Tree Farm Licence 61

PROPOSED MANAGEMENT PLAN #1

Version 1.1

July 8, 2019

Project 1280-3

Prepared for:

Angus Hope, RPF, PEng
Pacheedaht Andersen Timber Holdings Limited Partnership
1101-409 Granville Street
Vancouver, BC, V6C 2C6

Prepared by:

Forsite Consultants Ltd.
330 – 42nd Street SW
PO Box 2079
Salmon Arm, BC, V1E 4R1
250-832-3366

PATH
Pacheedaht Andersen Timber Holdings LP

FORSITE
Forest Management Specialists

Submission Page

Tree Farm Licence 61
Management Plan #5

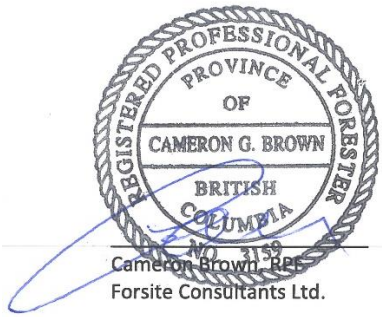
Licensee: Pacheedaht Andersen Timber Holdings Limited Partnership

This Management Plan #1 was prepared in part by:

Cosmin Man, RPF
Forsite Consultants Ltd.

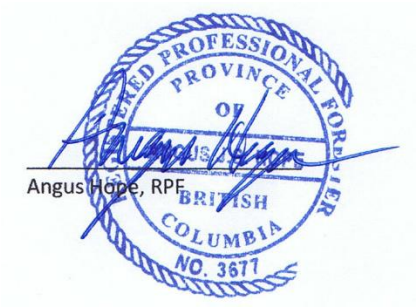
Preparations were initiated by Mark Perdue, RPF.

Preparation of this Management Plan #1 was supervised by:



Cameron Brown, RPF
Forsite Consultants Ltd.

This Management Plan #1 was submitted on behalf of Pacheedaht Andersen Timber Holdings Limited Partnership



Angus Hope, RPF

Management Plan #1 Approval Letter

(This page is intentionally blank)

Executive Summary

This is the first Management Plan prepared for Tree Farm Licence (TFL) 61 held by Pacheedaht Andersen Timber Holdings Limited Partnership (PATH). The completed plan meets the requirements of the *Tree Farm Licence Management Plan Regulation* (B.C. Reg. 280/2009) and is comprised of three main components:

- Management Plan that includes a general description of TFL land base, a brief history of the TFL, the title and a description of each of the publicly available planning documents used to guide forest management and operations in the TFL area, and a summary of the public review and First Nations referral process;
- Timber Supply Analysis of the short term and long term availability of timber for harvesting in the TFL area, including the impact of management practices on the availability of timber;
- Information Package includes supporting documentation for the Timber Supply Analysis.

The Management Plan must be approved by the Deputy Chief Forester who also considers the Timber Supply Analysis produced to determine the allowable annual cut (AAC) for this license.

Set on February 01, 2008, the current AAC for TFL 61 is 108,500 m^3/yr. The Timber Supply Analysis for this Management Plan #1 examined the current harvest practices and incorporated new information such as an updated forest inventory, operability mapping, stream classifications, provincial site productivity layer, ungulate winter range objectives, visual quality objectives, mature seral retention within the San Juan Ridge Special Resource Management Zone, and green-up requirements within the Enhanced Forest Resource Management Zone. With these changes, the proposed base case scenario increases the current AAC of 108,500 m^3/yr to the **recommended AAC of 124,300 m^3/yr**.

Contents

List of Figures

List of Tables

List of Acronyms

AAC	Allowable Annual Cut
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Option
CFLB	Crown Forest Land Base
CWH	Coastal Western Hemlock BEC zone
FAIB	Forest Analysis and Inventory Branch
FLNRORD	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FRPA	Forest and Range Practices Act
FSP	Forest Stewardship Plan
GAR	Government Action Regulation
IP	Information Package
MH	Mountain Hemlock BEC zone
MHA	Minimum Harvest Age
MP	Management Plan
OGMA	Old Growth Management Area
PA	Protected Area
PATH	Pacheedaht Andersen Timber Holding
RMZ	Resource Management Zone
RPF	Registered Professional Forester
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation Program for Stand Yields
TL	Timber Licence
VDYP	Variable Density Yield Prediction
VILUP	Vancouver Island Land Use Plan
VLI	Visual Landscape Inventory
VQO	Visual Quality Objective
VRI	Vegetation Resource Inventory

1 Introduction

This is the first Management Plan (MP) prepared for Tree Farm Licence (TFL) 61, and it must meet the requirements of the *Tree Farm Licence Management Plan Regulation* (B.C. Reg. 280/2009). This regulation, enacted by the provincial government in November 2009 (with associated amendments to the *Forest Act*), includes content requirements, submission timing and public review requirements for TFL Management Plans.

This document provides a general description and history of the TFL, lists the primary planning documents that guide the management of the TFL and summarizes outcomes from the public review and First Nations referral process. The draft MP also includes, as appendices, the accepted Information Package (IP) and a draft timber supply analysis.

2 Description of TFL 61

Tree Farm Licence (TFL) 61 is located on southern Vancouver Island near the communities of Port Renfrew, Jordon River, and Sooke (Figure 1). The TFL covers approximately 20,240 ha split into two units; the larger unit (Block 1) covers 17,192 ha and the smaller unit (Block 2) covers 3,048 ha. Approximately 18,545 ha (91.6%) is productive area suitable for forest management (i.e., Crown Forest Land Base - CFLB) which contributes towards meeting non-timber and other management objectives (e.g., biodiversity). Approximately 14,477 ha (71.5%) is expected to be available for timber harvesting (THLB) in the near term. As additional harvesting occurs, further reductions are implemented to address loss of productive land and retention for non-timber values (Long Term THLB =13,203 ha (65.2%). This TFL includes 1,652 ha of Timber Licence (TL) that have been harvested and reverted to the TFL and an additional 453 ha of active TLs are expected to be reverted to the TFL once harvested.

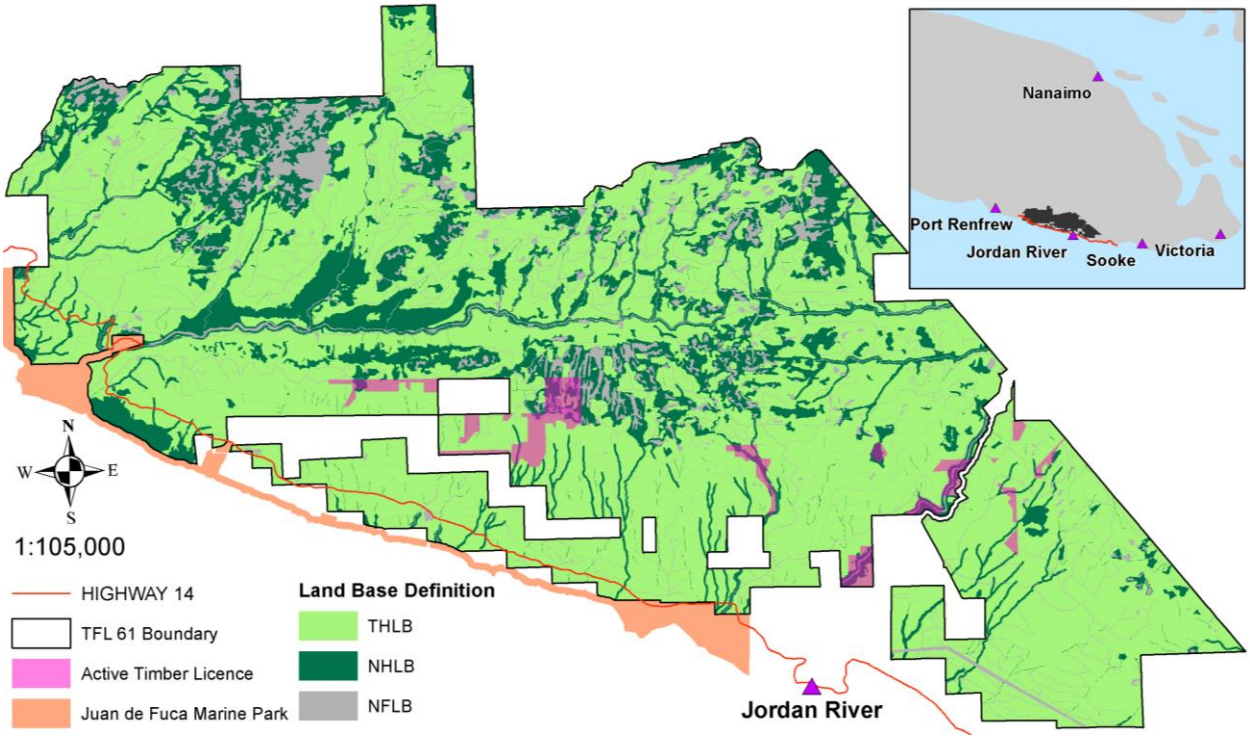


Figure 1 Location of TFL 61 and Land Base Classification

The TFL is primarily within the coastal western hemlock (CWH) biogeoclimatic ecosystem classification (BEC) zone, with higher elevations in the mountain hemlock (MH) zone. There are six CWH subzone variants, CWHmm1,

CWHmm2, CWHvm1, CWHvm2, CWHxm2, and one MH subzone variant MHmm1. Stand-initiating events within the TFL are rare, or infrequent.

3 History of TFL 61

3.1 LICENCE HOLDER AND ADMINISTRATION

The TFL 61 was originally Block 1 of TFL 25 granted to Alaska Pine and Cellulose Limited on May 21, 1958. Alaska Pine and Cellulose Limited went through a number of name changes; Rayonier Canada Ltd., Rayonier B.C. Ltd, Rayonier Canada (B.C.) Ltd., ITT Industries of Canada Ltd., Western Forest Products Ltd. Although TFL 25 has undergone a number of changes, Block 1 has been held continuously since its issuance.

In 2007, Western Forest Products Ltd. removed all private lands (12,137 ha) from TFL 25, most of this area (11,938 ha) was located within Block 1. In 2010 Block 1 was removed from TFL 25 to establish TFL 61. Pacheedaht Andersen Timber Holdings Limited Partnership acquired the licence for TFL 61 from Western Forest Products Ltd. on May 1, 2017. Since that time there have been no additions or deletions to the TFL.

3.2 CONSOLIDATIONS AND SUBDIVISIONS

No consolidations or subdivisions occurred to TFL 61 since its inception in 2007.

3.3 MAJOR BOUNDARY CHANGES

No boundary changes occurred since TFL inception in 2007.

3.4 ALLOWABLE ANNUAL CUT HISTORY

A summary of the allowable annual cut (AAC) history for TFL 25 (prior to 2010) and TFL 61 are provided in Table 1, details specific to TFL 25 Block 1 are provided where available. Relevant to the current plan, MP #9 for TFL 25 was approved in 1996, and in the determination the allowable annual cut attributable to Block 1 was reported as 175,000 m^3/yr.

Prior to the current analysis, the first timber supply analysis was completed in 2003. In that analysis the total area within TFL Block 1 was 32,202 ha, with a THLB area of 25,562 ha. The base case analysis reported an annual harvest of 292 ha/year, or an equivalent volume of 164,534 m^3/yr. Subsequent to the completion of the 2003 timber supply analysis, all private lands were removed from TFL 25 (January 31, 2007). At that time, the deputy chief forester administratively adjusted the AAC attributable to Block 1 by 66,500 m^3/yr or 38%, from 175,000 m^3/yr to 108,500 m^3/yr. This is the AAC which has been attributed to TFL25 Block 1 and the successor licence TFL 61, since 2007. On February 1, 2008 MP #10 was approved and the adjusted AAC of 108,500 m^3/yr was maintained until current analysis.

Table 1 AAC and Area Summary

Management Plan or Event	Date	Gross Area (ha)	THLB area (ha)	AAC (m^3/yr)
Licence Issued	1958	NA	NA	407,762
Close Utilization (All Blocks)	1966	NA	NA	594,654
Intermediate Utilization (Blocks 2 and 5)	1967	NA	NA	580,495
Adjustment for Operable Area Increase	1972	NA	NA	614,475
Close Utilization (except Block 5)	1975	NA	NA	668,277
Non-Timber Objectives	1977	NA	NA	615,891
Metric Conversion/Loss Factors	1980	NA	NA	653,180
TFL 25 AAC Determination	1987	NA	NA	653,000

Management Plan or Event	Date	Gross Area (ha)	THLB area (ha)	AAC (m^3/yr)
SBFEP Apportionment (Bill 28: 10,925 m^3)	1988	NA	NA	642,075
SBFEP Apportionment (Bill 28: 10,925 m^3)	1989	NA	NA	631,150
SBFEP Apportionment (Transfer: 20,757 m^3)	1989	NA	NA	610,393
Helicopter Operable Area Adjustment (55,000 m^3)	1990	NA	NA	708,000
TFL 25 MP #8	1993	NA	NA	783,000 [151,178]
TFL 25 MP #9	1996	458,446 [NA]*	NA [NA]	779,000 [175,000]
Removal of Block 4 (31,300 ha) and addition of Block 6 (53,364 ha); Administrative Adjustment	1998	480,806 [NA]	115,798 [NA]	692,000 [175,000]
Central Coast Designated Area Temporary AAC Reduction (Blocks 2 and 5; 135,000 m^3)	2002	NA [NA]	NA [NA]	599,500 [175,000]
Expiration of Designated Area and AAC Reduction	2003	NA [NA]	NA [NA]	692,000 [175,000]
Timber Supply Analysis	2003	480,149 [32,202]	138,077 [25,562]	748,241 [164,534]
LRMP Designated Area Temporary AAC Reduction (Block 5; 84,000 m^3)	2006	NA [NA]	NA [NA]	608,000 [175,000]
AAC Reduction (Block 6; 8,500 m^3)	2006	NA [NA]	NA [NA]	599,500 [175,000]
Removal of Private Lands; Administrative Adjustment (66,500 m^3)	2007	468,013 [20,264]	129,152 [NA]	533,000 [108,500]
TFL 25 MP #10	2008	468,013 [NA]	NA [NA]	529,500 [108,500]
TFL 61 MP #1	2019	20,241	14,477	TBD

**values for TFL25 Block 1 are indicated, where available, in square brackets.*

4 Publicly Available Planning Documents

4.1 REGIONAL AND LANDSCAPE LEVEL PLANS

TFL 61 is encompassed within the Vancouver Island Land Use Plan (VILUP), which became effective January, 2001. The VILUP provides direction to Landscape Unit Planning and identifies two resource management zones (RMZs) within the TFL 61 land base. The San Juan Ridge Special Resource Management Zone (SMZ 22 or SJRSMZ) and Enhanced Forestry Zone 47 (RMZ 47 or EFRMZ). The San Juan Special RMZ provides specific management priorities around the Kludahk Trail Recreational Feature that runs between Port Renfrew and Jordon River. Forest activities occurring within this area must be carried out with special consideration for non-timber values, such as visual quality and recreation activities, forest ecosystem structure and function, and wildlife habitat. The majority of TFL 61 is within Resource Management Zone 47, which is designated as an Enhanced Forestry Zone. The EFRMZ includes specific objectives to produce higher volumes and values of timber while respecting environmental protection standards.

Land Use orders have brought the main forestry aspects of the VILUP into legal objectives requiring corresponding Results and Strategies in Forest Stewardship Plans. These include:

- Order Establishing Resource Management Zones and Resource Management Zone Objectives within the area covered by the Vancouver Island Land Use Plan, pursuant to sections 3(1) and 3(2), as well as section 9.1 of the Forest Practices Code of British Columbia Act.

A number of Government Action Regulation (GAR) Orders are in effect for areas within TFL 61. These include:

- Ungulate Winter Range #u-1-012 (Black-tailed Deer/Roosevelt Elk) effective 25/11/2004
- Order Establishing Visual Quality Objectives for the South Island Natural Resource District December 1, 2005
- Order to Amend Visual Quality Objectives for the South Island Natural Resource District December 30, 2011
- Order to Identify Recreational Sites, Trails and Interpretive forest Sites as Resource Features for the South Island Forest District, December 1, 2005
- Wildlife habitat areas #1-166, #1-167, #1-169, #1-170 (Marbled Murrelet) established 21/01/2008
- Wildlife habitat areas #2-216, #2-217, #2-218, #2-219, #2-220, #2-223 (Red-legged Frog) established 09/04/2009

4.2 OPERATIONAL PLANS

The Forest Stewardship Plan (FSP) specifies results and strategies consistent with government objectives that apply to the land base. On March 24, 2014, the FSP for TFL 61 was approved under section 16 of the Forest and Range Practices Act (FRPA).

4.3 PLANS REQUIRED BY INDEPENDENT FORESTRY CERTIFICATION PROGRAMS

The TFL 61 is not currently managed under any forest certification program.

5 Timber Supply Analysis

The *Tree Farm Licence Management Plan Regulation* requires that management plans contain a Timber Supply Analysis that examines the short- and long-term availability of timber for harvesting in the TFL and considers how management practices influence on the availability of timber. The regulation also requires supporting information for the Timber Supply Analysis including resource inventories, a description of the model and analytical methods used to formulate the timber supply, and any other information relevant to timber supply on the TFL.

5.1 SUPPORTING DOCUMENTATION FOR TIMBER SUPPLY ANALYSIS

Following the public review period, the Timber Supply Analysis was completely redone and the report completely rewritten. The Timber Supply Analysis for TFL 61 (see Appendix 3 of the completely rewritten report) was prepared by Forsite Consultants Ltd. using the modelling software Patchworks™ (version 1.3, 2018-10-10).

Harvest forecasts were prepared using the licensee's assessment of the best available information on current forest management and the land base available for timber harvesting. Details for these assumptions are described in an IP accepted by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD)'s Forest Analysis and Inventory Branch on August 21, 2017 and then made available for public review and First Nations referral between September 13, 2017 and November 14, 2017. The IP was then updated to reflect public review comments and included in Appendix 2.

6 Public Review and First Nations Referral

Section 6 of the *TFL Management Plan Regulation* outlines the requirements for public review and comment. In accordance with this requirement, a proposed public review strategy was submitted to the FLNRORD on December

5, 2016 and was subsequently approved by the Regional Executive Director on December 9, 2016.

As outlined in the strategy (Appendix 1), two products from this management plan process were made available for public review and First Nations referral:

- A draft IP, and
- A draft MP, including the updated IP and draft Timber Supply Analysis.

In both cases, similar approaches were applied to invite the public and First Nations to review and comment on the draft material presented. PATH completed the following:

- Provided access to a printed copy at the PATH office in Jordon River,
- Provided access to a printed copy at the FLNRORD office in Port Alberni,
- Provided access to a printed copy by mail or e-mail if requested,
- Provided access to a website: https://pathlp.ca/tree-farm-licence-61,
- Emailed government agencies,
- Emailed or mailed to Stakeholders,
- Emailed to the Pacheedaht First Nation and the T'sou-ke First Nation, and
- Published newspaper advertisements.

All distributions and responses received were shared with the FLNRORD.

6.1 PUBLIC AND FIRST NATIONS REVIEW OF THE DRAFT INFORMATION PACKAGE

The draft IP was the first product made available for review. It described the information used to support the Timber Supply Analysis; including data inputs and assumptions. The review period for this draft document was scheduled from September 13, 2017 to November 14, 2017.

6.1.1 SUMMARY OF COMMENTS RECEIVED

The comments received during the public review period of the draft IP are summarized in Table 2.

Table 2 Comments Received on the Draft Information Package

Provided By	Summary of Comments or Questions	Response
Rosemary Jorna, Sooke Resident, (Nov 13, 2017)	• Would like clarification on how 250 year harvest plan will regenerate old-growth forest. • Believes that the MP must consider the Juan de Fuca Marine Trail and Juan de Fuca Provincial Park. • Believes that the park itself does not provide sufficient protection for the values of the trail and would like to see that no logging take place between the park and Highway 14.	• Notes that significant area of old-growth within the TFL will never be harvested. • Provides clarification on the purpose of the modelling analysis is to calculate sustainable harvest over the long-term, by ensuring harvest never exceeds growth and sensitivity analyses address uncertainties, and how much old-growth will be retained and created. • The trail itself is located on Provincial Park land, TFL areas adjacent to the park are managed to ensure that: the integrity of park boundary, the function of creeks are not impacted, and consider the visual impact of PATH operations. • Revised IP includes addition of Section 1.2.5 that describes management in areas adjacent to the Juan de Fuca Marine Provincial Park. • Loss of the area between the Park and Highway 14 will jeopardize the viability of TFL, PATH has had discussions with government regarding potential replacement.

Provided By	Summary of Comments or Questions	Response
Heather Phillips, Juan de Fuca Trails Society, (Dec 4, 2017)	• Believes that all timber between Highway and Juan de Fuca Provincial Park should be removed from TFL. • Believes that not harvesting within the area above will result in more eco-tourism and provide more economic benefit to communities in the CRD • Concerned with climate change and survival of regeneration.	• The trail itself is located on Provincial Park land, TFL areas adjacent to the park are managed to ensure that: the integrity of park boundary, the function of creeks are not impacted, and consider the visual impact of PATH operations. • TFL provides local employment, training, recreational and business opportunities. Roads provide recreational opportunity. • Core of business is forest management which also provides many environmental, climate, wildlife and carbon benefits. PATH concern is that reduction of the operable land base jeopardizes the viability of TFL. • Loss of the area between the Park and Highway 14 will jeopardise the viability of TFL. PATH has had discussions with government regarding potential replacement.
Nathaniel Glickman (Sept 26, 2017)	• Can the maps be added to the web site?	• Data package itself does not produce maps, but if there is specific map data of interested it will be provided.
Parvez Kumar, Sooke Resident, (Oct 25, 2017)	• Concerned with the small size trees being transported through Sooke. • Concerned that harvest units are not being reforested?	• Provided link to satellite imagery. • Highway trucks are TimberWest travelling from private lands, logs from TFL 61 are processed in Jordon River. • On TFL 61 Pacheedaht plants 900 – 1000 stems/ha within the same year of logging.
Kara M. White, Sooke Resident, (Nov 14, 2017)	• Ask for preservation of old growth groves within TFL 61. • Would like logging practices that minimize impact to the Juan de Fuca Marine Trail.	• The trail itself is located on Provincial Park land, TFL areas adjacent to the park are managed to ensure that: the integrity of park boundary, the function of creeks are not impacted, and consider the visual impact of PATH operations. • Majority of old growth in the vicinity of the trail is protected as part of a Wildlife Habitat Area and draft Old Growth Management Area.
Mark Ziegler, Juan de Fuca Trails Society, (Oct 2, 2017)	• Would like description of management surrounding the Juan de Fuca Marine Trail. (pers. Comm.)	• IP revised with addition of Section 1.2.5.
TJ Watt, Ken Wu, Andrea Inness, Ancient Forest Alliance (Nov 14, 2017)	• Interest in 'Jurassic Grove' 130 ha, 70 ha is already protected as WHA. Portions (18 ha) within draft OGMA, requests an OGMA expansion to protect remaining 60 ha. • Requests a second OGMA expansion (7 ha) at Loss Creek adjacent to Provincial Park to project additional old-growth. • A new OGMA (5 ha) near the Sombrio River along the TFL boundary to protect additional old-growth. • Protection the above mentioned 60 ha of old-growth is of primary concern and would help guarantee peace within the TFL.	• PATH will assess potential impacts of protecting these areas as part of the timber supply analysis. • Protection of the OGMA extension at Loss Creek makes sense. • TFL provides local employment, training, recreational and business opportunities. Roads provide recreational opportunity. • Core of business is forest management which also provides many environmental, climate, wildlife and carbon benefits. PATH concern is that reduction of the operable land base jeopardises the viability of TFL.
Allison Elliott, BC Hydro (Oct 18, 2017)	• BC Hydo has extensive infrastructure within TFL 61. • BC Hydro has experienced a good relationship with TFL management regarding hazard tree management, access, security. • BC Hydro would like to continue meeting regarding hazard tree management (VQO retention), gate security (lock boxes) and access. • BC Hydro would be willing to discuss cost sharing opportunities around access maintenance. • BC Hydo has provided funding for terrestrial compensation work, would like to continue to communicate to ensure TFL management does not cause any negative impacts on these projects.	• Agrees with experience of cooperation and the overlap of many management activities and will continue to maintain discussions on the points raised.
Derek Wulff, Capital Region Beekeepers	• No comment provided	•

Provided By	Summary of Comments or Questions	Response
Bill Fosdick, Capital Region Beekeepers	• No comment provided	•
Mike Hicks, Capital Regional District	• No comment provided	•
Gordon Joyce, RPF, T'Sou-ke Nation (Oct 24, 2017)	• Does the MP include a First Nations consultation process?	• Consultation process is the responsibility of the Province, PATH also seeks input.
Tracy Andrews, RPF, South Island Natural Resources District (Oct 24, 2017)	• It is not Provincial Policy to default to the 2/3 old seral target draw down in Low BEO without evident that it impacts timber supply. The need for it must be verified through timber supply analysis.	• Added description of drawdown application requirements in the data package. • Revised draw down to current level of old forest, less than 2/3 of target. • Included sensitivity analysis to be completed as part of the timber supply analysis.

6.1.2 SUMMARY OF REVISIONS

The following revisions were made to the IP as a result of the public review:

- Addition of Section 1.2.5 Juan de Fuca Marine Trail.
- Addition of sensitivity analysis to test the impact of stand regenerating disturbances in the non-timber harvest land base.

In addition, the following revisions to the IP were made after the review period:

- Correction to the site index assigned to managed stands where the Provincial Site Productivity Layer returned a null value. Previously, a default value of 20 was applied, this has been revised so that when available the existing VRI site index value is assigned. This change had minor impacts for some analysis units on yields and minimum harvest ages.
- Removal of sensitivity analysis to test the impact of adjusting natural stand yields to match 2010 VRI statistical adjustment as the original VRI was not used in the analysis.
- Removal of sensitivity analysis to test the impact of adjusting natural stand yields to match the 2017 South Island VRI volume as the VRI has not had a Phase 2 analysis completed.
- Addition of sensitivity analysis to test the impact of replacing the old seral retention targets with draft old growth management areas.
- Minor changes to body text in order to make a clearer description of key management assumptions (e.g., non-forest land base definition, corrected TIPSY and VDYP versions, minimum harvest ages, genetic gains, green-up ages for VQOs, NSRs, application of 1/3 drawdown biodiversity targets). Appendix 7 was updated to represent the more accurate strategy to determine green-up ages for VQOs (i.e., average green-up age for each VLI polygon not applicable anymore, instead each analysis unit overlapping the VLI polygons has its own age based on green-up height).
- Major changes due to correcting proper application of OAFs and genetic gains to TIPSY yields. The TIPSY yield tables and minimum harvest ages were adjusted accordingly.
- Appendix 2, minor change of site index class label from Very Low to Poor to align with the analysis unit names.

- Appendix 4 was reformatted by compacting the VDYP yield tables.
- Appendix 5 was adjusted to include the natural % of TIPSY regeneration assumptions.

6.2 PUBLIC AND FIRST NATIONS REVIEW OF THE DRAFT MANAGEMENT PLAN #1

The draft MP #1 was the second, and final, product made available for review. This document provides a general description and history of the TFL, listed the primary planning documents that guide the management of the TFL and summarized outcomes from the public review and First Nations referral process. The review period for the draft MP #1 was scheduled from January 23, 2019 to March 25, 2019.The draft MP #1 also included, as appendices, the accepted IP and a draft Timber Supply Analysis.

6.2.1 SUMMARY OF COMMENTS RECEIVED

The comments received during the public review period of the draft MP #1 are summarized in Table 3.

Table 3 Comments Received on the Draft Management Plan #1

Provided By	Summary of Comments or Questions	Response and Revisions
Mario Di Lucca, FAIB, (May 23, 2019)	• Completed revision of TIPSY curves following correct application of OAFs and genetic gains. Revisions to IP are required and a complete redo of the timber supply analysis.	• A complete redo of the timber supply analysis was conducted and the timber supply analysis report was completely rewritten. • The revisions to IP were also conducted (Appendices 5, 7, and 8)
	•	•

6.2.2 SUMMARY OF REVISIONS

In response to the comments received, the timber supply analysis was completely redone to address the updated TIPSY curves that correctly accounted for OAFs and genetic gains and the strategy to determine a proper harvest rate. The revised TIPSY yields had a ripple effect as changes to the minimum harvest ages and green-up ages were required. Consequently, the timber supply analysis report was completely rewritten to accurately reflect all changes and the proposed MP# 1 aligned to the updated harvest rates.

Appendix 1 Approved Public Review Strategy

TFL61 Management Plan #1

Proposed Referral and Public Review Strategy

Pacheedaht Andersen Timber Holdings LP (PATH) is preparing Management Plan (MP) #1 for TFL61. With the introduction of the *TFL Management Plan Regulation* in November 2009, the steps required to obtain an approved MP have changed. Under the *new* process, the tree farm license holder must obtain approval from the Regional Executive Director (RED) of a strategy for public review of the management plan. This must be approved one year prior to the date the management plan is submitted to the chief forester which, for TFL61, is 2017/08/01. This document is that proposed review strategy.

General

The first step in the strategy will be to make a draft timber supply analysis Information Package (IP) available for review. Comments received will be considered and a final IP submitted to the Forest Analysis and Inventory Branch (FAIB) of the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) for acceptance. Later the draft MP will be made available for review. The draft MP will include the timber supply analysis (TSA) and the accepted IP.

The draft IP and the draft MP will be distributed to FLNRO and First Nations and be made available to the public for review as detailed below (where applicable, references to the MP also apply to the IP for its review).

Agencies

Table 1 lists the agency contacts that will be sent the documents. Paper copies of the documents and maps associated with the MP will be sent to the South Island Natural Resources District (SINRD). All agency contacts will be sent a CD containing the documents and the maps. PATH will print the maps if requested to do so.

Table 1 – Agency Contacts

Agency	Contact
FAIB	Hal MacLean
SINRD	Tracy Andrews
Ecosystems Nanaimo	Ron Diederichs

FLNRO will notify other potentially interested provincial and federal agencies that the MP is available for review.

First Nations

The FLNRO will lead the consultation effort with the First Nations. The process for this is outlined in the TFL61 First Nation Consultation Strategy that has been developed by the FLNRO. The First Nations to be consulted are listed in Table 2.

Table 2 – First Nations

First Nation Name	Main Contact	Contact Information
Pacheedaht	Chief Jeff Jones and Tom Jones, Forestry Manager	Email: jeffj@pacheedaht.ca treaty@pacheedaht.ca referrals@pacheedaht.ca bandmanager@pacheedaht.ca
T'sou-ke	Chief Gordon Planes and Council	Email: adminstrator@tsoukenation.com Phone: 250-642-3957

Other Stakeholders and General Public

Notification letters will be sent to potentially interested stakeholders (based on a contact list that will include water licence holders, trappers (if names and addresses can be found), guide outfitters, and local governments). The letters and an introductory section on the PATH internet site will summarize the new MP content requirements. Ads will be run on two separate occasions in consecutive weeks in the *Sooke News Mirror* newspaper. The ad will state that the draft MP is available for review for a period of 60 days at the following locations:

- PATH Internet Site
- Queesto Office, Jordan River
- Pacheedaht Band Office, Port Renfrew

The ad will also provide phone numbers, fax numbers, and an email address for providing comments.

Newspaper Ad

The newspaper ad referred to above would look like the last page of this document (with "Day 1" and "Day 60" replaced with dates that are 60 calendar days apart).

Communications Sharing with FLNRO

As required by the *TFL Management Plan Regulation*, the final MP submission will include a description of this strategy and a summary of the comments received. It will also include a description of changes made to the MP due to the comments received. A separate but related submission will be made to the FLNRO at the time of the final MP submission. It will include a copy of all correspondence sent or received by PATH with regards to the review of TFL61 MP #1 and a summary of the public comments received as a result of the public review.

Sequential Summary of Steps

Table 3 present the chronological order for all steps described above. There is the possibility of iterations at some steps (e.g. more than one review strategy document may need to be submitted (Step 1) before the RED approves the strategy (Step 2)).

Table 3 – Sequence of Events

Step #	Event	Approximate Date(s)
1	Pacheedaht Andersen Timber Holdings submits review strategy (this document) to RED	Nov 9, 2016
2	RED approves review strategy	Dec 9, 2016
3	Pacheedaht Andersen Timber Holdings submits, refers, and advertises for review a draft IP	Jan 31, 2017
4	Review period (60 days) takes place	March 31, 2017
5	Pacheedaht Andersen Timber Holdings considers any comments received and submits a final IP	April 30, 2017
6	IP accepted by FAIB	April 30, 2017
7	Pacheedaht Andersen Timber Holdings submits, refers, and advertises for review a draft MP	June 2, 2017
8	Review period (60 days) takes place	June 2, 2017
9	Pacheedaht Andersen Timber Holdings considers any comments received and submits a final MP	August 1, 2017
10	Deputy Chief Forester approves MP and determines AAC	May 1, 2018

Tree Farm Licence 61, Management Plan #1

Available for Review and Comment

TFL 61, held by Pacheedaht Andersen Timber Holdings LP (PATH), covers roughly 20,230 hectares of land on southern Vancouver Island in the vicinity of Jordan River. The Management Plan (MP) provides a general description of the TFL, a brief history of the TFL, a list of publicly available planning documents that guide PATH 's operations on the TFL and a timber supply analysis for the TFL. The timber supply analysis provides information to assist the Chief Forester of BC in determining the allowable annual cut for TFL 61.

The MP for TFL 61 is available for public review from **Day 1** until **Day 60** during normal business hours at the following locations. Please call ahead to arrange an appointment to view:

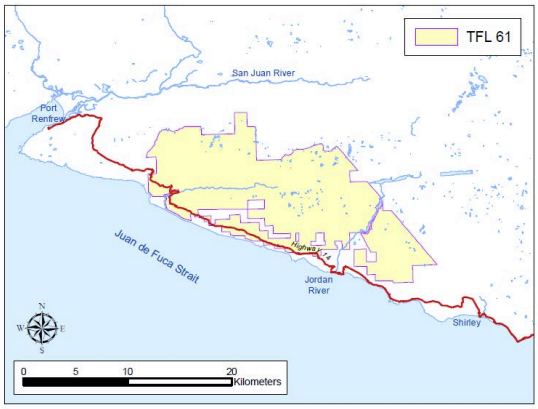
- Pacheedaht Andersen Timber Holdings Office, 11793 West Coat Road, Jordan River, BC, V9Z 1L1, Ph. (604) 803-1043
- Ministry of Forests, Lands, and Natural Resources Operators, 4885 Cherry Creek Road, Port Alberni, BC, V9Y 8E9, Ph. (250) 731-3000

You can also find the Management Plan at http://www.to be confirmed

A set of reference maps are included in the review materials.

Please write, fax, or email comments by day 60 to:
TFL 61 Management Plan
Pacheedaht Andersen Timber Holdings LP.

1101-409 Granville St.,
Vancouver, BC,
V6C 2S6
Fax: (604)681-1936
Email: publicreview@coll.bc.ca



Appendix 2 Accepted Information Package

Tree Farm Licence 61

Timber Supply Analysis Information Package

June 2019

Project 1280-3

Prepared by:

Forsite Consultants Ltd.
330 – 42nd Street SW
PO Box 2079
Salmon Arm, BC V1E 4R1
250.832.3366

FORSITE
Forest Management Specialists

Prepared for:

Angus Hope, PEng, RPF
Pacheedaht Andersen Timber Holdings Limited Partnership
1101-409 Granville Street
Vancouver, BC, V6C 2S6

Table of Contents

List of Appendices

List of Figures

List of Tables

List of Acronyms and Abbreviations

AAC	Allowable Annual Cut
AU	Analysis Unit
BCGW	BC Geographic Warehouse
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Option
CFLB	Crown Forest Land Base
CWH	Coastal Western Hemlock
DSI	South Island Natural Resource District
DWB	Decay, Waste, and Breakage
ERMA	Effective Riparian Management Area
FLNRO	BC Ministry of Forests, Lands and Natural Resource Operations
FRPA	Forests and Range Practices Act
GAR	Government Actions Regulations
GIS	Geographic Information System
IP	Information Package
HBS	Harvest Billing System
LU	Landscape Unit
MAI	Mean Annual Increment
MH	Mountain Hemlock
MP	Management Plan
NDT	Natural Disturbance Type
NVAF	Net Volume Adjustment Factor
OAF	Operational Adjustment Factors
OGMA	Old Growth Management Area
PATH	Pacheedaht Andersen Timber Holdings LP
PFT	Problem Forest Types
PSPL	Provincial Site Productivity Layer
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
SJRSMZ	San Juan Special Resource Management Zone
TFL	Tree Farm Licence
THLB	Timber Harvest Land Base
TIPSY	Table Interpolation for Stand Yields
TL	Timber Licence
TSA	Timber Supply Analysis
TSR	Timber Supply Review
UWR	Ungulate Winter Range
VDYP	Variable Density Yield Prediction
VILUP	Vancouver Island Land Use Plan
VLU	Visual Landscape Unit
VQO	Visual Quality Objective
VRI	Vegetation Resource Inventory
WFP	Western Forest Products
WHA	Wildlife Habitat Area
WTP	Wildlife Tree Patch

1 Introduction

Tree Farm Licence (TFL) 61 is located on southern Vancouver Island near the communities of Port Renfrew, Jordon River, and Sooke. Pacheedaht Andersen Timber Holding LP (PATH) acquired the TFL in 2010. Prior to 2010 the TFL was Block 1 of TFL 25, which was established in 1958. In 2007, all private lands were removed from TFL 25 Block 1.

The most recent timber supply analysis (TSA) for this area was completed in 2003 as part of the larger TFL 25 Management Plan (MP) #10. The current allowable annual cut (AAC) for TFL 61, established in May, 2010, is 108,500 cubic metres. British Columbia's *Forest Act - Tree Farm Licence Management Plan Regulation* requires the completion of a MP and AAC determination by May 2020. This information package (IP) and the upcoming analysis report are in support of this goal and are anticipated to be completed by December 2018.

This IP provides the necessary documentation of data sources, modelling assumptions, and procedures expected to be used in completing the current timber supply analysis for TFL 61.

1.1 Location

TFL 61 is located in southwestern Vancouver Island (Figure 1). The total area of TFL 61 is 20,240 ha and includes two units. The larger unit, Block 1, is 17,192 ha in size while Block 2 is 3,048 ha. Elevation across the TFL ranges from sea level to 1,100 m. The TFL is primarily within the coastal western hemlock (CWH) biogeoclimatic ecosystem classification (BEC) zone, with higher elevations in the mountain hemlock (MH) zone. There are six CWH subzone variants, CWHmm1, CWHmm2, CWHvh1, CWHvm1, CWHvm2, CWHxm2, and one MH subzone variant MHmm1. Stand-initiating events within the TFL are rare, or infrequent.

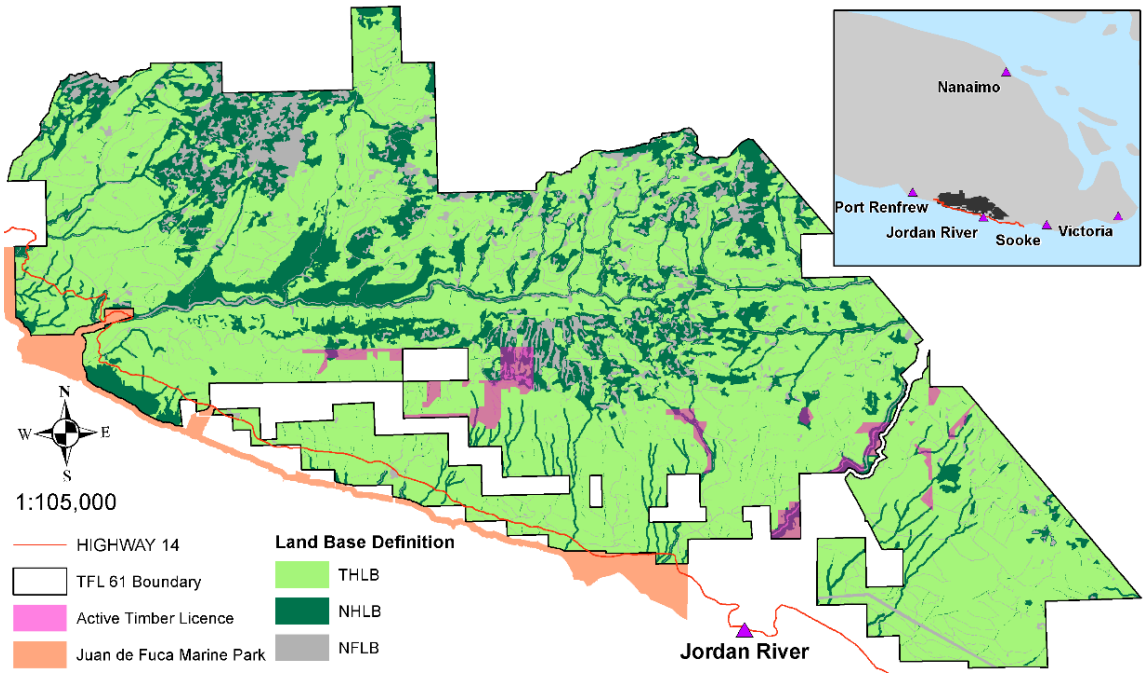


Figure 1. Location of TFL 61

1.2 Forest Management Considerations Affecting TFL 61

A number of special considerations are expected to influence forest management practices in the TFL and potentially impact timber supply. These topics are briefly described below.

1.2.1 Visual Quality Objectives, Travel Corridors, and Scenic Areas

Scenic areas and Visual Quality Objectives (VQOs) were established for the South Island Natural Resource District (DSI) through a government actions regulation (GAR) order. The analysis will apply forest cover objectives that are consistent with the established VQOs and the scenic class objectives based on the latest VQO map.

1.2.2 San Juan Ridge Special Management Zone

The San Juan Ridge Special Resource Management Zone (SJRSMZ) from the Vancouver Island Land Use Plan provides direction for management around the Kludahk Trail that runs between Port Renfrew and Jordon River. Forest activities occurring within this area must be carried out with special consideration for non-timber values, such as visual and recreation activities, forest ecosystem structure and function, and wildlife habitat. The analysis will maintain mature seral forest cover and VQOs consistent with the legal objectives established for the SJRSMZ.

1.2.3 Wildlife Habitat

Within TFL 61, ten wildlife habitat areas (WHAs) have been established – 4 for Marbled Murrelet and 6 for Red-legged Frog. These WHAs have been designated as No Harvest areas. Additionally, there are two No Harvest ungulate winter range (UWR) units within TFL 61. The analysis will remove all WHAs and UWRs from the Timber Harvest Land Base (THLB).

1.2.4 Monumental Cedar Reserve

PATH is working with the community of Port Renfrew to identify and manage sites for the supply of monumental cedar (cedar trees suitable for constructing large dugouts, large poles, split beams, and planks). A number of areas have been spatially delineated on the land base. The TSA will retain these areas within the THLB but will defer harvesting activities for 100 years.

In addition, PATH expects that monumental cedar within wildlife tree patches (WTP) and riparian reserves may be available for the community.

1.2.5 Juan de Fuca Marine Trail

The Juan de Fuca Marine Trail is part of the Juan de Fuca Provincial Park that runs along the shoreline and the TFL boundary. Management considerations include operational prescriptions designed to protect the park boundary from impacts from forestry operations. These considerations include wind-throw assessments when planning operations, and riparian assessments along creeks. Visual assessments are also used where sections of the trail are located close to the boundary of the TFL. The park and trail are more formally protected where the travel corridor along the West Coast highway overlaps the Park and Trail location.

2 Inventories and Data Sources

To ensure that all forest management objectives are appropriately considered in the upcoming TSA, a broad set of timber and non-timber forest resource datasets have been compiled. Table 1 describes the data used to build the TFL resultant file which is stored within an ArcGIS geodatabase and will be used to support forest estate modelling.

Table 1. Resource Data Sources and Vintage

Resource Topic	Data Coverage Name	Data Source	Acquisition Date
TFL Boundary	tfl61_blk1_2_final	PATH	2015-12-22
Cultural Heritage	archsites_30May17	FLNRO	2017-05-31
Ownership	WHSE_FOREST_VEGETATION.F_OWN	BCGW	2016-12-21
Timber Licence	WHSE_FOREST_TENURE.FTEN_TL_REMAINING_POLY_SVW	BCGW	2016-12-21
Timber Licence Elimination	WHSE_FOREST_TENURE.FTEN_TL_ELIMINATION_POLY_SVW	BCGW	2016-11-16
Forest Inventory	TFL61_2006_FC	PATH	2017-05-24
Harvest History	logging	PATH	2017-05-24
Operability	TFL61_Operability_2017	PATH	2016-12-19
Landscape Units	WHSE_LAND_USE_PLANNING.RMP_LANDSCAPE_UNIT_SVW	BCGW	2016-11-16
Non-Legal Planning Objectives	WHSE_LAND_USE_PLANNING.RMP_PLAN_NON_LEGAL_POLY_SVW	BCGW	2016-12-19
Draft Old Growth Management Areas	WHSE_LAND_USE_PLANNING.RMP_OGMA_NON_LEGAL_CURRENT_SVW	BCGW	2018-02-15
Legal Planning Objectives	WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW	BCGW	2016-12-19
Stream Classification	streams_update_AH.gdb	PATH	2016-05-26
Visuals	WHSE_FOREST_VEGETATION.REC_VISUAL_LANDSCAPE_INVENTORY	BCGW	
Visuals GAR Travel Corridor	Travel_Corridors_GAR2011_Amendment	BCGW	2016-12-19
Recreation Polygons	WHSE_FOREST_TENURE.FTEN_RECREATION_POLY_SVW	BCGW	2016-12-19
Recreation Inventory	WHSE_FOREST_VEGETATION.REC_FEATURES_INVENTORY	BCGW	2016-12-19
Recreation Opportunity Spectrum	WHSE_FOREST_VEGETATION.REC_OPPORTUNITY_SPECTRUM_INV	BCGW	2016-12-19
Terrestrial Ecosystem Mapping	ecosystems	PATH	2017-05-24
Terrain Stability	stability	PATH	
Cultural Cedar Reserves	TFL61_Cedar_Reserves_May_2017	PATH	2017-05-19
Research Installations	WHSE_FOREST_VEGETATION.RESPROJ_RSRCH_INSTLTNS_SVW	BCGW	2016-07-14
Wildlife Habitat Areas Legal	WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POL	BCGW	2016-12-16
Ungulate Winter Range Legal	WHSE_WILDLIFE_MANAGEMENT.WCP_UNGULATE_WINTER_RANGE_SP	BCGW	2016-12-16
Road Polygons	ERoadBuff_Dissolve_20170607	Forsite	2017-06-07
Classified Stream/Waterbodies RRZ/RMZ (Buffers)	a_Effective_RMA	Forsite	2017-01-05
Provincial Site Productivity Layer (PSPL) Forest Coverage	BC_Site_Prod_TFL61	BCGW	2015-12-22
Forest Inventory Update	TFL61_Updated_VRI_05072018	Forsite	2017-07-10

The BC Geographic Warehouse (BCGW) can be found at http://geobc.gov.bc.ca/.

2.1 Data Gathering and Preparation

2.1.1 Vegetation Resources Inventory

The Vegetation Resource Inventory (VRI) Phase I for TFL 61 was completed in 1998, Phase II VRI field sampling was completed in 1999, and a Net Volume Adjustment Factor (NVAF) analysis was completed in 2010.

As part of this project, the VRI was recently updated using a combination of LiDAR and RESULTS silviculture history records. The LiDAR data was captured on December 4, 2016. The approach used to update the inventory file is described briefly below. A more detailed update procedure document is included as Appendix 1.

2.2 Inventory Adjustments

The VRI forest inventory was updated to reflect harvesting to January 1, 2017. Polygon boundary adjustments were manually completed by a certified VRI interpreter based on Lidar height (1m CHM) data, stand age was then updated using the RESULTS silviculture history records. Stand ages were screened across the TFL by the VRI interpreter and adjusted if obvious discrepancies existed.

The stocking (stems/ha) attribute was updated using a Lidar derived individual tree inventory dataset produced by Forsite and polygons heights were adjusted using the Lidar Canopy Height Model (CHM). The updated stand height was used along with the polygon age to derive an updated site index using Site Tools (v4). Basal area values were left as per those found in the projected TFL VRI file.

The updated VRI inventory was then used to generate Variable Density Yield Prediction (VDYP) yield curves for each forest cover polygon.

2.3 Management Era

Stand history was used for land base classifications, assigning management objectives, and developing yield projections. Stand history was derived from the VRI and local knowledge.

Based on regeneration methods, harvest systems, protection, and non-timber resource management, TFL 61 has three distinct past management eras. A fourth era will characterize current and future activities.

Era 1 (Prior to 1960)

The primary method of stand regeneration in Era 1 was natural seeding. An estimated regeneration delay of 3 years was used to build the yield curves for Era 1. See Section 5.4 for modelling details.

Era 2 (1960 – 2000)

Era 2 is characterized by an extensive planting program with increased availability and variety of seedling stock. Regeneration delays were generally less than 2 years, and a conservative regeneration delay of 2 years will be applied to stands regenerated in Era 2. See Section 5.5 for modelling details.

Era 3 (2001 – 2016)

Era 3 is characterized by the extensive use of genetically improved seedling stock and reduced regeneration delays. A regeneration delay of 1 year will be applied to stands regenerated in Era 3. Gains resulting from genetic stock will be modelled as per Section 5.5.2.

Era 4 (Future)

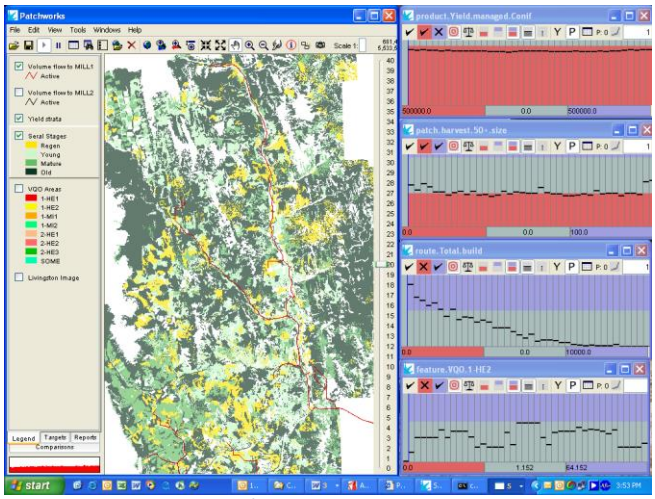
Assumptions are the same as Era 3 but yield reductions to account for future road development have been applied. Stands regenerated in Era 4 will have the genetic gains realized over the past 5 years.

3 Timber Supply Forecasts and Sensitivity Analyses

This section provides a summary of the modelling which will be completed following the acceptance of the Information Package. This includes the model and the intended harvest forecasts that will be completed and documented in the Analysis Report.

3.1 Model

The Patchworks modelling software will be used for timber supply forecasting and analysis. This suite of tools was developed by Tom Moore and Cary Lockwood, and is sold and maintained by Spatial Planning Systems Inc. of Deep River, Ontario (Tom Moore – www.spatial.ca). Patchworks is a fully spatial forest estate model that is capable of incorporating real world operational considerations into a strategic planning framework. It utilizes a goal seeking approach and an optimization heuristic to schedule activities across time and space in order to find a solution that best balances the targets/goals defined by the user. Targets can be set on any aspect of the problem formulation. For example, the solution can be influenced by issues such as mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, snag densities, coarse woody debris levels, equivalent clearcut areas, specific mill volumes by species, road building/hauling costs, delivered wood costs, and net present values.



3.2 Base Case

The base case scenario represents the current management practices within TFL 61. This is defined by operational management practices, characteristics of resource values, current silviculture practices, and estimates of present and future growth of forest stands. The base case analysis follows the assumptions described in this IP.

3.3 Alternative Harvest Flows

The shape of the harvest flow for the base case is generally guided by provincial policy to balance current and future harvest rates. Harvest flow objectives are to maximize long-term timber supply and maintain or increase short-term timber supply, while maintaining established non-timber resource values. In meeting these general objectives, harvest flow will conform to the following guidelines:

- The transition from short- to medium and long-term harvest levels will avoid any large or abrupt disruptions in timber supply (generally increases and decreases in steps of 10% per 10 year period);
- Potential drops in timber supply will avoid dropping below the maximum even flow harvest level; and
- Achieve the highest harvest level while maintaining a stable (flat line) growing stock.

PATH will explore alternative harvest flow options and present the recommended option as the base case.

3.4 Sensitivity Analyses

Sensitivity analyses help to illustrate the timber supply implications of alternative management scenarios, and quantify the uncertainty inherent in the data used to create the base case. Sensitivity analyses are performed by modifying one input and examining the impact that the change has on the model outputs. The following sensitivity analyses will be conducted as part the of TFL 61 analysis:

- Increase and decrease THLB by +/– 10%
- Increase and decrease regeneration delay by +/– 2 years
- Increase and decrease minimum harvest age +/- 10 years
- Increase and decrease volume projections for natural stand yields +/- 10%
- Increase and decrease volume projections for managed stand yields +/- 10%
- Replace drawdown seral retention with full retention requirements
- Remove old seral target requirements and apply draft old growth management areas
- Apply stand regenerating disturbances in non-timber harvest land base
- Apply stand regenerating disturbances in non-timber harvest land base and replace drawdown seral retention with full retention requirements

4 Land Base Definition

The land base definition begins with the total land area within the TFL boundaries, and applies the various legal, regulatory and operational classifications necessary to determine the Crown Forest Land Base (CFLB; the productive forest land area administered by the Crown), and the THLB (the net land base that is capable and available to support timber harvesting over time).

Land base constraints often overlap on the same area. Although it is important to know the entire area within each constraint, it is also important to account appropriately for these overlaps when determining the net area available for forest management activities (the THLB).

Table 2 reports the total area within each land base classification (ignoring overlaps), as well as the effective area removed within each classification (area that did not overlap with a previous netdown). The classifications are listed in the order in which they were applied, and each classification is described in more detail in the sections following.

4.1 Timber Harvesting Land Base Determination

The total area within the boundaries of TFL 61 is 20,240 hectares, including land and water. Reductions for non-crown, non-forest, non-productive, and roads totals 1,695 ha and results in a CFLB of 18,545 ha.

Spatial reductions of areas unsuitable for harvesting (4,067 ha) result in a current THLB of 14,477 ha. Non-spatial reductions for future WTP retention (507 ha) and future transportation infrastructure (767) reduce the THLB an additional 1,274 ha, making the expected future THLB 13,203 ha.

Table 2. Timber Harvesting Land Base Determination

	Total Area (ha)	Net Area (ha)	Percent of Total Area (%)	Percent of CFLB (%)
Total Area		20,240.1	100.0	
Less:				
Non-Forest	1,175.5	1,176.5	5.8	
Existing Roads and Trails	530.5	518.9	2.6	
Total Productive Crown Forest Land		**18,544.7**	**91.6**	**100.0**
Less:				
Archaeological Sites	4.1	4.0	0.0	0.0
Inoperable	533.5	426.4	2.1	2.3
Potentially Unstable Slopes	807.8	684.7	3.4	3.7
Low Productivity Forest	3,111.6	2,083.4	10.3	11.2
Effective Riparian Management Areas	1,796.5	734.8	3.6	4.0
Ungulate Winter Range	153.9	54.8	0.3	0.3
Wildlife Habitat Areas	489.9	46.5	0.2	0.3
Monumental Cedar Reserves	35.1	32.8	0.2	0.2
Current Timber Harvest Land Base		**14,477.3**	**71.5**	**78.1**
Less:				
Wildlife Tree Patches (WTP @ 3.5%)		506.7	2.5	32.7
Future Roads and Landings (@5.3%)		767.3	3.8	4.1
Future Timber Harvest Land Base		**13,203.3**	**65.2**	**71.2**

4.1.1 Total Area

The last timber supply analysis for the TFL 61 area was completed in 2003. At that time the total area of the TFL was 32,202 hectares. Since that time all private lands have been removed from TFL and the current total area is 20,240 hectares.

4.1.2 Timber Licence Reversions

TFL 61 includes 1,652 ha of Timber Licence (TL) area that has been harvested and reverted to the TFL. An additional 435 hectares remain as active TL (Table 3). It is assumed that all active TLs will revert to the TFL.

Table 3. Timber Licence Reversions

Timber Licence	Total Area (ha)	Active (ha)
T0002	516.8	48.1
T0011	270.3	62.4
T0022	511.3	90.1
T0055	787.9	234.0
Total	**2,086.4**	**434.6**

4.1.3 Non-Forest/Non-Productive Forest

Table 4 reports the areas within the TFL classified as non-forest and non-productive forest. These areas are captured in the forest cover inventory dataset and include various types of non-forest, non-productive, or non-commercial cover including water, snow, ice, rock, alpine, wetlands, and un-typed areas (field "WCS" with values 'SWAMP', 'HYDRO', 'LAKE', 'ROCK', 'BRUSH', 'SLIDE', 'RIVER', 'PIT', 'CREEK','NPFOR'). These areas have been removed from the CFLB, the total area within these classifications is 1,176 ha.

Table 4. Non-Forest Area

Non-Forest Type	Total Area (ha)
Alpine/Rock	16.3
Non-Productive Brush	7
Non-Productive Forest	410.4
Water	157.9
Wetland / Swamp	522.9
Slides	15.4
Hydro Right of Way	33.7
Pit	11.9
Total	**1175.5**

4.1.4 Roads, Trails, and Landings

PATH maintains a dataset of roads and trails located within TFL 61. This includes linear features within a spatial dataset and an accompanying database indicating the road class.

The area occupied by roads and trails was calculated by creating road polygons (buffers) around the linear features within the GIS dataset. The buffered road area is the assumed loss of productive land due to roads, trails, and landings. Road widths were adopted from the Arrowsmith Timber Supply Review (TSR) and are reported in Table *5*. It was assumed that abandoned roads become reforested over time, but with a reduced level of productivity. Although specific data is not available, abandoned roads were assumed to be 50% productive and were considered to be half of their original width.

Table 5. Total Road Length, Width and Area by Road Class

Road Class	Length (km)	Road Width (m)	GIS Buffer Area (ha)
Highway	18.3	16	29.2
Main	130.1	13	169.1
Branch	260.8	10	260.8
Spur	14.2	8	11.3
Main (abandoned)	4.8	6.5	3.1
Branch (abandoned)	109.6	5	54.8
Spur (abandoned)	5.5	4	2.2
Total	**543.2**		**530.5**

There are currently 531 ha of roads on the TFL; the net reduction for existing roads is 519 ha.

4.1.5 Archaeological Sites

Operational plans recognize and, wherever possible, protect First Nations cultural features and sites. Operationally, areas with high archeological feature potential as well as areas adjacent to areas of high potential require a field survey to confirm the presence or absence of cultural features. In most cases, these areas are surveyed by an archaeologist and members of the local First Nation. These surveys generate archaeological impact assessments that identify features, when they are found, and propose protection measures. Within this TFL, archeological sites requiring protection exists and were accessed from the FLNRO (RADD polygon dataset). The archaeological sites were 100% removed from the THLB.

4.1.6 Future Roads, Trails, and Landings

This area has been managed since 1958 and the transportation infrastructure is well established with a small portion of the land base currently undeveloped. The developed land base was delineated by applying a GIS buffer of 200 metres around all existing roads. It was assumed that areas within the buffer could be accessed without additional road infrastructure and areas beyond the buffer would require additional road construction and loss of productive forest land. It was also assumed that mature stands classified as helicopter operable would not require additional road construction; as a result these have not been included in the 'undeveloped' land base for future yield reductions.

To account for the loss of productive land for future roads a ratio of road-area to harvest-area was calculated. This ratio was then applied as a reduction to the future yield curves. To calculate this ratio, forested areas established after 1958 were considered harvested. There is currently a total of 9,980 ha of forest established after 1958, and within this area there is a total of 531 ha of road. Therefore a 5.3% reduction will be applied to future yield curves to account for future roads. Table 2 reports a net reduction of 767 ha for future roads, representing 5.3% of the future THLB.

4.1.7 Inoperable/ Inaccessible

PATH recently completed a physical operability assessment and delineated three operability classes; Operable (conventional), Operable (helicopter), and Inoperable. Inoperable areas were removed from the THLB. There is a total of 534 ha of Inoperable area that has been removed from the THLB (Table 6), with a net reduction of 426 ha.

Table 6. Operable Classifications

Operability Code	Area (ha)
Operable (conventional)	18,894.3
Operable (helicopter)	812.3
Inoperable	533.6
Total	**20,240.2**

4.1.8 Potentially Unstable Slopes

Detailed terrain stability mapping (Terrain Survey Intensity Level C) was completed for the TFL in 1992, and reclassified to BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO) standards in 1996. Table 7 reports the area within each terrain classification for the TFL.

Table 7. Terrain classifications and area.

Terrain Classification	Description	Area (ha)
Class I	No significant stability problems exist	3,775.9
Class II	There is a very low likelihood of landslides following timber harvesting or road construction	11,082.5
Class III	There is a low likelihood of landslide initiation following timber harvesting	2,757.6
Class IV	Expected to contain areas with a moderate likelihood of landslide initiation following timber harvesting or road construction	1,444.7
Class V	Expected to contain areas with a high likelihood of landslide initiation following timber harvesting or road construction	990.8
Unclassified	No terrain typing available	188.7
Total		**20,240.2**

While 'on-the-ground' based assessments ultimately determine terrain management practices, Class V areas without a history of harvest were completely removed from the THLB for modelling purposes. Additionally Class IV areas with slopes greater than 70% and without a harvest history were also removed from the THLB. The area removed from the THLB is reported in Table 8 (unclassified areas were not removed).

Table 8. Potentially unstable slopes removed from THLB.

Terrain Classification	Description	Area (ha)
Class IV	Slopes >70% with no harvest history	246.7
Class V	No harvest history	561.1
Total		**807.8**

A total of 808 ha was removed from the THLB, for a net reduction of 685 ha.

4.1.9 Low Site Productivity

Low productivity sites are areas that are unsuitable for timber management due to their low growth potential or low stocking. This analysis based the classification of low productivity on the potential to achieve a harvestable volume of 350 m^3/ha at 250 years of age for conifer stands, and the potential to achieve a harvestable volume of 200 m^3/ha at 250 years for deciduous stands. These volumes are consistent with those used to define minimum harvest ages. The potential to achieve these volume-age thresholds will be determined using the existing natural stand yield curves.

Previously harvested stands (established after 1958) were assumed to be capable of achieving the harvestable volume criteria regardless of site index.

There is a total of 3,112 ha with low site productivity, resulting in a 2,083 ha net reduction to the THLB.

4.1.10 Problem Forest Types

Problem forest types (PFT) are stands that contain tree species not currently utilized or that have marginal merchantability. Stands with low merchantability due to low growth potential were removed from the THLB as described above. There is assumed to be no PFTs in TFL 61.

Often deciduous leading stands are considered to be PFTs. However PATH has demonstrated performance in these stand types. Table 9 reports Harvest Billing Systems (HBS) deciduous harvest volumes for TFL 61 over the past five years. Within the TFL there is currently 235 ha of deciduous-leading stands, all of which are red alder leading. The current MP does include deciduous leading stands within the THLB and in timber supply projections. Consistent with the current plan, alder leading stands are included in the THLB and alder volume will contribute to timber supply in the upcoming analysis.

Table 9. Deciduous harvest volume from HBS

Harvest Billing Period	Deciduous Volume (m^3)
2012	1,255
2013	360
2014	265
2015	340
2016	15
Total	**2,235**

4.1.11 Riparian Management Areas

PATH maintains an ongoing stream/waterbody classification inventory that contains the most complete information regarding fish presence and riparian classification. The stream/waterbody inventory encompasses the entire TFL but is most complete in areas with past or upcoming development activity. PATH used its operational experience to reclassify some of the streams in less developed areas through a manual GIS exercise. Out of 1,038 km of streams, approximately 275.4 km were reclassified from non-classified to S6 and approximately 55.3 Km were reclassified from S5, S6, or non-classified to S3 or S4. Waterbodies were classified according to their area and BEC zone overlap.

Riparian Reserve Zones (RRZ) and Riparian Management Zones (RMZ) were created spatially through a GIS buffering process. To address partial harvesting in RMZ's, an Effective Riparian Management Area (ERMA) was calculated based on the RMZ width and percent retention (e.g. 40m RMZ X 10% retention = ERMA 4m). The retention levels used to calculate the ERMA were adopted from the Arrowsmith TSR.

Both the reserve zones and effective management zone widths were summed to get a gross riparian buffer width for use during modeling. Table 10 reports the assumptions for each riparian classification.

Table 10. Riparian buffers

Water Feature	Reserve Zone (m)	Management Zone (m)	RMZ % Basal Area Retention	Effective RMA (m)	Buffer Applied (m)	Area (ha)
Large Lake (L1)	10	0	n/a	0	10	7.0
Medium Lake (L2)	10	20	10	2	12	
Medium Lake (L3)	0	30	10	3	3	
Small Lake (L4)	0	30	10	3	3	16.7
Large Wetland (W1)	10	40	10	4	14	20.9
Medium Wetland (W2)	10	20	10	2	12	
Medium Wetland (W3)	0	30	10	3	3	162.6
Small Wetland (W4)	0	30	10	3	3	408.8
Wetland Complex (W5)	10	40	10	4	14	
Stream (S1)	50	20	20	4	54	240.2
Stream (S2)	30	20	20	4	34	197.9
Stream (S3)	20	20	20	4	24	660.7
Stream (S4)	0	30	10	3	3	12.8

Water Feature	Reserve Zone (m)	Management Zone (m)	RMZ % Basal Area Retention	Effective RMA (m)	Buffer Applied (m)	Area (ha)
Stream (S5)	0	30	10	3	3	69.1
Stream (S6)	0	20	0	0	0	
Total						**1,796.5**

The RRZ buffer widths extend from each side of the water feature edge. The total riparian area calculated is 1,796.6 ha resulting in a net impact on the THLB of 735 ha.

4.1.12 Ungulate Winter Range

UWR is the area necessary to meet the winter habitat requirements of specific ungulate species. Two polygons of UWR #U-1-012 occur within TFL 61. These areas are designated as No Harvest Zones for the protection of black-tailed deer. The total area of these units is 154 ha. These area have been removed from the THLB, and the net reduction is 55 ha.

4.1.13 Wildlife Habitat Area

Identified Wildlife Species are species that are at risk or are regionally important and require special management consideration. Identified species are managed through the establishment of WHAs and the implementation of general wildlife measures and WHA objectives, or through other management practices specified in strategic or landscape level plans.

Within TFL 61, there are 10 established WHAs (490 ha) designated as No Harvest Zones. These areas have been designated for the protection of Marbled Murrelet and Red-legged Frog habitat and have been removed from the THLB resulting in a net reduction of 47 ha. Table 11 reports the total WHA area for each species within TFL 61.

Table 11. Area with No Harvest WHAs

WHA Species	Area (ha)
Marbled Murrelet	351.2
Red-legged Frog	138.7
Total	**489.9**

4.1.14 Old Growth Management Areas

Currently there are no legally established Old Growth Management Areas (OGMA) within TFL 61. Landscape biodiversity objectives are managed through non-spatial old growth objectives and implementation policy. Modelling details for old growth retention is described in Section 6.4.1 below.

4.1.15 Research Installations

There are 34 research sites, totalling 81 ha (including the prescribed buffer) within TFL 61. The area of each installation varies from less than 1 ha to 26 ha, with an average installation size of 2.5 ha. It is assumed that most of these installations can be encompassed into other reserves such as WTP, RRZ, RMZ, and WHA areas. Based on this assumption research installations were not removed from the THLB.

4.1.16 Monumental Cedar Reserves

Monumental cedars are large or old cedar trees used in traditional First Nation practices such as canoe and pole carving and traditional-style buildings. The local community has an

ongoing use for these unique trees and PATH will pay particular attention to the identification, inventory and protection of potential monumental cedar reserves.

There are three monumental cedar reserves totaling 35 ha, with a net THLB reduction of 33 ha. Operationally, monumental cedar may also be retained within various retention areas such as WTPs or WHAs.

4.1.17 Wildlife Tree Retention

Wildlife Tree Retention provides for the maintenance of stand-level biodiversity. WTP requirements are outlined in the FRPA and include a minimum of 7% of the total annual cutblock area within WTPs.

Operationally, WTPs are located to coincide with other netdowns (i.e. riparian, inoperable) and minimize the impact on the THLB. It is assumed that 50% of WTPs will coincide with other land base netdowns, leaving a net impact of 3.5% (approximately 507 ha) on the THLB area. WTPs are modelled through a stand-level retention function in Patchworks, and the area reduction reported in Table 2 is an approximation of the net WTP area.

5 Growth and Yield

This section describes the information, data sources, assumptions, and methods for generating growth and yield estimates for TFL 61.

5.1 Analysis Units

To reduce complexity in the analysis, individual stands have been aggregated into broader analysis units (AU) based on their silviculture history, species composition, and site index value. These AUs are the basis for the development of yield curves.

Stands were aggregated based on leading species, site index class, and stand history (era). A species type code was assigned based on the leading species reported in the VRI. Site index classes were selected to characterize low/mod/high categories for each species. A stand history code was also assigned based on the silvicultural era of the stand. Details on these classifications are provided in Appendix 2.

5.2 Site Index

Site index is an estimate of site productivity for tree growth. This attribute provides a common base for comparing the productivity of different sites. Site index is species-specific and is expressed as the height of the dominant trees at the reference age of 50 years.

Estimates of site index are contained in the VRI inventory database and have been used to assign natural stands to AU's. Managed stands (regenerated after 1960) have been assigned site index values from silviculture history records (growth intercept methods), or the Provincial Site Productivity layer.

5.3 Utilization Level

Utilization specifications are established in the TFL 61 license document and define the maximum stump height, minimum top diameter (inside bark), and minimum diameter at breast

height for trees removed from harvested areas. Table 12 provides a summary of current utilization specifications.

Table 12. Utilization Specifications Used in the Development of Yield Curves

Species Type	Minimum DBH (cm)	Minimum Top DIB (cm)	Maximum Stump Height (cm)
Existing mature conifer (>120 yrs)	17.5	15.0	30.0
Natural conifer (<= 120 yrs)	12.5	10.0	30.0
Managed conifer	12.5	10.0	30.0
Alder	12.5	10.0	30.0

5.4 Yield Tables for Natural Stands

Yield tables for all mature stands (>120 yrs), deciduous stands, or stands naturally regenerated prior to 1960 (Era 1) were built using the VDYP version 7 model. VDYP is a FLNRO program that projects stand yields and attributes such as height, diameter, and volume.

A spatially delineated subset of the provincial VDYP dataset, including a wide buffer outside of the TFL, was batch processed in the VDYP model. Yield curves were developed for ages 10 through 350 in 10 year increments for each forest cover using VDYP. These individual polygon yield tables were then aggregated to generate an area-weighted average yield table for each AU within the CFLB.

Parameters used in the VDYP input file are included in Appendix 3 and projections for stand attributes for natural regenerated AUs is provided in Appendix 4. The VDYP parameters file and output file information will also be provided to the FLNRO Timber Supply Forester in an electronic format.

5.4.1 Decay, Waste, and Breakage for Natural Stands

Decay, waste, and breakage (DWB) factors are applied to natural stand yield tables to obtain net harvest volumes per hectare. This analysis used the default DWB values in the VDYP7 model, which are based on species, stand age, and BEC subzone.

5.5 Yield Tables for Regenerated Stands

Yield tables for regenerated stands were built using the FLNRO Table Interpolation for Stand Yields (TIPSY v4.4). TIPSY predicts the potential growth and yield of even-aged, single-species, managed stands.

Regenerated stands within the CFLB were aggregated by AU to derive an area-weighted site index and species composition. These area-weighted attributes were used as input variables in the TIPSY input file for each AU.

Stands regenerated in Era 2 were modelled in TIPSY as planted stands with a regeneration delay of 2 years, and Era 3 stands were modelled as planted stands with a regeneration delay of 1 year.

Parameters used in the TIPSY input files are included in Appendix 5 and projections for stand attributes for managed stand AUs are provided in Appendix 6. The TIPSY parameters file and output file information will be also provided to the FLNRO Timber Supply Forester in an electronic format.

5.5.1 Operational Adjustment Factors

Operational adjustment factors (OAF) are reductions applied to growth and yield model projections for regenerated stands to better reflect operational yields. OAF 1 reductions are applied uniformly throughout the entire projection to account for uncaptured potential site productivity (stocking levels). OAF 2 is an adjustment applied to regenerated stands to capture volume losses due to DWB. Details regarding the values for OAF 1 and OAF 2 used in this analysis are provided below.

5.5.1.1 Operational Adjustment Factor 1

The default OAF 1 factor commonly used is 15%. As part of MP#10 the previous analysis completed an evaluation of the land cover classification within the VRI and concluded that an OAF 1 value of 11% would be most appropriate. Although this analysis utilizes the same VRI, the more conservative default OAF 1 of 15% was utilized for managed stand yield curves because the methodology in the previous study was suspect.

5.5.1.2 Operational Adjustment Factor 2

Volume losses within managed stands due to decay, waste and breakage will be accounted for using an OAF 2 adjustment factor.

Throughout southern Vancouver Island managed Douglas-fir stands suffer volume losses due to laminated and armillaria root diseases, primarily within the CWHxm2 zone. Specific to TFL 61 the CWH xm2 occurs on along the southwest portions of TFL 61.

In the Arrowsmith TSR, a default OAF 2 value of 5% was used, while a 12.5% was applied to managed Douglas-fir stands (67 years of age our younger) in CWH xm1/xm2 zones. In this analysis a prorated OAF 2 of 6% will be applied to all managed Douglas-fir stands (See Table 13). All other managed stands had the default OAF 2 of 5% applied.

Table 13. Operational Adjustment Factor 2 for Douglas-fir leading stands in CWH xm2.

Species Type	CWH xm1 xm2	Other BEC zones	Combined
Douglas-fir leading	433.0	3,639.0	4,072.0
OAF 2	12.5%	5.0%	5.8%

5.5.2 Genetic Improvement

The previous licensee Western Forest Products (WFP) began planting genetically improved stock on the TFL in 1996. Details on the stock used by the previous licensee are not available. Accordingly, there were no genetic gains for units harvested prior to WFP (Eras 1 and 2). Era 3 includes WFP and PATH harvest units. Genetic gains for Era 3 were developed for each species based on information provided in MP#10, as well as data collected by PATH. Gains for three periods within Era 3 were averaged to derive a mean era gain for each species. Table 14 reports the Era 3 genetic gain calculations.

Table 14. Era 3 genetic gains

Species	2001 - 2006	2007 - 2011	2012 - 2016	Overall Era 3
Ba	0.0%	0.0%	0.0%	**0.0%**
Cw	2.0%	8.0%	13.6%	**7.9%**
Fd	6.0%	6.0%	12.3%	**8.1%**
Hw	2.0%	7.0%	0.0%	**3.0%**
Pw	0.0%	0.0%	0.0%	**0.0%**
Ss	2.0%	5.0%	0.0%	**2.3%**
Yc	8.0%	8.0%	0.0%	**5.3%**

Genetic gains for future regeneration will be based on statistics of the past 5 years. Table 15 provides the seed planning and registry (SPAR) system data regarding the seed stock used on the TFL over the past 5 years, as well as the calculated average genetic gain for each species over the past five years. For Era 4 stands, only 2 species will have genetic gains applied: Cw – 13.6% and Fd – 12.3%.

Table 15. Seedlot Statistics

Genetic Gain 2012-2017						
Year	**Species**	**Seed Class A**	**Growth Gain**	**Seed Class B**	**Total Seed**	**Net Growth Gain**
2015	Ba	0	0	3,000	3,000	0.0
2017	Cw	108,000	17	41,000	149,000	12.3
2015	Cw	31,000	9	16,000	47,000	5.9
2014	Cw	73,000	21	0	73,000	21.0
2013	Cw	88,500	15	5,000	93,500	14.2
2012	Cw	85,300	13	0	85,300	13.0
2017	Fdc	22,000	17	0	22,000	17.0
2015	Fdc	28,000	11	0	28,000	11.0
2014	Fdc	25,000	12	0	25,000	12.0
2013	Fdc	80,200	12	0	80,200	12.0
2012	Fdc	119,500	12	0	119,500	12.0
2013	Pw	33,000	0	0	33,000	0.0
2017	Ss	46,900	0	0	46,900	0.0
2014	Ss	6,500	0	0	6,500	0.0
2013	Ss	10,000	0	0	10,000	0.0
2012	Ss	6,200	0	0	6,200	0.0
2015	Yc	0	0	12,000	12,000	0.0
2013	Yc	5,000	0	16,000	21,000	0.0
Total		**768,100**		**28,000**	**796,100**	

In the TIPSY model, stand density (stems per hectare) input reflects the combined stocking of planted and naturally regenerated well-spaced stems when free-to-grow. For each species the net genetic gain applied in TIPSY was prorated to reflect the proportion of planted stock. Final values applied are shown below.

Table 16 Modelled managed stand yield genetic gains for planted stock

Species	Base Case Genetic Gain Values		
	Era 2	Era 3	Era 4
Cw	-	7.9%	13.6%
Fd	-	8.1%	12.3%
Hw	-	3.0%	-
Ss	-	2.3%	-
Yc	-	5.3%	-

5.5.3 Silviculture Management Regimes

Silviculture prescriptions define the species composition, seed source, stock type, and intensity applied to each site. Although silviculture practices have changed over time, site specific prescriptions can be generalized for each AU based on leading species, site index class, and stand history (era).

The characterization of past regeneration regimes is based on information provided in MP#10, this includes stands established in era 2 ('managed stands'), and era 3 ('genetic stands'). Future regeneration regimes managed by PATH are expected to be similar to past management,

although some aspects have been refined to better reflect current management into the future. Regeneration details are provided in Appendix 5.

5.6 Not Sufficiently Restock Areas

Not sufficiently restocked (NSR) areas were identified in the forest cover inventory where the field "WCS" included 'NSR' or 'SR'. Approximately 137 ha of THLB were identified as NSR and tier yield curves developed in VDYP (section 5.4) using the best available information from the forest cover inventory.

6 Integrated Resource Management

The Vancouver Island land use plan (VILUP) was approved in January 2001. The VILUP provides management direction for a number of non-timber resources. Where appropriate, these directives will be incorporated into the analysis as described below.

6.1 Cutblock Adjacency

Cutblock adjacency, or green-up, is a measure of tree height and site occupancy on a harvested site. The achievement of green-up height is required before adjacent areas may be harvested. There are situations when adjacency requirements are not applied, such as for salvage harvest and when applying patch size distributions consistent with the Biodiversity Guidebook. The intent of adjacency and/or patch size objectives is to ensure harvesting is distributed appropriately over the land base and no one area is harvested too extensively in a short period of time.

This concept will be modelled using a maximum disturbance limit on the THLB area outside of VQO's in each Landscape Unit (LU) to be no more than 25% <1.3m in height. The exception to this rule is for areas within the San Juan Ridge SMZ, where disturbance is limited to a maximum of 25% of the THLB area <3m in height. The age where the green—up height is achieved will be determined for each existing and future analysis unit during the yield development process.

6.2 Visual Quality Objectives

Forest cover requirements for the maintenance of visual quality will be modelled for each VLU based on a clear-cut with retention management regime, as is the most common practice on the TFL. Constraint assumptions have been adopted from the last Arrowsmith TSR.

The green-up height requirement will be determined for each analysis unit during the yield development process. Within each VLU, each existing and future stand will have a different age corresponding to the green-up height requirement.

Table 17 provides a summary of the criteria applied for creating the VQO forest cover requirements for each VLU. Appendix 7 provides detailed forest cover requirements for each visual landscape polygon within the TFL.

Table 17. VQOs

Visual Quality Class	Visual Absorption Capacity	Maximum Allowable Disturbance (%)	Green-up Height (m)
Maximum Modification	L - M	32.5	5.0
Modification	M - H	25.0	5.0
Modification	L	20.0	5.0

Visual Quality Class	Visual Absorption Capacity	Maximum Allowable Disturbance (%)	Green-up Height (m)
Partial Retention	M - H	15.0	5.0
Partial Retention	L	10.0	5.0
Retention	M - H	5.0	5.0
Retention	L	3.0	5.0
Preservation	M - H	0.5	5.0

6.3 Recreation Resources

The Kludahk Trail is an established recreational features that runs along the San Juan ridge between the communities of Port Renfrew and Jordon River. The VILUP established the SJRSMZ to provide management direction for the areas surrounding Kludahk Trail.

The SJRSMZ includes objectives for mature seral retention, cutblock size and visual quality, although the 2011 GAR order now provides direction for VQOs throughout the DSI. The forest cover requirements for the San Juan Ridge SMZ are provided in Table 18, which will be applied in the Patchworks model using the CFLB area in each SJR SMZ/BEC zone.

Table 18. Seral target for the SJRSMZ

Biogeoclimatic Unit	Mature Seral Stage	Mature Seral Forest Cover Requirement
CWH	>80 years	25%
CDF	>80 years	25%
MH	>120 years	25%

6.4 Biodiversity

Modelling landscape and stand-level biodiversity management objectives will be addressed through the retention of old forest cover and WTP retention. Details on how biodiversity objectives are integrated into the modelling environment are provided below.

6.4.1 Landscape-Level Biodiversity

Spatial OGMAs have not been legally established in TFL 61, thus landscape biodiversity objectives will be modelled based on the Provincial Non Spatial Old Growth Order.

Landscape biodiversity objectives will be modelled using forest cover retention levels for old and mature+ old seral stands within each LU, BEC, and Natural Disturbance Type (NDT). Where the application of these constraints in Low biodiversity emphasis option (BEO) areas are expected to reduce timber supply, a reduced level of retention for the old seral target is allowed. The reduced old seral retention target will be equivalent to 1/3 of the full target. The reduced retention will be increased to full target levels within 3 rotations subsequent to the date of the order (2004). For purposes of modeling, a rotation is assumed to be 60 years so the target must be met 180 years from 2004 (by year 2184). Within the Patchworks model, stands will be 'recruited' as needed to ensure that the target is met at that the beginning of that period.

Small isolated LU/NDT/BEC units with a total area less than 14 ha were merged with larger similar units. Table 19 reports the LU retention requirements for TFL 61.

Table 19. Landscape unit retention

LU	NDT	BEC Variant	BEO	CFLB Area (ha)	Old Forest Criteria (years)	2016 – 2184 Old Forest Retention (%)	2185 – 2316 Old Forest Retention (%)
Tugwell	NDT1	CWHvm1	Low	2,245.2	250	4.3	13.0
Tugwell	NDT1	CWHvm2	Low	1,498.8	250	4.3	13.0
Tugwell	NDT1	MHmm1	Low	121.9	250	6.3	19.0
Tugwell	NDT2	CWHmm1	Low	326.4	250	3.0	9.0
Tugwell	NDT2	CWHmm2	Low	213.7	250	3.0	9.0
Tugwell	NDT2	CWHxm2	Low	1,498.6	250	3.0	9.0
San Juan	NDT1	CWHvm2	Intermediate	92.8	250	13.0	13.0
Loss	NDT1	CWHvm1	Low	7,971.4	250	4.3	13.0
Loss	NDT1	CWHvm2	Low	4,144.2	250	4.3	13.0
Loss	NDT1	MHmm1	Low	431.6	250	6.3	19.0

Additional mature seral forest cover objectives are established for the SJRSMZ as discussed in section 6.3. These objectives will be modelled in addition to the LU cover objectives noted above.

6.4.2 Stand-Level Biodiversity

Stand-level biodiversity is implemented through the retention of WTPs. As described in Section 4.1.17, WTPs will be modelled by applying a 3.5% stand retention applied to each harvest unit.

7 Timber Harvesting

7.1 Minimum Harvestable Age/ Merchantability Standards

Minimum harvest criteria defines the minimum conditions necessary for a stand to be eligible for harvest. These criteria impact timber supply and reflect the balance between harvest flow objectives and operational considerations. In this analysis, the minimum harvest age criteria include a minimum volume requirement, a mean annual increment (MAI) requirement, and a minimum age:

- The minimum volume requirement is 350 m^3/ha for all coniferous stand types and 200 m^3/ha for alder types. The utilization standards for volume requirement include 17.5 cm DBH for naturally regenerated mature stands and 12.5 cm DBH for the rest of the stands (immature naturally regenerated and existing and future managed stands).
- MAI must be within 95% of the maximum MAI (all AU's).
- MHA will be at least 40 years for alder stand types and at least 60 years for coniferous stand types.
- If the volume criteria is never met for some low productivity stands, only the MAI criterion is used (approximately 138 ha THLB).

Minimum harvest age for each AU is provided in Appendix 8.

7.2 Harvest Rules

The Patchworks model is a heuristic model and does not use a harvest que to select stands for harvest – thus harvest rules such as 'oldest first' are not relevant. Stands are selected for harvest to best meet the multiple objectives established in the model.

7.3 Harvest Profile

The harvest profile reflects harvest priorities, stand and landscape level targets, and the various constraints integrated into the model. Generally, it should not be necessary to impose specific priorities for species, age, or stand condition to meet harvest profile targets. Model outputs will be analyzed to ensure management objectives and operational reality is captured. The model outputs produced include:

- Growing stock;
- Area harvested;
- Average age harvested;
- Volume per hectare harvested;
- Contributions of natural and managed stands;
- Age class composition;
- Seral stage distributions over time; and
- Alternative harvest flows.

An additional target will be applied in the model to capture the operational practice of harvesting within a mix of old and regenerated stands. Harvesting will be targeted to contain no more than 40% of the volume coming from natural stands. This target will not be applied as a strict rule and is not meant to impact timber supply.

7.4 Unsalvaged Losses

Unsalvaged timber losses due to natural causes, such as epidemic losses to insects and disease, and losses to fire and blowdown, will be incorporated into the analysis as a volume reduction applied to the projected timber supply forecast.

TFL 61 has an extensive road network, is readily accessible, and is located near processing facilities. This allows for the effective salvage of timber losses when necessary.

The Arrowsmith TSA currently has a THLB of 59,721 ha and an estimated 9,105 m^3/year of unsalvaged timber losses. Expressed as a ratio of losses per hectare of THLB, the Arrowsmith TSA has 0.1525 m^3/ha/year of unsalvaged losses. Based on this ratio, unsalvaged timber loss on the TFL is estimated to be 2,207 m^3/year.

7.5 Silvicultural Systems

The primary silvicultural system employed on the TFL is clearcut with retention. Specifics regarding opening size and patch size distribution are implemented at the operational level.

Appendix 1 *TFL 61 Lidar Inventory Update Procedures*

TFL 61 (Pacheedaht Andersen Timber Holdings Ltd.)

Inventory Update Procedures

Forsite has updated the existing VRI for TFL 61 using recently acquired December 2016 LiDAR data based on the following procedures:

Use crown closure and basal area from existing TFL 61 inventory, projected to 2017

Polygon (Line) Updates using Canopy Height Model (1x1m CHM)

1.) Delineated any new openings not reflected in current inventory
    a. Used standard VRI specs when delineating (minimum size, location accuracy)
    b. Delineated along RESULTS and FTA Blocks openings where harvested. (Note: Delineated according to Opening ID's, not just openings)
    c. Opening ID's can be inserted at a later date if required.
2.) Updated existing polygon boundaries where polygon edges looked to be ~5m out or more
    a. Used standard VRI specs - width of polygons and min size.
3.) Created new polygons where crown closure within an existing polygon appeared obviously different.
    a. Done commonly along edges of openings (assumption: blowdown)
    b. Kept species codes and ages the same as original VRI polygon, but calculated unique CC, sph, and Height
4.) Assigned some existing VRI attributes to new openings
    a. Used the data from existing VRI polygon that had the largest area within new opening (Similar to procedure used to integrate RESULTS polygons when creating a new VRI)
    b. Used original BCLC codes and admin data within polygon
    c. Does not reflect correct species string if new opening is planted

Age ("LSpcEstYr") Update (new RESULTS openings and Lidar openings)

1.) Updated age for new openings
    a. RESULTS (highest priority as per VRI updates)
        i. Used RESULTS layer from BCGW
        ii. Used newest planting age, ie PLNT1_DATE
        iii. PLNT2_DATE exists but is older than PLNT1. i.e. block needed replanting
        iv. If no plant date, then set age equal to age of adjacent opening if stem height / conditions looked similar.
        v. Assumed 1 year old stock at planting (i.e. 1+0). No 2 yr.
    b. FTA Blocks (2nd priority)
        i. Used PLN_HRV_DT for age
        ii. Used most recent plant date if conflicting dates with RESULTS polygons

c. Lidar (3rd priority)
    i. Used DSI_VRI age where available
    ii. Where DSI_VRI age not available, assumed age to match Lidar data capture date

Stand Height Update ("LSpcHt_2017")

1.) Generalized the 1m CHM data to a 5m CMH (tallest point in each 5mx5m pixel).
    a. This is done to eliminate small natural gaps (ground points) from the data if there is a tree within 5m.
    b. Where gaps are larger than this, we want to recognize them in the process as stocking would be getting below 400sph.
    c. Note that the height value in the 5m x 5m pixel is species indifferent.

2.) Young and mature stands need to be attributed differently because of the potentially wide range of heights in young stands (e.g. in-block retention, polygon boundaries catching mature stand edges).
    a. For each VRI polygon, a number of heights are calculated based on how much area meets a certain height threshold (0%, 5%, 10%...50%).
    b. For example, a mature poly may show that the tallest 5x5m pixel in the block is 59.99m tall (0% of area is taller), while 20% of the area is at least 42.79m, and 50% of the area is at least 35.4m tall.

3.) Assigned heights to each polygon with the following logic:
    a. Where the 50% area ht is <10m - used the 50% area ht (for all short/young stands used the 50% Area ht ensures that the retention cohort was not influencing the ht)
    b. Where the 50% area ht is 10-25m AND the ratio of 50% area ht/5% area ht <.65 – used the 50% area ht (for all stands with a wide range of heights, used the 50% Area ht)
    c. All other polygon hieghts determined using the 35% area ht. (for all mature stands or those with more homogenous heights, used the ht where at least 35% of the pixels were taller. This reflects the height of the dominant trees in the polygon).

Stocking ("SPH_2017") Update

1.) Stems per hectare generated using individual tree inventory (TSI)
    a. Spatial join to count stems in each polygon greater than 12.5cm DBH
    b. Converted to SPH
    c. Forested stands with LSPCAge<20 and SPH<500, replace SPH with 500.

Site Index Update ("SiteIndex2017")

1. Used the latest version of Site Tools (v 4.1 Beta – March 2017)
2. Input:

a. LiDAR heights
b. updated VRI ages
c. original VRI Site Index species ("SiteIndexSpc", generally the lead coniferous Species)

3. Where updated Site Index is 20.00m more than current inventory replace updated Site Index with current inventory (to eliminate extreme values)
4. For stands <= 20 yrs old no update is done because SI values for these stands will eventually be updated through the provincial site productivity layer.

Standing Inventory Volume Update ("VDWB")

Use VDYP7 in VRISTART mode to project current inventory volume based on updated stand attributes.

Appendix 2 ***Analysis Unit Classification***

Table A2-1. Analysis unit species types

Name	Inventory Species	CFLB Area (ha)
Ba	Ba, Bg	1,077.3
Cw	Cw	2,660.9
Dr	Dr	233.8
Fd	Fd	4,342.0
Hw	Hw, Hm	6,959.4
Ss	Ss	41.2
Yc	Yc	3,230.0
Total		**18,544.7**

Table A2-2. Analysis unit site index classes

Name	Site Index Range	CFLB Area (ha)
High	30.0+	3,864.2
Medium	20.0 – 29.9	9,536.5
Low	10.0 – 19.9	2,986.7
Poor	<10.0	2,157.3
Total		**18,544.7**

Table A2-3. Analysis unit stand history code

Regeneration Era	Name	Regeneration Establishment	CFLB Area (ha)
Mature	Mature	Prior 1960, Age >120 yrs	6,215.6
Era 1	Natural	Prior 1960, Age <=120 yrs	3,857.6
Era 2	Managed	1960 - 2000	6,656.2
Era 3	Genetic	2001 - 2016	1814.4
Era 4	Future	2017+	NA
Total			**18,544.7**

Table A2-4. Analysis unit areas

AU Name	AU Number	CFLB Area (ha)	Current THLB Area (ha)	Future CFLB Area (ha)	Future THLB Area (ha)
Mat_Ss_Low	1020	5.9	1.4	4.5	0
Mat_Ss_Med	1030	5.4	2.4	3	0
Mat_Ba_Poor	1110	14.3	14	0.3	0
Mat_Ba_Low	1120	99.2	72.4	26.8	0
Mat_Ba_Med	1130	6.6	6.6	0	0
Mat_Cw_Poor	1310	98.7	16.2	82.5	0
Mat_Cw_Low	1320	841.6	555.9	285.7	0
Mat_Cw_Med	1330	151.6	56.3	95.3	0
Mat_Cw_High	1340	46.7	11.7	35	0
Mat_Dr_Med	1430	2.4	0	2.4	0
Mat_Fd_Low	1520	21.4	21.3	0.1	0
Mat_Fd_Med	1530	4.4	0	4.4	0
Mat_Hw_Poor	1610	740	397.4	342.6	0
Mat_Hw_Low	1620	1,544.10	1,058.20	485.9	0
Mat_Hw_Med	1630	132.5	35.9	96.6	0
Mat_Hw_High	1640	29	15.8	13.2	0
Mat_Yc_Poor	1910	1,595.50	87.2	1,508.30	0
Mat_Yc_Low	1920	870.9	589	281.9	0
Mat_Yc_Med	1930	0.9	0.7	0.2	0
Mat_Yc_High	1940	4.4	2.4	2	0

AU Name	AU Number	CFLB Area (ha)	Current THLB Area (ha)	Future CFLB Area (ha)	Future THLB Area (ha)
Nat_Ss_High	2040	13.1	13.1	0	0
Nat_Ba_Low	2120	1.5	1.5	0	0
Nat_Ba_Med	2130	16.4	16.4	0	0
Nat_Cw_Low	2320	67.7	60.7	7	0
Nat_Cw_Med	2330	237.7	224.9	12.8	0
Nat_Cw_High	2340	6.6	6.5	0.1	0
Nat_Dr_Low	2420	3	1.3	1.7	0
Nat_Dr_Med	2430	115.7	90.1	25.6	0
Nat_Dr_High	2440	112.8	83.1	29.7	0
Nat_Fd_Low	2520	5.6	5.6	0	0
Nat_Fd_Med	2530	203.3	189.7	13.6	0
Nat_Fd_High	2540	1,132	1,083.40	48.6	0
Nat_Hw_Poor	2610	2.3	2.3	0	0
Nat_Hw_Low	2620	82.2	80.4	1.8	0
Nat_Hw_Med	2630	1,028.60	941.5	87.1	0
Nat_Hw_High	2640	684.8	626.7	58.1	0
Man_Ss_Med	3030	16.7	5.9	10.8	0
Man_Ba_Med	3130	905.2	874.9	30.3	0
Man_Cw_Low	3320	296.8	277	19.8	0
Man_Cw_Med	3330	463.1	409.4	53.7	0
Man_Fd_Med	3530	0.6	0.4	0.2	0
Man_Fd_High	3540	2579	2390.4	188.6	0
Man_Hw_Low	3620	0.4	0.4	0	0
Man_Hw_Med	3630	1,838.70	1,717.70	121	0
Man_Yc_Low	3920	159.7	152.5	7.2	0
Man_Yc_Med	3930	317.5	304.2	13.3	0
Man_Yc_High	3940	78.5	71.1	7.4	0
Gen_Ss_Med	4030	0	0	5.9	5.4
Gen_Ss_High	4040	0	0	13.1	12
Gen_Ba_Low	4120	8.3	8.3	9.8	9
Gen_Ba_Med	4130	25.9	25.4	917.1	835.9
Gen_Cw_Low	4320	146.6	146.2	484.2	441.3
Gen_Cw_Med	4330	298.9	273.6	933.2	828
Gen_Cw_High	4340	4.9	4.9	11.4	10.4
Gen_Fd_Low	4520	0	0	6.9	6.3
Gen_Fd_Med	4530	0.5	0.5	280.6	256
Gen_Fd_High	4540	395.2	391	3,952.10	3,600.40
Gen_Hw_Poor	4610	1.5	1.5	5.6	5.1
Gen_Hw_Low	4620	19.1	19.1	101.2	92.2
Gen_Hw_Med	4630	712.9	698.2	3,501.80	3,180.20
Gen_Hw_High	4640	4.7	4.7	631.4	575.8
Gen_Yc_Poor	4910	23.6	23.4	25	22.7
Gen_Yc_Low	4920	86.9	84.7	239.3	216.3
Gen_Yc_Med	4930	71.4	68.2	375.5	339.6
Gen_Yc_High	4940	15	14.3	89.7	81.2
Fut_Ss_Low	5020	0	0	1.4	1.3
Fut_Ss_Med	5030	0	0	2.4	2.2
Fut_Ba_Poor	5110	0	0	14	12.8
Fut_Ba_Low	5120	0	0	72.4	66.1
Fut_Ba_Med	5130	0	0	6.6	6
Fut_Cw_Poor	5310	0	0	16.2	14.8
Fut_Cw_Low	5320	0	0	555.9	507.1
Fut_Cw_Med	5330	0	0	56.3	51.4
Fut_Cw_High	5340	0	0	11.7	10.6

AU Name	AU Number	CFLB Area (ha)	Current THLB Area (ha)	Future CFLB Area (ha)	Future THLB Area (ha)
Fut_Fd_Low	5520	0	0	21.3	19.5
Fut_Hw_Poor	5610	0	0	397.4	362.5
Fut_Hw_Low	5620	0	0	1,058.20	965
Fut_Hw_Med	5630	0	0	35.9	32.7
Fut_Hw_High	5640	0	0	15.8	14.4
Fut_Yc_Poor	5910	0	0	87.2	79.5
Fut_Yc_Low	5920	0	0	589	537.1
Fut_Yc_Med	5930	0	0	0.7	0.7
Fut_Yc_High	5940	0	0	2.4	2.2
NSR_Hw_Poor	6610	1.8	1.8	0	0
NSR_Hw_Low	6620	1.3	1.3	0	0
NSR_Hw_Med	6630	135.6	129.7	5.9	0
NSR_Yc_Poor	6910	1.4	1.4	0	0
NSR_Yc_High	6940	4.4	3.6	0.8	0
Total		**18,544.70**	**14,477.30**	**18,544.40**	**13,203.30**

Appendix 3 ***VDYP Input Parameters***

Table A3-1 vdyp input parameters for naturally regenerated mature stands (>120 yrs)

```
# ---------------------------------------------------------------------
#
-ini C:\VDYP7\vdyp.ini
-ifmt DCSV
-ofmt YieldTable
#
# ---------------------------------------------------------------------
-i
T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\tfl61_vdyp_input.CSV
#
-o   T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\TFL61_out_175.dat
-e   T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\TFL61_err_175.err
#
#
# ----------------------------- debug logfiles YN
# -l T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\vdyp7_debug.log
#
-forward Yes
-back Yes
-includeprojmode Yes
-yieldtableincpolyid Yes
-c C:\VDYP7\VDYP_CFG\\
-d T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update
-dbg No
-v7save No
-util AC=17.5
-util AT=17.5
-util B= 17.5
-util C= 17.5
-util D= 17.5
-util E= 17.5
-util F= 17.5
-util H= 17.5
-util L= 17.5
-util MB=17.5
-util PA=17.5
-util PL=17.5
-util PW=17.5
-util PY=17.5
-util S= 17.5
-util Y= 17.5
-agestart 10
-ageend 350
-inc 10
-forcerefyear No
-forcecrntyear No
-progressfrequency 200
```

Table A3-2 vdyp input parameters for naturally regenerated immature stands (<=120 yrs)

```
# ---------------------------------------------------------------
#
-ini C:\VDYP7\vdyp.ini
-ifmt DCSV
-ofmt YieldTable
#
# ---------------------------------------------------------------
-i
T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\tfl61_vdyp_input.CSV
#
-o   T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\TFL61_out_125.dat
-e   T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\TFL61_err_125.err
#
#
# ---------------------------- debug logfiles YN
# -l T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update\vdyp7_debug.log
#
-forward Yes
-back Yes
-includeprojmode Yes
-yieldtableincpolyid Yes
-c C:\VDYP7\VDYP_CFG\\
-d T:\1280\3\04_Models\01_VDYP\03_VDYP_Model_Run_Build_Yields_with_CHM_TSI_update
-dbg No
-v7save No
-util AC=12.5
-util AT=12.5
-util B= 12.5
-util C= 12.5
-util D= 12.5
-util E= 12.5
-util F= 12.5
-util H= 12.5
-util L= 12.5
-util MB=12.5
-util PA=12.5
-util PL=12.5
-util PW=12.5
-util PY=12.5
-util S= 12.5
-util Y= 12.5
-agestart 10
-ageend 350
-inc 10
-forcerefyear No
-forcecrntyear No
-progressfrequency 20
```

Appendix 4 Yield Tables for Natural Stands (VDYP Output)

Age	Mat_Ba_L	Mat_Ba_M	Mat_Ba_P	Mat_Cw_H	Mat_Cw_L	Mat_Cw_M	Mat_Cw_P	Mat_Fd_L	Mat_Hw_H
0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
30	0	41	0	17	4	32	0	10	7
40	25	138	0	65	32	94	0	41	32
50	93	276	0	129	90	179	0	91	66
60	200	421	6	202	164	273	18	150	108
70	328	546	50	271	236	360	47	210	161
80	439	649	106	333	303	435	78	267	216
90	539	736	172	389	361	501	107	318	271
100	626	808	237	438	412	558	133	363	323
110	701	868	298	480	455	607	156	404	372
120	766	917	354	518	493	649	175	439	415
130	822	959	406	551	526	685	192	471	454
140	871	993	453	581	555	717	207	500	489
150	908	1016	491	603	577	742	217	523	515
160	932	1030	516	619	593	758	224	540	533
170	948	1037	533	629	603	769	229	552	544
180	957	1034	545	636	610	776	232	560	551
190	962	1031	552	641	614	779	234	567	555
200	965	1027	556	643	617	781	235	571	558
210	962	1022	554	643	616	779	234	572	556
220	959	1017	553	642	615	778	233	573	554
230	956	1011	551	641	613	776	232	574	552
240	953	1006	549	640	612	775	231	574	550
250	949	1001	547	639	610	773	231	574	548
260	946	995	545	638	609	771	230	575	546
270	943	990	544	638	607	769	229	575	545
280	939	985	542	637	605	767	228	575	543
290	936	980	540	636	603	765	227	574	541
300	932	975	538	636	602	762	226	574	539
310	928	970	536	635	600	760	225	574	537
320	925	966	534	634	597	758	224	574	536
330	921	962	531	633	596	756	223	573	534
340	916	957	529	632	594	754	222	573	531
350	912	953	526	631	592	752	221	572	529

Age	Mat_Hw_L	Mat_Hw_M	Mat_Hw_P	Mat_Ss_L	Mat_Ss_M	Mat_Yc_H	Mat_Yc_L	Mat_Yc_M	Mat_Yc_P
0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
30	5	27	0	0	0	0	0	0	0
40	36	89	0	39	0	0	1	0	0
50	99	177	3	131	0	50	21	0	0
60	181	271	23	251	15	91	69	34	4
70	270	361	57	374	55	139	116	76	15
80	357	442	99	485	114	190	166	126	28
90	437	513	143	584	183	240	212	177	43
100	508	575	187	669	251	287	254	224	58
110	571	629	227	742	316	329	291	265	73
120	627	675	263	806	376	367	322	300	86
130	675	716	295	860	431	400	350	331	97
140	718	751	323	907	483	429	374	357	107
150	749	776	345	940	523	452	393	376	115
160	769	791	359	960	549	468	405	389	120
170	781	798	368	971	567	479	414	396	123
180	788	802	373	975	578	486	419	401	124
190	790	804	376	975	584	491	422	404	125
200	789	803	376	972	587	495	424	404	126
210	783	798	374	962	583	494	422	402	125
220	777	794	371	953	579	494	421	400	124
230	771	790	368	944	575	493	419	398	124
240	765	786	365	936	571	493	417	395	123
250	758	783	362	928	567	492	415	393	122
260	752	779	359	920	564	491	413	390	121
270	746	776	357	913	560	490	411	388	121
280	740	773	354	905	557	489	409	385	120
290	734	770	351	898	554	488	407	382	119
300	728	767	348	892	550	487	404	379	119
310	722	764	345	885	547	485	402	377	118
320	716	761	342	879	544	484	399	374	117
330	711	779	341	874	542	483	398	373	123
340	706	775	339	872	541	482	397	372	123
350	702	770	337	871	540	481	396	371	122

Age	Nat_Ba_L	Nat_Ba_M	Nat_Cw_H	Nat_Cw_L	Nat_Cw_M	Nat_Dr_H	Nat_Dr_L	Nat_Dr_M	Nat_Fd_H
0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	30	0	21	0
20	0	0	56	0	0	266	96	222	29
30	0	156	192	13	68	434	195	372	172
40	72	363	323	69	133	510	247	443	338
50	121	543	426	132	194	542	272	471	493
60	161	689	512	174	251	554	281	477	633
70	226	802	615	220	322	567	281	474	763
80	285	915	706	275	400	573	275	471	874
90	335	1012	785	322	470	579	275	467	965
100	377	1096	855	360	530	584	278	471	1032
110	414	1170	896	393	581	588	279	474	1084
120	436	1231	931	422	624	588	278	473	1127
130	454	1279	955	446	662	584	275	469	1163
140	469	1314	975	466	691	575	271	460	1194
150	482	1333	990	483	713	560	265	447	1218
160	500	1338	997	500	730	542	260	434	1233
170	515	1338	1001	514	743	525	255	421	1242
180	526	1335	1001	524	751	510	249	410	1248
190	534	1331	1000	531	756	497	244	400	1250
200	539	1326	997	536	758	485	239	391	1252
210	540	1320	992	536	756	474	234	384	1250
220	540	1313	986	535	753	464	230	377	1246
230	540	1307	981	534	750	454	225	370	1243
240	540	1300	975	533	747	444	221	364	1240
250	539	1294	970	532	743	435	216	357	1237
260	539	1287	965	531	740	428	212	352	1234
270	538	1281	960	529	737	421	208	346	1230
280	537	1275	955	528	733	414	204	340	1227
290	537	1269	949	526	730	408	200	335	1224
300	536	1262	944	524	726	402	196	330	1221
310	535	1256	939	522	723	398	193	327	1218
320	532	1250	934	519	720	396	190	324	1215
330	529	1244	929	516	716	393	188	321	1212
340	527	1239	925	513	713	390	185	318	1209
350	524	1233	920	510	709	387	182	315	1206

Age	Nat_Fd_L	Nat_Fd_M	Nat_Hw_H	Nat_Hw_L	Nat_Hw_M	Nat_Hw_P	Nat_Ss_H
0	0	0	0	0	0	0	0
10	0	0	1	0	0	0	0
20	0	5	63	0	16	0	45
30	14	79	227	21	118	0	262
40	72	170	402	60	247	0	503
50	119	253	554	102	364	0	708
60	162	331	681	139	465	96	871
70	202	411	796	179	559	133	997
80	235	484	903	233	647	163	1113
90	264	550	1003	282	726	190	1207
100	288	606	1084	328	795	213	1284
110	308	652	1153	371	858	237	1346
120	325	688	1210	414	911	259	1391
130	340	720	1254	457	956	278	1421
140	354	747	1293	498	995	296	1437
150	367	768	1320	534	1022	309	1438
160	380	784	1337	562	1038	318	1427
170	391	796	1346	581	1047	324	1411
180	399	804	1350	595	1050	328	1392
190	405	809	1351	604	1050	330	1372
200	409	812	1349	609	1048	331	1351
210	410	811	1341	608	1041	331	1328
220	411	810	1332	606	1033	331	1309
230	412	809	1324	604	1027	331	1291
240	412	807	1316	602	1020	330	1273
250	412	806	1308	600	1013	330	1256
260	412	805	1300	598	1007	329	1239
270	412	803	1293	595	1000	329	1223
280	412	801	1285	593	994	328	1208
290	412	799	1278	591	988	327	1193
300	412	797	1271	588	981	327	1178
310	411	795	1264	585	976	326	1168
320	410	792	1258	583	970	324	1163
330	409	790	1252	580	965	322	1158
340	407	788	1247	577	960	321	1152
350	406	786	1241	574	954	319	1147

Appendix 5 TIPSY Input Parameters

Table A5-1 TIPSY input parameters for managed stands

AU Number	SPP1	SPP1 %	SPP2	SPP2 %	SPP3	SPP3 %	Site Index	Density	Planted %	Natural %	OAF2	Delay Planted	Delay Natural
Man_Ss_Med	HW	70	CW	20	FD	10	30.0	1000	100		5	2	
Man_Ba_Med	BA	59	HW	30	YC	11	24.0	1000	100		5	2	
Man_Cw_Low	CW	63	HW	30	BA	7	19.0	1000	100		5	2	
Man_Cw_Med	CW	64	HW	31	BA	5	21.0	1000	100		5	2	
Man_Fd_Med	FD	59	HW	29	CW	12	26.0	1000	100		6	2	
Man_Fd_High	FD	61	HW	39			32.0	1000	100		6	2	
Man_Hw_Low	HW	50	YC	35	BA	15	16.0	1000	100		5	2	
Man_Hw_Med	HW	56	FD	25	CW	19	26.0	1000	100		5	2	
Man_Yc_Low	HW	80	SS	11	BA	9	15.0	1000	100		5	2	
Man_Yc_Med	HW	68	YC	25	CW	7	22.0	1000	100		5	2	
Man_Yc_High	HW	56	YC	40	CW	4	34.0	1000	100		5	2	
Gen_Ss_Med	HW	70	CW	30	BA	0	29.0	1000	100		5	1	
Gen_Ss_High	HW	70	CW	30	BA	0	28.0	1000	100		5	1	
Gen_Ba_Low	BA	50	YC	30	HW	20	19.0	1000	100		5	1	
Gen_Ba_Med	BA	52	HW	32	YC	16	24.0	1000	100		5	1	
Gen_Cw_Low	CW	59	HW	29	BA	12	19.0	1000	100		5	1	
Gen_Cw_Med	CW	48	HW	37	FD	15	21.0	1000	100		5	1	
Gen_Cw_High	CW	71	HW	23	BA	6	32.0	1000	100		5	1	
Gen_Fd_Low	CW	71	HW	23	BA	6	26.0	1000	100		5	1	
Gen_Fd_Med	CW	71	HW	23	BA	6	31.0	1000	100		5	1	
Gen_Fd_High	FD	64	HW	36			33.0	1000	100		6	1	
Gen_Hw_Poor	HW	60	SS	35	CW	5	23.0	1000	100		5	1	
Gen_Hw_Low	HW	59	CW	24	YC	17	25.0	1000	100		5	1	
Gen_Hw_Med	HW	70	CW	16	BA	14	26.0	1000	100		5	1	
Gen_Hw_High	HW	65	BA	32	CW	3	27.0	1000	100		5	1	
Gen_Yc_Poor	YC	55	HW	30	CW	15	2.0	1000	100		5	1	
Gen_Yc_Low	YC	48	HW	47	BA	5	17.0	1000	100		5	1	
Gen_Yc_Med	HW	77	SS	14	BA	9	21.0	1000	100		5	1	
Gen_Yc_High	YC	48	HW	43	SS	9	35.0	1000	100		5	1	
Fut_Ss_Low	HW	70	CW	30			30.0	1000	90	10	5	1	2
Fut_Ss_Med	HW	70	CW	30			29.0	1000	90	10	5	1	2
Fut_Ba_Poor	BA	52	YC	32	HW	16	18.0	1000	90	10	5	1	2
Fut_Ba_Low	BA	52	YC	32	HW	16	25.0	1000	90	10	5	1	2
Fut_Ba_Med	BA	59	HW	29	YC	12	26.0	1000	90	10	5	1	2
Fut_Cw_Poor	CW	71	HW	23	BA	6	21.0	1000	90	10	5	1	2
Fut_Cw_Low	CW	71	HW	23	BA	6	21.0	1000	90	10	5	1	2
Fut_Cw_Med	CW	64	HW	26	FD	10	21.0	1000	90	10	5	1	2
Fut_Cw_High	CW	60	HW	35	BA	5	33.0	1000	90	10	5	1	2
Fut_Fd_Low	HW	70	CW	16	BA	14	32.0	1000	90	10	5	1	2
Fut_Hw_Poor	YC	48	HW	47	BA	5	23.0	1000	90	10	5	1	2
Fut_Hw_Low	HW	77	CW	14	YC	9	25.0	1000	90	10	5	1	2
Fut_Hw_Med	HW	48	CW	43	BA	9	26.0	1000	90	10	5	1	2
Fut_Hw_High	HW	70	BA	30			26.0	1000	90	10	5	1	2
Fut_Yc_Poor	YC	70	HW	30			10.0*	1000	90	10	5	1	2
Fut_Yc_Low	YC	50	HW	30	BA	20	11.0	1000	90	10	5	1	2
Fut_Yc_Med	HW	52	SS	32	BA	16	20.0	1000	90	10	5	1	2
Fut_Yc_High	YC	52	HW	32	SS	16	33.0	1000	90	10	5	1	2

*Minimum site index value permitted in TIPSY.

**Maximum site index value permitted in TIPSY.

Appendix 6 ***Managed Stand Yield Tables***

Age	Fut_Ba_L	Fut_Ba_M	Fut_Ba_P	Fut_Cw_H	Fut_Cw_L	Fut_Cw_M	Fut_Cw_P	Fut_Fd_L
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	3	8	0	0	0	0	0	39
30	77	108	12	53	45	41	45	170
40	195	242	72	149	140	131	140	320
50	322	388	149	261	247	238	247	471
60	452	531	231	362	347	335	347	603
70	575	662	311	473	456	441	456	722
80	685	779	391	571	555	540	555	820
90	786	881	466	649	642	624	642	902
100	875	967	536	733	715	695	715	973
110	951	1050	598	809	791	771	791	1033
120	1020	1121	656	868	857	837	857	1080
130	1085	1187	707	918	910	890	910	1120
140	1138	1249	755	963	957	935	957	1155
150	1189	1297	799	1001	999	973	999	1188
160	1238	1340	838	1033	1034	1007	1034	1217
170	1277	1380	871	1058	1065	1037	1065	1241
180	1312	1420	902	1076	1089	1062	1089	1264
190	1342	1458	930	1091	1111	1083	1111	1281
200	1372	1490	957	1103	1129	1102	1129	1294
210	1397	1518	984	1112	1144	1118	1144	1304
220	1421	1542	1006	1121	1157	1132	1157	1309
230	1443	1567	1027	1128	1170	1143	1170	1314
240	1462	1593	1047	1135	1180	1153	1180	1315
250	1480	1618	1065	1140	1190	1161	1190	1315
Age	**Fut_Hw_H**	**Fut_Hw_L**	**Fut_Hw_M**	**Fut_Hw_P**	**Fut_Ss_L**	**Fut_Ss_M**	**Fut_Yc_H**	**Fut_Yc_L**
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	14	1	9	3	0	20	147	0
30	135	54	104	55	5	143	415	0
40	282	158	228	135	55	308	705	3
50	445	269	362	212	122	478	971	19
60	598	382	494	285	201	637	1208	50
70	741	495	618	358	278	786	1417	87
80	861	601	727	423	348	925	1587	124
90	971	696	826	476	422	1041	1746	159
100	1070	779	911	525	491	1140	1885	193
110	1156	855	987	570	552	1226	2010	226
120	1228	924	1057	608	607	1294	2010	256
130	1297	984	1119	643	658	1353	2010	285
140	1358	1039	1165	672	707	1396	2010	310
150	1408	1091	1206	697	750	1435	2010	333
160	1452	1132	1246	719	789	1471	2010	353
170	1494	1169	1282	739	826	1500	2010	372
180	1536	1201	1313	754	859	1526	2010	388
190	1574	1233	1338	769	887	1529	2010	403
200	1604	1260	1361	782	912	1529	2010	417
210	1630	1285	1381	793	934	1529	2010	431
220	1655	1306	1400	803	954	1529	2010	445
230	1679	1324	1418	813	973	1529	2010	457
240	1702	1342	1434	818	989	1529	2010	468
250	1725	1358	1448	823	1003	1529	2010	479

Age	Fut_Yc_M	Fut_Yc_P	Gen_Ba_L	Gen_Ba_M	Gen_Cw_H	Gen_Cw_L	Gen_Cw_M	Gen_Fd_H
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	5	0	0	2	28	0	0	51
30	94	0	26	77	170	23	43	206
40	226	0	107	198	334	106	142	375
50	362	5	201	327	512	197	253	542
60	507	17	297	458	667	298	359	692
70	641	38	391	584	826	383	466	819
80	758	64	486	694	959	472	570	923
90	873	91	572	798	1078	555	662	1013
100	969	114	648	889	1178	632	739	1088
110	1055	139	719	968	1268	694	814	1148
120	1133	160	782	1037	1350	746	883	1197
130	1197	180	839	1101	1412	793	942	1242
140	1255	199	893	1157	1463	841	991	1282
150	1309	217	936	1207	1507	883	1035	1319
160	1356	233	976	1253	1544	921	1074	1351
170	1394	249	1013	1297	1576	949	1109	1379
180	1426	264	1049	1333	1603	971	1137	1396
190	1454	278	1081	1364	1621	991	1163	1411
200	1479	291	1107	1391	1635	1008	1186	1425
210	1503	303	1132	1417	1648	1024	1207	1425
220	1524	314	1155	1443	1659	1037	1225	1425
230	1541	323	1177	1468	1668	1047	1241	1425
240	1557	331	1199	1491	1677	1057	1255	1425
250	1572	340	1215	1511	1684	1066	1268	1425
Age	**Gen_Fd_L**	**Gen_Fd_M**	**Gen_Hw_H**	**Gen_Hw_L**	**Gen_Hw_M**	**Gen_Hw_P**	**Gen_Ss_H**	**Gen_Ss_M**
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	18	37	7	1	7	0	19	34
30	127	172	108	57	106	16	150	193
40	248	319	244	165	236	79	322	380
50	372	475	390	280	375	156	495	578
60	491	605	532	395	513	232	662	752
70	589	726	671	508	643	307	813	922
80	682	828	793	617	759	385	955	1069
90	760	910	897	713	861	458	1076	1191
100	826	983	992	797	948	522	1178	1294
110	880	1044	1077	873	1030	585	1265	1379
120	929	1095	1155	943	1103	644	1338	1448
130	972	1136	1223	1004	1169	697	1399	1500
140	1009	1170	1277	1059	1224	746	1446	1547
150	1038	1201	1327	1108	1267	791	1484	1587
160	1063	1228	1375	1154	1306	827	1519	1624
170	1085	1252	1418	1189	1343	859	1549	1624
180	1101	1273	1454	1222	1377	889	1575	1624
190	1115	1291	1484	1250	1406	918	1597	1624
200	1128	1307	1513	1274	1429	945	1617	1624
210	1140	1322	1539	1296	1448	971	1617	1624
220	1150	1336	1565	1316	1467	994	1617	1624
230	1156	1342	1589	1334	1483	1016	1617	1624
240	1162	1348	1610	1349	1500	1036	1617	1624
250	1167	1352	1630	1361	1515	1054	1617	1624

Age	Gen_Yc_H	Gen_Yc_L	Gen_Yc_M	Gen_Yc_P	Man_Ba_M	Man_Cw_L	Man_Cw_M	Man_Fd_H
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	72	0	5	0	1	0	0	18
30	275	7	100	0	58	13	29	145
40	502	56	237	0	175	85	119	287
50	729	129	378	6	299	171	223	444
60	939	204	525	22	427	263	331	578
70	1120	282	663	46	551	350	428	705
80	1281	350	779	77	663	430	530	812
90	1423	416	897	105	765	511	625	899
100	1549	481	995	132	857	588	702	977
110	1646	541	1080	158	936	655	767	1043
120	1741	594	1158	181	1004	708	837	1100
130	1826	642	1223	203	1069	754	900	1143
140	1897	682	1278	223	1128	799	950	1182
150	1959	718	1329	241	1180	841	994	1218
160	2016	747	1376	259	1227	880	1032	1250
170	2067	774	1416	275	1272	915	1065	1278
180	2067	798	1449	291	1311	940	1092	1303
190	2067	818	1479	305	1344	962	1115	1327
200	2067	837	1500	319	1373	981	1135	1349
210	2067	854	1515	331	1400	999	1153	1363
220	2067	869	1529	343	1428	1014	1169	1374
230	2067	884	1542	352	1454	1025	1183	1383
240	2067	897	1553	361	1479	1036	1195	1389
250	2067	910	1563	369	1501	1046	1206	1389

Age	Man_Fd_M	Man_Hw_L	Man_Hw_M	Man_Ss_M	Man_Yc_H	Man_Yc_L	Man_Yc_M	
0	0	0	0	0	0	0	0	
10	0	0	0	0	0	0	0	
20	2	0	1	19	47	0	0	
30	70	0	72	164	238	1	40	
40	173	15	195	348	458	18	143	
50	269	59	325	539	690	69	258	
60	371	114	460	714	893	128	372	
70	467	169	588	881	1083	187	486	
80	545	221	709	1032	1252	247	596	
90	620	273	813	1156	1393	303	694	
100	686	323	904	1262	1530	353	777	
110	744	372	989	1349	1633	399	857	
120	793	418	1064	1422	1728	445	932	
130	835	460	1133	1477	1815	487	993	
140	872	499	1196	1524	1891	525	1048	
150	906	535	1245	1567	1957	559	1097	
160	936	570	1288	1604	2016	590	1141	
170	962	602	1330	1636	2068	619	1177	
180	985	632	1369	1636	2114	644	1209	
190	1003	660	1403	1636	2114	667	1236	
200	1017	685	1431	1636	2114	687	1259	
210	1030	709	1455	1636	2114	703	1279	
220	1042	731	1477	1636	2114	717	1298	
230	1052	750	1498	1636	2114	730	1314	
240	1063	766	1518	1636	2114	741	1327	
250	1071	782	1538	1636	2114	752	1339	

Appendix 7 *Visual Landscape Inventory Polygons and Forest Cover Requirements*

Table A7-1. Visual Landscape Inventory Units and Forest Cover Criteria

Visual Landscape Inventory Unit	Visual Quality Class	Visual Absorption Capacity	Area (ha)	Weighted Site Index	Maximum Disturbance
220900	Modification	Medium	84.4	22	25
220607	Modification	High	906.0	26	25
219756	Modification	Medium	49.9	25	25
219873	Modification	Medium	9.0	20	25
221497	Modification	Medium	255.4	24	25
219204	Maximum Modification	Low	12.3	25	32.5
219361	Maximum Modification	Medium	39.7	25	32.5
219549	Maximum Modification	Medium	1.2	20	32.5
220077	Maximum Modification	Medium	36.0	25	32.5
219202	Preservation	High	0.1	20	0.5
219754	Preservation	High	1.8	12	0.5
219820	Preservation	High	8.9	22	0.5
220300	Preservation	High	0.5	26	0.5
220377	Preservation	High	2.8	9	0.5
221049	Preservation	High	0.9	24	0.5
221005	Preservation	High	4.3	26	3
219148	Preservation	Medium	1.1	17	0.5
219279	Preservation	Medium	1.0	26	0.5
219314	Preservation	Medium	2.4	21	0.5
219452	Preservation	Medium	0.5	13	0.5
219914	Preservation	Medium	2.0	18	0.5
220079	Preservation	Medium	2.7	13	0.5
220578	Preservation	Medium	11.8	16	0.5
220697	Preservation	Medium	1.2	11	0.5
220698	Preservation	Medium	0.9	26	0.5
221299	Preservation	Medium	1.1	11	0.5
221534	Preservation	Medium	43.2	20	0.5
219152	Partial Retention	Low	78.2	32	10
219579	Partial Retention	Medium	437.5	30	15
221888	Partial Retention	Medium	516.8	28	15
221889	Partial Retention	Medium	0.1	26	15
221907	Retention	Low	15.8	25	10
219146	Retention	Medium	21.0	29	15
221138	Retention	Medium	170.8	29	15
221140	Retention	Medium	19.9	30	15
221533	Retention	Medium	108.9	29	15
221684	Retention	Medium	6.2	32	15
221685	Retention	Medium	12.8	29	15
221695	Retention	Medium	7.3	34	15
221696	Retention	Medium	12.3	34	15
221697	Retention	Medium	3.9	28	15

Appendix 8 Minimum Harvest Ages

Table A8-1. Minimum Harvest Age

AU name	AU number	MHA (yrs)
Mat_Ss_Low	1020	88
Mat_Ss_Med	1030	130
Mat_Ba_Poor	1110	130
Mat_Ba_Low	1120	93
Mat_Ba_Med	1130	70
Mat_Cw_Poor	1310	140
Mat_Cw_Low	1320	89
Mat_Cw_Med	1330	76
Mat_Cw_High	1340	84
Mat_Fd_Low	1520	98
Mat_Hw_Poor	1610	154
Mat_Hw_Low	1620	95
Mat_Hw_Med	1630	79
Mat_Hw_High	1640	106
Mat_Yc_Poor	1910	150
Mat_Yc_Low	1920	130
Mat_Yc_Med	1930	138
Mat_Yc_High	1940	116
Nat_Ss_High	2040	60
Nat_Ba_Low	2120	94
Nat_Ba_Med	2130	60
Nat_Cw_Low	2320	98
Nat_Cw_Med	2330	82
Nat_Cw_High	2340	60
Nat_Dr_Low	2420	40
Nat_Dr_Med	2430	40
Nat_Dr_High	2440	40
Nat_Fd_Low	2520	80
Nat_Fd_Med	2530	68
Nat_Fd_High	2540	60
Nat_Hw_Poor	2610	120
Nat_Hw_Low	2620	112
Nat_Hw_Med	2630	60
Nat_Hw_High	2640	60
Man_Ss_Med	3030	65
Man_Ba_Med	3130	77
Man_Cw_Low	3320	90
Man_Cw_Med	3330	82
Man_Fd_Med	3530	68
Man_Fd_High	3540	61
Man_Hw_Low	3620	111
Man_Hw_Med	3630	74
Man_Yc_Low	3920	104
Man_Yc_Med	3930	79
Man_Yc_High	3940	60
Gen_Ss_Med	4030	63
Gen_Ss_High	4040	66
Gen_Ba_Low	4120	85
Gen_Ba_Med	4130	73
Gen_Cw_Low	4320	84
Gen_Cw_Med	4330	78
Gen_Cw_High	4340	64
Gen_Fd_Low	4520	60
Gen_Fd_Med	4530	60
Gen_Fd_High	4540	60
Gen_Hw_Poor	4610	91
Gen_Hw_Low	4620	77
Gen_Hw_Med	4630	69
Gen_Hw_High	4640	69
Gen_Yc_Poor	4910	160
Gen_Yc_Low	4920	95
Gen_Yc_Med	4930	70
Gen_Yc_High	4940	60
Fut_Ss_Low	5020	96
Fut_Ss_Med	5030	66
Fut_Ba_Poor	5110	91
Fut_Ba_Low	5120	73
Fut_Ba_Med	5130	68
Fut_Cw_Poor	5310	78
Fut_Cw_Low	5320	78
Fut_Cw_Med	5330	78
Fut_Cw_High	5340	76
Fut_Fd_Low	5520	60
Fut_Hw_Poor	5610	69
Fut_Hw_Low	5620	78
Fut_Hw_Med	5630	68
Fut_Hw_High	5640	65
Fut_Yc_Poor	5910	180
Fut_Yc_Low	5920	159
Fut_Yc_Med	5930	72
Fut_Yc_High	5940	60
NSR_Hw_Poor	6610	110
NSR_Hw_Low	6620	86
NSR_Hw_Med	6630	66
NSR_Yc_Poor	6910	140
NSR_Yc_High	6940	77

Appendix 3 Timber Supply Analysis

Tree Farm Licence 61 – Management Plan #1

TIMBER SUPPLY ANALYSIS

Version 1.1

June 20, 2019

Project 1280-3

Prepared for:

Angus Hope, RPF
Pacheedaht Andersen Timber Holdings Limited Partnership
1101-409 Granville Street
Vancouver, BC V6C 2C6

Prepared by:

Forsite Consultants Ltd.
330 – 42nd Street SW
PO Box 2079
Salmon Arm, BC V1E 4R1
250-832-3366

Executive Summary

This report documents the timber supply analysis for Management Plan #1 for Tree Farm Licence 61 (TFL 61) held by Pacheedaht Andersen Timber Holding LP. Timber supply reviews for Tree Farm Licences are typically completed once every ten years to capture changes in data, practices, policy or legislation influencing forest management. The last analysis for TFL 61 was completed in 2003 when it was a subset (Block 1) of TFL 25. The current Annual Allowable Cut (AAC) was established in 2010 at 108,500 m^3/year.

This timber supply analysis provides forecasts of future harvest levels over time with consideration of a wide range of physical, biological, social, and economic factors. These factors encompass both the timber and non-timber values found in forests and ensure that timber-harvesting objectives are balanced against social and ecological values such as wildlife, biodiversity, watershed health, and recreational opportunities.

An Information Package (IP) providing detailed technical information and assumptions regarding current forest management practices, policy and legislation was produced for this analysis. This document was accepted by the Ministry of Forests, Lands, Natural Resource Operations & Rural Development (FLNRORD) on August 21, 2017 and then underwent a public review beginning in September 2017. An updated Information Package that reflects changes made in response to public comment and other review comments from FLNRORD is included as an appendix to Management Plan #1 (final version dated June 2019).

This Analysis Report focuses on a forest management scenario known as the "Base Case" that reflects current management practices in TFL 61. A number of sensitivity analyses are also presented that assess how results might be affected by uncertainties in data or assumptions. Together, these analyses provide a foundation for discussions with government, First Nations, and stakeholders in the determination of an appropriate AAC.

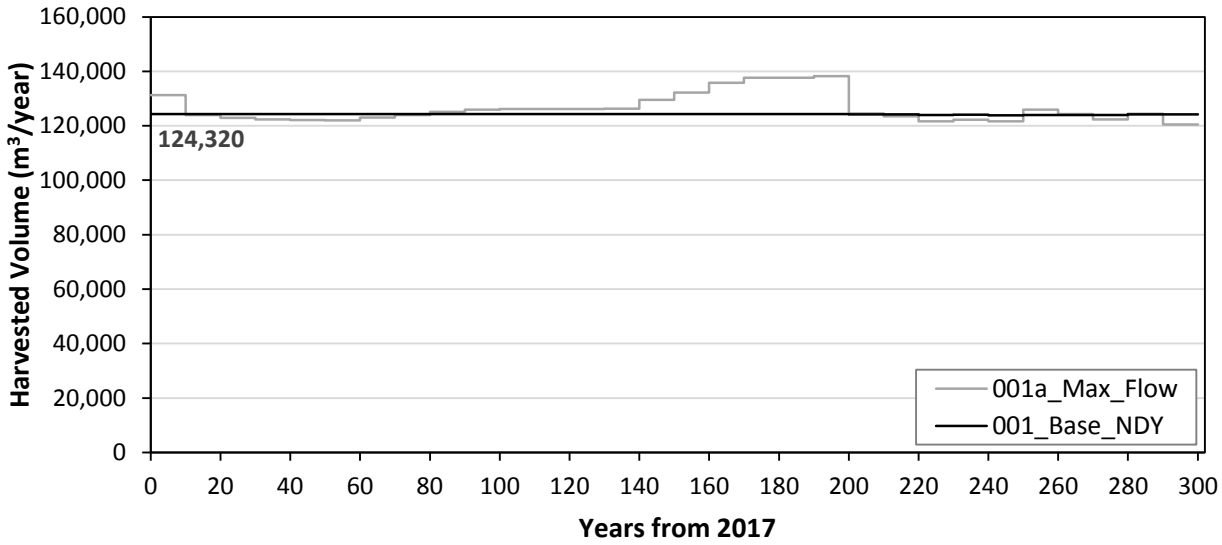
TFL 61 consists of approximately 20,240 ha of crown land on southern Vancouver Island in southwestern British Columbia. The crown forested land base in the TFL was determined to be 18,545 ha (91.6% of total TFL), and the timber harvesting land base was estimated to be 14,477 ha (71.5% of total TFL). The key changes affecting forest management since the 2003 analysis include:

- TFL boundary changes – exclusion of all private lands and inclusion of timber licences reversions.
- Use of LiDAR-updated stand heights in the VRI, and provincial site index estimated for managed stands.
- Reserved from harvesting the recently approved UWR and WHA orders.
- Use of improved modelling tools (newer growth and yield models and a spatially explicit heuristic forest estate model).

The Base Case scenario harvests approximately 124,300 m^3/year (14.5% more than the current AAC) for the entire 300-year planning horizon. The requirement to have a non-declining THLB growing stock in the last 100 years of the 300-year planning horizon significantly constrained the mid- and long-term harvest flow. Availability of merchantable timber was lowest 50 years from now, and this period was key to defining the projected harvest level.

The harvest flows were particularly sensitive to changes in THLB area and yield estimates. Changing the THLB size or TIPSY yields by ±10% had the largest impacts on harvest flows because these changes significantly impacted growing stock in the period where it was highly constrained. The minimal response arising from changing VDYP curves suggests that the flat line forecast is largely defined by timber availability 50 years from now – which relies little on the harvest of natural stands. Reducing the minimum harvest ages by 10 years showed a slight negative change in harvest flow, and a 10 year increase in MHA had a somewhat larger negative impact on the harvest flow

– suggesting the harvest ages being used in the Base Case are optimal. The use of draft OGMAs to replace the landscape-level biodiversity targets set by the Provincial Non Spatial Growth Order had little impact on harvest flows. However, caution is appropriate when placing more area in reserves because unpredicted natural disturbances can put more pressure on THLB to meet non-timber objectives and thus significantly reduce the harvest flow.



Scenario	Key Metrics				Difference relative to 001			
	THLB (ha)*	Harvest Rate (m³/year)	THLB Growing Stock Yr 0 (m³)	THLB Growing Stock Yr 300 (m³)	THLB (ha)	Harvest Rate (m³/year)	THLB Growing Stock Yr 0 (m³)	THLB Growing Stock Yr 300 (m³)
001_Base_NDY	***13,970***	***124,320***	***4,653,329***	***3,734,517***				
010_THLB_10pctPlus	15,367	134,823	5,118,662	3,928,533	10.0%	8.4%	10.0%	5.2%
011_THLB_10pctMinus	12,573	112,475	4,187,996	3,177,315	-10.0%	-9.5%	-10.0%	-14.9%
012_RegDel_2yrsPlus	13,970	121,610	4,535,182	3,503,665	0.0%	-2.2%	-2.5%	-6.2%
013_RegDel_2yrsMinus	13,970	126,621	4,776,597	3,555,164	0.0%	1.9%	2.6%	-4.8%
014_MHA_10yrsPlus	13,970	122,540	4,653,329	4,189,700	0.0%	-1.4%	0.0%	12.2%
015_MHA_10yrsMinus	13,970	123,891	4,653,329	3,740,074	0.0%	-0.3%	0.0%	0.1%
016_VDYP_10pctPlus	13,970	125,227	5,004,672	3,643,446	0.0%	0.7%	7.6%	-2.4%
017_VDYP_10pctMinus	13,970	123,522	4,301,986	3,493,543	0.0%	-0.6%	-7.6%	-6.5%
018_TIPSY_10pctPlus	13,970	136,406	4,767,319	3,858,466	0.0%	9.7%	2.4%	3.3%
019_TIPSY_10pctMinus	13,970	112,671	4,539,343	3,381,091	0.0%	-9.4%	-2.4%	-9.5%
020_BIOD_full	13,970	122,549	4,653,329	3,893,673	0.0%	-1.4%	0.0%	4.3%
021_draftOGMA	13,970	123,393	4,653,329	3,681,778	0.0%	-0.7%	0.0%	-1.4%
022_Dist_NHLB	13,970	119,721	4,653,329	3,892,542	0.0%	-3.7%	0.0%	4.2%
023_BIOD_full_Dist_NHLB	13,970	120,511	4,653,329	3,765,557	0.0%	-3.1%	0.0%	0.8%

Table of Contents

List of Figures

List of Tables

Acknowledgements

We thank Angus Hope of Pacheedaht Anderson Timber Holdings Ltd for the generous access to his time, judgement, and support throughout the project.

We would like to also thank government staff for their timely provision of data and thorough review/acceptance process. Government staff who reviewed and provided comments on the Inventory Update and Information Package are:

- Tracy Andrews (Resource Officer) of South Island Natural Resources District
- David Cruickshank (Authorizations Forester) of South Island Natural Resources District
- Roman Bilek (Senior Inventory Technician) of the Forest Analysis and Inventory Branch.
- Keith Boyes (Stewardship Forester) of the Ministry of Forests, Lands and Natural Resource Operations and Rural Development
- Jim Brown (Senior Timber Supply Forester) of the Forest Analysis and Inventory Branch.
- Christopher Butson (Remote Sensing Specialist) of the Forest Analysis and Inventory Branch.
- Erin Moore (Timber Supply Forester) of the Forest Analysis and Inventory Branch.
- Andreas Enrich (Timber Supply Forester) of the Forest Analysis and Inventory Branch.
- Graham Hawkins (Team Lead Inventory Operations) of the Forest Analysis and Inventory Branch.
- Nicole Gagnon (First Nations Policy Analyst) of the First Nations Relations Branch
- Hal McLean (Timber Supply Forester) of the Forest Analysis and Inventory Branch.
- Gordon Nienaber (Timber Supply Forester) of the Forest Analysis and Inventory Branch.
- Tim Salkeld (Manager, Forest Inventory) of the Forest Analysis and Inventory Branch.
- Wenli Xu (Forest Mensurationist) of the Forest Analysis and Inventory Branch.

Forsite staff who contributed to this project include:

- Cosmin Man (Forest Analyst)
- Cam Brown (Senior Forest Analyst, Technical Review)
- Michael Chubey (Land Information Specialist)
- Shelley Desautels (GIS Analyst)
- Geoff Lawless (Inventory Forester)
- Mark Perdue (Senior Forest Analyst, Project Manager)
- Stephen Smyrl (Senior GIS Analyst)

List of Acronyms

AAC	Annual Allowable Cut
AU	Analysis Unit
BA	Balsam (*Abies amabilis*)
BEC	Biogeoclimatic Ecosystem Classification
CFLB	Crown Forest Land Base
CW	Western redcedar (*Thuja plicata*)
CWH	Coastal Western Hemlock BEC zone
DSI	Natural Resources District
EM	Existing Managed Stands
EN	Existing Natural Stands
FAIB	FLNRORD Forest Analysis and Inventory Branch
FD	Douglas-fir (*Pseudotsuga menziesii*)
FLNRORD	BC Ministry of Forest, Lands, Natural Resource Operations and Rural Development
FM	Future Managed Stands
GW	Genetic Worth
HW	Western hemlock (*Tsuga heterophylla*)
LiDAR	Light Detection and Ranging
LRSY	Long Range Sustained Yield
LU	Landscape Unit
MAI	Mean Annual Increment
MH	Mountain Hemlock BEC zone
MHA	Minimum Harvest Age
MP	Management Plan
NDY	Non-Declining Yield
NFLB	Non-Forested Land Base
NHLB	Non-Harvestable Land Base
NRL	Non-recoverable Losses
NSR	Not-Sufficiently Restocked
NVAF	Net Volume Adjustment Factors
OGMA	Old Growth Management Area
PATH	Pacheedaht Andersen Timber Holding
PSPL	Provincial Site Productivity Layer PSPL
SI	Site Index
SPH	Stems per hectare
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation Program for Stand Yields
TL	Timber Licence
VDYP	Variable Density Yield Prediction
VQO	Visual Quality Objective
VRI	Vegetation Resource Inventory
YC	Yellow cypress (*Chamaecyparis nootkatensis*)

1 Introduction

The Pacheedaht Andersen Timber Holding LP (PATH), the holder of the Tree Farm Licence (TFL) 61, is undertaking a Management Plan #1 (MP1) process – due for approval by May 2020. As part of the MP1 process, a timber supply analysis was conducted to examine the short- and long-term effects of current forest management practices on the available timber harvest.

This timber supply analysis provides forecasts of future harvest levels over time with consideration of a wide range of physical, biological, social and economic factors. These factors encompass both, the timber and non-timber values found in our forests and ensure that timber harvesting is balanced against social and ecological values such as wildlife, biodiversity, watershed health, and recreational opportunities.

An Information Package provides detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis. PATH prepared an Information Package for this analysis, accepted by the FLNRORD on August 21, 2017, and made it available for review by public and First Nations over 60 days beginning in September 13, 2017. An updated Information Package that reflects minor changes made in response to the public review, and other comments provided by government staff is included in Appendix 2 of the Management Plan #1 document (final version dated June 2019). Very little of the information package is repeated in this document.

This Analysis Report document provides a timber supply forecast for the Base Case scenario, which reflects current practices on the TFL, and also provides several sensitivity analyses that illustrate how results may be affected by uncertainties in data or assumptions. This information is meant to support public discussion on appropriate harvest levels and will provide British Columbia's Chief Forester with much of the information needed to establish a new Annual Allowable Cut (AAC). This Analysis Report does not establish a new AAC – a final AAC will be determined by the Chief Forester then described in a published rationale document.

Reviews of the projected timber supply for TFLs are typically completed every ten years to capture changes in data, practices, policy or legislation influencing forest management. The last analysis for TFL 61 was completed in 2003 (as part of the larger TFL 25 MP #10 (Western Forest Products Limited, 2003)) but the landbase was substantially different. When TFL 61 was created in 2010, an Annual Allowable Cut (AAC) of 108,500 m^3/year was established.

2 Project Area

2.1 DESCRIPTION

TFL 61 is located near the communities of Port Renfrew, Jordan River, and Sooke on southern Vancouver Island in southwestern British Columbia (Figure 1). The TFL covers approximately 20,240 ha split into two units; the larger unit (Block 1) covers 17,192 ha and the smaller unit (Block 2) covers 3,048 ha. Approximately 18,545 ha (91.6%) is productive area suitable for forest management (i.e., Crown Forest Land Base - CFLB) which contributes towards meeting non-timber and other management objectives (e.g., biodiversity). Approximately 14,477 ha (71.5%) is expected to be available for timber harvesting (THLB) in the near term. As additional harvesting occurs, further reductions are implemented to address loss of productive land and retention for non-timber values (Long Term THLB =13,203 ha (65.2%). This TFL includes 1,652 ha of Timber Licence (TL) that have been harvested and reverted to the TFL and an additional 453 ha of active TLs are expected to be reverted to the TFL once harvested.

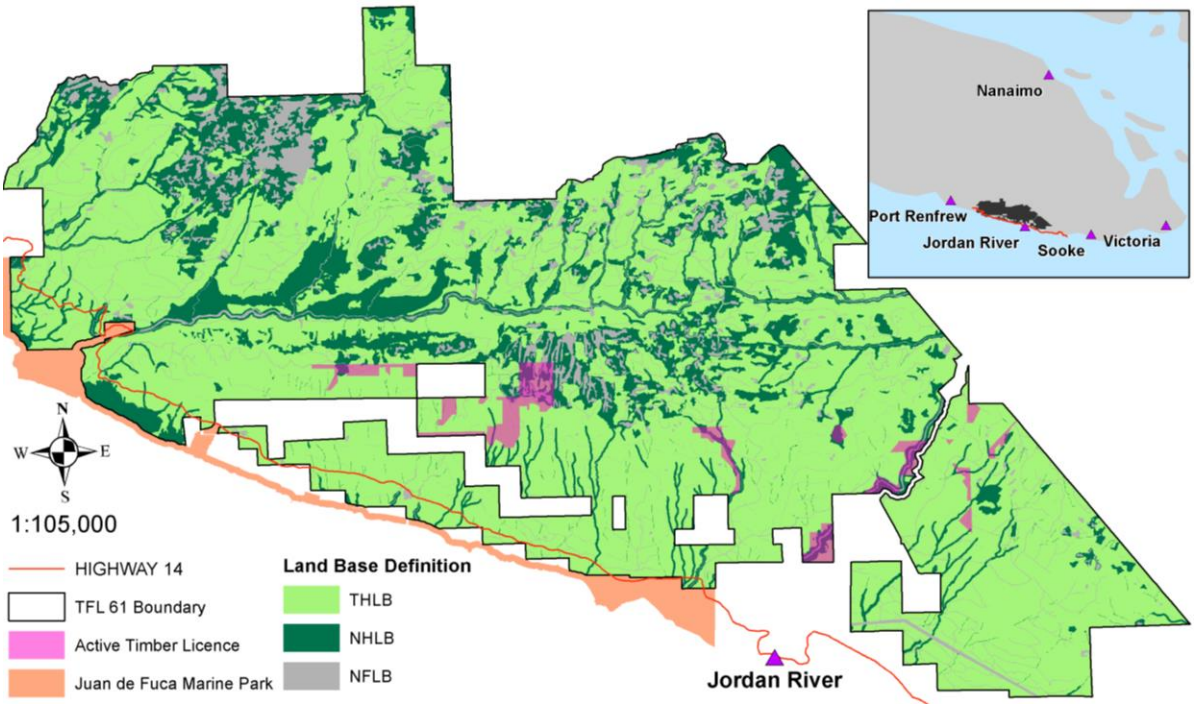


Figure 1 Location of TFL 61. NFLB, Non-Forest Land Base.

The TFL is primarily within the coastal western hemlock (CWH) (97%) biogeoclimatic ecosystem classification (BEC) zone, with higher elevations in the mountain hemlock (MH) zone (Figure 2). There are six CWH subzone variants within this TFL, CWHmm1, CWHmm2, CWHvh1, CWHvm1, CWHvm2, CWHxm2, and one MH subzone variant MHmm1 characterized by relatively rare stand-initiating events.

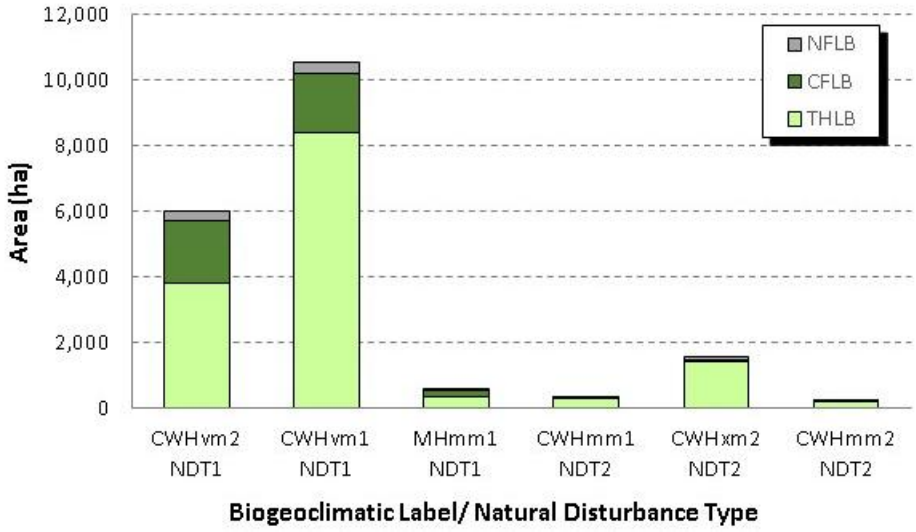


Figure 2 Area Distribution by BEC Variant

The CFLB is dominated by western hemlock (38%), Douglas-fir (23%), western red cedar (14%), yellow cedar (17%) and balsam stands (6%) (Figure 3). Less common stand types such as sitka spruce and deciduous make up the remaining 1% of the land base.

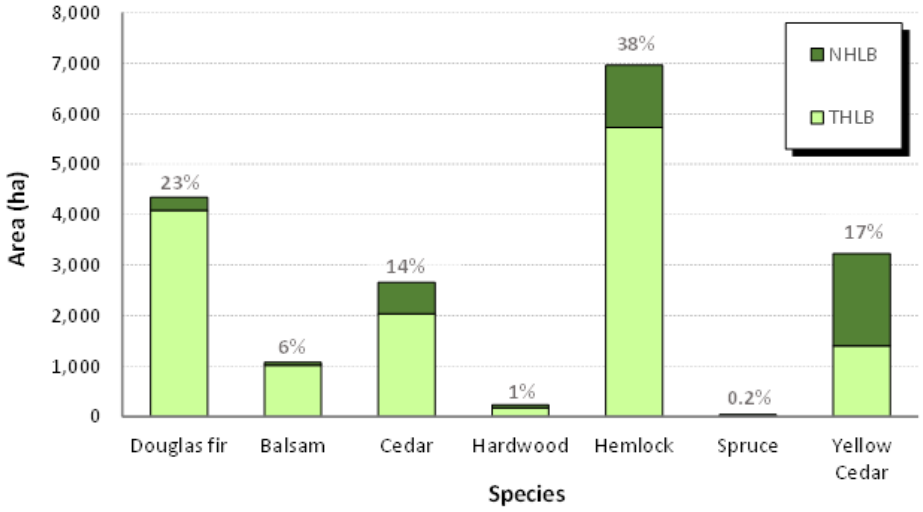


Figure 3 Area Distribution by Leading Species

The area of old forest is evenly distributed between the NHLB (3,249 ha or 53% of all old forest) and THLB (2,902 has or 47% of all old forest) (Figure 4). Old forests represent a large proportion of the NHLB (79% of total NHLB), while the THLB contains only 20% old forest. Eighty percent of the THLB is younger than 120 years of age.

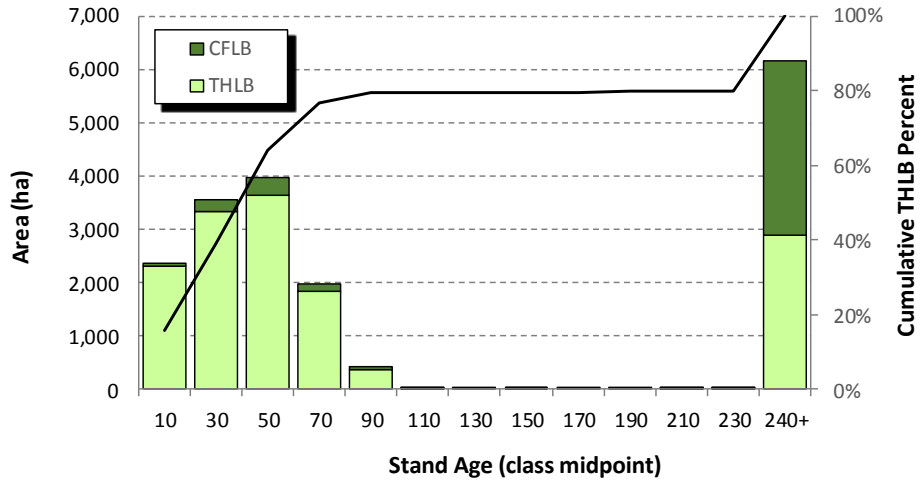


Figure 4 Area Distribution by Age Classes

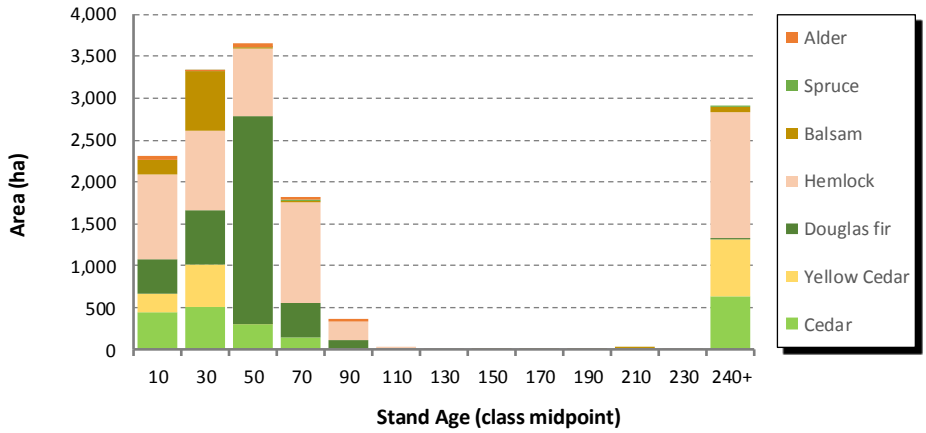


Figure 5 THLB Area Distribution by Age Class and Leading Species

The current area distribution by site index (i.e., top height in m at age 50) indicates that most of the THLB is relatively productive with a site index over 20 m (Figure 6). The site index value includes both, the vegetation resource inventory (VRI) values for naturally regenerated stands and the Provincial Site Productivity Layer (PSPL) for previously harvested stands. Overall, the current THLB area-weighted average site index is 24.0 m. As the naturally regenerated stands are converted to managed stands, their site index values will be based on the PSPL. The PSPL more accurately represents the potential performance of managed stands. When the entire THLB is comprised of managed stands, the overall site index will be 26.1 m, 1.41 m higher than the current area-weighted average site index.

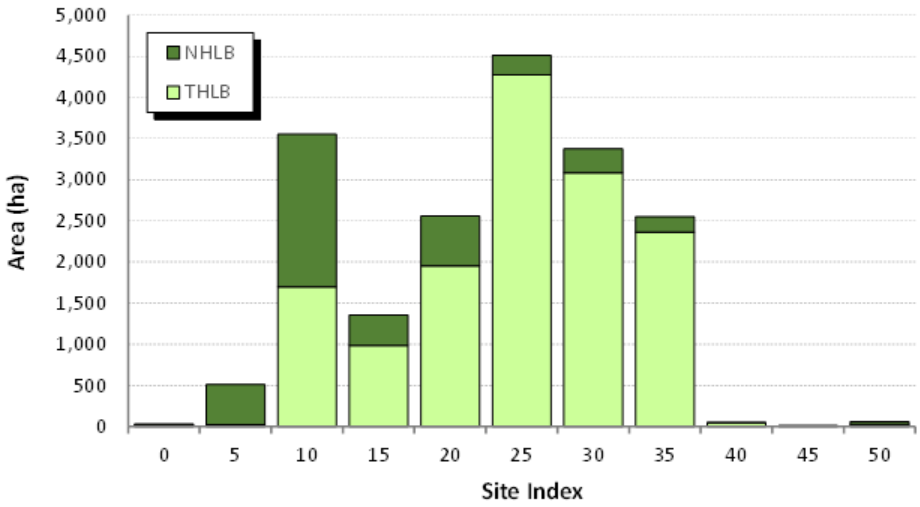


Figure 6 Area Distribution by Site Index

2.2 FOREST INVENTORY

The VRI for TFL 61 was completed in 1999 with additional analysis completed in 2010 to derive Net Volume Adjustment Factors (NVAF). The NVAF is an adjustment factor that is used during sample compilation to produce unbiased estimates of net merchantable tree volume. The NVAF analysis determined that overall, the VRI overestimated inventory volume by an average of 3.4%, including an overestimate of second growth by 17.5% and an underestimate of old growth by 9.5%. In preparing for this analysis, the TFL 61 inventory was updated using LiDAR data to capture changes in stand height, stocking, site index, and recent depletions.

As this analysis was being initiated in 2017, FLNRO completed a separate inventory of the South Island Natural Resources District (DSI) where TFL61 resides. A comparison of the LiDAR-updated TFL inventory and the DSI-VRI found that the DSI-VRI estimated a total inventory volume of 5.50 million m^3, 15% below the LiDAR-updated TFL inventory volume of 6.33 million m^3 (Figure 7, Table 1). Similarly, within the THLB, the DSI-VRI volume is 4.12 million m^3, 14% below the LiDAR-updated TFL volume of 4.71 million m^3. Prior to the two inventory updates, the original TFL inventory (projected to 2017) estimated a volume of 7.28 million m^3.

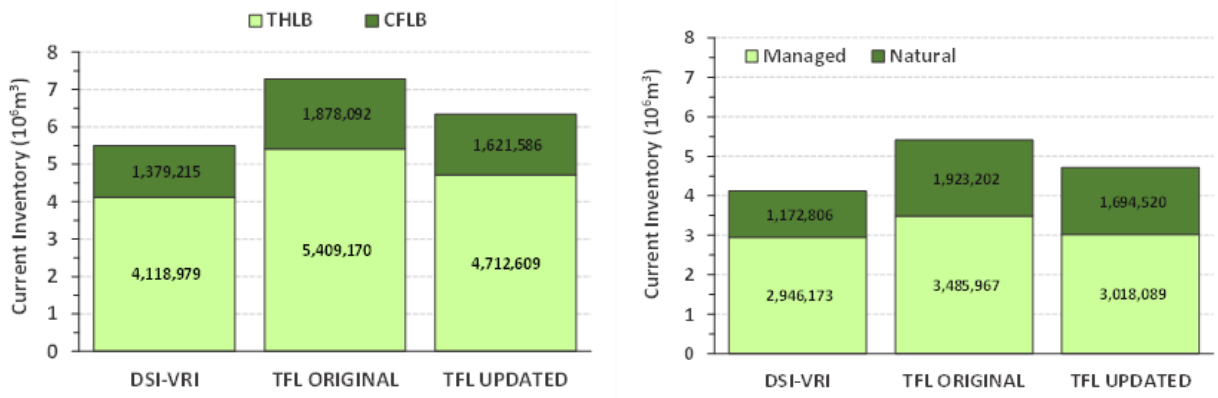


Figure 7 Comparing Volume Inventory Between the Three Available Sources (Total CFLB left, THLB by Stand Type, right)

Table 1 Inventories Comparisons

Stand Type	TFL Original (2017 projected) (Million m^3)	DSI-VRI (% Difference from Original)	LiDAR Update TFL (% Difference from Original)
THLB Natural	1.92	-39%	-12%
THLB Managed	3.49	-15%	-13%
Total CFLB	**7.28**	**-24%**	**-13%**

Prior to completing the Information Package, the project team had to decide which inventory would be most appropriate for use in the timber supply analysis. Because the DSI-VRI had significantly coarser forest cover typing (large polygons), and had not yet been checked with an NVAF analysis, the LiDAR-updated TFL inventory was deemed most appropriate for this timber supply analysis. Details of the LiDAR inventory update process are provided in the Information Package.

Although the LiDAR-updated TFL inventory indicates a higher volume than the DSI-VRI, there is some indication that the LiDAR-updated inventory underestimates timber volume on the TFL. The LiDAR data, which was used to update the inventory heights and stems densities, is known to underestimate density by missing stems that are hidden under larger trees or stems located relatively close to each other. Given the uncertainty with the inventory information, a comparison with the cruise data was conducted. The cruise data used in the comparison was based on 423 cutting permit cruise plots within 18 blocks, including 244 plots within 9 blocks in second growth and 179 plots within 9 blocks in old growth. It was found that the LiDAR updated VRI inventory underestimated density (stems per hectare or SPH) by 39% and basal area by 14%. In addition, a comparison with FAIB transect data (small sample) with the LiDAR updated VRI inventory indicated that an underestimation of SPH by 19% and basal area by 11%.

Inventory volumes are derived using stand attributes in the VRI inventory. Inaccuracies in VRI attributes impact natural stand yields and create uncertainties around harvest levels. Thus, this analysis includes a number of sensitivity analyses around and natural and managed stand yields.

2.3 NON-TIMBER OBJECTIVES

Forest cover requirements are applied in the forest estate model to recognize non-timber objectives. These requirements maintain appropriate levels of specific forest types needed to satisfy the non-timber objectives (e.g., wildlife habitat, biological diversity etc.) and limit harvesting within the THLB. Any impacts on harvest depend on the area (THLB vs. NHLB), age class distribution (young vs. old), and spatial distribution of the various non-timber objectives and the degree of overlap between the non-timber objectives (i.e., retaining one stand can serve multiple non-timber objectives). While the old seral targets and management zones (special plus enhanced) cover virtually the entire land base, visual quality targets cover a relatively small area (3,513 ha) (Figure 8, Table 2). Old seral targets are likely to most limit timber harvesting, followed by visual quality objectives. The management zone objectives (i.e., green-up) are not expected to significantly constrain harvesting. The key role of the green-up objectives is avoid overharvesting within one landscape unit at the expense of other landscape unit.

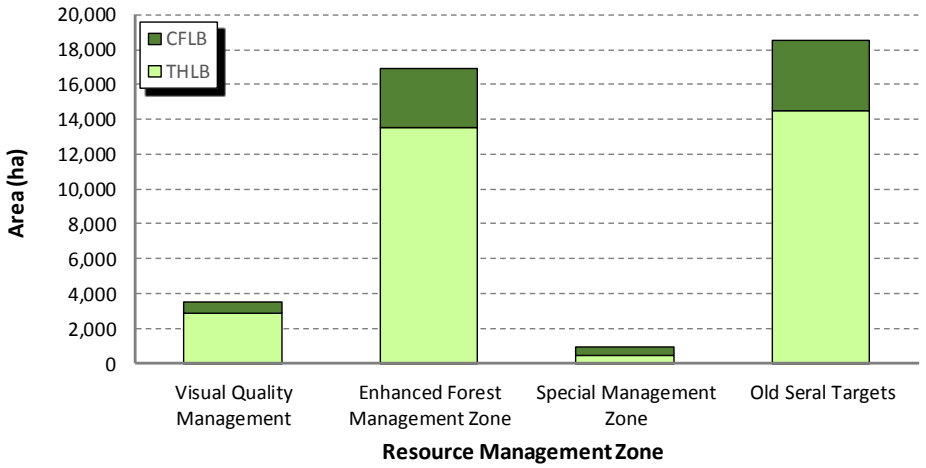


Figure 8 Area Distribution by Non-Timber Objective

Table 2 Non-Timber Objectives Area Summary

Value	CFLB (ha)	THLB (ha)	% of Total CFLB	% of Total THLB
Visual Quality Management	620	2,893	15%	20%
Enhanced Forest Management Area	3,411	13,504	84%	93%
Special Management Area	471	486	12%	3%
Old Seral Targets	4,067	14,477	100%	100%

3 Timber Values

The Base Case scenario presented in this report was based on the best information available and reflects management practices currently employed within the TFL. The current AAC for TFL 61 is 108,500 m³/year. Non-recoverable losses (NRL) in the THLB were estimated to be 2,207 m³/year and, unless otherwise noted, were subtracted from the graphs, tables, and harvest forecasts in this report.

3.1 HARVEST FLOW

3.1.1 LONG RUN SUSTAINED YIELD

The Long Run Sustained Yield (LRSY) is calculated as the sum of the future THLB area of each regenerated analysis unit, multiplied by the maximum mean annual increment (MAI) of the analysis unit. LRSY represents the theoretical maximum even-flow yield that can be sustained across the land base and is used as a benchmark to evaluate model runs.

To achieve LRSY, each stand must be harvested at the age where the MAI is greatest. In practice, this does not occur because some stands may not be available for harvest at the specified age due to non-timber resource requirements or simply too much area in a single age class. In addition, minimum harvest ages for this analysis were reduced from the optimum age to provide some modelling flexibility by allowing harvest once the stand has achieved 95% of the maximum MAI. In some cases, the model may harvest stands at this reduced age to offset non-timber objectives required on other portions of the land base.

The LRSY calculated for the Base Case scenario was 127,690 m^3/year. After accounting for non-recoverable losses (i.e. reducing by 2,207 m^3/year), a LRSY of 125,483 m^3/year was used to compare with model run long term harvest levels.

3.1.2 DEVELOPING THE BASE CASE HARVEST FLOW

This analysis was conducted in Patchworks™, a heuristic, spatially explicit forest estate model. Because of the heuristic nature, the approach applied to develop sustainable harvest flows was different from those used in simulation or true-optimization forest estate models. Two harvest flows were developed to support the Base Case: Max Flow and Non-Declining Yield (Base NDY). The Max Flow run was first developed to demonstrate the maximum harvest flow that can be sustained over each period and then the Base NDY harvest flow was adjusted to maintain a steady harvest flow over multiple periods.

For the first harvest flow (Max Flow), the analyst applied the following steps:

1) Set the model to develop a 'no-constraints' harvest flow over 1 million iterations (i.e., as high as possible with no restrictions on period changes or standing volume). Initially, the only constraints applied were related to treatment operability windows (e.g., minimum harvest ages) and transition rules.
2) Activate non-timber objectives (i.e., visual quality, biodiversity (old and mature seral), and green-up), and run the harvest schedule for another million iterations.
3) Implement a target to ensure the standing volume on the THLB does not decline over the last 100 years of the 300-year planning horizon. Allow the model to develop the harvest schedule until the change in objective function over 500,000 consecutive iterations reaches less than 0.0000001%. Because this particular land base was relatively small, the analyst could run the model longer to develop the best solution possible.

For the second harvest flow (Base NDY), the analyst included an extra step to the ones described above for the Max Flow:

4) Before setting the standing volume objective (step 3 above), adjust the model to manually develop a non-declining harvest flow.

The Base NDY harvest flow was developed as the Base Case scenario (Figure 9), with an initial harvest flow of ~124,300 m^3/year that was maintained over the rest of the 300-year planning horizon. The Base NDY harvest flow

was ~1,100 m^3/year (0.9%) lower than LRSY, indicating that the THLB is relatively unconstrained by the non-timber objectives in the long term.

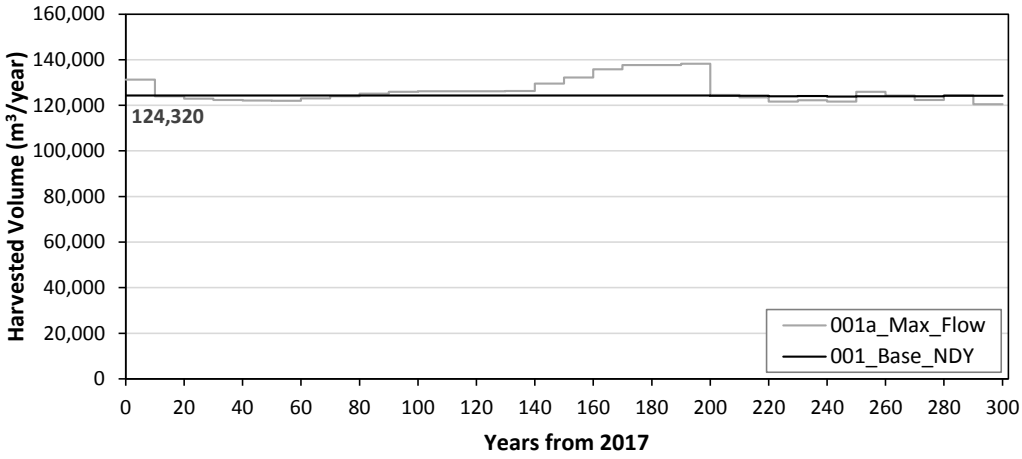


Figure 9 Base Case – Harvest Flows - Max Flow and Base NDY

3.2 OTHER METRICS

This section describes various attributes of harvested stands and the overall state of the forest modelled throughout the planning horizon. The information presented below was used to validate assumptions and review their relative impact on the overall composition of the forest to understand and evaluate the Base Case Scenario. Similar metrics were reported for all model runs, but only the key ones were included in this document to support key elements relevant to this analysis.

3.2.1 GROWING STOCK

Growing stock was controlled in the model by implementing a target to ensure the standing volume on the effective THLB does not decline over the last 100 years (step 3 above), which is clearly demonstrated in Figure 10.

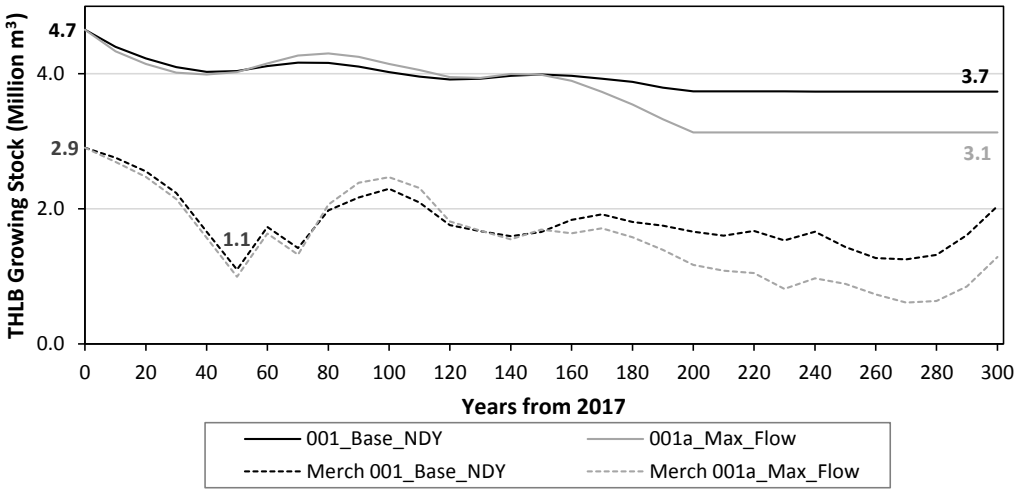


Figure 10 Base Case – THLB Growing Stock (Total and Merchantable) - Max Flow and Base NDY

Aside from slight increases between the 4th and 8th decade and between the 12th and 15th decade, the total growing stock associated with the Base NDY continually decreased until the 20th decade where it leveled off to approximately 3.7 million m³. The merchantable growing stock reached its lowest level (pinch point) of 1.1 million m³ in the 5th decade, but it is also low near the end of the planning horizon – suggesting another pinch point. Note that the initial THLB growing stock of 4.7 million m3 corresponds with the value reported in section 2.2 (Figure 7).

3.2.2 AGE CLASS

The area distributions by age classes at years 0, 100, 200, and 300 are illustrated in Figure 11. The modelled forest nearly achieves a regulated state within 200 years as harvesting on the THLB transitioned to future managed stands, which were subsequently harvested close to their culmination age.

Note that at 300 years, there are virtually no THLB stands older than 141 years (except the area reserved for stand-level biodiversity objectives – THLB-Retention), indicating that the THLB was not needed to meet non timber objectives for old growth. This is why the long-term harvest flow is very close to LRSY. Because there were no disturbances programmed for the nonTHLB, these stands continued to age in perpetuity and by the end of the 300-year planning horizon, they were older than 240 years.

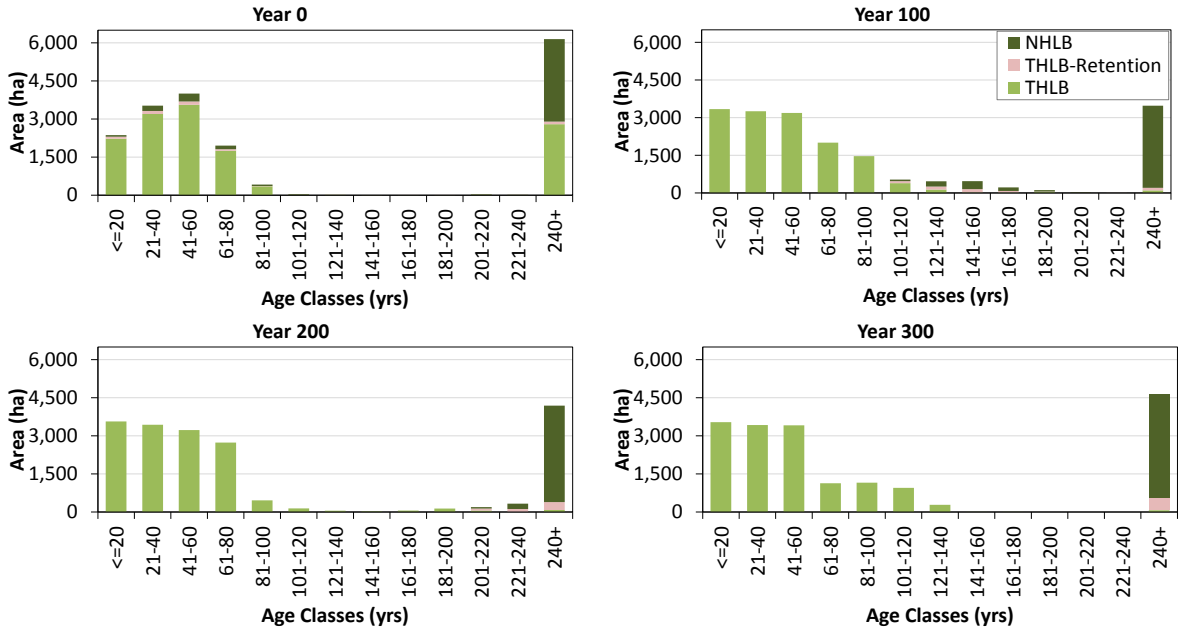


Figure 11 Base Case – Area Distribution by Age Class (at 0, 100, 200, 300 years)

3.2.3 HARVEST ATTRIBUTES

The model harvested existing stands (i.e., both existing natural (EN) and existing managed (EM)) over the first 70 years of the 300-year planning horizon (Figure 12). Following that, the model quickly transitioned to harvest future managed stands (FM). Small amount of existing natural stands (present in 2017) continued to be harvested over the rest of the planning horizon but they are almost entirely converted to managed stands by year 60.

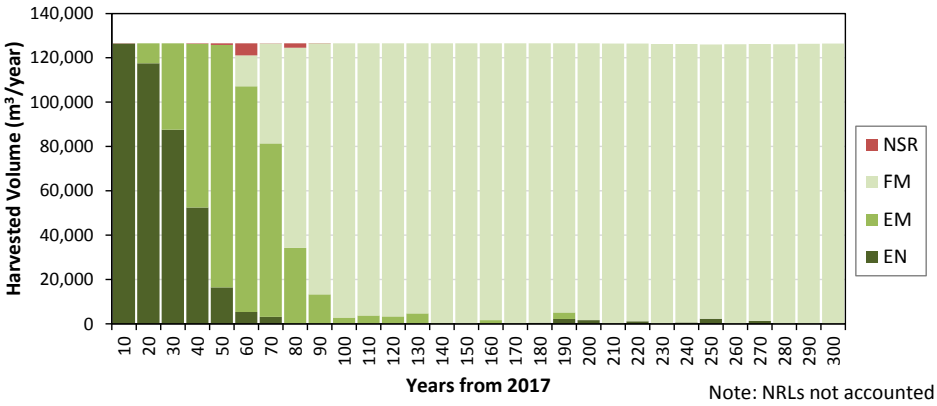


Figure 12 Base Case – Harvested Volume by Management State

The average age at harvest decreased from 298 years in decade 1, to 80-100 years for much of the mid and long term (Figure 13). This dynamic reflects the harvest of older stands over the short- and mid-term, and the transition to harvesting younger, more productive stands over the long-term. The average volume at harvest increased from 591 m³/ha at the beginning of the planning horizon to 855 m³/ha by year 120, then slightly decreased to a low of 700 m³/ha at the end of the planning horizon (Figure 13). These volume/ha values are very similar to those shown in the last analysis (TFL 25 Block 1).

Inversely to average volume harvested, the average area harvested annually decreased from 214 ha/year to a low of 148 ha/year by year 120, then steadily increased to 181 ha/year by the end of the 300-year planning horizon.

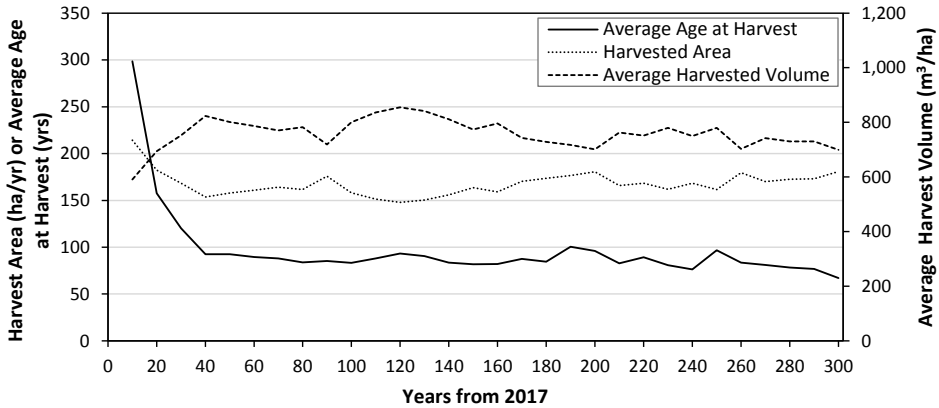


Figure 13 Base Case – Average Age, Average Volume and Annual Area at Harvest

In the 1st decade, most of the volume was harvested from stands older than 200 years, while for the rest of the planning horizon, most of the volume was harvested from stands 60-120 years (Figure 14). Significant portions of the landbase currently exist as managed stands (Figure 4), so the harvest flow only relies on existing natural stands for a short period of time.

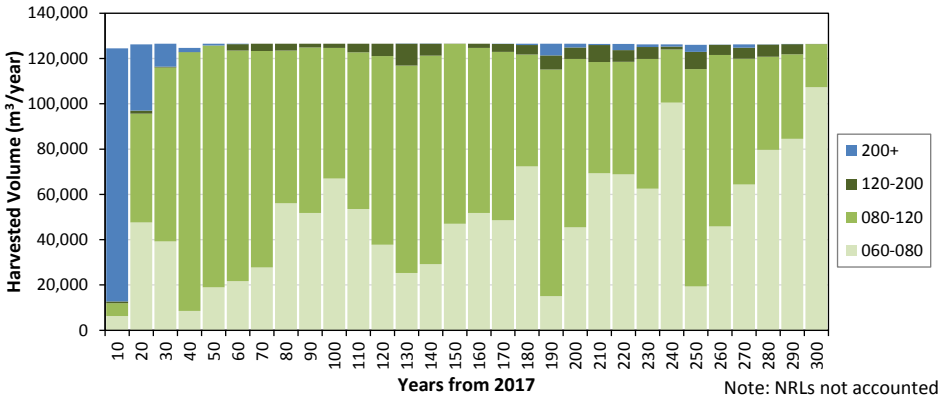


Figure 14 Base Case – Harvested Volume by Age Class

In the short-term, most of the volume was harvested from stands with average volumes between 475 and 800 m³/ha with some important contribution of stands with average volumes < 475 m^3/ha (Figure 15). This finding indicates that not many of the existing natural stands harvested in the short-term had standing volumes >800 m^3/ha. In the mid-term, the harvest flow was mostly formed by the stands with an average volume >800 m^3/ha. As the forest estate model transitioned more and more stands to future managed stands, it was possible to harvest more stands, with volumes between 475-800 m^3/ha on shorter cycles. This finding can also be seen in Figure 13 where the harvest area slightly increases and the average volume slightly decreases towards the end of the 300-year planning horizon.

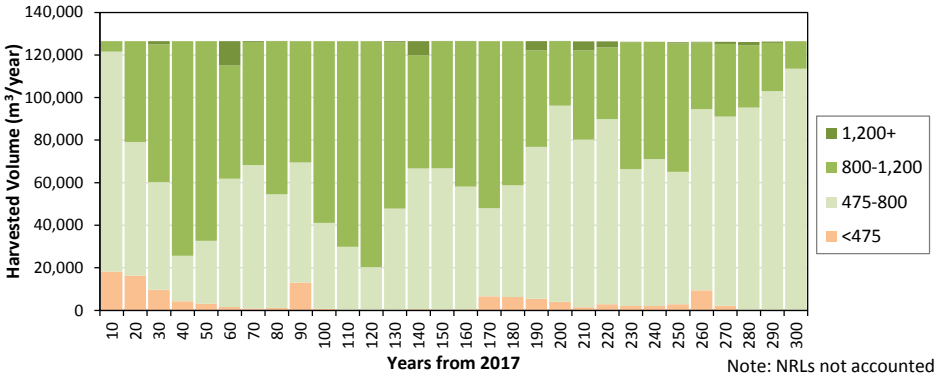


Figure 15 Base Case – Harvested Volume by Average Volume Class at Harvest

Throughout the 300-year planning horizon, western hemlock (HW), Douglas-fir (FD), and western redcedar (CW) comprised the majority of the harvest (Figure 16). Amabilis fir (BA) and cypress (YC) made important contribution to the harvest while other species (OTH) contributions were minor.

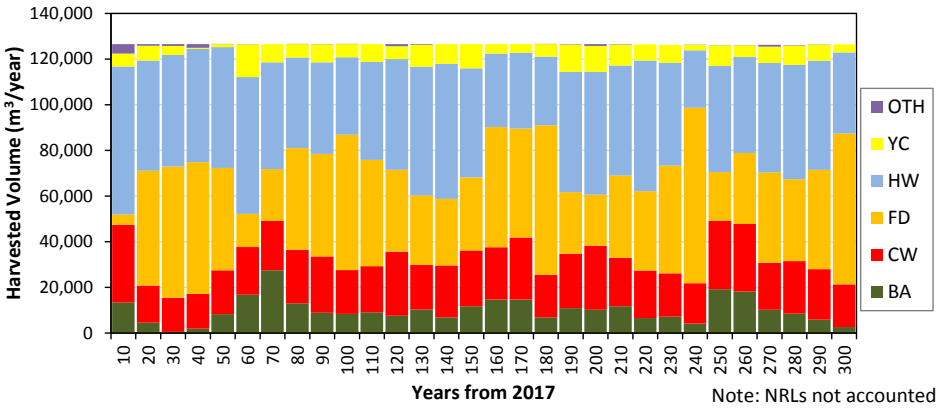


Figure 16 Base Case – Distribution of Harvested Volume by Individual Species

4 Non-Timber Values

While many non-timber values were addressed as reductions to the THLB or stand-level retention (e.g., riparian, wildlife trees), several non-timber objectives were modelled using forest cover requirements assigned to specific geographic areas (e.g. VQOs, green-up, and mature and old seral retention, etc). The generalized performance of these objectives are summarized in Table 3 where the percent achievement of the target value is determined and then put into one of three conditions classes (violated, tight, or surplus).

- Violated: <95 (highlighted red) – the achieved value is violating the target (either above or below the target by more than 5% depending on the target type, maximum or minimum, respectively). The objective would be actively limiting harvest in this area during the timeframe in question.
- Tight: 95-105 (highlighted light yellow) – the achieved value is within +/- 5% of the target value; suggesting that the objective is likely to be limiting harvest.
- Surplus: >105 or Infinity (highlighted dark green) – the achieved value has at least 5% surplus relative to the target and is unlikely to be limiting harvest. Infinity results from no current disturbance in a max disturbance objective.

The most constraining objectives were old seral percent retention for Tugwell CWHxm2 and VQO polygon 219579 (i.e., highlighted light yellow). These findings are in line with the discussion in section 2.3. Table 3 indicates that non-timber constraints had very little influence on the forecasted harvest flows, although it appears that the P/R/PR VQO's are locking out some THLB from harvest – but they are very small area of the landbase.

Table 3 Non-Timber Objectives Summary

Objective	Target (%)	Area (ha)		Year							
	Min/Max	CFLB	THLB	0	20	50	100	150	200	250	300
VQO.MM_M_220900	32.5	93	84	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.MM_L_219204	32.5	17	12	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.MM_M_219361	32.5	42	40	>105	Infinity	Infinity	>105	Infinity	Infinity	Infinity	Infinity
VQO.MM_M_219549	32.5	1	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.MM_M_220077	32.5	38	36	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.M_H_220607	25	1,189	906	>105	Infinity	>105	>105	>105	>105	>105	>105
VQO.M_M_219756	25	79	50	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.M_M_219873	25	10	9	<95	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.M_M_221497	25	303	255	>105	Infinity	>105	>105	>105	>105	>105	>105
VQO.PR_L_219152	10	87	78	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.PR_M_219579	15	474	438	<95	95-105	>105	95-105	>105	95-105	>105	>105

Objective	Target (%)	Area (ha)		Year							
	Min/Max	CFLB	THLB	0	20	50	100	150	200	250	300
VQO.PR_M_221888	15	529	517	<95	>105	>105	>105	>105	>105	>105	>105
VQO.PR_M_221889	15	0	0	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_H_219202	0.5	0	0	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_H_219754	0.5	3	2	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_H_219820	0.5	40	9	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_H_220300	0.5	1	0	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_H_220377	0.5	8	3	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_H_221049	0.5	1	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_L_221005	0.3	17	4	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_219148	0.5	2	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_219279	0.5	1	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_219314	0.5	5	2	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_219452	0.5	9	0	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_219914	0.5	4	2	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_220079	0.5	3	3	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_220578	0.5	84	12	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_220697	0.5	3	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_220698	0.5	7	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_221299	0.5	1	1	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.P_M_221534	0.5	44	43	<95	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_L_221907	3	16	16	<95	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_219146	5	21	21	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221138	5	172	171	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221140	5	20	20	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221533	5	114	109	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221684	5	6	6	<95	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221685	5	16	13	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221695	5	7	7	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221696	5	12	12	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
VQO.R_M_221697	5	4	4	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
GRNUP.Los	25	6,915	6,915	>105	>105	>105	>105	>105	>105	>105	>105
GRNUP.SMA_Los	25	244	244	>105	Infinity	Infinity	Infinity	>105	Infinity	>105	Infinity
GRNUP.SMA_Tug	25	28	28	>105	Infinity	Infinity	Infinity	95-105	>105	Infinity	Infinity
GRNUP.San	25	60	60	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	>105	Infinity
GRNUP.Tug	25	4,337	4,337	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.MAT.Los_CW	25	646	302	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.MAT.Los_MH	25	240	154	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.MAT.Tug_MH	25	71	30	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.Los_CWHvm1	4.3/13*	7,971	6,450	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.Los_CWHvm2	4.3/13*	4,144	2,652	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.Los_MHmm1	6.3/19*	432	315	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.San_CWHvm1	None	2	0	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.San_CWHvm2	3/9*	90	60	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.Tug_CWHmm1	3/9*	326	295	>105	>105	>105	>105	>105	95-105	>105	>105
BIOD.OLD.Tug_CWHmm2	4.3/13*	214	196	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.Tug_CWHvm1	4.3/13*	2,245	1,944	>105	>105	>105	>105	>105	95-105	>105	>105
BIOD.OLD.Tug_CWHvm2	3/9*	1,499	1,105	>105	>105	>105	>105	>105	>105	>105	>105
BIOD.OLD.Tug_CWHxm2	6.3/19*	1,499	1,415	>105	95-105	95-105	95-105	95-105	95-105	>105	>105
BIOD.OLD.Tug_MHmm1	6.3/19*	122	47	>105	>105	>105	>105	>105	>105	>105	>105

**1/3 drawdown for the first 168 years of the 300-year planning horizon, then full target is applied.*

5 Sensitivity Analyses

Sensitivity analyses are commonly performed to provide perspective on the impacts of changes to data or assumptions that are subject to uncertainty. Usually only one variable (data or assumption) applied in the Base Case is changed to explore how sensitive key indicators (e.g., harvest flow) respond to that variable. Sensitivity analyses are a key component of the timber supply analysis processes as they provide the Chief Forester with the

information necessary to assess the potential uncertainty associated with the information used to develop the Base Case.

Table 4 lists the sensitivity analyses completed and compared against the Base Case scenario [001]. Given that the Base Case NDY resulted in an even-flow harvest rate and all sensitivity runs were modeled with the same even flow approach, detailed sensitivity analyses harvest flow graphs are not included here. For simplicity of communicating information, only the harvest level and its % change from the base case are provided (see Table 5) .

Table 4 Sensitivity Analyses Description

<table>
<tr><th>Category</th><th>ID</th><th>Sensitivity</th><th>Description</th></tr>
<tr><td rowspan="2">Land Base Definition</td><td>010</td><td>THLB increased (+) 10%</td><td>The modeled size of each polygon in the THLB was increased by 10%. The size of each non-THLB polygon was reduced by an offsetting percentage to keep the total CFLB area constant.</td></tr>
<tr><td>011</td><td>THLB decreased (-) 10%</td><td>The modeled size of each polygon in the THLB was decreased by 10% The size of each non-THLB polygon was reduced by an offsetting percentage to keep the total CFLB area constant.</td></tr>
<tr><td rowspan="7">Yield Curves and MHA</td><td>012</td><td>Regeneration Delay Extended (+) 2 years</td><td>Regeneration for planted stock and naturally stems increased by 2 years. MHA, VQO and green-up age curves were adjusted accordingly.</td></tr>
<tr><td>013</td><td>Regeneration Delay Reduced (-) 2 years</td><td>Regeneration for planted stock and naturally regenerated stems reduced by 2 years to a minimum of 0 years. MHA, VQO and green-up age curves were adjusted accordingly.</td></tr>
<tr><td>014</td><td>MHA Decreased (-) 10 years</td><td>Minimum harvest ages were decreased by 10 years. Low productivity forest classification was not adjusted.</td></tr>
<tr><td>015</td><td>MHA Increased (+) 10 years</td><td>Minimum harvest ages were increased by 10 years. Low productivity forest classification was not adjusted.</td></tr>
<tr><td>016</td><td>NSY Increased (+) 10%</td><td>The yields associated with each natural stand analysis unit were increased by 10%. MHA, VQO and green-up age curves were adjusted accordingly.</td></tr>
<tr><td>017</td><td>NSY Decreased (-) 10%</td><td>The yields associated with each natural stand analysis unit were decreased by 10%. MHA, VQO and green-up age curves were adjusted accordingly.</td></tr>
<tr><td>018</td><td>MSY Increased (+) 10%</td><td>The yields associated with each managed stand analysis unit were increased by 10%. MHA, VQO and green-up age curves were adjusted accordingly.</td></tr>
<tr><td>019</td><td>MSY Decreased (-) 10%</td><td>The yields associated with each managed stand analysis unit were decreased by 10%. MHA, VQO and green-up age curves were adjusted accordingly.</td></tr>
<tr><td rowspan="3">Non-Timber Values</td><td>020</td><td>No Old Seral Drawdown</td><td>Apply full old seral targets throughout the entire 300-year planning horizon</td></tr>
<tr><td>021</td><td>Draft OGMAs</td><td>Replace old seral target requirements with draft spatial OGMAs. Mature seral target requirements for the San Juan Ridge Special Resource Management Zone were applied.</td></tr>
<tr><td>022</td><td>Disturbance in NHLB</td><td>Randomly apply disturbance within of each LU/BEC/NDT type by Biodiversity Guidebook (BC Ministry of Forests and BC Ministry of Environment, Lands and Parks, 1995) disturbance intervals and old seral definitions and requirements.
<table>
<tr><th>BEC</th><th>NDT</th><th>Dist Int (yrs)</th><th>OLD Defn (yrs)</th><th>% Area > OLD</th><th>Effective Rotation Age (yrs)</th><th>Contributing NHLB Area (ha)</th><th>Periodic Area Disturbed (ha/year)</th></tr>
<tr><td>CWH</td><td>1</td><td>250</td><td>250</td><td>37%</td><td>395</td><td>3,742</td><td>9.4</td></tr>
<tr><td>CWH</td><td>2</td><td>250</td><td>250</td><td>37%</td><td>395</td><td>134</td><td>0.4</td></tr>
<tr><td>MH</td><td>1</td><td>350</td><td>250</td><td>49%</td><td>490</td><td>192</td><td>0.4</td></tr>
<tr><td colspan="6">Total</td><td>4,067</td><td>10.2</td></tr>
</table>
</td></tr>
<tr><td>023</td><td>020 + 022</td><td>No Old Seral drawdown and Disturbance in NHLB</td></tr>
</table>

The largest impacts on the harvest rate were observed when the THLB or managed yield curves were changed by ±10%. The lowest impact on harvest rate were observed when MHA were decreased by 10 years, natural yields were changed by ±10% and draft OGMAs replaced the old seral biodiversity objectives. The minimal response arising from changing VDYP curves suggests that the flat line forecast is heavily influenced by the mid and longer

term pinch points (see growing stock discussion).

Table 5 Sensitivity Analyses Summary Results

Scenario	Key Metrics				Difference relative to 001			
	THLB (ha)*	Harvest Rate (m^3/year)	THLB Growing Stock Yr 0 (m^3)	THLB Growing Stock Yr 300 (m^3)	THLB (ha)	Harvest Rate (m^3/year)	THLB Growing Stock Yr 0 (m^3)	THLB Growing Stock Yr 300 (m^3)
001_Base_NDY	***13,970***	***124,320***	***4,653,329***	***3,734,517***				
010_THLB_10pctPlus	15,367	134,823	5,118,662	3,928,533	10.0%	8.4%	10.0%	5.2%
011_THLB_10pctMinus	12,573	112,475	4,187,996	3,177,315	-10.0%	-9.5%	-10.0%	-14.9%
012_RegDel_2yrsPlus	13,970	121,610	4,535,182	3,503,665	0.0%	-2.2%	-2.5%	-6.2%
013_RegDel_2yrsMinus	13,970	126,621	4,776,597	3,555,164	0.0%	1.9%	2.6%	-4.8%
014_MHA_10yrsPlus	13,970	122,540	4,653,329	4,189,700	0.0%	-1.4%	0.0%	12.2%
015_MHA_10yrsMinus	13,970	123,891	4,653,329	3,740,074	0.0%	-0.3%	0.0%	0.1%
016_VDYP_10pctPlus	13,970	125,227	5,004,672	3,643,446	0.0%	0.7%	7.6%	-2.4%
017_VDYP_10pctMinus	13,970	123,522	4,301,986	3,493,543	0.0%	-0.6%	-7.6%	-6.5%
018_TIPSY_10pctPlus	13,970	136,406	4,767,319	3,858,466	0.0%	9.7%	2.4%	3.3%
019_TIPSY_10pctMinus	13,970	112,671	4,539,343	3,381,091	0.0%	-9.4%	-2.4%	-9.5%
020_BIOD_full	13,970	122,549	4,653,329	3,893,673	0.0%	-1.4%	0.0%	4.3%
021_draftOGMA	13,970	123,393	4,653,329	3,681,778	0.0%	-0.7%	0.0%	-1.4%
022_Dist_NHLB	13,970	119,721	4,653,329	3,892,542	0.0%	-3.7%	0.0%	4.2%
023_BIOD_full_Dist_NHLB	13,970	120,511	4,653,329	3,765,557	0.0%	-3.1%	0.0%	0.8%

**Effective THLB that excludes in-block retention.*

6 Differences from the Previous Timber Supply Analysis

The last timber supply analysis for TFL 61 was completed in 2003 as part of the larger TFL 25 MP#10 (Western Forest Products Limited, 2003) but the landbase was substantially different. When TFL 25 Block 1's crown land was extracted/adjusted to create TFL 61 in 2010, an Annual Allowable Cut (AAC) of 108,500 m^3/year was established for the new area. No rationale for this AAC was posted publicly.

Because of the substantial differences in areas, it is difficult to compare with the previous analysis. Compared to the current AAC, our Base Case harvest rate is 15,800 m^3/year (14.5%) higher.

Several input datasets and assumptions changed since the previous timber supply analysis completed in 2003. While these differences were detailed in the Information package document (Forsite Consulatnts Ltd., 2019), a list of the significant changes is provided below:

- TFL boundary changes – exclusion of all private lands and inclusion of timber licence reversions. TFL 25 Block 1 Schedule B (crown) lands total 19,829 ha gross and 16,418 ha THLB.
- Use of LiDAR-updated forest inventory to develop yields for existing natural stands. Growing stock is difficult to compare but initial harvest volume/ha outputs from 2003 and now are very similar (~580m3/ha).
- Use of provincial managed site index estimates to develop yields for managed stands.
- Improved stream network, classification, and riparian retention based on ongoing stream/waterbody inventory maintenance.
- Use of newly established ungulate winter range orders (#u-1-012) and 10 wildlife habitat areas for Marbled Murrelet and Red-legged Frog.

- Use of minimum volume and age where 95% of the mean annual increment is used to define minimum harvest ages, compared to use of DBHq of 30 cm and age where 95% of the mean annual increment is achieved.
- Different analysis units and regeneration assumptions for managed stands, including the use of silviculture eras for managed stands and species composition changes to align with current operational reality.
- Use of VDYP 7.30a for natural stand volume projections rather than version 6.4.
- Use of TIPSY version 4.4 for managed stand volume projections rather than version 3.0.
- Use of PATCHWORKS™ model rather than Complan.

7 Discussion and Recommendation

The Base Case scenario harvests ~124,300 m³/year for the entire 300-year planning horizon. The requirement to have a non-declining THLB growing stock in the last 100 years of the 300-year planning horizon had a significant impact in determining the long-term harvest flow. This finding indicates that the TFL was relatively unconstrained and the forest estate model did not have to recruit large THLB areas to meet non-timber objectives. The area by age class distribution and the non-timber objectives performance results confirmed the above finding.

A number of sensitivity analyses were completed to assess the impacts of potential uncertainty in data and modelling assumptions. The results from these model runs are summarized in Table 5. While differences in harvest flow resulted from changes to the land base definition, yield curves and MHA, and non-timber values, they are considered appropriate. These sensitivity analysis reinforced the finding that the harvest flow was being heavily influenced by timber availability in the mid and longer term (pinch points at year 50 and 270), and that harvest ages were highly aligned with culmination ages. When given the opportunity to reduce harvest ages, there was no benefit because it would have moved harvest ages away (lower) than culmination ages, while increasing harvest ages forced the model to wait beyond culmination ages.

The use of full landscape-level biodiversity targets from the beginning of the planning horizon reduced the harvest flow by 1.4%, indicating that the drawdown in low BEO units is benefiting timber supply in at least one LU. However, when the draft OGMAs were used instead, the harvest flow impact was only 0.7%. This indicates that the draft OGMAs tie up more area than currently required.

Implementing random disturbances within the NHLB as guided by the Biodiversity Guidebook (BC Ministry of Forests and BC Ministry of Environment, Lands and Parks, 1995) had a significant negative impact on the harvest flow (-3.7%). This occur because the Base Case relies almost exclusively on the NonTHLB to meet non timber objectives, and it is assumed to live to very old ages. While this is consistent with the stand types occurring on the landbase, there are risks associated with increased rates of disturbance due to climate change. When full landscape-level biodiversity targets and disturbances within the NHLB were implemented, the negative impact on harvest flow was lower (-3.1%). The lower negative impact of 0.6% can be considered insignificant and attributed to the heuristic nature of the forest estate model used in this analysis, where subtle changes are addressed dynamically throughout the entire planning horizon.

Based on the information provided above that examines both timber and non-timber values, PATH recommends a harvest rate of 124,300 m³/year over the next management plan period.

8 References

BC Ministry of Forests and BC Ministry of Environment, Lands and Parks. (1995). *Biodiversity Guidebook.* Victoria: BC Ministry of Forests, Lands and Natural Resource Operations.

Forsite Consulatnts Ltd. (2019). *Tree Farm Licence 61, Information Package May 2019.* Vancouver, BC: Pacheedaht Andersen Timber Holdings Limited Partnership.

Western Forest Products Limited. (2003). *Tree Farm Licence 25, Proposed Managemnt Plan 10.* Vancouver, BC: Western Forest Products Limited.