Type IV Silviculture Strategy

Data Package – Morice TSA

Version 1.7

DRAFT

Prepared by:
Forest Ecosystem Solutions Ltd
227 – 998 Harbourside Drive
North Vancouver, BC
V7P 3T2
604-998-2222
amakitalo@forestecosystem.ca

Prepared for:

BC Ministry of Forests, Lands and Natural Resource Operations
Resource Practices Branch
PO Box 9513 Stn Prov Govt
Victoria, BC V8W 9C2

Table of Contents

Table of Contents i
List of Figures i
List of Tables i

1 Introduction 1
1.1 Context 1
1.2 Project Objectives 1
1.3 Study Area 2

2 Current Situation 5
2.1 Timber Supply Issues 5
2.2 Previous Silviculture Strategies 7

3 Modelling Approach 8
3.1 Model 8
3.2 Data Sources 8
3.3 Forest Inventory 9
3.4 MPB 9
3.5 Site Index 9

4 Base Case Scenario 10
4.1 Key Assumptions 10
4.2 Land Base Assumptions 10
4.3 Forest Management Assumptions 18
4.4 Growth and Yield Assumptions 25
4.5 Natural Disturbance Assumptions 36
4.6 Silviculture 38

5 Silviculture Strategies for Exploration 44

6 References 45

List of Figures

Figure 1: Location of Morice TSA 2
Figure 2: BEC Variants in the Morice TSA 3
Figure 3: Current age class distribution in the Morice TSA 5
Figure 4: Example of MPB yield curves; pine-leading stand, with 65% dead at age 110, with high density advanced regen 33
Figure 5: Shelf life for dead pine sawlogs 34

List of Tables

Table 1: Average site productivity in the Morice TSA 3
Table 2: Historical and current AAC 5
Table 3: Spatial Data Sources 8
Table 4: Morice TSA netdown summary 11
Table 5: Lands not managed by the BC Forest Service 11
Table 6: Non-Forest in Morice TSA 12
Table 7: Roads in the Morice TSA 12
Table 8: Parks and Protected Areas in Morice TSA 13
Table 9: Environmentally Sensitive Areas 13
Table 10: Problem Forest Types 14
Table 11: Takla Caribou Habitat Areas 14

Table 12: Terrain Stability Classes ... 15
Table 13: LRMP No Harvest Areas in Morice TSA ... 15
Table 14: Riparian Reserve and Management Zone Buffers ... 16
Table 15: Wildlife Tree Patch percents ... 17
Table 16: Management Assumptions –Base Case ... 19
Table 17: Visual classes and maximum allowable disturbance ... 20
Table 18: CFLB area of visuals within each slope class (ha) ... 20
Table 19: Visual Effective Green-up heights (m) ... 20
Table 20: WHA 6-333 Constraints ... 20
Table 21: HBEA and ASM areas in Morice TSA ... 21
Table 22: HBEA Seral Stage Targets ... 22
Table 23: GFA Seral Stage Targets ... 22
Table 24: Utilization levels used in the analysis ... 23
Table 25: Natural Stand Analysis Units in the Morice TSA (stands not attacked by MPB) ... 26
Table 26: Natural Stand Analysis Units for MPB attacked stands ... 27
Table 27: Analysis units; existing managed stands 11 to 17 years old ... 29
Table 28: Analysis units; existing managed stands 18 to 40 years old ... 30
Table 29: Analysis units; future managed stands ... 31
Table 30: MPB attack modelling in the THLB ... 32
Table 31: Advanced regeneration density classes ... 34
Table 32: Summary of 2006 - 2008 Survey in pine-leading plantations in the Lakes TSA ... 35
Table 33: Minimum target area to be disturbed annually in each BEC variant ... 37
Table 34: Non-Recoverable Losses ... 37
Table 35: Genetic gain for existing managed stands established between 1995 and 2002 in the Morice TSA ... 38
Table 36: Genetic gain for future managed stands in the Morice TSA ... 39
Table 37: Regeneration assumptions for existing managed stands 11 to 17 years old ... 40
Table 38: Regeneration assumptions for existing managed stands 18 to 40 years old ... 41
Table 39: Regeneration assumptions for future managed stands ... 42

1 Introduction

1.1 Context

This document is the second of four documents that make up a type IV Silviculture Strategy:

1. Situational Analysis – describes in general terms the situation for the unit – this could be in the form of a PowerPoint presentation with associated notes or a compendium document.
2. **Data Package - describes the information that is material to the analysis including the model used, data inputs and assumptions.**
3. Modeling and Analysis report –provides modeling outputs and rationale for choosing a preferred scenario.
4. Silviculture Strategy –provides treatment options, associated targets, timeframes and benefits.

1.2 Project Objectives

The Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) has initiated a type 4 silviculture strategy for the Morice timber supply area (TSA). The strategy will help MFLNRO work towards the government's strategic objectives such as:

- Best return from investments and activities on the forest and range land base;
- Encourage investments to benefit forest and range resources;
- Manage the pest, disease and wildfire impacts;
- Mitigate mid-term timber supply shortage caused by the MPB;
- Maximize timber growth in the provincial forests.

The silviculture strategy will be a result of collaboration and sharing of ideas involving MFLNRO Victoria staff, MFLNRO local staff, other government and industry stakeholders, and other professionals. The ultimate goal is a realistic strategy that will be owned and championed by district staff and licensees. In particular, the silviculture strategies currently being developed for the Morice, Lakes, Quesnel, Williams Lake and 100 Mile House TSAs will produce:

- A fully rationalized plan to guide the expenditure of public silviculture funds to improve the future timber supply and habitat supply;
- A plan with a consistent format and content so that expanding it to regional and provincial levels is feasible and so that comparisons between management units are possible;
- A plan containing the right information in the right format so that it can be utilized by government and industry for resource management related decision making;
- Silviculture regimes and associated standards that may potentially be adopted in forest stewardship plans as required standards for basic silviculture operations.

1.3 Study Area

The Morice TSA covers of approximately 1.5 million hectares in North-Western BC (Figure 1). The TSA, along with the neighbouring Lakes TSA is administered by the Nadina Forest District in Burns Lake.

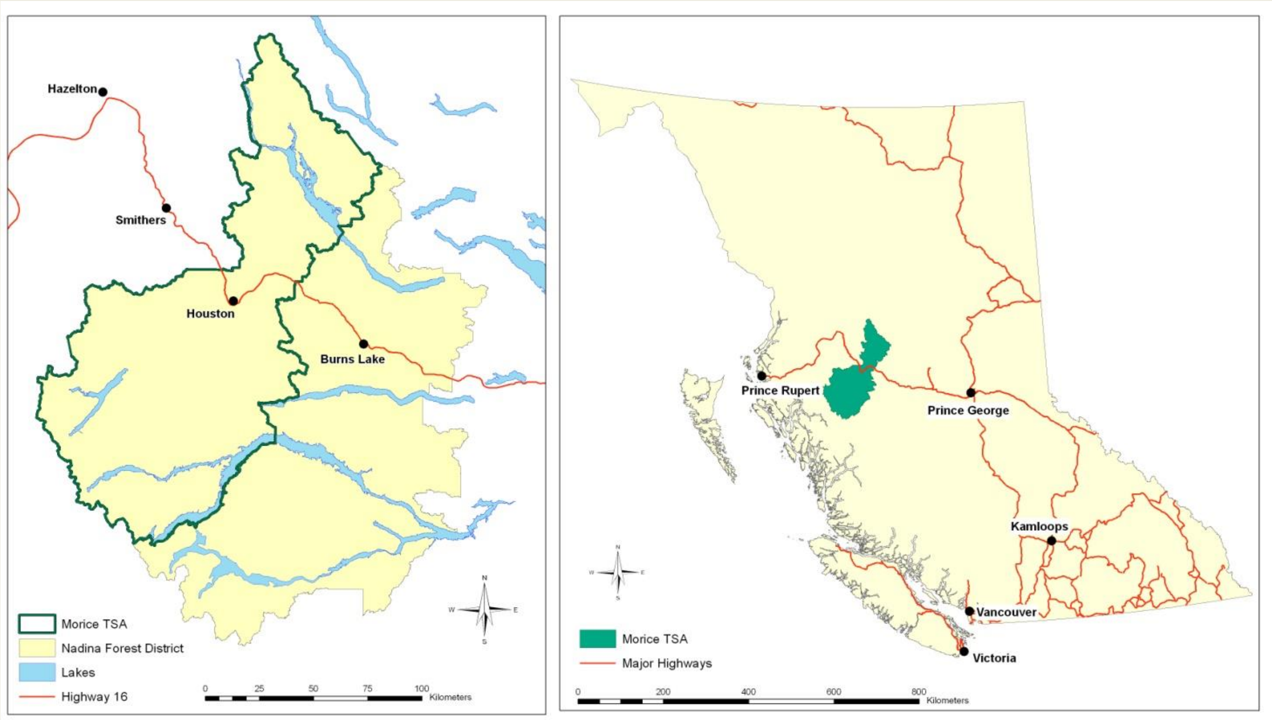

Figure 1: Location of Morice TSA

Approximately 932 000 hectares of the TSA are considered productive forest while 64 percent or 595,771 hectares of the productive forest are classified as timber harvesting land base (THLB) and available for harvesting.

The climate in the TSA is transitional between the coast and interior. The dominant biogeoclimatic zone variants in the Morice TSA are subboreal spruce (SBS) forest types with englemann spruce-subalpine fir (ESSF) and some coastal western hemlock (CWH) (Figure 2).

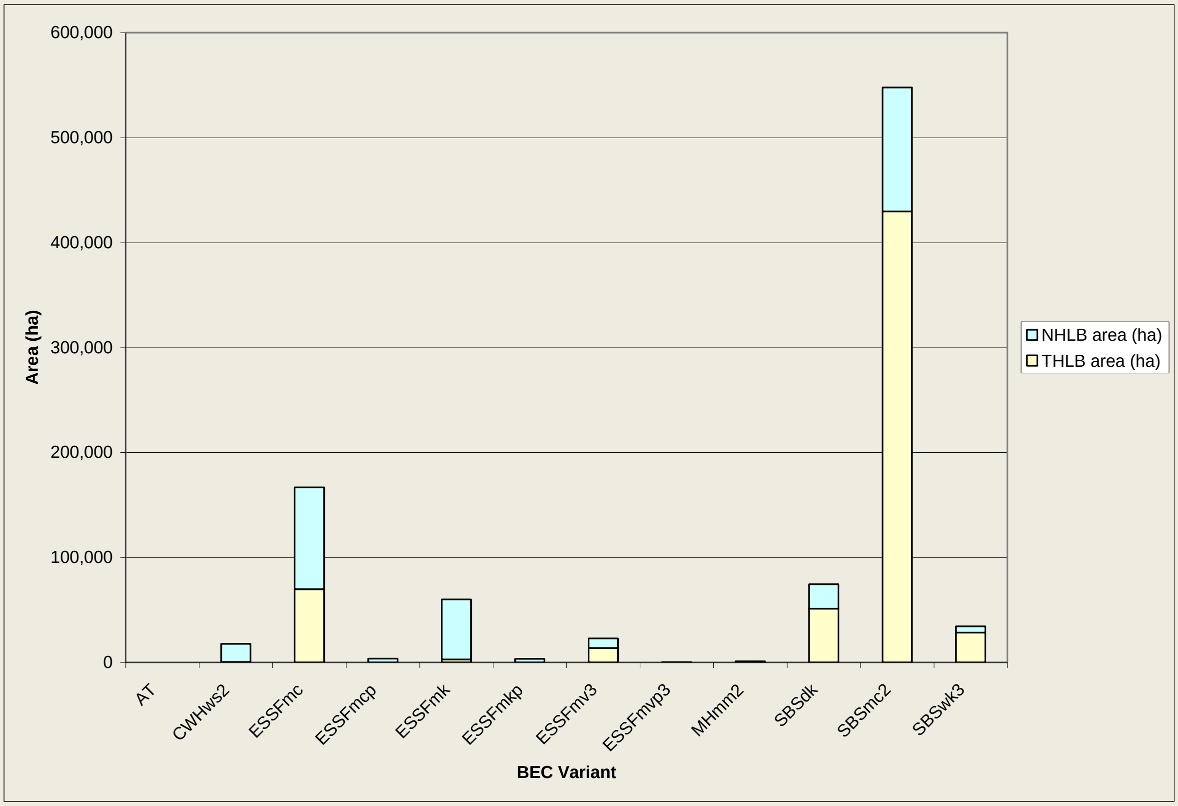

Figure 2: BEC Variants in the Morice TSA

Lodgepole pine dominates the landscape with approximately 50% of the THLB area consisting of lodgepole pine leading stands. Hybrid spruce and subalpine fir (balsam) leading stands form the rest of the THLB with approximately equal shares (each around 25%).

The productivity of the growing sites in the Morice TSA is modest. Table 1 shows the average site indices for natural and managed balsam, pine and spruce leading stands.

Table 1: Average site productivity in the Morice TSA

Site Index Type	Balsam	Pine	Spruce
VRI Site Index Average (THLB):	12.3	16.6	14.3
SIBEC average (THLB):	16.0	18.2	18.4

1.3.1 Morice Land and Resource Management Plan

The Morice Land and Resource Management Plan (LRMP) was approved in 2007. The plan is a result of negotiations that involved public and provincial government sectors and two area First Nations. It contains direction for the sustainable management of Crown land and resources in the plan area.

The plan gives general management guidance regarding consultation, community values, economic values and ecosystem values. The plan further provides area specific management direction in twenty geographic resource management zones (RMZ). Additional objectives, measures and targets apply to certain resources or activities in these zones. In some cases the plan identifies areas where timber harvesting is not recommended while in others, timber harvesting should adhere to specific management directions.

Protected areas have been identified for their natural, cultural heritage and/or recreational values in accordance with the Provincial Protected Areas Strategy (PAS). Logging, mining and hydroelectric development are prohibited in all these areas. The LRMP identifies seven new protected areas, in addition to previously existing provincial parks and ecological reserves. Approximately 123,000 hectares – 8.2 percent of the total plan area – are set aside as protected areas.

Although portions of the LRMP related to biodiversity and the designation of special management zones – including no timber harvest zones – remain to be legally implemented, the directions contained in the *draft Ministerial Order for Land Use Objectives – Morice Land and Resource Management Plan Area (May 2010)* – will be incorporated in the base case for this analysis.

1.3.2 Morice and Lakes IFPA

Six forest licensees in both the Morice and Lakes TSAs hold an Innovative Forest Practices Agreement (IFPA). The IFPA was awarded in 1999 under Section 59.1 of the Forest Act. IFPAs are expected to provide the forest industry with opportunities to practice innovative forest management.

The IFPA licensees have completed a Sustainable Forest Management Plan (SFMP) for the Morice TSA. The plan contains innovative practises; the licensees investigated the impact of these practises and submitted a request in 2007 for an AAC increase under Section 59.1 (7) of the Forest Act.

In 2008 the regional manager granted an AAC increase of 200,000 m^3 per year for five years to the IFPA. The increase was attributed to:

- Reduced operational adjustment factors through field studies;
- SIBEC site indices (PEM);
- Increased utilization, stump height surveys;
- Increased ratio of spruce to pine in plantations;
- Genetically improved seed, licensee seed orchards; and
- MPB mitigation through harvest scheduling.

Ongoing monitoring and reporting was set as a condition for the maintenance of the increased AAC.

2 Current Situation

2.1 Timber Supply Issues

2.1.1 Historical and Current AAC

The current AAC in the Morice TSA is 2.165 million m^3 per year with 550,000 m^3 attributable to non-pine species. It was adjusted in 2008 from 1.961 million m^3 (Table 2) in response to changes to log grade regulations.

Table 2: Historical and current AAC

	1996	2002	2008	Current
AAC (000,000m3)	1.986	1.961	2.165	2.165

For the past 5 years, an average of 2.4 million m^3 has been harvested in the Morice TSA annually. Of this average amount, about 804,000 m^3 is attributable to non-pine species.

2.1.2 Age Class Distribution

The current age class distribution for the Morice TSA is presented in Figure 3. Over 20% of the THLB is between 0 and 20 years old and 35% of the THLB is younger than 41 years of age.

The majority of the stands of the TSA are mature. Stands in the younger age classes (0-2) mostly originate from harvesting activities. There are little natural immature stands in the TSA (age classes 3 and 4).

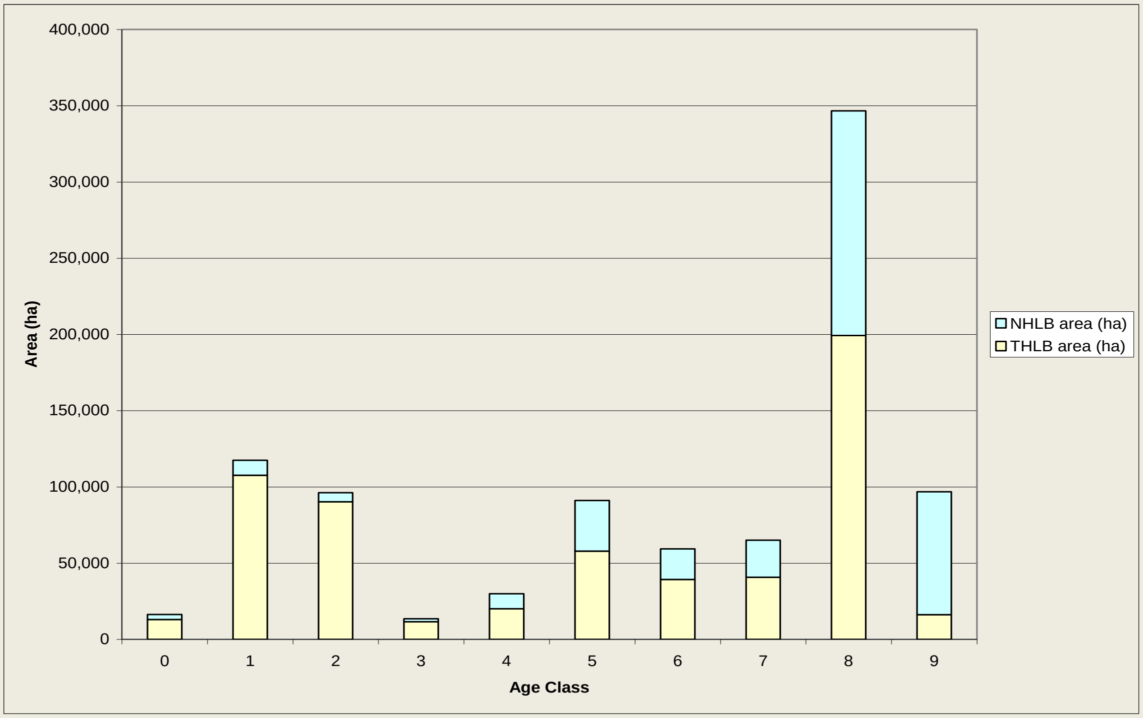

Figure 3: Current age class distribution in the Morice TSA

2.1.3 Current Timber Supply Situation – Mid-Term

Several timber supply and related analyses have been completed in the Morice TSA in the past decade. These analyses were completed for a range of purposes and used a variety of data and management assumptions. As a result, timber supply forecasts differ. Some of these analyses are described below:

- TSR 2 in 2002 predicted a mid-term and a long-term harvest level of 1,803,000 m^3 per year; however, no beetle impacts were included in that analysis;
- The urgent timber supply review in 2008 presented 3 scenarios with different assumptions regarding short-term harvest and shelf life. The predicted mid-term timber supply varied between 895,000 m^3 and 1,085,000 m^3 depending on the scenario;
- The 2009 Type 2 silviculture analysis base case forecasts a mid-term harvest level as low as 674,595 m^3 per year;
- In 2012, an analysis completed for the Special Committee on Timber Supply forecasted a mid-term harvest level of 1,504,000 m^3 per year.

Some of the key differences in management assumptions are listed below:

- TSR 2 assume endemic levels of MPB and did not incorporate the current MPB epidemic;
- The size of the timber harvesting land base differs by analysis;
- The Type 2 base case used no genetic gain;
- Spatial patch targets were incorporated in the Type 2 analysis;
- The Type 2 analysis incorporated draft seral stage targets from the Morice LRMP while other analyses used the targets from the Provincial Non-Spatial Old Growth Order;
- SIBEC based site indices were used as the basis for future managed stands and their modelling in the Type 2 analysis; and
- MPB related mortality was accounted for differently in all analyses.

The latest version of the British Columbia Mountain Pine Beetle Model (BCMPB 9) predicts a total mature pine kill of 35.6 million cubic metres for the Morice TSA by 2021. This represents approximately 62% of the mature pine that was on the timber harvesting land base in 1999.

2.1.4 Forest Health

Currently, harvest is focusing on pine-stands killed by the MPB. In the mid-term, the timber supply will be dependent on surviving pine stands and non-pine stands. Non-pine species are also susceptible to damaging agents and spruce and balsam bark beetles have periodically attacked portions of the TSA. The long-term health of non-pine species should be a consideration to ensure that the mature non-pine volume will be available in the future.

The timber supply towards the end of the mid-term is dependent on currently young, managed stands. The timing and magnitude of silviculture investments in these immature stands could have significant timber supply impacts. Many of these stands are pine-leading and damaging agents, such as hard pine rusts and foliar diseases are present. The impact of these forest health agents on the long-term productivity of these stands is unknown.

2.2 Previous Silviculture Strategies

In August 2005, due to the significant impact of the MPB epidemic on timber supply and habitat in the TSA, the Ministry of Forests and Range (MoFR) commissioned an update to the original March 2000 type 1 silviculture strategy. This update primarily dealt with government-funded intensive and backlog silviculture opportunities, and reforestation of unharvested dead pine stands.

The following strategies were recommended for timber supply (quality and quantity):

1. Comprehensive TSA fertilization strategy; localized candidate stand and site criteria; identify opportunity areas.
2. Fertilization of young mature spruce- leading stands 60 to 80 years old to generate short-term volume gains.
3. Fertilization of immature spruce- leading stands according to the TSA fertilization strategy. Pine-leading stands should be considered once the MPB epidemic subsides.
4. Non- Recoverable Losses Reforestation Strategy.
5. Treatment of NRL Areas.
6. Forest Health Surveys.
7. Seed collections; Douglas fir and possibly pine to replace seed prone to rust.
8. Backlog NSR, reclassification.
9. Past Wildfire Areas, mapping and surveys, machine knockdown, planting.

The following basic silviculture strategies were promoted:

1. Revisit TSA stocking standards.
2. Establish a diversity of tree species where ecologically feasible to attain full site occupancy and to buffer against future pest and disease losses.
3. When planting, utilize improved seed.

In 2007, a Type 2 silviculture strategy for the Morice TSA focusing on the development of silviculture strategies that would promote additional timber supply and enhance habitat for the mid-term was initiated. The analysis focused on several topics such as treatments of stands that were not expected to be severely attacked by the MPB; prioritization of rehabilitation of MPB attacked stands and impact of the use of genetically improved stock. Those habitat indicators that were integral to the sustainable forest management plan (SFMP) prepared by IFPA members were also investigated.

The Type 2 analysis modeled several learning scenarios and built a preferred scenario including components from the learning scenarios. The preferred scenario contained actions and treatments that were predicted to mitigate the MPB infestation and increase the mid-term harvest level. These included genetic improvement, increasing the spruce component in selected ecosystems, fertilization and rehabilitation of attacked pine stands.

The predicted impacts were significant: the midterm harvest level increases were between 21.9% and 43.9% compared to the base case that was developed for the project.

3 Modelling Approach

3.1 Model

For this analysis Forest Simulation Optimization System (FSOS) is used for modelling. FSOS can operate as both a simulation and a heuristic optimization model using the same database. Simulation allows for sensitivity analysis and utilizes a hard constraint-based approach. Optimization is a target-oriented approach representing a shift in modeling approach from "what can we take from the forest" to "what can we create in the forest." Blocking and scheduling is conducted separately in simulation, and simultaneously in optimization. Scheduling in simulation progresses one period at a time, while optimization planning considers all periods at the same time. Data can be spatial and/or non-spatial. FSOS accommodates overlapping resource values and constraints and can account for multiple values such as timber, silvicultural treatments, carbon allocation, biodiversity, wildlife, and visual quality. Algorithms employed in FSOS include simulated annealing, Tabu search algorithms, and Hill Climbing.

3.2 Data Sources

The data and assumptions for this project were provided by the Nadina Forest District (DND). The base case of this analysis is considered to reflect current management in the Morice TSA. Table 3 lists all the spatial data layers used in the analysis, with their source and vintage.

Table 3: Spatial Data Sources

Layer Name	Description	Source	Vintage
tsa_bdy	Morice TSA boundary	LRDW	2010
alr_clp	Agricultural land reserve	LRDW	2012
car_wha	Telkwa caribou herd draft WHA	DND	2011
takla_high	Takla caribou herd high value habitat	DND	2011
takla_med	Takla caribou herd medium value habitat	DND	2011
wha_final	Legal WHA 6-283 to 6-286	MFLNRO	2012
wha_noharv	Telkwa caribou herd draft no harvest areas	DND	2011
park_pa	Parks and Protected Areas	LRDW	2012
goats_2011	Mountain Goat habitat	DND	2011
Indian_res	Indian reserves	LRDW	2012
own_clp	General ownership	LRDW	2012
lrmp_data	LRMP area specific management zone	DND	2011
ogma_v9	Draft OGMAs	DND	2011
op_areas_mr	licensee operating areas	DND	2011
elev_1360	Elevation above and below 1360m	DND	2011
atsm	Terrain stability mapping	DND	1998
vqo_2011	Updated VLI	DND	2011
rd_buff	Road buffers	DND	2011
rip_buffd	Riparian buffers	DND	2011
woodlot	Woodlots	LRDW	2012
rslt_open	RESULTS openings	LRDW	2012
vri_mor	VRI	LRDW	2011
PEM_final	Predictive ecosystem mapping, combination of two projects	FESL (Timberline and MSRM)	2007, 2001
fsw	Fisheries sensitive watershed	DND	2012
morice_pined	Pine beetle kill, cycle time, etc	MFLNRO	2012

Layer Name	Description	Source	Vintage
site_productivity	Provincial site index layer: Raster SIBEC site indices by species for entire province	MFLNRO	2012
lu_morice	Landscape Units	LRDW	2012
bcmpb_v9	Mountain Pine Beetle outbreak projection	MFLNRO	2011
fire_mor	Historical fire boundaries from wildfires, includes all fires up to summer of 2012	LRDW	2012

3.3 Forest Inventory

The current forest inventory in the Morice TSA is mostly a vegetation resource inventory (VRI) converted from the old forest cover inventory (FC1). Only 5% or 74,588 ha of the VRI is new phase 1 VRI. The inventory was projected to January 1, 2011 by Forest Analysis and Inventory Branch and projected further to (Jan 1, 2013) by FESL to reflect the starting date of the analysis.

Depletions were updated from the RESULTS data base with the latest update date of March 31, 2012. All the recent fires since year 2000 were also incorporated in the data.

3.4 MPB

The latest MPB outbreak projection (BCMPB v.9) was used to model the MPB. In the Morice TSA continued spread and mortality is forecast for the next 10 years. This was factored into the analysis.

3.5 Site Index

Predictive ecosystem mapping covers most of the TSA. SIBEC based site indices were used for modelling managed stands. The site indices were provided by the Forest Analysis and Inventory Branch through the provincial site index layer.

4 Base Case Scenario

4.1 Key Assumptions

The following key assumptions are employed in this analysis:

- Silviculture opportunity evaluation is not limited by factors such as the availability of funding, funding source, or the ability to deliver a program. However, the final preferred strategy will be plausible.
- “Normal” market conditions will prevail in terms of demand and prices for timber and fibre.

4.2 Land Base Assumptions

Landbase assumptions define the crown forested land base (CFLB) and timber harvesting land base (THLB). The THLB is designated to support timber harvesting while the CFLB is identified as the broader land base that can contribute toward meeting non-timber objectives (i.e. biodiversity).

The netdown classification is an exclusionary procedure. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area of netdown factors (e.g. inoperable) is often greater than the net area removed; a result of overlapping resource issues.

The classifications of the land base in the Morice TSA are:

Excluded Land Base (EXLB) — private lands, non-forested areas, and roads are excluded from the CFLB. These areas are excluded because they do not contain forest or are not managed by the Forest Service.

Non-Harvestable Land Base (NHLB) — the portion of the CFLB where harvesting will not occur according to current forest practices. The NHLB includes some areas that are currently not harvestable due to economic considerations, so there is a possibility that some or all of these areas could become harvestable under different economic conditions.

Timber Harvesting Land Base (THLB) — the productive forested land that is harvestable according to current forest practices and legislation.

The THLB netdown is shown in Table 4 with each reduction described below.

Table 4: Morice TSA netdown summary

Netdown Category	Net Area (ha)	Gross Area (ha)
Total Area	**1,501,710**	
Not Managed by BCFS	82,096	82,096
Non-Forest	478,114	496,214
Roads	9,254	11,620
Crown Forested Land Base Area	**932,246**	
Parks and Protected Areas	49,867	131,183
Environmentally Sensitive Areas	49,588	103,678
Inoperable	16,808	213,977
Problem Forests	42,722	73,444
Low Productivity Sites	63,934	605,523
Telkwa Caribou No Harvest	17,671	76,913
Takla Caribou High Value Habitat	277	2,680
Goat Winter Range	6,206	120,052
Old Growth Management Areas	24,533	65,933
Terrain Stability	8,804	53,299
LRMP No Harvest Areas	16,473	277,272
Riparian Areas	17,040	46,169
WTP (aspatial)	22,553	47,754
Timber Harvesting Land Base Area	**595,771**	

4.2.1 Not Managed by BCFS

Private lands, Indian Reserves, Woodlots and Community Forests were excluded from the CFLB. These areas are shown in Table 5.

Table 5: Lands not managed by the BC Forest Service

Not BCFS category	Area (ha)
Indian Reserves	2,079
Community Forests	22,165
Woodlots	22,306
Private Lands	28,558
Other Reserves	6,988
Total	82,096

4.2.2 Non-Forest

Non-forest was defined using the VRI field Forest_Mgmt_Land_Base_Ind, which indicates the productive forest based on site index, non-productive descriptor and logging history. All records where Forest_Mgmt_Land_Base_Ind was "N" were removed as non-forest. The RESULTS openings dataset was also used to ensure all recent harvesting was included as forest. If a VRI record was described as non-forest, but it was harvested in RESULTS, it was classified as forest. The areas are shown in Table 6.

Table 6: Non-Forest in Morice TSA

Category	Area (ha)
Forest_Mgmt_Land_Base_Ind = “N”	496,668
LESS: RESULTS harvesting	-454
Non-Forest Area	496,214

4.2.3 Roads

Road data was provided by the Nadina Forest District as polygons and was added to the resultant semi-spatially. For each resultant polygon, the percent of the area that is road was calculated. This approach is more accurate than an aspatial reduction and does not add many small polygons to the resultant. The percent reduction is applied in the netdown and the roads are removed from the CFLB. Table 7 shows the road classes with their areas, widths, and lengths.

Table 7: Roads in the Morice TSA

Road Type	**Area (ha)**	**Road Width (m)**	**Length (km)**
Major Highway	613	60	102
Secondary Highway	15	60	3
Mainline	655	27.3	240
Operational Road	7,904	19	4,160
In-block Road	2,432	8.4	2,896
Other Road	0.4	8.4	0.5
Total	11,620		7,401

4.2.4 Parks and Protected Areas

All provincial parks, protected areas and ecological reserves were removed from the THLB. The area of each protected area is shown in Table 8.

Table 8: Parks and Protected Areas in Morice TSA

Protected Area Name	Area (ha)
Atna River Park	21,061
Babine Lake Marine Park - Smithers Landing Site	28
Burnie River Protected Area	2,343
Little Andrews Bay Marine Park	102
Morice Lake Park	52,485
Morice River Ecological Reserve	355
Nadina Mountain Park	2,790
Neneikekh/Nanika-Kidprice Park	17,015
Old Man Lake Park	326
Red Bluff Park	156
Tazdli Wyiez Bin/Burnie-Shea Park	34,511
Topley Park	11
Total	131,183

4.2.5 Environmentally Sensitive Areas

ESAs were delineated as part of the forest cover inventory, and although the data is no longer included with VRI, it is still used in timber supply netdowns where new data is not yet available. Areas flagged as difficult regeneration (P) and avalanche areas (A) were removed from the THLB. These areas are shown in Table 9.

Table 9: Environmentally Sensitive Areas

ESA 1	Area (ha)
A	80
AP	292
P	57,873
PR	95
PW	678
SA	253
SP	44,407
Total	103,678

4.2.6 Inoperable Areas

All areas above 1360 m elevation are considered inoperable. There are 213,977 ha in this category.

4.2.7 Problem Forest Types

Problem forest types (non-merchantable timber) are those that are operable and exceed the low site criteria, but are not harvested. These are Whitebark Pine stands, hemlock stands, and deciduous stands (based on leading species), as well as spruce/larch and spruce/hemlock stands (leading species is spruce; second species is larch or hemlock). Areas that have been previously harvested remain in the THLB. Table 10 shows the area for each species group.

Table 10: Problem Forest Types

Species	Area (ha)
Whitebark Pine (PA)	3,728
Hemlock (H, HM, HW)	19,465
Deciduous (AC, AT, EP)	50,211
Spruce-Hemlock	34
Spruce-Larch	6
Total	73,444

4.2.8 Low Productivity Sites

All stands not previously harvested with a site index less than 8 m are considered low productivity stands and removed from the THLB. The total area is 605,517 ha.

4.2.9 Telkwa Caribou No Harvest

The Telkwa no harvest areas in draft WHA 6-333 (MFLNRO, 2012b) were removed from the THLB. The total area is 76,913 ha.

4.2.10 Takla Caribou Habitat

The Takla Caribou habitat areas are defined as high or medium value habitat (MOE, 2009). The high value habitat areas are 100% removed from the THLB. The medium value areas are dealt with as a constraint in the model (section 0), and are not part of the netdown. The areas are shown in Table 11.

Table 11: Takla Caribou Habitat Areas

Takla Caribou	Area (ha)
High value habitat	2,680
Medium value habitat	1,365

4.2.11 Goat Winter Range

Draft UWR 6-003 mountain goat winter range areas are removed from the THLB (MFLNRO, 2012a). Although a minor amount of harvesting is permitted in these areas, this amount is so small that it cannot be modelled at a landscape level. The total area within the UWR is 120,052 ha.

4.2.12 Old Growth Management Areas

Draft OGMAs have been delineated in the Morice TSA and are removed from the THLB. The total area within the OGMAs is 65,933 ha.

4.2.13 Terrain Stability

Reconnaissance-level terrain stability mapping was completed for the Morice TSA in 1998. All areas mapped as unstable (U) and potentially unstable (P) are removed from the THLB. The areas are shown in Table 12.

Table 12: Terrain Stability Classes

Stability Class	Area (ha)
U	16,069
P	39,507
Total	55,577

4.2.14 LRMP No Harvest Areas

There are a number of areas that were previously excluded from harvesting under part 13 of the Forest Act. Some of these areas have now become parks and the remaining areas are considered permanently unavailable for harvesting in the Morice Land and Resource Management Plan (ILMB, 2007). The areas are shown in Table 13.

Table 13: LRMP No Harvest Areas in Morice TSA

LRMP No Harvest Area	Area (ha)
Babine Lake East Arm 30m Buffer	1,148
Bulkley 5m Floodplain	2,454
Bulkley River 200yr Flood Plain	2,200
Grease Trail 100m Buffer	517
Herd Dome	12,366
Lower Nadina River 5m Floodplain	1,510
Morice Range Nanika Lake 1	12,292
Morice Range Nanika Lake 2	53,117
Morice Range Nanika Lake 3	10,652
Morice River 5m Flood Plain	4,811
Morrison Lake 30m Buffer	1,402
Nanika River 5m Flood Plain	375
Starr Creek	7,923
Swan Lake China Nose 1	1,773
Swan Lake China Nose 2	274
Tahtsa Troitsa	164,332
Upper Nadina River 5m Floodplain	125
Total	277,272

4.2.15 Riparian Areas

Riparian reserve and management zone buffers were provided by DND and added to the resultant semi-spatially (same process as for roads). The reserve zones are 100% removed from the THLB while the management zones are partially removed. Table 14 shows the buffers and areas for each riparian class. The total area in this category is 46,169 ha.

Table 14: Riparian Reserve and Management Zone Buffers

Riparian Class	Reserve Zone Width (m)	Management Zone Width (m)	Management Zone percent reduction	Reserve zone area (ha)	Management zone area (ha)	
					Total	Netdown reduction
S1	50	20	50%	5,369	1,784	892
S2	30	20	50%	8.133	4,417	2,209
S3	20	20	50%	7,653	6,463	3,232
L1	10	0	0%	2,590	0	0
W1	10	40	25%	3,611	12,094	3,023
W5	10	40	25%	5,372	16,338	4,085
Total				32,729	41,097	13,440

Management zone reductions are only applied for those riparian classes that have a reserve zone. There are no reductions for S4, S5, S6, L3 or W3.

4.2.16 Wildlife Tree Patches

An aspatial reduction for wildlife tree patches is applied at the end of the netdown to the THLB. The reduction percent for each landscape unit and BEC variant is shown in Table 15. The WTP percent shown below correspond to LRMP targets, adjusted to account for overlap with other THLB netdowns (e.g. riparian). Monitoring data collected since 2005 under the Forest and Range Evaluation Program (FREP) indicates that 54% of the WTR area overlaps other netdowns.

Table 15: Wildlife Tree Patch percents

Landscape Unit	BEC Variant	WTP Percent	Landscape Unit	BEC Variant	WTP Percent
Buck	ESSFmc	3.6%	Owen	SBSmc2	4.1%
Buck	ESSFmcp	5.0%	Parrott	ESSFmc	3.2%
Buck	SBSdk	4.1%	Parrott	ESSFmcp	5.4%
Buck	SBSmc2	4.1%	Parrott	SBSdk	4.1%
Burnie	ESSFmk	4.5%	Parrott	SBSmc2	4.1%
Burnie	ESSFmkp	4.5%	Sibola	CWHws2	9.0%
Fulton	ESSFmc	2.7%	Sibola	ESSFmk	1.4%
Fulton	ESSFmcp	6.8%	Sibola	ESSFmkp	4.5%
Fulton	SBSmc2	4.1%	Sibola	MHmm2	9.0%
Gosnel	ESSFmc	3.6%	Sibola	SBSmc2	4.1%
Gosnel	ESSFmcp	7.7%	Tahtsa	ESSFmc	2.7%
Gosnel	ESSFmk	3.6%	Tahtsa	ESSFmcp	7.7%
Gosnel	ESSFmkp	4.5%	Tahtsa	ESSFmk	1.4%
Gosnel	SBSmc2	4.1%	Tahtsa	SBSdk	3.6%
Granisle	ESSFmc	4.1%	Tahtsa	SBSmc2	4.1%
Granisle	SBSmc2	3.6%	Thautil	ESSFmc	3.2%
Houston - Tommy	ESSFmc	3.2%	Thautil	ESSFmcp	6.3%
Houston - Tommy	ESSFmcp	6.3%	Thautil	SBSmc2	4.1%
Houston - Tommy	SBSdk	3.6%	Tochcha - Natowite	ESSFmv3	2.7%
Houston - Tommy	SBSmc2	4.1%	Tochcha - Natowite	ESSFmvp3	7.7%
Kidprice	ESSFmc	3.2%	Tochcha - Natowite	SBSmc2	4.1%
Kidprice	ESSFmk	4.1%	Tochcha - Natowite	SBSwk3	2.7%
Kidprice	SBSmc2	4.1%	Topley	ESSFmc	1.8%
Morice Lake	ESSFmc	3.6%	Topley	ESSFmcp	4.5%
Morice Lake	SBSmc2	0.9%	Topley	SBSmc2	3.6%
Morrison	ESSFmc	2.7%	Triotsa	CWHws2	9.0%
Morrison	ESSFmv3	3.6%	Triotsa	ESSFmk	1.4%
Morrison	SBSmc2	3.6%	Triotsa	ESSFmkp	4.5%
Nadina	ESSFmc	2.3%	Triotsa	MHmm2	9.0%
Nadina	SBSdk	4.1%	Valley	ESSFmc	2.3%
Nadina	SBSmc2	4.1%	Valley	ESSFmcp	4.5%
North Babine	ESSFmv3	3.6%	Valley	SBSdk	2.7%
North Babine	SBSdk	3.2%	Valley	SBSmc2	2.3%
North Babine	SBSmc2	3.6%	Whitesail	ESSFmc	2.7%
Owen	ESSFmc	3.2%	Whitesail	ESSFmk	3.2%
Owen	ESSFmcp	5.4%	Whitesail	SBSdk	3.6%
Owen	SBSdk	3.6%	Whitesail	SBSmc2	4.1%

4.3 Forest Management Assumptions

Management assumptions define how non-timber values are reflected or addressed in the model and how forest management in the TSA occurs

4.3.1 Age 2012 Calculation

The VRI dataset is projected to 2011 and includes some recent depletions; the RESULTS dataset includes depletions up to March 2012. In some cases, the VRI projected age reflects the date of the depletion, however this is not consistent. Based on the date of the air photos used for the inventory, all depletions prior to 1990 are assumed to be accounted for in the existing VRI data. For the purposes of calculating the age in 2012, the regeneration delay for harvested blocks is assumed to be 1 year, with 1 year old trees planted. The regeneration delay for a wildfire is assumed to be 10 years for natural regeneration.

The following rules were used to update age:

1) For depletions since 1990, calculate expected age (2011-harvest date), and compare with VRI age
2) If VRI age is less than expected age, keep VRI age (may be regeneration delay)
3) If VRI age is greater than expected age, use expected age
4) For burns since 1990, calculate expected age as 2011 – fire year – 10, and repeat steps 2 and 3
5) If VRI age is null and there is a harvest date before 1990, use expected age (2011-harvest date)
6) If VRI age is null, with no harvest date, and polygon is CFLB, assume age = 0
7) For all other records, use VRI age
8) Add 1 year to all records to project to 2012.

4.3.2 Base Case Management Assumptions

The assumptions used in the base case model are listed in Table 16, and described in further detail below.

Table 16: Management Assumptions –Base Case

Criteria	Assumption
Green-up	Max 25% <3m height within the THLB applied by Landscape Unit. These only apply in non-scenic areas where visual quality objectives are not designated.
Visuals	P-0%; R-1.5%; PR-7%, M-18% with green-up height defined based on average slope. These limits apply to the CFLB.
Caribou	For the Telkwa Caribou WHA (outside the no harvest areas) a minimum target for old forest and a maximum limit for young forest were applied to the CFLB based on BEC unit. For the Takla Caribou medium habitat areas, no more than 30% can be removed every 80 years.
Seral Stage Targets	Targets for early, mature+old, and old seral stages are defined based on BEC, with higher targets for high biodiversity emphasis areas. These targets are applied to the CFLB as per the Morice LRMP.
Initial Harvest Rate	The initial harvest rate was set at the current AAC for the Morice TSA (2.165 million m^3/yr)
Harvest Rule	Relative oldest first, queue by age/minimum harvest age. Priority on MPB-attacked stands.
Utilization	Pine 12.5, all other species 17.5
Harvest Flow Objectives	Maximize mid-term timber supply. No short-term timber supply increase.
Volume Exclusions	All deciduous-leading stands and the deciduous component of coniferous stands
Harvest Priority	Attacked pine stands – Stands with the highest percentage of mortality first
Minimum Harvest Criteria	150 m^3 per ha
Harvest Quality Objectives	Harvest profile not limited in the base case; scenarios likely to investigate impact of cycle time and limiting the amount of small volume
Silviculture Systems	Clearcut with reserves

4.3.2.1 Green-up

As a surrogate for cutblock adjacency, a green-up target was applied to the THLB. No more than 25% of the THLB can be less than 3 m in height at any time. This limit is applied by landscape unit in all areas that are not within visual polygons.

4.3.2.2 Visuals

The visual landscape inventory dataset field EVQO was used to determine the disturbance limits, and the green-up height was defined based on the average slope of the visual polygon. The limits and green-up heights are shown in Table 17, Table 18, and Table 19. The targets were applied to the CFLB portion of each visual polygon separately.

Table 17: Visual classes and maximum allowable disturbance

Visual Class	Maximum Allowable Disturbance	Number of polygons	Total CFLB Area (ha)
Preservation (P)	0%	30	12,509
Retention (R)	1.5%	148	33,233
Partial Retention (PR)	7%	335	126,328
Modification (M)	18%	193	45,090

Table 18: CFLB area of visuals within each slope class (ha)

EVQO	Slope Class								
	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65+	Total
P	114	542	1,184	343	10,088	238	0	0	12,509
R	928	13,663	9,313	6,391	2,563	363	12	0	33,233
PR	2,307	65,757	51,267	6,281	697	19	0	0	126,328
M	327	17,522	22,575	4,497	159	9	0	0	45,090
Total	3,676	97,484	84,339	17,512	13,508	629	12	0	217,160

Table 19: Visual Effective Green-up heights (m)

EVQO	Slope Class							
	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65+
P and R	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
PR and M	3.0	3.5	4.5	5.5	6.5	7.5	8.5	9.5

4.3.2.3 Telkwa Caribou Draft WHA 6-333

The No Harvest areas of the WHA are removed in the netdown (Section 4.2.9), and the remaining area has harvest limits and old forest targets based on BEC subzone (MFLNRO, 2012b). These constraints apply to the CFLB area. In all cases, the minimum age to meet the old forest target is 80, and the harvest limit is applied to stands less than 40 years old. The targets are shown in Table 20.

Table 20: WHA 6-333 Constraints

BEC Subzone	Harvesting limit	Old forest target	CFLB Area (ha)
ESSF	28%	60%	19,564
SBSdk	39%	45%	7,334
SBSmc	28%	60%	51,182

4.3.2.4 Takla Caribou Medium Habitat

The Takla Caribou high value habitat areas are removed in the netdown (section 4.2.10), and the medium value habitat is constrained such no more than 30% can be harvested every 80 years. This was modelled as at least 30% of the CFLB area must be greater than 160 years old, and no more than 30% of the CFLB area can be less than 80 years old (MOE, 2009). There are a total of 1,238 ha of CFLB in the medium habitat area.

4.3.2.5 Seral Stage Targets

The Morice LRMP (MoAL, 2007), defines high biodiversity emphasis areas (HBEA) and area specific management areas (ASM). The Draft Ministerial Order (MoAL, 2010) provides targets for old, old and mature, and early seral stages for HBEAs and for the general forest area (GFA). The GFA is defined as all CFLB areas that are not part of any HBEA. The HBEAs and ASMs are shown in Table 21. Most of the ASMs are included in the GFA, and do not have specific seral targets, however, those ASMs shown with an asterisk (*) have a specific mature + old target defined below (the early and old targets are the same as for the GFA).

Table 21: HBEA and ASM areas in Morice TSA

HBEA	CFLB (ha)
Friday/Nakinilerak/Hautete Lakes	7,340
Morice River Buffer Above Thautil/Gosnell Confluence	2,822
Morice River Buffer Below Thautil/Gosnell Confluence	13,567
Morrison Lake	5,821
Nanika River Buffer	1,489
Thautil / Gosnell	31,313
ASM	CFLB (ha)
Babine Lake East Arm	1,115
Bulkley River	1,890
Granisle Com Rec Forest	196
Grease Trail 400m Buffer on 100m NTHA*	1,692
Houston Com Rec Forest	3,115
Le Talh Giz / Old Fort Mountain*	3,762
Lower Nadina River 5m Flood Plain 500m Buffer*	3,966
Matzehtzel / Nez Lake	11,405
Morice Mountain	4,346
Nadina / Owen	10,636
Twinkle / Horseshoe Lake Chain	4,227
Upper Nadina River 5m Flood Plain 500m Buffer*	633

These targets apply to the CFLB. In the HBEA, targets are applied by BEC variant within each HBEA, and for the GFA they are applied by BEC variant within each landscape unit. In all cases, the early seral stage is defined as stands younger than 40 years. The mature seral stage consists of stands between 100 and 140 years old, while the old seral stage is defined as 140 years old and older. The seral stage targets are shown in Table 22 and Table 23. Some of the HBEAs and ASMs have higher targets for mature + old seral, these are listed below.

Table 22: HBEA Seral Stage Targets

BEC Variant	% Representation Across Each HBEA			CFLB Area (ha)
	Early Seral Maximum	Mature + Old Seral Minimum	Old Seral Minimum	
CWH ws2 and MHmm2	16	71	70	0
ESSF mc and ESSF mv3	28	48	42	11,358
ESSF mk	7	86	84	1,064
SBS dk	50	21	16	7,210
SBS mc2 and SBS wk3	37	33	26	42,618
Total				62,250

Table 23: GFA Seral Stage Targets

BEC Variant	% Representation Across each LU in the GFA			CFLB Area (ha)
	Early Seral Maximum	Mature + Old Seral Minimum	Old Seral Minimum	
CWH ws2 and MH mm2	27	64	62	18,839
ESSF mc and ESSF mv3	38	37	34	178,236
ESSF mk	9	83	82	58,956
SBS dk	64	10	8	67,201
SBS mc2 and SBS wk3	48	20	17	269,778
Total				862,789

The following HBEAs have a mature+old seral target of 70% of the CFLB (regardless of BEC). The early and old seral targets remain the same.

- Nanika River HBEA
- Morice River HBEA above the Thautil/Gosnell Confluence
- Nadina/Owen Area Specific Management Zone (ASM)
- Grease Trail 400m Buffer ASM

The following areas have a mature+old seral target of 50% of the CFLB (regardless of BEC). The early and old seral targets remain the same.

- Morice River HBEA below the Thautil/Gosnell Confluence
- Nadina River ASM
- Le Talh Giz ASM

4.3.2.6 Stand Level Biodiversity

Stand level biodiversity was modeled as an aspatial area netdown as described in section 4.2.16.

4.3.2.7 Initial Harvest Level

The initial harvest level will be set at the current AAC of 2.165 million m^3 per year with 550,000 cubic metres attributable to non-pine species.

4.3.2.8 Harvest Rule

The relative oldest harvest rule will be used in the simulation mode of the analysis. This harvest rule queues the stands for harvest based on the stands age relative to its minimum harvest age. In heuristics there is no set harvest rule. Rather, the model attempts to harvest each stand at an age beneficial to the over all solution of the model.

4.3.2.9 Utilization Levels

The utilization levels used in this analysis are shown in Table 24

Table 24: Utilization levels used in the analysis

Leading Species	Minimum Diameter at Breast Height	Maximum Stump Height	Minimum Top Diameter Inside Bark
Pine	12.5 cm	30 cm	10 cm
Non-Pine	17.5 cm	30 cm	10 cm

4.3.2.10 Volume Exclusions

Deciduous species and deciduous volumes were excluded in this analysis.

4.3.2.11 Harvest Priority

Harvest priority was set to MPB infested pine stands to favour them in the analysis.

4.3.2.12 Minimum Harvest Criteria

Minimum harvest criteria are used to determine the age when stands become available for harvesting. While harvesting may take place at the minimum age periodically to meet the harvest target, most stands will not be harvested until past the minimum ages due to management objectives for other resource values.

For this analysis, the minimum harvest volume was set at 150 m^3 per hectare for pine and spruce stands, and 200 m^3 for balsam stands.

4.3.2.13 Harvest Profile

The base case will not target a specific harvest profile. Cycle time constraints and limiting the amount of small volumes in harvest may be investigated in further scenarios.

4.3.2.14 Silviculture Systems

Clearcut with reserves is the silviculture system in the Morice TSA.

4.3.3 Related Strategies

This silviculture strategy will consider other related strategies and if feasible incorporate components of them in modelling and strategy development.

4.3.3.1 Wildfire Management

A wildfire management plan is currently being prepared for the Morice TSA. The planning team is in the process of setting the planning priorities. The focus will be on risk to life and structures with appropriate buffers planned. This silviculture strategy will attempt to coordinate proposed treatments in conjunction with the draft fire management strategy. This will ensure that treatments are not proposed for areas where high fire risk prevails. On the other hand, where treatments are proposed as part of the wildfire management strategy they may be combined with silviculture treatments where feasible.

4.3.3.2 Forest Health Strategy

A forest health strategy may recommend actions to prevent future forest health problems and address current ones. The growth and yield assumptions for this analysis account for MPB through the modelling of natural stand yields and the shelf life of the MPB killed timber. The overall harvesting strategy in the TSA is to salvage as much dead pine as possible.

Hard pine rusts, foliar diseases and insects, such as root collar weevil and MPB are present in immature stands dominated by pine. These forest health issues can impact the timber supply and merchantability of pine stands. . This silviculture strategy will account for these pests and diseases in the modelling of young stands and will promote forest management strategies that will reduce the incidents of diseases in future stands.

4.3.3.3 Enhanced Retention Strategy

The Morice LRMP sets retention targets for different land use zones. In some cases, the targets do not exist; rather a commitment to establish targets is outlined in the document. The monitoring of retention is accomplished through the LRMP Monitoring Report.

4.3.3.4 Climate Change

There is no climate change strategy for the Morice TSA yet. While this analysis will not incorporate climate change into modelling directly, climate change will be considered when designing and recommending future silviculture treatments.

4.4 Growth and Yield Assumptions

Growth and yield assumptions define the net volumes that are realized when natural and managed stands are harvested. They also describe various tree and stand attributes over time (i.e., volume, height, diameter, presence of dead trees, etc.).

4.4.1 Analysis Units

The CFLB was divided into analysis units in the following categories: natural, existing managed, and future managed. All stands older than 40 years were assigned to natural stand analysis units while stands less than 40 years old were considered to be existing managed stands. Recently harvested stands (less than 11 years old) were assigned to future managed analysis units. All stands harvested in the model eventually transition to future managed stands. Natural stands were further divided based on MPB attack.

4.4.1.1 Natural Stands

Natural stand analysis units for the Morice TSA were defined based on species, site index, and volume. The species and site index classes were similar to those used in TSR2 (MOF, 2002). These classes were further subdivided into volume classes using volume at age 140 from VDYP 7. The classes were different for MPB attacked and not attacked stands. Table 25 lists the natural analysis units, their site indices and volume cut-offs for non-MPB stands.

Table 25: Natural Stand Analysis Units in the Morice TSA (stands not attacked by MPB)

Analysis Unit Name	Leading Species	Site Index Range (m)	Volume Range (m3/ha)
Ba_good_1	B, BA, BL	>14	<300
Ba_good_2	B, BA, BL	>14	300-350
Ba_good_3	B, BA, BL	>14	350-400
Ba_good_4	B, BA, BL	>14	400-450
Ba_good_5	B, BA, BL	>14	>=450
Ba_med_1	B, BA, BL	11-14	<240
Ba_med_2	B, BA, BL	11-14	240-280
Ba_med_3	B, BA, BL	11-14	280-320
Ba_med_4	B, BA, BL	11-14	>=320
Ba_poor_1	B, BA, BL	<11	<80
Ba_poor_2	B, BA, BL	<11	80-130
Ba_poor_3	B, BA, BL	<11	130-180
Ba_poor_4	B, BA, BL	<11	180-230
Ba_poor_5	B, BA, BL	<11	>=230
Pl_good_1	PL, PLI, PA, PM, FD	>19	<400
Pl_good_2	PL, PLI, PA, PM, FD	>19	400-480
Pl_good_3	PL, PLI, PA, PM, FD	>19	>=480
Pl_med_1	PL, PLI, PA, PM, FD	15-19	<270
Pl_med_2	PL, PLI, PA, PM, FD	15-19	270-370
Pl_med_3	PL, PLI, PA, PM, FD	15-19	>=370
Pl_poor_1	PL, PLI, PA, PM, FD	<15	<160
Pl_poor_2	PL, PLI, PA, PM, FD	<15	160-250
Pl_poor_3	PL, PLI, PA, PM, FD	<15	>=250
Sx_good_1	S, SB, SW, SX	>16	<300
Sx_good_2	S, SB, SW, SX	>16	300-350
Sx_good_3	S, SB, SW, SX	>16	350-400
Sx_good_4	S, SB, SW, SX	>16	400-450
Sx_good_5	S, SB, SW, SX	>16	>=450
Sx_med_1	S, SB, SW, SX	12-16	<220
Sx_med_2	S, SB, SW, SX	12-16	220-270
Sx_med_3	S, SB, SW, SX	12-16	270-320
Sx_med_4	S, SB, SW, SX	12-16	320-370
Sx_med_5	S, SB, SW, SX	12-16	>=370
Sx_poor_1	S, SB, SW, SX	<12	<130
Sx_poor_2	S, SB, SW, SX	<12	130-180
Sx_poor_3	S, SB, SW, SX	<12	180-230
Sx_poor_4	S, SB, SW, SX	<12	230-280
Sx_poor_5	S, SB, SW, SX	<12	>=280
Decid	AC, ACB, ACT, AT, EP	all	all
Hw	H, HW, HM	all	all

Notes: As deciduous and hemlock stands are mostly in the NHLB, there is only one AU for each
There are 2.5 ha of Douglas Fir stands in the TSA; these were grouped with the pine for this analysis

For those stands attacked by the mountain pine beetle, the species and site index classes were the same, but the volume classes were constructed differently (Table 26). Changes to volume due to beetle kill were not considered in the classification.

Table 26: Natural Stand Analysis Units for MPB attacked stands

Analysis Unit Name	Leading Species	Site Index Range (m)	Volume Range (m3/ha)
Ba_good_1	B, BA, BL	>14	<320
Ba_good_2	B, BA, BL	>14	320-370
Ba_good_3	B, BA, BL	>14	370-420
Ba_good_4	B, BA, BL	>14	>=420
Ba_med_1	B, BA, BL	11-14	<240
Ba_med_2	B, BA, BL	11-14	240-310
Ba_med_3	B, BA, BL	11-14	>=310
Ba_poor_1	B, BA, BL	<11	<140
Ba_poor_2	B, BA, BL	<11	140-220
Ba_poor_3	B, BA, BL	<11	>=220
Pl_good_1	PL, PLI, PA, PM, FD	>19	<310
Pl_good_2	PL, PLI, PA, PM, FD	>19	310-370
Pl_good_3	PL, PLI, PA, PM, FD	>19	370-410
Pl_good_4	PL, PLI, PA, PM, FD	>19	410-460
Pl_good_5	PL, PLI, PA, PM, FD	>19	460-510
Pl_good_6	PL, PLI, PA, PM, FD	>19	>=510
Pl_med_1	PL, PLI, PA, PM, FD	15-19	<240
Pl_med_2	PL, PLI, PA, PM, FD	15-19	240-290
Pl_med_3	PL, PLI, PA, PM, FD	15-19	290-350
Pl_med_4	PL, PLI, PA, PM, FD	15-19	350-400
Pl_med_5	PL, PLI, PA, PM, FD	15-19	>=400
Pl_poor_1	PL, PLI, PA, PM, FD	<15	<140
Pl_poor_2	PL, PLI, PA, PM, FD	<15	140-200
Pl_poor_3	PL, PLI, PA, PM, FD	<15	200-260
Pl_poor_4	PL, PLI, PA, PM, FD	<15	260-310
Pl_poor_5	PL, PLI, PA, PM, FD	<15	>=310
Sx_good_1	S, SB, SW, SX	>16	<300
Sx_good_2	S, SB, SW, SX	>16	300-360
Sx_good_3	S, SB, SW, SX	>16	360-410
Sx_good_4	S, SB, SW, SX	>16	410-470
Sx_good_5	S, SB, SW, SX	>16	>=470
Sx_med_1	S, SB, SW, SX	12-16	<240
Sx_med_2	S, SB, SW, SX	12-16	240-280
Sx_med_3	S, SB, SW, SX	12-16	280-330
Sx_med_4	S, SB, SW, SX	12-16	330-390
Sx_med_5	S, SB, SW, SX	12-16	>=390
Sx_poor_1	S, SB, SW, SX	<12	<110
Sx_poor_2	S, SB, SW, SX	<12	110-180
Sx_poor_3	S, SB, SW, SX	<12	180-230
Sx_poor_4	S, SB, SW, SX	<12	230-290
Sx_poor_5	S, SB, SW, SX	<12	>=290
Decid	AC, ACB, ACT, AT, EP	all	all
Hw	H, HW, HM	all	all

The analysis units in Table 26 were further subdivided based on the age at death and severity of mountain pine beetle attack. Data from the BCMPB v9 analysis and forecast was used for this process. For attacked stands, the age at death (age at which at least 50% of pine is dead) was divided into 5-year increments, starting at age 60. The attack severity was defined based on the maximum percent of the stand that was dead, or predicted to be dead in the future. The five severity classes were defined as follows:

- Class 1: >0-<=25% dead
- Class 2: >25-<=50% dead
- Class 3: >50-<=70% dead
- Class 4: >70-<=90% dead
- Class 5: >90% dead

This process increased the number of natural stand analysis units from 40 to 4,356. An example analysis unit name for a MPB-attacked stand is Pl_good_3_mpb_95_5, meaning the stand is pine-leading, with site index >19 and volume at age 140 between 370 and 410 m^3/ha. The MPB attack age at death is 95, and the severity of attack is class 5.

For the NHLB, all stands were classified into analysis units using the species and site index classes as above (volume was not considered). MPB-attacked NHLB stands were further split based on attack severity. Stands with an attack severity of >50% dead (class 3, 4, 5) were grouped together, as were those with a severity <=50% dead (class 1, 2). Growing stock losses due to MPB were not tracked in the NHLB yield curves.

4.4.1.2 Existing Managed Stands

Existing managed stands were defined as those stands that are currently between 11 and 40 years old. These stands were further divided to those with genetic gain (11 to 17 years old) and the ones without genetic gain (18 to 40 years old). Analysis units for existing managed stands are shown in Table 27 and Table 28.

Table 27: Analysis units; existing managed stands 11 to 17 years old

AU	Name	Leading Species	Site Index Range (m)	THLB Area (ha)
6151	EM_ESSF_ba_1_gw	BL	<15	255
6152	EM_ESSF_ba_2_gw	BL	>=15	68
6153	EM_ESSF_pi_1_gw	PL	<=17	1,552
6154	EM_ESSF_pi_2_gw	PL	>17	424
6155	EM_ESSF_sx_1_gw	SX	<17.5	878
6156	EM_ESSF_sx_2_gw	SX	>=17.5	594
6157	EM_SBSdk_basx_1_gw	BL or SX	<16.5	360
6158	EM_SBSdk_basx_2_gw	BL or SX	16.5-18.4	543
6159	EM_SBSdk_basx_3_gw	BL or SX	18.5-20.4	258
6160	EM_SBSdk_basx_4_gw	BL or SX	>=20.5	290
6161	EM_SBSdk_pi_1_gw	PL	<19.5	845
6162	EM_SBSdk_pi_2_gw	PL	19.5-20.4	1,239
6163	EM_SBSdk_pi_3_gw	PL	>=20.5	943
6164	EM_SBSmc2_basx_1_gw	BL or SX	<18.5	802
6165	EM_SBSmc2_basx_2_gw	BL or SX	18.5-19.4	6,221
6166	EM_SBSmc2_basx_3_gw	BL or SX	>=19.5	945
6167	EM_SBSmc2_pi_1_gw	PL	<17.5	123
6168	EM_SBSmc2_pi_2_gw	PL	17.5-19.4	15,322
6169	EM_SBSmc2_pi_3_gw	PL	>=19.5	1,827
Total				33,489

Table 28: Analysis units; existing managed stands 18 to 40 years old

AU	Name	Leading Species	Site Index Range (m)	THLB Area (ha)
6101	EM_ESSF_ba_1	BL	<15	197
6102	EM_ESSF_ba_2	BL	>=15	136
6103	EM_ESSF_pi_1	PL	<=17	3,424
6104	EM_ESSF_pi_2	PL	>17	1,030
6105	EM_ESSF_sx_1	SX	<17.5	815
6106	EM_ESSF_sx_2	SX	>=17.5	1,517
6107	EM_SBSdk_basx_1	BL or SX	<16.5	323
6108	EM_SBSdk_basx_2	BL or SX	16.5-18.4	892
6109	EM_SBSdk_basx_3	BL or SX	18.5-20.4	966
6110	EM_SBSdk_basx_4	BL or SX	>=20.5	376
6111	EM_SBSdk_pi_1	PL	<19.5	2,893
6112	EM_SBSdk_pi_2	PL	19.5-20.4	8,541
6113	EM_SBSdk_pi_3	PL	>=20.5	1,867
6114	EM_SBSmc2_basx_1	BL or SX	<18.5	1,388
6115	EM_SBSmc2_basx_2	BL or SX	18.5-19.4	22,975
6116	EM_SBSmc2_basx_3	BL or SX	>=19.5	2,023
6117	EM_SBSmc2_pi_1	PL	<17.5	123
6118	EM_SBSmc2_pi_2	PL	17.5-19.4	15,322
6119	EM_SBSmc2_pi_3	PL	>=19.5	1,827
Total				103,451

4.4.1.3

4.4.1.4 Future Managed Stands

Table 29 shows the analysis units for future managed stands. Future managed stands include those stands that are currently between 0 and 10 years old.

Table 29: Analysis units; future managed stands

AU	Name	Current Leading Species	Site Index Range (Current Leading Sp)	THLB Area (ha)
6001	FM_ESSF_ba_1	BL	<13	7,472
6002	FM_ESSF_ba_2	BL	13 - 15.1	29,770
6003	FM_ESSF_ba_3	BL	>=15.2	1,375
6004	FM_ESSF_pi_1	PL	<17	27,307
6005	FM_ESSF_pi_2	PL	>=17	4,450
6006	FM_ESSF_sx_1	SX	<15	2,242
6007	FM_ESSF_sx_2	SX	15 - 17.9	7,381
6008	FM_ESSF_sx_3	SX	18 - 18.9	1,456
6009	FM_ESSF_sx_4	SX	>=19	4,675
6010	FM_SBSdk_basx_1	BL or SX	<15	8,141
6011	FM_SBSdk_basx_2	BL or SX	15 – 17.9	7,222
6012	FM_SBSdk_basx_3	BL or SX	18 – 18.9	11,716
6013	FM_SBSdk_basx_4	BL or SX	>=19	3,458
6014	FM_SBSdk_pi_1	PL	<18	1,997
6015	FM_SBSdk_pi_2	PL	18 – 19.9	25,836
6016	FM_SBSdk_pi_3	PL	>=20	21,501
6017	FM_SBSmc2_basx_1	BL or SX	<15	248
6018	FM_SBSmc2_basx_2	BL or SX	15 – 17.9	3,746
6019	FM_SBSmc2_basx_3	BL or SX	18 – 18.9	129,114
6020	FM_SBSmc2_basx_4	BL or SX	>=19	51,036
6021	FM_SBSmc2_pi_1	PL	<18	16,029
6022	FM_SBSmc2_pi_2	PL	18 - 18.6	207,095
6023	FM_SBSmc2_pi_3	PL	>=18.7	22,466
Total				595,734

4.4.2 Modelling of MPB Impacted Stands 60 Years and Older

Each THLB attacked stand greater than 60 years old at the time of the MPB attack is modelled as shown in Table 30. The year of death is defined as the year when the cumulative kill reaches 50%. If the cumulative kill does not reach 50% by the end of the BCMPB projection (2026), the year of death is the weighted average year of attack for the stand. The percent dead is the pine component of the stand multiplied by the maximum cumulative percent killed from the BCMPB v9 data. The percent live is 100% minus percent dead.

Table 30: MPB attack modelling in the THLB

Severity of Attack	Stand Component	Timing	Yield/Volume Projection
>= 50% dead	Dead overstory	Adjusted at year of death	VDYP, shelf life of 15 years. Volume drops to 85% at year of death, and remains for 2 more years, then declines linearly to 0 over the next 13 years.
	Live overstory	Adjusted at year of death	Total yield times percent live.
	Regeneration	Advanced regeneration starts 10 years before year of death.	Advanced regen curves generated in TASS. TASS projections with high clumpiness factor. Potential site index less 2 metres. Adjust OAF1 to 25% and OAF2 to 15% 10 year advanced regeneration. Randomly assign density class for modeling stand densities based on BEC variants from Coates data
<50% dead	Dead overstory	Adjusted at year of death	VDYP, shelf life of 15 years. Volume drops to 85% at year of death, and remains for 2 more years, then declines linearly to 0 over the next 13 years
	Live overstory	Adjusted at year of death	Total yield times percent live.
	Regeneration	Assume no regeneration	Stand will continue to grow on the live overstory yield curve.

Each stand may have up to three yield curves associated with it:

- ***Yield*** *curve for dead timber (percent dead * VDYP volume) that remains static at 85% for 3 years after which the volume drops linearly to 0 m³/ha over the next 13 years. This volume is lost if it is not harvested before the total volume per ha falls below the minimum harvest volume. .*
- ***Post-attack live curve*** *((total volume – percent dead)*VDYP volume);.*
- ***Advanced regeneration curve*** *(TASS curves provided by Forsite); this curve starts at age zero with a positive regeneration delay of 10 years. All stands >= 50% dead were assigned an advanced regeneration curve. Based on Coates study (2012), stands were randomly assigned to high, medium or low density advanced regeneration.*

These three curves were added together to make the composite curve for the stand, then the curves for all stands within each analysis unit were averaged to make the final curves used in the model. All stands >= 50% dead had their ages reset to the age of the regeneration after the end of the shelf life. The live volume was maintained, but the stand was considered to be young.

Figure 4 provides an example of how a post-attack dead volume yield curve, post-attack live curve, and a regenerating curve were combined to make a composite curve.

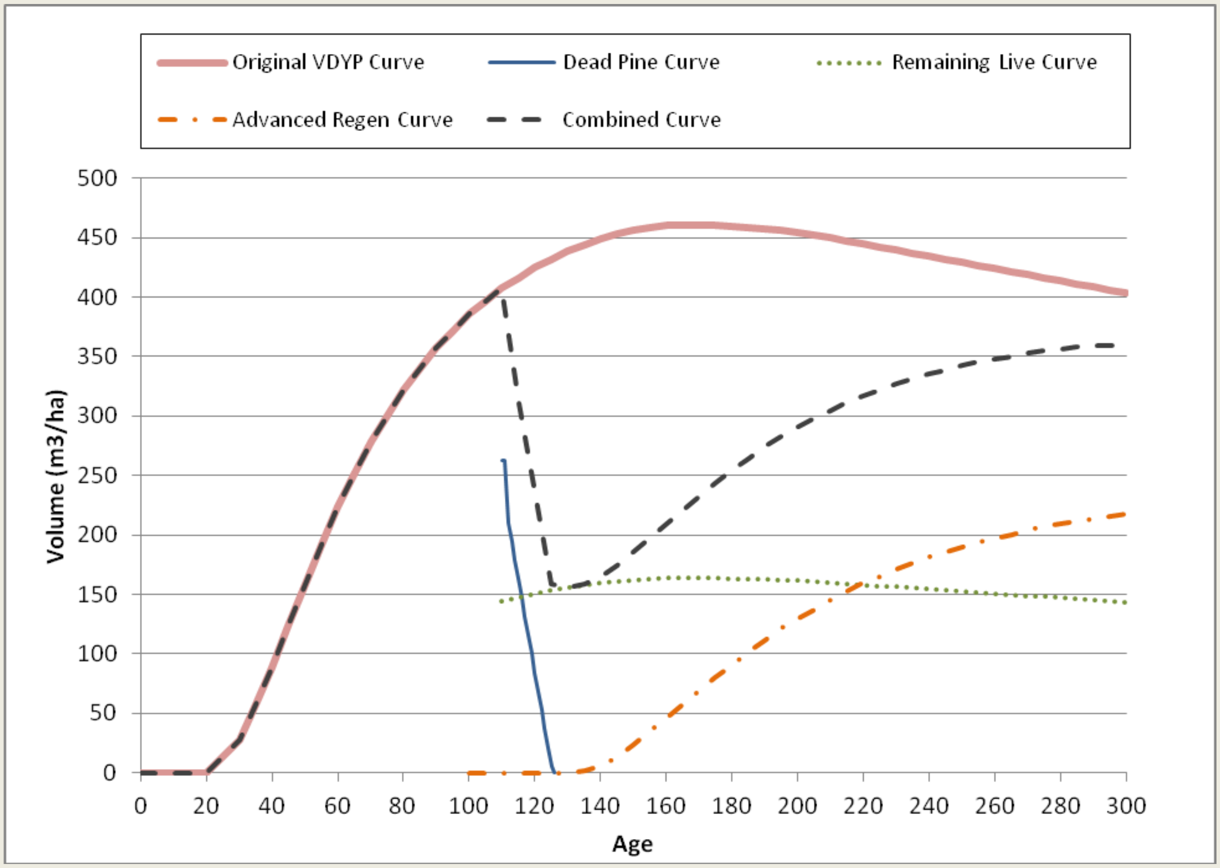

Figure 4: Example of MPB yield curves; pine-leading stand, with 65% dead at age 110, with high density advanced regen

For the NHLB attacked by MPB, stands >50% dead were assigned to break up 20 years after year of death and regenerate on the same natural curve. Stands <=50% dead were not set to break up; rather they were assumed to continue growing. Growing stock losses due to MPB were not tracked in the NHLB.

4.4.2.1 Shelf Life

The merchantability of beetle-killed wood remains an important uncertainty in timber supply analyses. In this analysis shelf life is defined as the time a stand remains economically viable for sawlog harvesting. The shelf life starts at the year of death (as defined above). The status quo shelf life assumptions in most timber supply analyses to date have assumed 100% retention of merchantability for 15 years, after which the volume is no longer usable. This analysis assumes that a time period of 15 years is required from the average time of death until the stand becomes entirely un-merchantable. The merchantability is assumed to be 85% at the year of death, and for the next 2 years, then decline in a linear fashion to 0 at year 15 as shown in Figure 5. This approach is consistent with other on-going Type 4 silviculture strategies. The shelf life for other product types could be longer; however, it is not modeled in this analysis.

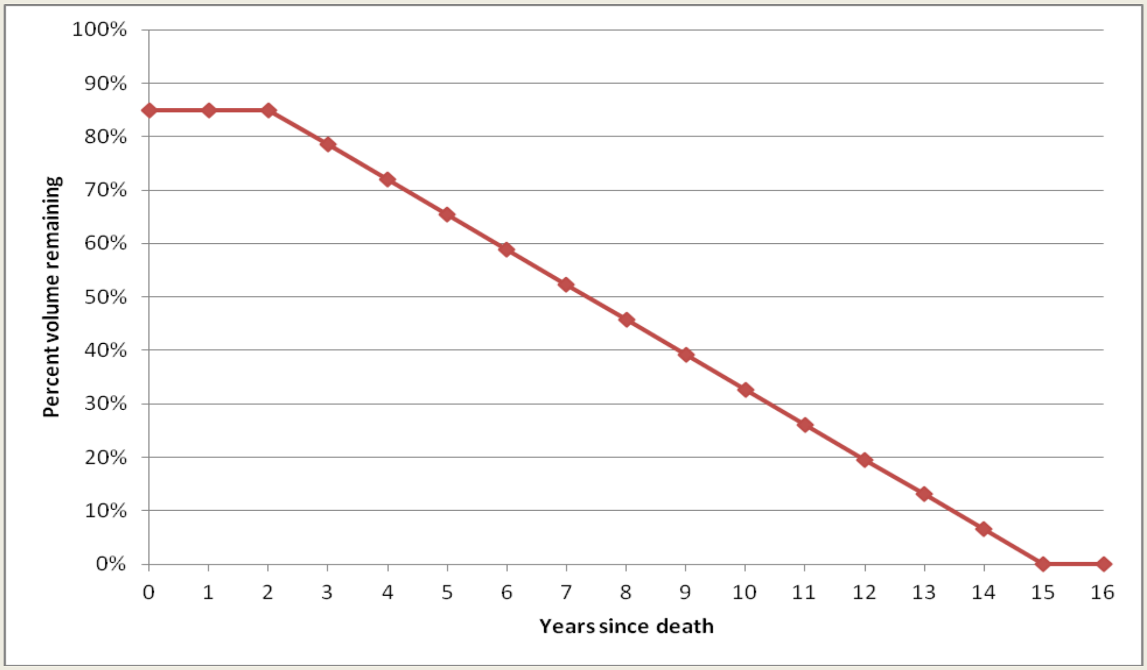

Figure 5: Shelf life for dead pine sawlogs

4.4.2.2 Minimum harvest volume of MPB Impacted stands

The minimum harvest criteria in this analysis is 150 m^3 per ha. The same criteria apply to the MPB impacted stands; unless the sum of live and dead volume is 150 m^3 or more the stand will not get harvested. Note that the shelf life assumptions in the analysis will reduce the merchantable dead volume to zero in 15 years after death. As a result, some stands may be eligible for harvest at the very beginning of the planning horizon but not in 10 years. On the other hand, the secondary structure and the remaining live trees may reach the minimum harvest criteria over time, and the stand may again become eligible for harvesting.

4.4.2.3 Modelling the advanced regeneration component

All pine-leading stands with >= 50% dead component were assumed to have advanced regeneration as per Coates and Sachs (2012). The density classes shown in Table 31 were randomly distributed in pine leading stands with >= 50% mortality.

Table 31: Advanced regeneration density classes

BEC	Low Density Class (200/ha)	Med Density Class (800/ha)	High Density Class (1600/ha)
SBSmc2	20%	20%	60%
SBSdk	30%	20%	50%
ESSFmc	5%	10%	85%

The methodology for modelling growth and yield for advanced regeneration was originally developed by Jim Thrower for Forsite Consultants Ltd (Thrower, 2013). TASS projections with high clumpiness factor were used. The modelling used potential site indices reduced by 2 metres and adjusted OAF1 to 25% and OAF2 to 15%. The regeneration lag was set to positive 10 years, i.e. the initiation of the regenerating stand was set 10 years before the death of the stand. The yield curves were originally produced for the Lakes TSA and were provided to FESL by Forsite Consultants Ltd. These yield curves were considered suitable for use in the Morice TSA as well. A detailed description of the developed methodology is presented in the appendix.

4.4.3 MPB impact in young pine stands (<60 years old)

Data on the MPB attack in young stands were collected in the Lakes TSA between 2006 and 2008. 29% of age class 2 stands showed attack with 1% of the stands reverting back to NSR status (Table 32). 48% of the age class 3 stands indicated MPB attack with 24% of these stands classified as NSR. According to the Nadina Forest District staff, a similar pattern exists in the Morice TSA.

Table 32: Summary of 2006 - 2008 Survey in pine-leading plantations in the Lakes TSA

Age Class	Total Area (ha)	Total Area with MPB (ha)	MPB %	NSR % MPB
1	6,140	270	0.04%	0%
2	10,874	3,144	29%	1%
3	1,699	819	48%	24%

The MPB impacts in these stands were modeled by increasing the OAF 1 in TIPSY for all pine leading existing managed stands.

4.4.4 Stand Projection Models

The variable density yield prediction (Batch VDYP 7.7a.33) model developed by the MFLNRO was used for estimating the timber volumes of natural stands.

The table interpolation program for stand yields (BatchTIPSY, 4.2), developed by the MFLNRO were used to estimate timber volumes for existing and future managed stands. All stands older than 40 years were considered natural stands while stands less than 40 years old and future stands were considered to be managed stands.

4.4.4.1 Decay, Waste, and Breakage

Default reductions to stand volume for decay, waste and breakage were applied to the VDYP7 model Zone.

4.4.4.2 Operational Adjustment Factors in Managed Stand Yields

Operational adjustment factors (OAF) are used to adjust timber yield estimates. They represent yield reductions that on average occur in managed stands that are growing in operational conditions. OAF 1 is a linear reduction of yield designed to account for small unproductive areas within stands, uneven distribution of stems, endemic losses and other random risk factors. OAF 2 reduces yields for decay, waste and breakage. It is non-linear in nature, lowering the predicted volume at a rate that will achieve the specified factor in 100 years and continue to increase thereafter based on the number of years since stand initiation.

In most analyses, the default OAF1 and OAF2 values of 15% and 5%, respectively, are used. The district and regional staff are concerned over the condition some of of the existing managed stands in the Morice

TSA; they do not appear to grow as well as expected due to pests and diseases. It is believed that the currently employed establishment densities for reforestation may not provide an adequate buffer against pests and diseases and the future managed stands will continue to underperform as compared to default TIPSY assumptions, particularly OAF1 and OAF2. There is an on-going discussion regarding the operational adjustment factors to be used in growth and yield modelling in the Morice TSA. For the purposes of this analysis, an OAF1 value of 20% will be used for managed pine-leading stands and the standard OAF1 value of 15% will be used for all managed non-pine leading stands. The default OAF2 value of 5% will be applied to all future stands.

4.5 Natural Disturbance Assumptions

4.5.1 Non-Harvestable Land Base

A disturbance function was used in the analysis to prevent the non-timber harvesting land base from continually aging and providing a disproportionate and often improbable amount of old forest cover conditions to satisfy landscape biodiversity requirements,. The document “Modeling Options for Disturbance Outside the THLB – Working Paper” (Forest Analysis Branch, 2003) provides direction for disturbing areas of the landscape outside of the THLB. There are a variety of possible approaches to applying a disturbance in the non-timber harvesting land base. While each approach has its strengths and weaknesses there remains a significant amount of uncertainty as to what the most appropriate methodology is. The age reset by variant for the non-timber harvesting land base methodology was applied. The methodology is as follows:

1. List the estimated return interval for disturbance in each variant and NDT in the TSA (Landscape Unit Planning Guide Appendix 2).
2. Establish the estimated minimum target % of old seral that would be expected (Landscape Unit Planning Guide Appendix 2). The target was established using the intermediate biodiversity option.
3. Calculate a rotation age based on the age distribution described in step 2 (old age / (1- target %).
4. Divide the contributing non-THLB area in the variant by the calculated rotation age to determine the annual minimum disturbance target for each variant.

Table 33 identifies the minimum target area to be disturbed annually within each BEC variant for the Morice TSA.

Table 33: Minimum target area to be disturbed annually in each BEC variant

BEC	NDT	Mean Event Interval	Old Age	Old Seral Target % BEO = I	Rotation Age	NHLB Area (ha)	Annual Disturbance Area (ha)	Annual Disturbance %
AT	5	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CWH ws2	2	200	250	9.0%	275	17,421	63.4	0.4%
ESSF mc	2	200	250	9.0%	275	97,226	353.9	0.4%
ESSF mcp	5	n/a	n/a	n/a	n/a	3,551	n/a	n/a
ESSF mk	2	200	250	9.0%	275	57,213	208.3	0.4%
ESSF mkp	5	n/a	n/a	n/a	n/a	3,298	n/a	n/a
ESSF mv3	2	200	250	9.0%	275	9,097	33.1	0.4%
ESSF mvp3	5	n/a	n/a	n/a	n/a	215	n/a	n/a
MH mm2	1	350	250	19.0%	309	1,083	3.5	0.3%
SBS dk	3	125	140	11.0%	157	23,297	148.1	0.6%
SBS mc2	3	125	140	11.0%	157	118,090	750.7	0.6%
SBS wk3	3	125	140	11.0%	157	5,913	37.6	0.6%

4.5.2 Timber Harvesting Land Base, Non-Recoverable Losses

The Nadina Forest District has compiled estimates for average annual volume losses in the THLB due to insects, fire and wind. These are shown in Table 15. The numbers are prorated for the THLB in this analysis. The non-recoverable losses caused by the MPB are not considered here. It is assumed that the modelling of MPB as described earlier in this documents accounts for MPB related losses adequately.

Table 34: Non-Recoverable Losses

Loss Agent	Annual Non-Recoverable Losses (m^3/yr)
Spruce Bark Beetle	742
Balsam Bark Beetle	43,548
Fire	10,498
Wind	7,635
Total	62,423

4.5.2.1 Insects

Spruce Bark Beetle (IBS)

The salvage of recent spruce bark beetle attacked stands (2000-2001) and subsequent suppression of the infestation was successful. The district is assuming that suppression activities will continue to be effective with future losses predicted to be at the same level as the estimated endemic total losses in 2005 at 777 m^3.

Western Balsam Bark Beetle (IBB)

According to the Nadina Forest District staff, Western balsam bark beetle is widespread across the Morice TSA. The attack has remained high between the years 2000-2005. VDYP yield predictions consider the volume losses due to IBB because of the endemic nature of the attack.

The district expects there to be additional non-recoverable losses in IBB attacked stands due to the current focus on harvesting MPB attacked pine leading stands. These losses are estimated at 45,628 m^3 per year. This estimate was determined by analyzing grade 3 volumes for years 2000 to 2005.

4.5.2.2 Fire

The district staff reviewed the years from 2001-2005 for fire losses and estimated them to be approximately 11,000 m^3/year. The district further concluded that this level of losses reasonably predicts future losses as well.

4.5.2.3 Wind

The Nadina Forest District staff has concerns over increasing wind throw risk due to the MPB epidemic. The dead and dying pine stands and their harvest are predicted to render the remaining stands less windfirm due to large openings and higher water table. However, due to uncertainty associated with predicting future non-recoverable losses due to wind the district suggests to use the same level of wind losses as in the 2001 timber supply review at 8,000 m^3 per year.

4.6 Silviculture

4.6.1 Silviculture Systems

The silviculture system in the TSA is assumed to be clear cut with reserves.

4.6.2 Genetic Gain

Genetic gain was applied to the yield curves of existing and future managed stands.

RESULTS data were used to calculate the proportion of trees planted from genetically improved seed (class A) for those existing managed stands established between years 1995 and 2002. No genetic gain was applied to older existing managed stands. The genetic worth estimated by the tree improvement branch staff for each seedlot was used to estimate the weighted average genetic worth for each species. These are shown in Table 35.

Table 35: Genetic gain for existing managed stands established between 1995 and 2002 in the Morice TSA

Species	Weighted Average Genetic Gain of Seedlots Used	Percent Planted with Class A Seed	Genetic gain used in analysis
Sw	4.58	95.93	4.40
Pl	9.81	5.24	0.51

The same approach was used to estimate the genetic gain for future managed stands. The genetic gain data and planting information from the last 10 years was assumed to predict future genetic gains. The genetic gains applied in the analysis to future managed stands are shown in Table 36.

Table 36: Genetic gain for future managed stands in the Morice TSA

Species	Weighted Average Genetic Gain of Seedlots Used	Percent Planted with Class A Seed	Genetic gain used in analysis
Sw	12.65	100.00	12.65
Pl	9.62	44.12	4.24

4.6.3 Regeneration Assumptions

Regeneration assumptions for existing managed stands and future managed sands were developed in cooperation with the Nadina Forest District staff. The assumptions for future managed stands reflect current practise while the existing managed stand assumptions were derived by analysing RESULTS data using the following approach:

1. Split the existing managed stands (EM) to those with genetic gain (11 to 17 years old) and those without (18 to 40 years old);
2. Determine site index cut-offs, so that they work with the 2 populations of EM stands;
3. Assign average site index for each group; the site index was taken from RESULTS where a spatial link existed; otherwise the provincial site index layer was used;
4. Silviculture survey data was analyzed for densities. Averages were developed for total well-spaced stems per ha for each analysis unit. The well-spaced numbers were input into TIPSY to establish the estimated initial density for each analysis unit;
5. Historical planting data was analyzed for density to ensure that the initial densities derived from total well-spaced stems per ha as described above were reasonable;
6. Historical planting data was analyzed for planted species distribution;
7. Silviculture survey data was analyzed for species distribution of well-spaced stems. These data were used to incorporate BL ingress into modeling.

Table 37: Regeneration assumptions for existing managed stands 11 to 17 years old

AU	Name	SI	Init Density	Regen Delay (yrs)	Sp1	%	Sp2	%	Sp3	%	Sp4	%	Planted %	BL Ingress %	OAF1	OAF2
6151	EM_ESSF_ba_1_gw	14.4	1600	2, 3 ingress	BL	46	SW	30	PL	24			85	15	0.85	0.95
6152	EM_ESSF_ba_2_gw	15.7	1600	2, 3 ingress	BL	47	SW	45	PL	8			85	15	0.85	0.95
6153	EM_ESSF_pi_1_gw	16.4	1600	2	PL	55	SW	31	BL	14			100	0	0.80	0.95
6154	EM_ESSF_pi_2_gw	19.6	1700	2	PL	67	SW	24	BL	9			100	0	0.80	0.95
6155	EM_ESSF_sx_1_gw	15.8	1600	2	SW	63	PL	20	BL	17			100	0	0.85	0.95
6156	EM_ESSF_sx_2_gw	20.1	1500	2	SW	58	BL	24	PL	18			100	0	0.85	0.95
6157	EM_SBSdk_basx_1_gw	14.1	1600	2	SW	52	PL	36	BL	12			100	0	0.85	0.95
6158	EM_SBSdk_basx_2_gw	17.9	1500	2	SW	59	PL	39	BL	2			100	0	0.85	0.95
6159	EM_SBSdk_basx_3_gw	19.3	1500	2	SW	58	PL	32	BL	10			100	0	0.85	0.95
6160	EM_SBSdk_basx_4_gw	25.4	1600	2	SW	64	PL	32	BL	4			100	0	0.85	0.95
6161	EM_SBSdk_pi_1_gw	17.6	1650	2	PL	61	SW	35	BL	4			100	0	0.80	0.95
6162	EM_SBSdk_pi_2_gw	20.0	1600	2	PL	64	SW	30	BL	6			100	0	0.80	0.95
6163	EM_SBSdk_pi_3_gw	24.0	1650	2	PL	67	SW	31	BL	2			100	0	0.80	0.95
6164	EM_SBSmc2_basx_1_gw	16.6	1450	2, 3 ingress	SW	35	PL	32	BL	33			90	10	0.85	0.95
6165	EM_SBSmc2_basx_2_gw	19.0	1550	2	SW	58	PL	32	BL	10			100	0	0.85	0.95
6166	EM_SBSmc2_basx_3_gw	22.8	1550	2	SW	67	PL	25	BL	8			100	0	0.85	0.95
6167	EM_SBSmc2_pi_1_gw	16.9	1700	2, 3 ingress	PL	63	SW	27	BL	10			95	5	0.80	0.95
6168	EM_SBSmc2_pi_2_gw	18.3	1650	2	PL	63	SW	31	BL	6			100	0	0.80	0.95
6169	EM_SBSmc2_pi_3_gw	21.4	1550	2	PL	66	SW	29	BL	5			100	0	0.80	0.95

Genetic gain for SW = 4.40
Genetic gain for PL = 0.51

Table 38: Regeneration assumptions for existing managed stands 18 to 40 years old

AU	Name	SI	Init Density	Regen Delay (yrs)	Sp1	%	Sp2	%	Sp3	%	Sp4	%	Planted %	BL Ingress %	OAF1	OAF2
6101	EM_ESSF_ba_1	13.9	1700	2, 3 ingress	BL	54	SW	28	PL	18			55	45	0.85	0.95
6102	EM_ESSF_ba_2	15.1	1800	2, 3 ingress	BL	48	SW	30	PL	22			70	30	0.85	0.95
6103	EM_ESSF_pi_1	16.4	1600	2, 3 ingress	PL	68	SW	22	BL	10			90	10	0.80	0.95
6104	EM_ESSF_pi_2	19.2	1650	2, 3 ingress	PL	70	SW	25	BL	5			95	5	0.80	0.95
6105	EM_ESSF_sx_1	16.1	1450	2, 3 ingress	SW	77	PL	8	BL	15			85	15	0.85	0.95
6106	EM_ESSF_sx_2	19.2	1600	2, 3 ingress	SW	61	PL	29	BL	10			90	10	0.85	0.95
6107	EM_SBSdk_basx_1	13.7	1650	2	SW	54	PL	44	BL	2			100	0	0.85	0.95
6108	EM_SBSdk_basx_2	17.9	1500	2	SW	63	PL	36	BL	1			100	0	0.85	0.95
6109	EM_SBSdk_basx_3	18.9	1500	2, 3 ingress	SW	54	PL	36	FD	5	BL	5	95	5	0.85	0.95
6110	EM_SBSdk_basx_4	21.8	1550	2	SW	68	PL	32					100	0	0.85	0.95
6111	EM_SBSdk_pi_1	18.1	1600	2	PL	76	SW	24					100	0	0.80	0.95
6112	EM_SBSdk_pi_2	20.0	1500	2	PL	71	SW	29					100	0	0.80	0.95
6113	EM_SBSdk_pi_3	21.3	1600	2	PL	76	SW	24					100	0	0.80	0.95
6114	EM_SBSmc2_basx_1	16.7	1700	2, 3 ingress	SW	46	PL	25	BL	22	FD	7	80	20	0.85	0.95
6115	EM_SBSmc2_basx_2	19.0	1550	2, 3 ingress	SW	59	PL	31	BL	10			90	10	0.85	0.95
6116	EM_SBSmc2_basx_3	21.4	1650	2	SW	73	PL	25	BL	2			100	0	0.85	0.95
6117	EM_SBSmc2_pi_1	16.6	1500	2, 3 ingress	PL	75	SW	20	BL	5			95	5	0.80	0.95
6118	EM_SBSmc2_pi_2	18.4	1600	2, 3 ingress	PL	63	SW	32	BL	5			95	5	0.80	0.95
6119	EM_SBSmc2_pi_3	20.9	1600	2, 3 ingress	PL	67	SW	28	BL	5			95	5	0.80	0.95

No genetic gain

Table 39: Regeneration assumptions for future managed stands

AU	Name	SI	Init Density	Regen Delay (yrs)	sp1	%	sp2	%	sp3	%	Regen Method	OAF1	OAF2
6001	FM_ESSF_ba_1	15.9	1400	2	Sx	50	Pl	50			P	0.8	0.95
6002	FM_ESSF_ba_2	16.7	1400	2	Sx	80	Pl	20			P	0.85	0.95
6003	FM_ESSF_ba_3	18.7	1400	2	Sx	75	Pl	20	Bl	5	P	0.85	0.95
6004	FM_ESSF_pi_1	16.4	1400	2	Sx	50	Pl	50			P	0.8	0.95
6005	FM_ESSF_pi_2	17.4	1400	2	Sx	60	Pl	40			P	0.85	0.95
6006	FM_ESSF_sx_1	15.2	1400	2	Pl	60	Sx	30	Bl	10	P	0.8	0.95
6007	FM_ESSF_sx_2	16.0	1400	2	Sx	60	Pl	40			P	0.85	0.95
6008	FM_ESSF_sx_3	18.8	1400	2	Sx	60	Pl	40			P	0.85	0.95
6009	FM_ESSF_sx_4	19.1	1400	2	Sx	50	Pl	50			P	0.8	0.95
6010	FM_SBSdk_basx_1	16.5	1400	2	Pl	60	Sx	30	Bl	10	P	0.8	0.95
6011	FM_SBSdk_basx_2	16.9	1400	2	Sx	60	Pl	40			P	0.85	0.95
6012	FM_SBSdk_basx_3	18.5	1400	2	Sx	60	Pl	40			P	0.85	0.95
6013	FM_SBSdk_basx_4	19.4	1400	2	Sx	50	Pl	50			P	0.8	0.95
6014	FM_SBSdk_pi_1	16.5	1400	2	Pl	50	Sx	50			P	0.8	0.95
6015	FM_SBSdk_pi_2	17.9	1400	2	Sx	50	Pl	50			P	0.8	0.95
6016	FM_SBSdk_pi_3	18.2	1400	2	Sx	50	Pl	50			P	0.8	0.95
6017	FM_SBSmc2_basx_1	13.3	1400	2	Pl	60	Sx	30	Bl	10	P	0.8	0.95
6018	FM_SBSmc2_basx_2	18.3	1400	2	Sx	60	Pl	40			P	0.85	0.95
6019	FM_SBSmc2_basx_3	18.9	1400	2	Sx	60	Pl	40			P	0.85	0.95
6020	FM_SBSmc2_basx_4	19.2	1400	2	Sx	50	Pl	50			P	0.8	0.95
6021	FM_SBSmc2_pi_1	18.6	1400	2	Sx	60	Pl	40			P	0.85	0.95
6022	FM_SBSmc2_pi_2	18.9	1400	2	Sx	60	Pl	40			P	0.85	0.95
6023	FM_SBSmc2_pi_3	19.1	1400	2	Sx	50	Pl	50			P	0.8	0.95

Genetic gain for SW = 12.65
Genetic gain for PL = 4.24

4.6.4 Non-Satisfactorily Restocked Areas (NSR)

Recently harvested areas are classified as non-satisfactorily restocked (NSR) until they have been regenerated and surveyed. These areas are called current NSR and are included in the THLB. According to the Nadina Forest District staff, there is no backlog NSR in the Morice TSA. The past backlog areas have been either successfully regenerated or reclassified though surveys.

4.6.5 Fertilization

Approximately 3,000 hectares have been fertilized since 2007.

4.6.6 Wildfire Areas

The district staff provided FESL with shape files of candidate rehabilitation areas within past wildfire areas. These areas will be left to regenerate naturally with a 15 year regeneration lag.

5 Silviculture Strategies for Exploration

The following potential strategies were discussed at the initial Morice TSA silviculture strategy work shop:

1. Target dead pine and other species in harvest operations;
2. Rehabilitate unsalvaged pine stands;
3. Utilize secondary structure;
4. Fertilization of spruce, repeat regimes, older stands;
5. Fertilization of pine, criteria vs. potential diseases;
6. Fertilization of balsam, mixed with spruce, balsam secondary structure
7. Monitoring strategy
8. Partial harvesting

The final strategies will be decided upon in the second Morice TSA silviculture strategy work shop on July 3, 2013.

6 References

Coates, K.D. and Sachs, D.L., 2012. Current State of Knowledge Regarding Secondary Structure in Mountain Pine Beetle Impacted Landscapes. Report, MPB Impacted Stands Assessment Project, January 2012.

Ministry of Agriculture and Lands, Integrated Land Management Bureau, 2007. Morice Land and Resource Management Plan.

Ministry of Agriculture and Lands, 2010. Land Use Objectives, Morice Land and Resource Management Plan Area, Draft Ministerial Order.

Ministry of Environment, 2009. Order – Ungulate Winter Range #U-7-003, Mountain Caribou – Upper Fraser, Hart Ranges, and Mount Robson Planning Units.

Ministry of Forests, Lands, and Natural Resource Operations, 2011. Morice Timber Supply Area, Wildlife and Biodiversity Timber Supply Analysis Data Package.

Ministry of Forests, Lands, and Natural Resource Operations, 2012a. Order – Mountain Goat Ungulate Winter Range #U-6-003, Revised Draft

Ministry of Forests, Lands, and Natural Resource Operations, 2012b. Order – Wildlife Habitat Area #6-333, Draft.

Ministry of Forests, Timber Supply Branch, 2002. Timber Supply Review, Morice Timber Supply Area Analysis Report.

Ministry of Forests, Timber Supply Branch, 2002. Morice Timber Supply Area: Rationale for Allowable Annual Cut (AAC) Determination.

Ministry of Forests, Forest Analysis Branch, 2003. Modelling Options for Disturbance of Areas Outside of the Timber Harvesting Land Base, Draft Working Paper.

Thrower, J., 2013, Understory Yield Tables for MPB-Impacted Stands in the Lakes TSA: Application in the Type IV Silviculture Analysis., File Report prepared for Forsite Consultants Ltd.

Ministry of Forests and Range, 2007. Urgent Timber Supply Review for the Morice Timber Supply Area, Public Discussion Paper.

Ministry of Forests and Range, 2008. Morice Supply Area: Rationale for Allowable Annual Cut (AAC) Determination.

Ministry of Forests, Lands, and Natural Resource Operations, 2012. Mid-Term Timber Supply, Morice Timber Supply Area. Mid-Term Timber Supply Project.

Ministry of Forests, Lands, and Natural Resource Operations, 2012. Species Monitoring Report, Morice TSA, Summary Charts and Graphs.

Ministry of Agriculture and Lands, Integrated Land Management Bureau, February 2007. Morice Land and Resource Management Plan.

Canfor 2012 Morice Defined Forest Area, Sustainable Forest Management Plan.

Tesera Systems Inc.,2009. Morice and Lakes Timber Supply Area, Innovative Forest Practices Agreement, Morice TSA Type2 Sivilculture Investment Strategy Information Package.

Tesera Systems Inc.,2009. Morice and Lakes Timber Supply Area, Innovative Forest Practices Agreement, Draft Morice Type II Analysis and Preferred Silviculture Strategy Report.