Eniyud Community Forest

Timber Supply Analysis

December 2016

Project [1363-1]

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Acknowledgements

Forsite would like to thank Gord Chipman, RPF (Eniyud Community Forest Manager) for his valuable input and local expertise in completing this analysis.

Declaration

I, Mark Perdue, RPF# 4008, declare that the timber supply review has meet the requirements of section 6.02 (a)-(f) of the community forest agreement document.

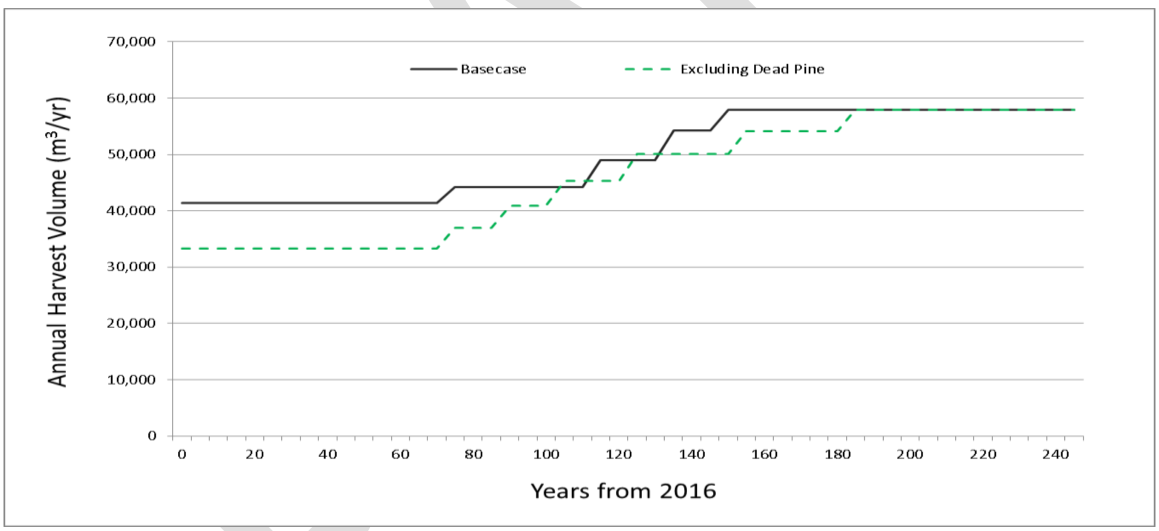
Signed: ______________________________ Date: November 28, 2016

Executive Summary

The Eniyud Community Forest (ECF or Community Forest) is located near the communities of Redstone/Puntzi and Tatla Lake. The ECF covers an area of 114,571 ha within the Williams Lake Timber Supply Area (TSA). The ECF was established in 2008 with an AAC of 40,000 m^3/yr. This document outlines the modeling assumptions, methodologies and results of timber supply analysis work completed to support the setting of a new allowable annual cut for ECF's Management Plan #2.

The crown forested land base (CFLB) is 84,916 ha (74% of the ECF) and the long-term timber harvesting land base is 41,234 ha (35% of ECF). Large portions of the ECF land base are classified as non-forest (25,385 ha), or have low productivity (42,402 ha). Similar to the Williams Lake TSA, the ECF has been severely affected by the Mountain Pine Beetle (MPB) epidemic. Based on VRI data, more than seventy percent of stands within the THLB have been impacted by MPB (over 40% of stands are at least 30% dead) leaving 19% of the volume on the THLB considered dead.

The projected harvest forecasts for the ECF seek to balance management objectives for the land base with changing forest conditions. In the Base Case analysis, short-term harvest levels were 41,400 m^3/yr. MPB stands were prioritized resulting in 86% of the harvest in the first ten years coming from MPB impacted stands. Sensitivity analysis indicates that completely removing dead volume from the forest inventory reduces short-term harvest levels to 33,300 m^3/yr. This indicates that timber supply on the ECF is highly sensitive to the viability of harvesting dead pine volume.



ECF staff have indicated that opportunities for salvaging dead pine is very limited due to challenging economics and low volumes per hectare. Harvest levels should reflect the uncertainty of pine mortality projections and merchantability. One option may be to allocate specific harvest levels for low volume and heavily impacted pine leading stands (for example low volume MDWR stands, or pine leading stand with high levels of mortality), and for relatively higher volume stands. Such a partition will provide continued opportunities to salvage dead pine where economically feasible, and establish a sustainable level of harvest for more productive stands.

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1 Introduction

The Eniyud Community Forest encompasses approximately 114,571 hectares and is located near the communities of Redstone/Puntzi Lakeand Tatla Lake, in central BC. The Community Forest is within the Williams Lake Timber Supply Area, and currently has an Allowable Annual Cut (AAC) of 40,000m^3/yr.

Forest conditions and management direction in the ECF has changed since 2008; the Cariboo Chilcotin Land Use Plan (CCLUP) has been implemented, the provincial inventory has been updated to reflect new estimates of MPB mortality, and a provincial productivity database is now available to provide improved estimates of site productivity in regenerated stands. In addition to these changes, there are concerns regarding the shelf-life of MPB attacked stands, and how changes in these stands will affect timber supply.

This analysis will adopt many of the management and modelling assumptions used in the 2014 Williams Lake TSR. The TSR protocol will be used to classify the timber harvesting land base (THLB), define forest inventory, growth and yield characteristics, forest management standards, and characterize the impacts of timber inventory losses due to MPB within the area. This Information Package addresses topics identified in the Management Plan Template: Companion Document which are summarized in Table 1.

This document outlines the land base, growth and yield, management and modelling assumptions, and reports on the results of the timber supply analysis work completed in support of the new AAC and ECF's Management Plan #2.

1.1 Location of Eniyud Community Forest

The ECF is located on the Chilcotin Plateau near the western extent of the Williams Lake Timber Supply Area (TSA). The ECF is comprised of two blocks, the larger (106,294 ha) block surrounds the community of Tatla Lake, the smaller (8,277 ha) block is located near Puntzi Lake. Figure 1 illustrates the location of the ECF.

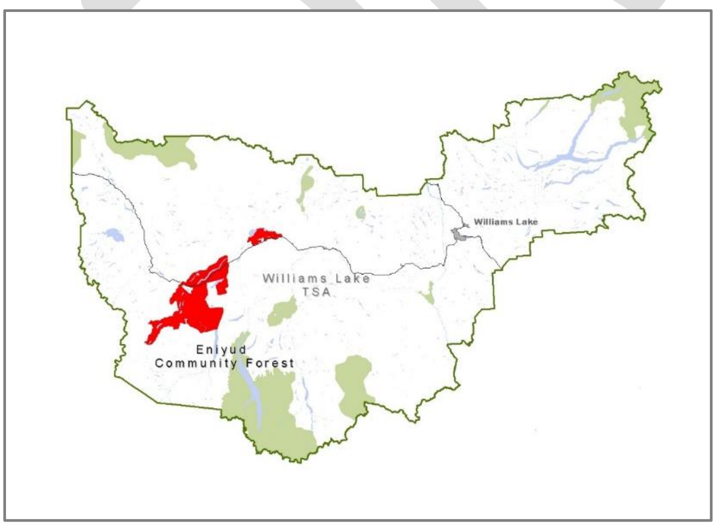


Figure 1. Eniyud Community Forest within the Williams Lake TSA

2 Data Sources

Several datasets covering administrative, inventory, and management guidance information were included in the analysis (Table 1). These datasets were processed to develop a resultant dataset that was used to build the forest estate model. The resultant information is stored within an ArcGIS geodatabase and is available on request.

Table 1. Data Sources

Description	Source
Rivers	WHSE_BASEMAPPING.FWA_RIVERS_POLY
Lakes	WHSE_BASEMAPPING.FWA_LAKES_POLY
Wetlands	WHSE_BASEMAPPING.FWA_WETLANDS_POLY
Streams	WHSE_BASEMAPPING.FWA_STREAM_NETWORKS_SP
Roads	WHSE_BASEMAPPING.DRA_DIGITAL_ROAD_ATLAS_LINE_SP
Community Forest Boundary	WHSE_FOREST_TENURE.FTEN_MANAGED_LICENCE_POLY_SVW
Provincial Site Productivity Layer	Site_Prod_with_All_PEM_TEM_v3_20130630
Park, Ecological Reserves, Protected Areas	WHSE_TANTALIS.TA_PARK_ECORES_PA_SVW
Vegetation Resources Inventory (VRI)	WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY
Forest Depletions Disturbance	WHSE_FOREST_VEGETATION.RSLT_OPENING_SVW
Forest Depletions Forest Cover	WHSE_FOREST_VEGETATION.RSLT_FOREST_COVER_INV_SVW
Wildfires (historic to 2015)	WHSE_LAND_AND_NATURAL_RESOURCE .PROT_HISTORICAL_FIRE_POLYS_SP
Landscape Units	WHSE_LAND_USE_PLANNING.RMP_LANDSCAPE_UNIT_SVW
Legal Planning Objectives	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW
Old Growth Management Areas	WHSE_LAND_USE_PLANNING.RMP_OGMA_NON_LEGAL_CURRENT_SVW
Lake Management Classes	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW
Community Areas of Special Concern	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW
Future Grassland	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW
Visual Landscape Inventory	WHSE_FOREST_VEGETATION.REC_VISUAL_LANDSCAPE_INVENTORY
Critical Fish Habitat	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW
Recreation Polygons	WHSE_FOREST_TENURE.FTEN_RECREATION_POLY_SVW
Trail Buffers	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW
Biogeoclimatic Ecosystem Classification (BEC)	FOREST_VEGETATION_BECv9_OCT2015
Forest Tenure Ownership	FOREST_VEGETATION_F_OWN_MAR2016
Ungulate Winter Ranges - Legal	WILDLIFE_MANAGEMENT_UNGULATE_WINTER_RANGE_JUN2016
Wildlife Habitat Area - Legal	WHSE_WILDLIFE_MANAGEMENT_WCP_WILDLIFE_HABITAT_AREA_P
Permanent Sample Plots	WHSE_FOREST_VEGETATION.GRY_PSP_STATUS_ACTIVE
Wildfire (2015)	WHSE_LAND_AND_NATURAL_RESOURCE .PROT_CURRENT_FIRE_POLYS_SP
Wildlife (pre-2015)	WHSE_LAND_AND_NATURAL_RESOURCE .PROT_HISTORICAL_FIRE_POLYS_SP
Operability (Slope Classes)	Forsite Consultant Ltd.
Road Buffers	Forsite Consultant Ltd.
Riparian Buffers	Forsite Consultant Ltd.

2.1 Forest Inventory

The ECF TSA will use the most recent version of the Vegetation Resources Inventory (VRI). The VRI used in this analysis was projected to January 1, 2015 and updated to January 1, 2016 in the modelling database. The VRI data includes the most recent version of MPB mortality ratios which will be used to forecast MPB shelf-life and losses.

The VRI in this analysis has not been statistically adjusted, although adjustments have been made to the VDYP and TIPSY yields to reflect the impact of MPB mortality and shelf-life. Details on those adjustments are further described in Sections 2.1.1 and 5.7.

2.1.1 Adjustments for Harvesting and Natural Disturbance

The VRI forest inventory data set was updated for disturbances resulting from recent harvesting, fire occurrences and the mountain pine beetle infestation.

Recent harvesting disturbances were captured using the provincial RESULTS (Reporting Silviculture Updates and Land Tracking System). Similarly, the provincial historic and current fire history datasets were used to update for recent fire occurrences. The specific stand attribute values used in the updating process were derived from the RESULTS records, or alternatively estimated from the pre-disturbance stand conditions in the VRI where necessary. It was assumed that stand regeneration occurred at the time of disturbance, and were given an age of 0 at that date.

The BC Provincial Scale Mountain Pine Beetle Model (BCMPBv9) was developed by FAIB to assess the impacts of mountain pine beetle outbreak and management interactions across the province. The model uses forest cover data, the Provincial Aerial Overview Survey of Forest Health and information from a stand-level mountain pine beetle (MPB) population model to estimate the extent of pine mortality, and to project possible courses of infestation into the future. The BCMPB results have been incorporated into the VRI so that live and dead timber volumes within that dataset include these estimates of mortality to the projection year. In projecting timber supply potential, the future impacts of MPB must also be considered with regard to the changes in growth and yield as well as potential salvage opportunities. Specific information about how future impacts of MPB were incorporated into this analysis is detailed in the modelling management assumptions, Section 5.7.

2.1.2 Provincial Site Productivity Layer

The Provincial site productivity layer was used to classify the site productivity for regenerated stands. Traditional methods of estimating site productivity, such as remote sensing, often underestimate site potential in mature stands, and the site productivity layer was developed to provide a consistent, improved source of information for young stands.

The productivity layer provides point estimates of site index for each species based on data that correlates site index with the Biogeoclimatic Ecological Classification (BGC) system. BEC mapping in the Williams Lake TSA is based on Predictive Ecosystem Mapping (PEM).

Point estimates from the provincial productivity layer were aggregated into similar site productivity polygons using the Thiessen methodology, which is available within the ArcGIS application. The site productivity polygons were then intersected with forest inventory polygons and an area weighted average site index value was calculated for the leading species reported in the VRI.

3 Land Base Definition

3.1 Land Base Summary

The ECF covers 114,571 ha, of which approximately 7,351 ha is non-Crown land and 25,385 ha is non-forested land (Table 2). The remaining area, approximately 84,916 ha, is the Crown Forest Land Base (CFLB) that can contribute toward meeting non-timber and management objectives (i.e., biodiversity). A subset of the CFLB is appropriate for timber harvesting and is referred to as the timber harvesting land base (THLB). In the ECF, the current effective THLB is 42,468 ha (50% of the CFLB, 37% of Total Area) and the future THLB is calculated to be 41,234 ha (49% of the CFLB, 36% of the Total Area). The difference between CFLB and THLB is called non-THLB (NTHLB). Table 2 provides additional detail and the subsections below a description of each line item.

Table 2. Land Base Definition

	Total Area	Net Area
TOTAL AREA		***114,571***
Non-Crown Land	7,351	7,351
Non-Forest Land	25,385	22,304
TOTAL PRODUCTIVE CROWN FOREST LAND		***84,916***
Non-Commercial Deciduous Forest Types	8,137	7,091
Low Productivity Sites	42,402	16,908
Critical Fish Habitat	826	336
Riparian Reserve	8,838	934
Old Growth Management Areas	9,580	5,106
Community Areas of Special Concern	19,635	4,667
Steep Slopes - Inoperable	13,167	3,351
Visual Quality Objective (LMZ-A, VQO-P)	313	0
Permanent Sample Plot	44	14
Riparian Management Zones	7,937	743
Recreational Trail Buffers	2,753	587
SPATIALLY EXCLUDED LAND BASE	-	*45,179*
Wildlife Tree Retention	45,179	2,711
CURRENT TIMBER HARVEST LAND BASE		***42,468***
Future Grassland Area	3,276	130
Future Road Area	45,179	1,104
FUTURE TIMBER HARVEST LAND BASE		***41,234***

Figure 2 illustrates the Timber Harvest Land Base (THLB), Non-THLB (NTHLB) and Non-Crown Forest land Lase (NCFLB) of the ECF.

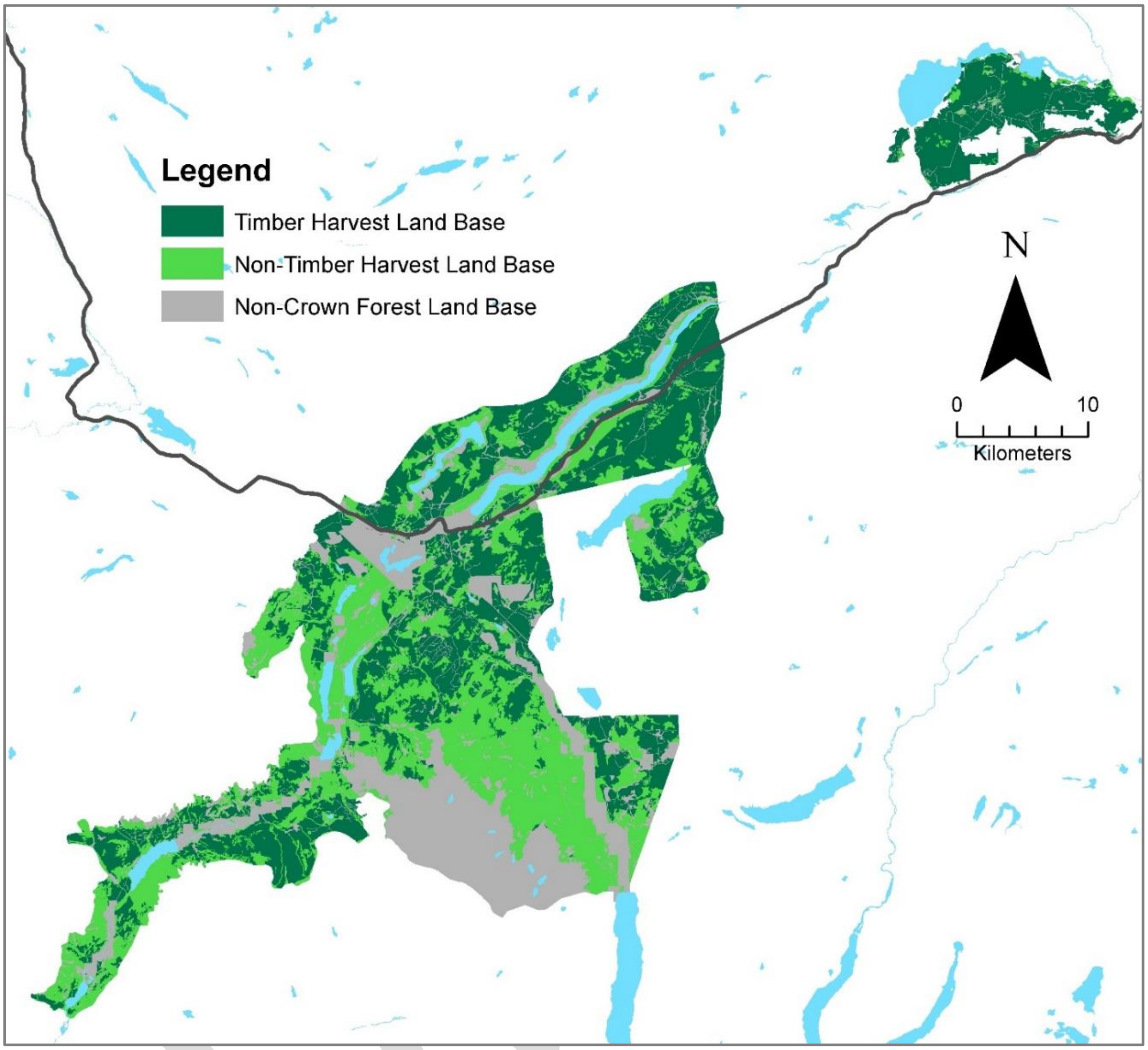


Figure 2. Land Base Definition Map

3.1 Non-Crown Land

Non-Crown land is identified as private land, Indian reserves, woodlots, and controlled recreation areas. The Provincial ownership coverage was used to define Crown Forest based on ownership and schedule as per the 2014 TSR. These were identified using the ownership layer where OWN = 40 and SCHEDULE = N.

There are two Woodlot Licences within the boundaries of the ECF, the areas of each of these licences has been removed from the ECF for the purpose of this analysis. There is approximately 7,351 ha of 'non-Crown' lands within the ECF.

Parks, protected areas or ecological reserves were removed from the CFLB. This includes 1,588 ha within the Patterson Lake Park.

3.2 Non-Forest

Using the 2014 TSR protocol the BCLCS classification was used to delineate non-vegetated and non-treed (e.g., lakes, swamps, rock, alpine, brush, etc.). The non-forest areas were identified using the Vegetation Resource Inventory (VRI) layer, non-forest layers (lakes, wetlands, roads), and the harvest history from the VRI and Blocks layers. Areas were identified using the following layers and assumptions:

- Lakes layer
- Wetlands layer
- Road right-of ways, landings, and powerlines
- Unclassified areas: BC Land Classification Scheme (BCLCS_LEVEL_1 ="U")
- Non Vegetated: BC Land Classification Scheme (BCLCS_LEVEL_1 = "N" and BCLCS_LEVEL_2 <> "T") and no harvest history in VRI and Blocks layers
- Vegetated Non Tree: BC Land Classification Scheme (BCLCS_LEVEL_1 = "V" and BCLCS_LEVEL_2 <> "T") and no harvest history in VRI and Blocks layers

Using the 2014 TSR protocol the BCLCS classification was used to delineate non-vegetated and non-treed (e.g., lakes, swamps, rock, alpine, brush, etc.). Non-forest land was removed from the CFLB. There are approximately 25,385 (including road) ha of non-forest land, the net reduction is 22,304 ha.

3.3 Roads and Landings

Existing roads from the provincial digital road atlas were used to generate road buffers. Tenured roads were assigned a 25 m width while non-tenured were assigned a 15 m width. There is approximately 1,641 ha of roads within the ECF, all roads were removed from the CFLB. No reductions were applied for existing landings.

3.4 Inoperable Areas

Stands with average slopes of 40% or greater were considered inoperable and removed from the THLB. Within each forest cover polygon, digital elevation model (DEM) points was used to find an average slope. Within the ECF there is approximately 13,167 ha with average slopes greater than 40% which resulted in a net reduction for steep slopes of 3,351 ha.

3.5 Low Productivity Stands

Low productivity stands are forested areas that have low tree growth potential. These stands are identified spatially using site index values (i.e., top height in metres at age 50) by leading species in the VRI layer. Stands with a site index of 7m or less without a harvest history were removed from the THLB. There is approximately 42,402 ha of low productivity sites leading to a net reduction of 16,908 ha

3.6 Deciduous Forest Types

VRI polygons with deciduous leading species and without a harvest history were removed from the THLB but remain in the CFLB as they may contribute to other non-timber management objectives. Additionally the deciduous component of non-deciduous stands was removed from all yield tables. There is approximately 8,137 ha of deciduous leading stands resulting in a net reduction of 7,091 ha.

3.7 Problem Forest Types / Non-Commercial

Once low productivity sites were removed, low volume was not used as a criteria for removing stands from the THLB. Each stand must meet the minimum harvest criteria described below before being harvested. Some stands may not meet the MHA within the planning horizon.

3.8 Wildlife Habitat Areas

There are no WHA areas within the ECF.

3.9 Recreation Sites

Designated recreational trail buffers from the CCLUP dataset were incorporated into the modelling database. Within the trail buffer polygon an 85% retention level was used. In the modelling environment this retention is applied as stand level retention. To complete the net down table an 85% percent area reduction was applied to stands within the buffer. There are approximately 2,753 ha of trail buffers and the net reduction was 587 ha.

3.10 Community Areas of Special Concern

The CCLUP designated Community Areas of Special Concern (CASC) and these areas (19,635 ha) were removed from the THLB for a net reduction of 4,667 ha.

3.11 Critical Fish Habitat

The CCLUP designated approximately 826 ha of Critical Fish Habitat and these areas have been removed from the THLB for a net reduction of 336 ha.

3.12 Future Grassland Areas

The CCLUP dataset identified 3,276 ha within the entire ECF land base to be managed for future grassland restoration. Future grassland areas that are currently forested will be harvested once and then deferred from any future harvest.

In the modelling environment, future grassland areas are retained in the THLB but the yield curves for future stands have been reduced by 0.3% (ratio of net grassland area with the THLB, 141 ha / 42,468 ha).

3.13 Riparian Reserves and Management Zones

The riparian netdown assumptions follow those used in the Williams Lake TSA data package. A fish stream inventory was not available for the Community Forest, so the Freshwater Atlas database was used to classify lakes, rivers, streams and wetlands. Riparian reserve zones and management zones were then then applied to the classified streams based on the criteria outlined in Table 3.

Table 3. Riparian Classification and Buffer Widths

Waterbody Class	Definition	Buffer Widths (m)	
		RRZ	RMZ
Large Stream	Where FWA stream centerline overlaps an FWA “two line” river. Buffer on “two line” river. Or Stream Order ≥ 6.	50	20
Medium Stream	For remaining FWA line work where the FWA feature code of GA24850000 or GA24850140 (definite, “indefinite) or Stream Order 3, 4, 5.	30	20
Small Stream	For remaining FWA line work where the FWA feature code of GA24850150 (intermittent) or Stream Orders 1 and 2.	0	30
Large Lake	>=5 ha	15	0
Medium Lake	>= 1 ha and <5 ha	10	20
Small Lake	<1 ha	0	30
Large Wetland	>5 ha	10	40
Medium Wetland	1-5 ha	10	20
Small Wetland	< 1 ha	10	40

Riparian Reserves Zones are removed from the THLB. Two levels of reduction have been applied to Riparian Management Zones, a 50% reduction applied to small wetland and lake RMAs and a 25% reduction applied to all other management buffers.

There are approximately 8,838 ha of riparian reserve, the net reduction for RRZ was 934 ha. There are 6,901 ha of RMA-25% and 1,036 ha of RMA-50% within the ECF. The net reduction to the THLB was 743 ha.

3.14 Old Growth Management Areas

Established Permanent Old Growth Management Areas were removed from the THLB. Established Transitional OGMAs are included in the THLB and within the modelling environment these areas will be deferred from harvest until 2030. There are 9,580 ha of Permanent OGMAs, 5,106 ha of Transitional OGMAs and no rotating OGMAs within the ECF.

3.15 Wildlife Tree Reserve Areas

Wildlife tree reserves areas (WTRA) are retention areas within a cut-block. The Chilcotin Sustainable Resource Management Plan (CSRMP) sets out stand level biodiversity requirements as reported in Table 4. These retention levels were used to determine an overall average level of retention of 6%, which was then applied against the THLB area after all other reductions. In the FPS model WTPs will be applied as a stand level constraint.

Additionally, because there is significant overlap between WTP retention and other netdowns (i.e., riparian, inoperable, steep slopes, recreation) it is expected that the net THLB impact of WTP retention will be less than 6% used in this analysis. To address this issue a sensitivity analysis will be completed using a 3% WTP retention level.

Table 4. Wildlife Tree Retention Area Percentage Requirements

Landscape Unit	BEC Subzone	THLB Area (ha)	WTRA Target Retention (%)
Bidwell/Lava	ESSF xv	10.0	7
	MS xv	14.7	6
Crazy Creek	ESSF xv	105.3	NA
	IDF dw	721.7	4
	MS dc	2.5	5
Klinaklini	MS xv	15.0	NA
Middle Lake	ESSF xv	65.6	NA
	IDF dw	3,827.2	7
	MS dc	534.4	5
	MS xv	7.7	5
Puntzi	IDF dk	4,119.7	6
Pyper	IDF dk	2,440.5	6
	IDF xm	22.4	6
Sisters	IDF dk	641.8	8
	IDF xm	17.2	8
Tatla/Little Eagle	ESSF xv	30.9	7
	IDF dk	2,865.7	5
	MS xv	1,946.1	6
	SBPS xc	17,449.6	7
Upper Tatlayoko	ESSF xv	192.6	4
	IDF dk	4,468.4	5
	IDF dw	83.4	3
	MS dc	0.6	5
	MS xv	1,174.3	6
	SBPS xc	169.5	6
Westbranch	ESSF xv	854.2	3
	IDF dk	2,328.3	5
	IDF dw	1,222.1	4
	MS dc	755.1	3
	MS xv	772.6	5
	SBPS xc	1.2	4
Wtd Average			6.0%

3.16 Future Roads and Landings

The Williams Lake TSR reported the average amount of on-block permanent access was 2.4%. A 2.4% reduction was applied to all future managed stand yield curves in this analysis, but to show this impact on the landbase in the netdown table, 2.4% of all THLB unmanaged stands (e.g. >73 years old) was assumed. Based on this ratio, approximately 1,104 ha of forest is expected to become road in the future.

Road impacts on existing managed stands were addressed through spatial netdowns described in Section 3.3.

4 Current Forest Conditions

The current age class distribution for the ECF indicates a wide range of ages on the land base. A large portion of the land base (78%) is mature, with many stands (25%) older than 240 years.

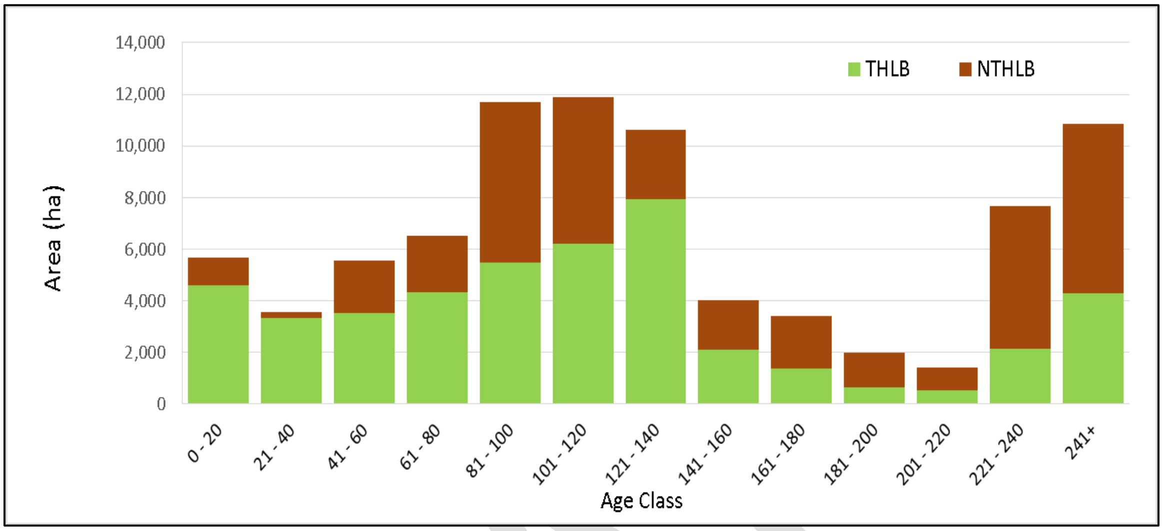


Figure 3. Current Age Class Distribution

Most of the area within the ECF currently consists largely of lodgepole pine and Douglas-fir leading stands (Figure 4), with smaller proportions of yellow pine, and at higher elevations spruce and balsam.

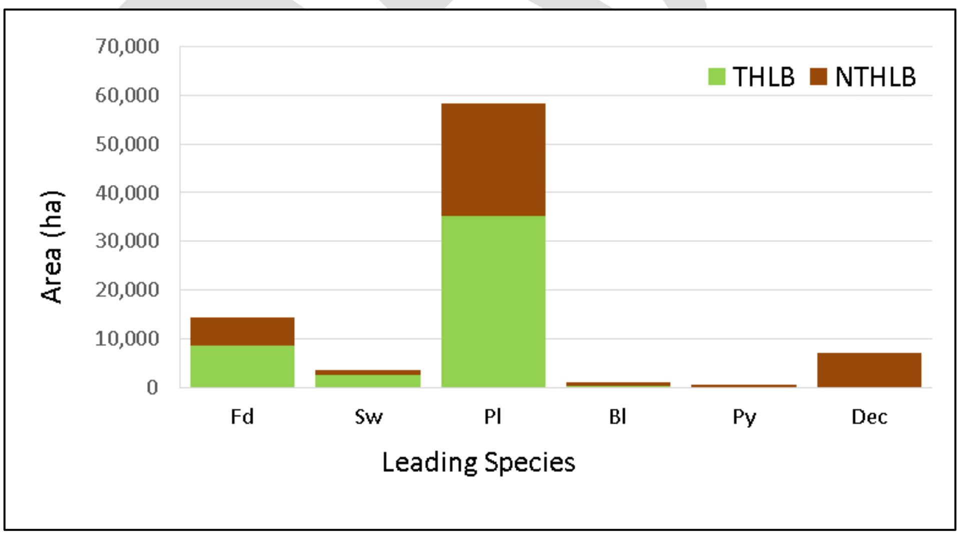


Figure 4. Current Area Distribution by Leading Species

The area-weighted average site productivity on the THLB is 12.3 m (Figure 5). This includes adjustments for managed stands using the province's managed stand site productivity layer.

Figure 5. Site Index Distribution within the ECF

Most (69%) stands within the ECF have been impacted by MPB, within the THLB 71% of stands have been impacted. Figure 6 is a frequency distribution of stands by the level of stand disturbance.

Figure 6. MPB Dead Percentage of Existing Natural

5 Modelling Assumptions

5.1 Analysis Units

Analysis units (AU) represent groups of stands with common characteristics such as species composition, site productivity, BEC zone, management regime, etc. In the ECF, the AU definitions were based on the regeneration era, leading species, site index and stand age at time of disturbance (Appendix 1). There are five broad groups of AU's:

1. Existing *Natural* stands (green highlight) – established prior to 1965, no road reduction, no genetic gains
2. MDWR *Selection* harvest stands (brown) – FD leading stands within the IDFdk, IDFdw, or MDWR, established prior to 1965, no road reduction, no genetic gains
3. Existing *Managed* stands (orange) – established between 1965 and 1987, no road reduction, no genetic gains
4. Existing managed stands with *Genetic* stock (blue) – established since 1988, no road reduction, genetic gains
5. *Future* managed stands with genetic stock purple) – road reduction with genetic gains.

To accommodate management objectives and yield projections MPB impacted (*Disturbed*) mature stands were further classified according to their age at the time of attack. Details regarding this classification are provided in Section 5.8 below.

5.2 Minimum Harvest Ages

For even-age silviculture regimes two criteria were used to define the minimum harvest ages (MHA), these include a minimum age and a minimum volume (m^3/ha).

- Pl leading stands: must be >=60 yrs old and have >= 80 m^3/ha
- Other stands: must be >=80 yrs old and have >= 120 m^3/ha
- MPB disturbed stands: eligible at base year disturbance

For group-selection silviculture regimes, the minimum harvest age matched the assumptions used in Williams Lake TSR.

5.3 Growth and Yield Models

The yield curves for natural AUs were generated using the Variable Density Yield Projection model (VDYP v7). For each forested polygon in the VRI layer with no harvest history, a yield curve was generated and an area weighted average curve was produced for each AU. The yield curves for the managed AUs were generated using the batch version of the Table Interpolation for Stand Yields model (TIPSY v4.3).

Table 5 reports the species composition, site index values, and planting densities used to build the yield curves for managed stands. The operational adjustment factors applied in the TIPSY model were 0.85 for OAF1 and 0.95 for OAF2.

Table 5. Regeneration Assumptions for Managed Stands using TIPSY

Stand Group	Species	Percent Composition	Site Index	Planting Density
MAN34_PL_POOR	PL/FD/SX	97/2/1	11	900
MAN34_PL_MED	PL/FD/SX	97/2/1	16	900
MAN34_PL_GOOD	PL/SX/FD	74/13/13	18	940
MAN34_FD_MED/GOOD	PL/FD/SX	60/33/7	17	882
MAN34_SW_MED	SX/PL/FD	44/30/26	16	1082
MAN34_MPB_PL_POOR	PL/FD/SX	97/2/1	9	900
MAN34_MPB_PL_MED	PL/FD/SX	97/2/1	16	900
MAN34_MPB_PL_GOOD	PL/FD/SX	97/2/1	16	900
MAN00_MPB_PL_POOR	PL/FD/SX	97/2/1	9	900
MAN00_MPB_PL_MED	PL/FD/SX	97/2/1	16	900
MAN00_MPB_PL_GOOD	PL/SX/FD	74/13/13	18	940
MAN17_FD_POOR	PL/FD/SX	60/33/7	9	882
MAN17_FD_MED/GOOD	PL/FD/SX	60/33/7	19	882
MAN17_SW_POOR	SX/PL/FD	44/30/26	12	1082
MAN17_SW_MED	SX/PL/FD	44/30/26	16	1082
MAN17_SW_GOOD	SX/PL/FD	52/29/19	18	1437
GEN_PL_POOR	PL/FD/SX	97/2/1	10	1800
GEN_PL_MED	PL/FD/SX	97/2/1	16	1800
GEN_PL_GOOD	PL/SX/FD	74/13/13	19	1800
GEN_FD_POOR	PL/FD/SX	60/33/7	10	1800
GEN_FD_MED/GOOD	PL/FD/SX	60/33/7	15	1800
GEN_SW_POOR	SX/PL/FD	44/30/26	10	1800
GEN_SW_MED	SX/PL/FD	44/30/26	17	1800
GEN_SW_GOOD	SX/PL/FD	52/29/19	18	1800

5.4 Not Sufficiently Restocked

Based on the VRI there is a total of 2,198 ha of NSR within the ECF, this includes 1,761 ha of NSR within the THLB. Some NSR is due to natural disturbances (1,036 ha), and the remaining NSR area has a harvest history (1,162 ha). NSR stands with a harvest history were assigned an age of 0 years, NSR stands with a natural disturbance history were assigned an age of 0 years at the time of disturbance. This assumption is consistent with the TSR which assumed that all pre-1987 NSR area would be declared free-growing by 2015, and 70% of post-1987 NSR would be reforested within a 7-year regeneration window.

5.5 Regeneration Delay

For all managed stand yield curves, it was assumed there would be no delay in regeneration.

5.6 Genetic Gains

Broadly, BGC zone boundaries reflect managed stand regeneration regimes in the ECF. Stands in the ESSF and MS BGC zones are managed under a natural regeneration regime, while the IDF and SBPS BGC zones are managed under a planting regime (Gord Chipman, personal communication). The actual method of regeneration is relevant because of the use of genetically improved stock and the potential improvement of yields. To reflect the use of genetically improved stock a ratio of natural/planted regeneration was used to adjust to the genetic gains for each species outlined in the TSR. In the TSR the improved yields for genetically improved stock include: Fdi (1.7%), Pli (0.1%) and Sx (5.7%). These values were adjusted to reflect the relative use of planted stock within each stand type and BGC zone. Table 6 below reports the adjusted gains associated with genetically improved stock for each major stand group.

Table 6. Genetic Gains

Stand Group	Planted (%)	Douglas-fir	Lodgepole pine	Spruce
Pl-Poor	85	1.4	0.1	4.8
Pl-Med	86	1.5	0.1	4.9
Pl-High	68	1.2	0.1	3.9
Fdi-Poor	97	1.6	0.1	5.5
Fdi-Med/High	99	1.7	0.1	5.7
Sw-Poor	41	0.7	0	2.4
Sw-Med	65	1.1	0.1	3.7
Sw-High	99	1.7	0.1	5.6

5.7 Utilization Levels

For both natural and managed stands, and all commercial species, a minimum diameter at breast height (dbh) of 12.5 cm (15.0 cm diameter at stump height) and a minimum top diameter inside bark (dib) of 10 cm and maximum stump height (dsh) of 30 cm was assigned.

5.8 Mountain Pine Beetle

Yield curves developed for existing natural stands incorporate MPB mortality and shelf-life. Consistent with the 2014 TSR, shelf life is assumed to be 20 years. Stand disturbed by MPB were classified (10-year classes) according to their age at the time of attack. Disturbed stand yields incorporated the live and dead components of stand volumes for 20 years after which dead volume was excluded from stand yield. The 20-year shelf life period was initiated at the time of disturbance reported in the VRI dataset.

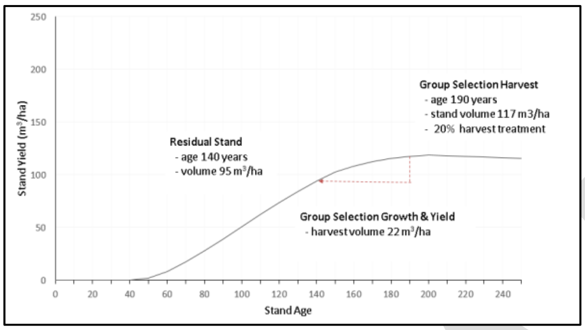
In young stands MPB mortality was considered non-merchantable. MPB mortality rates in young stands are consistent with the 2014 TSR, and the level of mortality assigned to these stands was based on stand age and the percentage of pine in the stand. These classification criteria are described in Table 5 above.

5.9 Silvicultural Systems

Within this analysis two silvicultural systems are applied:

1. Douglas-fir leading stand types in the IDFdk, IDFdw zones or within MDWR are managed under a group selection harvest where approximately 25% of the volume is removed every 45-50 years (Figure 7). The treatment ages and intensity were designed to capture the stand conditions, growth and timber volume flow characteristics of the Williams Lake TSR.
2. All other stand types used a clearcut (CC) harvest with reserves system.

SEL_FD_POOR



SEL_FD_MED/GOOD

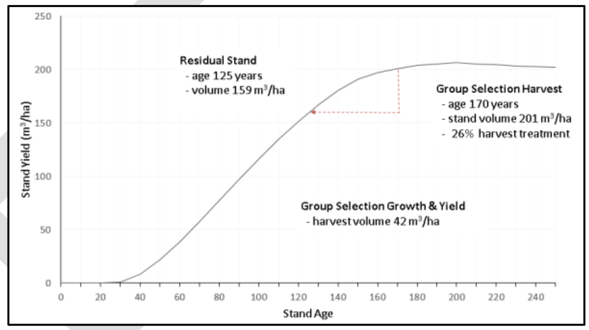


Figure 7. Partial Cut Silvicultural System Design

5.10 Natural Disturbances / Unsalvaged Losses

Non-recoverable losses (NRL) in the THB due to fire, windthrow, and insects (Douglas-fir beetle and Spruce bark beetle) were prorated from the Williams Lake TSA data package document (Table 7).

Table 7. Non-Recoverable Losses on THLB

Cause of Loss	TSA NRL (m^3/yr)	Factor (ECF THLB/TSA THLB)	ECF Prorated NRL (m^3/yr)
Fire	35,480	0.023208	823
Douglas-fir beetle	18,846	0.023208	437
Spruce beetle	31,000	0.023208	719
Western spruce budworm	55,543	0.023208	1,289
Wind	8,684	0.023208	202
Total	**149,553**		**3,471**

5.11 Integrated Resource Management

Integrated resources management refers to the management of non-timber values occurring on the land base. Detailed management guidance was taken from the Williams Lake TSR and the CCLUP. The following section describes how this management guidance is translated into modelling assumptions and constraints.

5.11.1 Landscape Level Biodiversity

The landscape biodiversity objectives will be achieved by reserving Permanent OGMAs from harvesting for the entire planning period, and by reserving Transitional OGMAs until 2030 (Figure 8).

Additionally, landscape level biodiversity targets for mature/old forest retention within the CFLB fir each landscape units, BEC zone, and natural disturbance type (NDT). Specific mature/old seral retention targets are provided in Appendix 3.

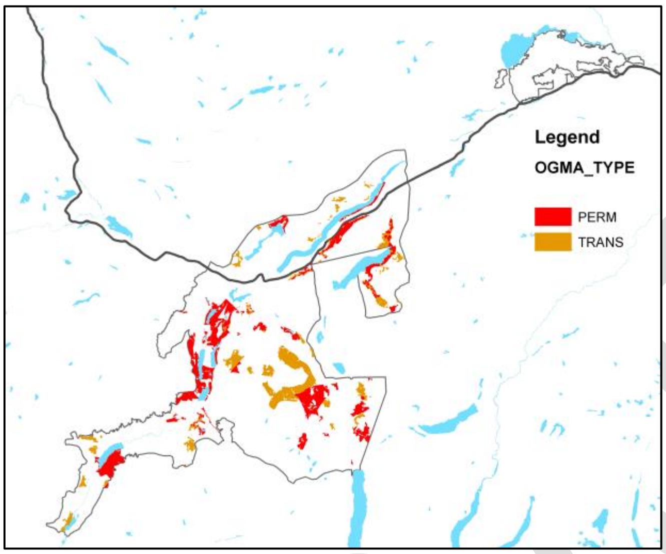


Figure 8. OGMA Locations within ECF

5.11.2 Stand Level Biodiversity

The stand level biodiversity is achieved by retaining a percentage of the harvestable block area. An area weighted stand retention (6%) was calculated and applied in the model as a stand level retention at the time of harvest.

5.11.3 Visual Quality

Modelling of visual quality objectives in the ECF analysis will include setting a maximum allowable disturbance limit for each Visual Landscape Inventory (VLI) polygon. Visual quality management areas and dsitrubance limits are shown in Figure 9. Lakeshore Management Units are modelling similar to VLI units based on allowable disturbance limits. The VQO classifications and their corresponding Lakeshore Management Class (LMC), and disturbance thresholds are provided in Table 8.

Lakeshore management units with overlapping VLI polygons were merged and managed as a single VLI-LMU polygon. Where visual quality objectives for the merged VLI-LMU polygons differed, the higher objective was assigned to the combined unit.

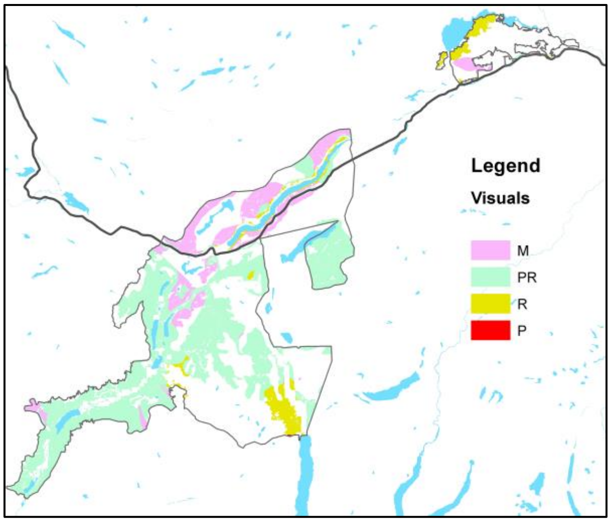


Figure 9. Visual quality objectives within ECF

Table 8 provides the definition for disturbed areas in terms of stand height and age. Age was used in the model.

Table 8. Maximum Alteration Allowed for Visually Sensitive Areas

VQO	LMC	Clearcut Disturbance (% max)	Partial Cut Disturbance (% max)	Disturbance Age (m/yr)
P	A	Removed from THLB		
R	B	10	20	6.0 (17)
PR	C	20	40	5.5 (15)
M	D	30	60	5.0 (13)
MM	E	50	100	5.0 (13)

5.11.4 Mule Deer Winter Range

Management guidelines for Mule Deer Winter Range (MDWR) areas are detailed in the Ungulate Winter Range (UWR) Order #U-5-002 (Figure 10). Stand level management is specific for the Transition/Deep Snowpack, the Shallow and Moderate Snowpack Zones and within each of these zones by Stand Structure Habitat Class.

In the ECF all stands within UWR #U-5-002 are Douglas-fir leading, and primarily (96%) all of these within the moderate snowpack zone. Similarly, within the ECF most Ungulate Winter Range is within the Moderate Habitat Structure Class, although High and Low Habitat Structure Classes do exist within the ECF. To simplify this analysis all MDWR habitat was considered to be within the Moderate Stand Structure Habitat Class and managed under a Group Selection harvest system, described in Section 5.8.

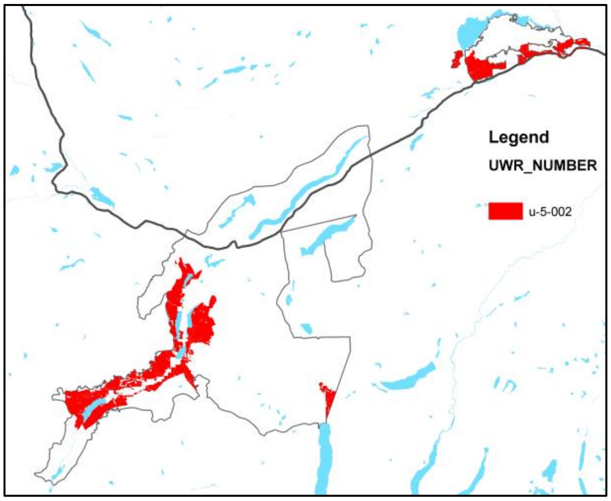


Figure 10. Mule Deer Winter Range Habitat within ECF

5.11.5 Recreation

Designated recreational trail buffers from the CCLUP dataset were incorporated into the modelling database. The model had an 85% retention requirement applied across all trail buffers.

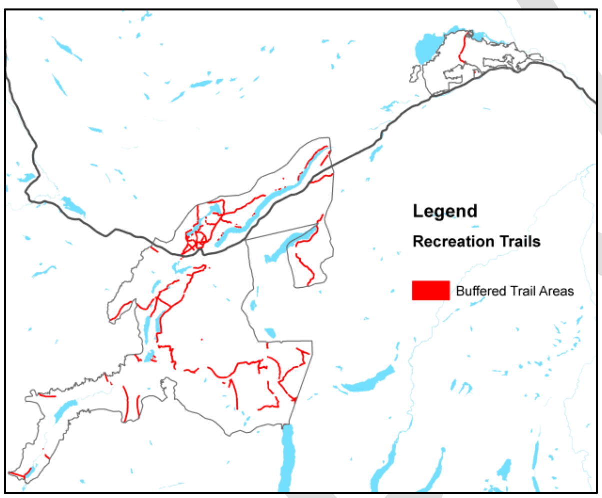


Figure 11. Recreation trails within ECF

5.12 Forest Estate Model

For the purpose of this analysis, the Forest Planning Studio-ATLAS (FPS-ATLAS) model was utilized (Nelson, 2003). FPS-ATLAS is a spatially explicit forest estate simulation model that uses stand groups (i.e., AUs) linked to yield curves to forecast the growth of spatially identified polygons. The harvest rate is determined using an oldest-first algorithm combined with a suite of user defined harvest priorities.

6 Results – Basecase

6.1 Long Run Sustained Yield

The long run sustained yield (LRSY) for this land base is approximately 70,100 m^3/yr, this assumes that all stands are harvested at the age when culmination of mean annual increment (CMAI) is achieved (Appendix 2). This translates into a weighted average growth/harvest rate of 1.65 m^3/yr/ha (LRSY divided by THLB area), and represents the theoretical maximum long-term harvest rate that could be achieved without consideration of non-timber values.

6.2 Harvest Priority

Harvesting was prioritized by stand type and age. MPB impacted stands were assigned the highest priority, followed by existing mature stands, managed, selection, genetic and future. Within these broad priority categories stands were further prioritized using the *Oldest/MinHarveAge* criteria which ranks stands in descending order based on the difference between their current age and minimum harvest age.

6.3 Harvest Volume

Alternative harvest flow strategies were analyzed for the Basecase. For modelling purposes *sustainable* was defined as a flow strategy that provided a non-declining harvest rate, and maintained a non-declining growing stock on the THLB over the last 100 years of the planning horizon. Potential decreases or increases in harvest rates were limited to a maximum change of +/- 10% per. Additionally, harvest rates were not permitted to exceed the theoretical LRSY prior to deductions before unsalvaged losses.

The maximum Even Flow Yield (EFY) was found to be 41,400 m^3/yr, and the maximum Long Term Harvest Level (LTHL) was found to be 57,900 m^3/yr. (Figure 12). Increases in timber harvest were possible in years 2091, 2131, 2151 and 2166. The LTHL is 8,700 m^3/yr below theoretical LRSY after reductions for unsalvaged losses.

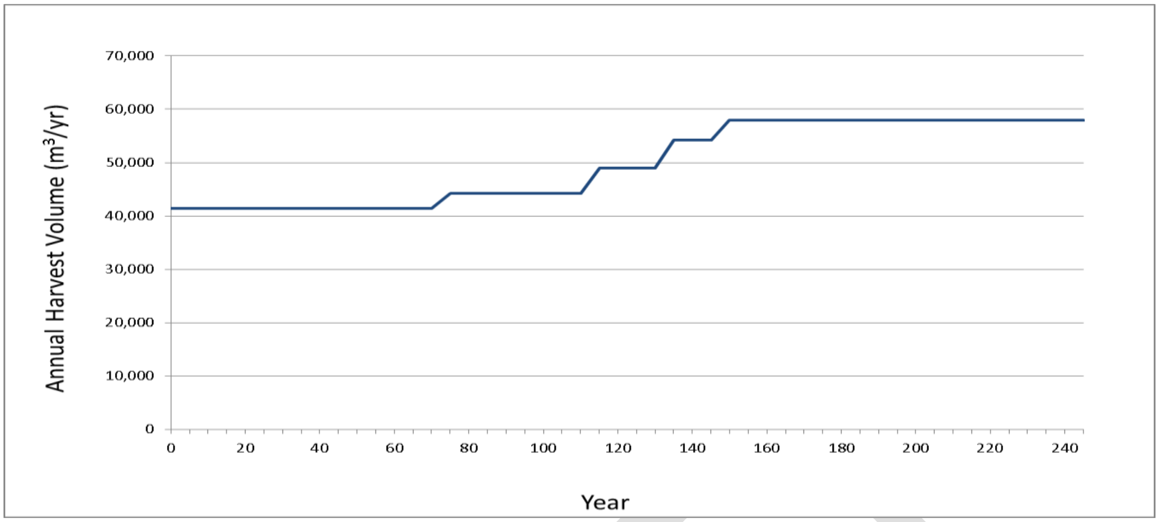


Figure 12. Basecase – Annual Harvest Rate

MPB stands were prioritized in the model to capture potential MPB mortality within the 20 year shelf-life period (Figure 13). Harvesting in MPB stands continued after the MPB shelf-life period, although yields are reduced to account for losses. After the first decade harvest volume is primarily from existing Natural stands until harvesting in Managed stands begins in the sixth decade.

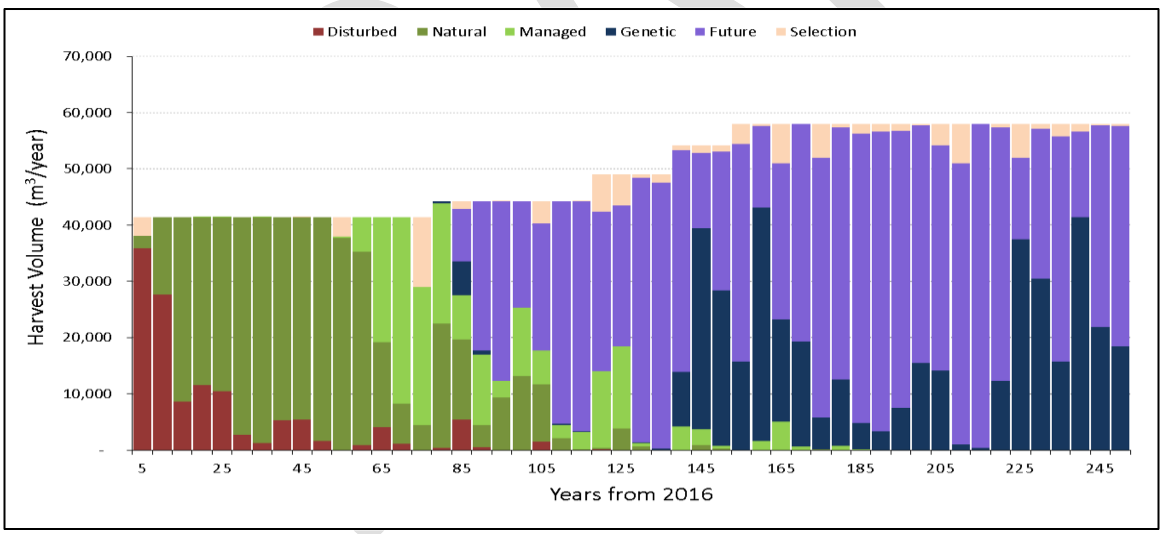


Figure 13. Basecase – Harvest Volume by Stand Type

Figure 14 reports the species of harvest volume based on the species composition of each analysis unit. Over the entire planning horizon harvest volume is 84% Lodgepole pine, 11% Douglas fir, 4% spruce and 1% balsam. Spruce volume increases in the mid to late terms as harvesting occurs in regenerated stands which include spruce in the regeneration treatment.

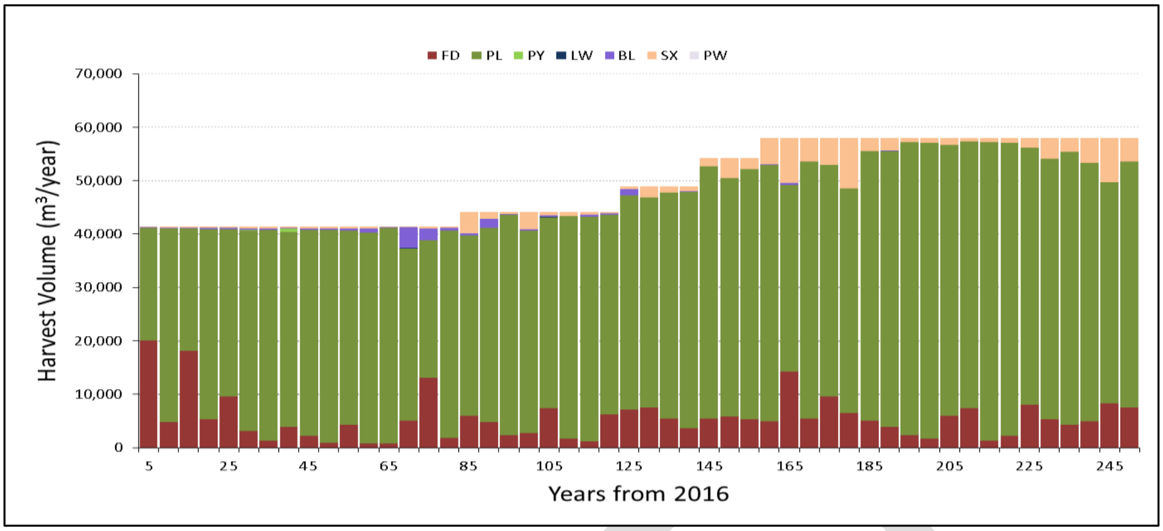


Figure 14. Basecase – Harvest Volume by Species

The average harvest volume (m^3/ha) for each stand type is shown in Figure 15. The highest harvest volumes are expected from managed stands using genetic stock. The lowest harvest volumes are from selection harvests. MPB impacted stands also have low harvest volumes, particularly in the second period when the expected shelf-life of dead volume terminates. Average harvest volume in MPB stands increases over time as understory regeneration becomes merchantable. In the long-term average harvest volume in the Future and Genetic stand types becomes relatively consistent.

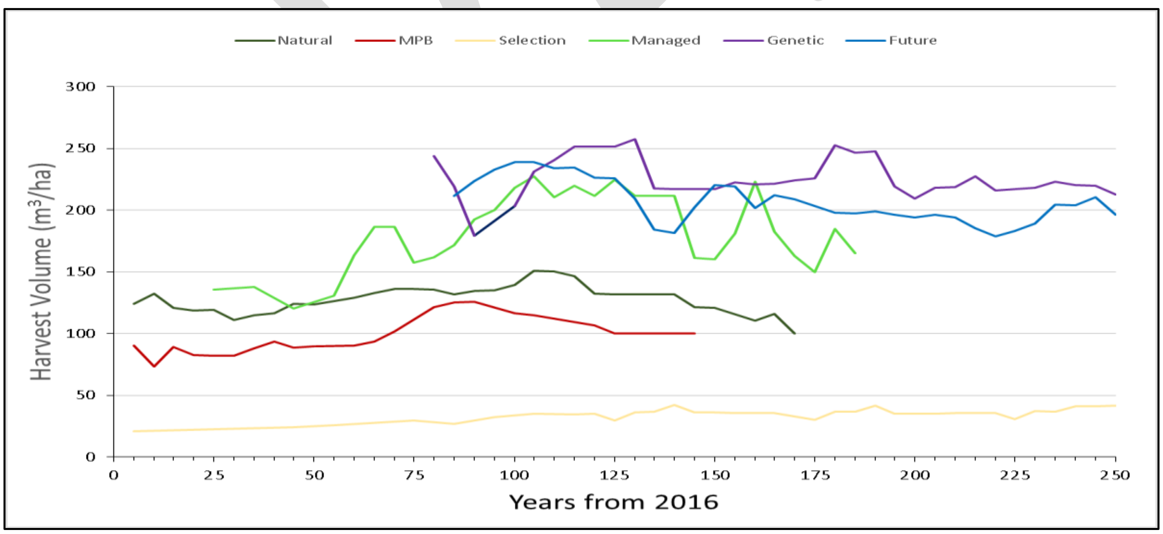


Figure 15. Basecase – Average Harvest Volumes

6.4 Growing Stock

Figure 16 shows the standing timber volume within the THLB by stand type. The abrupt increase in standing inventory in the fourth period is due to the addition of the Transitional OGMA to the THLB in 2030. In 2016 timber inventory is 2.83 million m^3 increasing throughout the planning horizon to 3.64 million m^3 in 2256. Standing inventory volume in non-declining over the final 100 years of the planning horizon.

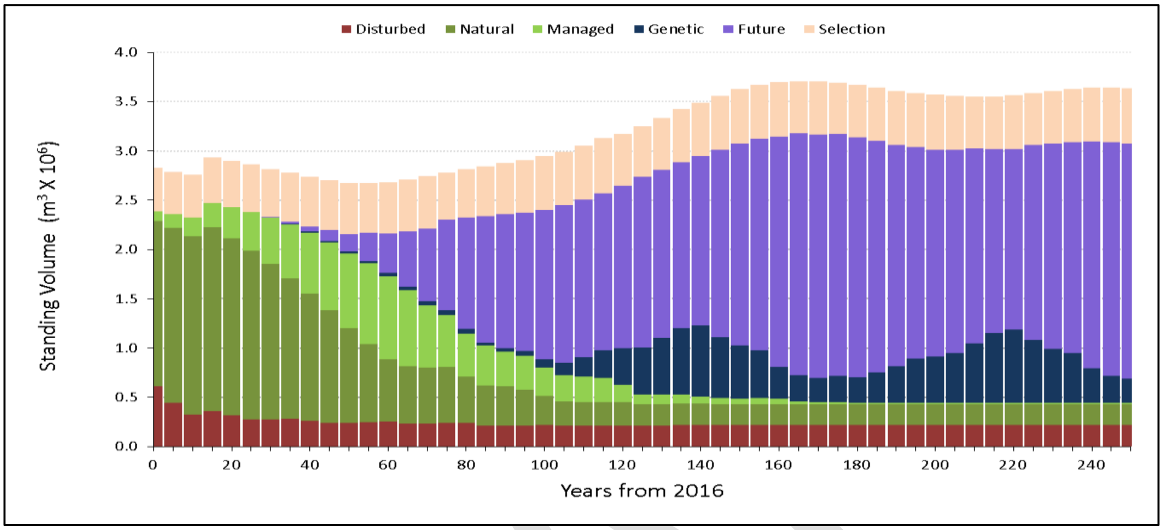


Figure 16. Basecase – THLB Standing Volume

Figure 17 shows the age-class distribution for the THLB at years 0, 125 and 250 of the modelling projection. The percentage of older stands (141+ years) within the THLB in 2016 is 25%, over the planning horizon this percentage increases slightly to 28% by 2256.

Figure 17. THLB Age-Class Distribution at Year 250

7 Sensitivity Analyses

Sensitivity analyses investigate the potential impacts of uncertainty in the Basecase. The sensitivity analyses completed include:

- Decrease in stand yields (2)
- Decrease in MDWR operability (1)
- Decrease in WTP retention (1)
- Increase/decrease minimum harvest ages (2)
- Increase in regeneration delay (2)

7.1 Decrease in Stand Yields

A key set of assumptions in the timber supply analysis are the yield estimates. Short-term timber supply is a particular concern to the ECF who have experienced difficulty in identifying stands with sufficient harvestable volume to meet their current AAC. Two sensitivity analyses were conducted to investigate the uncertainty in yield projections on timber supply in the ECF. These include:

(1) Genetic gains (GG) were removed from the managed stands and,

(2) Standing dead volume was removed from MPB disturbed stands.

Genetic gains were removed from managed stand yields creating specific yield curves in TIPSY and incorporating the new yield curves in the FPS-ATLAS model. For both sensitivities the MHA for each stand type was adjusted to reflect the new yields.

Relative to the Basecase the removal of genetic gains had a minor impact, reducing harvest levels from 44,200 m3/yr to 43,800 m3/yr between the years 2091 and 2126 (Figure 18).

The removal of standing dead timber represent a 19% reduction in current standing inventory, from 2.83mm to 2.30mm m3 (Figure 19). Figure 18 illustrates that relative to the Basecase removing the standing dead volume in MPB disturbed stands had a 19% impact on initial harvest levels, reducing harvest levels to 33,300 m3/yr. This reduced harvest level persists for 110 years (2126), as MPB stands regenerate growing stock increases and harvest volumes increase to levels similar to the Basecase.

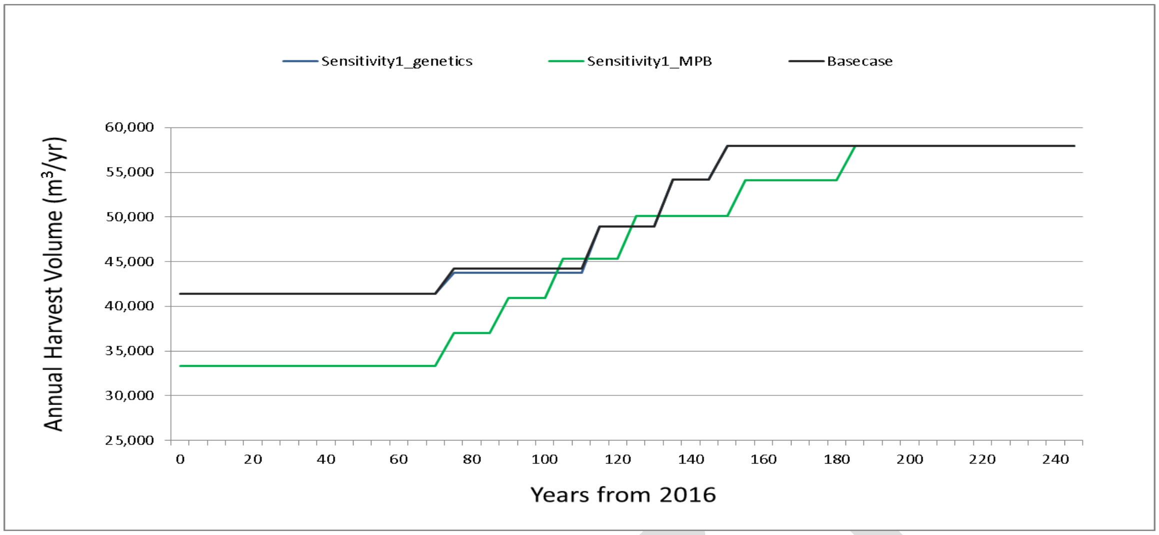


Figure 18. Sensitivity Analyses for Yields – Comparing Harvest Volume

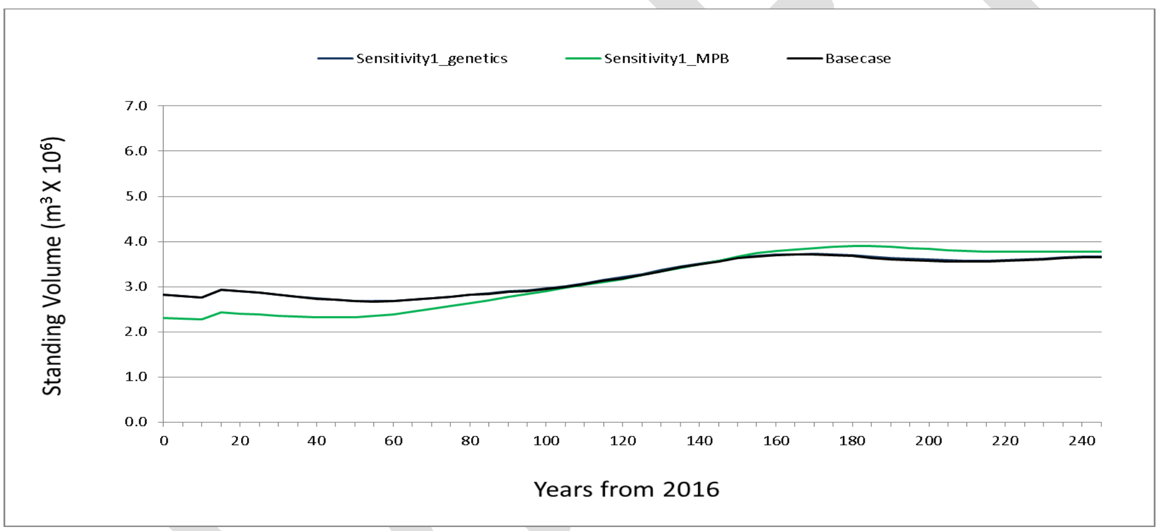


Figure 19. Sensitivity Analyses for Yields – Comparing Growing Stock Volume

7.1 Decrease in MDWR Operability

The Williams Lake TSR noted a concern that stands within the MDWR/IDFxm subzone may not support sufficient volume for a viable harvest opportunity under a group selection system. The ECF has expressed a similar concern that existing stand volumes, and the basal area retention requirements in the MDWR, reduce operability in these areas with low initial stocking (Gord Chipman, personal communication). A sensitivity analysis was completed to test the sensitivity of MDWR habitat on timber supply.

To test the impact of potentially inoperable areas within MDWR stands with a Poor site index (< SI 12m) were removed from the THLB (2,611 ha). This area reduction represents 60% of the MDWR, and 6% of the THLB, within the ECF.

Figure 20 illustrates the impact of removing low-site MDWR, short-term harvest levels are 2% lower when compared to the Basecase. This low impact is due to the relatively low harvest priority, and consequently low harvest levels of MDWR in the Basecase. The removal of low-site MDWR results in a 9% reduction in initial growing stock relative to the Basecase, over the planning period this difference in is increased to 10%

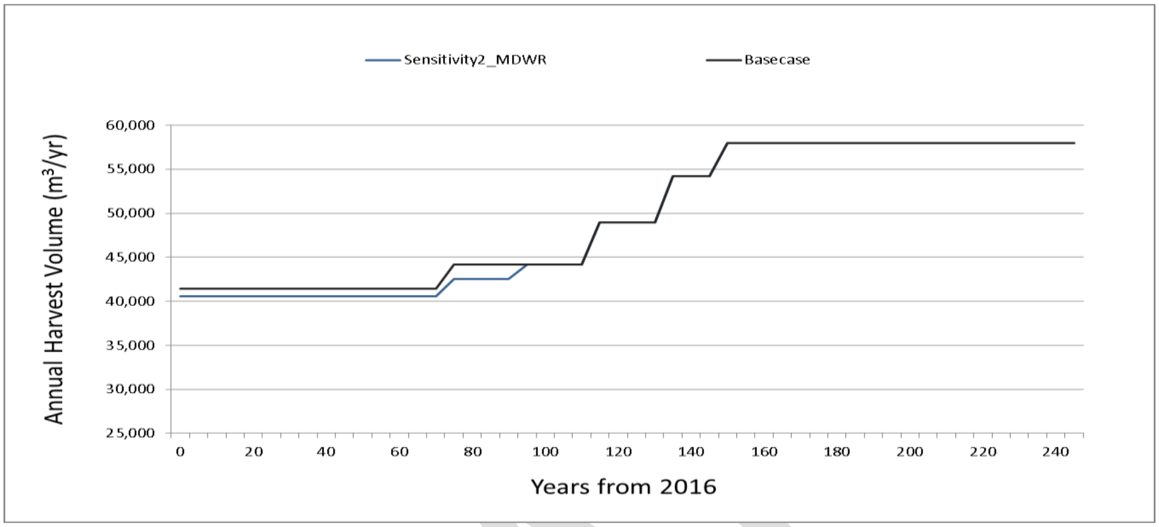


Figure 20. Sensitivity Analyses for MDWR – Comparing Harvest Volume

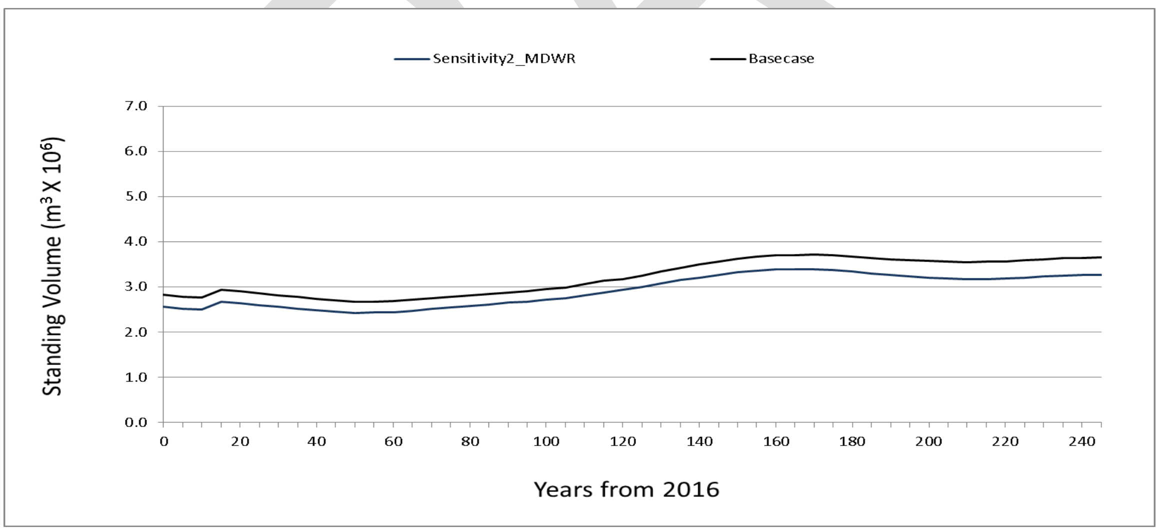


Figure 21. Sensitivity Analyses for MDWR – Comparing Stock Volume

7.1 Decrease in Wildlife Tree Patch Retention

Based on stand level biodiversity objectives an overall Wildlife Tree Patch (WTO) retention level of 6% is required. However, because there is significant overlap between WTP retention and other netdowns the net impact of WTP is expected to be less. To investigate the potential impact a sensitivity analysis was completed using a 3% WTP retention level.

The reduction in WTP retention resulted in a 3% increase in timber harvest relative to the Basecase. The decrease in WTP retention also increases growing stock (3%) relative to the Basecase, throughout the planning horizon.

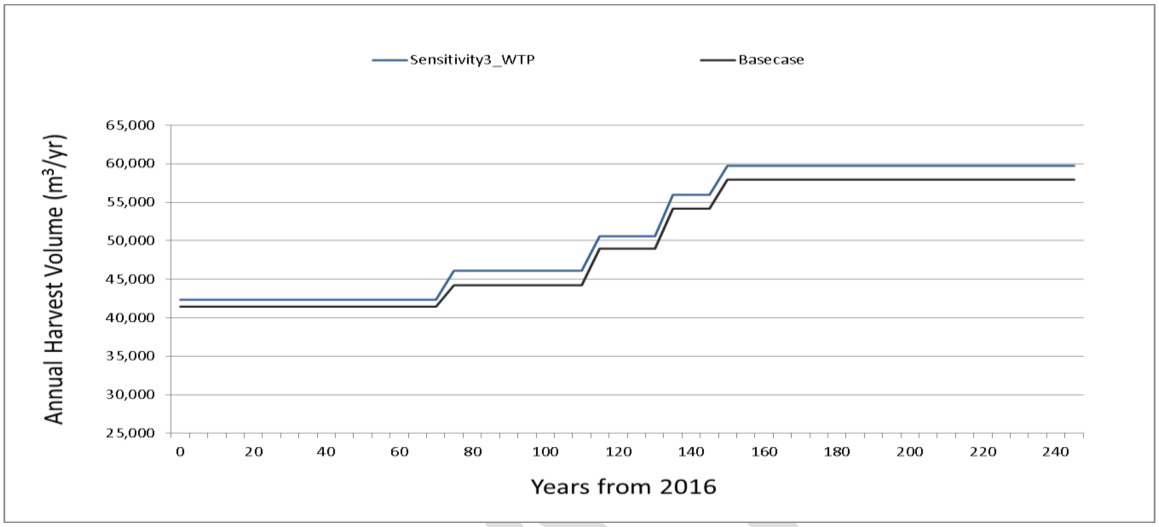


Figure 22. Sensitivity Analyses for WTP – Comparing Harvest Volume

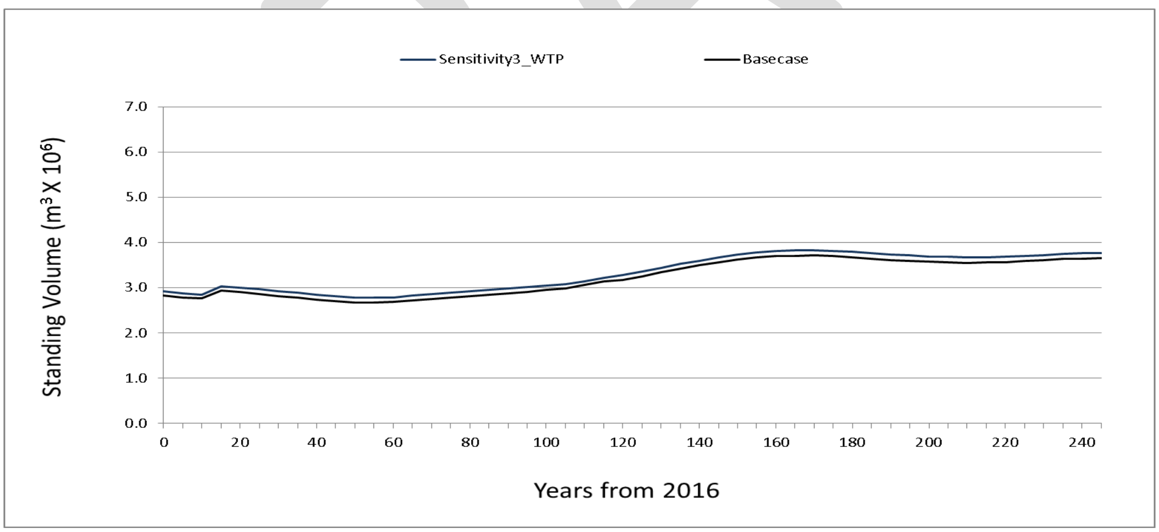


Figure 23. Sensitivity Analyses for WTP – Comparing Stock Volume

7.2 Increase/Decrease in Minimum Harvest Ages

Two sensitivity analyses were completed to examine uncertainty around minimum harvest age criteria. In the first scenario MHAs were increased by 10 years, in the second MHAs were decreased by 10 years.

Relative to the Basecase increasing the MHA extends reduces short-term harvest levels from 41,400 m3/yr to 39,500 m3/yr, and delays the increase to the long term harvest level by 5 years (Figure 24). Early in the planning horizon growing stock increases slightly, relative to the Basecase and stands are delayed from harvest. As stands achieve MHA growing stock is decreased relative to the Basecase and the two scenarios have similar growing stock by the end of the planning horizon.

Relative to the Basecase decreasing the MHA increases short timber supply (1,900 m3/yr or 5%) as stands are harvested earlier. In the long-term, reducing the MHA results in lower yields as stands are harvested before CMAI, this results in decreased timber harvest (2,800 m3/yr or 5%) relative to the Basecase. At the end of the planning horizon growing stock is decreased (10%) relative to the Basecase (Figure 25).

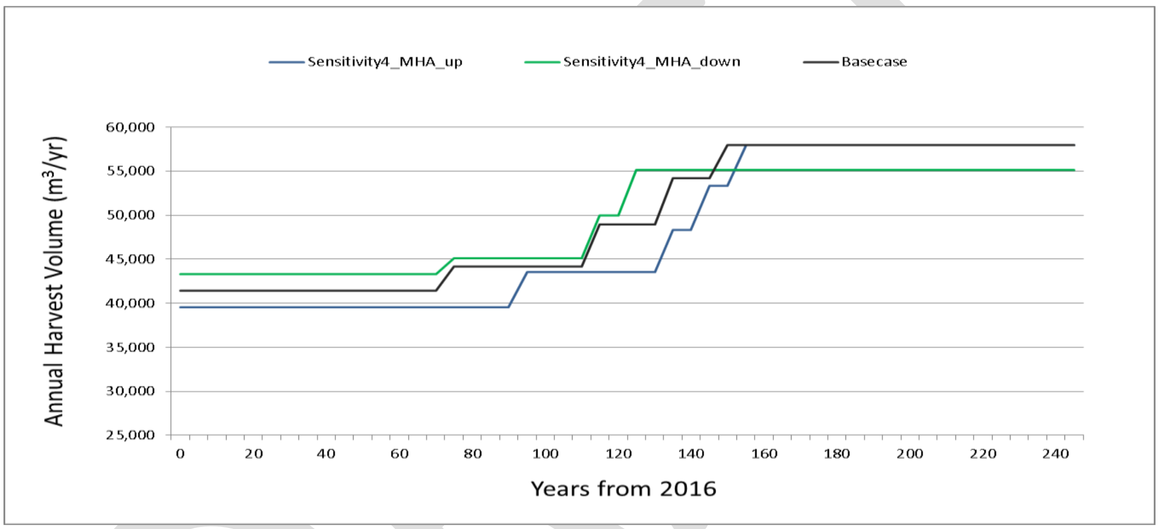


Figure 24. Sensitivity Analyses for MHAs – Comparing Harvest Volume

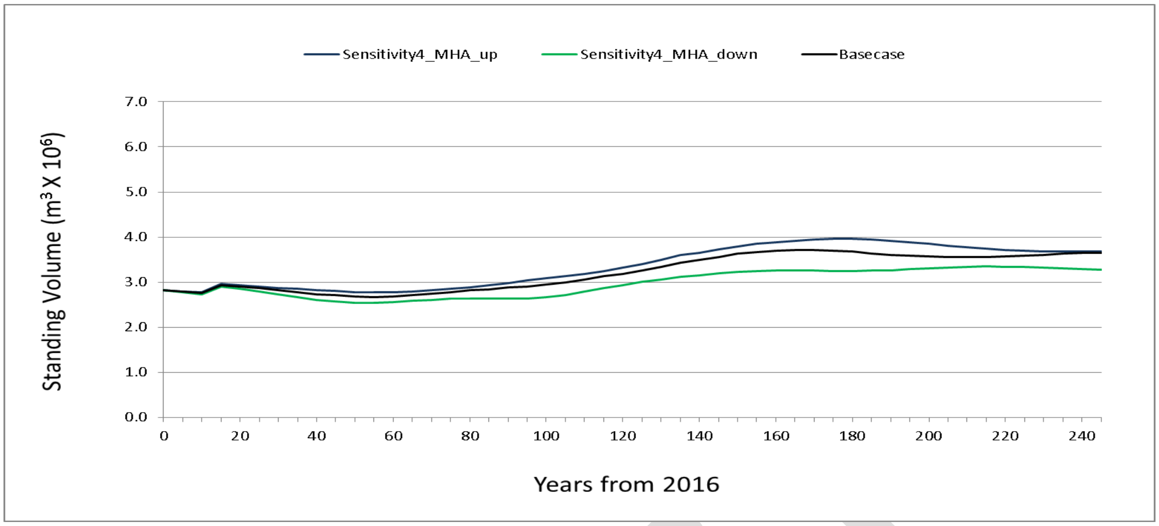


Figure 25. ***Sensitivity Analyses for MHAs – Comparing Standing Volume***

7.3 Increase in Regeneration Delays

Two sensitivity analyses investigated the impact of regeneration delays on timber supply. In the Basecase NSR stands with a harvest history were assigned an age of 0 years and NSR stands with a natural disturbance history were assigned an age of 0 years at the time of disturbance. In the first sensitivity NSR stands with a history of disturbance were assigned an age of -2 at the time of disturbance, the ages of stands without a disturbance history were not changed.

Increasing the regeneration delay for NSR stands impacts timber supply (0.2%) and growing stock negligibly (Figure 26, Figure 27).

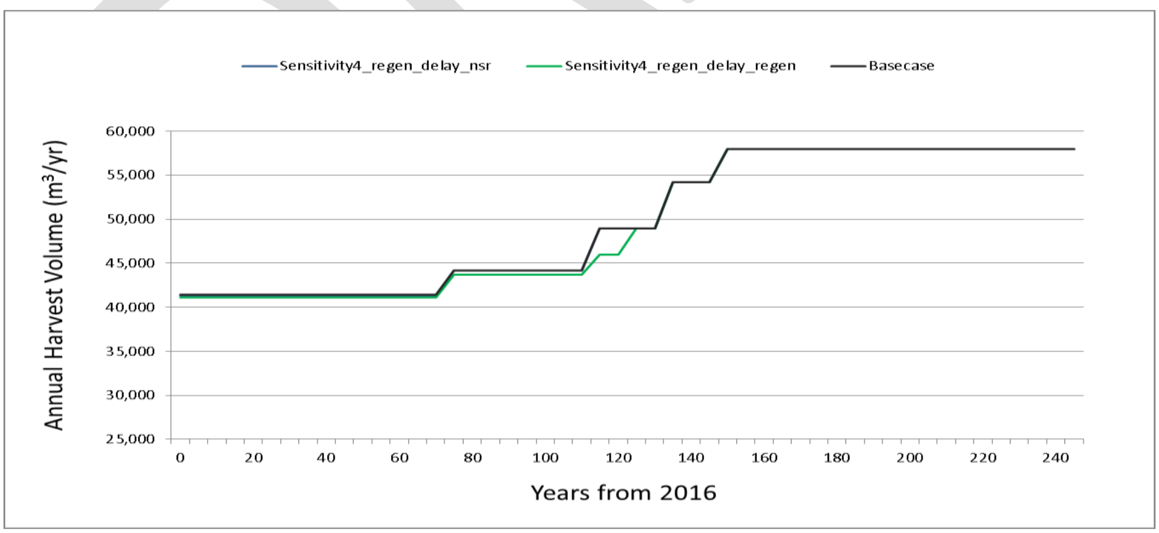


Figure 26. ***Sensitivity Analyses for Regeneration Delays – Comparing Harvest Volume***

In the Basecase analysis it was assumed that there was no regeneration delay when establishing managed stands. The second sensitivity analysis investigated the impact of a 2 year regeneration delay for managed stands. The regeneration delay was modelled by rerunning the TIPSY model to include the regeneration delay and incorporating the new yield curves in the FPS-ATLAS model.

Increasing the regeneration delay for managed stands by 2 years results in a less than 0.7% decrease in short-term timber supply (Figure 26). Long-term timber supply was not changed, although growing stock at the end of the planning horizon, was reduced by 6% compared with the Basecase (Figure 27).

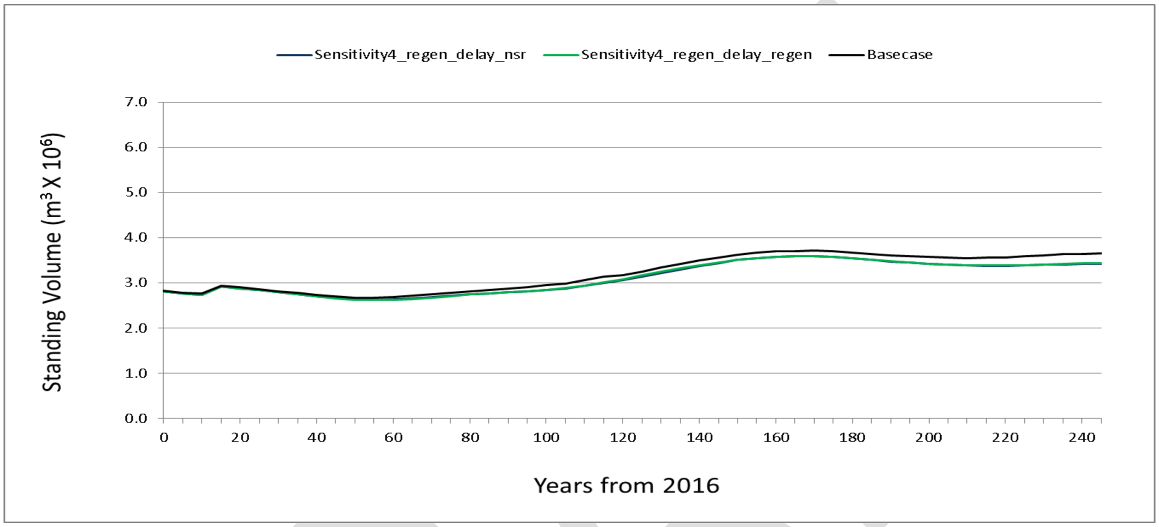


Figure 27. Sensitivity Analyses for Regeneration Delays – Comparing Standing Volume

8 Conclusions

The harvest forecast for the ECF seeks to balance resource management objectives on a land base amidst changing forest conditions. The objective was to achieve a maximum sustainable, non-declining harvest rate for the entire planning horizon. In the Basecase analysis initial harvest levels were found to be 41,400 m3/yr, increasing to the long term harvest level of 57,900 m3/yr in 2066. The initial harvest level is 1,400 m3/yr greater than the current AAC.

Sensitivity analyses identified a number of key factors potentially impacting harvest levels for the ECF. There are concerns that within the IDFxm subzone opportunities for implementing group selection silviculture system are severely limited due to operability. Within the ECF 60% of MDWR have a site index of 12m and lower. Sensitivity analysis found that excluding these poor sites reduces the THLB by 6% and short-term harvest levels by 2%. The Basecase assumed immediate site regeneration, sensitivity analysis indicates that potential delays in regeneration could reduce timber supply by 1%. The Basecase assumed a 6% WTP retention level, this is expected to be more than the net retention required to meet stand level biodiversity objectives. Sensitivity analysis found that a 3% WTP retention level increases harvest levels by 3%, relative to the Basecase, throughout the planning horizon. Sensitivity analysis found that increasing the minimum harvest age by 10 years resulted in a 1,500 m3/year reduction is short-term harvest levels. Conversely, decreasing the minimum harvest age by 10 years increases short-term timber supply although reduces long-term harvest levels by 2,800 m3/yr (5%).

More than seventy percent of stands within the THLB have been impacted by MPB, based on VRI data more than 19% of the timber volume within the THLB is dead, and more than 40% of all stands include 30% dead volume. In the Basecase 86% of harvest volume in the first ten years is from MPB affected stands. Sensitivity analysis indicates that removing dead timber from the forest inventory reduces short-term harvest levels to 33,300 m3/yr, 17% less than the current AAC, and 20% below the Basecase level of 34,700 m3/yr.

Timber supply on the ECF is sensitive to estimates of standing dead timber volume. Additional uncertainty surrounds inventory estimates of mortality, as well as the shelf life and merchantable of dead pine volume. Local knowledge suggests that forest inventory data overestimates timber volume on the ECF (Gord Chipman, personal communication). Harvest levels should reflect the uncertainty of pine mortality projections and merchantability. One option may be to allocate specific harvest levels for low volume and heavily impacted pine leading stands (for example low volume MDWR stands, or pine leading stand with high levels of mortality), and for relatively higher volume stands. Such a partition will provide continued opportunities to salvage dead pine where economically feasible, and establish a sustainable level of harvest for more productive stands.

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Appendix 1. Analysis Unit Definitions

Stand Type (Analysis Unit)	Stand Establishment Date	Minimum Harvest Age	Stand Age of Disturbance	Area (ha)
NAT_DEC_LOW	Prior 1965	NA	NA	1,861
NAT_DEC_POOR	Prior 1965	NA	NA	3,798
NAT_DEC_MED	Prior 1965	NA	NA	998
NAT_DEC_GOOD	Prior 1965	NA	NA	343
NAT_BL_LOW	Prior 1965	NA	NA	724
NAT_BL_POOR	Prior 1965	105	NA	55
NAT_BL_POOR_ADL40	Prior 1965	999	40 - 50	8
NAT_BL_POOR_ADL100	Prior 1965	145	100+	60
NAT_BL_MED	Prior 1965	85	NA	202
NAT_BL_MED_ADL40	Prior 1965	85	40 - 50	3
NAT_BL_MED_ADL70	Prior 1965	95	70 - 80	45
NAT_PL_LOW	Prior 1965	NA	NA	13,224
NAT_PL_POOR	Prior 1965	115	NA	19,606
NAT_PL_POOR_ADL50	Prior 1965	155	50 - 60	4
NAT_PL_POOR_ADL60	Prior 1965	165	60 - 70	7
NAT_PL_POOR_ADL70	Prior 1965	165	70 - 80	191
NAT_PL_POOR_ADL80	Prior 1965	145	80 - 90	3,167
NAT_PL_POOR_ADL100	Prior 1965	145	100+	3,457
NAT_PL_MED	Prior 1965	95	NA	6,111
NAT_PL_MED_ADL40	Prior 1965	105	40 - 50	339
NAT_PL_MED_ADL50	Prior 1965	95	50 - 60	871
NAT_PL_MED_ADL60	Prior 1965	135	60 - 70	1,612
NAT_PL_MED_ADL70	Prior 1965	65	70 - 80	762
NAT_PL_MED_ADL80	Prior 1965	75	80 - 90	35
NAT_PL_MED_ADL100	Prior 1965	75	100+	713
NAT_PL_GOOD	Prior 1965	60	NA	239
NAT_PL_GOOD_ADL50	Prior 1965	125	50 - 60	12
NAT_PL_GOOD_ADL60	Prior 1965	60	60 - 70	20
NAT_PL_GOOD_ADL70	Prior 1965	65	70 - 80	5
NAT_PL_GOOD_ADL80	Prior 1965	60	80 - 90	63
NAT_PL_GOOD_ADL100	Prior 1965	60	100+	6
NAT_FD_LOW	Prior 1965	NA	NA	338
NAT_FD_POOR	Prior 1965	999	NA	2,488
NAT_FD_POOR_ADL80	Prior 1965	205	80 - 90	19
NAT_FD_POOR_ADL100	Prior 1965	999	100+	1,615
NAT_FD_MED/GOOD	Prior 1965	105	NA	894
NAT_FD_MED/GOOD_ADL50	Prior 1965	135	50 - 60	25
NAT_FD_MED/GOOD_ADL70	Prior 1965	105	70 - 80	532
NAT_FD_MED/GOOD_ADL80	Prior 1965	999	80 - 90	72

Stand Type (Analysis Unit)	Stand Establishment Date	Minimum Harvest Age	Stand Age of Disturbance	Area (ha)
NAT_FD_MED/GOOD_ADL100	Prior 1965	95	100+	647
NAT_SW_LOW	Prior 1965	NA	NA	434
NAT_SW_POOR	Prior 1965	145	NA	268
NAT_SW_POOR_ADL100	Prior 1965	135	100+	258
NAT_SW_MED	Prior 1965	95	NA	1,380
NAT_SW_MED_ADL70	Prior 1965	999	70 - 80	16
NAT_SW_MED_ADL100	Prior 1965	115	100+	5
NAT_SW_GOOD	Prior 1965	95	NA	218
NAT_PY_LOW	Prior 1965	NA	NA	366
NAT_PY_POOR_ADL100	Prior 1965	105	100+	2
NAT_PY_MED_ADL70	Prior 1965	135	70 - 80	154
SEL_FD_POOR	Prior 1965	190	NA	4,636
SEL_FD_MED/GOOD	Prior 1965	170	NA	2,489
MAN34_PL_POOR	Managed	60	34 - 58	94
MAN34_PL_MED	Managed	60	34 - 58	1,218
MAN34_PL_GOOD	Managed	60	34 - 58	92
MAN34_FD_MED/GOOD	Managed	60	34 - 58	213
MAN34_SW_MED	Managed	85	34 - 58	89
MAN34_MPB_PL_POOR	Managed	60	34 - 58	24
MAN34_MPB_PL_MED	Managed	60	34 - 58	1,719
MAN34_MPB_PL_GOOD	Managed	80	34 - 58	12
MAN00_MPB_PL_POOR	Managed	80	0 - 33	3
MAN00_MPB_PL_MED	Managed	80	0 - 33	3,977
MAN00_MPB_PL_GOOD	Managed	80	0 - 33	7
MAN17_FD_MED/GOOD	Managed	80	17 - 33	166
MAN17_SW_POOR	Managed	80	17 - 33	1
MAN17_SW_MED	Managed	80	17 - 33	323
MAN17_SW_GOOD	Managed	80	17 - 33	48
GEN_FD_MED/GOOD	Genetic	80	NA	22
GEN_SW_POOR	Genetic	105	NA	6
GEN_SW_MED	Genetic	80	NA	209
GEN_SW_GOOD	Genetic	80	NA	111
FUT_PL_POOR	Future	155	NA	0
FUT_PL_MED	Future	80	NA	0
FUT_PL_GOOD	Future	80	NA	0
FUT_FD_POOR	Future	135	NA	0
FUT_FD_MED/GOOD	Future	80	NA	0
FUT_SW_POOR	Future	115	NA	0
FUT_SW_MED	Future	80	NA	0
FUT_SW_GOOD	Future	80	NA	0

Stand Type (Analysis Unit)	Stand Establishment Date	Minimum Harvest Age	Stand Age of Disturbance	Area (ha)
FUT_PW_POOR	Future	105	NA	0
FUT_PW_MED	Future	80	NA	0

Appendix 2. Long Run Sustained Yield

Future Analysis Unit	THLB Area (ha)	Treat	CMAI (m^3/ha/yr)	LRSY (m^3/yr)
SEL_FD_POOR	2,382	PH	0.69	1,644
SEL_FD_MED/GOOD	1,531	PH	1.29	1,975
GEN_PL_POOR	55	CC	1.01	55
GEN_PL_MED	5,241	CC	2.73	14,307
GEN_PL_GOOD	70	CC	4.43	308
GEN_FD_POOR	0	CC	1.11	0
GEN_FD_MED/GOOD	377	CC	2.44	920
GEN_SW_POOR	4	CC	1.33	5
GEN_SW_MED	432	CC	2.78	1,202
GEN_SW_GOOD	144	CC	4.25	611
FUT_PL_POOR	19,497	CC	0.98	19,107
FUT_PL_MED	7,146	CC	2.65	18,937
FUT_PL_GOOD	200	CC	4.3	861
FUT_FD_POOR	2,252	CC	1.08	2,432
FUT_FD_MED/GOOD	1,164	CC	2.38	2,770
FUT_SW_POOR	452	CC	1.29	583
FUT_SW_MED	1,192	CC	2.7	3,218
FUT_SW_GOOD	198	CC	4.13	819
FUT_PW_POOR	0	CC	1.57	0
FUT_PW_MED	133	CC	2.42	321
TOTAL	**42,468**		**1.65**	**70,074**

*The current THLB is used as yield curves incorporate reductions for future roads and grassland area reductions.

Appendix 3. Mature/Old Seral Retention Targets

NDT Unit/BEC Unit/Landscape Unit/ Biodiversity Emphasis	Mature/Old Seral Retention Requirement (%)	Minimum Mature Age	Area (ha)
NDT2_ESSF_Bidwell/Lava_Intermediate	28	120	12
NDT2_ESSF_Crazy Creek_Low	14	120	627
NDT2_ESSF_Klinaklini_Intermediate	28	120	4
NDT2_ESSF_Middle Lake_Low	14	120	155
NDT2_ESSF_Tatla/Little Eagle_Low	14	120	53
NDT2_ESSF_Upper Tatlayoko_Intermediate	28	120	4,932
NDT2_ESSF_Westbranch_High	42	120	3047
NDT3_MS_Bidwell/Lava_Intermediate	26	100	18
NDT3_MS_Crazy Creek_Low	14	120	53
NDT3_MS_Klinaklini_Intermediate	26	100	26
NDT3_MS_Middle Lake_Low	14	120	946
NDT3_MS_Ottarasko_Low	14	120	17
NDT3_MS_Tatla/Little Eagle_Low	14	120	2,380
NDT3_MS_Upper Tatlayoko_Intermediate	26	100	3,302
NDT3_MS_Westbranch_High	39	100	3,072
NDT3_SBPS_Tatla/Little Eagle_Low	8	100	25,631
NDT3_SBPS_Upper Tatlayoko_Intermediate	17	100	183
NDT3_SBPS_Westbranch_High	25	100	58
NDT4_IDF_Crazy Creek_Low	11	100	2,099
NDT4_IDF_FD_Crazy Creek_Low	22	100	359
NDT4_IDF_FD_Middle Lake_Low	22	100	3,254
NDT4_IDF_FD_Ottarasko_Low	22	100	40
NDT4_IDF_FD_Puntzi_Low	22	100	926
NDT4_IDF_FD_Pyper_Low	22	100	740
NDT4_IDF_FD_Sisters_Intermediate	43	100	364
NDT4_IDF_FD_Tatla/Little Eagle_Low	22	100	510
NDT4_IDF_FD_Upper Tatlayoko_Intermediate	43	100	2,676
NDT4_IDF_FD_Westbranch_High	65	100	3,159
NDT4_IDF_Klinaklini_Intermediate	23	100	0
NDT4_IDF_Middle Lake_Low	11	100	3,281
NDT4_IDF_Ottarasko_Low	11	100	28
NDT4_IDF_Puntzi_Low	11	100	3,624
NDT4_IDF_Pyper_Low	11	100	1,852
NDT4_IDF_Sisters_Intermediate	23	100	374
NDT4_IDF_Tatla/Little Eagle_Low	11	100	3,829
NDT4_IDF_Upper Tatlayoko_Intermediate	23	100	7,390
NDT4_IDF_Westbranch_High	34	100	5,895