Management Plan #1
Spel̓kúmtn Community Forest
Community Forest Agreement K5X

Prepared by Adrian Litz, RPF and Sarah Weber, MSc
Hedberg and Associates Consulting Ltd.

September 28, 2018

RPF Signature and Seal:

REGISTERED PROFESSIONAL FORESTER
PROVINCE OF BRITISH COLUMBIA
ADRIAN F. LITZ
NO. 4365

Authorized Signatories on behalf of the Licensee:

Lil'wat Nation:	Village of Pemberton:
Dean Nelson	
Signature	Signature
Chief Dean Nelson	Mayor Mike Richman
October 1 2018	October 1, 2018
Date	Date

Table of Contents

List of Tables and Figures 5

1 Introduction 6

1.1 Consistencies and Related Planning and Policy Documents 6

1.1.1 Higher Level Plans 6

1.1.2 Lil'wat Plans and Policies 6

1.1.3 Village of Pemberton Plans and Policies 6

1.2 Management Plan Scope 6

2 Mission Statement, Guiding Principles and Values 7

2.1 Mission Statement 7

2.2 Guiding Principles 7

2.3 Values 7

3 Spel̓kúmtn Community Forest Goals and Objectives 8

3.1 Social, Economic and Broad Resource Management Goals 8

3.2 Specific Resource Management Objectives 8

4 Linkage of Spel̓kúmtn Community Forest Goals to Provincial Community Forest Program Goals 9

5 Botanical Forest Products 11

6 Consultation and Communication with Other Forest Users 12

6.1 First Nations and Stakeholders Identified 12

6.2 Consultation Objectives 13

6.3 Measures to Consult 13

6.3.1 Lil'wat Nation Forestry Specific Referral Process 13

6.3.2 General Consultation Process 13

6.4 Annual Reporting Plan 14

7 Timber Inventories and Management 14

7.1 Biogeoclimatic Classification 14

7.2 Natural Disturbance Types 14

7.3 Species Composition 15
7.4 Age Class Distribution and Age of Harvested Trees 15
7.5 Site Productivity 17
7.5.1 Site Productivity Objectives 17
7.6 Growing Stock 18
7.7 Timber Harvest Specifications 18
7.8 Timber Harvest Objectives 19
7.9 Timber Harvesting Systems and Equipment 19
7.10 Utilization, Coarse Woody Debris Management and Salvage 19
7.11 Silviculture Practices 19
7.11.1 Silviculture Systems 20
7.11.2 Reforestation 20
7.11.3 Stand Tending 21
7.11.4 Deciduous Species 21
8 Non-timber Values Inventory, Conservation and Management 21
8.1 Soils 21
8.1.1 Soils Overview 21
8.1.2 Management Direction for Soils 21
8.2 Biodiversity 21
8.2.1 Old Growth 22
8.2.2 Wildlife Tree Retention Areas 22
8.2.3 Individual Tree Retention 23
8.3 Wildlife 23
8.3.1 Wildlife Species at Risk 23
8.3.2 Ungulate Winter Range 25
8.4 Plant Species and Ecological Communities at Risk 25
8.5 Water, Riparian Areas and Fish Habitat 25
8.5.1 Rivers, Streams, Lakes and Wetlands 25
8.5.2 Floodplain Management Areas 26
8.5.3 Community Watersheds 26
8.6 Cultural Heritage and Archaeological Values and Resources 26
8.6.1 Parks and Conservancies 26
8.6.2 Lil'wat Nation A7x7ūlḿecw (Spirited Ground) Areas 26

8.6.3 Skelulátkwa/Owl Creek Cultural Education Area (Lil'wat Nation) 28
8.6.4 Archaeological Values and Resources 29
8.7 Wildland Areas 29
8.8 Botanical Resources and Non-Timber Forest Products 29
8.8.1 Botanical Inventory Procedure 30
8.8.2 Botanical Resources Management Measures 30
8.9 Forest Health 30
8.9.1 Summary of Current Forest Health Issues 30
8.9.2 Management of Forest Health 31
8.9.3 Fire 31
8.9.4 Invasive Species 31
8.9.5 Pesticides and Herbicides 32
8.10 Terrain 32
8.11 Roads and Access Structures 32
8.12 Recreation 32
8.12.1 Recreation Feature Inventory 33
8.12.2 Non-Motorized Recreation Zones 33
8.12.3 Recreation Sites, Trails and Interpretive Forest 33
8.12.4 Recreation Stakeholders and User Groups 33
8.13 Visual Quality and Scenic Areas 34
8.14 Climate Change 34
8.15 Other Tenures within the CFA license area 34
8.15.1 Commercial Recreation Tenures 34
8.15.2 Guide Outfitters 34
8.15.3 Mineral Tenures 34
8.15.4 Rangeland 35
8.15.5 Traplines 35
8.15.6 Utility Right of Ways 35
8.15.7 Water Licences 35
8.15.8 Other Crown Tenures 35
9 Proposed Allowable Annual Cut and Rationale 36
9.1 Proposed Allowable Annual Cut 36
9.2 Allowable Annual Cut Rationale 36

10 References.....37

11 Appendices.....39

List of Tables and Figures

Table 1: Linkage of Community Forest Program Goals to SCF Management Goals.....9

Table 2. Utilization Standards.....18

Table 3. Lil'wat Nation A7x7ūlḿecw (Spirited Grounds) in Spel̓kúmtn Community Forest.....27

Table 4. Ranking of Priority Pests in DSQ.....30

Figure 1: BEC Subzone and NDT Distribution in Spel̓kúmtn Community Forest.....15

Figure 2. Ten year age class distribution on the CFLB.....16

Figure 3. Age class distribution at 0, 50, 100 and 200 years in the future.....17

Figure 4. Base Case Growing Stock by Species.....18

1 Introduction

Spel̓kúmtn Community Forest (SCF) will be held and managed by Spelkumtn Community Forest Limited Partnership (SCFLP). SCFLP is a partnership between the Lil'wat Nation (LN) and the Village of Pemberton (VOP) where Spelkumtn Community Forest Corporation (SCFC) is the General Partner and the LN and VOP are Limited Partners. The LN and VOP are shareholders of SCFC.

This management plan was prepared as required as part of the Community Forest Agreement (CFA) application for CFA K5X – the Spel̓kúmtn Community Forest. The purpose of this management plan is to link the communities and their values to the management of the Community Forest and to establish an annual allowable cut (AAC) for the CFA (BC MFLNRO 2015).

1.1 Consistencies and Related Planning and Policy Documents

This management plan is consistent with

- the Community Forest Agreement dated (*insert date when available*),
- all relevant forestry legislation,
- any applicable Higher Level plans under the *Forest Range and Practices Act* (FRPA), and
- any commitments agreed to by both parties to this agreement.

In addition to this management plan, the SCF will operate in accordance with an approved Forest Stewardship Plan (FSP), which identifies the specific legal requirements.

1.1.1 Higher Level Plans

The Higher Level plans applicable to the SCF area are the Sea-to-Sky Land and Resource Management Plan (LRMP) and Landscape Unit Plans for each of the five Landscape Units (LUs) in the SCF (i.e. Billygoat, Birkenhead, Railroad, Ryan and Soo LUs).

1.1.2 Lil'wat Plans and Policies

Lil'wat Nation plans and policies considered throughout management of the Community Forest include the Lil'wat Land Use Plan Phase 1 (2006), Lil'wat Nation Botanical Resource Strategy, Lil'wat Nation Small Scale forestry document, and the Lil'wat Heritage Policy.

1.1.3 Village of Pemberton Plans and Policies

- Village of Pemberton Strategic Priorities 2015
- Village of Pemberton Official Community Plan

1.2 Management Plan Scope

This management plan has been written as a requirement for the application for a CFA license. The plan is not intended to convey all of the specific operational procedures that will be adopted by the Licensee. The Licensee may choose to develop an Operating or Working Plan that would include more detailed measures and forest management practices.

2 Mission Statement, Guiding Principles and Values

2.1 Mission Statement

Spelkumtn Community Forest Limited Partnership will operate a safe, profitable and sustainable community forest. The community forest will be managed for environmental, social and economic values while taking into consideration the desires of its member and neighbouring communities.

2.2 Guiding Principles

As indicated in Article 2.4 of the SCFLP Limited Partnership Agreement, the Community Forest Licence will be managed in accordance with the following principles:

a) forestry operations will be operated to show a profit, and demonstrate the value and viability of forestry to the VOP and LN;

b) subject to provincial requirements in the Community Forest Licence, forest planning and operations will be conducted to maximize long-term security of employment and contracting opportunities in preference for VOP and local residents, including LN members;

c) forest planning and operations will follow the best model sustainable forestry practices;

d) forest planning and operations will respect the land use plans and the cultural, recreational, educational and aesthetic values/objectives of both the LN and the VOP, including without limitation management of viewscapes, recreational trails and riparian values; and

e) decisions will be made by consensus where possible, recognizing both cultural and sustainability interests of the Partners.

2.3 Values

Management of the Spel̓kúmtn Community Forest recognizes and respect a set of shared community values. These values were identified through the Community Forest Feasibility Study and related public events, discussions with council members and other community representatives, and Village of Pemberton and Lil'wat Nation strategic planning and policy documents. Values for the Community Forest include:

- Environmental stewardship
- Wildlife conservation and habitat enhancement
- Community relationships
- Watershed protection
- Culture
- Recreation
- Economic viability
- Viewscapes
- Giving back to the community
- Social responsibility
- Connection between land and people, connection to nature
- Outdoor lifestyle

3 Spel̓kúmtn Community Forest Goals and Objectives

3.1 Social, Economic and Broad Resource Management Goals

As expressed by the partners, the social, economic and broad resource management goals for the Spel̓kúmtn Community Forest are as follows:

- Strengthen connections and collaboration between the Pemberton and Lil'wat communities.
- Management reflects sustainable forestry principles and practices.
- Provide economic and social benefits to the Lil'wat and Pemberton communities.
- Support the creation and maintenance of local jobs and businesses.
- Operate in an economically viable manner.
- Support the development of secondary/value added industries.
- Collaborate with diverse partners to support education, training and research about forest ecosystems and forestry.
- Protect and enhance recreational values for community use and tourism.
- Prioritize and practice safety throughout all operations for forest workers, community members and the public.
- Reflect the values of both Lil'wat and Pemberton communities in forest management.

3.2 Specific Resource Management Objectives

Further to the goals, management of the SCF is guided by a series of specific resource management objectives regarding both timber and non-timber resource values:

- Manage for an ecologically sustainable perpetual timber harvest rate.
- Protect and maintain water quality, including drinking water.
- Protect and enhance riparian areas and aquatic habitat.
- Maintain and enhance biodiversity at the stand and landscape level.
- Protect, restore and enhance wildlife and fish habitat.
- Protect species at risk.
- Protect the function and productivity of forest soils.
- Maintain the visual quality of viewscapes.
- Protect and respect Lil'wat cultural and traditional use sites and values across the landscape.
- Maintain forest health.
- Protect and enhance recreation values and uses.
- Protect culturally valued botanical resources.
- Integrate wildfire considerations throughout management.
- Reforest harvested areas with a diverse mix of ecologically suited species.

4 Linkage of Spel̓kúmtn Community Forest Goals to Provincial Community Forest Program Goals

The BC provincial government has set a series of goals for Community Forest Program (BC MFLNRO 2015). These are to:

1. provide long-term opportunities for achieving a range of community objectives, values and priorities
2. diversify the use of and benefits derived from the community forest agreement area
3. provide social and economic benefits to British Columbia
4. undertake community forestry consistent with sound principles of environmental stewardship that reflect a broad spectrum of values
5. promote community involvement and participation
6. promote communication and strengthen relationships between Aboriginal and non-Aboriginal communities and persons
7. foster innovation
8. advocate forest worker safety

Goals for the SCF are consistent and linked with the provincial Community Forest Program goals in multiple inter-connected ways, as summarized in Table 1.

Table 1: Linkage of Community Forest Program Goals to SCF Management Goals

SCF Social, Economic and Broad Resource Management Goals	Responds to Government Goal #s	Description
Strengthen connections and collaboration between the Pemberton and Lil'wat communities.	5, 6	Communication and relationships between the Aboriginal and non-Aboriginal communities of Lil'wat and Pemberton will be strengthened by working together in partnership on management and use of the Community Forest. Community involvement and participation will be encouraged and integrated into operation of the SCF across multiple goals and objectives.
Management reflects sustainable forestry principles and practices.	1, 3, 4, 7	The use of sustainable forestry practices and supports the provision of opportunities to achieve community objectives and values in the long term, the capacity of the land to provide social and economic benefits to the local communities and BC. It is consistent with sound environmental stewardship. Innovation is needed to implement new best practices and knowledge as it emerges.
Provide economic and social benefits to the Lil'wat and Pemberton communities.	1, 2, 3, 5, 6	A focus on long term and diverse social and economic benefits supports the capacity to provide such benefits to Lil'wat, Pemberton and BC. Community involvement and inter-community relationships are integral to achieving the goals.

SCF Social, Economic and Broad Resource Management Goals	Responds to Government Goal #s	Description
Support the creation and maintenance of local jobs and businesses.	1, 2, 3, 4, 5, 6, 7	Community involvement, communication, relationship building and innovation are key to identifying and implementing job and business opportunities. Environmental stewardship is needed to sustain the opportunities in the long term.
Operate in an economically viable manner.	1, 2, 3	Being disciplined about operating in an economically viable manner is important in order to be able to maintain opportunities in the long term and provide social and economic benefits to the communities and BC.
Support the development of secondary/value added industries.	1, 2, 3, 5, 6, 7	The development of such industries would need to be economically viable for the SCF business so that it can be maintained in the long term. Innovation, inter-community relationship building and community involvement are part of the development process for secondary and value added industries.
Collaborate with diverse partners to support education, training and research about forest ecosystems and forestry.	1, 2, 3, 5, 6, 7	A focus on education, training and research provides many opportunities for community participation, strengthening understanding and relationships between Aboriginal and non-Aboriginal communities, fostering innovation and supporting a diverse array of benefits to the local community, BC and beyond.
Protect and enhance recreational values for community use and tourism.	1, 2, 3, 5, 6	Recreation is an important lifestyle value for local residents and provides economic opportunities through tourism based businesses. Community involvement will be important to guide the management of recreation values in the SCF.
Prioritize and practice safety throughout all operations for forest workers, community members and the public.	5, 6, 7, 8	Due to high level of use of the SCF landbase by community members and visitors, interaction with forest workers is likely. The implementation of safety for all will require community and forest worker engagement and awareness with clear communication of safety practices and protocols.
Reflect the values of both Lil'wat and Pemberton communities in forest management.	1, 2, 4, 5, 6, 7	Managing to reflect the diversity of values from both communities will call on a process of promoting communication, relationships and mutual learning. Both of the partner communities strongly value environmental stewardship.

5 Botanical Forest Products

Botanical forest products are forest resources other than timber that are harvested for commercial, personal or traditional purposes. These include wild edible mushrooms, floral and greenery products, medicinal and pharmaceutical products, wild berries and fruit, and craft products (BC MAL 2008).

As defined in the Lil'wat Land Use Plan (Lil'wat Nation 2006) "Botanical resources include all the plants - the trees, shrubs, herbs, grasses, mosses, and mushrooms that are found in Lil'wat Traditional Territory". Botanicals are culturally and socially important to Lil'wat and are also an emerging sector of the forest economy.

Spel̓kúmtn Community Forest will not be harvesting or managing botanical forest products for commercial purposes at this time. The partners may wish to add them to the license in the future.

In the meantime, botanical and non-timber forest products need to be considered in forest management for conservation purposes, so that they will continue to thrive and be present across the landbase.

SCF supports the rights of First Nations to gather food, medicinal and craft materials for individual or community use. The Community Forest will be managed in such a way as to allow that activity.

Botanical Resources and NTFPs are further addressed in section 8.8.

6 Consultation and Communication with Other Forest Users

6.1 First Nations and Stakeholders Identified

First Nations with interests in the SCF area and stakeholders with potential interests are listed in the sections below. Specific stakeholder individuals and groups may change over time. The Licensee will endeavour to maintain an up to date list of relevant contacts to facilitate information sharing and consultation in the case of proposed operations that may affect First Nations and stakeholders identified.

First Nations

- Lil'wat Nation

Communities and General Public

- Mount Currie
- Pemberton
- Local residents and community members throughout SLRD Area C
- Other private landowners
- Community groups
  - Pemberton Valley Trails Association
  - Pemberton Off Road Cycling Association
  - Pemberton Valley Snowmobile Club
  - Pemberton Wildlife Association
- Rotary Club of Pemberton
- Stewardship Pemberton Society
- Pemberton & District Chamber of Commerce
- Tourism Pemberton
- Coast to Cascades Grizzly Bear Initiative
- Sea to Sky Invasive Species Council
- Additional groups and individuals that self-identify

Governments and Government Agencies

- Village of Pemberton
- Squamish Lillooet Regional District
- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development
- BC Ministry of Environment and Climate Change Strategy
- Other BC government agencies/representatives e.g. Sites and Trails Recreation Officer
- Pemberton Valley Dyking District

Other Land Users

- Water licence holders
- Commercial recreation tenure holders
- Trapline holders
- Guide outfitters
- Mineral tenure holders
- Road permit holders

- Utility Right of Way holders
- Neighbouring forest tenure holders
- Local forest based businesses
- Other Crown Tenure holders

6.2 Consultation Objectives

Through an ongoing consultation process the Licensee aims to inform Lil'wat Nation and all relevant stakeholders of proposed timber harvest, road and other forest management plans, receive feedback, listen to and acknowledge concerns and aspirations and provide feedback on how the input influenced forest management decisions (adapted from IAP2 2007).

The consultation objectives are:

To provide First Nation and community stakeholders with clear information about and assist them in understanding proposed forestry activities.

To provide opportunity for First Nations and stakeholder feedback on proposed forestry plans and to consider the input in management decisions.

6.3 Measures to Consult

Two parallel consultation processes will be undertaken – one for general consultation, and another with Lil'wat Nation specifically.

6.3.1 Lil'wat Nation Forestry Specific Referral Process

Lil'wat is the sole First Nation with traditional territory overlapping the SCF. The Community Forest is located entirely within the Lil'wat Traditional Territory. It is essential that Lil'wat Nation is consulted on an ongoing basis about proposed forest management activities in the SCF.

Consultation with Lil'wat Nation will be broadly guided by the Lil'wat Nation Land Use Referral Consultation Policy and the Lil'wat Land and Resource Referral Process, or any new versions of these policies as they evolve over time. Further to those two documents a Forestry Specific Referral Process is being developed in collaboration with Lil'wat Land and Resources Department (LRD).

All harvesting and road building activities planned in the Community Forest will go through the Forestry Specific Referrals process currently under development with the Lil'wat Land Use Referral Committee (RC) and the LRD.

6.3.2 General Consultation Process

Spel̓kúmtn Community Forest aims to develop and maintain positive working relationships and strong communications with all forest users, community groups, government agencies and other stakeholders with interests in the SCF landbase.

Consultation regarding operational/block level activities will be carried out with potentially affected stakeholders on an ongoing basis, as relevant to the location of planned harvesting and road building or deactivation activities. Potentially affected stakeholders will be notified and their input considered in management decisions. Additional strategies will be developed and implemented to communicate with the general public and other interested stakeholders who self-identify. A proposed practice is to hold open houses each year at which the following year's harvest plans are presented.

6.4 Annual Reporting Plan

The Spel̓kúmtn Community Forest will report annually to the partner communities and key stakeholders. Annual reporting will include a written report made available to the communities and a community meeting or open house. Open houses may take place in both Mount Currie and Pemberton, or the location may alternate between years. Reporting will describe performance on the SCF guiding principles and/or values, broad social, economic and resource management goals and provincial Community Forest Program goals.

7 Timber Inventories and Management

A Timber Supply Analysis for the SCF area was completed by Forsite Consultants Ltd. (Forsite 2018) (Appendix 1). Information in following sections is sourced and summarized from the Forsite report.

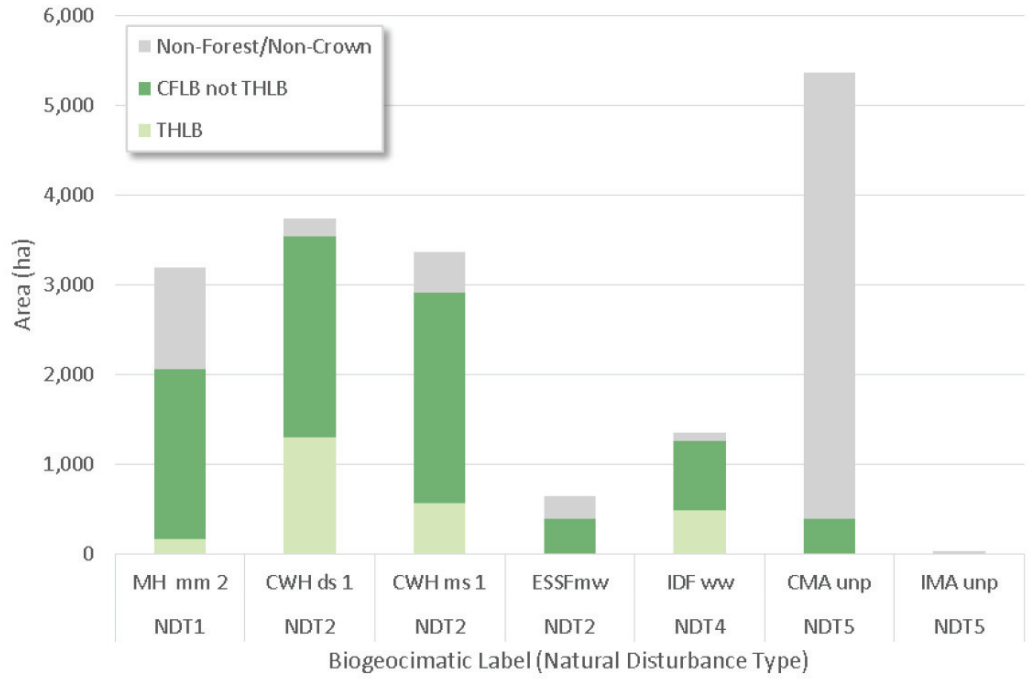
7.1 Biogeoclimatic Classification

The SCF land base includes six forested biogeoclimatic (BEC) zones - the Mountain Hemlock (MH), Coastal Western Hemlock (CWH), Engelmann Spruce-Subalpine Fir (ESSF), Interior Douglas Fir (IDF) and two alpine zones with no productive timber – the Interior Mountain-heather Alpine (IMA) and Coastal Mountain-heather Alpine (CMA). The relative amount of area within each BEC zone and subzone/variant is illustrated in Figure 1 and their location across the SCF landscape is shown on the Ecosystems and Old Growth Map in Appendix 2.

7.2 Natural Disturbance Types

For the purpose of setting biodiversity objectives, five natural disturbance types (NDTs) are recognized as occurring in British Columbia with natural disturbance regimes ranging from rare-stand initiating events to frequent stand-maintaining fires. The SCF area covers four NDTs - NDT 1, 2, 4 and 5. Each BEC zone/subzone/variant is associated with an NDT. The NDTs associated with ecosystem units in the SCF are shown in Figure 1.

Figure 1: BEC Subzone and NDT Distribution in Spel̓kúmtn Community Forest



Source: Forsite 2018

7.3 Species Composition

The forested area of the SCF is primarily covered with Douglas-fir and Amabilis Fir leading stands. Additionally there are Western hemlock, Western redcedar, Lodgepole pine and Yellow pine leading stands (Forsite 2018).

Deciduous (broad-leaf) trees are found at low levels across the SCF, generally as dispersed individual stems or small clumps within forested stands dominated by conifers. Deciduous trees are often found at higher density within riparian areas or on disturbed sites (old roads and landings) within previously harvested areas.

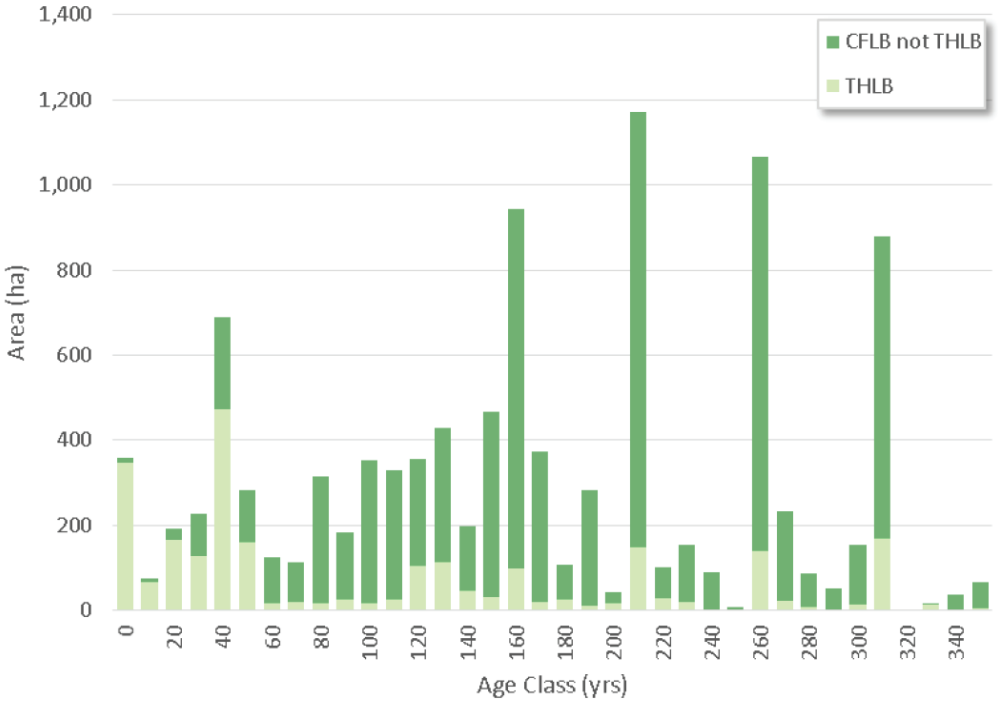
7.4 Age Class Distribution and Age of Harvested Trees

The current age class distribution on the Timber Harvesting Land Base (THLB) indicates a very young land base (Figures 2 and 3). The THLB refers to land that is available and suitable for timber harvesting and contributes to the AAC. Approximately 1300 hectares (ha) are less than 50 years old. However, much of the non-harvesting landbase (NHLB) is older than 160 years (Forsite 2018). As the land base converts to managed stands the remaining old forest in the THLB is forecast to transition to younger stands, and the distribution of THLB spans mostly from 0 to 100 years (Figure3) (Forsite 2018).

The non-harvesting landbase (NHLB) is the area within the contributing forest land base (CFLB) that is not harvestable. CFLB is the broader productive forest that can contribute to meeting non-timber objectives (e.g. biodiversity).

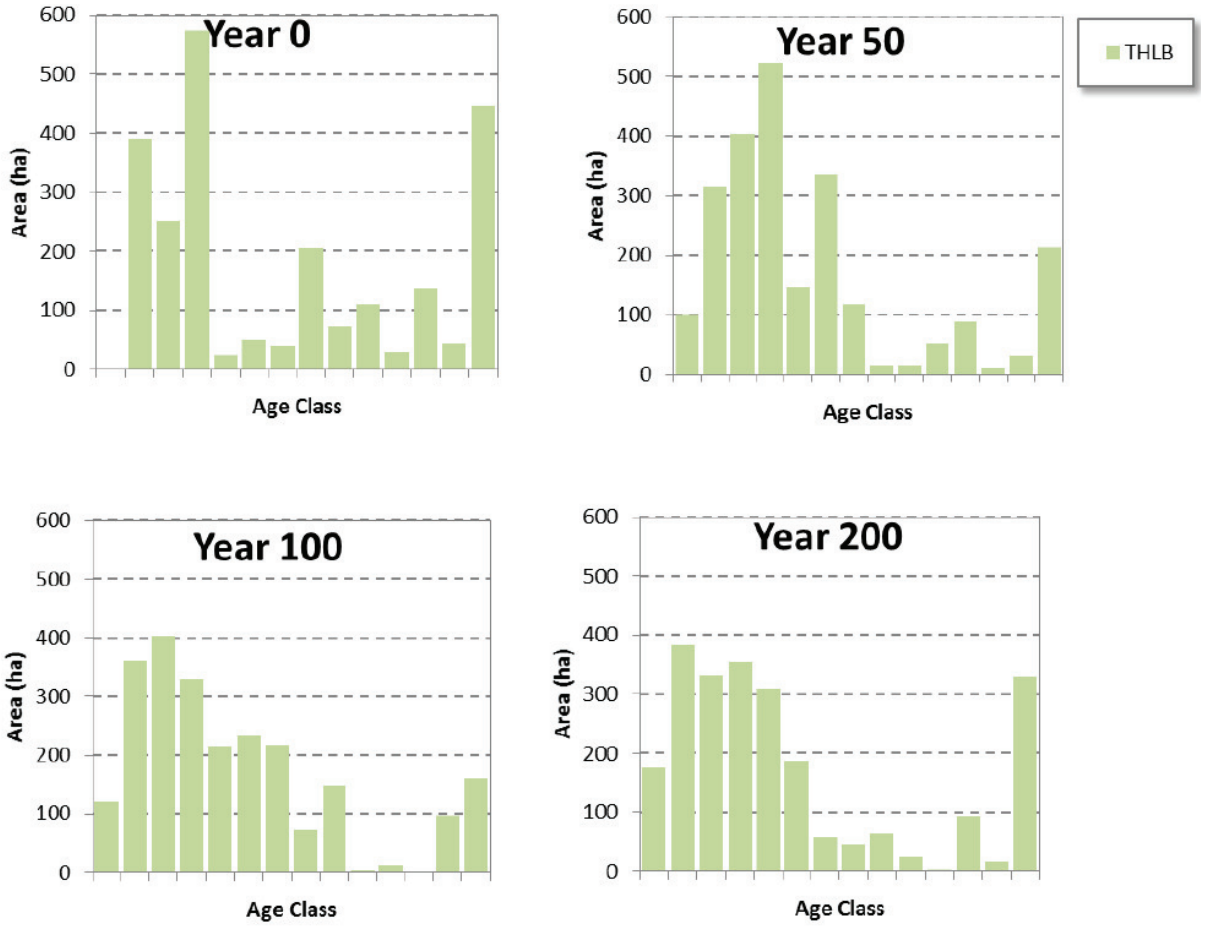
For the first 50 years, approximately 50% of the harvest comes from stands greater than 200 years, and for the first 20 years 85% comes from stands older than 120 years (Forsite 2018).

Figure 2. Ten year age class distribution on the CFLB



Source: Forsite 2018

Figure 3. Age class distribution at 0, 50, 100 and 200 years in the future



Source: Forsite 2018

7.5 Site Productivity

Site index (SI) is a unit used to reflect the productive capacity of a stand, expressed as the height that the best trees on the site will be at 50 years breast height age. The average SI for the Community Forest is estimated to be between 20.3m (inventory SI) and 23.7m (managed SI), depending on the inputs and calculation method (Forsite 2018).

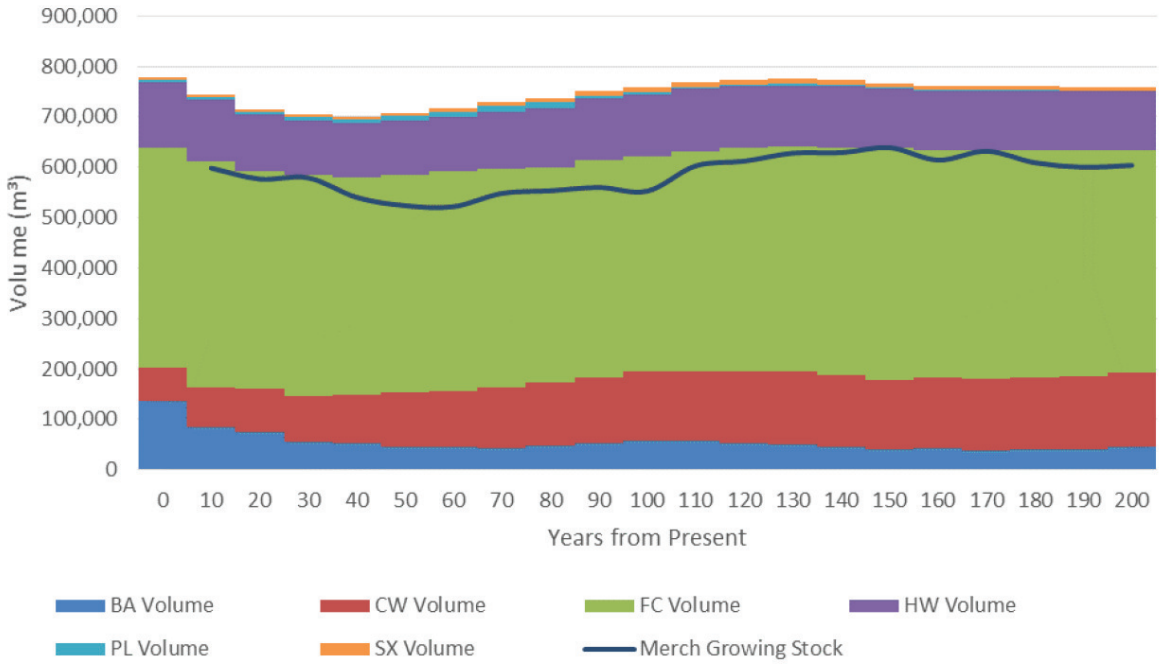
7.5.1 Site Productivity Objectives

The goal with regards to site productivity is to conserve and maintain site productivity. To meet this goal the Licensee will undertake a range of actions – for example through appropriate soil management (Section 8.1), prompt reforestation and other silviculture activities (Section 7.11). Improvement of site productivity on post free growing stands is an additional objective. During operational planning, the Licensee will identify post free growing areas which are suitable for site productivity improvement activities (e.g. stem improvement treatments, thinning, spacing, fertilization). When available through the BC Forest Investment Account (FIA) and Forests for Tomorrow (FFT) programs, site productivity and stand improvement project funding will be applied for to complete site productivity activities.

7.6 Growing Stock

The THLB growing stock is forecast to decline from an initial volume of 765,955 m³ to a low of 687,734 m³. It then slowly increases to steady long term growing stock of 683,000 m³ (Figure 4). Over time the proportion of Balsam (BA) decreases while the volume of Douglas-fir (FC) and Cedar (CW) increases. This is due to the composition of the managed stands being heavily cedar and Douglas-fir (Forsite 2018).

Figure 4. Base Case Growing Stock by Species



Source: Forsite 2018

Note: BA=Amablis Fir/Balsam, CW=Western redcedar, FC=Douglas-fir, HW=Western Hemlock, PL=Lodgepole Pine, SX=Hybrid Spruce

7.7 Timber Harvest Specifications

Utilization standards applied to determine the merchantable growing stock in the timber supply analysis are presented in Table 2.

Table 2. Utilization Standards

Leading Species	Minimum Diameter at Breast Height (DBH) cm	Maximum Stump Height (cm)	Minimum Top Diameter (cm)
Pine	12.5	30.0	10.0
Other ≤ 120 yrs	12.5	30.0	10.0
Other > 120 yrs	17.5	30.0	10.0

Source: Forsite 2018

7.8 Timber Harvest Objectives

The objective for timber within the SCF is to optimize the commercial value of the timber resource relative to changing market conditions and opportunities. More specific objectives related to timber are to:

- Maximize sustainable revenue by meeting cut control levels.
- Maintain the diversity of stand types and species mixes across the licence area by applying a variety of harvesting, silviculture system and reforestation strategies.
- Identify stand/stem improvement opportunities and pursue funding opportunities to perform those activities which increase stand/product.
- Maintain flexibility in harvest timing plans to prioritize timber harvest from stands affected by root disease, wind damage or other biotic/abiotic factors to mitigate the loss of timber values and/or site productivity.

7.9 Timber Harvesting Systems and Equipment

The Licensee will utilize a range of different timber harvesting systems including ground based, overhead cable and helicopter logging techniques. Priority considerations for the selection of harvest system include engineering/operability constraints, worker safety and protection of values such as soil, riparian and vegetation resources.

7.10 Utilization, Coarse Woody Debris Management and Salvage

Timber utilization and waste and residue allowances will be consistent with the regional/provincial standards and, for wildfire hazard risk mitigation, the *Wildfire Act* of BC. The Licensee will strive to maximize utilization and minimize waste throughout all operations.

Non-merchantable wood waste remaining on harvested sites will be managed to ensure a minimum amount of woody debris is distributed across the harvested area while reducing the amount of fine woody materials on site in order to minimize wildfire risk.

The Licensee will explore ways to facilitate salvage opportunities for Lil'wat and Pemberton community members.

7.11 Silviculture Practices

Silviculture is the art and science of managing the establishment, growth, composition, health and quality of forests to meet the needs and values of the landowners and society on a sustainable basis (BC 2018). Aspects of silviculture include harvesting, regeneration (e.g. site preparation, tree planting, sowing), stand tending (e.g. spacing, pruning) and protection of forest health.

The overall silviculture strategy for the SCF is to ensure prompt reforestation of all harvested areas and to design harvesting and stand management activities so that the diversity of tree species, stand types and structure are compatible with the natural range of variability at the stand and landscape level.

The Licensee will strive to be consistent with the silviculture objectives identified in the Lil'wat-BC Agreement (Lil'wat Nation and BC 2008):

- The application of silviculture treatments, including regeneration, that maintain a diversity of tree species and stand types compatible with the range of natural variability at the landscape level.

- Silviculture and stand management prescriptions that contain objectives and measures for the maintenance and/or restoration of stand structure to conditions compatible with the range of natural variability at the stand and landscape level are encouraged.
- Maintenance and restoration of structural components, including at a minimum canopy complexity, live wildlife trees, snags and coarse woody debris, to quantities and at distributions that are compatible with the range of natural variability at the stand and landscape level.

The following sections describe how the overall silviculture objectives will be implemented through the choice of silviculture system, reforestation and stand tending practices.

7.11.1 Silviculture Systems

The term "silviculture system" refers to the pattern of harvesting that is applied to achieve a desired structural outcome. Silviculture systems encompass a variety of harvest patterns ranging from clearcut systems which remove all trees within a harvest area at one time to retention and group selection systems which retain a portion of the trees in various spatial patterns.

The choice of silviculture system will take into account a number of factors including pre-harvest stand structure and the level of protection required for identified values on the site such as existing plant communities and culturally valued botanicals, soil conditions, wildlife habitat, riparian, recreation and visual values. The evaluation of the existing values and the level of protection required for each (as assessed during site plan development stages) will determine the silviculture system and the number and distribution of trees to be retained. The choice of silviculture system also considers the nature of culturally important botanicals (e.g. degree of sensitivity to timber harvest impacts, do they require shade or benefit from increased light), the site conditions, topography and operability constraints.

The Licensee strives to implement a variety of ecologically appropriate silviculture systems in order to create a mosaic of harvest patterns and stand types similar to the patterns present on the landscape resulting from natural disturbances such as wildfires, windthrow and pest factors.

7.11.2 Reforestation

Regeneration of forests is a critical element of sustainable forest management. Key considerations in reforestation planning include tree species diversity, genetic diversity, forest health and climate change.

Reforestation of harvested areas is a legal obligation held by the Licensee. During the site plan development stage, the prescribing forester will identify the biogeoclimatic zone/subzone/site series combinations found within the planned harvest area and identify the desired species mix, distribution and density for reforestation. The overall reforestation objective is to maintain a diversity of tree species compatible with the range of natural variability at the landscape level.

The stocking standards to be applied within the SCF are developed for the range of sites and conditions found across the license area. Where available, new information regarding the impact of climate change upon British Columbia's forested ecosystems and implications for stocking standards will be taken into account.

The overall objective for reforestation of harvested areas is to establish a healthy stand of trees which meet the height and density requirements for Free Growing (FG), within the timeline specified by the relevant stocking standard.

7.11.3 Stand Tending

Post FG there are a number of stand tending activities which can be performed to improve the quality, volume or economic value of the stand at the time of future harvesting (e.g. spacing, commercial and pre-commercial thinning, pruning and fertilization). The Licensee will identify post FG stands that are appropriate for stand tending or forest health improvement activities and work with district and regional Ministry of Forests, Lands and Natural Resource Operations and Rural Development (BC MFLNRORD) staff to gain access to funding to perform activities on identified candidate areas.

7.11.4 Deciduous Species

Although not managed for commercial timber objectives, deciduous species will be managed for other values (e.g. cultural, biodiversity and ecosystem values). Where deciduous species are present within planned harvest areas the cultural value and ecosystem role of these species will be considered. Management will seek to maintain deciduous species across the landscape at current levels and distribution.

8 Non-timber Values Inventory, Conservation and Management

This section describes the non-timber cultural, social and environmental resource values found across the SCF area and outlines high level management objectives. Inventory information was sourced through the BC Land and Resource Data Warehouse (LRDW).

8.1 Soils

8.1.1 Soils Overview

The dominant forest soil type in the region is a ferrohumic podzol (Agriculture Canada and BC MOE 1978). Soils are typically well-drained, gravelly sandy loams, and are generally medium to coarse-textured, but local variability is high.

8.1.2 Management Direction for Soils

Protecting soil properties and soil ecosystem functions is a critical aspect of sustainable forest management. The primary forest management activities which require soil disturbances are road construction and maintenance activities as well as cut block harvesting activities. Prior to any soil disturbance activities soil assessments will be carried out by a qualified person to determine soil types, and the level of risk for impacts from forestry activities. To ensure protection of forest soils, site specific plans, prescriptions and operational measures will be developed by a forest professional to guide primary forest activities based on the results of soil assessments. Terrain stability assessments will also be commissioned as needed to identify areas of potential slope instability and to provide mitigation measures to be utilized to minimize risks to soil and other forest resources from landslides or mass wasting events.

8.2 Biodiversity

Maintenance and enhancement of biodiversity is an important value for the Community Forest, at both the landscape and stand levels. Measures that will be applied to protect biodiversity include maintaining a component of old growth across the landbase, creation of Wildlife Tree Retention Areas (WTRAs), use of retention silviculture systems (section 7.11.1) and individual tree retention strategies at the site level,

protecting wildlife (section 8.3) and species at risk (sections 8.3 and 8.4), respecting riparian buffers (section 8.5) and reforesting harvested areas with a diverse mix of ecologically suited species (section 7.11.2).

8.2.1 Old Growth

Old growth is generally defined as forest older than 250 years, or older than 120 years for Lodgepole pine stands (Coast Information Team 2004, Lil'wat Botanical Resource Strategy). The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another (Lil'wat Nation n.d.). A similar definition is given by the BC government i.e. "Old growth forest" means a stand of trees 250 years or older in the Coastal Western Hemlock and Interior Douglas Fir biogeoclimatic zones (BC MFLNRO 2013).

The Lil'wat Land Use Plan and the Land Use Planning Agreement between the Lil'wat Nation and the Province of BC identify preservation of old growth forest stands and their attributes as an important component of conserving biodiversity and a range of non-timber values. Schedule E of the Lil'wat-BC Agreement contains the following management objectives regarding old growth:

- Maintain representative examples of old condition forested stands in culturally and ecologically important biogeoclimatic variants.
- Maintain habitat for old growth dependent species.
- Maintain recruitment habitat for cultural cedar and other culturally important species.
- Maintain culturally and ecologically important ecosystems, including but not limited to riparian areas, red and blue listed species habitat, and traditional and cultural use sites.

The Licensee is committed to appropriate management for the identified old growth objectives within the SCF area. The primary mechanisms for old growth conservation and management in the Community Forest are Old Growth Management Areas (OGMAs), Wildlife Tree Retention Areas (WTRAs) and choice of harvest systems and block level retention strategies.

OGMAs are legally established in all landscape units in the Community Forest (Appendix 2: Wildlife, Water and Old Growth Map) with the objective of maintaining intact old growth stands across the landbase. The SCF landbase contains 772 ha of approved OGMAs across five landscape units (Forsite 2018). Timber harvesting within OGMAs is restricted to only minor alterations and is subject to requirements to ensure suitable replacement areas are identified and established.

The Licensee will remain consistent with the land use orders establishing old growth areas exempted from harvest and to ensure that representative old growth features and values are maintained at the site level.

8.2.2 Wildlife Tree Retention Areas

The primary purpose of WTRAs is to provide stand-level biodiversity and habitat for wildlife tree users on every cut block. In addition to valuable wildlife habitat, wildlife tree retention provides a present and future source of coarse woody debris (CWD), a source of native mycorrhizal fungi, arboreal lichen, and invertebrates. Patch retention also maintains understory shrubs and herbs in an undisturbed state that can result in protection of other elements of biological value and provides for recolonization of the cut block. In general, WTRAs provides for some structural diversity both now and in the future (BC 2006).

Legal objectives for WTRA targets are established for each BEC zone/subzone within each LU in the SCF landbase. The targets are defined as the WTRA percentage required to be retained for each cut block. Areas designated as WTRA will be retained from harvest until the trees on the net area to be reforested

of the cut block to which the WTRA relates have developed attributes that are consistent with a mature seral condition.

The FSP for the SCF commits the license holder to comply with the targets set for WTRA on each area they harvest, by establishing WTRAs consistent with or exceeding area targets for each individual cut block planned for harvest.

Selection of WTRAs will target areas containing wildlife trees or trees with increased biodiversity values (e.g. broken tops, perching platforms, nesting cavities, nests, bear dens) and areas with evidence of wildlife use (e.g. game trails, day beds). Riparian areas which generally contain higher ecological diversity values will be prioritized for designation as WTRAs. Other objectives, including protection of culturally valued botanicals and plant communities will also be considered when identifying suitable WTRAs.

8.2.3 Individual Tree Retention

Old growth values and biodiversity will also be promoted at the site level by retaining individual trees. Trees chosen for retention will include a range of species, ages, diameter classes and heights. Retention trees will be selected to cover the range of variability found within the stand and to maintain representation of the current stand values on the site. The Licensee will strive to apply retention silviculture systems to allow some existing old growth values to be retained or to develop on each cut block following harvest.

8.3 Wildlife

Conservation of wildlife and their habitat is an important aspect of forest management in the Community Forest. A wide range of wildlife species inhabit the lands within the SCF, a number of which have been identified as requiring special consideration during forest management. These include regionally important wildlife and ungulate species such as Mountain Goat, Black-tailed deer and Moose, and various species at risk.

All forest management and harvesting activities completed by the Licensee will be consistent with the objectives set by government for protection of identified wildlife species and their habitat. “Identified wildlife” can be broadly described as umbrella species, and protection of these species and their habitats translates to benefits to a number of other forest dwelling wildlife species.

8.3.1 Wildlife Species at Risk

In the Sea to Sky Natural Resource District (DSQ), in which the SCF is located, there are four species at risk with established Wildlife Habitat Areas (WHAs) and General Wildlife Measures (GWM). These species are Grizzly Bear *(Ursus arctos)*, Marbled Murrelet *(Brachyramphus marmoratus)*, Coastal Tailed Frog *(Ascaphus truei)* and Spotted Owl *(Strix occidentalis)* (Appendix 2: Wildlife, Water and Old Growth Map). The purpose of WHAs is to conserve those habitats considered most limiting to a given species. WHAs designate critical habitats in which activities are managed to limit their impact on the wildlife species for which the area was established (BC MOE 2018). GWMs are the specific management practices by which WHAs are managed.

There are additional species at risk with potential to be present within the SCF, such as Northern Goshawk (*Accipiter gentilis laingi*) and Pacific Water Shrew (*Sorex bendirii*), for which no WHAs or GWM have been developed and which will be addressed through other measures.

In addition, specific wildlife features identified during site planning (e.g. bear dens, mineral licks, raptor nests, high value forage areas) will be managed to preserve or maintain their function.

8.3.1.1 Grizzly Bear

The SCF contains established Grizzly Bear WHAs with associated GWM. The purpose of the WHAs is to protect key Grizzly Bear habitat. In addition to the minimum legal requirement for Grizzly Bear management the Licensee plans to apply further strategies and best practices at the site level, including consideration of Grizzly Bear during access planning.

8.3.1.2 Marbled Murrelet

While there are established WHAs for Marbled Murrelet within the Sea to Sky Natural Resource District, there are none within the Community Forest. The SCF landbase is considered to have a low likelihood of having significant amounts of suitable nesting habitat. As the SCF area is generally greater than 50km from the sea, the likelihood of any areas containing the microhabitat biophysical attributes required to sustain Marbled Murrelet populations is low. No management for this identified wildlife species is required.

8.3.1.3 Coastal Tailed Frog

While WHAs for Coastal Tailed Frog have been established within the Sea to Sky Natural Resource, none WHAs are present within the SCF area. Management of Coastal Tailed Frog habitat is an important component of site level water quality management. The Licensee will manage for Coastal Tailed Frogs through assessments and management strategies at the site level.

8.3.1.4 Spotted Owl

Two types of Spotted Owl WHAs are established within the SCF area - Long Term Owl Habitat Area (LTOHA) and Managed Forest Habitat Areas (MFHA). Any harvesting within LTOHA is required to enhance or create Spotted Owl habitat. The Licensee will avoid planning harvesting activities within any LTOHA. No harvesting to enhance or create spotted owl habitat will be considered unless specifically required to address forest health issues.

Spotted Owl MFHAs are available for timber harvesting if structural attributes are retained that maintain options for all or portions of the MFHA to become future Spotted Owl habitat and, if necessary, LTOHA. The GWMs specify levels and distribution of retention that must be met on all harvest areas within the MFHA. The Licensee may plan and conduct harvesting and other forest management activities within MFHA, consistent with the legally established GWMs.

8.3.1.5 Northern Goshawk

At the time of writing there are no provincial level requirements to manage for Northern Goshawk habitat and no WHA have been established for this species. Management for Northern Goshawk will be undertaken through strategies applied at the site level.

8.3.1.6 Pacific Water Shrew

At the time of writing there are no provincial level requirements to manage for Pacific Water Shrew habitat and no WHAs have been established for this species. The current documented range of the Pacific Water Shrew in British Columbia includes the Fraser Valley, Lower Mainland and as far north as Squamish. The Pacific Water Shrew is not currently believed to inhabit the Community Forest area, but little is known about this species, and suitable habitat types may exist that could support Pacific Water Shrew populations. Management for Pacific Water Shrew will be undertaken through strategies applied at the site level, where site level assessments indicate presence of this species and their habitat.

8.3.1.7 Other Wildlife Species at Risk

Other wildlife species at risk will be managed through completion of site level assessments during block layout and site plan development. Assessments will include office review of reported occurrences, available habitat descriptions and best management practices and a field review to determine the presence of the species or their preferred habitat. Available species-specific management direction or best management practices will be applied for species at risk and their habitat where identified.

8.3.2 Ungulate Winter Range

Within the DSQ and the SCF, species specific ungulate winter ranges (UWRs) have been established to provide for and protect spatially defined areas containing high suitability habitat attributes considered to be required for the winter survival of identified ungulate species – Mountain Goat (*Oreamnos americanus*), Black-tailed deer (*Odocoileus hemionus*) and Moose (*Alces americanus*) (Appendix 2: Wildlife, Water and Old Growth Map). Species specific results, strategies and objectives have been legally defined for management of each UWR polygon.

In some UWRs in the SCF (Mountain Goat Winter Range, Deer Winter Range – Retention) timber harvesting is not permitted. In other UWRs (Deer Winter Range – Rotational Units and Moose Winter Range Forage Management Zones) some harvesting is permitted but only consistent with specific management requirements to protect the key habitat features.

In addition to the legal measures, site level management of habitat and habitat features for ungulate species is an important objective for the Community Forest.

8.4 Plant Species and Ecological Communities at Risk

A number of plant species and ecological communities at risk are either known or have potential to occur within the SCF land base. At the local level, the Lil'wat Land Use Plan indicates that productive plant habitats in the Traditional Territory that are most endangered or rare include low to mid-elevation floodplains and alluvial forests, low-elevation warm-aspect rock outcrops, dry closed forests, and high-elevation avalanche tracks and meadows. Lil'wat botanical studies have revealed that the most threatened biogeoclimatic units for culturally important plants are in areas identified by the province as the Interior Douglas Fir wet warm zone (IDFww) and Coastal Western Hemlock dry sub maritime zone (CWHds1) plant communities (Lil'wat Nation 2006), both of which occur in the licence area.

As for the procedure for wildlife species at risk, plants species and ecological communities at risk will be managed through completion of site level assessments during block layout and site plan development stages to determine if there are plant species or ecological communities at risk present or reported to be present.

8.5 Water, Riparian Areas and Fish Habitat

8.5.1 Rivers, Streams, Lakes and Wetlands

Numerous rivers, streams, wetlands and lakes are found throughout the SCF, representing a range of riparian classes. Larger rivers within or bordering the Community Forest include the Lillooet and Green Rivers. Named creeks include portions of Gravell, Miller, Pemberton and Peq Creeks.

In addition to FRPA requirements, the Licensee will strive to be consistent with the Lil'wat Land Use Plan and other Lil'wat policy documents which give direction for the management of water, riparian areas and

fish habitat. As noted in the Lil'wat Land Use Plan, "Riparian setbacks must be large enough to maintain the water quality and riparian habitats that protect healthy fish, wildlife, and human populations."

The Licensee will manage riparian areas to maintain a multitude of values and to avoid adverse impacts on water quality and aquatic habitat, including fish habitat. Site level management of water features and associated riparian areas and fish habitat will be accomplished by classifying, assessing and prescribing appropriate measures to protect each individual feature.

8.5.2 Floodplain Management Areas

The Green River Floodplain Management Area is partially within and immediately adjacent to the Community Forest (Appendix 2: Cultural Features Map). Objectives for Floodplain Management Areas are designated by the Ministerial Order for Land Use Objectives for the Sea-to-Sky LRMP (BC MFLNRO 2013). As per the legal objectives for floodplain management areas, the functional integrity of the floodplain ecosystems will be maintained by:

- Limiting the total area available for timber harvesting to a maximum of 20% of each floodplain management area over a rotation, and
- Retaining a fully representative suite of forest types, plant communities, and wildlife habitats within each floodplain management area, where practicable.

8.5.3 Community Watersheds

Portions of two community watersheds – Peq and Pemberton – are located within the Community Forest (Appendix 2: Wildlife, Water and Old Growth Map). Forestry activities within the watersheds will follow FRPA requirements and the Pemberton Community Watershed Integrated Water Management Plan (IWMP). In accordance with the IWMP Pemberton Creek has a 100m buffer applied to it.

At the time of writing there is no watershed plan or watershed assessment completed for Peq Community Watershed.

8.6 Cultural Heritage and Archaeological Values and Resources

8.6.1 Parks and Conservancies

The boundaries for the SCF were carefully delineated around any parks and conservancies, so there are none located within the SCF. Nairn Falls Provincial Park borders the SCF.

8.6.2 Lil'wat Nation A7x7ūlḿecw (Spirited Ground) Areas

Lil'wat A7x7ūlḿecw (Spirited Grounds) are a type of Cultural Place established through the Ministerial Order – Land Use Objectives for the Sea to Sky Land and Resources Plan (BC MFLNRO 2013). The overall objective of First Nations' Cultural Places is to "protect heritage resources within the cultural places and to support First Nations' food, social, ceremonial and spiritual use of the forest" (BC MFLNRO 2013).

Spirited Grounds are designated as category A, B or C, with distinct management objectives defining the land use activities permitted for each category. Within the Community Forest there are two Category A and five Category B Spirited Grounds (Table 3) (Appendix 2: Cultural Features Map and Spirited Ground Areas Map). The Category A Spirited Ground were removed from the THLB as timber harvest is not permitted within them. The CF also borders the MacKenzie Basin and Mosquito Lake Spirited Ground Areas, both of which are Category A and has corners touching the Birkenhead Bailey Bridge (Cat. B) and Smoke-a-Butt Trail (Cat. A) Spirited Grounds.

Table 3. Lil'wat Nation A7x7ūlḿecw (Spirited Grounds) in Spel̓kúmtn Community Forest

A7x7ūlḿecw (Spirited Ground)	Category	Assessment Required (as per BC MAL 2008 Appendix 4)	Notes
Grandfather Mountain	A	Aboriginal Interest and Use Study	
North Millar	A	Archaeological Impact Assessment, Aboriginal Interest and Use Study	
Ivey Lake West	B	Preliminary Field Reconnaissance, Botanical Resource Strategy	
Gravell Creek	B	Archaeological Overview Assessment, Botanical Resource Strategy	
Green-Lillooet River	B	Archaeological Impact Assessment, Aboriginal Interest and Use Study	
Ts'zil	B	Aboriginal Interest and Use Study	
Signal Hill	B	Archaeological Impact Assessment, Aboriginal Interest and Use Study	Opportunities will be considered to coordinate forest fire management strategies within the boundary.

Management in Spirited Grounds

The Licensee will follow the management direction provided by the order (BC MFLNRO 2013) to ensure protection of cultural heritage resources within Spirited Grounds. As per the LRMP (BC MAL 2008), overall objectives for all categories of Spirited Ground Areas are:

- To maintain resources that provide opportunities for social, ceremonial and cultural uses by First Nations.
- To maintain natural and aesthetic conditions that are conducive to spiritual and cultural uses.
- To provide for the continuation of cultural activities and traditional renewable resource harvesting activities.

The objectives for Category A Spirited Grounds are:

- Protect the cultural heritage resources within category A Spirited Grounds, to support First Nations' food, social, ceremonial and spiritual use of the forest.
- Maintain 100% of the forested area within Category A Spirited Grounds.
- No timber harvesting is permitted within Category A Spirited Grounds, except as necessary to maintain forest health or address a safety hazard.
- Existing roads may be maintained. No new roads for the purpose of timber harvesting will be contemplated.
- Where timber harvesting opportunities are identified immediately adjacent to Category A Spirited Ground boundaries, block boundary layout will be completed in such a way as to ensure no portion of the Spirited Grounds are within the harvest area.
- During harvest of areas adjacent to Category A Spirited Grounds, harvesting plans will specify that no disturbance is permitted to areas outside of the falling boundary.

In Category B A7x7ūlḿecw (Spirited Grounds) resource development activities are generally permitted where they do not impact the cultural values associated with the area, as determined through the appropriate assessment and consultation with First Nations (BC MAL 2008). Timber harvesting is permitted within most Category B areas, subject to consideration of cultural values. Forestry activities within or adjacent to Category B areas will be subject to enhanced planning and consultation measures and guided by the Lil'wat Nation Botanical Resource Strategy.

Appendix 4 of the Sea-to-Sky LRMP identifies the types of assessments required prior to authorization of activities in Spirited Ground areas. The range of required assessments for Cat B areas in the SCF include Aboriginal Interest and Use Study, Archeological Impact Assessment, Preliminary Field Reconnaissance and/or a Botanical Resource study (Table 3). Assessments appropriate to the area will be completed.

8.6.3 Skelulátkwa/Owl Creek Cultural Education Area (Lil'wat Nation)

A portion of the Skelulátkwa/Owl Creek Cultural Education Area is located within the Community Forest (Appendix 2: Cultural Features Map and Spirited Ground Areas Map). A range of activities are allowed where they do not conflict with First Nations cultural and educational learning activities (BC MAL 2008). Objectives for the Skelulátkwa/Owl Creek Cultural Education Area (as per the LRMP) are:

- To protect and enhance opportunities for Lil'wat cultural education as it relates to the land and natural resources.
- To maintain natural conditions that are conducive to spiritual and cultural inspiration.
- To protect and maintain social, ceremonial and cultural uses by First Nations.
- To protect and enhance the integrity of First Nations cultural and heritage resources, including Lil'wat Nation A7x7ūlḿecw (Spirited Ground) Areas.
- To maintain important wildlife, ecological and natural backcountry/wilderness values.
- To focus economic opportunities on Lil'wat learning and community development.

Forestry development in Skelulátkwa/Owl Creek Cultural Education Area is permitted subject to the following conditions:

- Lil'wat Nation will be contacted early in the planning process and given the opportunity to provide management recommendations and information relating to site level values requiring consideration.
- No new forestry roads will be constructed within the Skelulátkwa/Owl Creek Cultural Education Area. Existing access roads may be maintained.
- All development activities within the Skelulátkwa/Owl Creek watershed will be undertaken in a manner compatible with the cultural interests and values of First Nations.
- The Skelulátkwa/Owl Creek Trail will be managed in a way that protects the cultural integrity of the trail. Management strategies for recreation use of the trail will be developed in cooperation with First Nations.
- A Botanical Resource Inventory and any other assessments appropriate to the area will be completed. Completed assessment information will be provided to Lil'wat Nation.
- Operational plans will be developed based on information received from First Nations and from the results of the completed assessments. The plans will specify the measures to be utilized to reduce or eliminate any impact from the proposed development on the integrity of botanical resources or the First Nations cultural values for the area.

8.6.4 Archaeological Values and Resources

Within the context of Lil'wat Heritage Policy, Lil'wat archaeological sites are defined as those locations that contain artifacts or features that are tangible, physical remains of ancestral activity and occupation. This includes all pre-contact or proto-historic sites situated within Lil'wat territory (whether or not registered with the provincial government), objects or materials recovered from within the territory (Lil'wat Nation 2005).

An Archaeological Overview Assessment (AOA) was completed for the Sea to Sky District in 1997 as a source of information to be incorporated into forestry planning processes. Based on a predictive model, the AOA resulted in a series of maps which delineate areas of high, medium or low archaeological potential (Millenia Research 1997). Other information sources include publically available Traditional Use studies and registered archaeological sites.

Archaeological site information will be sought and considered during site level planning and referrals with Lil'wat Nation. Forest management within the SCF will take into account Lil'wat cultural policies such as the Heritage Policy. The Licensee will work with the Lil'wat Land and Resources Department, the Lil'wat Land Use Referral Committee, and others to protect cultural heritage resources as much as possible during forest management activities. A forestry specific referrals process is being created to guide ongoing consultation with Lil'wat Nation regarding forestry activities (section 6.3.1), including consideration of cultural and heritage values.

The potential for and presence of archaeological and heritage values will be assessed at the site level, and considered during harvest planning activities.

8.7 Wildland Areas

Wildlands are land use zones designated through the Sea-to-Sky LRMP. Individual Wildland Zones have been assigned one of four emphases to reflect the resource value(s) of primary consideration and with which the Zone's management must be consistent – Cultural, Recreation, Tourism and Wildlife. Part of Rutherford Headwaters Wildland Zone is within the Community Forest. It is designated as Recreation emphasis. Mount Currie and Place Glacier Ridge Wildlands border portions of the Community Forest. Both are designated Recreation (Appendix 2: Cultural Features Map).

Commercial logging is prohibited in Wildland zones, thus they are removed from harvest. The management strategy for Wildlands in and adjacent to the SCF is to ensure no disturbance to them is caused by primary forest management activities.

8.8 Botanical Resources and Non-Timber Forest Products

As noted in section 5, while botanicals and other non-timber forest products are not included as resources to be harvested under this SCF at this time, they need to be considered in forest management so that they will continue to thrive and be present across the landbase.

The Botanical Resource Strategy (Lil'wat Nation n.d.) was created to guide forest practices on Lil'wat territory in a way that protects and maintains botanical resources. While it was originally written with respect to Category B A7x7ūlḿecw (Spirited Ground) areas, the Licensee will strive to consider cultural botanicals and the recommendations of the Strategy in forest management decisions throughout the SCF to the greatest extent that is economically feasible.

8.8.1 Botanical Inventory Procedure

A comprehensive inventory of botanical and non-timber forest products does not currently exist for the Community Forest area. However, in response to the Botanical Resource Strategy a system has been developed for recording basic inventory information about plants found in areas where timber harvest is being planned. The Licensee will collect inventory information on botanicals throughout the SCF area during the course of operational planning, as follows. Botanical resource inventory information will be collected concurrently with site plan fieldwork when feasible, or during other fieldwork prior to harvest. The botanical resource survey information is submitted to the Lil'wat Land and Resources Department to be added to their botanical inventory records, thus contributing to the database of botanical resource locations.

8.8.2 Botanical Resources Management Measures

The Licensee will consider and aim to minimize impacts to productive areas of culturally important botanical resources. In addition to contributing to inventory information, a variety of measures will be taken to protect and maintain botanical resources during the course of forest management on the SCF.

8.9 Forest Health

8.9.1 Summary of Current Forest Health Issues

This section describes the most prominent known forest health issues, risks and opportunities in the license area. Information is compiled from multiple sources – the 2010 Forest Health Strategy for the Squamish Forest District, the 2015-2017 Coastal TSA Forest Health Overview, the Coast Area Forest Health Aerial Overview Survey as well as the field-based knowledge of local forest professionals. The Forest Health Strategy for the Squamish Forest District provides a list of priority forest health pests and damage agents (Table 4).

Table 4. Ranking of Priority Pests in DSQ

Very High	High	Medium
Mature Forests		
Laminated root rot *(Phellinus)*	Douglas-fir beetle	Swiss needle cast
Armillaria root rot (*Armillaria*)	Spruce beetle	Balsam woolly adelgid
Mountain pine beetle	Annosus root rot	Pine needle cast
Western spruce budworm	Hemlock dwarf mistletoe	Black stain root rot
White pine blister rust		Western balsam bark beetle
Fire		Western hemlock looper
		Gypsy Moth
Plantations		
Phellinus	Mammals (deer, elk)	Swiss needle cast
Armillaria	Western gall rust	Annosus root rot
White pine blister rust	Hemlock dwarf mistletoe	Dothiostroma needle blight
	Spruce weevil	Pine needle cast
	Balsam woolly adelgid	
	Douglas-fir needle cast	

Source: BC MOFR 2010

More recently, the 2015-2017 Coastal TSA Forest Health Overview (BC MFLNRO 2015) highlighted the following pests and abiotic damage agents as being present in the Soo Timber Supply Area (in which the SCF is located):

- Balsam Woolly Adelgid,
- Douglas-Fir Beetle,
- Mountain Pine Beetle,
- Spruce beetle,
- Western Balsam Bark Beetle,
- Western Spruce Budworm,
- Root Diseases – the Soo TSA contains areas with extensive amounts of root disease, primarily laminated root disease of Douglas-fir and *Armillaria* root disease on many conifer hosts,
- Flooding, and
- Slides.

The 2017 aerial survey noted Balsam Bark Beetle attacks on *Abies lasiocarpa* (subalpine fir) at higher elevation (B.A. Blackwell 2017).

8.9.2 Management of Forest Health

Management for the maintenance of forest health across the SCF area requires monitoring at both the landscape and site level to identify outbreaks and incidences of forest pests and to plan forest harvesting operations so that increases in damage, pests, or pest potential do not occur. It is important to note that many forest health issues are a result of uncontrollable factors such as weather and climate patterns over which the licensee has no control.

Specific strategies and processes will be put in place by the Licensee to address, manage and reduce the potential for major forest insect and disease outbreaks, animal damage and windthrow.

8.9.3 Fire

As noted above, fire is a major forest health factor in the DSQ, including within the SCF. Management of wildfire risk across the SCF is a critical component of forest management. Landscape level planning for management of wildfire risk is beyond the scope of this plan, however the Licensee intends to work with municipal, regional and provincial governments to contribute to initiatives and programs designed to address wildfire risks, especially at the community/forestland interface. Management of forest fuels and wildfire risk will be incorporated into site level planning, activities and monitoring

8.9.4 Invasive Species

Invasive species are species that are not native to a region, and can have a negative impact ecologically, socially or economically. Invasive species tend to favour disturbance, grow rapidly and are hard to get rid of, while outcompeting native species.

The IDFww is identified as being a high risk biogeoclimatic variant at the landscape level within the DSQ. At the local level, riparian, wetland, estuaries, open ecologically significant terrestrial areas (including forest gaps), private farms and rangelands are highly likely to include to priority invasive plants (BC MOFR 2010).

The Sea to Sky Invasive Species Council (SSISC) is a non-profit society that works in cooperation with organizations, governments and industry as part of a province wide effort to minimize the negative

impacts caused by invasive species (SSISC 2018). The SSISC plays a large role in detection, reporting and eradication as well as public education. They have developed a list of priority invasive species with management categories by region. The most current list maintained by SSISC can be accessed at

http://ssisc.ca/wp-content/uploads/2018/06/SSISC-SPECIES-LIST-Priority-by-Sub-Region-2018-Website-2018-06-28.pdf

The Licensee will take measures to prevent the introduction or spread of invasive plants if such introduction or spread is likely to be the result of forest practices carried out in SCF.

8.9.5 Pesticides and Herbicides

Management direction in the Lil'wat Land Use includes eliminating the use of pesticides and herbicides in the Traditional Territory. The Licensee intends to avoid all use of pesticides and herbicides within the SCF unless no other practicable alternative is available for specific situations.

In accordance with the Lil'wat Heritage Policy, herbicide and pesticide use in and around plant harvesting areas is prohibited.

8.10 Terrain

Much of the SCF terrain is steep, rugged and mountainous. A slope theme map (Appendix 2: Slope Theme Map) illustrates the relative steepness throughout the licence area and serves as a tool to assist planners in identifying slope constraints.

8.11 Roads and Access Structures

FSRs within the SCF include Miller Bench, Owl Creek, McKenzie Basin, and Green River FSRs (Appendix 2: Overview and Access Map). FSRs in the SCF are used by a variety of industrial, recreational, commercial and public users.

The primary objective for roads within the SCF is to maintain access to a road network to facilitate forest management activities while minimizing the amount of productive area impacted by forest roads. Roads management within the SCF will consider current and future road needs including those for non-forestry uses. The Licensee will consider the needs of community members and non-forestry uses such as recreation during access management planning and decision making.

Roads developed for harvesting will be designed and located to avoid sensitive ecosystem features, high productivity areas for culturally important botanical resources or other important forest resource values. Roads will be managed in such a way as to minimize impacts on wildlife.

All designs, construction, use, maintenance and repairs to roads and associated structures completed by the Licensee will be consistent with the BC Forest Road Regulations, BC Forest Service Road Use Regulations and with the MFLNRO Engineering Manual.

8.12 Recreation

Outdoor recreation is an important part of the local lifestyle and culture, and for tourists visiting the area. Recreation-based and supporting service businesses provide significant economic contributions to the region. Recreation activities take place in areas established specifically for recreation (e.g. trails) and across the broader landscape within the licence and surrounding areas. Recreation includes both non-commercial (public) and commercial activities. Recreational activities (commercial and non-commercial) in the license area include:

- Backcountry skiing (heli-skiing and self-propelled),
- Snowmobiling,
- River activities (rafting, kayaking, canoeing, jetboating) such as on the Green and Lillooet Rivers,
- Other water-based activities (kayaking, canoeing, paddle boarding, swimming, beach activities),
- Hiking / Camping
- Mountain Biking,
- ATV riding,
- Horse trail riding,
- Mountain climbing,
- Nature viewing,
- Fishing; and
- Paragliding.

(adapted from BC MAL 2008)

The Licensee will strive to maintain and enhance recreation opportunities within the Community Forest area.

8.12.1 Recreation Feature Inventory

The Recreation Features Inventory (RFI) is a provincial system developed to classify recreation opportunities, features and experiences across provincially designated landscape planning units. This system allows forest managers to identify the general type and nature of recreation uses occurring within the landscape planning units of interest. The last recreation inventory RFI update for the Squamish Forest District occurred in 1998. Although dated, it provides a baseline inventory resource for recreation land use, features and activities within the license area.

8.12.2 Non-Motorized Recreation Zones

Through the Sea-to-Sky LRMP and subsequent stakeholder negotiations, recreation zones have been established to guide the type of recreation activities which are desired and appropriate for specific portions of the landscape – particularly for motorized and non-motorized activities. These zones have not been legally established at the time of writing. Portions of the CF are zoned non-motorized (air access) (RA1-A) for non-commercial recreation. The southern portion of the CF borders areas zoned as non-motorized (RA1) (Appendix 2: Recreation and Other Tenures Map).

8.12.3 Recreation Sites, Trails and Interpretive Forest

There are no Recreation Sites, Recreation Reserves or Interpretive Forests within the Community Forest. Numerous established/designated recreation trails are located within the SCF. For some trails there are agreements with stakeholder or user groups regarding maintenance and operation. The Licensee will consult with trail stakeholders and take appropriate measures to minimize and mitigate impacts to trails during forestry operations.

8.12.4 Recreation Stakeholders and User Groups

There are a variety of public and commercial recreation stakeholders and community groups representing a range of activities across the SCF (Section 6.1). Stakeholders include people participating in any recreation activity on the SCF landbase. A description of information sharing and consultation for these stakeholders is outlined in section 6.3.2 (General Consultation Process).

8.13 Visual Quality and Scenic Areas

The Sea to Sky Visual Landscape Inventory (VLI) was completed in 1991 and is currently being updated. The VLI identifies areas that may be visually impacted by forest management activities and stratifies the landscape into distinct "visual polygons". A standard classification system is used to assign to each polygon the:

i) Visual Sensitivity Class (VSC)

ii) Visual Absorption Capacity (VAC)

iii) Existing Visual Condition (EVC)

iv) Visual Quality Objective (VQO)

Provincial legislation and policies guide the management of the visual landscape within known Scenic Areas. Scenic Areas are visually sensitive areas or scenic landscapes identified through the Provincial Visual Landscape Inventory (VLI). All VLI polygons with VQOs are considered to form part of a Scenic Area. The portions of the SCF area which are subject to visual quality objectives are identified on the Visual Inventory Map in Appendix 2.

The Licensee aims to manage the visual landscape with the broad objectives of minimizing the visual impact of forest harvesting operations, especially when viewed from significant public viewpoints, residential areas or when traveling along major transportation corridors within the plan area.

Forest operations will be consistent with established Visual Quality Objectives.

8.14 Climate Change

As new information emerges on forest management practices in a changing climate, it will be considered and best practices implemented to ensure the long-term viability of the forest to provide the range of values and opportunities described in this plan. New stocking standards based on climate change predictions and field observations may be adopted.

8.15 Other Tenures within the CFA license area

A variety of Crown land tenures and licences exist within and overlap the SCF license area (Appendix 2: Recreation and Other Tenures Map) as detailed in the following sub-sections. A database of the relevant contacts is maintained by the Licensee so that they can be consulted if potentially affected by proposed timber harvesting. Consultation protocols are described in section 6.3.2 (General Consultation Process).

8.15.1 Commercial Recreation Tenures

Four commercial recreation tenure holders operate within the SCF area. Activities undertaken through these tenures include heli skiing, heli hiking, and other guided outdoor recreation.

8.15.2 Guide Outfitters

One guide outfitter tenure overlaps portions of the SCF.

8.15.3 Mineral Tenures

Six mineral claims exist within the SCF area.

8.15.4 Rangeland

There are no rangeland tenures within the Community Forest.

8.15.5 Traplines

Nine traplines exist within the SCF area, six of which are associated with Lil'wat community members.

8.15.6 Utility Right of Ways

Numerous utility right-of-ways are located across the SCF. These consist primarily of above ground electric transmission lines for BC Hydro, and independent power projects. In Miller Creek there is also a right-of-way for the penstock associated the Miller Creek independent power project. Utility Right of Ways holders include BC Hydro, Pemberton Valley Dyking District, and Brown Miller Power Gp Inc.

8.15.7 Water Licences

Eleven water licences exist within the SCF, spanning both domestic and commercial use. These licenses allow the holder(s) to extract a specified amount of water from surface or ground water sources. Purposes of the water use include power production (commercial), domestic water supply, irrigation and community waterworks. The location of water license points of diversion within the SCF area are illustrated on Wildlife, Water and Old Growth Map in Appendix 2.

8.15.8 Other Crown Tenures

A variety of other tenure holders occupy small areas across the SCF for uses such as quarrying, communications infrastructure, waterpower, transportation, commercial, and institutional use.

9 Proposed Allowable Annual Cut and Rationale

9.1 Proposed Allowable Annual Cut

The proposed AAC for the Spel̓kúmtn Community Forest is 13, 000m^3/year.

9.2 Allowable Annual Cut Rationale

A Timber Supply Analysis (TSA) was completed by Forsite Consultants (Appendix 1). The analysis took into account timber harvest reductions necessary to facilitate the management and conservation of non-timber resource values in the CFA area including soils, environmentally sensitive areas, biodiversity (via OGMAs and WTRAs), wildlife (via WHAs and UWRs), riparian area buffers, floodplain management areas, community watersheds, cultural heritage values, visual quality and other areas reserved from harvest such as Category A Lil'wat Spirited Grounds and Wildlands Zones designated through the Sea-to-Sky LRMP. The specific non-timber management reductions, and harvesting, growth and yield, natural disturbance and modelling assumptions are detailed in the Forsite TSA report.

The Ministry of Forests, Lands, Natural Resource Operations and Rural Development completed a separate TSA for the proposed CFA based on the most recent Soo Timber Supply Area Timber Supply Review information.

The Forsite analysis resulted in a projected short term (20yrs) cut of 11,000m^3/yr, decreasing to a long term cut of 10,000m^3/yr. The Ministry analysis projects an estimated cut of 13,128m^3/yr. The difference between the Ministry and the Forsite analyses is largely due to differences in visual constraints, between what was modeled in the SCF and what was modeled in the Soo Timber Supply Area. The Forsite analysis shows that the proportion of the SCF THLB constrained by visual quality objectives is 40% higher than within the Soo Timber Supply Area overall.

Consistent with the Ministry projection the SCF has decided to apply for an AAC of 13,000m^3/yr, as their proposed AAC and the SCF intends to manage to an annual harvest level of 11,000m^3/yr. By assigning the higher AAC, consistent with the Ministry TSR model, the flexibility to increase harvesting levels beyond the planned 11,000m^3/yr following future AAC analysis will be enabled. Future AAC analysis will consider factors anticipated to provide an uplift effect to the AAC, such as improved forest inventory and site index information, and increased growth rates of managed stands resulting from future fertilization treatments and seedling genetic gain technology. Also, although difficult to predict it is expected that portions of the SCF will be identified as appropriate for community wildfire protection treatments, and a portion of these areas will fall within areas previously identified as constrained from harvest. It is anticipated that harvesting associated with wildfire protection treatments occurring within areas of the SCF currently identified as constrained has the potential for AAC uplift effect.

10 References

Agriculture Canada and BC MOE 1978. The Soil Landscapes of British Columbia. Eds. K.W.G. Valentine, P.N. Sprout, T.E. Baker and L.M. Lavkulich. Victoria, BC 1978. Reprinted August 1986. Accessed June 10, 2018 at http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soils_Reports/Soil_Landscapes_of_BC_1986.pdf

B.A. Blackwell 2010. Lil'wat Nation Small Scale Forestry - Considerations for forest management as applied on Lil'wat Nation Forest Licenses. Submitted to Lil'wat Nation Lands and Resources Department. March 2010.

B.A. Blackwell 2017. Coast Area Forest Health Aerial Overview Survey. 2017 Summary Report.

BC 2006. Wildlife Tree Retention: Management Guidance. May 16, 2006. Accessed June 15, 2018. https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/conservation-habitat-management/wildlife-conservation/wildlife-tree-committee/wt-guidance-05-2006.pdf

BC 2018. Silviculture Strategies webpage. Accessed June 14, 2018. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silviculture-strategy

BC MFLNRO 2015. Management Plan Template Companion Document. December 2015 Forest Tenures Branch.

BC MAL 2008. Sea-to-Sky Land and Resource Management Plan. April 2008.

BC MFLNRO 2013. Ministerial Order for Land Use Objectives for the Sea-to-Sky Land and Resource Management Plan. August 13, 2013. As amended from the original order of 2011.

BC MFLNRO 2015. Coast Area – 2015-2017 Coastal Timber Supply Areas Forest Health Overview. February 2015 (v.2.0).

BC MOFR 2010. Squamish Forest District Forest Health Strategy. April 28, 2010.

Forsite 2018. Spel̓kúmtn Community Forest Timber Supply Analysis Data Package & Base Case Results. Version 1.0 September 2018. Project 1282-3.

IAP2 2007. International Association for Public Participation (IAP2) Foundations of Public Participation.

Lil'wat Nation n.d. Lil'wat Nation Botanical Resource Strategy A7x7ūlḿecw (Spirited Ground) Areas: Category B.

Lil'wat Nation 2005. Lil'wat Heritage Policy. November 8, 2005

Lil'wat Nation 2006. Lil'wat Land Use Plan: Phase 1. The Vision and Plan for the Land and Resources of Lil'wat Nation Traditional Territory. August 1, 2006.

Lil'wat Nation and BC 2008. Lil'wat Nation - British Columbia Land Use Planning Agreement.

Millenia Research 1997. Archaeological Overview Assessment of the Squamish Forest District. Technical Report. Accessed June 14, 2018 https://www.for.gov.bc.ca/ftp/archaeology/external/!publish/web/raad/SQUAM/Squamish%20AOA%20Technical%20Report.pdf

Robin B. Clark 2016. Community Forest Feasibility Study for the Village of Pemberton. 1 January 2016.

SSISC 2018. SSISC webpage. Accessed June 22, 2018. http://ssisc.ca/

11 Appendices

Appendix 1 - Timber Supply Analysis Report prepared by Forsite Consultants Ltd.

Appendix 2 - Maps

- Ecosystems and Old Growth Map
- Wildlife, Water and Old Growth Map
- Cultural Features Map
- Spirited Ground Areas Map
- Recreation and Other Tenures Map
- Slope Theme Map
- Overview and Access Map
- Visual Inventory Map

Spel̓kúmtn Community Forest

Timber Supply Analysis Data Package & Base Case Results

Version 1.0

September 2018

Project 1282-3

Prepared by:

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

Prepared for:

Lil'wat Forestry Ventures
P.O Box 605
Mount Currie, BC
V0N 2K0

Table of Contents

Table of Contents i

List of Figures iii

List of Tables iii

Signatures of Preparing and Supervising Foresters iv

1 Introduction 1

2 Land Base Definition 2

2.1 Inventory 2
2.2 Data Sources 2
2.3 Exclusions from contributing forest 6
2.3.1 Non-Vegetated / Non-Forested 6
2.3.2 Utility Right of Ways 6
2.3.3 Existing Roads 6
2.4 Reductions from THLB 7
2.4.1 LRMP Objectives 7
2.4.2 Old Growth Management Areas (OGMAs) 7
2.4.3 Wildlife Habitat Areas (WHAs) 8
2.4.4 Ungulate Winter Ranges (UWRs) 8
2.4.5 Parks and Conservancies 8
2.4.6 Operability Restrictions 8
2.4.7 Low Timber Growing Potential 9
2.4.8 Non-merchantable forest types 9
2.4.9 Riparian 9
2.4.10 WTRAs and in-block Retention 10
2.4.11 Isolated stands 11
2.4.12 Future Roads, Trails and Landings 11
2.5 Landbase Characteristics 11

3 Non-Timber Management Assumptions 15

3.1 LRMP Objectives 15
3.2 Ungulate Winter Ranges (UWRs) 15
3.3 Community Watersheds 15
3.4 Visual Quality Objectives 15
3.5 Prescribed Wildlife Tree Patches & Stand-Level Biodiversity 16
3.6 Timber licenses 16

4 Harvesting Assumptions 17

4.1 Utilization 17
4.2 Minimum Harvest Criteria 17
4.3 Silvicultural Systems 17

5 Growth and Yield Assumptions 17

5.1 Analysis Unit Characteristics 17
5.2 Stand Projection Models 18
5.3 Decay, Waste, and Breakage 18
5.4 Managed and Natural Stand Definitions 18
5.5 Site Index Assignments 19
5.6 Regeneration 19

6 Natural Disturbance Assumptions 20

7 Modelling Assumptions 20

7.1 Patchworks™ Model Description 20
7.2 Modeling assumptions 21

7.3 Harvest Priorities and Target Weightings 21

8 Analysis Report 22

8.1 Long Run Sustainable Yield Calculation 22
8.2 Harvest Volume 22
8.3 Growing Stock 24
8.4 Constraints 26

9 Discussion 29

Appendix I VLI Polygon Percent and Heights 30

List of Figures

Figure 1 Location Map of Spel̓kúmtn CFA....2
Figure 2 Graphical Representation of Landbase Breakdown....5
Figure 3 Landbase classification map....6
Figure 4 BEC sub zone and NDT distribution on the CFA....11
Figure 5 Area by leading species on the CFLB....12
Figure 6 Ten year age class distribution on the CFLB....13
Figure 7 Inventory Site Index....14
Figure 8 Managed Site index on the THLB from TSR3 site index adjustment....14
Figure 9 Base case harvest levels....23
Figure 10 Volume harvested by harvest system....23
Figure 11 Harvest Stand Age Profile (Volume Harvested)....24
Figure 12 Base Case Growing stock by species....25
Figure 13 Age class distribution at 0, 50, 100, and 200 years in the future....26
Figure 14 VQO constraints for M - VQO polygons containing the most THLB....27
Figure 15 VQO constraints for PR - VQO polygons containing the most THLB....27
Figure 16 VQO Constraints for R - VQO Polygons (all within CFA)....28
Figure 17 Community watershed Targets and values....28

List of Tables

Table 1 Publicly available planning documents....1
Table 2 Data sources used....3
Table 3 Area Land Base Assignments....4
Table 4 Category A spirited grounds to be removed from THLB....7
Table 5 Wildland Zones for Cultural, Recreation, Tourism, and Wildlife....7
Table 6 OGMA gross area by LU....7
Table 7 Operability classifications within the CFA....8
Table 8 Environmentally sensitive classifications....9
Table 9 Minimum Requirements for Growing Potential....9
Table 10 Riparian Buffers Applied....10
Table 11 Landscape Unit/BEC sub zone combinations covered by a legal order for WTRA percents....10
Table 12 Floodplain and Riparian management for the LRMP....15
Table 13 Community watersheds....15
Table 14 P2P Ratios and VEG Heights by Slope Class....16
Table 15 VQO by Percent Alterations....16
Table 16 Utilization Standards....17
Table 17 Minimum harvestable volume criteria for existing and managed stands....17
Table 18 Analysis Unit Stratification Characteristics....18
Table 19 Regeneration Assumptions for Existing and Future Managed Stands....19
Table 20 Unsalvaged Losses on the THLB....20
Table 21 Model Assumptions....21
Table 22 Long Run Sustainable Yield Calculation....22
Table 23 Area within Visual Polygons compared between the SOO TSA and the SCF....29
Table 24 VQO modelling requirements....30

Signatures of Preparing and Supervising Foresters

	"I certify that I have determined that this work was performed to an acceptable standard"
Kat Gunion, RPF #4915 Forsite Consultants Ltd. Preparing Forester	

REGISTERED PROFESSIONAL FORESTER PROVINCE OF JOHN RANDALL SPYKSMA BRITISH COLUMBIA NO. 3259	
Randy Spyksma, MSc, RPF #3259 Forsite Consultants Ltd. Supervising Forester	

1 Introduction

Lil'wat Nation and the Village of Pemberton are currently investigating obtaining a Community Forest Agreement (CFA). The tenure surrounds the community of Pemberton and the Mount Currie IR. The proposed area encompasses 142,288 hectares within the current boundary of the SOO Timber Supply Area (TSA) and the Sea to Sky Forest District. 63,488 hectares within the boundary is considered productive forest land. Of this, 16,225 hectares is estimated to be available for timber harvesting. Publicly available planning documents are listed in Table 1.

Table 1 Publicly available planning documents

Plan Type	Plan Title	Description	Web Link (as of Dec 2017)
Regional Land use Plan	Sea To Sky Land and Resource Management Plan (2008)	Documenting land use planning within the Sea to Sky corridor.	https://www.for.gov.bc.ca/tasb/slrp/plan79.html
Forest Stewardship Plan (FSP)	PEBBLE CREEK TIMBER LTD. CREEKSIDE RESOURCES INC. LIL'WAT FORESTRY VENTURES LIMITED PARTNERSHIP FOREST STEWARDSHIP PLAN (2012)	This FSP specifies results and Strategies to comply with the Forest Range and Practices Act (FRPA). Forestry activities that fall under this FSP must adhere to the results and strategies outlined in this document.	https://www.for.gov.bc.ca/ftp/DSQ/external/!publish/Forest%20Stewardship%20Plans/Pebble%20Creek%20Creekside%20%20212/Extension-Amendment2%20FSP%203.0.pdf
Timber Supply Review (TSR)	Soo Timber Supply Area Timber Supply Review (Data Package 2008)	This document outlines the assumptions that were made when defining the AAC for the SOO TSA.	https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/soo_tsa_data_package.pdf
Landscape Unit Objective Orders	BILLYGOAT LANDSCAPE UNIT (2004)	Landscape unit objectives define Wildlife Tree Retention Areas (WTRAs) required for in-block retention based by Bec Zone and Sub zone. Landscape unit objectives also set forth objectives for Old Growth Management Areas (OGMAs).	https://www.for.gov.bc.ca/tasb/slrp/srmp/coast/sea_to_sky/reports/Billygoat_LUP_Order_Objectives_July8_04.pdf
	Birkenhead and Gates Landscape units (2005)		https://www.for.gov.bc.ca/tasb/slrp/srmp/coast/sea_to_sky/reports/Birkenhead_LU_Legal_Order_Objectives.pdf
	Railroad Landscape Unit (2004)		https://www.for.gov.bc.ca/tasb/slrp/srmp/coast/sea_to_sky/reports/Railroad_LUP_Order_Objectives_July8_04.pdf
	Ryan Landscape Unit (2004)		https://www.for.gov.bc.ca/tasb/slrp/srmp/coast/sea_to_sky/reports/Ryan_LUP_Order_Objectives_July8_04.pdf
	Soo Landscape Unit (2004)		https://www.for.gov.bc.ca/tasb/slrp/srmp/coast/sea_to_sky/reports/Soo_LUP_Order_Objectives_July8_04.pdf
	Amendment to Soo Landscape unit (2010)		https://www.for.gov.bc.ca/tasb/slrp/srmp/coast/sea_to_sky/reports/Pages_from_SooLU_ApprovedBoundaryAmendment.pdf

This document outlines the land base, growth and yield, management and modelling assumptions, and reports the results of the timber supply analysis work completed in support of the development of this new tenure.

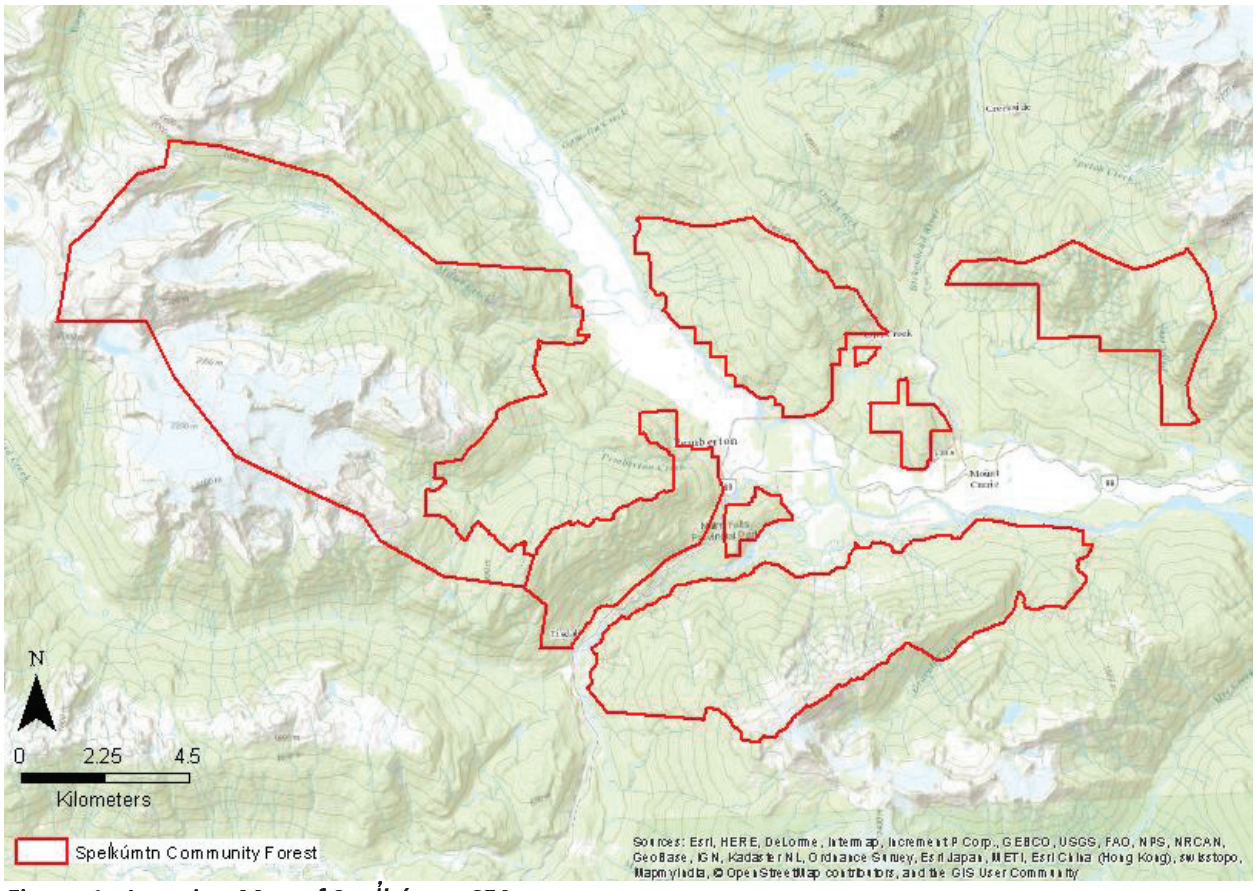


Figure 1 Location Map of Spel̓kúmtn CFA.

2 Land Base Definition

2.1 Inventory

Vegetation Resources Inventory (VRI) was used for this analysis. Inventory attributes (Age) attributed to 2016 were photo captured between 1964 and 2015. FLNRO projected stand attributes to 2016, and Forsite projected ages forward one year to 2017. Additionally, depletions were reflected using Forest Tenures (FTEN) Cut Blocks, Reporting Silviculture Updates and Land Status Tracking System (RESULTS) Forest Cover, RESULTS Forest Reserves, and RESULTS Openings current to October 2017.

2.2 Data Sources

Several datasets covering administrative, inventory, and management guidance information were included in the analysis (

Table 2). These datasets were processed to develop a resultant dataset that was used to build the forest estate model.

Table 2 Data sources used.

Data Class	Data Description	Source	Forsite Internal Name	Vintage
Base	Utility Corridors, Gas, Hydro	LRDW	TANTALIS_CROWN_RIGHTS_OF_WAY	2017
Tenure	Forest Ownership	static	FOREST_VEGETATION_F_OWN	2017
	remaining Timber Licences	FLNRO	Remaining_TL	
	Consolidated Tenure layer including, CFA, FNWL, WL1666, IR6&7	Forsite	UNION_TENURES	
Forest	Biogeoclimatic Ecosystem Classification (BECv10)	LRDW	BEC	2016
	Forest Cover with depletions from Results, FTA. Reserves, and managed site productivity.	LRDW	VRI_SI_DEP	2017
LUP	Landscape Units	LRDW	LU	2017
	OGMAS	LRDW	LAND_USE_OGMAS	2016
	Category A Spirited Places. Selected from LAND_USE_PLANNING_RMP	LRDW	Spirited_Category_A	2017
	Wildand_Zones Selected from LAND_USE_PLANNING_RMP	LRDW/forsite	Wild_Land_Zones	2017
Resource	Community Watershed	LRDW	WLS_COMMUNITY_WATERSHED	
	Operability – areas classified as: inoperable, helicopter, conventional	FLNRO	OPERABILITY	2011
	Visual Landscape Inventory	LRDW	FOREST_VEGETATION_REC_VISUAL	2017
	Terrain Stability Assessement	LRDW	STABILITY_CLASS	2017
	Pemberton Creek Buffer – Pemberton creek buffered by 100m	Forsite	Pemberton _creek_Buffer	2017
	ESAs	MFLNRO	ESA	2011
	Riparian Buffers – Created from streams, river poly, lakes	Forsite	Riparian_buffered	2017
	Road Buffer - based on Road Segments and Road Atlas, buffered	Forsite	Road_Buffer_All	2017
Wildlife	UWR	LRDW	WILDLIFE_MANAGEMENT_UWR_for_resultant	2017
	Wildlife Habitat Areas (WHA)	LRDW	WILDLIFE_HABITAT_AREAS	2017

Land base assumptions are used to define the contributing forest landbase (CFLB) and the timber harvesting land base (THLB) in the study area. The THLB is designated to support timber harvesting while the CFLB is identified as the broader productive forest that can contribute toward meeting non-timber objectives (e.g. biodiversity). The CFLB includes the THLB, and the area within the CFLB that is not harvestable, is called the non-harvesting landbase (NHLB). In the CFA, the effective long term THLB is 2,275ha (12.8% of the gross area). The short term THLB does not include current mapped WTRAs which are non-harvestable for a term of 50 years. The land base area summary is provided in Table 3.

Table 3 Area Land Base Assignments

Land Base element	Total Area (ha)	Effective Area (ha)*	% Total Area	% CFLB
Total Crown area (CFA)	**17,730**	**17,730**	**100%**	
Less:				
Non/Veg Non Forested	7,359	7,100	40.0%	
Utility Right of Ways	23	14	0.1%	
Existing Roads	77	67	0.4%	
Managed Forest land Base (MFLB)		**10,549**	**59%**	**100%**
Less:				
Spirited Grounds A	19	14	0.1%	0.1%
Wildland	5,915	692	3.9%	6.6%
OGMA	772	674	3.8%	6.4%
WHA Grizzly	632	107	0.6%	1.0%
WHA LTOH	42	27	0.2%	0.3%
UWR	2,894	1,950	11.0%	18.5%
Crown Reserves	19	0	0.0%	0.0%
Steep Slopes	12,380	3,107	17.5%	29.4%
ESA	2,687	189	1.1%	1.8%
Low Timber Growing	8,995	1,104	6.2%	10.5%
Pine Low SI	366	12	0.1%	0.1%
Unmerch Species	241	0	0.0%	0.0%
Riparian	363	20	0.1%	0.2%
Pemberton Creek	23	3	0.0%	0.0%
Isolated	2	2	0.0%	0.0%
Temporary Exclusions:				
Reserves	44	28	0.2%	0.3%
Spatial Timber harvesting land base - Short Term		**2,621**	**14.8%**	**24.8%**
Plus:				
Reserves		28		
Spatial Timber harvesting land base - Long Term		**2,649**	**14.9%**	**25.1%**
Riparian (streams) 2%		44	0.3%	0.4%
Stand Level Retention- WTRA		176	1.0%	1.7%
Spotted Owl MFHA		27	0.2%	0.3%
Effective timber harvesting land base		**2,401**	**13.5%**	**22.8%**
Less Future Non-Spatial Netdowns:				
Future permanent roads (0.6%)		15	0.1%	0.1%
Effective future timber harvesting land base		**2,386**	**13.5%**	**22.6%**

*Effective netdown area represents the area that was actually removed as a result of a given factor. Removals are applied in the order shown above. Areas removed lower on the list do not contain areas that overlap with factors that occur higher on the list. For example, lake buffers netdown does not include non-forested area.

**Aspatial netdowns are applied in the model or yield curves and are not reflected in the GIS dataset areas.

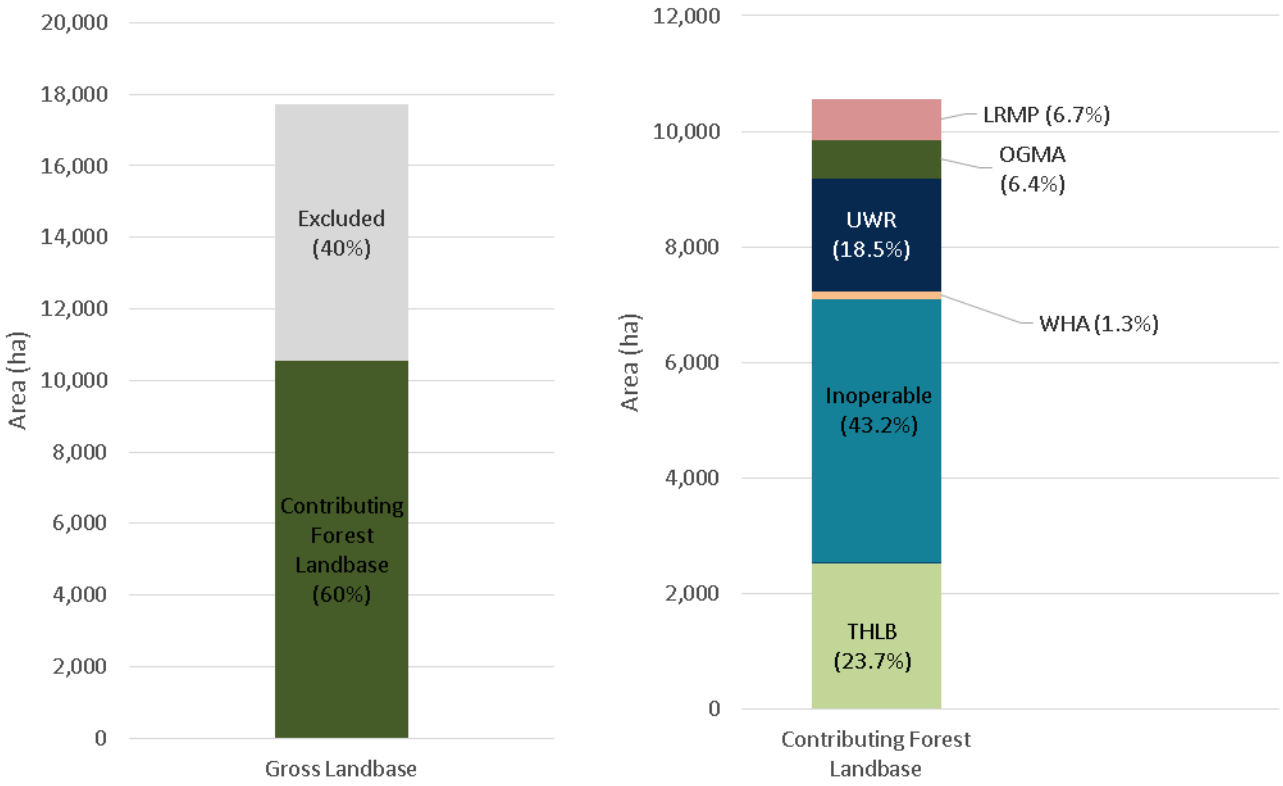


Figure 2 Graphical Representation of Landbase Breakdown

In Figure 3 the landbase is broken down between excluded (grey), forested non-THLB (dark green), and THLB (Light green).

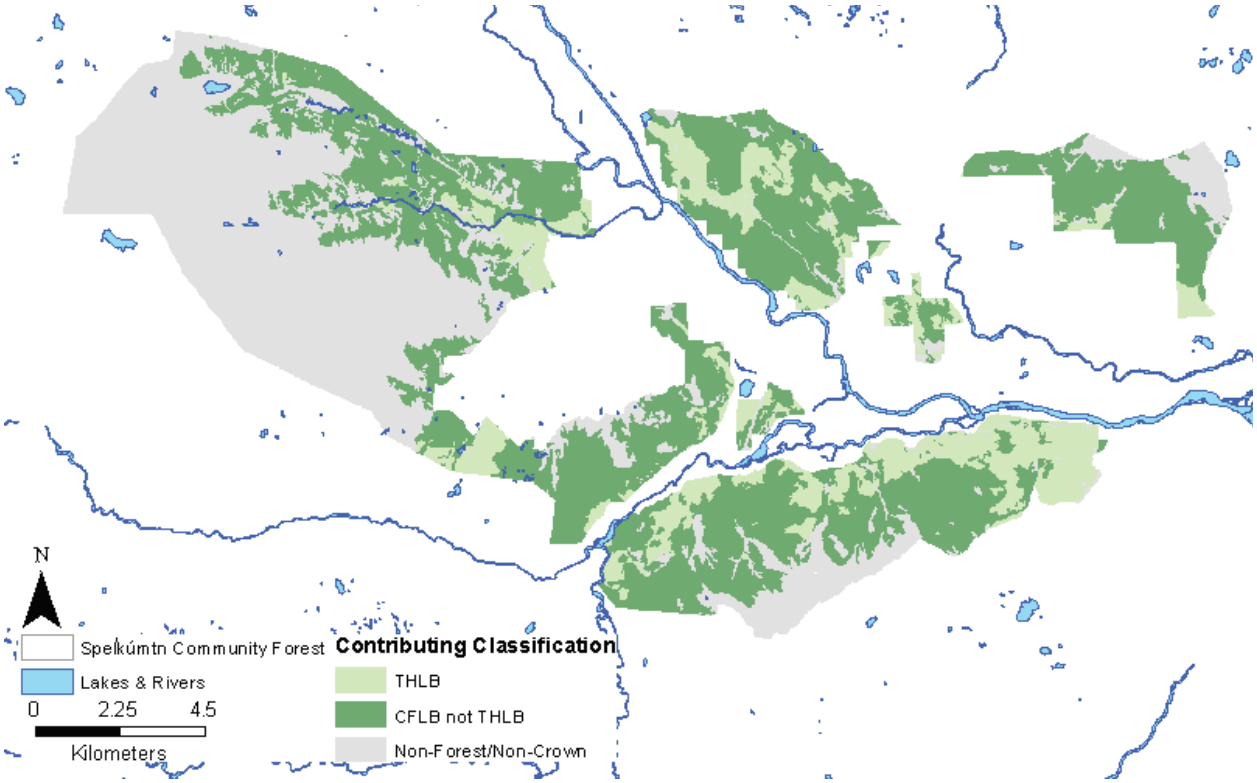


Figure 3 Landbase classification map.

2.3 Exclusions from contributing forest

Exclusions are removed from the analysis and do not contribute to timber harvesting or non-timber constraints.

2.3.1 Non-Vegetated / Non-Forested

The BCLCS land classifications system was used to define Non-vegetated and non-forested areas. Forest is defined as polygons classified as treed vegetation on wetlands or uplands with a site index of 5 or greater. In addition, any polygons with a previous harvesting history are considered to be forested regardless of the BCLCS classification.

2.3.2 Utility Right of Ways

Right-of ways for Transmission lines, electric power lines, and water power lines are all spatially removed from the landbase. These rights of way were identified using the Tantalus data, and cross referenced with spot imagery. There are 23 hectares of right of ways in the CFA, of which 14 hectares are effectively removed from the landbase.

2.3.3 Existing Roads

Existing roads come from the BC road atlas and FTEN Road Segments. They are buffered based on road class and road description. Main roads are buffered by 26 metres (13 metres each side of a linear feature, and smaller operational roads are buffered to a 10 metre width (5m each side of the linear feature). There are 77 hectares of buffered roads within the CFA, of which 67 hectares are effectively removed from the landbase.

2.4 Reductions from THLB

Forested lands that are removed from the THLB can still contribute to non-timber objectives (e.g., VQO, Green-up, Wildlife habitat).

2.4.1 LRMP Objectives

The Sea to Sky LRMP was adopted in 2008. Within the LRMP there are spatial reductions for Spirited Grounds. These areas are described in this sub section. Non-timber management associated with the LRMP is discussed in sub-section 3.1.

Spirited Grounds

Category A spirited grounds Areas were removed from the THLB. Table 4 shows the gross areas of each of the spirited areas, and wildland zones within the CFA.

Table 4 Category A spirited grounds to be removed from THLB.

Spirited Area	Area (ha)
Grandfather Mountain spirited ground area	1
North Millar spirited ground area	18
Total	19

In total 19 hectares of spirited grounds are within the CFA boundary. Spirited grounds are responsible for 14 hectares being removed from the THLB.

Wildland Zones

The wildland zones are defined in the LRMP and they are to be removed from harvest. Table 5 describes the zones that overlap the CFA.

Table 5 Wildland Zones for Cultural, Recreation, Tourism, and Wildlife.

Type	Name	Area
Recreation	Rutherford Headwaters	5,910
Total		5,915

2.4.2 Old Growth Management Areas (OGMAs)

All of the landscape units within the CFA have approved OGMAs. These will be used to satisfy old seral requirements and were removed from the THLB. There are 772 hectares of approved OGMAs across five landscape units. 674 hectares are effectively removed due to OGMAS.

Table 6 OGMA gross area by LU.

LU	Area (ha)
Billygoat	48
Birkenhead	113
Railroad	106
Ryan	267
Soo	237
Total	772

2.4.3 Wildlife Habitat Areas (WHAs)

Designated WHAs for Long Term Owl Habitat (LTOH) and grizzly bear habitat have been delineated and were removed from the THLB. LTOH covers a gross area of 42 hectares while effectively removing 27 ha, and the Grizzly habitat covers 632 hectares and removed 107 from the THLB.

Areas within the Spotted Owl MFHA have a requirement of leaving 40 stems per hectare of the largest 80 stems per hectare. This will be emulated in the model by implementing a constraint to reserve an additional 20% aspatial retention for blocks within these polygons. Within the CFA this will effectively remove 78 hectares.

2.4.4 Ungulate Winter Ranges (UWRs)

Two UWR orders cover the area, including u-2-002 for Goat Winter Range, and u-200-5 for Moose Core Winter Range and Retention Deer Winter Range. All of these areas were removed from the THLB.

2.4.5 Parks and Conservancies

The boundaries for the CFA have been carefully delineated around any parks and conservancies in the area. No further reductions were required.

2.4.6 Operability Restrictions

Steep Slopes

FLNRO developed an operability layer for TSRII and improved it for TSR3. This layer distinguishes between conventional logging, (cable, grapple, yarder), helicopter logging, and inoperable areas. Inoperable areas were removed from the THLB except for areas where previous harvest has occurred. This resulted in 12,380 hectares being removed from the THLB due to inoperable conditions.

The helicopter and conventional classifications are used when assigning growing potential based on minimum volume requirements (section 2.4.7).

Table 7 Operability classifications within the CFA.

Operability	Area (ha)
Conventional	4,170
Helicopter	1,190
Inoperable	**12,380**

Unstable Soils /Environmentally Sensitive Areas

Terrain stability mapping has only been completed within the Pemberton Community Watershed. The class U and V polygons are outside the CFA.

In the remainder of the area, the Environmentally Sensitive area mapping from FLNRO was used. Any polygons that have been labelled as ESA_1 (identified sensitive) for soils, snow, regeneration, or recreation were fully removed from the THLB. The gross area classified as ESA is 2,687 ha with 189 ha removed for this reason.

Table 8 Environmentally sensitive classifications

ESA Category	Area (ha)
Regeneration	1,110
Recreation	74
Soils	1,503
Total	2,687

2.4.7 Low Timber Growing Potential

Stands with low timber growing potential were removed from the THLB based on achieving a minimum volume at a cut off age, depending on harvesting method and species as outlined in Table 9. If the stand is currently older than the cut off age and exceeds the required volume, then it is still considered merchantable. In addition to these requirements, pine stands must have a managed site index of greater than or equal to 20 metres.

Table 9 Minimum Requirements for Growing Potential.

Leading Species	Age Cut off	Projected/Current Volume Conventional	Projected Volume Requirements Heli
Fir	140	350 m^3/ha	400 m^3/ha
Cedar	140	350 m^3/ha	400 m^3/ha
Hemlock/Balsam	140	350 m^3/ha	400 m^3/ha
Spruce	140	300 m^3/ha	400 m^3/ha
Pine	140	300 m^3/ha	350 m^3/ha

2.4.8 Non-merchantable forest types

Ponderosa pine, larch, alder, birch, cotton wood and maple were removed from the THLB. Although 1,374 hectares of these non-merchantable forest types were identified, all of these types were removed for other netdown reasons resulting in an effective netdown area of zero.

2.4.9 Riparian

Freshwater Atlas Rivers, Lakes, and Wetlands were obtained from DataBC. The large rivers were identified and classified from field experience. The buffers were defined using the Forest Practices and Planning Regulation (FPPR) management requirements listed in Table 10. The FPPR states that 20% of the management zone must be maintained. Therefore, the area buffered was calculated by summing the riparian reserve zone and 20% of the riparian management zone.

In accordance with the Pemberton community watershed Integrated Water Management Plan, Pemberton creek has a 100m buffer applied to it. All other streams were then buffered by 5m each side. The proportion of the small streams that cover the THLB was then applied as an aspatial reduction of 2% from each THLB polygon.

Lakes and wetlands were classified by size and a buffer applied spatially on the landbase. Lillooet Lake has a special buffer discussed in section 3.1.

Table 10 Riparian Buffers Applied

Riparian Class	Size	Description	Buffer Width(m)			
			Riparian Management Area (m)	Riparian Reserve Zone (m)	Riparian Management Zone (m)	Effective Riparian Buffer (m)
Streams	S1 – B	Fish Bearing & > 20m Wide	70	50	20	54
	S2	Fish Bearing & 5m to 20m wide	50	30	20	34
	S3	Fish Bearing & 1.5m to 5m wide	40	20	20	44
	Small	All other Fresh water atlas	10 m(5m each side) Applied aspatially in modelling			
Lakes and Wetlands	Large	Area ≥ 5ha				20 m
	Medium	Area ≥1ha <5ha				15 m
	Small	Area <1ha				20m

2.4.10 WTRAs and in-block Retention

Seven landscape units have legal objectives defined for the amount of wildlife tree retention required (Table 11). These will be modelled as an aspatial THLB reduction.

Table 11 Landscape Unit/BEC sub zone combinations covered by a legal order for WTRA percents.

Landscape Unit	Bec sub zone	Percent WTRA
Billygoat	IDF ww	12
	CWH ds	7
	CWH ms	2
	MH mm	0
Birkenhead	IDf ww	5
	CWH ds	4
	CWH ms	3
	MH mm	2
	ESSF mw	0
Railroad	CWH ds	8
	IDf ww	8
	ESSF mw	0
	MH mm	0
	CWH ms	6
Ryan	CWH ds	10
	CWH ms	8
	MH mm	0
Soo	CWH ds	8
	CWH ms	7
	MH mm	3

2.4.11 Isolated stands

After all the THLB was identified, stands that are less than half a hectare, and further than 100m from other THLB or a current road were removed as an isolated stand.

2.4.12 Future Roads, Trails and Landings

In this analysis, the future road reduction is determined to be 2% of the area harvested that is further than 300m from an existing road, using the equation below:

$$\%\ of\ THLB\ as\ Future\ Road = \frac{(\text{Area of THLB} > 300\text{m from road}) * 0.02}{Area\ of\ THLB}$$

$$\frac{(728) * 0.02}{2{,}289} = (0.6\%)$$

This percentage is applied in the model as a yield reduction for all future managed stands following harvest of existing natural stands.

2.5 Landbase Characteristics

The proposed tenure covers six biogeoclimatic (BEC) zones, including the MH, CWH, ESSF, IDF, CMA, and IMA (Figure 4). CMA and IMA are alpine zones with no productive timber, but polygons within these zones with a site index greater than five are assumed to be forested and are capable of contributing to non-timber forest requirements. The area also covers four natural disturbance types (NDT). These zones and disturbance types drive natural disturbance and productivity on the landbase.

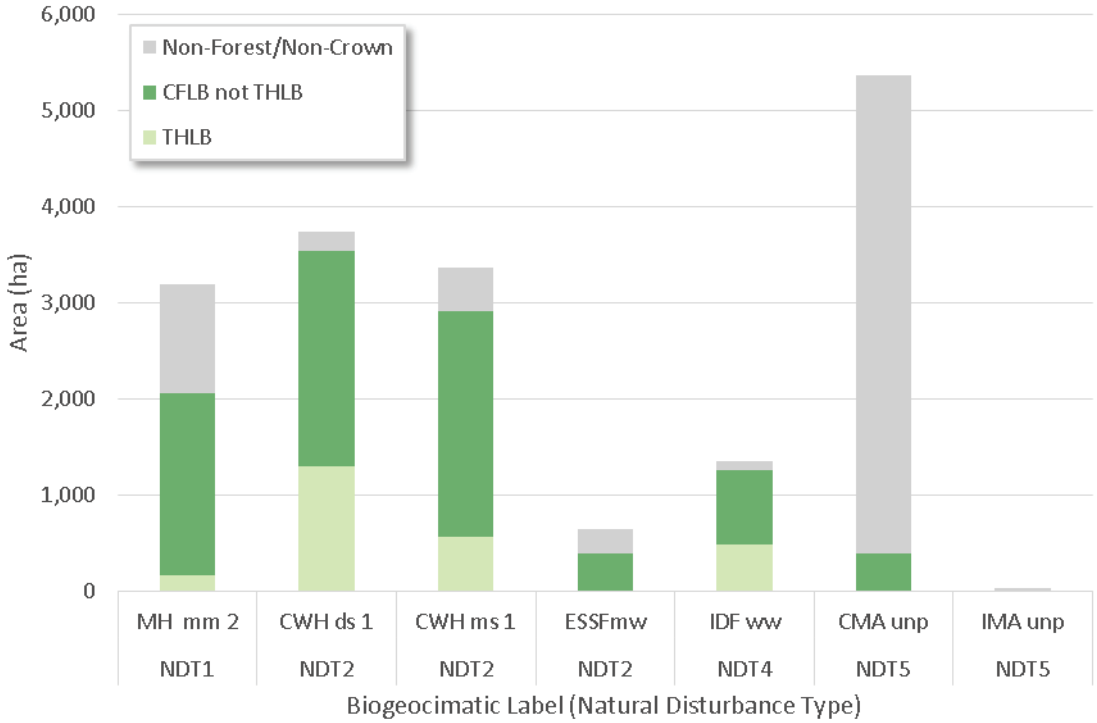
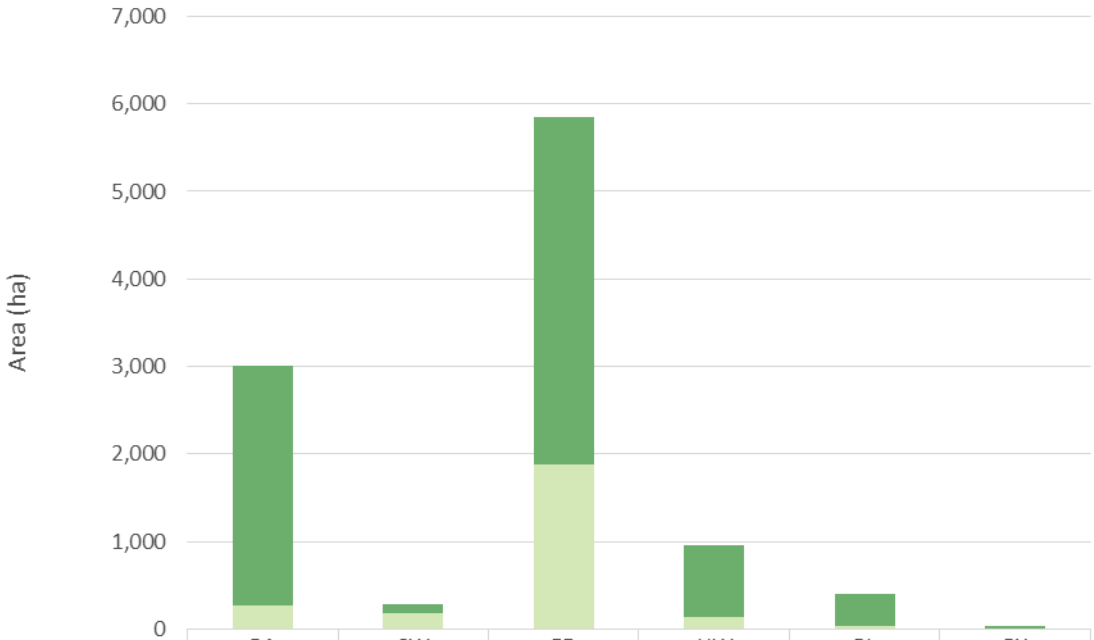


Figure 4 BEC sub zone and NDT distribution on the CFA

The forested area of the CFA is mostly covered with Douglas-fir and Amabilis Fir leading stands. Additionally there is cedar, hemlock, pine, deciduous, and spruce leading stands (Figure 5).



	BA	CW	FD	HW	PL	PY
CFLB not THLB	2,743	108	3,974	821	365	35
THLB	271	182	1,881	139	35	

Figure 5 Area by leading species on the CFLB.

The age class distribution of the THLB on the landbase indicates a very young land base (Figure 6). Approximately 1,300 hectares are less than 50 years old. However, much of the NHLB is older than 160 years.

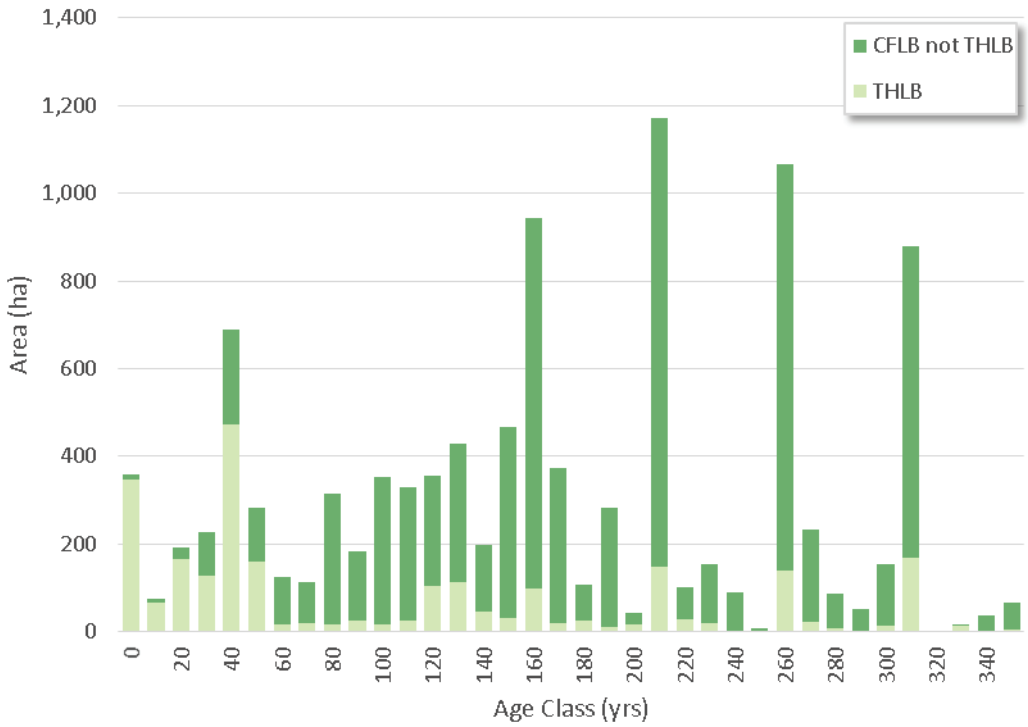


Figure 6 Ten year age class distribution on the CFLB

Site index (SI) is used to define the productivity of a stand. Site index is the height that the best trees on the site will be at 50 years breast height age. There are two SIs, inventory (Figure 7) and managed (Figure 8). Inventory SI comes from the VRI inventory. Managed site index was taken from the SOO TSR resultant. The TSR did a site index adjustment based on work done by timberline in 2008. Instead of replicating this work, each of our resultant polygons was overlayed with the TSR resultant polygons. A weighted average for each THLB polygon was calculated and then assigned as the managed site index. The resulting weighted average site index was 23.7 m.

Managed site index is often higher than the inventory site index. On the CFA, the weighted average is 3.4 metres taller (20.3m inventory SI versus 23.7m managed SI). Site index is discussed further in section 5.5.

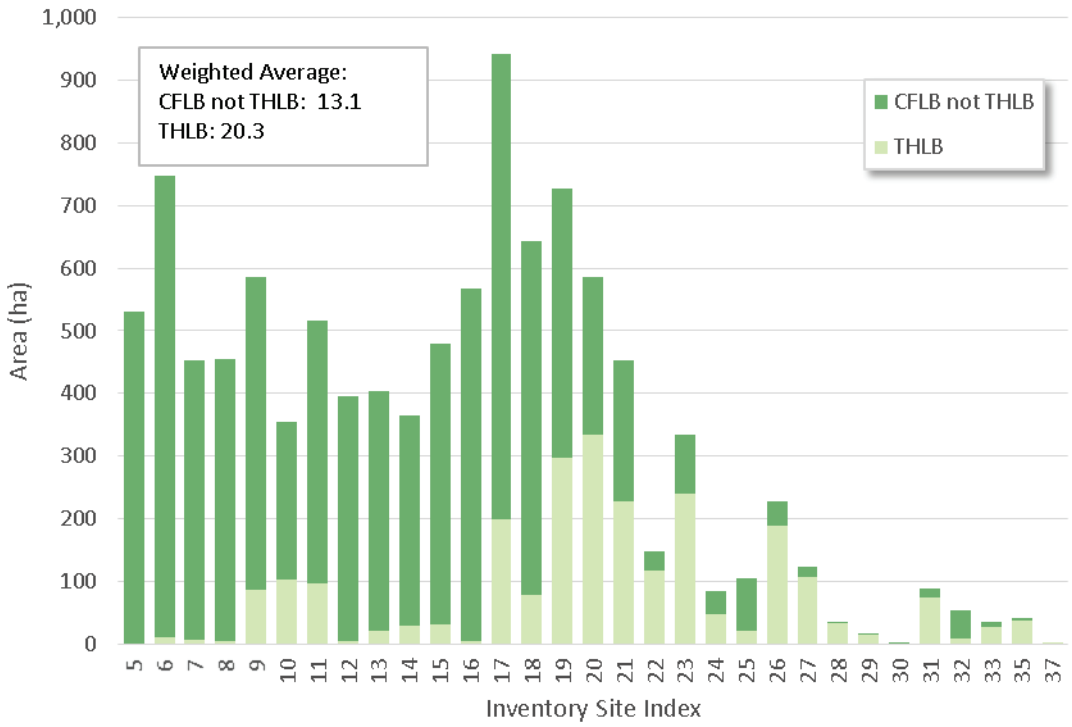


Figure 7 Inventory Site Index

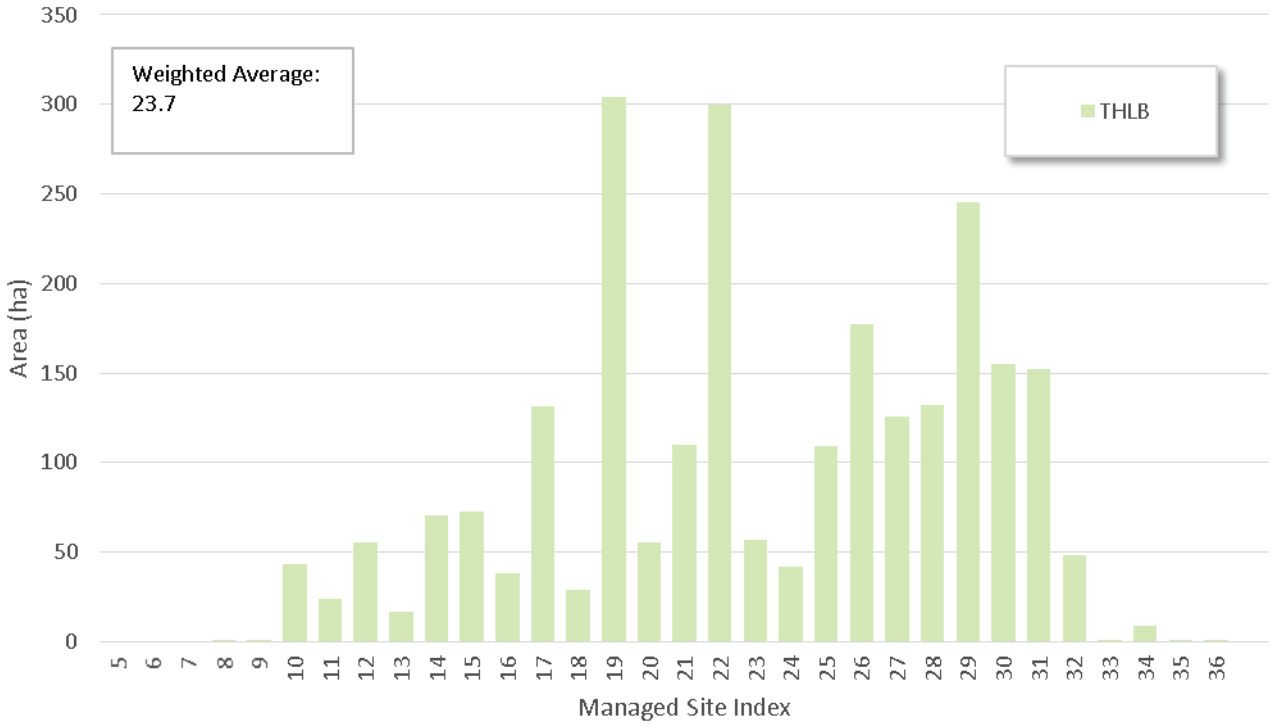


Figure 8 Managed Site index on the THLB from TSR3 site index adjustment.

3 Non-Timber Management Assumptions

Non-timber management assumptions are targets on the landbase that require a certain percentage to meet a certain criteria. An example might be 10% must be in an old seral state, or no greater than 5% may be less than five metres tall. Often these constraints are applied at a spatial level using BEC Zone or LU, stating that these constraints must be applied within each LU, or within a certain watershed.

3.1 LRMP Objectives

Floodplain Management Areas/ Riparian Management

The constraints described in Table 12 are constraints for the LRMP objectives for floodplain management areas. Within the the floodplain management areas less than 20% will be less than 60 years old.

Table 12 Floodplain and Riparian management for the LRMP

Location	Management
Lower Green River Floodplain	➢ <20% wil be less than 60 yrs

3.2 Ungulate Winter Ranges (UWRs)

UWR order u-2-005 has two management constraints. First, Deer Rotation Winter Range has two requirements defined as allowing a maximum of 20% of area to be less than 20 years in age, and a minimum of 20% of the area must be older than 100 years. Second, a Moose Forage Management Zone has a constraint at an operational scale and will not be modelled.

3.3 Community Watersheds

There are two community watersheds within the CFA (Table 13). They were treated the same as they were in TSR, and were modelled by ensuring that no more than 5% of the forested area can be less than five metres tall.

Table 13 Community watersheds

Community Watershed	CFLB (ha)
Pemberton Creek	205
Peq Creek	229
Total	434

3.4 Visual Quality Objectives

VQO Polygons within the CFA area will were modelled by using Plan to Perspective (P2P) ratios and Visually Effective Green-up (VEG) heights for 5% slope class increments to determine the maximum percent alterations. The P2P ratios and VEG heights assessed by slope class, as well as the allowable VQO percent alterations are detailed in Table 14 and Table 15, respectively. Raster cells (20x20m) were assigned slope classes, and the P2P ratio was calculated by weighting the number of raster cells (i.e. slope class) per VQO polygon in the CFLB.

$$\text{Eg: P2P} = \frac{(\#\text{cells in } 0\text{–}5)*4.68 + (\#\text{cells in } 5\text{–}10)*4.23 + \ldots}{total\ \#\ of\ Cells}$$

Table 14 P2P Ratios and VEG Heights by Slope Class

	Modified Visual Unit Slope Classes for P2P Ratios and VEG Heights														
Slope %	0-5	5.1-10	10.1-15	15.1 -20	20.1 -25	25.1 -30	30.1 -35	35.1 -40	40.1 -45	45.1 -50	50.1 -55	55.1 -60	60.1 -65	65.1 -70	70+
P2P Ratio	4.68	4.23	3.77	3.41	3.04	2.75	2.45	2.22	1.98	1.79	1.6	1.45	1.29	1.17	1.04
VEG Height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.5	8.0	8.5	8.5	8.5

Table 15 VQO by Percent Alterations

VQO	Permissible % Alteration in Perspective View	Proposed % Alteration in Perspective View
Preservation	0	0
Retention	0 – 1.5	0.8
Partial Retention	1.6 – 7.0	4.3
Modification	7.1 – 18.0	12.6
Maximum Modification	18.1 – 30.0	24.1

The percent denudation applied to each Visual Landscape Inventory polygon in the model is calculated as the weighted P2P ratio by slope class multiplied by the proposed percent alteration in perspective view for the polygon. The resulting percent denudation value is then applied as a constraint on the maximum proportion of the polygon that can be below the VEG height at any given time.

The next step is to determine age when the VEG height is achieved for each of the Visual Landscape Inventory polygons. For this purpose, the area weighted site index (i.e., top height in m at age 50) and most prevalent species within each Visual Landscape Inventory polygon are determined based on the proportion of predicted future stands. Once the existing stand is harvested and regenerated, it is possible to estimate the age at which the regenerated stand reaches the previously-determined VEG height. The area-weighted average site index is determined from the provincial site productivity layer, while the prevalent species is determined as the leading species with the highest area in each Visual Landscape Inventory polygon. Then, the site index and species are entered in Site Tools (v.4.1 beta) to determine the age where VEG height is reached. Note that deciduous stands are all considered to be dominated by trembling aspen and Visual Landscape Inventory polygons with no site index estimates are assumed to have the area-weighted site index average for the entire land-base.

The calculations for all of the VQO polygons with THLB are listed in Appendix I. To address visuals across the landbase there is a further target set of patches of trees less than 3m not exceeding 40 hectares.

3.5 Prescribed Wildlife Tree Patches & Stand-Level Biodiversity

Existing reserves have been identified using the RESULTS reserve layer. Each wildlife tree patch is to be locked from harvest eligibility for 59 years from the WTP established date.

3.6 Timber licenses

Portions of Timber licenses that have not reverted back to the crown will initially be unavailable for harvest. Once the model harvests them (the harvested volume will not contribute to the yield), they will then be available for harvest within the Lil'wat tenure for the following rotations. The harvest of the TL stands will be targeted to be completed in the first decade.

4 Harvesting Assumptions

This section describes the criteria and considerations used to model timber harvesting activities.

4.1 Utilization

Utilization standards used to determine merchantable volumes for this analysis are shown in Table 16.

Table 16 Utilization Standards

Leading Species	Minimum Diameter at Breast Height (DBH) cm	Maximum Stump Height (cm)	Minimum Top Diameter (cm)
Pine	12.5	30.0	10.0
Other ≤ 120 yrs	12.5	30.0	10.0
Other > 120 yrs	17.5	30.0	10.0

Non-merchantable species are also removed from the yield curves. This includes all deciduous, ponderosa pine, larch and yew volume.

4.2 Minimum Harvest Criteria

In order for a stand to be considered economic and eligible for harvest within the model it must meet the minimum volume per hectare (MVH) criteria based on leading species and Harvest Method.

Table 17 Minimum harvestable volume criteria for existing and managed stands

Leading Species	Conventional Landbase	Helicopter landbase
Pine	300 m³/ha	350 m³/ha
Cedar/Spruce	300 m³/ha	400 m³/ha
All Other	350 m³/ha	400 m³/ha

4.3 Silvicultural Systems

The dominant silviculture system used in the tenures is clearcut with reserves (WTPs, riparian reserves, etc.) and this is how treatments will be recognized in the model.

5 Growth and Yield Assumptions

5.1 Analysis Unit Characteristics

Often natural stands are stratified into analysis units to produce weighted average yield curves for modelling. However in this analysis a yield curve was generated for each individual VRI polygon.

In contrast, the yield curves (both existing and future) for managed stands were generated by stratifying the VRI into analysis units based on leading species and managed site productivity class. Table 18 shows a summary of the analysis units for future managed yield curves.

Table 18 Analysis Unit Stratification Characteristics

AU Name	Leading Species	Site index Range (managed Site Index)
1.F-VG	Douglas-Fir	≥30
2.F-G	Douglas Fir	26-29.9
3.F-M	Douglas Fir	20.0 to 25.9
4.F-P	Douglas Fir	<20
5.CS-GM	Cedar/Spruce	≥ 20
6.CS-P	Cedar/Spruce	<20
7.HB-G	Hemlock/Balsam	≥25
8.HB-M	Hemlock/Balsam	20.0 to 24.9
9.HB-P	Hemlock/Balsam	<20
10. P-A	Pine	≥20

5.2 Stand Projection Models

Yield curves developed for existing natural stands were prepared using the Variable Density Yield Prediction (VDYP) 7 for each forest cover polygon. Existing and future managed stand yield curves for each AU were generated using the Table Interpolation Program for Stand Yields (TIPSY) 4.3. All non-merchantable species (Ponderosa pine, larch, alder, birch, cotton wood and maple) were removed from the yields.

5.3 Decay, Waste, and Breakage

For natural stands, reductions to stand volume for decay, waste and breakage factors were set to the default provincial stand loss factors. These factors were applied in the development of the VDYP7 yield curves.

For managed stands, operational adjustment factors (OAF) are utilized in the TIPSY model. An OAF1 of 15% was applied, while OAF2 increases from 0% to 5% by the time the stands reach 100 years of age.

5.4 Managed and Natural Stand Definitions

To project stand growth and yield, stands are classified as natural or managed stands based on their year of establishment and leading species. Natural stands are all current stands other than Fir Leading stands established pre-1973. Natural stand yields are generated using VDYP. Managed stands are considered to be stands all stands except fir leading stands established 1973 and later.

In TSR an analysis was done of existing stands, and fir stands established after 1973 had undergone stand tending and reflected managed stand practices. Stands with other leading species generally had high stem counts and were more represented by a natural yield curve.

Stands that are disturbed through harvesting regenerate to a managed stand, whereas stands that are disturbed by a natural agent and not salvaged regenerate to a natural stand.

5.5 Site Index Assignments

Site index reflects the potential productive capacity of a stand. The inventory site index was used as the site productivity input to develop yield curves for existing natural stands while the managed site index was used for existing managed and future managed stands.

For this analysis, an area-weighted average site index for managed stands was calculated for each leading species type using site indices sourced from the Provincial Site Productivity Layer estimates.

5.6 Regeneration

Regeneration assumptions (TISPY inputs) for existing and future managed stands are summarized in Table 19. No stands are assumed to have genetic gains.

These curves will be developed in a multi-part process.

1. Run the planted portion using the inputs, with the total stems per hectare (Natural +Managed), as the SPH for TIPSY.
2. Run the natural portion using the inputs, with the total stems per hectare (Natural +Managed), as the SPH for TIPSY.
3. Create weighted average yield curves using the number of stems of each type.

Table 19 Regeneration Assumptions for Existing and Future Managed Stands

AU Name	Planted Information					Natural Ingress Information		
	Composition	Stems per hectare	Regen Delay (yrs)	OAFs 1	OAFs 2	Composition	Stems per Hectare	Weighted Avg. SI_{50}
1.F-VG	Fdc80 Cw20	1200	1	15	5	Hw80 Cw20	250	33.01
2.F-G	Fdc80 Cw20	1200	1	15	5	Hw80 Cw20	250	27.42
3.F-M	Fdc80 Cw20	1000	1	15	5	Hw80 Cw20	216	22.63
4.F-P	Fdc86 Cw14	1000	1	15	5	Hw50 Fdc30 Cw20	866	17.32
5.CS-GM	Cw50 Sx21 Fdc20 Ba9	600	1	15	5	Cw50 Hw30 Ba20	1200	22.47
6.CS-P	Sx84 Cw7 Yc5 Fdc4	600	1	15	5	Ba40 Sx40 Cw10 Hw10	1913	15.4
7.HB-G	Sx25 Cw23 Fdc20 Ba20 Yc12	350	1	15	5	Fdc30 Ba25 Cw20 Hw20 Yc5	2707	26.37
8.HB-M	Sx25 Cw23 Fdc20 Ba20 Yc12	400	1	15	5	Ba30 Hw25 Fdc25 Cw15 Yc5	1938	22
9.HB-P	Sx25 Cw23 Fdc20 Ba20	600	2	15	5	Fdc30 Cw15 Ba30 Hw20 Yc5	2936	15.99
10. P-A	Fdc40 Cw25 Plc20 Sx15	800	1	15	5	Hw30 Fdc20 Cw20 Ba10 Plc5	1000	18.7

6 Natural Disturbance Assumptions

Disturbances within the THLB are modeled as unsalvaged, or non-recoverable losses (NRL). This analysis adopted the NRL used for the Soo TSA TSR3, which were pro-rated to each tenure's THLB area.

The Soo TSR THLB is approximately 98,000 hectares, and the CFA spatial THLB is 2,508 hectares, or 2.6% of the Soo. This indicates that the NRLs will be 2.6% of those used in the Soo TSR, which gives an annual NRL of 884 m^3/year (Table 20). Harvest flows from the model will be reduced by this amount.

Table 20 Unsalvaged Losses on the THLB

Cause of Loss	TSR	CFA
Fires	30 000 m^3/yr	780
Insects	4000 m^3/yr	104
Total	34 000 m^3/yr	884

7 Modelling Assumptions

7.1 Patchworks™ Model Description

For forecasting and analysis, the PATCHWORKS™ modeling software was used. This suite of tools is sold / maintained by Spatial Planning Systems Inc. of Deep River, Ontario (www.spatial.ca).

Patchworks is a fully spatial forest estate model that can incorporate real world operational considerations into a strategic planning framework. It is unique in its ability to dynamically assess spatial relationships during modeling and adapt solutions to achieve spatial objectives. 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 applied to 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, CWD levels, ECA's, specific mill volumes by species, road building/hauling costs, delivered wood costs, net present values, etc. Patchworks continually generates alternative solutions until the user decides a stable solution has been found. Solutions with attributes that fall outside of specified ranges (targets) are penalized and the goal seeking algorithm works to minimize these penalties – resulting in a solution that reflects the user's objectives and priorities.

Patchworks' flexible interactive approach is unique in several respects:

- Patchworks' interface allows for highly interactive analysis of trade-offs between competing sustainability goals.
- Patchworks integrates operational-scale decision-making within a strategic-analysis environment: realistic spatial harvest allocations can be optimized over long-term planning horizons. Patchworks can simultaneously evaluate forest operations and log transportation problems using a multiple-product to multiple-destination formulation. The model can identify in precise detail how wood will flow to mills over a complex set of road construction and transportation alternatives.
- Allocation decisions can be made considering one or many objectives simultaneously and objectives can be weighted for importance relative to each other. (softer vs. harder constraints)

- Allocation decisions can include choices between stand treatment types (Clearcut vs. partial cut, fertilization, rehabilitation, etc.).
- Unlimited capacity to represent a problem – only solution times limit model size.
- Fully customizable reporting on economic, social, and environmental conditions over time. Reports are built web-ready for easy sharing of analysis results – even comparisons of multiple indicators across multiple scenarios.

7.2 Modeling assumptions

Table 21 Model Assumptions

Criteria	Factor Applied
Blocking	Polygons were grouped into blocks using the built-in patchworks blocking tool (group fragments). Multi-part blocks were created with a target block size of 15 ha. A 20 m distance threshold was used meaning that polygons up to 20 m apart could be considered part of the same block. Blocks were stratified on the following attributes: Analysis Units, and Contributing Classification (i.e. THLB vs NHLB) and were not allowed to contain polygons with more than a 5 year age gap.
Target Block Size	A target block size of 15 ha was used. The blocking tool will attempt to group polygons into 15 ha blocks as long as they meet the specified stratification criteria.
Minimum Block Size	Efforts were made to minimize the incidence of very small blocks (Blocks < 0.1 ha). This is not dependant on the patchworks blocking tool but rather through a GIS eliminate process conducted on the input spatial modeling file.
Planning Horizon	A planning horizon of 200 years will be used split into 10 year periods (20periods x 10 years).

7.3 Harvest Priorities and Target Weightings

The concept of harvest priorities (e.g. oldest first) is not relevant in an optimization/heuristic model. However, within Patchworks, it is necessary to weight various targets or objectives relative to each other so that solutions reflect management priorities. In this analysis, the harvest volume target was weighted substantially lower than all other targets to insure that non timber objectives were not sacrificed to deliver volume. Using this approach harvest volume is attractive to the model only when all other issues have been addressed (e.g. old seral objectives). Weights are set to take into account the scale of different units associated with targets (ha vs m^3 vs %'s).

Patchworks generates millions of alternative solutions and ranks them depending on how well they achieve the user's objectives. For this reason the user must decide when to terminate the search for a better solution. A search is terminated when a specific defined criterion for a 'stable' solution has been achieved. This helps ensure that differences between scenario results occur because of model input differences and not from extra effort spent finding a better solution. For the purpose of this project, Patchwork results were accepted once the objective function improved by less than 0.0001% over 300,000 iterations.

Additionally flow constraints were placed on the model so that for the last 100 years, the growing stock is non-declining, and that after the initial surge in volume, the harvest level remains even.

8 Analysis Report

8.1 Long Run Sustainable Yield Calculation

The Long Run Sustainable Yield (LRSY) is theoretically the largest yield that can be harvested from a forest over an indefinite period. It assumes that stands are harvested when they reach their maximum or culmination mean annual increment (CMAI) and that there is an equal amount of area in each age class by AU (i.e. fully regulated forest). It also assumes there are no non-timber constraints applied. For this analysis, it was calculated by determining the maximum Mean Annual Increment of each future managed AU and multiplying the THLB area within each AU.

Table 22 Long Run Sustainable Yield Calculation.

YG	Effective Area (ha)	Total Volume (m^3/yr)	Mean annual Increment (m^3/ha/yr)
1	318	3,758	11.80
2	539	4,483	8.31
3	617	3,427	5.56
4	249	927	3.72
5	141	990	7.05
6	24	84	3.51
7	27	222	8.13
8	112	642	5.72
9	348	1,304	3.74
10	25	102	4.04
Total	2,401	15,939	6.64

8.2 Harvest Volume

The harvest assumption for this run is even flow with minimal variation, and increased short term. This harvest must be capable of being maintained with a flat growing stock in the last 50 years.

The base case harvest flow is presented in Figure 9. All harvest volume numbers are net of non-recoverable loss (884 m^3/ha).

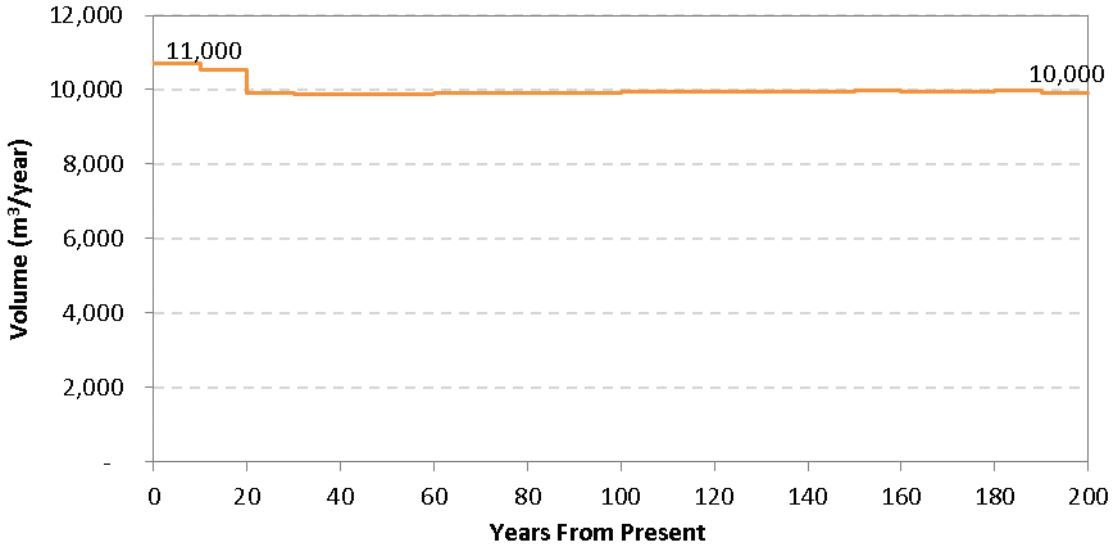


Figure 9 Base case harvest levels

The base case results indicate that an initial harvest flow of 11,000 m³/year is available in the short term and 10,000m³/ha over the rest of the planning horizon.

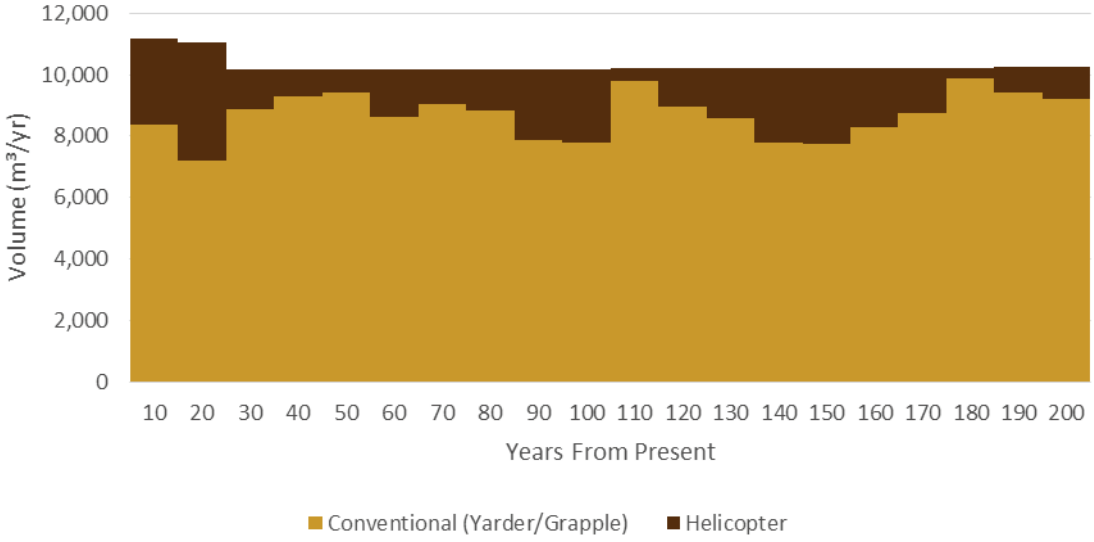


Figure 10 Volume harvested by harvest system.

The landbase was classified for two different logging systems, Conventional (yarder/grapple), and helicopter (Figure 10).The long term harvest flow results in an average of 15% of the volume being harvested from land classified as helicopter access; however, in the short term, this average is much larger at 30% for the first 20 years.

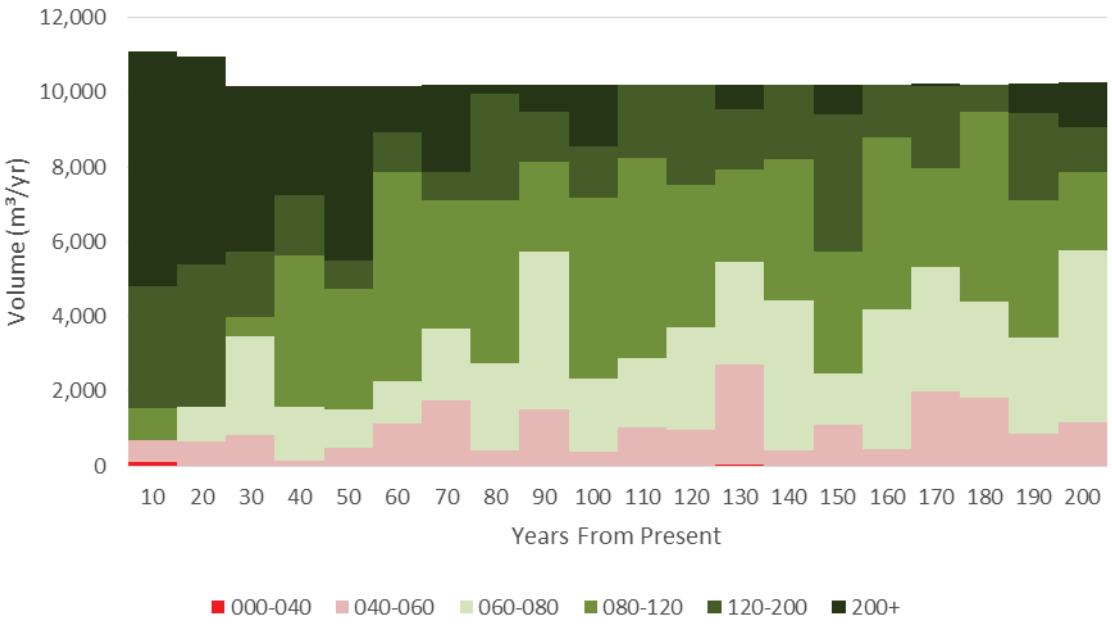


Figure 11 Harvest Stand Age Profile (Volume Harvested).

The age class on the landbase is already quite young, (as can be seen below in Figure 13). Figure 11 shows the age class of the harvested stands. For the first 50 years, there is still approximately 50% of the harvest that comes from stands greater than 200 years, and for the first 20 years 85% comes from stands older than 120 years. At the beginning of the planning horizon, the average harvest age is 215 yrs, and in year 60, it drops to 117 years.

8.3 Growing Stock

The THLB growing stock declines from an initial volume of 765,955 m³ to a low of 687,734 m³ at year 40. It then slowly increases to steady long term growing stock of 683,000 m³ (Figure 12). Over time the proportion of Balsam decreases while the volume of Douglas-fir and Cedar increases. This is due to the composition of the managed stands being heavily cedar and Douglas-fir. This graph also shows the merchantable growing stock over time (starting in the first period). Generally the merchantable growing stock will fluctuate while the age class distribution stabilizes, and over time (longer than this planning horizon) it will even out to a consistent value.

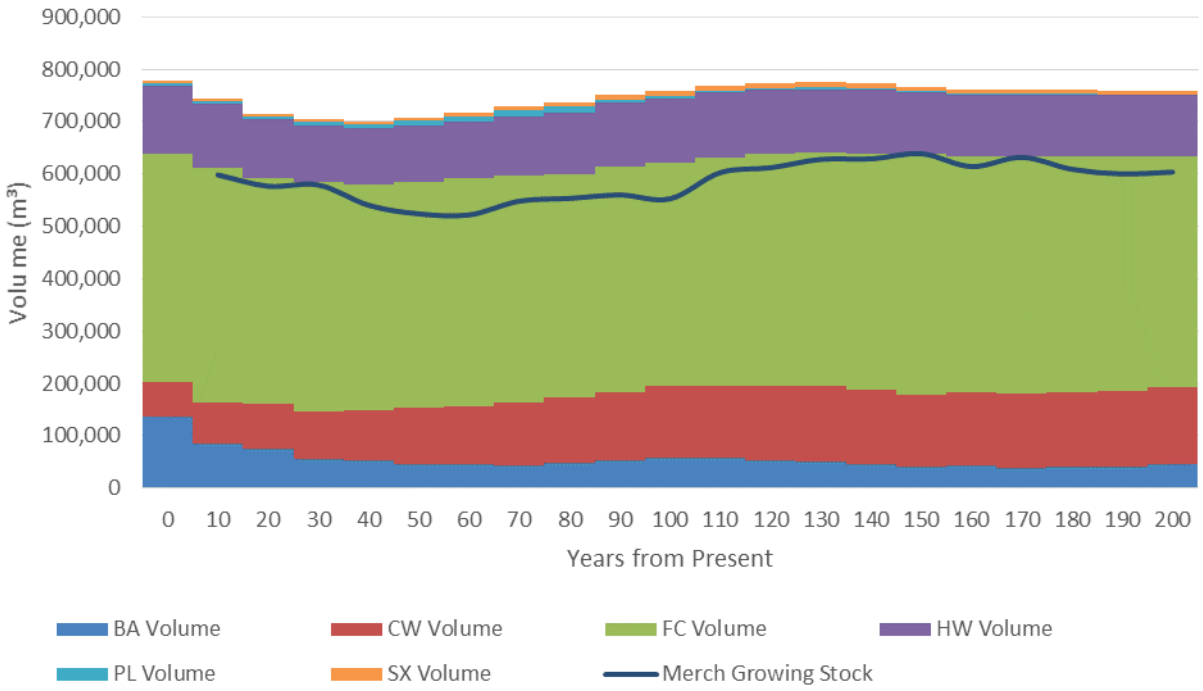


Figure 12 Base Case Growing stock by species.

The timber harvesting landbase is already young. As the landbase converts to managed stands the remaining old in the THLB transitions to younger stands, and the distribution of THLB spans mostly from 0 to 100 years (Figure 13).

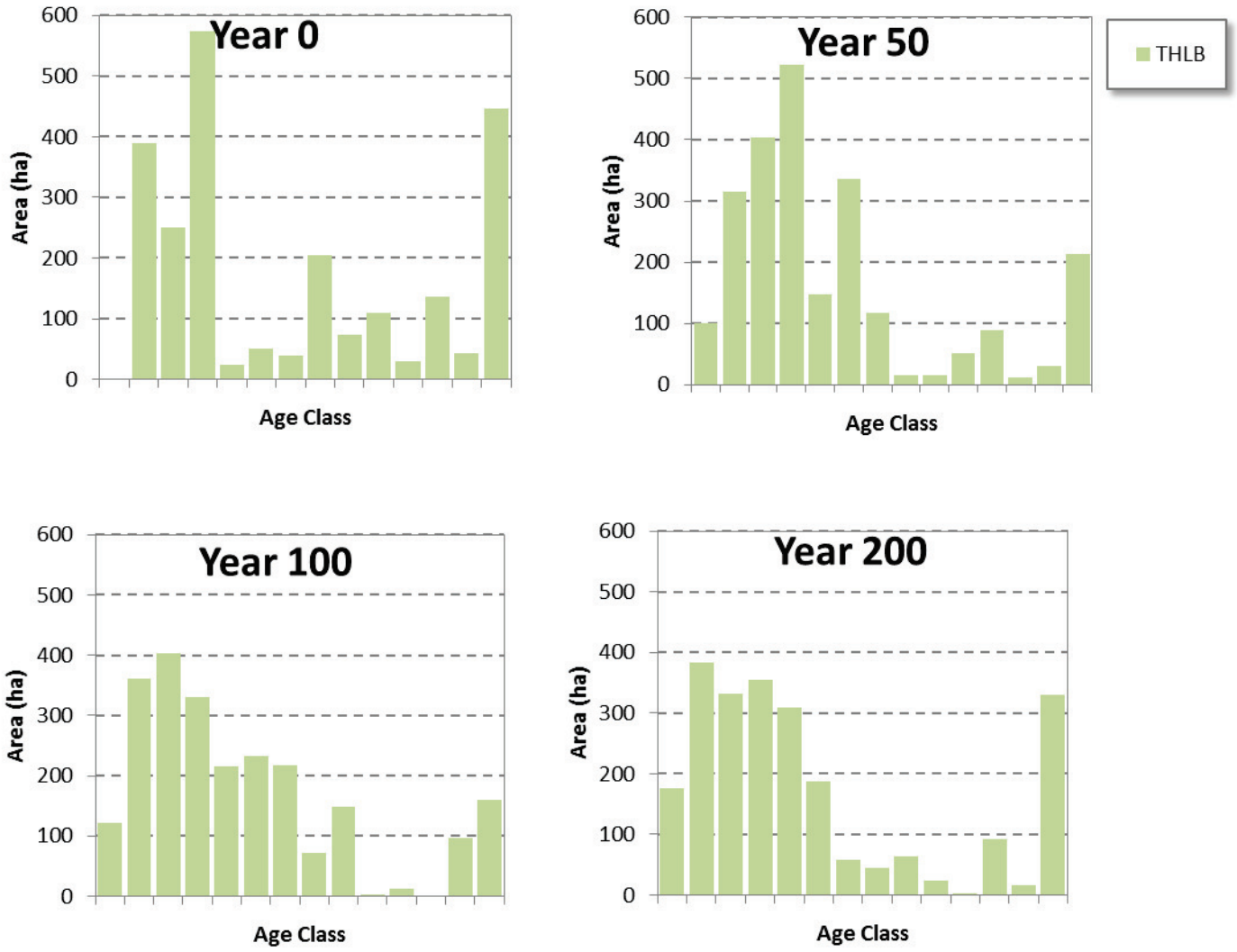


Figure 13 Age class distribution at 0, 50, 100, and 200 years in the future.

8.4 Constraints

The most constraining features on the landbase are the visual landscape inventory Retention and Partial retention polygons. The Modification polygons with the largest THLB contribution are shown in Figure 14[1]. In some periods these polygons come close to the constraints, but they are not continuously constraining.

[1] The percentages in the figures for VQOs are the values for the entire VQO polygon that overlaps the AOI of FNWL CFA, WL1666, and IR 6&7. The VQO's selected here are ordered by largest THLB contribution to the CFA.

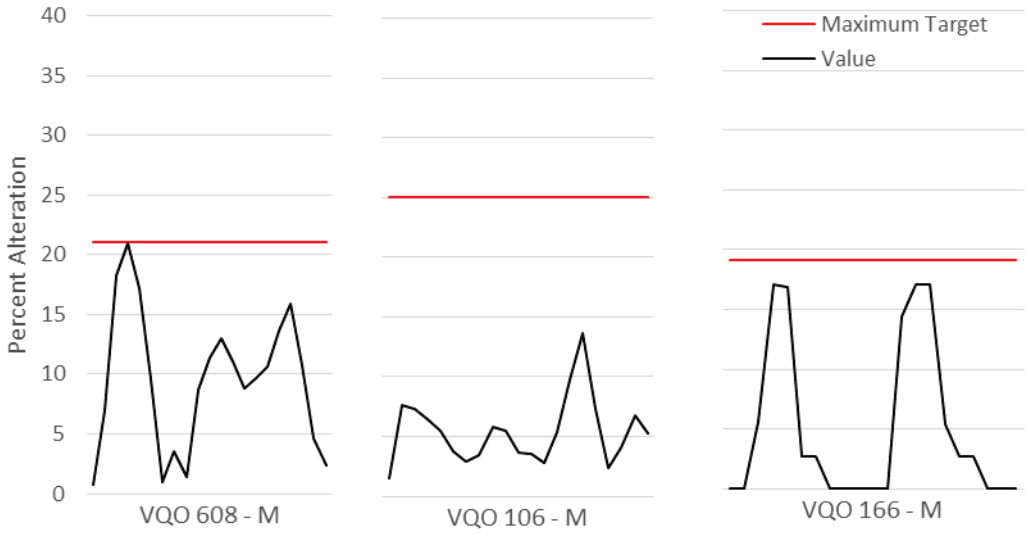


Figure 14 VQO constraints for M - VQO polygons containing the most THLB.

This is not the same for the VQO constraints shown in Figure 15 and Figure 16. These polygons are highly constrained throughout the entire planning horizon.

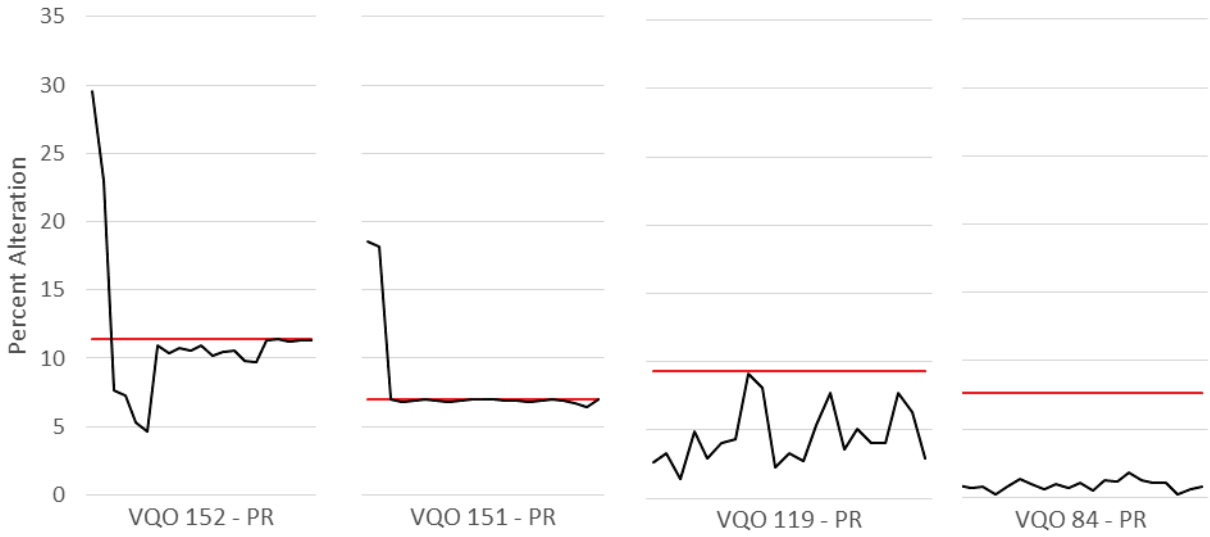


Figure 15 VQO constraints for PR - VQO polygons containing the most THLB

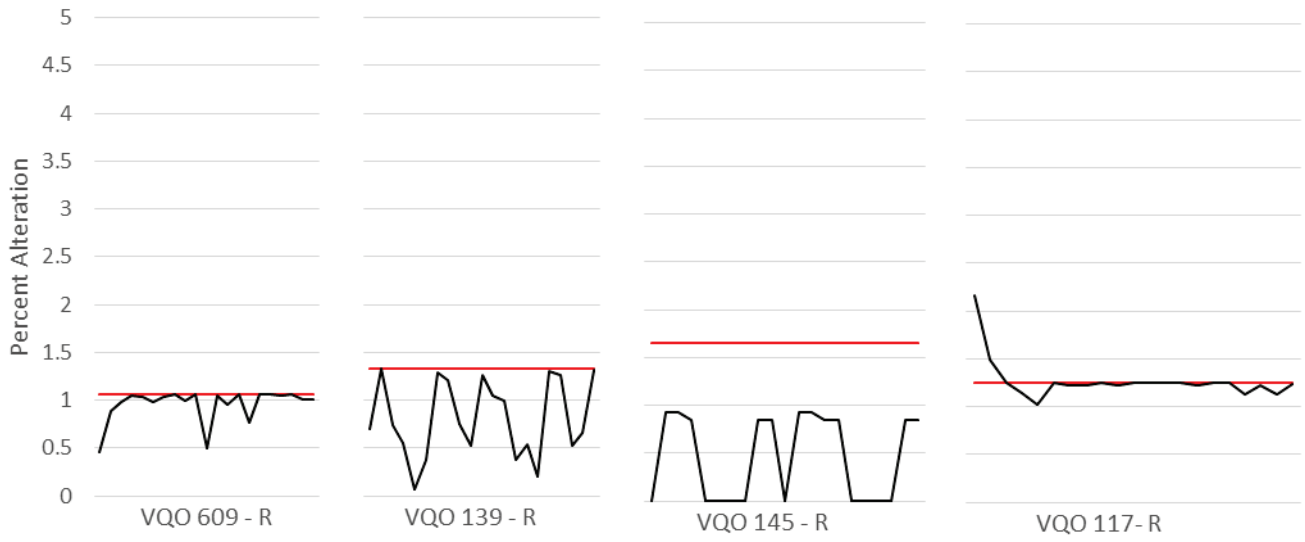


Figure 16 VQO Constraints for R - VQO Polygons (all within CFA)

There are two community watersheds that overlap the CFA, Peq, and Pemberton. A 5% disturbance target is placed on the watersheds. Neither of these watersheds are constraining in the model (Figure 17).

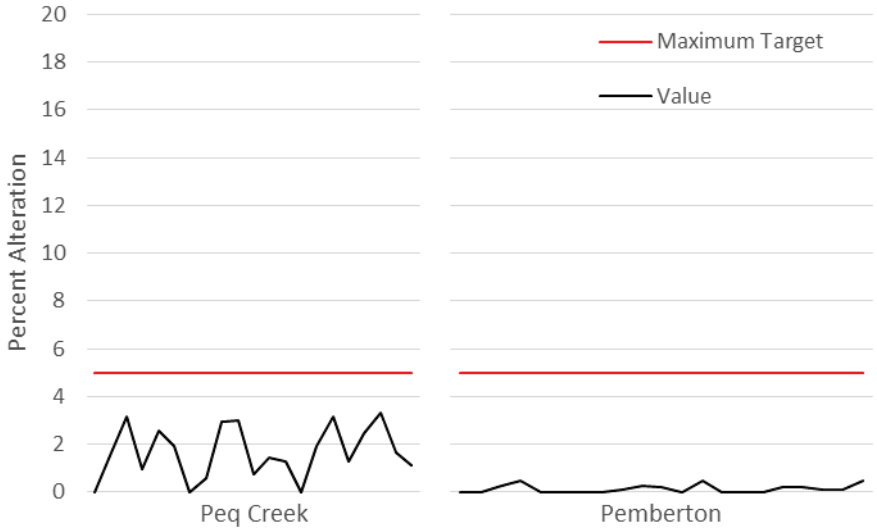


Figure 17 Community watershed Targets and values.

9 Discussion

The base case harvest forecast shows a projected long term cut of 10,000 m³/yr. This value is lower than LRSY because constraints such as the VQOs, the LRMP objectives, and the community watersheds are constraining across the planning horizon.

The Ministry of Forests, Lands, Natural Resource Operations & Rural Development has completed an analysis of this tenure which resulted in a cut of 13,128m³/yr compared to the 10,000 m³ as presented in this report. The difference between the Ministry's analysis and that presented here is largely due to differences in visual constraints between what was modeled in the SCF, and what was modeled in the Soo TSA (Table 23).

Table 23 Area within Visual Polygons compared between the SOO TSA and the SCF

	MFLB Percentage		THLB Percentage	
Group	**TSA**	**SCF**	**TSA**	**SCF**
RVQC = R	4%	25%	3%	13%
RVQC = PR_L	3%	1%	3%	2%
RVQC = PR_M	13%	30%	13%	36%
RVQC = PR_H	5%	15%	5%	26%
RVQC = M	13%	9%	14%	10%
Outside VQOs	**62%**	**20%**	**62%**	**12%**

As Table 23 shows, the proportion of the THLB that is constrained by visual quality objectives within the THLB is 40% higher within the SCF, than within the Soo TSAs THLB. Section 8.4 demonstrates that many of the VQO polygons are constrained throughout the planning horizon, limiting the harvest within these areas.

Appendix I VLI Polygon Percent and Heights

VLI polygons with no THLB were not included as constraints in the Model.

Table 24 VQO modelling requirements

VLI Polygon Number	Forested Area (ha)	P2P Ratio	Green up Height ht (m)	VQO	ALT	Maximum percent of CFLB under Greenup height (%)
12	107	2.38	6.20	PR	4.3	10.21
13	80	1.98	6.83	M	12.6	24.93
21	1,240	2.11	6.69	M	12.6	26.53
23	468	2.05	6.74	PR	4.3	8.82
33	74	2.21	6.52	M	12.6	27.86
34	28	1.92	6.99	PR	4.3	8.26
35	21	2.92	5.35	PR	4.3	12.55
37	44	1.17	8.37	M	12.6	14.76
38	1,225	2.01	6.81	M	12.6	25.30
44	19	1.32	8.08	PR	4.3	5.67
48	179	1.20	8.26	M	12.6	15.14
51	626	1.38	7.96	PR	4.3	5.93
52	293	1.48	7.81	M	12.6	18.61
53	29	1.49	7.78	M	12.6	18.75
56	684	3.03	5.21	R	0.8	2.42
57	427	1.92	6.98	PR	4.3	8.27
58	1,289	1.64	7.50	PR	4.3	7.06
60	504	1.44	7.87	M	12.6	18.09
61	1,002	1.37	7.98	PR	4.3	5.90
62	661	1.78	7.26	M	12.6	22.45
63	52	1.41	7.91	M	12.6	17.78
71	557	1.45	7.82	PR	4.3	6.26
74	132	1.64	7.49	R	0.8	1.31
75	258	1.78	7.22	PR	4.3	7.66
79	202	1.23	8.24	M	12.6	15.56
80	475	1.28	8.14	PR	4.3	5.49
81	390	2.48	6.06	M	12.6	31.30
82	492	1.73	7.32	M	12.6	21.75
84	2,869	1.77	7.28	PR	4.3	7.60
88	366	1.79	7.21	M	12.6	22.52
89	374	2.02	6.84	PR	4.3	8.66
90	703	1.62	7.58	PR	4.3	6.94
91	1,222	1.63	7.52	PR	4.3	6.99
92	43	1.11	8.43	PR	4.3	4.76
94	392	1.43	7.86	M	12.6	18.02
96	87	1.68	7.44	M	12.6	21.14

VLI Polygon Number	Forested Area (ha)	P2P Ratio	Green up Height ht (m)	VQO	ALT	Maximum percent of CFLB under Greenup height (%)
97	648	1.46	7.84	PR	4.3	6.26
98	9	1.15	8.34	M	12.6	14.55
99	62	2.20	6.49	PR	4.3	9.44
101	184	2.05	6.80	M	12.6	25.80
104	38	3.10	5.09	R	0.8	2.48
105	657	1.77	7.28	PR	4.3	7.60
106	899	1.98	6.90	M	12.6	24.99
107	174	1.68	7.44	PR	4.3	7.21
109	758	2.71	5.71	M	12.6	34.13
111	154	3.42	4.58	PR	4.3	14.71
113	374	1.94	6.97	PR	4.3	8.35
115	243	1.46	7.82	M	12.6	18.46
117	2,623	1.57	7.62	R	0.8	1.26
118	712	1.87	7.08	PR	4.3	8.03
119	715	2.16	6.57	PR	4.3	9.29
120	361	1.95	6.94	PR	4.3	8.40
122	2	1.32	8.03	R	0.8	1.06
124	289	1.54	7.69	PR	4.3	6.63
128	83	2.95	5.34	PR	4.3	12.68
129	11	1.55	7.69	PR	4.3	6.68
130	446	2.68	5.68	PR	4.3	11.52
131	357	2.83	5.51	PR	4.3	12.16
133	118	2.25	6.38	PR	4.3	9.67
135	137	2.31	6.30	PR	4.3	9.95
136	71	1.66	7.47	R	0.8	1.33
139	180	1.67	7.44	R	0.8	1.33
141	842	1.61	7.57	PR	4.3	6.91
143	92	2.05	6.75	PR	4.3	8.82
144	951	1.62	7.55	PR	4.3	6.96
145	43	2.07	6.72	R	0.8	1.66
148	203	2.72	5.72	PR	4.3	11.71
149	766	1.36	7.99	M	12.6	17.16
150	57	1.71	7.33	PR	4.3	7.34
151	925	1.62	7.53	PR	4.3	6.96
152	449	2.65	5.75	PR	4.3	11.38
157	317	1.50	7.76	PR	4.3	6.43
159	264	1.65	7.49	PR	4.3	7.10
163	173	1.83	7.18	PR	4.3	7.86
166	193	1.52	7.71	M	12.6	19.15
168	1,284	1.75	7.31	PR	4.3	7.52

VLI Polygon Number	Forested Area (ha)	P2P Ratio	Green up Height ht (m)	VQO	ALT	Maximum percent of CFLB under Greenup height (%)
171	1,043	1.72	7.36	PR	4.3	7.38
175	716	2.35	6.25	M	12.6	29.62
182	569	2.31	6.34	PR	4.3	9.94
186	212	1.70	7.44	M	12.6	21.40
198	14	2.31	6.44	PR	4.3	9.95
204	509	1.79	7.21	PR	4.3	7.72
225	164	2.56	5.90	PR	4.3	11.00
242	0	3.46	4.55	PR	4.3	14.90
605	1,388	1.59	7.58	M	12.6	20.08
606	43	1.63	7.54	M	12.6	20.56
608	371	1.67	7.44	M	12.6	21.07
609	1,465	1.33	8.05	R	0.8	1.07
614	242	2.39	6.25	PR	4.3	10.29
615	87	3.06	5.20	PR	4.3	13.17
616	261	3.19	4.97	PR	4.3	13.70
617	62	3.55	4.43	PR	4.3	15.25