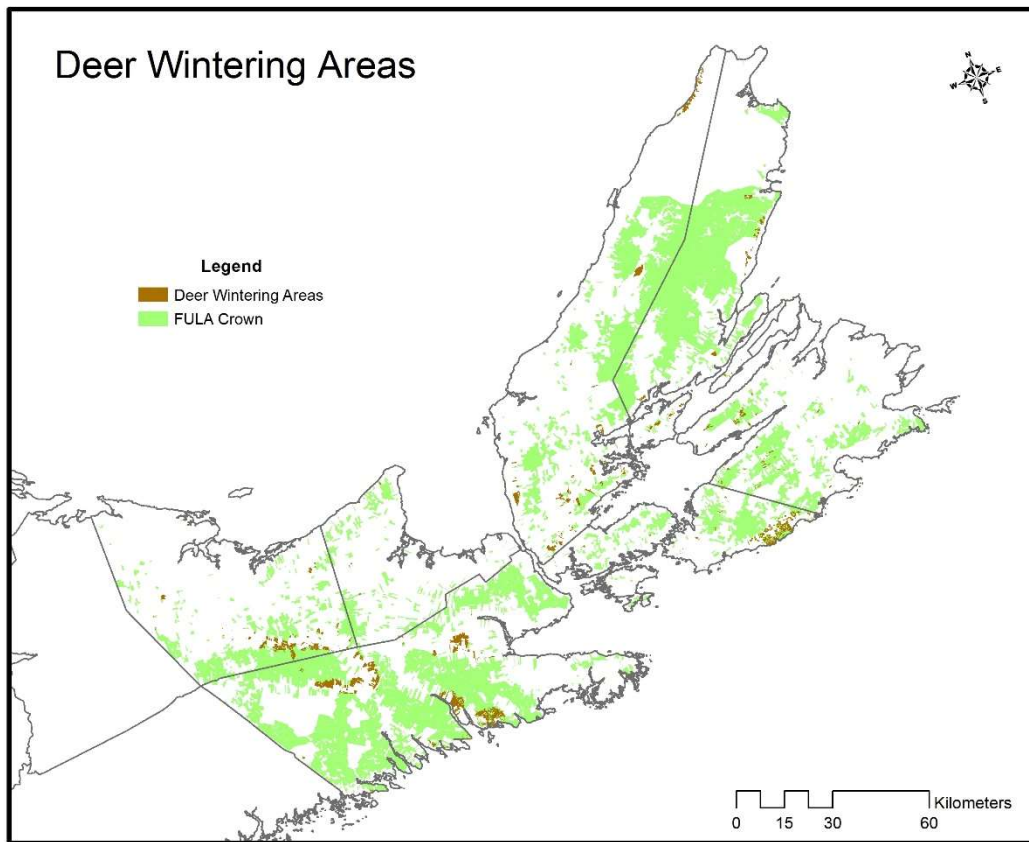


Figure 16. Deer Wintering Areas

2.5.4 Mainland Moose Concentration Areas

Moose concentration areas (MCA) were obtained from the NSDNRR Wildlife Division (February 2012 – Sean Basquill). Five MCA's are identified by the layer throughout mainland Nova Scotia. The model's moose targets were only used for Crown land, which made up about 40% of the overall provincial area inside MCAs. Within the Significant Mainland Moose Population Concentration zones defined by NSDNR's Wildlife Division in February 2012, moose Special Management Practices (SMPs) will be used (https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_Mainland_Moose.pdf). These SMP's were incorporated into the model where practical.

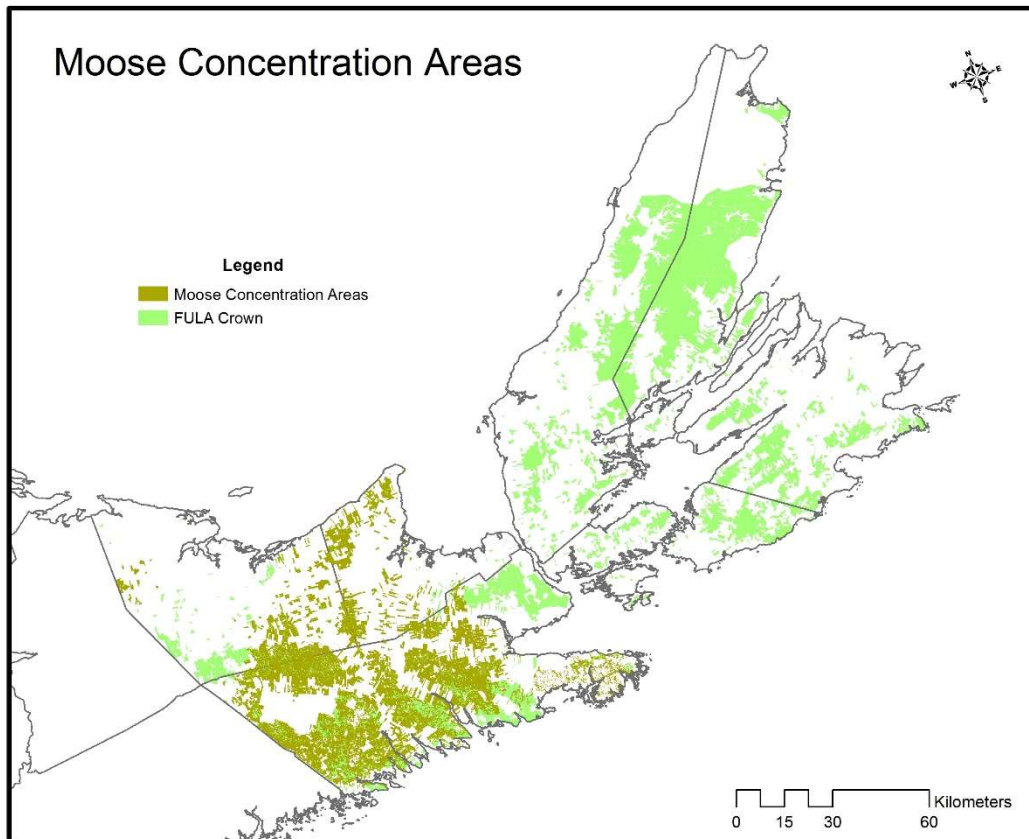


Figure 17. Moose Concentration Areas

2.5.5 Wood Turtle Habitat

While conserving the ecosystems necessary for vital life activities including overwintering, basking, nesting, and foraging, special management approaches for wood turtles should address their general sensitivity to land use throughout their active period. The model analysis incorporated provincial SMPs (https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_Wood_Turtles.pdf) where feasible.

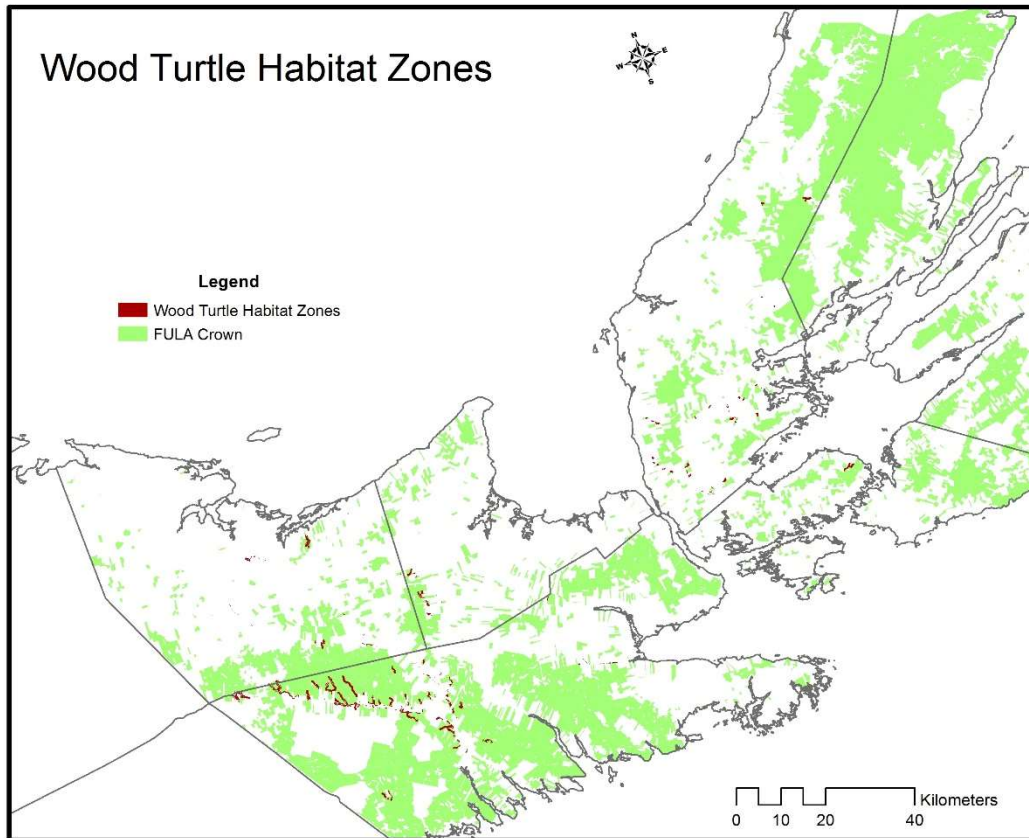


Figure 18. Wood Turtle Habitat Zones

2.5.6 BFL Habitat Buffers (200-500m)

Numerous lichen species have evolved to survive in particular, frequently hostile habitats. These lichens are habitat specialists because they can only live and grow in a certain set of environmental circumstances. They cannot tolerate physical or environmental change. Air quality and controlling moisture are two major issues for lichens that live in forests. Numerous endangered lichen species in Nova Scotia require consistent moist conditions in addition to air that is largely free of pollutants. As a

result, any land use change that drastically modifies the microclimate around a forest lichen could endanger its long-term survival.

For the endangered boreal felt lichen, there are two main zones within the 500 meter special management zone: a 200 m protected zone and a 300 m restricted zone. The protected zone exists immediately surrounding a known boreal felt lichen location. Management activities are not permitted in this zone. However, the 300 m restricted zone does allow for some management that follows the provincial special management practices for boreal felt lichen (https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_BFL_At-Risk-Lichens.pdf). These management practices were incorporated into the model where practical.

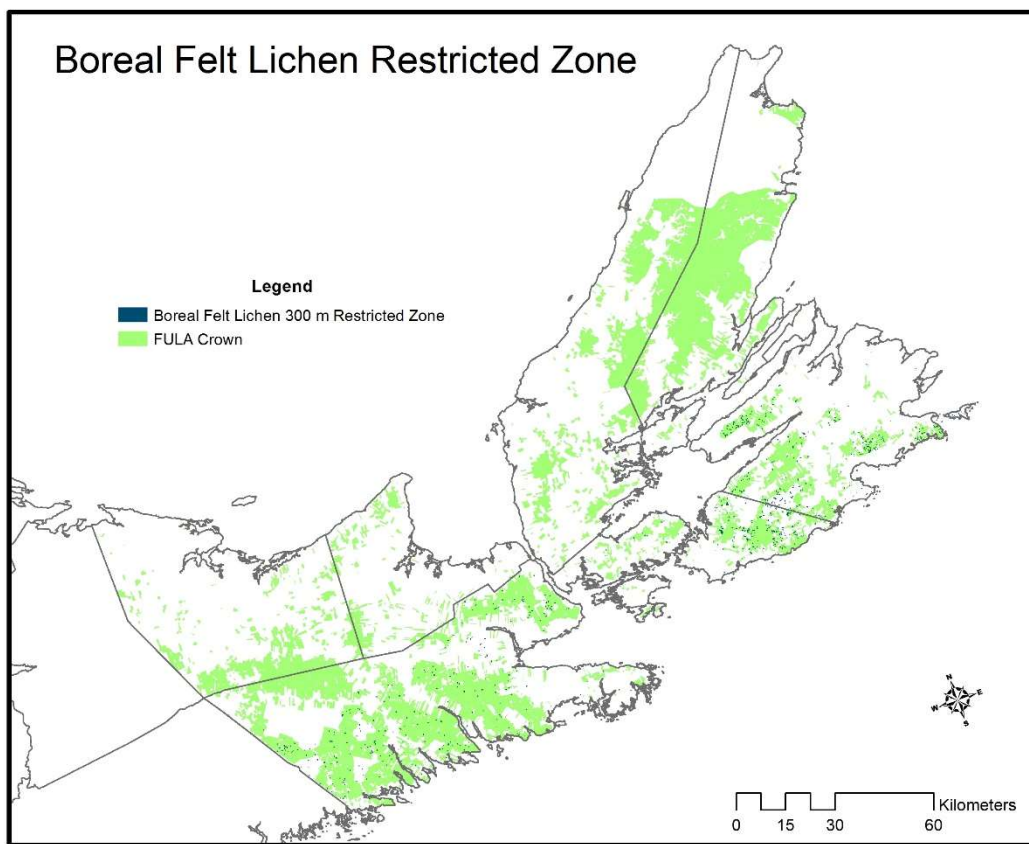


Figure 19. Boreal Felt Lichen Restricted Zone

2.5.7 Bicknell's Thrush Habitat Areas

In 2020, the federal recovery strategy for the Bicknell's thrush (BITH) was published by Environment and Climate Change Canada. In the breeding range, habitat loss or degradation due to forestry operations is classified as "High Level of Concern" with "High Severity" and "Medium Causal Certainty" in Section 4.2 of the Recovery Strategy. In Section 7.1.2 of the Recovery Strategy, the term "appropriate habitat" is defined in terms of its biophysical characteristics. Critical habitat for the Bicknell's Thrush has been partially defined in the recovery strategy. It relates to both suitable and potential suitable habitat that fall within a polygon with a 5-km radius created from all the coordinates of a breeding record that was perhaps, probably, or definitely proven between June 1 and August 15 from 1995 to 2014." The interim guidance and special management practices for bicknell's thrush habitat by the provincial government were incorporated into the 2021 model as practical.

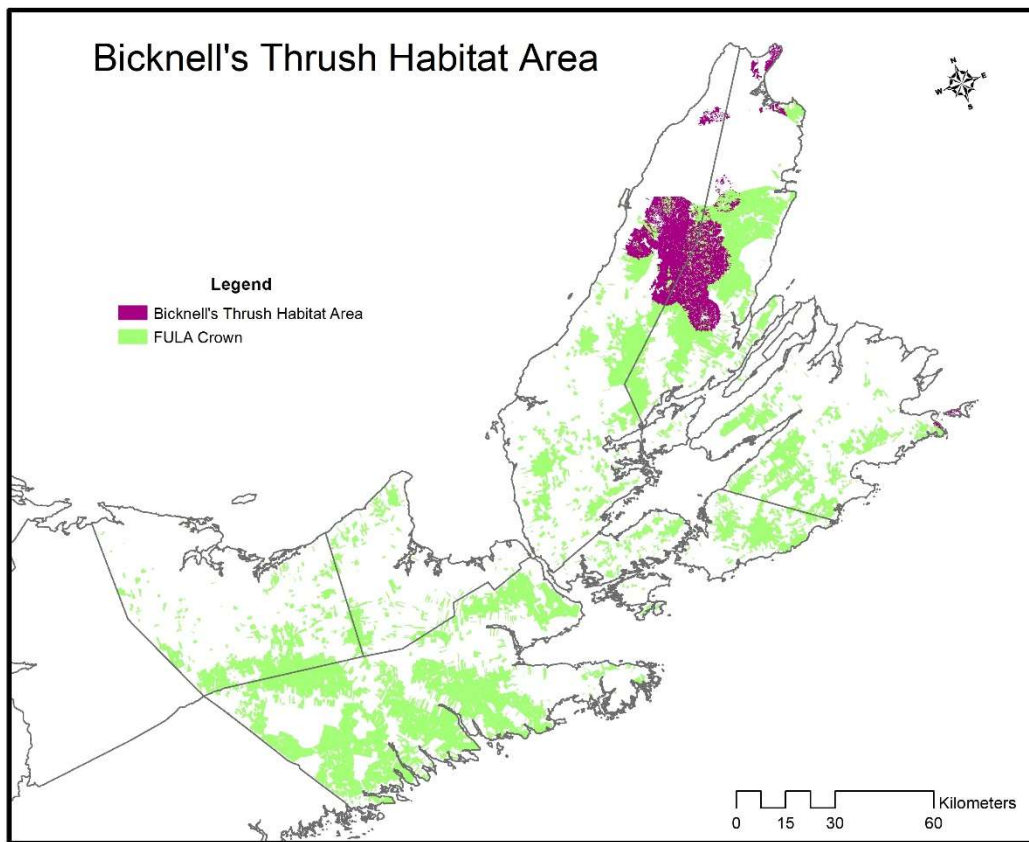


Figure 20. Bicknell's Thrush Habitat Area

2.5.8 Rare Ecosystems

Data source: NS Department of Natural Resources & Renewables, Forestry division, Ecosystems group, ecological land classification mapping, January 2021.

Change since last PHP analysis: N/A (not included in last analysis), 3,581 ha were added to the 2021 model analysis.

Rare ecosystems are now flagged in the model and are off limits to clear cut harvesting, although some partial/selection harvesting is permitted.

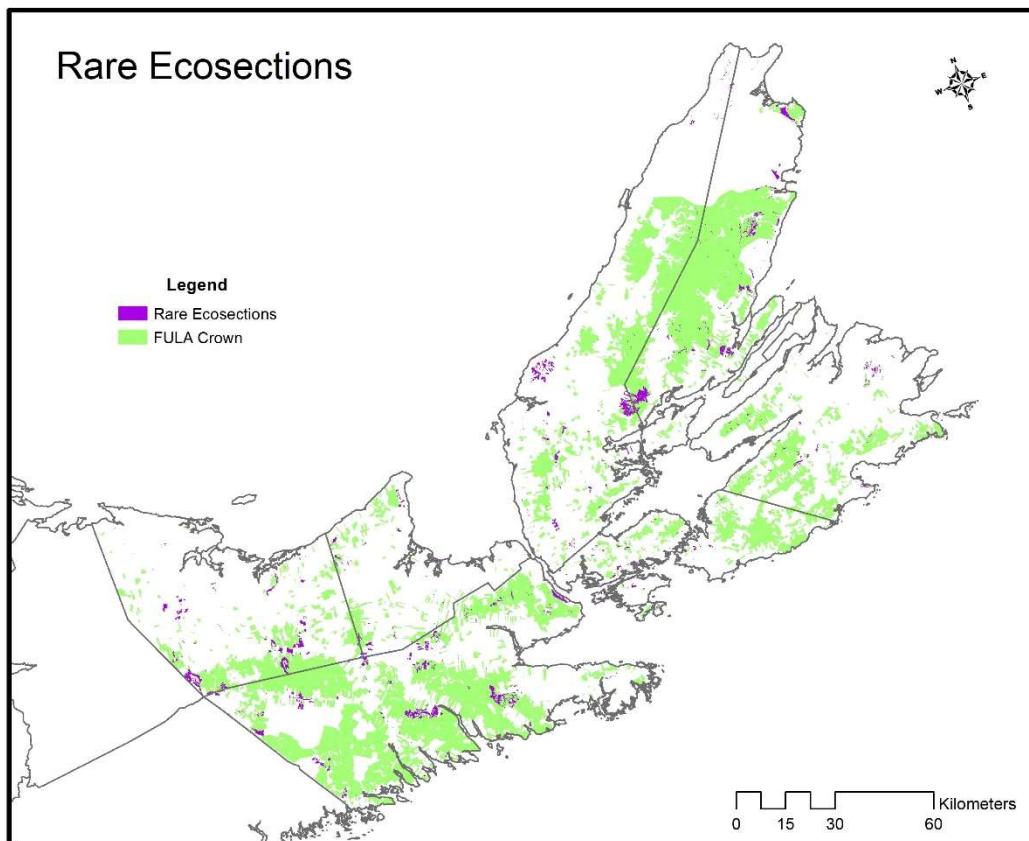


Figure 21. Rare Ecosystems

2.5.9 Protected Areas 100m Buffer

Data source: Resource Analysis Group, January 2021.

Change since last PHP analysis: N/A (not included in last analysis)

A 100-meter buffer was created around each protected area (both proposed and designated) for tracking in the model. Currently policy direction on Crown is that no clearcutting within the 100m protected area buffers. The buffered areas were flagged to denote proposed vs. designated; and where overlap occurred, designated areas got precedence over proposed buffers.

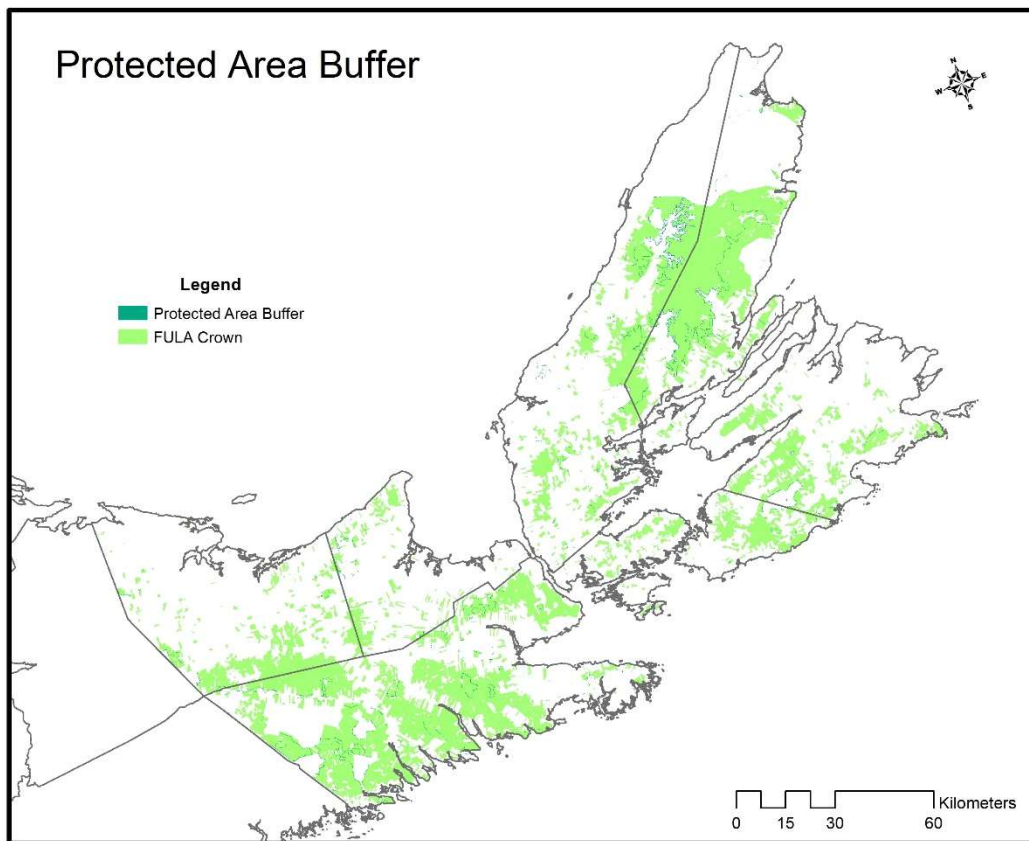


Figure 22. Protected Area Buffer

2.5.10 Connectivity Corridors

PHP identified a suite of indicators for annual monitoring. One of those indicators is related to connectivity corridors. The main function of these corridors is to maintain landscape level connectivity between protected areas and old forest areas. The main objective within each corridor is to maintain a 100-meter wide continuous canopy cover (minimum 30%) corridor within the 500-meter wide Connectivity Management Zone (CMZ). The CMZ's are monitored within the 100 meters to ensure a continuous canopy cover and CMZ's are not severed across their width.

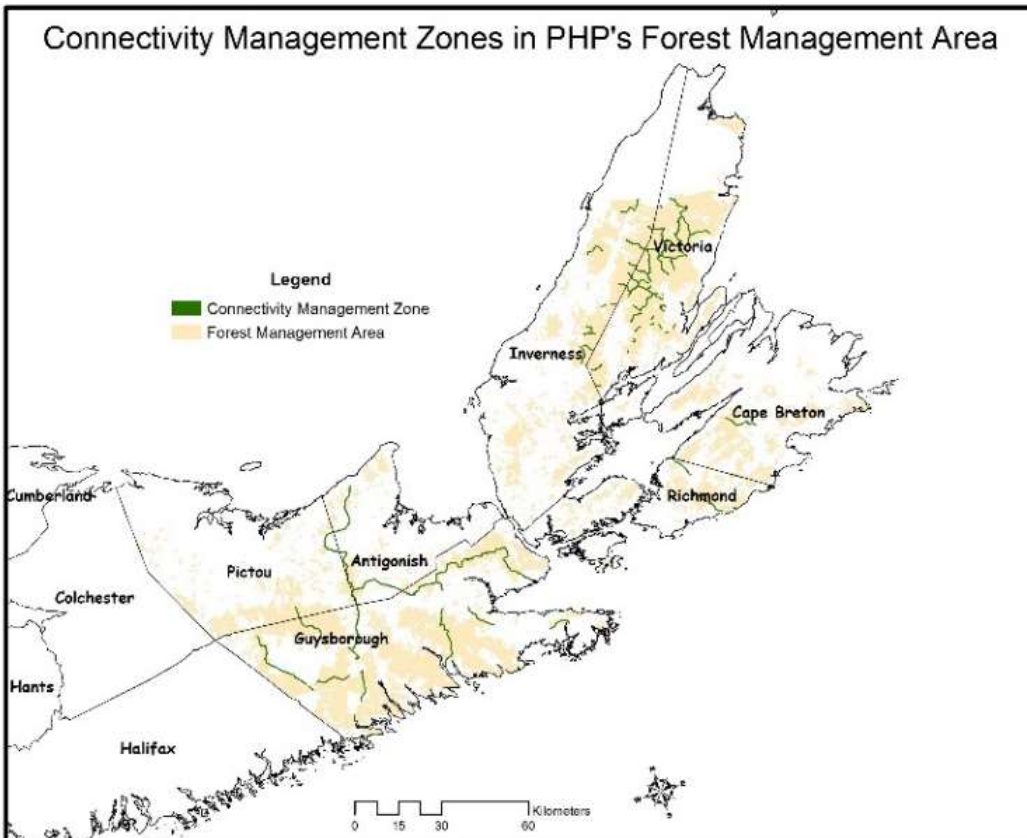


Figure 23. Connectivity Management Corridors

2.5.11 PHP Watersheds (Margaree & St. Mary's)

Another high conservation value monitored by PHP are the Margaree and St. Mary's River watersheds. Both watersheds provide many ecological benefits as well as many tourism and recreation benefits, including salmon and trout fishing, hiking, and paddling. These watersheds are also home to many at-risk listed species and other rare habitat features.

PHP has identified these watersheds as important for monitoring their non-clearcut condition status. The objective in both watersheds is to maintain a high level of non-clearcut condition in the St. Mary's

and Margaree watersheds, and restoration management, for the Crown lands PHP manages within them. Each watershed shall also have minimum 80% of its area (that is managed by PHP) in a non-clearcut condition (greater than 10 years of age), and 90% of each watershed shall be managed for restoration (i.e. no more than 10% of each watershed will be established as a FSC plantation). The necessary prescriptive management objectives for these watersheds have been built into the 2021 model.

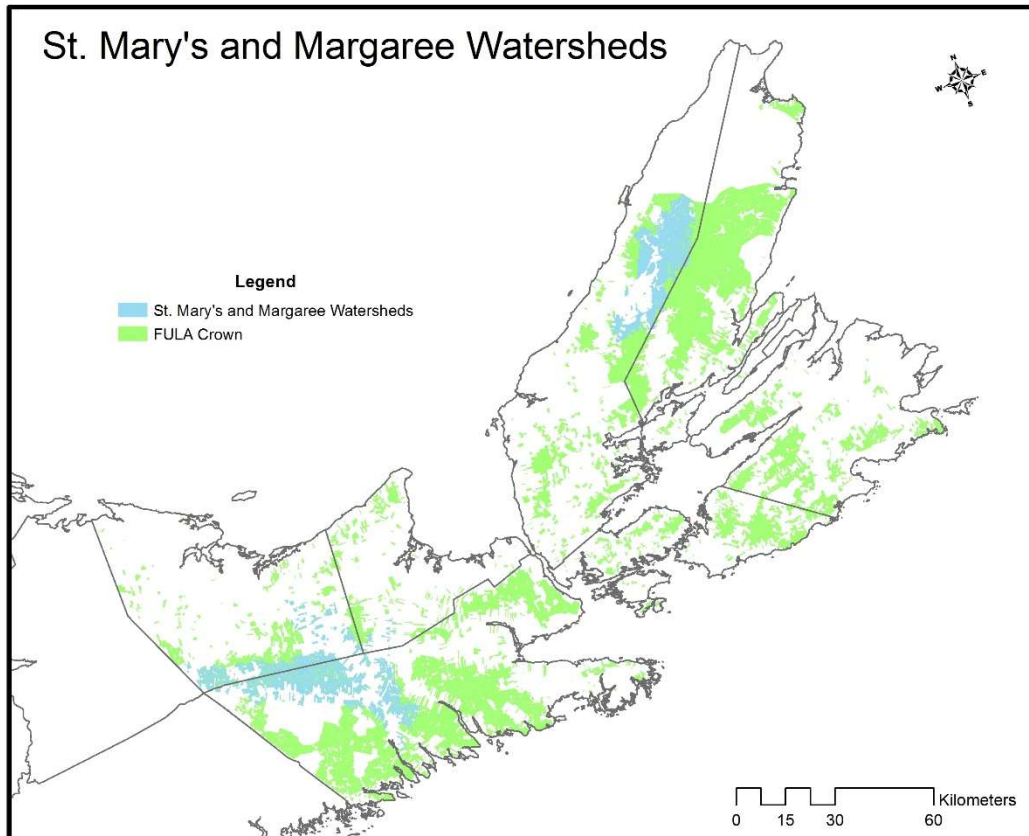


Figure 24. St. Mary's River and Margaree River Watersheds

2.5.12 IRM – C2 Areas

By using integrated resource management (IRM), you may get the most out of a forest or other natural area while ensuring that the benefits are sustainable for future generations. It looks at the connections between different resource usage and how managing one resource affects other resources.

Planning for resource sectors was synchronised through the development of an Integrated Resource Management (IRM) process to maximise numerous benefits and reduce conflicts (NSDNR, 2003). Teams

of professionals and technical experts from the fields of minerals, forestry, recreation, wildlife, and parks make up the natural resources IRM. Identifying primary values and locations with overlapping and maybe conflicting values spatially over all of Nova Scotia Crown land produced three zones of which two are designed to inform tactical and operational planning (NSDNR, 2003):

C1 Use of General Resources

C2 Multiple and Adaptive Resource Use

C3 Limited Use and Protected

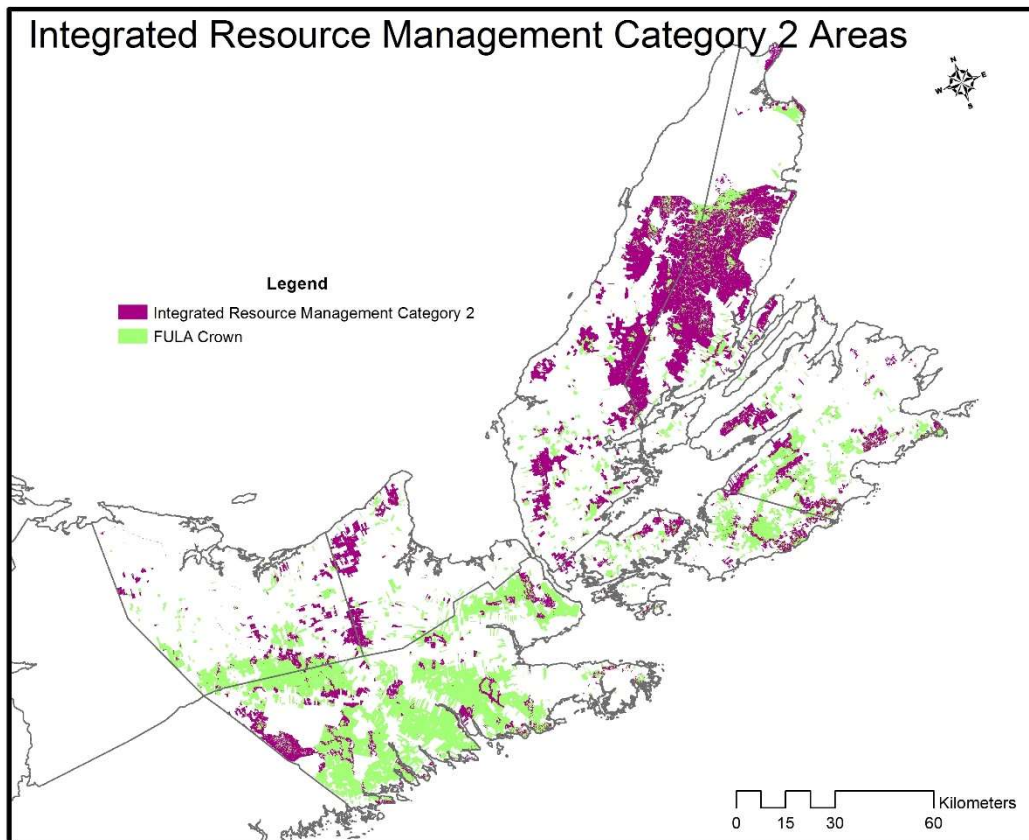


Figure 25. Integrated Resource Management, C2 Areas

2.6 Working Landbase – No Restrictions

The remaining FULA Crown lands that do not contain any of the above restrictions is considered as the working landbase with no restrictions in the model. The total land area for this landbase is approximately 44,000 hectares.

3 FOREST MODELING THEMES

3.1 Theme 1: Ecoregion/Natural Disturbance Regime

The Nova Scotia Ecological Land Classification (ELC) Layer serves as the foundation for this classification. Natural Disturbance Regime (NDR) code and Ecoregion number were combined to provide unique values for this theme. As a large portion of the forested landbase intersected this class, the open seral NDR was combined with the frequent disturbance regime to create unique combinations of ecoregion/NDR.

For assignments involving yield curves, this theme is a CLFM requirement. Groups of ecoregions were used to stratify the natural stand yields. The model receives this data in the form of an index that is given to each distinct theme value. Although the yield assignment just needs ecoregion, which is the first digit of the ecodistrict code, the ELC ecodistrict unit is utilised as the index value. During model setup, a dominating ecodistrict was chosen for each ecoregion because the model aims for ecosystem objectives at the ecoregion level). The seral scores and seral classifications of forest communities are also determined using the ecodistrict index value (Theme 7). Since each ecodistrict's seral score values are distinct, using the dominating ecodistrict within each ecoregion adds value.

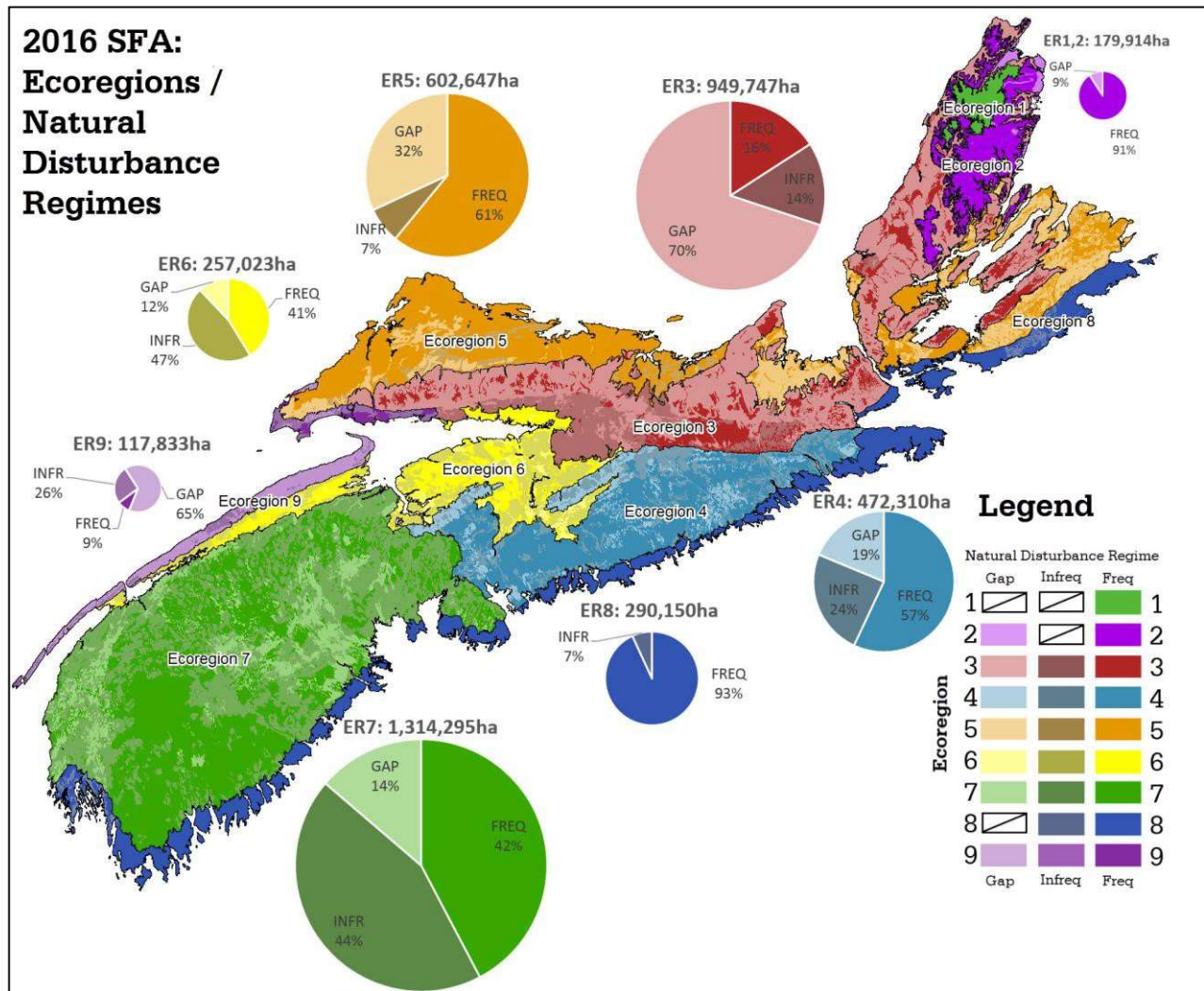


Figure 26. Theme 1: Ecoregions/Natural Disturbance Regimes

3.2 Theme 2: Management Unit

Theme 2 contains a crucial administrative classification known as the Management Unit that is utilised throughout the analysis (MU). The categorization is based on data from various sources:

- NS County layer; obtained in 2003 from the NSDNR GIS Section. Additionally, county classifications were utilised to identify administrative regions.
- Crown Lands layer: obtained in November 2015 from the NSDNR Lands Services Branch. This layer revealed the boundaries of Crown land as well as the licenced lands managed by Port Hawkesbury Paper.

- The Historic Forestry Division Ownership layer is derived from the Forest Inventory Section's "owner" layer as of 2004. Federal Crown and Aboriginal Reserve Lands were obtained from this layer.
- Mi'kmaq Forest Initiative Lands layer; This layer was provided by Lands Services branch (Bruce McQuarrie) in 2015 and includes the Bear River and St. Croix blocks.

The Crown ownership class where the major crown licenses were separated out as distinct MU's. For the eastern Crown this resulted into two MUs: Port Hawkesbury Paper License [CRNLICPHP] and unlicensed eastern crown [CRNUNLICE].

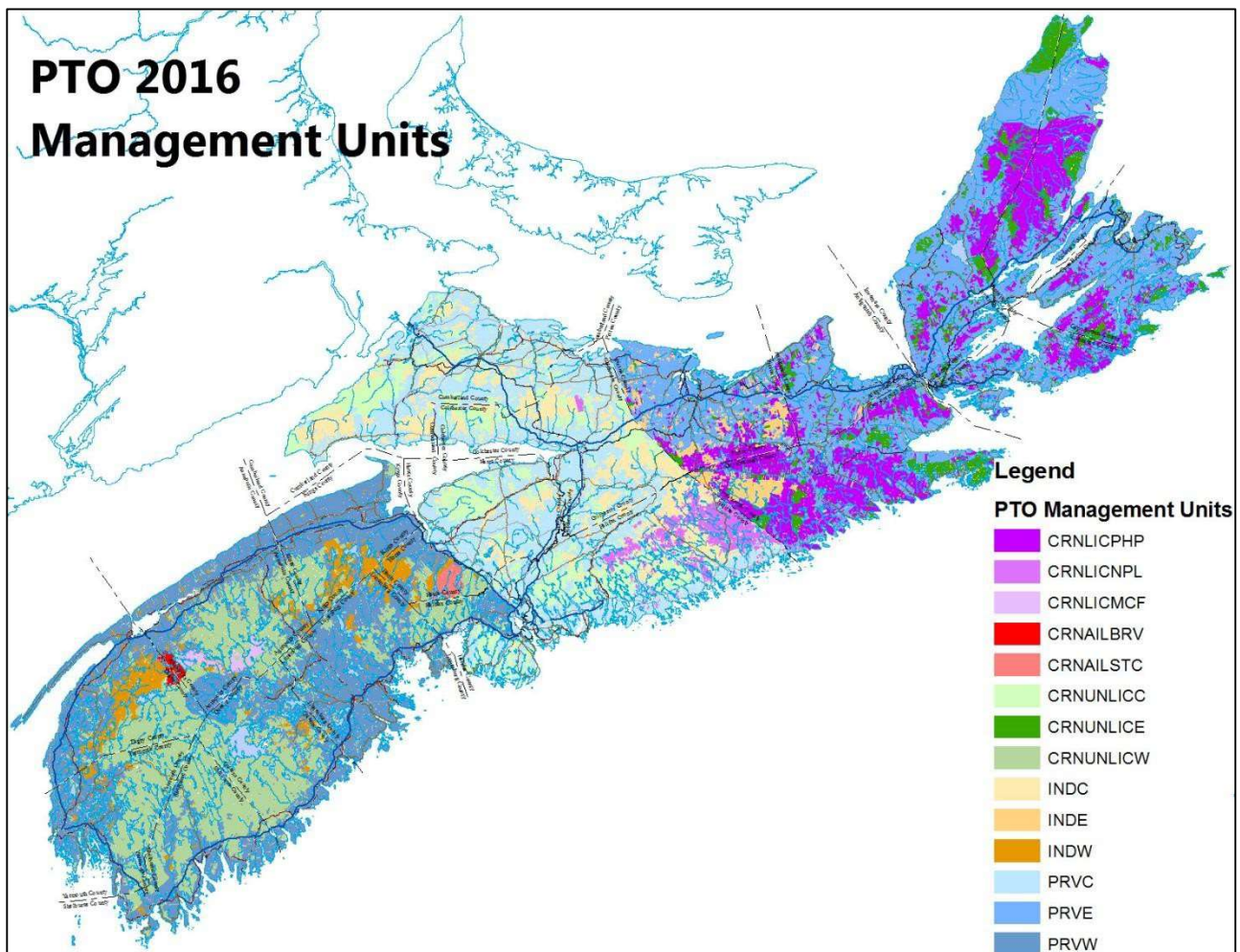


Figure 27. Theme 2: Management Units

(note: PHP's management unit is called CRNLICPHP)

3.3 Theme 3: Wildlife Habitat Zones

Three distinct wildlife habitat zones are identified by theme 3, which is a static theme:

1. Moose Concentration Areas (MC)
2. Deer Wintering Areas (DWA)
3. Marten Patches, MP

For locations outside of any of the wildlife habitat zones, the fourth code "NONE" was applied. There was some overlap between the zones, which was managed by straightforward priority rules. Priority was given to marten patches, then DWA, then moose concentration regions. The overlap area was recorded independently throughout Phase 1 of the 2016 strategic forest analysis (SFA) process, resulting in additional codes and a more sophisticated model. As a result of the priority rules being fairly compatible with all wildlife habitat objectives, the final SFA adopted them as part of the model's final streamlining procedure.

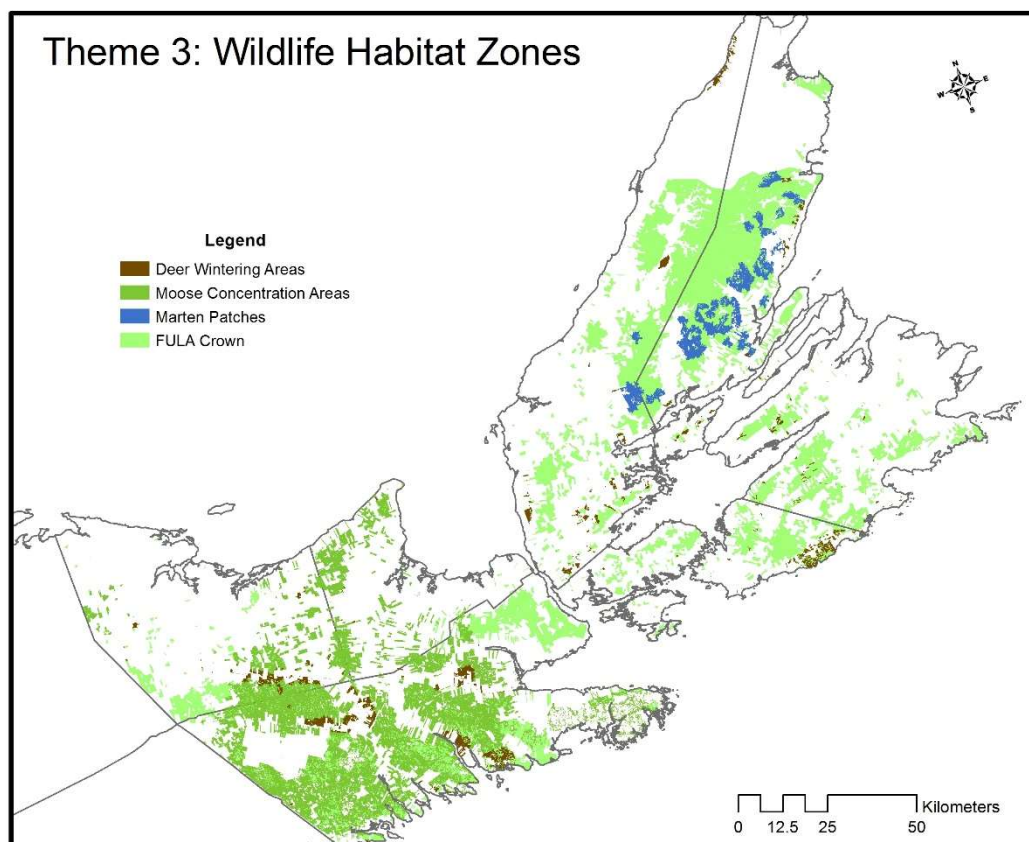


Figure 28. Theme 3: Wildlife Habitat Zones

3.4 Theme 4: Post Harvest Transition Zones

Theme 4 is a fixed theme that serves as a repository for a particular biological land categorization that directs post-harvest transitions in the context of a clearcut event. The classification was done as a part of a research study that looked at how permanent sample plots responded to clear-cutting or overstory removal harvesting.

The provincial ecological land classification (ELC) layer is where the classification is derived. The classification separates the province into four groups based on the ELC rules. Theme 4 post-harvest transitions ecogroup code descriptions are shown below.

Ecogroup	Description (based on ELC)
EG1	Ecoregions 1 ,8 and 2 excluding the Tolerant Hardwood Hills element
EG2	Ecoregion 5 and Ecodistricts 620,630
EG3	Ecoregion 9 and Ecoregion 2 Tolerant Hardwood Hills element and Ecoregion 3 excluding Ecodistrict 370
EG4	Ecoregions 4,7 and Ecodistricts 370,610

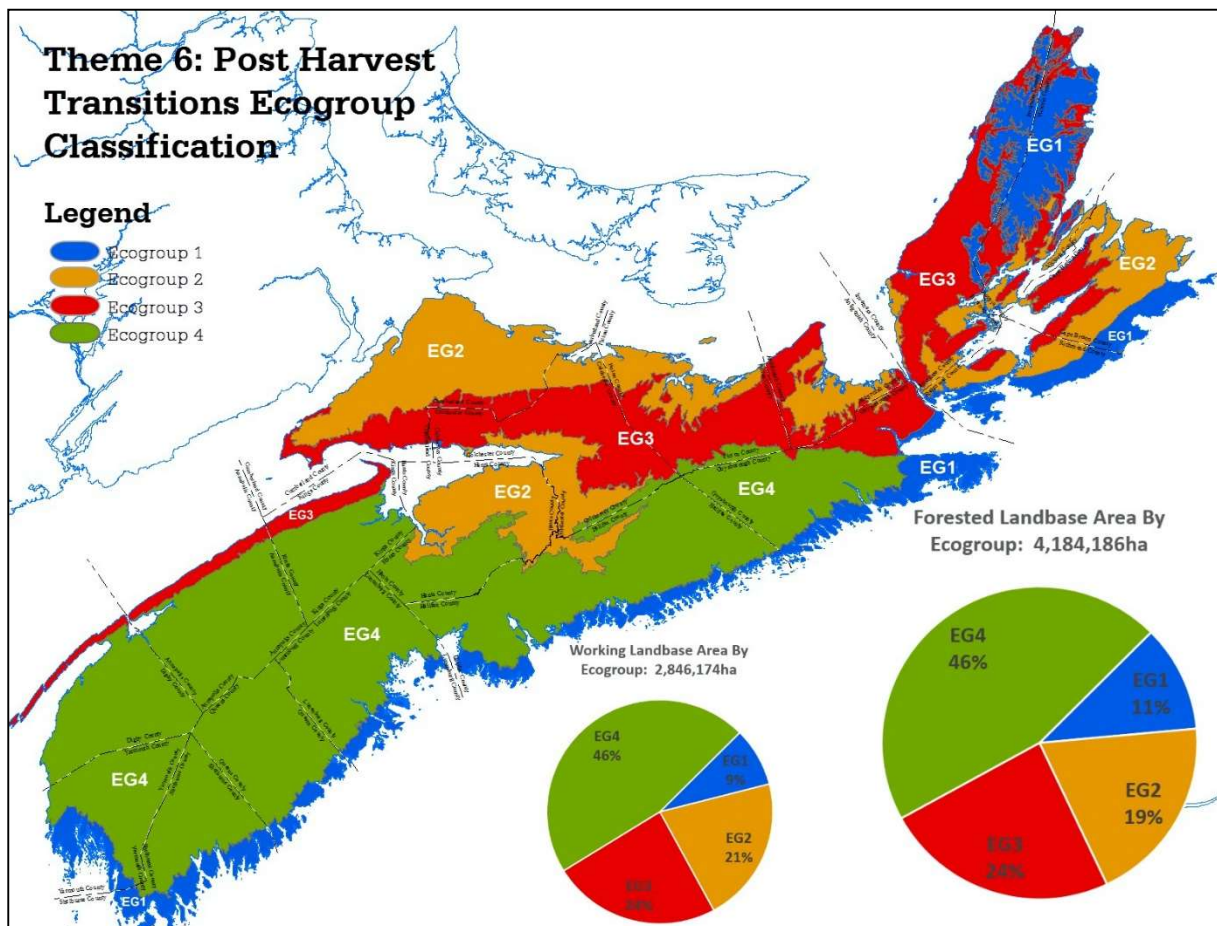


Figure 29. Theme 4: Post Harvest Transitions Ecogroup Classification

3.5 Theme 5: Forest Communities

For the yield curve assignment, theme 5 is a requirement. It is a dynamic theme in that changes in treatment activities over the projection may affect the forest community. Rules for assigning forest communities are mostly based on species information interpreted from forest inventory photos. This species information is augmented with more recent data where it is available because it may be out of date.

A crucial stratification for strategic planning is the forest community. It offers a way to organise around 90,000 different species stand calls according to dominating tree species affiliations. Over 40 distinct tree species are used in photo interpretation, and each species is given a percentage of the crown closure in 10% classes, with a total of 100% for all the species. Up to four different species may be allocated. For instance, a stand with the label "RS10" would be entirely made of red spruce, whereas a stand with the label "BF05RM05" would be split equally between balsam fir and red maple at the crown. The NSDNRR created the taxonomy of forest communities in to be used in strategic forest planning.

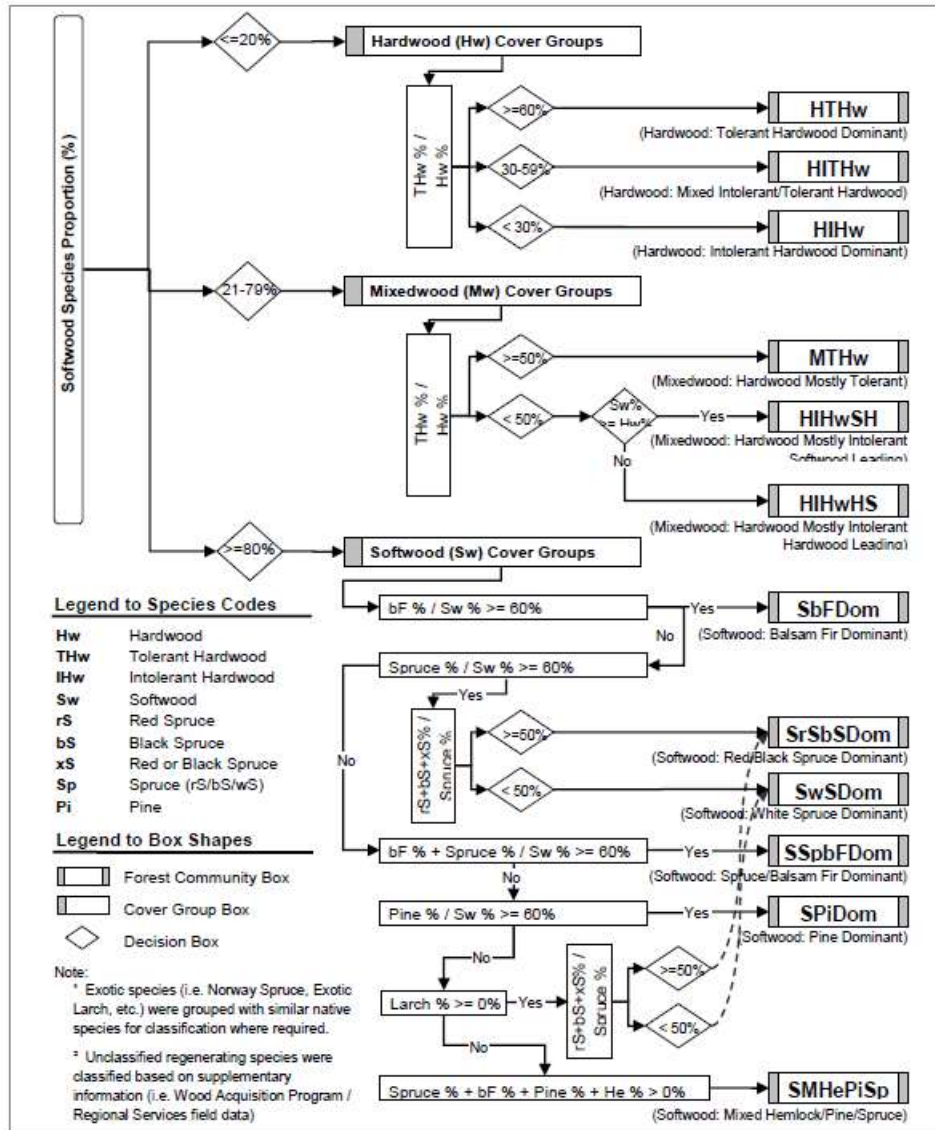
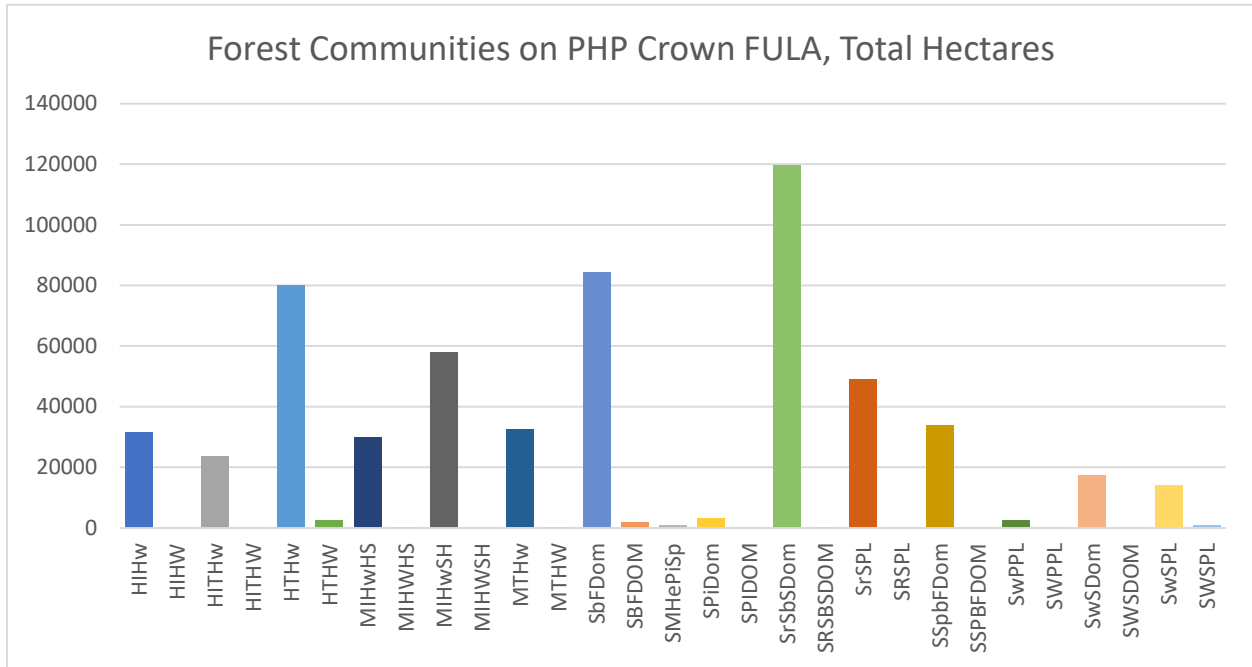


Figure 30. Theme 5: Forest Community Assignment Rules

Due to a recent harvest or the height of the stand being too short to interpret species, significant areas of the forest inventory on the forested landbase have no species call. This is referred to as "unclassified regeneration" in the modelling process. If treatment records are not accessible, historical inventory (prior photo interpretation) data was employed as a source of species information in this case. If neither is available, a default forest community of "MIHwSH" is assigned.

For modelling purposes, plantations on the working landbase are given priority over base forest community assignment guidelines. Based on the prevalent planted species, a plantation community is assigned to recognised plantations. The dominant species would be determined by either treatment update records or photo-interpretation species calls. The name "plantation forest community," which is based on the majority planted species, can be deceptive because many plantation sites have numerous species present, and plantations frequently experience extensive natural ingrowth that alters the

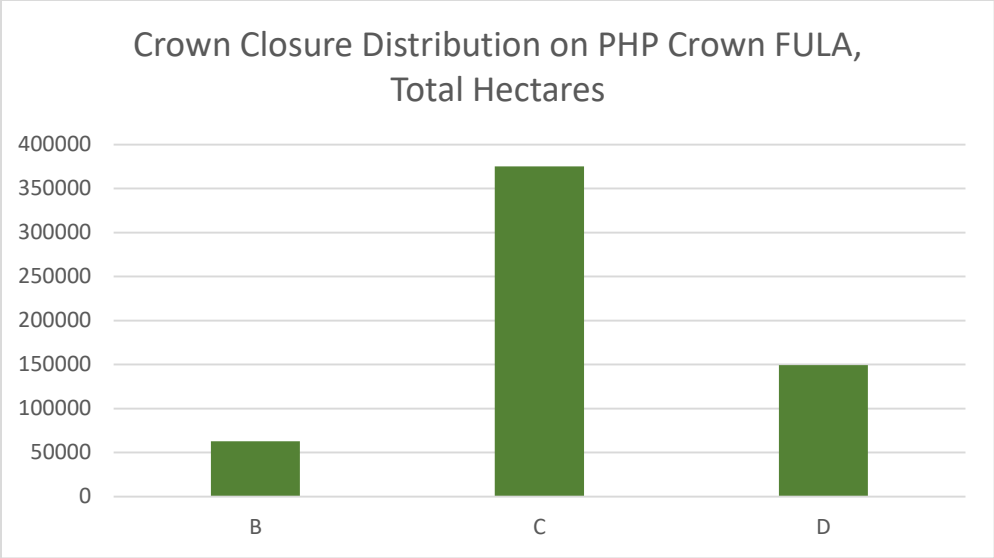
species composition. Typically, this will result in an oversimplification of species diversity. In general, this will result in an oversimplification of the species variety for the area managed by plantations. Future model development could benefit from this. Below shows the distribution of forest communities on PHP Crown FULA lands (working landbase).



3.6 Theme 6: Crown Closure / Stocking Classes

For the yield curve assignment, theme 6 is a requirement. It is a dynamic theme as well because changes in treatment activity might alter the crown closure class over the projection. Crown closure guidelines are generally based on crown closure information interpreted from forest inventory photos and, when available, more recent data. The four classifications A, B, C, and D generally correlate to crown closure percent's of 0-30%, 31-50%, 51-70%, and 71-100% as determined by photo interpretation.

Although there are four classes, the "A" crown closure class was combined with the "B" class for the sake of model efficiency and simplification. Less than 2% of the working forest was affected by this merger. Because there was insufficient ground sampling in stands in the "A" crown closure class to allow for the production of independent yield curves, none of the natural yields had a standalone curve for the "A" crown closure class; instead, it was always averaged into an aggregate strata group. It always refers to the same yield curve in this situation, regardless of whether it is designated "A" or "B."

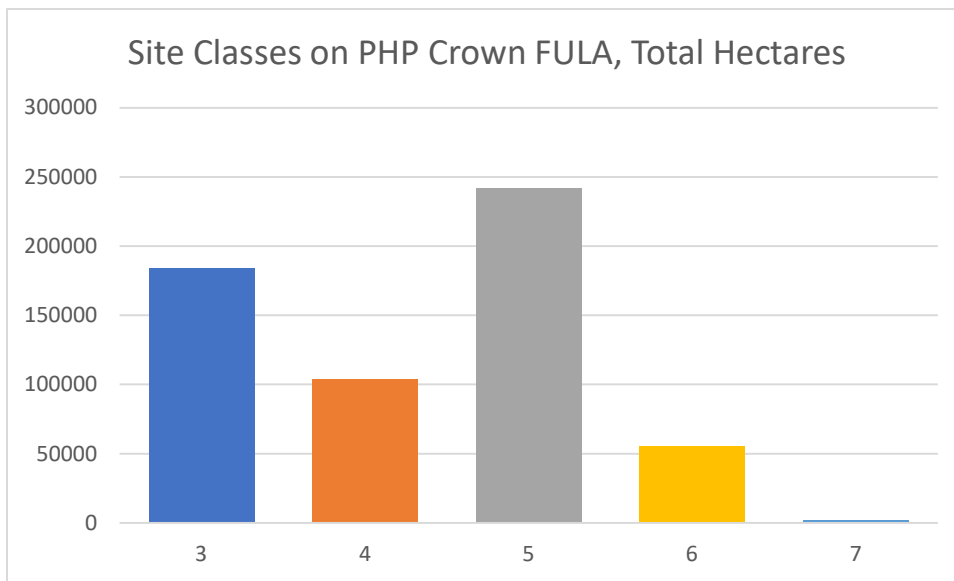


3.7 Theme 7: Site Classes

Theme 7 is a required theme for yield curve assignment. It is not a dynamic theme in that the site class will never change over the projection. Site class assignment rules are primarily based on the forest inventory photo interpreted hardwood and softwood land capability information. For modeling purposes the hardwood and softwood land capability classes are merged into a single classification as shown below.

Nova Scotia Forest Inventory Attribute	Theme 9 Site Classes				
	3	4	5	6	7
Softwood Land Capability Class [site_sw]	1,2,3	4	5	6	7-13
Hardwood Land Capability Class [site_hw]	-	1	2	3	4-7
Woodstock Thematic Indices					
Softwood Land Capability	lc=3	lc=4	lc=5	lc=6	lc=7
Site Index (height (m) @ age 50)	si=11.85	si=13.60	si=15.38	si=17.06	si=18.56

Low softwood land capability (LC) sites, which made up a small percentage of the area, were combined into theme 7 site class 3. Additionally, the softwood LC 1, 2 classes are not included in the working landbase since they are excluded from harvest as an Inoperable/Subjective Removal. Since the higher softwood LC classes make up a relatively minor fraction of the total landbase, they were combined into site class 7. Based on similar site indices, the hardwood and softwood LC classes were blended. For instance, the typical site class in the province, softwood LC 5, and hardwood LC 2 would both exhibit comparable height growth tendencies. On less favourable sites, hardwood stands typically do not exist, hence in theme 7 site class 3, there are no hardwood LCs. Additionally, because they only make up a small percentage of the total landbase; the upper Hardwood LCs were combined into the theme 7 site class 7. The distribution of the theme 7 site class area is show below for PHP Crown working landbase.



3.8 Theme 8: Forest Management State

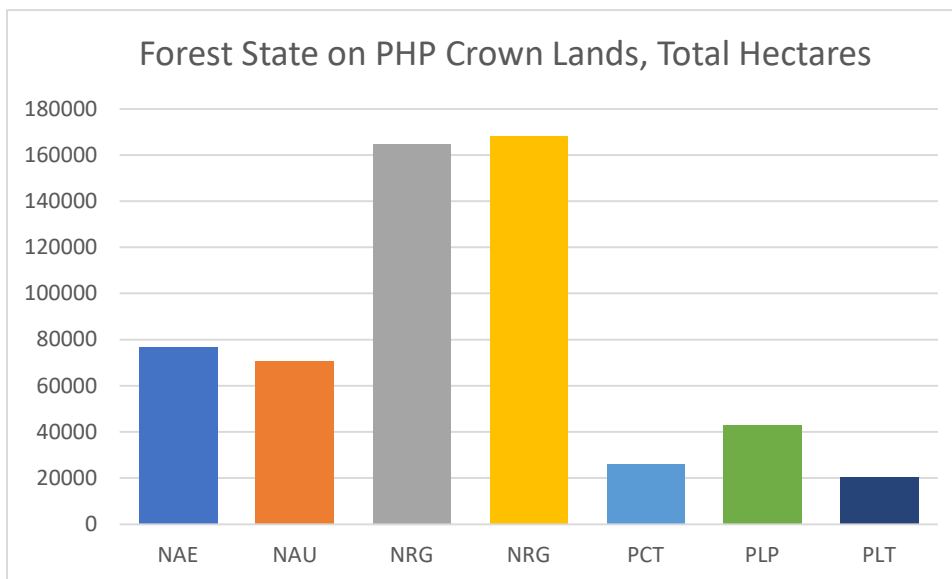
For the yield curve assignment, theme 8 is a requirement. It is a dynamic theme as well because changes in treatment activity transitions might affect how the forest is managed during the course of the projection. The model's primary mechanism for directing significant changes in management, whether it be starting a new plantation or returning an old one to its naturally unmanaged form, is the forest state. The fundamental theme of the Woodstock action, regime, transition, and yield sections, is the forest state. The rules for assigning the initial starting inventory's forest condition are based on a variety of data sources that were utilised to put together the history of the forest management treatments.

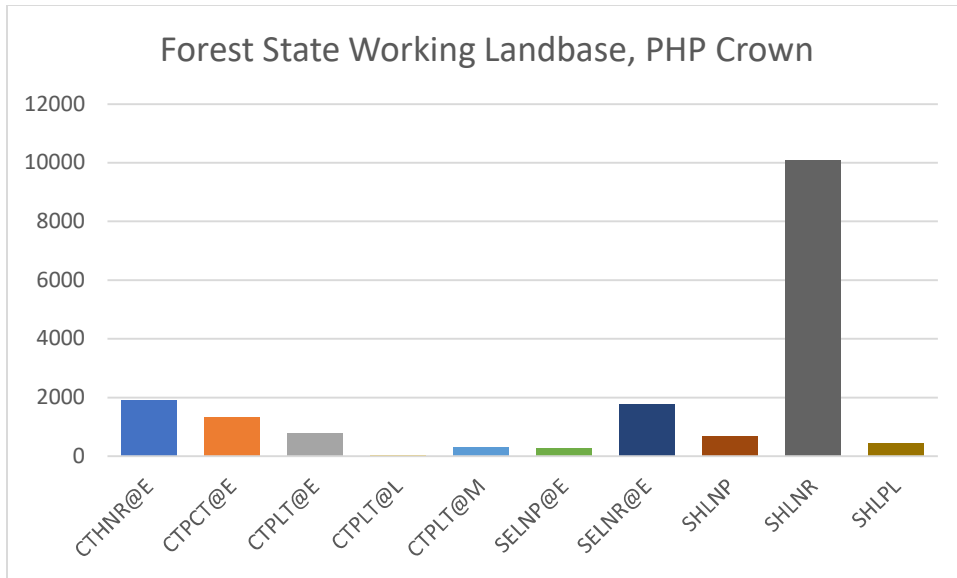
There are two main sources of the information that was used to determine the initial forest state. The first is the forest inventory data, which has a distinct associated treatment table with historical silviculture and harvest records for each photo-interpreted stand and includes some information within the "fornon" attributes. The data from the forest inventory are combined with all other treatment and harvest records in the second primary source. This dataset, which is constantly expanding, connects to multiple sources of treatment records kept by the government and/or business.

With definitions for 64 different codes, theme 8 forest state is the most complicated theme in the model. These codes are divided into smaller sets known as base forest states for the sake of simplicity. Then, for various activities (commercial thinning, selection harvest) at various temporal entries, these base forest states have derivatives (early, mid, late). For instance, the derivative code for the commercial thinning action at the early entry age (CTPCT@E) is derived from the base state PCT (natural pre-commercially thinned stand).

Base states are initially classified according to whether they are forest growth states (i.e., have a yield curve) or model control states, which exist solely for the purpose of regulating model behaviour and do not have yield curves connected with them. Six of the eight foundation forest states—along with two control states—are based on forest development.

#	Base State	Description
1	NAE	Natural evenaged unmanaged
2	NAU	Natural un-evenaged unmanaged
3	NRG	Natural evenaged regenerating
4	PCT	Precommercially thinned natural
5	PLT	Plantation management area
6	SHL	Pre-existing shelterwood area
7	DEL	Delay state post clearcut
8	ESC	Plantation rotation control





3.9 Theme 9: Exclusion Zones 1 & 2

The categorization used to identify different exclusion zones within the forested landbase is found in theme 9. The Woodstock model's functioning landbase is defined by this theme, which is set up similarly to theme 10 and interacts with theme 10 in this regard. The initial exclusion code assignment for the projection is static for theme 9 within the model.

The areas excluded from plans for forest management are typically represented by themes 9 and 10. Numerous factors, such as protected areas, incline slopes, or low productivity, could be the cause of the exclusion. The numerous exclusion codes are combined for modelling purposes in order to simplify and improve efficiency. In general, there is a lot of overlap among the exclusions, making it challenging to describe them in a single group. The net grouping of all exclusions is represented in the model by a single code, "X." Everything else that isn't categorised as an exclusion is represented by the code "NOEXCL."

3.10 Theme 10: High Production Forest Area

A crucial choice in the overall TRIAD approach is how much area should be allotted to high production forests (HPF). According to the High Production Forestry discussion paper, a suitable area on the eastern crown landbase is projected to be 76,000 hectares, or around 10.5% of the eastern crown landbase. It was determined to target a 5% or 35,000 ha HPF zone while taking some sensitivity into account for expanding or contracting the zone due to the lack of explicit policy limits. The overall acceptable area has not yet been evaluated through any landscape-level method that will undoubtedly lower the maximum as indicated in the discussion paper.

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