

The 2012-21 Forest Management Plan For Crown License 7

Submitted July 31th, 2014 (v4)

*Prepared and submitted by J. D. Irving, Limited on July 31th, 2014, to the New Brunswick
Department of Natural Resources as required under the New Brunswick Crown Lands
and Forest Act.*



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Executive Summary

Key results of the 2012-2021 Crown License 7 management plan:

Table i. Summary of AAC volumes (m³/year) by zone and species group for License 7.

Zone and Prescription	Harvest Area	Spruce/Fir/Jp	Hardwood	White Pine	Cedar
	(ha/year)	(m ³ /yr)	(m ³ /yr)	(m ³ /yr)	(m ³ /yr)
Conservation & Inoperable Zones	1,600	47,000	13,000	5,000	1,000
Natural Non-CC (1st-Entry)	2,430	58,300	57,900	1,400	4,600
Natural Non-CC (2nd-Entry)	1,880	68,800	45,900	33,700	2,000
Natural CC	11,020	791,800	311,500	39,200	22,800
CT	1,560	64,200	7,200	3,000	-
CC Plantation	340	40,800	2,500	-	-
CC PCT	840	113,600	15,900	5,000	-
CC Jack Pine	410	50,900	2,500	-	-
CC CT1 (Jack Pine)	260	31,900	1,100	-	-
Total(s)	20,300	1,268,000	457,000	88,000	31,000

Table ii. Summary of Silviculture levels over time for Crown License 7.

Year of Plan	License Area (ha)	Harvest Volume (m ³ /yr)				Silviculture (ha/yr)	
		Spruce/Fir/Jp	Hardwood	White Pine	Cedar	Plant	PCT
2012	1,046,966	1,268,000	457,000	88,000	31,000	3,500	1,000
2007	1,049,917	897,000	473,000	78,410	25,560	5,185	3,610
2002	968,128	1,006,540	524,609	45,500	19,206	4,711	6,230
1997	972,059	922,000	388,000	47,600	19,800	3,605	6,295
1993	975,000	825,500	293,500	50,250	26,125	3,040	2,710

23% of the Crown land on License 7 is in mapped designated zones with a primary management objective of conservation and includes the following:

- 53 New Brunswick protected areas (92,873 hectares)
- 162 individual unique sites (14,527 hectares)
- 168 deer wintering area management yards (49,050 hectares)
- 1,683 old forest wildlife habitat stands (35,771 hectares)
- 11,296 old forest stands (60,201 hectares)
- 8,652 old forest community stands (47,697 hectares)
- 29,000 km network of riparian and wetland buffers (101,352 hectares)

In addition, another 10% of the productive forest land base will be focused on conservation due to unmapped watercourse buffer requirements, unmapped wildlife habitat buffers and inoperable areas.

Outcomes of this updated forestry strategy and management plan include:

- Increase in legally protected areas,
- Increase in industry investments,
- Increase in forest sector jobs,
- Increase in mill production,
- Increase need for wood from private woodlots,
- Increase in Government royalty revenues, and
- Decrease in Government costs for License management.

Introduction

This document describes in summary form, the major components of the 2012-21 Crown forest management plan covering Crown Timber Licenses #6 and #7, collectively referred to herein as License 7. While achieving DNR objectives and requirements, this forest management strategy for Crown License 7 is ecologically sustainable, economically viable and socially responsible.

Development of the management plan involved using the current forest inventory and an optimization model to arrive at an 80 year strategy which meets specific management objectives. The first 10 years (2012-2021) was spatially blocked to form a management plan which takes into consideration operational realities and constraints.

Scientific and technological advances in forestry practices have been incorporated into this management plan. The continuously updated forest inventory has been strengthened by ground plot data collected to forecast growth and yield over time. An array of even-aged and uneven-aged treatments are utilized to achieve the stand and forest level objectives of the management plan.

Forest Management Objectives

The Vision and Goals, as defined in “A Strategy for Crown Lands Forest Management”, has been established by the Minister of Natural Resources through a stakeholder and public input process. A key goal of this management strategy is to put the New Brunswick forestry sector in a stronger position to compete in the world market place.

To encourage capital investments, a new timber objective creates the certainty of wood supply needed for industry to invest in its long term future. The wood supply objective is to maximize the combined log-potential of Spruce/Fir/Jpine and Hardwood over the 100-year planning horizon.

Managed stands are starting to be harvested and will form a greater proportion of total wood harvest in the future. Commercial thinning 1,500 ha/year of managed stand sites on License 7 will provide additional volume today and support improved quality from these stands in the future.

The proportion of clear cut harvesting will decrease in the long term.

Harvesting wood from tougher environments will be a focus in 2012-2021; this includes steep slopes on hills and previous defined inoperable areas. This management plan will target an annual harvest of 70,000 m³/year on License 7.

The amount of Crown land designated as Protected Natural Areas (PNA), legally protected forest lands in which no forestry activity can ever take place, has almost doubled since 2001. Fifty-three PNA's covering 92,873 hectares are now located on License 7.

J.D. Irving's Unique Sites program objective is to manage each site to maintain and protect its unique features or attributes. These areas are considered unique due to a biological, geological, geographical, cultural or other recreational characteristic or feature of the area. The current unique site program includes 162 individual sites (14,527 hectares).

Management objectives for the New Brunswick Crown forest also include the maintenance of specific amounts of a variety of old forest conditions within each ecoregion. The goals are that the full range of naturally-

occurring forest communities be maintained and that old-forest vertebrate species remain viable. License 7 includes: 60,201 hectares of designated old forest stands, 47,697 hectares of designated old forest communities, and 35,771 hectares of designated old wildlife habitat stands.

DNR has established a policy and management requirement that designated areas where there has been evidence of significant deer wintering activity must be managed with a primary objective of maintaining or improving the long-term area of “critical deer wintering habitat”. Over 49,000 hectares defining 168 deer wintering areas (DWAs) on License 7 will continue to be managed and monitored to support the local deer population.

Continued protection of lakes, rivers, and streams with watercourse buffers as per the current legislation creates a network of over 29,000 km covering 101,352 hectares across License 7.

A new “Results-based” management approach is also being introduced and implemented, where performance will be measured and publicly reported annually. Licensees will be accountable for achieving required outcomes for the management of Crown forests.

The outcomes of this updated forestry strategy are expected to include:

- Increase in legally protected areas,
- Increase in industry investments,
- Increase in forest sector jobs,
- Increase in mill production,
- Increase need for wood from private woodlots,
- Increase in Government royalty revenues, and
- Decrease in Government costs for License management.

License Location and Overview

License 7 covers approximately 1,047,000 hectares which are located within ten counties: Northumberland, Kent, Westmorland, Albert, Saint John, Kings, Queens, Sunbury, York, and Charlotte (Figure 1).

The land base for this Crown License was characterized from the digital forest inventory cooperatively maintained by DNR and JD Irving, Ltd.

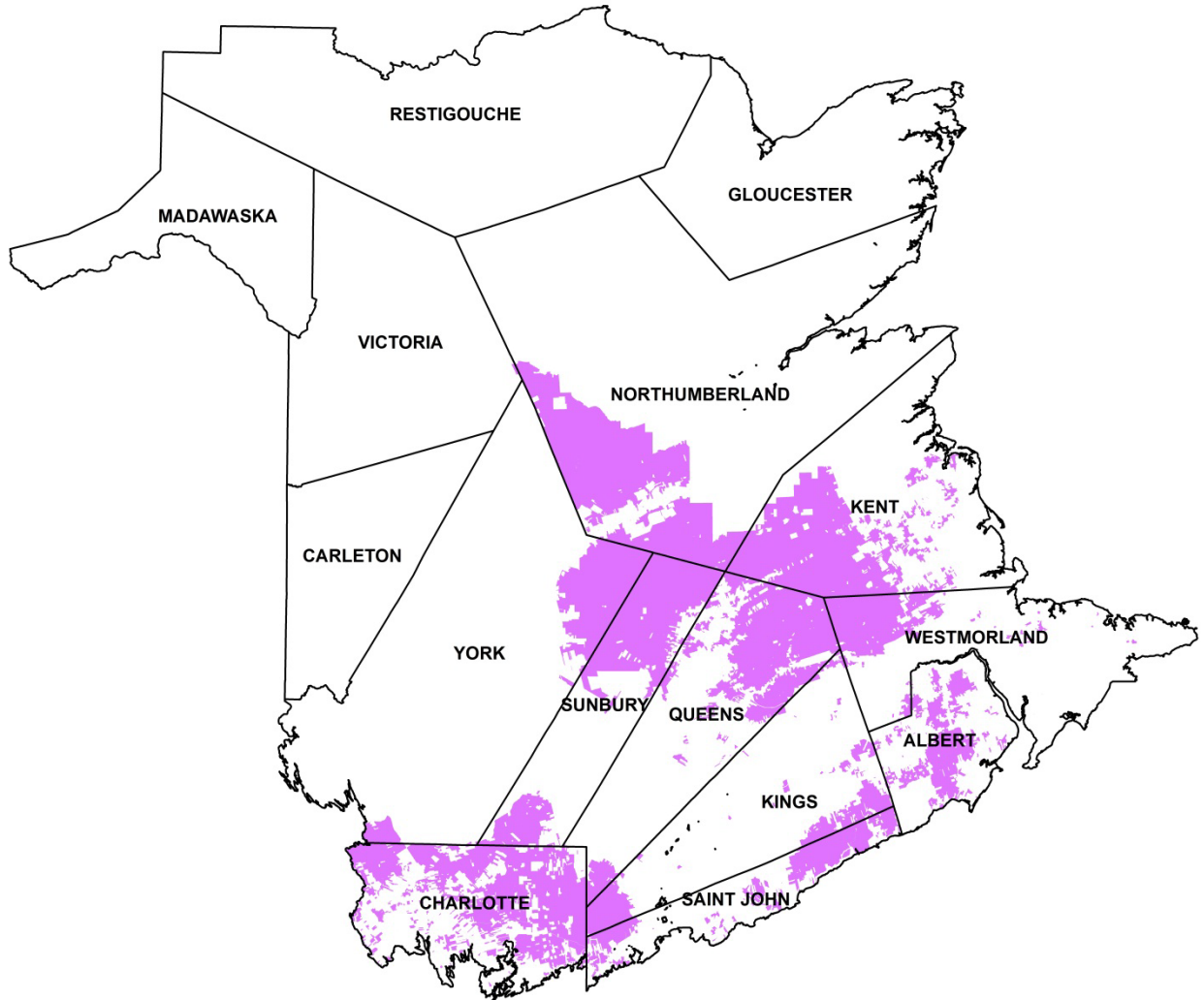


Figure 1: Location of Crown License 7.

License Area Description

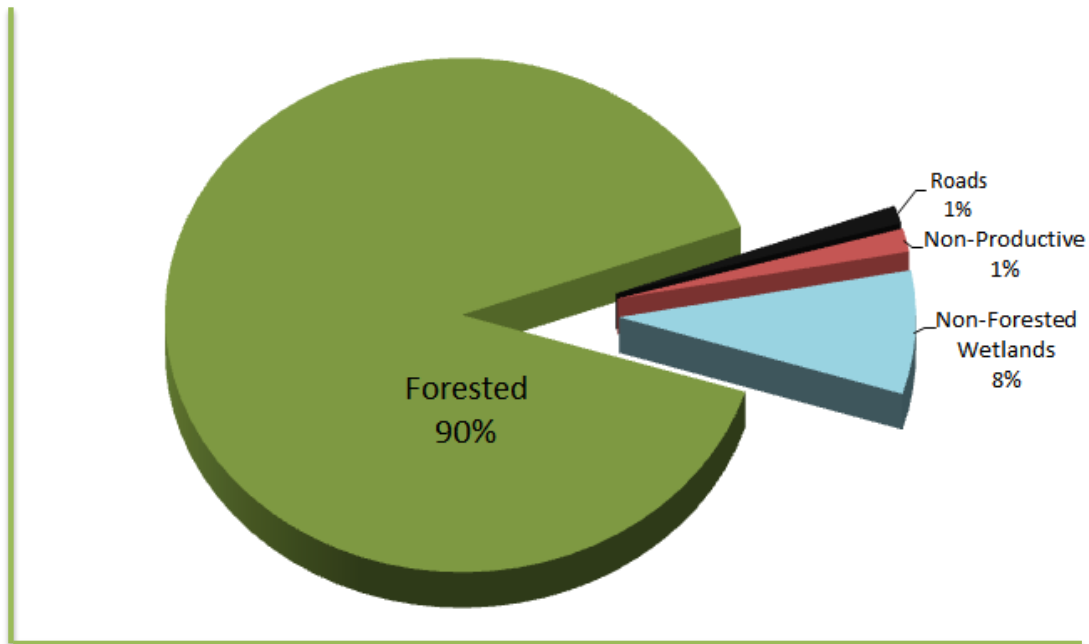


Figure 2: Total area (1.047 million hectares) by land class for License 7.

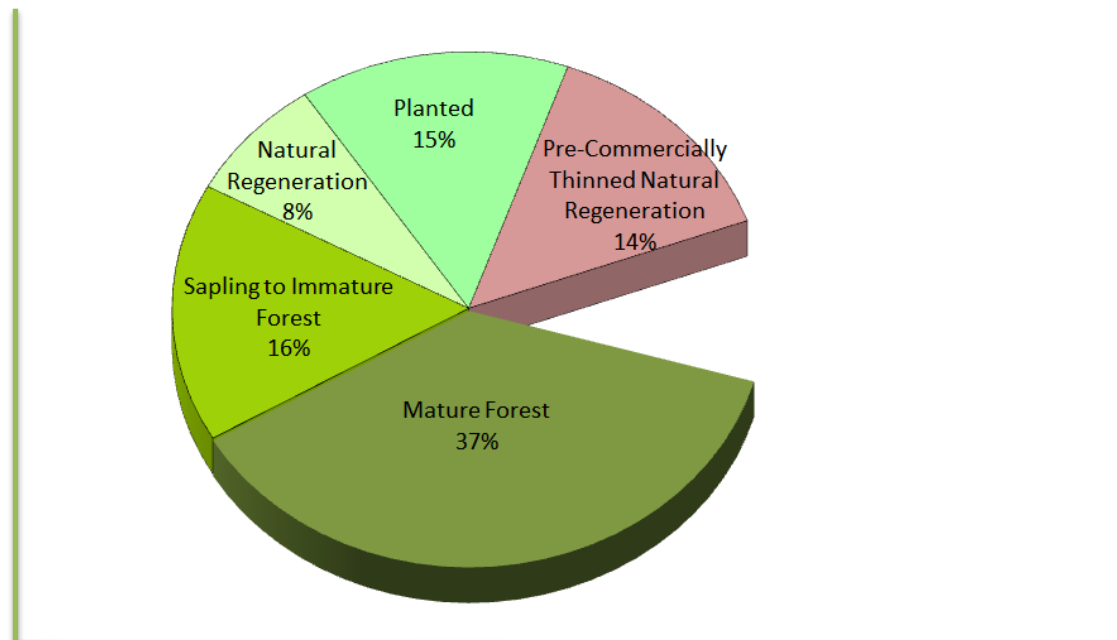


Figure 3: Productive forest (0.952 million hectares) by broad stand type for License 7.

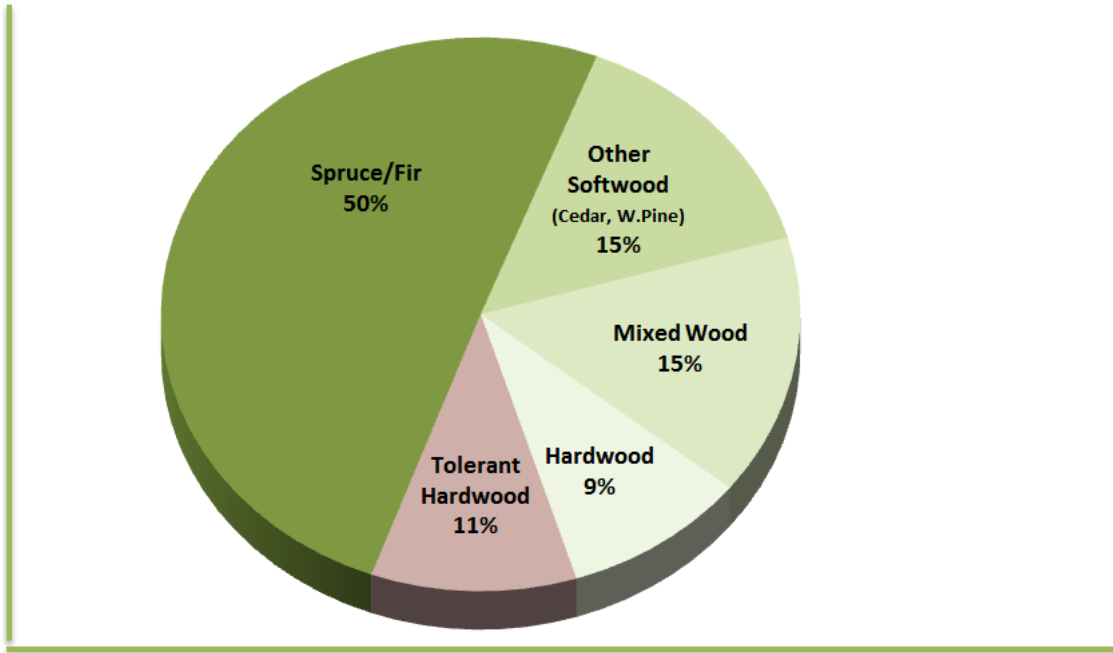


Figure 4: Distribution of mature forest area (0.393 million hectares) for License 7.

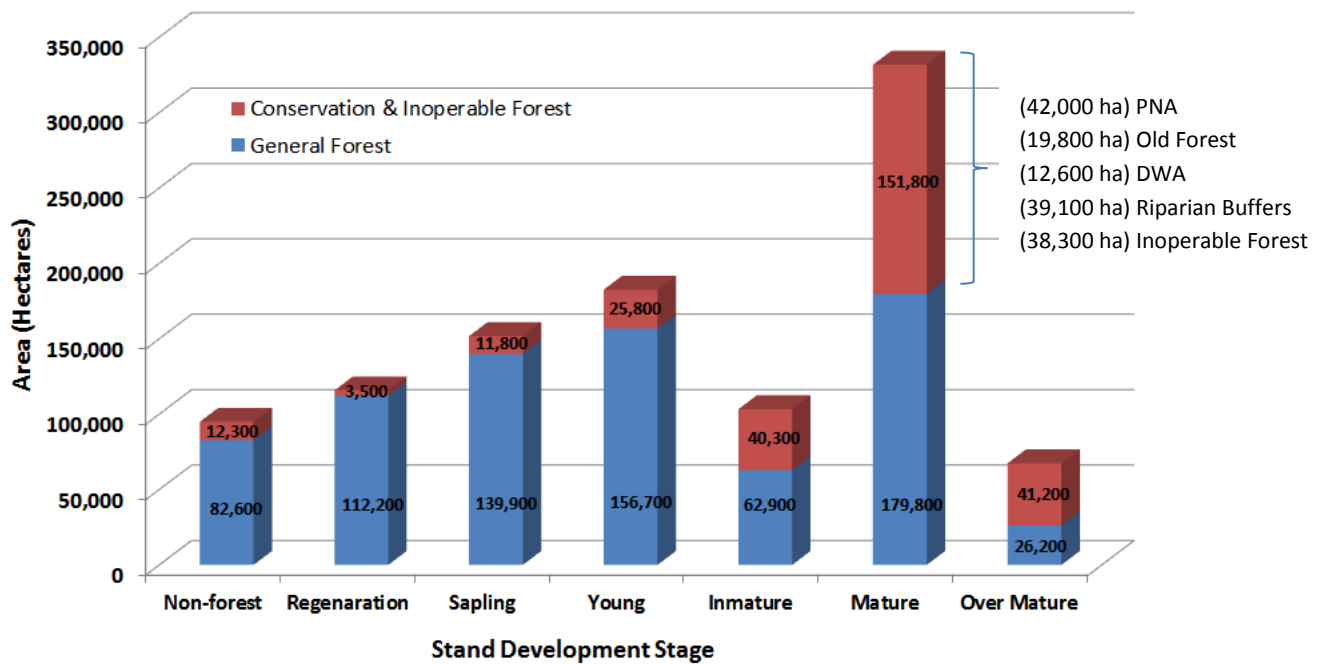


Figure 5: Development stage distribution on License 7.

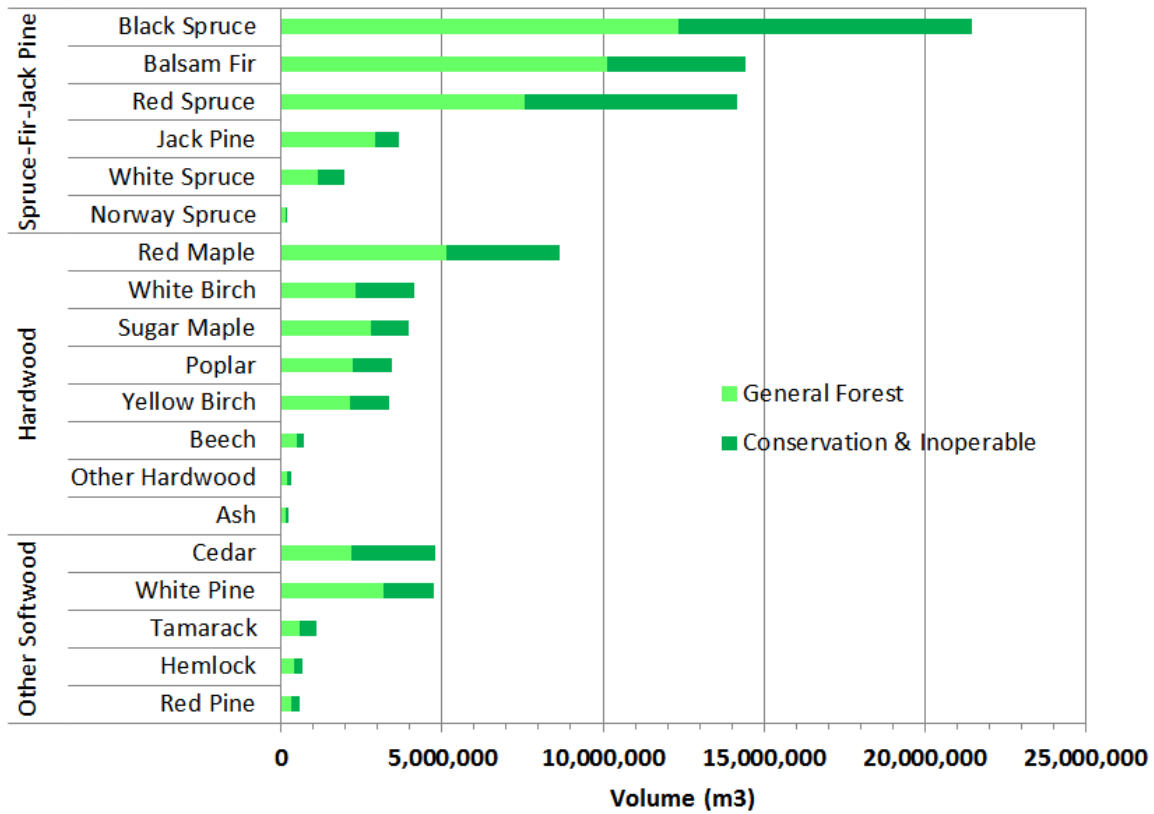


Figure 6: Net merchantable inventory by species group for License 7.

Table 1. Plantations and Pre-Commercial Thinning activities from 2002-13.
(Since 1970 over 148,700 ha have been planted and over 154,000 ha pre-commercially thinned).

Year -->	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
PCT (ha/yr)	760	790	1,937	3,298	6,195	1,994	3,667	4,378	5,366	6,339	5,673	6,076
Planted (ha/yr)	4,977	5,650	5,447	4,967	5,763	5,794	5,521	5,129	4,757	4,436	4,635	3,581

Table 2: Distribution of forested area by management zone for License 7.

Forest Zones	Protected Areas	Deer Yards	Riparian Buffers	Old Forest	Old Forest Community	Wildlife	Unique Sites	Inoperable Areas	Mutually Exclusive	Total Hectares
Protected Areas	38,302	13,134	13,567	32,404	26,312	19,995	9,281	2,690	92,873	92,873
Deer Yards		20,135	7,476	17,919	13,142	11,379	666	749	35,351	49,050
Riparian Buffers		6,847	71,720	8,843	6,924	4,344	6,126	4,740	82,239	101,352
Old Forest		16,602	8,843	1,937	47,697	35,772	4,831	9,820	13,883	60,201
Old Forest Community		12,327	6,924	47,697	1,065	23,268	4,175	8,250	0	47,697
Old Forest Wildlife		10,234	4,344	35,772	23,268	1,938	3,044	4,280	0	35,771
Unique Sites		629	6,126	4,831	4,175	3,044	353	1,440	353	14,527
Inoperable Areas		749	4,740	9,820	8,250	4,280	1,440	64,897	64,897	79,524

Note:

DNR Conservation forest = 224,346

JDI Unique + Opcon = 65,250

Total Forest Zones = 289,596 hectares

Harvest Prescriptions

The harvest prescriptions we utilize include:

1. **Even-aged Management:** prescriptions where the forest stand is managed as predominantly one or two age-classes. This grouping includes the regeneration systems of Final Harvest (clear-cutting or over-story removal) and shelter wood harvest, as well as intermediate treatments such as commercial thinning. The list of prescriptions under this grouping include:
 - **Clear-cuts:** Removes most of the merchantable stems of all species within an area. The treatment is generally applied in mature to over-mature stands and leads to the creation of new, even-aged stands through either natural regeneration or planted trees. Operational variations include leaving residual islands or patches of standing timber largely for wildlife purposes and conforming to the natural stand boundaries. We have described these modifications under the term – variable retention clear-cuts.
 - **Over Story Removal:** Over story removal harvest prescriptions remove most of the merchantable stems of all species in a single treatment entry. This even aged management prescription is designed to protect and release well established regeneration in the under story. Full planting is usually not required following an over story removal harvest.
 - **Commercial Thinning:** Commercial thinning is generally prescribed in planted stands or previously pre-commercially thinned areas. The primary objective of this treatment is to remove a portion of the trees, usually focusing on lower quality stems, in order to allow the remaining trees to continue growing vigorously. This prescription generally removes 35-45% of the merchantable volume. Depending upon the species, density, and site productivity, the commercial thinning may be prescribed in stands varying from 20 to 30 years old. Once a stand has been commercially thinned, it is normally locked out from harvest eligibility for the next 10 year period.

Table 3. Commercial thinning treatments reported by species, site, and volume harvested.

Forest Stand Type	Species Group	Site Class	Commercial Thin (age)	Volume Cut (m3/ha)	Final Harvest (Age)	Volume Cut (m3/ha)	Total (m3/ha)
Planted Stand	Black/Red Spruce	1	30	50	40	155-185	205-235
Planted Stand	Black/Red Spruce	2	35	45	45	115-145	160-190
Planted Stand	Black/Red Spruce	3	-	-	40	-	145-165
Planted Stand	Black/Red Spruce	4	-	-	40	-	145-165
Planted Stand	Norway/White Spruce	1	25	55	35	195-240	240-295
Planted Stand	Norway/White Spruce	2	30	50	40	190-235	235-290
Planted Stand	Norway/White Spruce	3	35	45	45	135-185	180-230
Planted Stand	Norway/White Spruce	4	-	-	40	-	180-230
Pre-Commercial Thin	Spruce/Fir	1	30	50	40	95-115	145-165
Pre-Commercial Thin	Spruce/Fir	2	35	45	45	100-120	145-165
Pre-Commercial Thin	Spruce/Fir	3	-	-	40	-	145-165
Pre-Commercial Thin	Spruce/Fir	4	-	-	40	-	145-165

- **Shelter wood and Multiple Pass Harvesting:** Shelter wood and multiple pass treatments are often practiced in stands with a goal of promoting natural regeneration or salvaging mortality. In most situations, this prescription is even aged management. In shelter wood or multiple pass harvest prescriptions, up to 50-75% of the standing volume may be removed in the first pass. The second entry is normally delayed by 10-15 years, depending upon the specific stand conditions and objectives. There are some variations on the standard shelter wood that may be prescribed in specific circumstances including irregular shelter wood methods. Harvest areas operated in strips are considered a Strip-Patch prescription.
2. **Uneven-aged management:** prescriptions where the area is managed to maintain multiple age classes with an objective to retain a forest canopy indefinitely. This grouping typically includes individual tree selection and riparian zone treatments. The array of prescriptions under this grouping includes:
- **Riparian – Selection Harvest:** The purpose of selection harvesting in riparian stands is to regenerate and maintain an uneven-aged forest structure. This prescription typically occurs in riparian zones, but may also occur in other special management zones.

- **Single Tree Selection:** Single tree selection harvest is usually classical uneven-aged management. Ideally, this prescription targets tolerant hardwood, tolerant mixed wood or cedar dominated stands. In addition, harvesting in riparian zones, recreational, aesthetically important, or other constrained zones may require that a single tree selection treatment is utilized. Typically, uneven aged management may remove 30-40% of the stand volume each entry, depending upon the specific stand condition with subsequent entries separated by 20 to 30 years. The objective of the single tree selection treatment is generally to develop a full range of age and diameter classes in the stand.

Silviculture Prescriptions

Intensive silviculture treatments provide a cost-effective means to increase both the short and long-term yield of desired timber products as well as meeting specific habitat objectives. The silviculture treatments that will be undertaken in this regard include the following: Tree Planting, Pre-Commercial Thinning, Herbicide Release, and Plantation Cleaning

Tree planting and pre-commercial thinning (PCT) are common silviculture treatments used in forestry across North America. A commitment to undertake a silviculture program is necessary to ensure a sustainable and increasing AAC in the long-term. This includes a planting program of 3,500 ha/year and a pre-commercial thinning (pct) program of 1,000 ha/year. The benefits from these intensive treatments are clearly demonstrated by an increasing growing stock capable of supporting an increasing harvest level over time. This program is restricted due to the basic silviculture funding budget of 6 million \$/year.

Tree Planting

Areas that have been clear-cut may be eligible for and benefit from planting if the area is not sufficiently stocked with natural regeneration. Depending upon the specific site conditions, the following species may be planted: Black Spruce, Norway Spruce, White Spruce, Red Spruce, White Pine, Jack Pine, or Eastern Cedar.

Trees are planted usually after site preparation by scarification, at a density of 1,600 – 2,000 trees per hectare.

A Tree Improvement program is in place to improve the genetic quality and adaptability of the planting stock. Work has been underway for more than 30 years and focuses on the spruces and pines that we commonly plant. The future yield improvements that we expect because of this Tree Improvement program have been scheduled and incorporated into our growth and yield curves utilized in this Management Plan (Table 4).

Table 4. Summary of yield increases by species and year as a result of the Tree Improvement Program.

Planted Species	White Spruce			Black Spruce					Red Spruce		Norway Spruce
	1992	1997	2007	1992	1997	2002	2007	2009	2002	2007	2007
Year Incorporated											
Average Yield Improvement*	5%	10%	20%	5%	10%	15%	20%	25%	5%	10%	10%

*The average yield improvement is over and above the 1990 planting stock.

Pre-Commercial Thinning (PCT)

Naturally regenerated areas may be eligible for, and receive a pre-commercial thinning treatment if there is both a high stocking (>60%) and a high density (>5,000 stems per hectare) of commercial tree species.

Herbicide Release

The use of herbicides is a silviculture tool that is very carefully scrutinized prior to its use. In some situations, however, competition to young regeneration from grasses, raspberries or other brush species necessitates this treatment.

Planted Stand Cleaning

Planted stands may be eligible for, and receive a pre-commercial treatment called plantation cleaning. The goal of the cleaning is to provide sufficient growing space for the future crop trees. Planted stands are assessed for cleaning between age 5-10. When required plantation cleaning work is usually done using crews equipped with mechanized brush saws, similar to the PCT treatment.

The Conservation Forest

Twenty three percent (23%) of the Crown land on License 7 is in mapped designated zones with a primary management objective of conservation and includes the following:

- 53 New Brunswick protected areas (92,873 hectares)
- 162 individual unique sites (14,527 hectares)
- 168 deer wintering area management yards (49,050 hectares)
- 1,683 old forest wildlife habitat stands (35,771 hectares)
- 11,296 old forest stands (60,201 hectares)
- 8,652 old forest community stands (47,697 hectares)
- 29,000 km network of riparian and wetland buffers (101,352 hectares)

The above list does not include conservation areas along unmapped watercourses, bird nest sites and other unmapped wildlife protection areas, and operationally inoperable areas.

We are assuming an AAC of 40,000 m³/year Spruce/Fir/Jpine and 10,000 m³/year Hardwood from the conservation forest (Riparian buffers, DWA, and Unique sites). This AAC will be derived from stand level appropriate prescriptions.

New Brunswick Protected Natural Areas

In 2001, ten large, representative Protected Natural Areas (PNA) were announced. All of these sites were placed under special legislation in 2003. The PNA legislation is known as the Protected Natural Areas Act and Regulations. In 2014 an additional 23,330 hectares have been added to the PNA Program. In total 92,873 hectares have been designated to this zone within Crown License 7. As of 2007, there is no AAC associated with the NB Protected Natural Areas within the License.

Unique Sites

J.D. Irving's Unique Areas program objective is to manage each site to maintain and protect its unique features or attributes. Forest harvesting is

not necessarily prohibited; however any management activity must be completely compatible with protecting that special feature. Occasionally, salvage operations are scheduled to recover imminent mortality resulting from wind-throw or blow-down in these unique areas.

Riparian Buffers

The management objective for Riparian Buffers is to maintain an over story forest canopy. The purpose of selection harvesting in riparian stands is to regenerate and maintain an uneven-aged forest structure.

Harvesting within these buffers is normally by the riparian select cut prescription, with periodic entries every 15 to 25 years. Removals target the highest risk volume while maintaining a residual canopy, typically 18 m²/ha. This prescription generally removes 30-35% of the merchantable volume. Harvesting activity must not deposit any slash or residues within the watercourse and equipment will be controlled to prevent any soil disturbance within 15 meters of the water course.

Harvesting in riparian buffer management will target the removal of unstable trees.

Deer Wintering Areas

Each DWA is reviewed individually for harvest opportunities while respecting the long-term strategy of managing towards softwood-dominant stand types to provide deer wintering habitat and browse.

Deer wintering area management targets the removal of declining stands in order to replace them with stands which will provide future habitat.

Old Forest Communities and Old Forest Wildlife Habitat

A Crown forest management goal is to maintain the supply of old forest wildlife habitats and forest communities which provide the diversity and distribution of life that requires attributes of old forest. The maintenance of old forest has been a component of Crown forest management plans since

1992. Old Forest Communities (OFC) are the basic building blocks of a strategy to supply old forest conditions on Crown land. Old Forest Wildlife Habitats (OFWH) are for the maintenance of vertebrate wildlife populations and are associated to aggregates of OFC. Any harvesting in these areas must maintain the old forest habitat condition.

Table 5. License 7 target levels of Old Forest Wildlife Habitat (OFWH) by Eco-region for the 2012-2021 forest management plan.

Eco-region	Old Forest Wildlife Habitat Types					
	Spruce/Fir (OSFH)	Pine (OPIH)	Tol Hardwood (OTHIH)	Hardwood (OHWH)	Mixwood (OMWH)	Balsam Fir (OFH)
1	0	0	26	26	18	0
3	2,607	0	4,122	2,574	2,962	5,904
4	1,982	0	547	531	516	2,109
5	7,333	600	2,321	1,362	1,941	8,963
6	9,518	1,592	1,018	1,186	2,106	10,398
7	0	129	93	144	684	484

* The OFWH forest stands do overlap with each other.

Table 6. License 7 target levels of Old Forest Communities (OFC) by Eco-region for the 2012-2021 forest management plan.

Ecoregion	Old Forest Community														Total (ha)
	Hemlock	Cedar	R Spruce	BS-M W Spruce	Balsam Fir	SWTH	R Pine	W Pine	THP	THSW	BS-P	J Pine	Larch	Total (ha)	
3	0	6	4,448	488	18	57	520	0	0	2,542	1,294	324	0	0	9,697
4	0	147	3,639	557	0	0	0	0	0	287	52	0	44	4,726	
5	65	1,914	5,695	1,202	93	119	456	444	254	1,153	615	1,387	0	203	13,600
6	108	435	4,044	3,017	84	70	327	168	1,495	115	446	6,367	1,045	183	17,904
7	0	0	350	357	0	0	0	59	74	0	56	828	20	42	1,786
Total (ha)	173	2,502	18,176	5,621	195	246	1,303	671	1,823	3,810	2,698	8,958	1,065	472	47,713

License Level Indicators

Annual Allowable Cut (AAC) reported in m³/year

Table 7: Sustainable harvest levels by major species groups on License 7.

Zone and Prescription	Harvest Area	Spruce/Fir/Jp	Hardwood	White Pine	Cedar
	(ha/year)	(m ³ /yr)	(m ³ /yr)	(m ³ /yr)	(m ³ /yr)
Conservation & Inoperable Zones	1,600	47,000	13,000	5,000	1,000
Natural Non-CC (1st-Entry)	2,430	58,300	57,900	1,400	4,600
Natural Non-CC (2nd-Entry)	1,880	68,800	45,900	33,700	2,000
Natural CC	11,020	791,800	311,500	39,200	22,800
CT	1,560	64,200	7,200	3,000	-
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CC PCT	840	113,600	15,900	5,000	-
CC Jack Pine	410	50,900	2,500	-	-
CC CT1 (Jack Pine)	260	31,900	1,100	-	-
Total(s)	20,300	1,268,000	457,000	88,000	31,000

Silviculture Levels reported in hectares/year

Table 8: Silviculture levels for Crown License 7.

Planting (ha/year)	Pre-Commercial Thinning (ha/year)			Commercial Thinning (ha/year)
	Swd Dominate	Mixwood Dominate	Hwd Dominate	
3,500	250	450	300	1,500

Operational Net Downs

History and experience have shown that it is neither possible nor practical to access and operate every blocked hectare so various net down factors have been applied to derive the indicated harvest levels. These factors include the following:

- Low volume, inoperable stands that occur within the mapped harvest block,
- Steep slopes that occur within the harvest block,
- Structural and biological diversity features,
- Unmapped streams, wet areas, and other sensitive areas, and
- Product yield adjustments for Cedar and White Pine saw material.

The resulting operational net downs are listed in Table 9. These have been applied to the gross volume from the harvest blocking of natural and managed stands in the general forest zone.

Table 9. Operational net downs by species group and broad stand type.

Net-Down Adjustments	Spruce-Fir			Hardwood			White Pine Logs			Cedar Saw Material		
	Natural CC	Natural Non-CC & 2nd Pass	Managed Stands	Natural CC	Natural Non-CC & 2nd Pass	Managed Stands	Natural CC	Natural Non-CC & 2nd Pass	Managed Stands	Natural CC	Natural Non-CC & 2nd Pass	Managed Stands
Within Block Net Down	17%	2%	2%	14%	2%	2%	15%	2%	2%	20%	2%	2%
Product Yield	0%	0%	0%	0%	0%	0%	25%	25%	25%	50%	50%	50%
Total Net-Down After Blocking	17%	10%	2%	14%	10%	2%	40%	10%	27%	70%	10%	52%

Harvest Treatment Levels

Table 10. Summary of 2014-2036 harvest area distribution by prescription.

Period	Total Harvest (Hectares / Year)					
	ha/year	Final Harvest	Shelterwood	Strip-Patch	Selection	Commercial Thin
2014-2016	20,300	13,600	600	3,200	1,400	1,500
2017-2021	20,300	13,600	600	3,200	1,400	1,500
2022-2026	18,500	8,700	400	3,800	2,000	3,600
2027-2031	14,700	8,100	200	3,000	1,600	1,800
2032-2036	14,600	8,600	200	2,000	900	2,900

Table 11. Summary of 2014-2036 total harvest area (Ha/year) reported by prescription percent.

Period	Total Harvest (% Hectares / Year)					
	ha/year	Final Harvest	Shelterwood	Strip-Patch	Selection	Commercial Thin
2014-2016	20,300	67.0%	3.0%	15.8%	6.9%	7.4%
2017-2021	20,300	67.0%	3.0%	15.8%	6.9%	7.4%
2022-2026	18,500	47.0%	2.2%	20.5%	10.8%	19.5%
2027-2031	14,700	55.1%	1.4%	20.4%	10.9%	12.2%
2032-2036	14,600	58.9%	1.4%	13.7%	6.2%	19.9%

Table 12. Summary of 2014-2036 Spruce/Fir/Jpine harvest volume (m³/year) reported by prescription percent.

Period	SFJ Harvest (% AAC / Year)					
	m ³ /year	Final Harvest	Shelterwood	Strip-Patch	Selection	Commercial Thin
2014-2016	1,268,000	85.1%	0.9%	7.7%	1.2%	5.1%
2017-2021	1,268,000	85.1%	0.9%	7.7%	1.2%	5.1%
2022-2026	1,268,000	76.7%	0.5%	10.3%	1.8%	10.8%
2027-2031	1,268,000	86.5%	0.3%	6.3%	1.6%	5.3%
2032-2036	1,268,000	84.5%	0.3%	4.2%	1.4%	9.6%

Table 13. Summary of 2014-2036 Hardwood harvest volume (m³/year) reported by prescription percent.

Period	HWD Harvest		(% AAC / Year)			
	m ³ /year	Final Harvest	Shelterwood	Strip-Patch	Selection	Commercial Thin
2014-2016	457,000	76.6%	1.0%	15.0%	5.9%	1.6%
2017-2021	457,000	76.6%	1.0%	15.0%	5.9%	1.6%
2022-2026	395,500	52.3%	1.6%	20.7%	18.0%	7.5%
2027-2031	395,500	59.3%	0.3%	23.1%	12.8%	4.4%
2032-2036	395,400	76.3%	0.3%	12.1%	5.0%	6.4%

Table 14. Summary of 2014-2036 White Pine harvest volume (m³/year) reported by prescription percent.

Period	WP Harvest		(% AAC / Year)			
	m ³ /year	Final Harvest	Shelterwood	Strip-Patch	Selection	Commercial Thin
2014-2016	88,000	86.9%	1.8%	6.6%	1.1%	3.4%
2017-2021	88,000	86.9%	1.8%	6.6%	1.1%	3.4%
2022-2026	89,800	73.6%	0.8%	15.1%	1.1%	9.4%
2027-2031	78,800	81.2%	0.5%	11.8%	1.1%	5.3%
2032-2036	78,000	87.9%	0.5%	6.0%	1.2%	4.4%

Table 15. Summary of 2014-2036 Cedar harvest volume (m³/year) reported by prescription percent.

Period	EC Harvest		(% AAC / Year)			
	m ³ /year	Final Harvest	Shelterwood	Strip-Patch	Selection	Commercial Thin
2014-2016	31,000	79.0%	5.2%	11.7%	3.9%	0.3%
2017-2021	31,000	79.0%	5.2%	11.7%	3.9%	0.3%
2022-2026	26,800	68.3%	1.1%	24.3%	4.1%	2.2%
2027-2031	14,200	67.6%	0.7%	23.9%	6.3%	1.4%
2032-2036	8,000	60.0%	1.3%	28.8%	7.5%	2.5%

The Management Plan also provides “fall out” volumes of several minor species. Table 16 summarizes the expected availability of these species for the 2012-2036 planning period.

Table 16. Fallout volumes (m³/year) of minor species from 2014-2036.

Tree Species	2014-2021	2022-2036
	(m ³ /year)	(m ³ /year)
Hemlock	9,700	5,800
Tamarack	16,600	8,800
Red Pine	9,500	9,100

Note that Sirococcus in Red Pine is rapidly decimating this tree species on the License and in the Province.

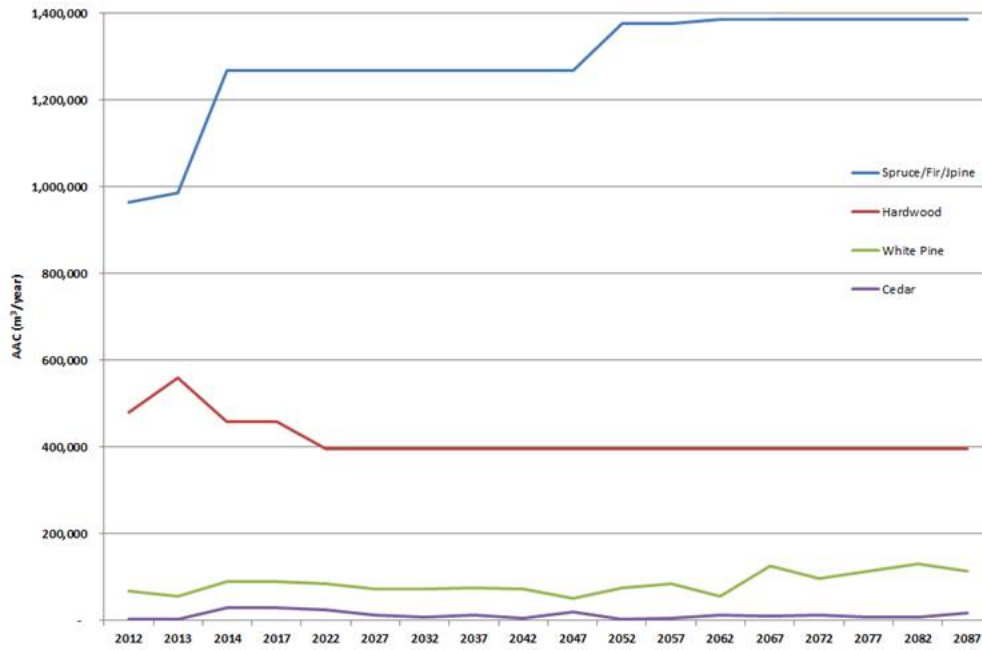


Figure 7: Long term harvest levels (m³/year) by Species group.

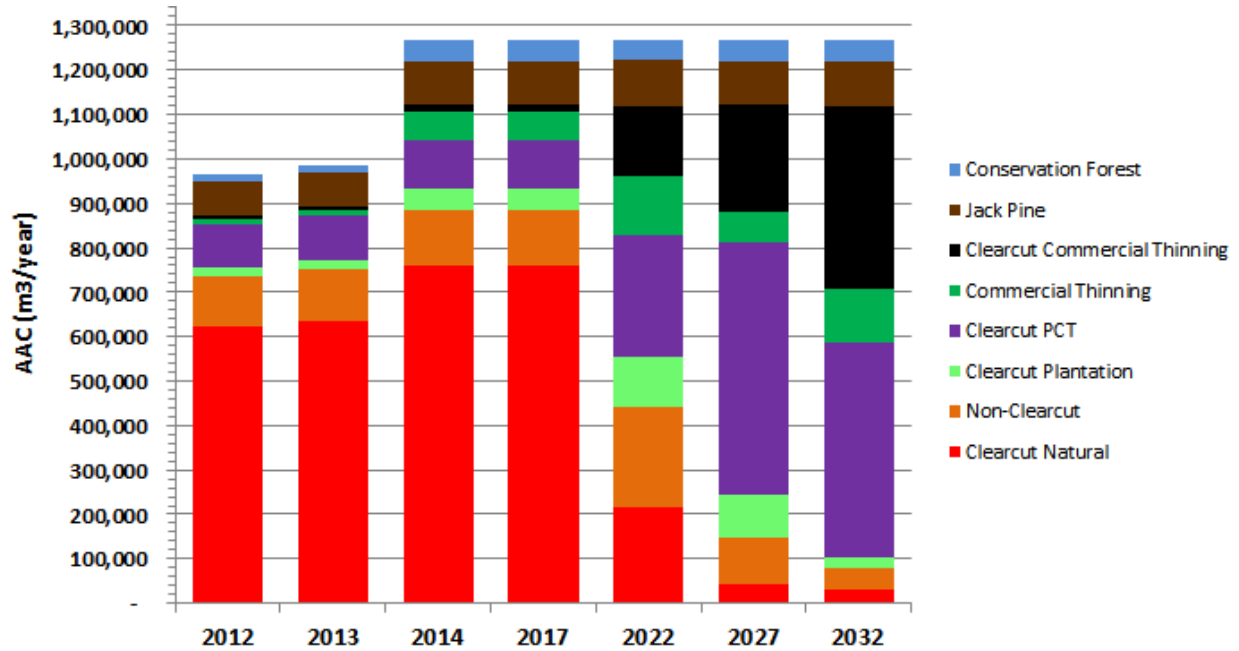


Figure 8: Spruce/Fir/Jpine annual harvest (m³/year) by forest stand type.

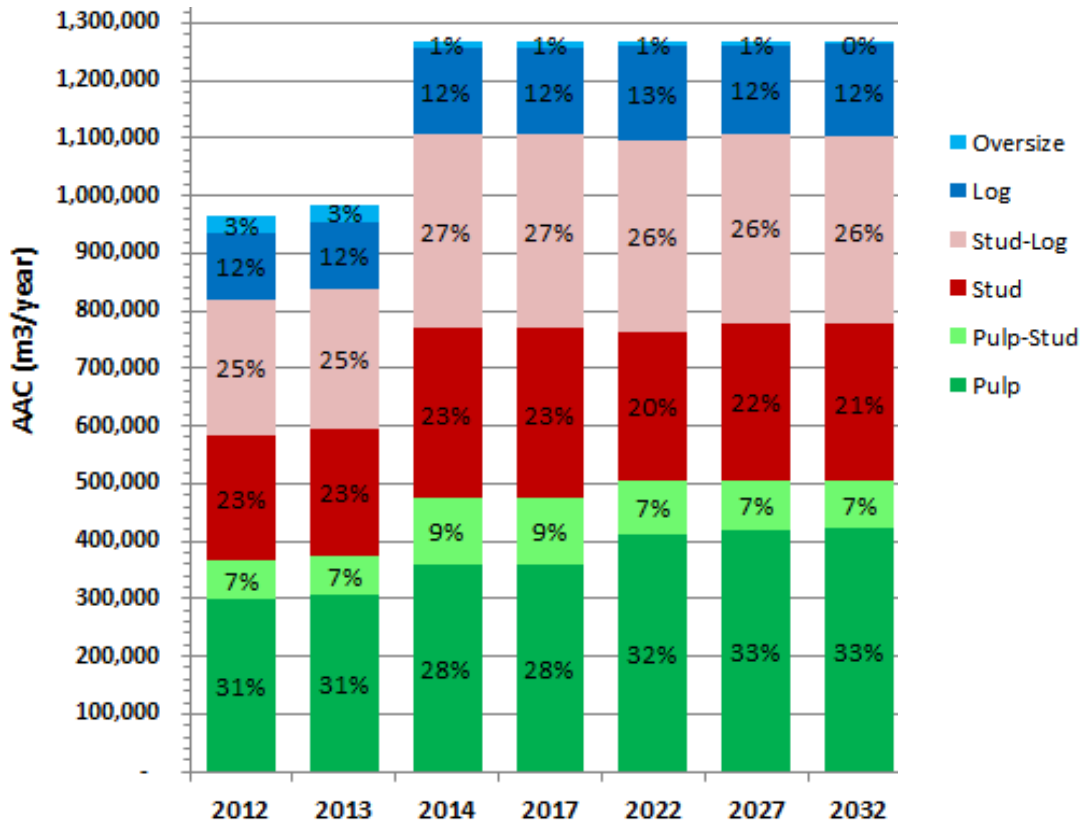


Figure 9: Distribution of Spruce/Fir/Jpine products from the forest over time.

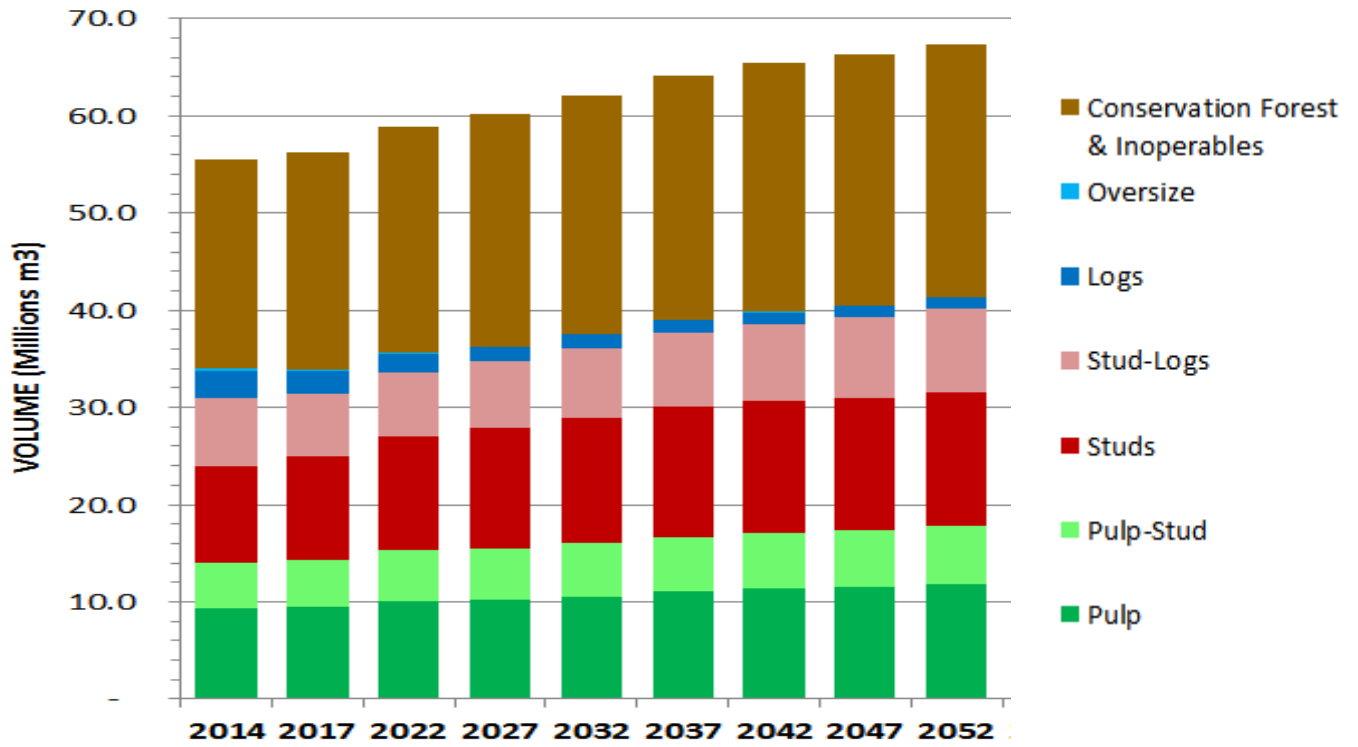


Figure 10: Spruce/Fir/Jpine growing stock (m3) over time for the forest.

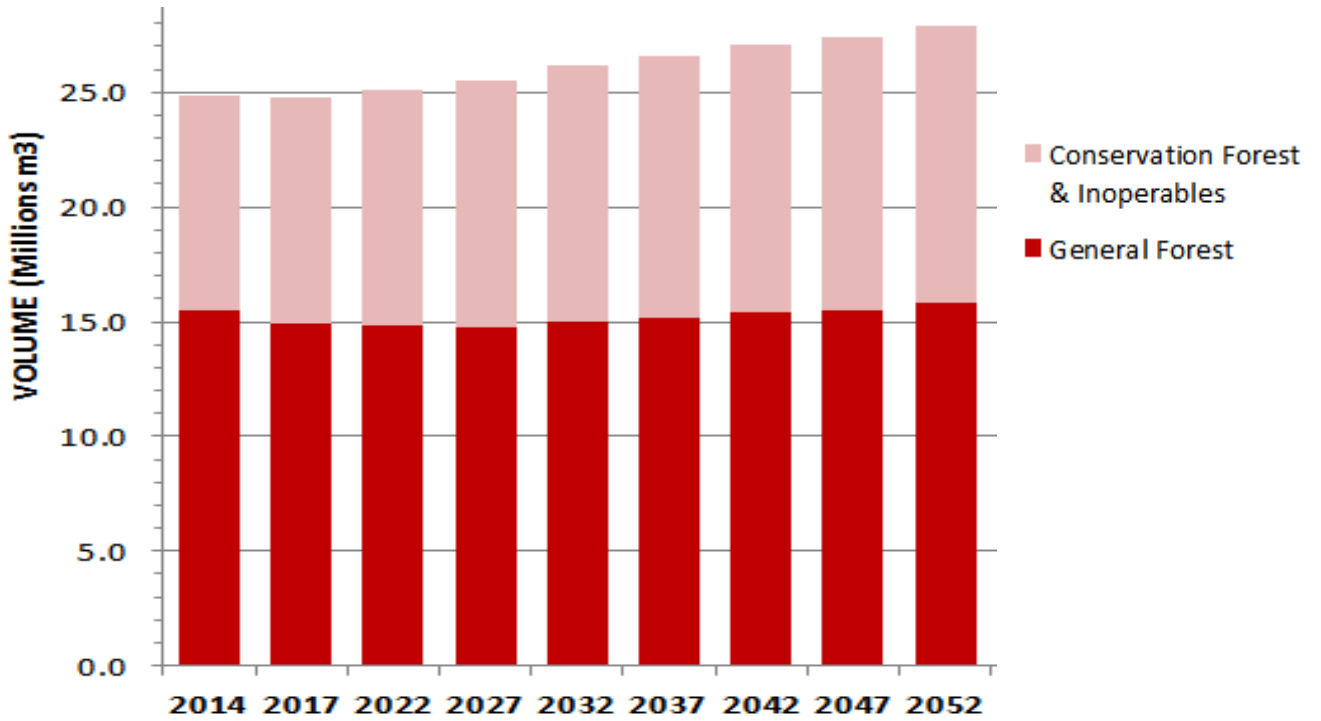


Figure 11: Hardwood growing stock (m3) over time for the forest.

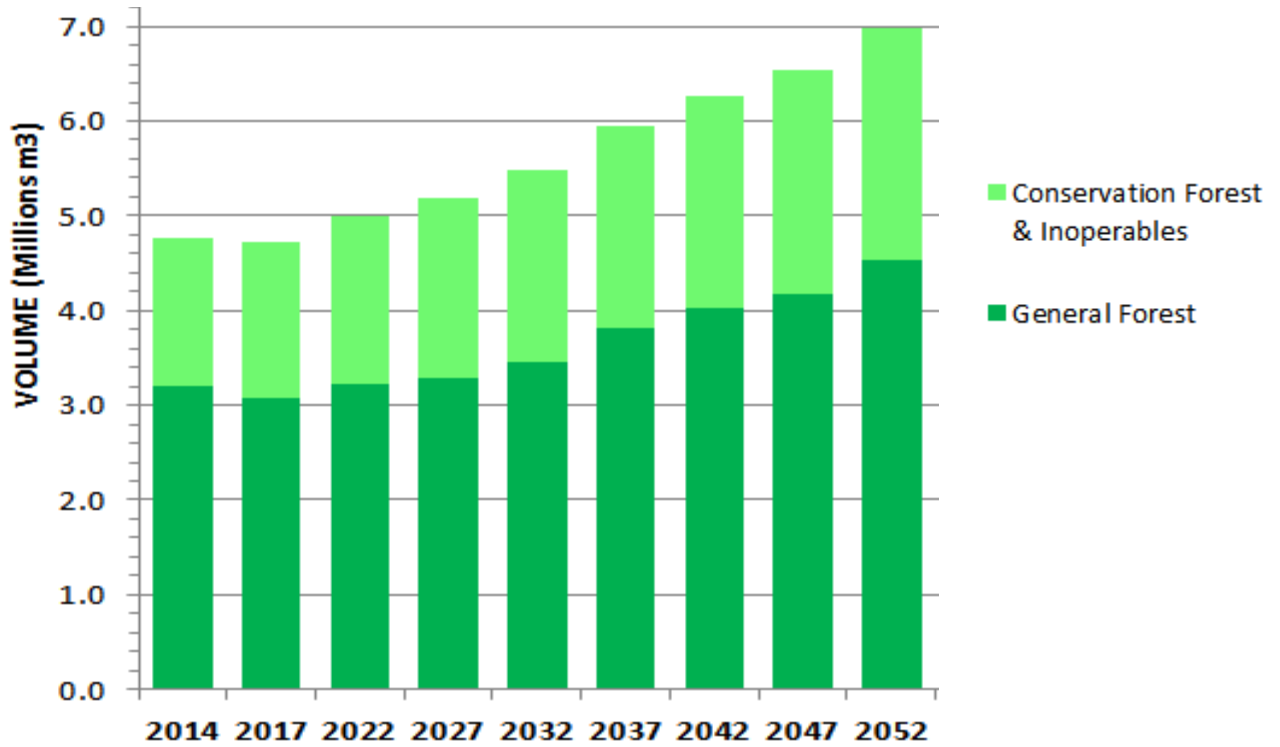


Figure 12: White Pine growing stock (m3) over time for the entire forest..

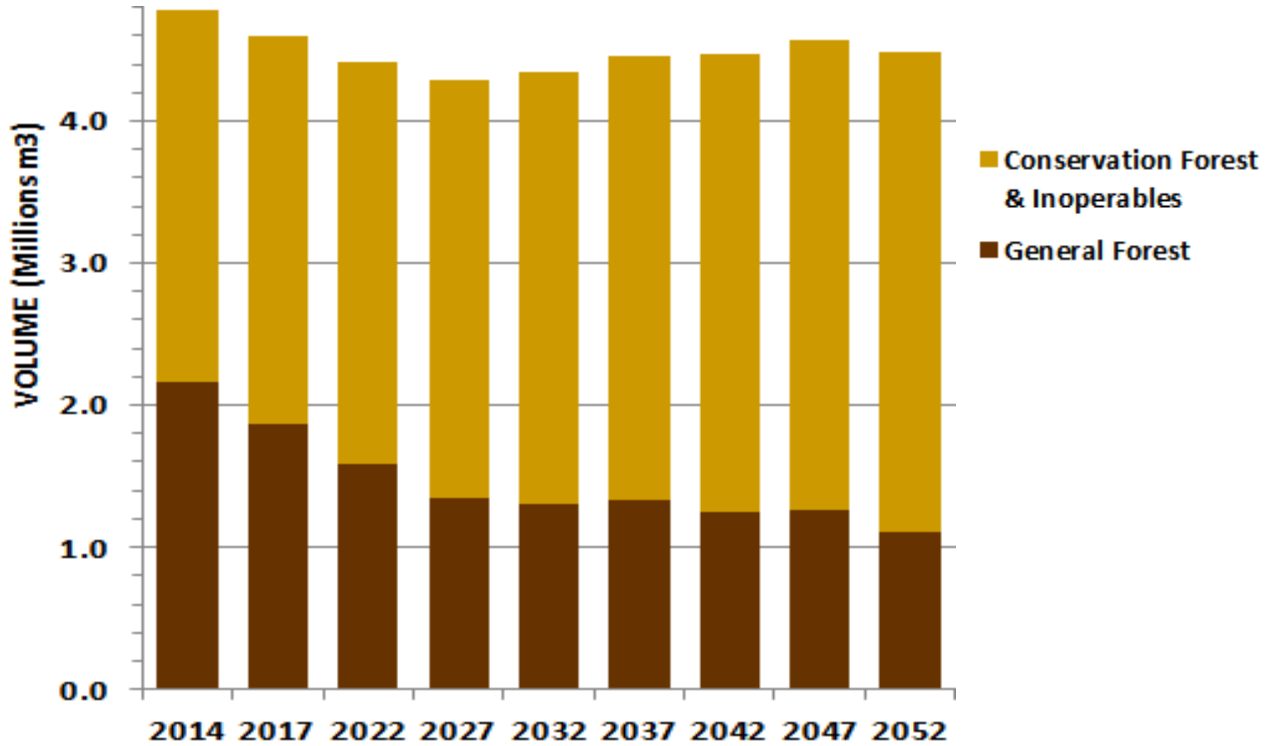


Figure 13: Cedar growing stock (m3) over time for the entire forest.

Table 17: Total forest area by broad stand type for License 7 over time.

Stand Type	2014	2022	2037	2062
Natural Regen	82,649	127,230	94,021	72,543
Spruce-Fir-Jack Pine	284,996	234,480	246,080	262,938
Cedar	21,777	21,624	23,754	25,896
White Pine	13,538	12,692	16,974	16,435
Other Softwood	35,316	29,388	28,300	27,534
Mixedwood	92,269	92,346	121,622	157,242
Hardwood	117,072	109,378	113,444	119,490
Planted	153,491	167,223	197,089	196,783
CT Plantation	2,822	10,264	13,200	32,528
PCT Softwood	117,291	106,895	57,417	25,338
CT PCT	3,869	6,798	11,241	276
PCT Softwood Mix	12,062	13,118	4,065	2,547
PCT Hardwood	15,237	20,955	25,182	12,840
Non-Forested	94,610	94,610	94,610	94,610
Total (Hecaters)	1,047,000	1,047,000	1,047,000	1,047,000

Table 18: Mature/Over mature forest stand type for License7 over time.

Stand Type	MATURE & OVERMATURE *			
	2014	2022	2037	2062
Natural Regen	-	-	-	-
Spruce-Fir-Jack Pine	198,021	155,364	138,717	137,932
Cedar	21,603	21,184	18,814	16,331
White Pine	10,412	7,662	6,428	5,695
Other Softwood	25,440	20,563	18,105	18,617
Mixed Wood	60,059	47,777	38,351	58,943
Hardwood	77,791	67,568	55,607	63,162
Planted	-	-	-	9,076
CT Plantation	-	-	-	121
PCT Softwood	-	2,303	11,649	11,700
CT PCT	-	212	223	261
PCT Softwood Mix	-	200	2,178	608
PCT Hardwood	-	274	608	1,490
Non-Forested	-	-	-	-
Total (Hecaters)	393,327	323,106	290,678	323,937

* Forest Stand maturity is defined in Appendix 4.

Forest Management Plan Summary

Key results of the 2012-2021 Crown License 7 management plan:

Table i. Summary of AAC volumes (m³/year) by zone and species group for License 7.

Zone and Prescription	Harvest Area (ha/year)	Spruce/Fir/Jp (m³/yr)	Hardwood (m³/yr)	White Pine (m³/yr)	Cedar (m³/yr)
Conservation & Inoperable Zones	1,600	47,000	13,000	5,000	1,000
Natural Non-CC (1st-Entry)	2,430	58,300	57,900	1,400	4,600
Natural Non-CC (2nd-Entry)	1,880	68,800	45,900	33,700	2,000
Natural CC	11,020	791,800	311,500	39,200	22,800
CT	1,560	64,200	7,200	3,000	-
CC Plantation	340	40,800	2,500	-	-
CC PCT	840	113,600	15,900	5,000	-
CC Jack Pine	410	50,900	2,500	-	-
CC CT1 (Jack Pine)	260	31,900	1,100	-	-
Total(s)	20,300	1,268,000	457,000	88,000	31,000

Table ii. Summary of Silviculture levels over time for Crown License 7.

Year of Plan	License Area (ha)	Harvest Volume (m³/yr)				Silviculture (ha/yr)	
		Spruce/Fir/Jp	Hardwood	White Pine	Cedar	Plant	PCT
2012	1,046,966	1,268,000	457,000	88,000	31,000	3,500	1,000
2007	1,049,917	897,000	473,000	78,410	25,560	5,185	3,610
2002	968,128	1,006,540	524,609	45,500	19,206	4,711	6,230
1997	972,059	922,000	388,000	47,600	19,800	3,605	6,295
1993	975,000	825,500	293,500	50,250	26,125	3,040	2,710

23% of the Crown land on License 7 is in mapped designated zones with a primary management objective of conservation and includes the following:

- 53 New Brunswick protected areas (92,873 hectares)
- 162 individual unique sites (14,527 hectares)
- 168 deer wintering area management yards (49,050 hectares)
- 1,683 old forest wildlife habitat stands (35,771 hectares)
- 11,296 old forest stands (60,201 hectares)
- 8,652 old forest community stands (47,697 hectares)
- 29,000 km network of riparian and wetland buffers (101,352 hectares)

In addition, another 10% of the productive forest land base will be focused on conservation due to unmapped watercourse buffer requirements, unmapped wildlife habitat buffers and inoperable areas.

Outcomes of this updated forestry strategy and management plan include:

- Increase in legally protected areas,
- Increase in industry investments,
- Increase in forest sector jobs,
- Increase in mill production,
- Increase need for wood from private woodlots,
- Increase in Government royalty revenues, and
- Decrease in Government costs for License management.

Important Improvement Opportunities and Management Issues

There are several important improvement opportunities and management issues that should be considered and resolved so that management and future plans can be improved. These are outlined below:

Acquisition of LiDAR coverage for Crown Land:

- Remote sensing imagery and data using Light Detection And Ranging (LiDAR) technology has the potential to greatly improve the accuracy and precision of mapping watercourses (presently about 50% of the watercourses in the Province are not mapped, and those that are often not precise enough) and interpreting timber inventories.
- LiDAR technology can also provide many benefits for forest operations and other resource sectors in addition to utilities and municipalities. It can be used to improve flood forecasting, safety planning and habitat and environmental analyses.
- **It is urgent that Government acquires and makes LiDAR coverage available for the entire Province as soon as possible.**

Basic Silviculture Funding on Licence 7:

- Basic silviculture funding from Government for License 7 has been significantly reduced in this 2014-2021 period compared to the levels provided during the 2007-2011 period. The Government previously approved levels that supported 5,185 hectares of tree planting related activity and 3,610 hectares of pre-commercial thinning with an approximate cost of \$8M per year.

- For this new management plan, funding support has been reduced to approximately \$6M per year; supporting only approximately 3,500 to 4,000 hectares of tree planting and 1,000 hectares of pre-commercial thinning per year.
- In addition there is no funding available for commercial thinning operations which are very costly and will be dramatically increasing over the next 10 to 15 years.
- **This funding reduction will negatively impact the future growth and wood supply potential from the License. DNR should ensure each License is receiving an equitable share of the available silviculture funding support.**

Volume and Product Yield Forecasts From Managed Stands:

- JDI's empirical experience and recent LiDAR data analysis provides strong evidence that the standard yield curves for managed stands are seriously underestimating the present and future volumes in planted and pre-commercially thinned areas.
- In addition, our actual experience indicates higher pulp percentages in commercial thinning(s) than is predicted in the Growth & Yield Group's models (we believe this can be explained because this treatment targets the smaller and poorly formed trees for removal).
- As pointed out in Appendix III, we have adjusted the standard volume and product yields to be more consistent with recent data and our experience and expectations.
- **We strongly recommend that Industry, DNR and the Growth & Yield experts fully investigate this issue and use the best available new data to revise managed stand volume and product yield curves. We are prepared to fully participate in this important work.**

Hardwood Harvest Levels:

- As noted within the document, this management plan and strategy outlines a long term sustainable hardwood AAC of 395,000 m³ per year. Our blocked plan outlines harvesting approximately 457,000 m³ per year for the 2014-2021 to address fallout of hardwood from softwood focused prescription while still maintaining a responsible level of quality hardwood stand improvement prescriptions aimed at increasing high-grade hardwood yields in the long term.

- It is also important to note that if DNR advocated and implemented a hardwood quality improvement silviculture program (pre-commercial and commercial thinning) we believe there could be an immediate increased “allowable cut effect”.
- **We recommend that DNR investigate securing additional funding to support opportunities for a quality hardwood focused silviculture program on Crown Land.**

Mitigating Impacts of Insect, Disease, Wind and Fire Damage:

- The harvest levels outlined in this Management Plan do not assume any abnormal level of insect, disease, wind, fire or other environmental events that cause significant timber damage beyond the levels experienced over the past 20 years.
- It is also important to note that we expect spruce budworm to cause some damage to spruce and fir trees over the next 10 years which we hope to be able to mitigate with adjustments to our harvest areas and schedules.
- We also expect siroccoccus to devastate Red Pine stands on the License, and we are working aggressively to salvage as many of these areas as practical.
- Climate change is expected to cause more storm events resulting in more wind damage. The recent post-hurricane storm “Arthur” has caused some wind damage that we are currently assessing. We will be diligently redirecting our operations to salvage areas severely affected by wind or storm damage.
- We will adjust our Operating Plans and our harvest areas on an “as needed” basis in order to salvage damaged trees and minimize wood supply and AAC impacts.
- If we experience widespread catastrophic events in the future from these types of environmental risks; it may be necessary to re-calculate the AAC as a result of unpredicted damage that cannot be mitigated.
- **We cannot be accountable for the short and long term AAC and wood supply impacts caused by catastrophic damages that we cannot practically mitigate.**

Appendices

Appendix I – Management planning forecast tools

Appendix II – Forest stand development – Growth & Yields

Appendix III – Recent inventory enhancements

Appendix IV – Mature/Over mature forest stand type definitions

APPENDIX I – Management Planning Tools and Methodology

Development of a forest management strategy requires analysis of a wide range of options, selection of a preferred scenario and concludes with a spatially blocked treatment schedule. A management strategy is defined by a particular set of objectives and constraints applied to the forest resource, creating a prediction of the future state, and the treatments required to get there. Exploring and choosing among alternative scenarios or strategies requires forecasting and assessing the outputs using well-defined performance indicators.

Alternative management strategies for the License 7 were explored using Woodstock, the Remsoft® spatial forest planning system. Inputs to the modeling system included the following:

- A description of the forest derived from the GIS forest inventory data.
- A set of harvest and silviculture treatment options & the rules for application.
- Yield curve forecasts of how the forest will change over time with respect to feasible interventions.

Given these inputs and a set of objectives and constraints, the Remsoft® Spatial Planning System uses linear programming to identify the optimal strategy and resulting treatment schedule. The initial treatment schedule is considered a non-spatial plan as it has not been translated into forester-designed harvest blocks scheduled to meet the operational considerations on the ground. District staff carefully grouped the remaining mature forest stands into harvest blocks and assigned each a prescription based on operational feasibility and ecological sustainability. Each block was also assigned a 5-year period to which it will be harvested.

The strategy for the general forest was developed following the exploration of many scenarios which looked at key inputs and settings such as model objectives, constraints and treatment operability limits. One of the greatest values derived from building forest models is the ability to test a variety of different assumptions and evaluate their relative outcomes. Sometimes results can be counterintuitive or reveal temporal linkages that connect seemingly unrelated actions for parts of the forest. In addition, different assumptions frequently test different aspects of the model and allow for a more critical view of whether the model is biologically realistic and how the different facets of the model fit together.

APPENDIX II – Forest Stand Development – Growth and Yield Forecasts

A fundamental process in developing a forest management plan is quantifying the forest inventory today and through time. The process begins by using aerial photos of the land base along with data collected in the field to describe the forest today in terms of standing volume by tree species. How the forest changes over time through growth and mortality is determined by creating projections (yield curves) which use today's forest inventory description as a starting point along with additional field data such as FDS and Permanent Sample Plot (PSP) plot data.

Data Sources

There are three major sources of data which are employed to generate yield curves (volume forecast over time). The first one, a digital forest inventory, is compiled from interpretation of recent aerial photographs. The second source of data comes from the company's Forest Development Survey (FDS) program. These are ground plots used to ground-truth the photo interpretation. FDS plots are established in a large number of stands which serve as a snapshot of the forest structure at a distinct point in time. The third data source is the PSP network that is used to validate and calibrate the growth model. It also provides detailed data on the stand dynamics (growth and mortality) for different components of the forest.

The footprint of harvest and silviculture operations occurring throughout each year are collected digitally in the field and their attributes and spatial configurations are used to continually update the photo-interpreted forest inventory. A continuously up-to-date inventory is the fundamental base for establishing accurate estimates of the forest structure that will provide, among other things, timber volume and wildlife habitat predictions. All growth and yield forecasting activities have been linked back to the forest stands within the digital (GIS) forest inventory.

The descriptive information for each forested stand is extensive. Each stand is assigned a strata name based on its attributes. Some of the most commonly used attributes to define strata includes:

- FUNA (Forest Unit Name = tree species grouping),
- Stand maturity stage,
- Crown Closure, and

- Previous harvest or silviculture treatments
- Stand Type (PL, PCT, NAT, *etc.*)

The Forest Development Survey (FDS) data network serves several major functions:

- It acts to validate and correct the photo-interpreted digital forest inventory; providing quantitative structural information for a representative sample of stands.
- It acts as a mechanism to describe the development of various management strata defined by the forest management planner.
- It is used to initialize and validate the STAMAN stand growth model, which forecasts today's inventory into the future.

STAMAN (stand management) is a stand table tree projection model which is used to forecast future forest conditions. STAMAN runs on a versatile and robust platform and has been used in many contexts including: timber development prediction, habitat supply forecasting, and integrated pest management planning. The STAMAN model is currently under the management of the New Brunswick Growth and Yield Unit technical committee coordinator who is responsible for its maintenance and development. During preparation of this management plan, STAMAN was used to develop growth & yield predictions for existing mature natural forest stands and some managed stands.

The NBGYU database provides the means to forecast stratum-level yields. Calendar based yield curves were generated as well as the conventional age-dependent yield (Figure 1). All unmanaged stand yield curves for this management plan were built using the calendar based approach while an age-based approach was used for the managed and regenerating stands.

The current NB Growth and Yield managed stand forecasts are under predicting inventory volume by about 10-15% at age 25 and over predicting volume by 10-30% for older managed stands (35+ years) compared to LIDAR captured on the Bay Shore in 2013. These are of course broad trends. On a stratum by stratum basis, bias varies considerably. Much of this bias can be corrected by partitioning managed stratum by period of establishment (i.e. pre vs. post 1980s). However this

revised stratification is time consuming and as such is out of scope for the 2012-2021 crown management plan. As an alternative the standard base yield curves have been scaled to account for the higher expected volume forecast (Planted stands and PCT strata are listed below).

PLANTATIONS				
YIELD CURVE	Vol/ha of		New Vol/ha of	
	SFJ@40yrs	Adjustment	SFJ@40yrs	HECTARES
LI07-BS-PRSTOCK-X-00	99	40%	139	12,404
LI07-BS-WLSTOCK-2-00	119	30%	155	2,410
LI07-BS-WLSTOCK-2-10	129	30%	167	3,381
LI07-BS-WLSTOCK-2-20	138	30%	180	2,646
LI07-BS-WLSTOCK-X-00	100	40%	141	5,614
LI07-BS-WLSTOCK-X-05	104	40%	146	1,486
LI07-BS-WLSTOCK-X-10	108	40%	152	12,170
LI07-BS-WLSTOCK-X-20	116	40%	163	12,115
LI07-JP-WLSTOCK-2-00	146	35%	197	2,860
LI07-JP-WLSTOCK-2-10	159	35%	215	1,190
LI07-JP-WLSTOCK-X-00	141	5%	148	10,907
LI07-JP-WLSTOCK-X-05	147	5%	154	1,989
LI07-JP-WLSTOCK-X-10	153	5%	161	11,757
LI07-JP-WLSTOCK-X-20	165	5%	173	5,985
PROV-NO-FAILPLT-X-00	97	40%	135	4,707
PROV-NS-WLSTOCK-X-00	179	30%	232	3,685
PROV-NS-WLSTOCK-X-10	179	35%	241	4,431
PROV-RS-WLSTOCK-X-00	127	50%	191	3,782
PROV-WS-PRSTOCK-X-00	144	10%	159	8,283
PROV-WS-WLSTOCK-1-20	281	5%	295	800
PROV-WS-WLSTOCK-X-10	172	18%	203	3,445
PROV-WS-WLSTOCK-X-20	186	23%	229	14,174

PRECOMMERCIAL THINNGINS				
YIELD CURVE	Vol/ha of		New Vol/ha of	
	Total@40yrs	Adjustment	Total@40yrs	HECTARES
NOXX-BFIR-CTI-SW	146	10%	161	4,703
NOXX-BFSP-CTI-SW	134	20%	160	5,853
NOXX-BSBF-CTE-SW	127	25%	159	2,330
NOXX-SFMX-CTI-SH	132	20%	158	2,677
SOXX-BFSP-CTI-SW	133	25%	166	22,194
SOXX-BSBF-CTE-SW	114	35%	154	23,397
SOXX-BSPR-CTE-SW	91	70%	156	15,375
SOXX-SFMX-CTI-SH	132	25%	166	9,435
SOXX-SPRC-CTE-SW	112	30%	146	16,148

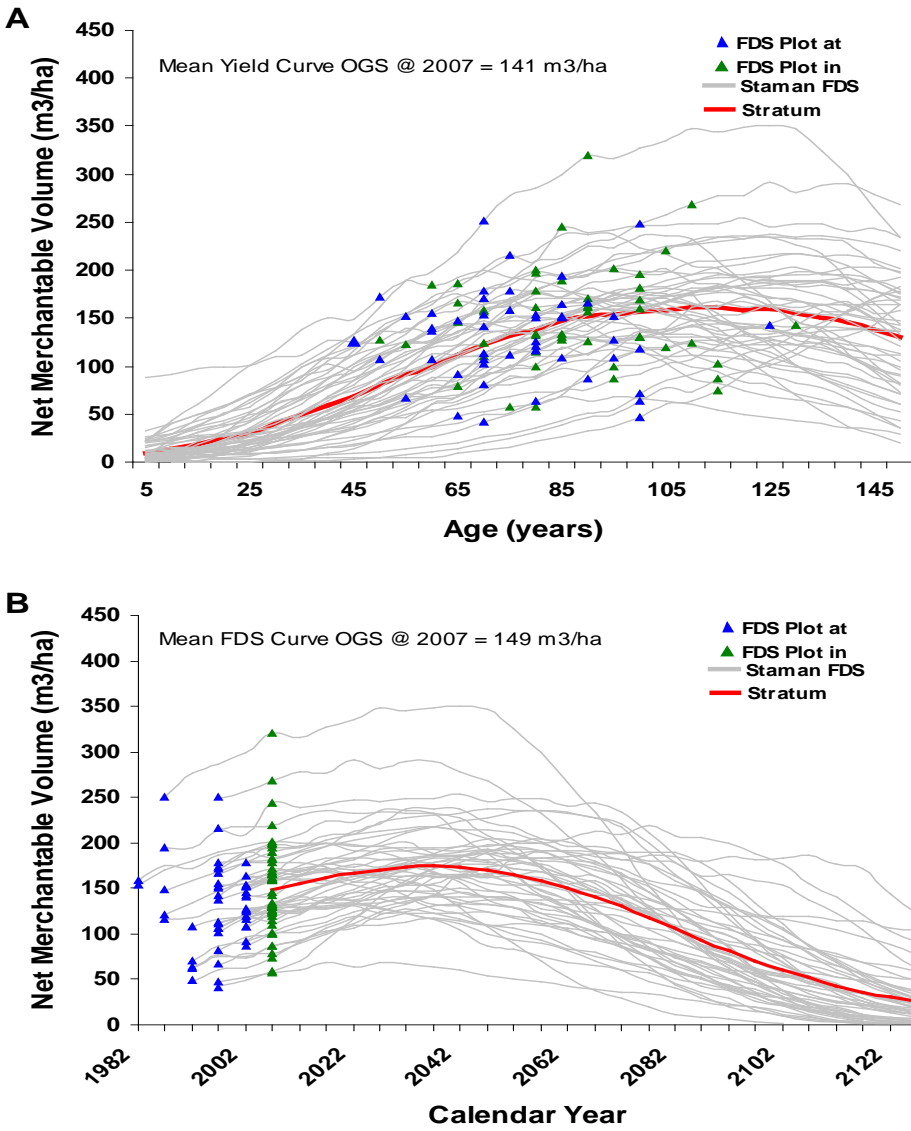
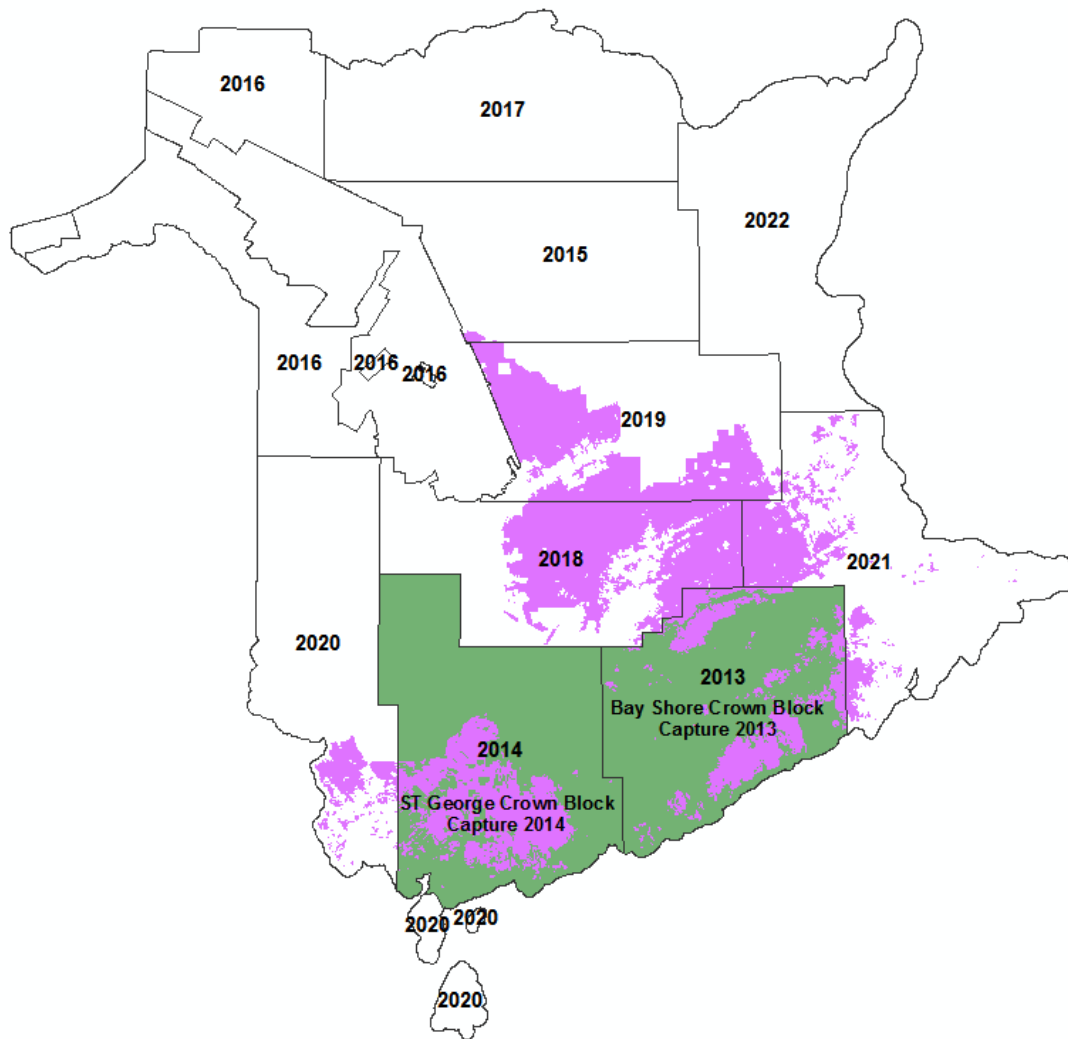


Figure 1. Age and calendar based yield curves.

APPENDIX III – Recent Inventory Enhancements

It is urgent that Government acquires and makes LiDAR coverage available for the entire Province as soon as possible. The figure below identifies the two flight blocks in southern New Brunswick that have been recently flown by DNR for both LiDAR and digital imagery capture.



Light Detection and Ranging (LiDAR) technology is an important aid for many aspects of forest management. LiDAR data has been employed to enhance forest-level resource inventory such as tree height, basal area, total volume, merchantable volume, biomass, and stand density. The data improves the forest inventory which is critical as the forest industry struggles to remain competitive. Improved inventory greatly enhance planning and optimization of forest management activities. Other digital products derived from LiDAR technology include: hill shade models, bare earth elevation models, and slope/contour mapping.

APPENDIX IV – Mature/Over mature forest stand type definitions

Species	STAND AGE					
	R	S	Y	I	M	O
Balsam Fir	0-12	10-25	20-35	30-50	45-70	65 +
Red Spruce	0-12	10-30	25-45	40-70	65-110	105+
Black Spruce	0-12	10-30	25-45	40-70	65-110	105+
White Spruce	0-10	8-20	15-40	35-60	55-110	105+
White Pine	0-12	10-30	25-50	45-90	85-160	155+
Jack Pine	0-10	8-20	15-40	35-70	65-110	105+
Red Pine	0-10	8-20	15-40	35-70	65-110	105+
Eastern Cedar	0-12	10-30	25-45	40-70	65-110	105+
Eastern Hemlock	0-12	10-30	25-50	45-90	85-140	135+
Larch	0-10	8-20	15-45	40-70	65-110	105+
Tolerant Hardwoods	0-12	10-30	25-50	45-80	75-160	155+
Red Maple	0-12	10-25	20-45	40-70	65-110	105+
Intolerant Hardwoods	0-10	8-20	15-35	30-50	45-70	65+
Grey Birch	0-8	5-15	25-Oct	20-40	35-50	45+

R - Regenerating - A renewed forest crop with trees less than 3 meters in height and no merchantable volume present.

S - Sapling - A forested stand whose trees are between two and seven meters tall and have a DBH between 1.0 cm and 9.0 cm but have not yet accumulated any merchantable volume.

Y - Young - A forested stand which has grown past the sapling stage and is accumulating merchantable volume at a rapid rate. The majority of stems at this development stage have a DBH > 9.1 cm.

I - Immature - A forested stand which is accumulating merchantable volume at a reasonable rate but is older and approaching maturity. Significant merchantable volume is present.

M – Mature - A forested stand which is no longer accumulating merchantable volume, but is stable because growth and mortality are about equal. Significant volume is again present at this stage.

O - Over mature - A forested stand which is losing merchantable volume at a rapid rate due to natural mortality.