Tree Farm Licence 6

Timber Supply Analysis Information Package

In Preparation of

MANAGEMENT PLAN 11

Submitted to the
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Forest Analysis & Inventory Branch
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Revision History

The following revisions were made to Version 1 (April 2024) of the Information Package to create this document.

Version	Date	Description
1.0	April 30, 2024	Initial version

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1 INTRODUCTION

1.1 Background

Tree Farm Licence (TFL) 6 is situated on the northern part of Vancouver Island, near Quatsino Sound. It spans from Nahwitti Lake to the north to Victoria Lake to the south, and from Winter Harbour in the west to Port McNeill in the east, as illustrated in Figure 1.

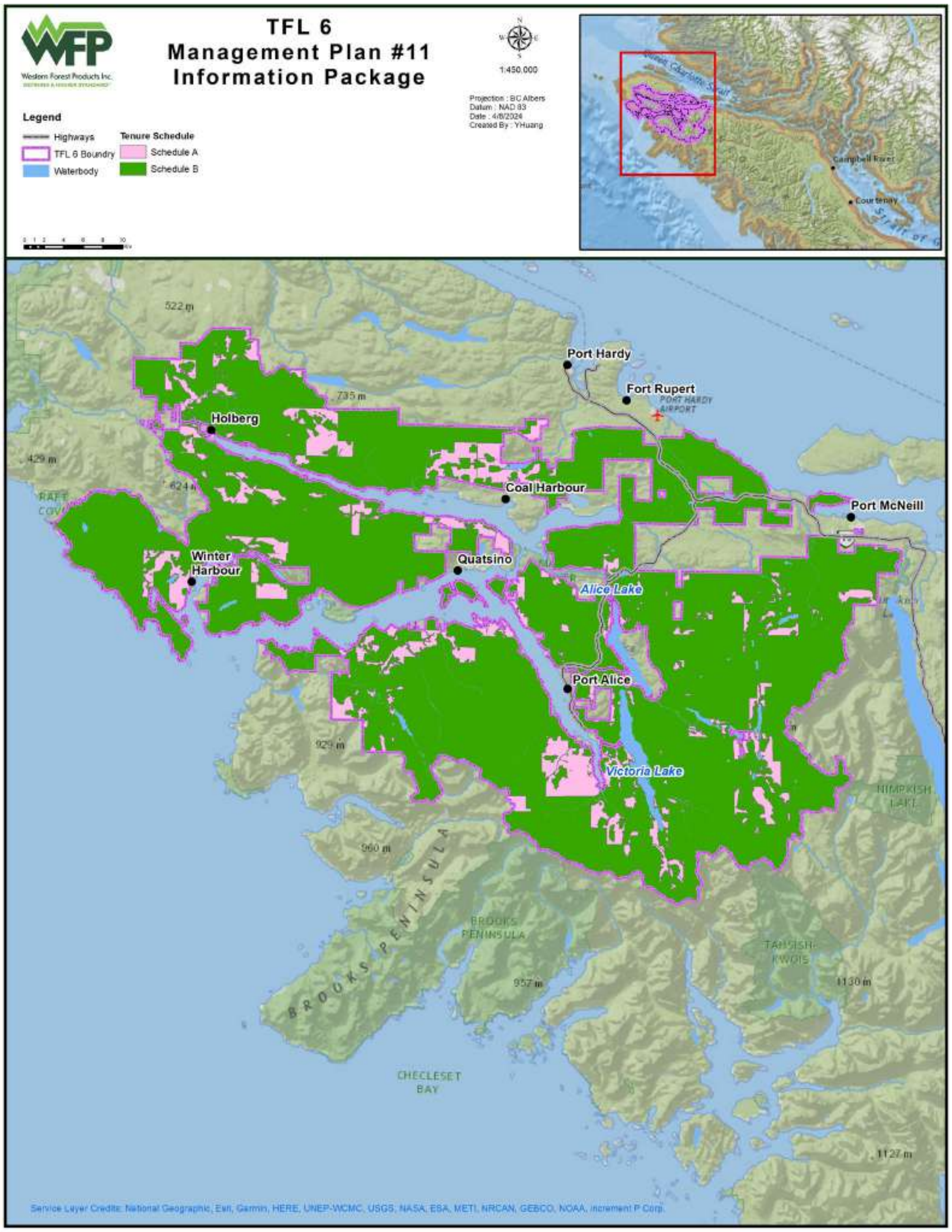

Figure 1 TFL 6 Overview

Forest Management Licence (FML) No. 6 (Quatsino) was initially granted in 1950 to the British Columbia Pulp and Paper Company Limited. FMLs were subsequently renamed as Tree Farm Licences (TFLs).

The ownership of the license has undergone changes due to corporate name changes, acquisitions, and mergers. Western Forest Products Inc. (hereinafter referred to as Western or WFP) is the holder of TFL 6. Since 1950, there have been ten Management Plans (formerly called ‘Management and Working Plans’) for the TFL.

The Information Package (IP) offers a condensed overview of the data, assumptions, and modelling methods suggested for incorporation into the Timber Supply Analysis (TSA) for Management Plan (MP) #11. Its purpose is to provide a comprehensive explanation of the elements connected to timber supply, which the provincial Chief Forester needs to take into account when establishing an Allowable Annual Cut (AAC), and to elucidate how these elements will be employed in the analysis.

The latest TSA for this TFL was concluded in 2011 and documented in TFL 6 MP #10, submitted by WFP (Western Forest Products Inc., 2011). The corresponding AAC was established by the Chief Forester at 1,160,000 m^3/year in 2012. In January 2015, TFL 39 Block 4 was incorporated into TFL 6 through Instrument 54, leading to an increase in AAC to 1,362,600 m^3/year. This AAC was extended for an additional 2 years in 2021 by the Chief Forester, anticipating improvements in forest inventory through Light Detection and Ranging (LiDAR) and substantial collaboration with First Nations. This extension remains in effect.

WFP will conduct a timber supply analysis with the goal of estimating timber harvests over a 300-year planning horizon, divided into five-year planning periods. This analysis will be based on the estimated harvestable land base informed by the collaborative development of the Quatsino (TFL 6) IRMP, early engagement with First Nations, existing timber volumes, and regenerating forest growth rates. The harvest forecast will evaluate the impacts on timber supply stemming from legal environmental protection and management practices, encompassing higher-level plans, operational requirements of the *Forest and Range Practices Act* (FRPA), approved Forest Stewardship Plan (FSP), orders, and other regulations and guidelines relevant to timber supply. Sensitivity analyses will be employed to explore the effects of different management scenarios and assess the relative importance of variations in assumptions. These scenarios might involve actions such as removing areas from the Timber Harvesting Land Base (THLB), implementing forest cover constraints, or modifying growth and yield (G&Y) estimates. The timber supply forecast balances achieving long-term sustainable harvest levels with minimizing disruptions during the shift from current harvesting rates to levels for the mid-term and long-term.

1.2 First Nations Interests

On November 28, 2019, the BC *Declaration on the Rights of Indigenous Peoples Act* (DRIPA) came into effect. The legislation creates a framework for greater collaboration with Indigenous groups in decision-making as it relates to forestry. First Nation values and interests play a crucial role in shaping contemporary forestry practices within TFL 6. In addition to the Quatsino (TFL 6) IRMP, WFP has sought to engage with each of the Indigenous Groups listed in Table 1 to collaborate on the TFL 6 Timber Supply Review (TSR). This engagement is expected to continue throughout the TSR process. WFP recognizes that the Province might have an agreement with a distinct definition of the Territory boundary or engagement level, which may differ from WFP's understanding.

Table 1 TFL 6 Area Indigenous Groups

First Nation Name	Total Area within Territory (Ha) - Contain Overlaps	Proportion of TFL 6 relative to the Territory (%)
Kwakiutl	30,849	14%
‘Namgis	4,016	2%
Quatsino	186,096	86%
Tlatlasikwala	9,890	5%
TFL 6 Total	217,200	

Several collaborative initiatives informing the TSR are currently in progress. For instance, in July 2022, a Bridging Agreement was established between Quatsino First Nation (Quatsino) and WFP, outlining a collaborative vision and approach to sharing opportunities related to forest resources in Quatsino's traditional territory. This agreement lays the groundwork for ongoing collaboration in land use and stewardship decisions through an Integrated Resource Management Plan (IRMP) guided by Quatsino's Land Use Plan. Work on the IRMP is well underway with weekly working sessions and the outcomes of this IRMP will be incorporated into the TSR.

In January 2021, the Gwa’ni Project, covering most of the Nimpkish Valley and including a small portion of TFL 6, was formally launched between the ‘Namgis First Nation (‘Namgis) and the Province under a Memorandum of Understanding for Modernized Land Use Planning. The Gwa’ni Project goals include evaluating the existing Vancouver Island Land Use Plan, in order to provide more effective management direction for the resource values found within the project area. As this IP was being prepared, the public consultation process for the consensus recommendation of the Gwa’ni Project was underway.

Table 2 details the sections in this document where discussions on First Nations interests are presented.

Table 2 Sections Discussing First Nation Interests

First Nations Interests	Section
Cultural Heritage	Section 3.5.2 Implementation Instructions from 2021 TFL 6 AAC Postponement Order
	Section 6.16 Cultural Heritage Resources
	Section 6.22 Karst
Fish Habitat	Section 6.9 Riparian Management Areas
	Section 10.3.4 Community Watersheds
	Section 10.3.6 Other Watersheds
Wildlife	Section 6.10 Ungulate Winter Ranges
	Section 6.12 Wildlife Habitat Areas
Old Growth and Biodiversity	Section 5.3 Current Age Class Distributions
	Section 6.11 Old Growth Management Areas
	Section 6.17 Existing Stand-level Reserves
	Section 6.21 Big Tree Reserves
	Section 6.23 Future Stand-level Retention
	Section 7.1 Resource Management Zones
	Section 7.2 Landscape Units
	Section 10.3.8 VILUP Higher Level Plan
	Section 10.4.3 Silvicultural Systems
Visual Quality	Section 10.3.1 Visual Quality

1.3 Analysis Area

The majority of the forests in TFL 6 are situated in the maritime variants of the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic (BEC) zones, with Coastal Mountain-heather Alpine (CMA) at high elevation. The annual precipitation varies between 3,000 and 5,000 mm. The climate is characterized by mild and wet winters, with daily mean minimum temperatures ranging from 0 °C to 2°C between December and February. Summers are generally cool and moist, with daily mean maximum temperatures in July and August typically ranging from 18°C to 20°C. However, local climates within TFL can vary significantly due to topographical influences and the movement of low cloud and fog from offshore onto northern Vancouver Island.

Communities within or near TFL 6 include:

- Port Hardy
- Port McNeill
- Port Alice
- Fort Rupert
- Coal Harbour
- Holberg
- Quatsino
- Winter Harbour
- Jeune Landing

Nearby provincial parks include:

- Muqqiwn/Brooks Peninsula Park
- Tahsish-Kwois Park
- Nimpkish Lake Park
- Marble River Park
- Raft Cove Park
- Quatsino Park
- Cape Scott Park
- Lower Nimpkish Park
- Misty Lake Ecological Reserve

TFL 6 is situated within 8 Landscape Units (LUs) and 8 Resource Management Zones (RMZs) designated by the Vancouver Island Land Use Plan (VILUP)[1]. The details of these Landscape Units and Resource Management Zones are provided in Table 3.

Table 3 Landscape Units and Resource Management Zones for TFL 6

Landscape Unit	Biodiversity Emphasis (BEO)	Resource Management Zone (Type)	Resource Management Zone Type
Holberg	Low	Holberg	Enhanced
Keogh	Low	Keogh-Cluxewe	Enhanced
Klaskish	Low	Klaskish	General
Lower Nimpkish	Low	Koprino	Special
Mahatta	Low	Mahatta-Neuroutsos	Enhanced
Marble	Intermediate	Marble	General
Neroutsos	Low	San Josef-Koprino	Enhanced
San Josef	Intermediate	West Coast Nahwitti Lowlands	Special

[1] Although the spatial data might indicate slight overlaps with the following LUs (Nahwitti and Tsulquate) and RMZs (Brooks Bay, Kashutl, Marble River, Nahwitti-Tsulquate, Nimpkish, Quatsino, Raft Cove, Tahsish, and Tahsish-Kwois), these overlaps are likely due to discrepancies between the data and real-world conditions. In reality, these "sliver" LUs and RMZs do not correspond to the actual height-of-land or the TFL boundary.

The Vancouver Island Land Use Plan Higher Level Plan Order (VILUP), implemented in 2000, assigned legal objectives under the *Forest Practices Code of British Columbia Act* and continued under FRPA. These objectives supplement the broader FRPA requirements that apply across the entire area, including Enhanced Forestry Zones, General Management Zones, and Special Management Zones.

Some LUs and RMZs may partially intersect with the boundary of TFL 6. Additionally, minor variations might exist in the spatial data used to create the Geographic Information System (GIS) geo-database, even when representing the same real-world features. This can lead to challenges when applying management restrictions based on RMZ types to these small overlapping areas, often referred to as "slivers." More information on RMZs and LUs can be found in Section 7.1 and 7.2.

2 PROCESS

2.1 Overview

This Information Package is submitted for review to the Timber Supply/Geomatics Forester at the Forest Analysis and Inventory Branch (FAIB) within the British Columbia Ministry of Forests (MoFOR). Once approved, the IP will serve as a guide for the timber supply analysis and will be appended to MP #11 along with the Timber Supply Analysis (TSA) report. These documents will play a role in the Chief Forester's decision on determining the new AAC for TFL 6. Two opportunities for review and comment will be offered, allowing input from the public and other stakeholders include reviewing this initial draft IP and the draft MP. These opportunities are in addition to the collaborative planning and early engagement actively underway with First Nations.

2.2 Analysis Approach

The intricacies of timber supply necessitate more than a single forecast to adequately depict the timber supply potential for TFL 6. Due to uncertainties surrounding how well the assumptions in the analysis align with the actual timber availability, operational planning, and the various options for adjusting harvest levels in response to the timber supply dynamics, a series of modelled forecasts will be developed. These forecasts aim to illustrate the impacts and dynamics of uncertainties in the timber supply process or alternative management practices. The forecasts include:

- **Base Case**: This represents the current knowledge, performance, and forest management practices in TFL 6. Other forecasts will be compared against the Base Case.
- **Sensitivity Analyses**: These analyses are employed to quantify the risks associated with uncertainties in the assumptions or data used in the analysis. Conducted through variable-controlling methods, sensitivity analyses involve modifying one area of uncertainty and assessing the implications of the change on various aspects of the land base.

2.3 Data Preparation and Missing Data

WFP constructed a GIS geo-database by utilizing various resource inventory spatial datasets through a series of ArcGIS geo-processing procedures. Each polygon in this master database is assigned a unique identification number, and all the summaries and values in this IP document are derived from this database.

The reliability of the data in this document is contingent upon the source data used during processing, and the data sources are listed in each section of the IP document. Despite efforts to ensure data accuracy, an exact match was not always achievable among various datasets with overlapping coverages. Some datasets had to be manipulated to approximate the best fit. For example, watersheds and landscape unit boundaries might differ in the GIS data used for the master database, even though they are defined by the same height-of-land in reality. While the final resultant is a close approximation of the actual landscape, caution should be exercised when viewing geographic data results on a large scale.

WFP reserves the right to modify any data, netdown order, or calculation in the future if it improves the accuracy of the analysis. Any such modifications will be documented in subsequent versions of the IP.

3 TIMBER SUPPLY FORECASTS AND SENSITIVITY ANALYSES

This section outlines the management scenarios that will be incorporated into the timber supply analysis. It provides information on the details, assumptions, and sensitivities associated with each scenario.

3.1 Base Case

The Base Case depicts the present operational needs and managerial approaches adopted in the TFL. The prediction of existing forest management practices takes into account the established land use designations, such as VILUP Resource Management Zones, current regulations, and guidelines, including the FRPA and approved FSPs. This option serves as the foundation for assessing various timber supply projections.

Current management of TFL 6 includes:

- The operable land base of forested area accessible using conventional (ground and cable) and non-conventional (helicopter) harvesting methods. Harvest methods are based on a spatially delineated physical operability dataset via Land Base Blocking (LBB) process (Section 5.2.1) for TFL 6.
- Exclusion of uneconomic mature forest stands (Section 6.13).
- Harvesting of both mature and immature/second-growth stands.
- Silviculture carried out on all regenerated stands to meet free growing requirements. All harvested areas are planted (Section 7.3.1.2).
- Known tree improvement gains will be applied to existing stands established since 2001 and future regenerated stands (Section 8.2.7.2).
- Visual quality objectives (VQOs) are modelled with upper range disturbance assumed based on the VQOs Government Action Regulation (GAR) order established on September 24, 2010, for Tree Farm Licence 6 & Block 7, Pacific Timber Supply Area (Section 10.3.1).
- Green-up heights for cutblock adjacency are assigned based on Resource Management Zones established in the Vancouver Island Higher Level Plan. Special and General Zones have a 3-metre green-up requirement while Enhanced Zones have a 1.3-metre green-up height (Section 10.3.2).
- Future wildlife tree retention and other stand-level retention within the THLB are accounted for by a percentage area reduction (Section 6.23).
- Established Old Growth Management Areas (OGMAs) are excluded from the THLB (Section 6.11). Mature seral targets are integrated into the two Special Management Zones in accordance with VILUP (Section 10.3.8). Regarding landscape units, old seral stage targets are assigned to each BEC variant, guided by the *Order Establishing Provincial Non-Spatial Old Growth Objectives* (NSOG) effective June 30, 2004 (Section 10.3.3).
- Established Ungulate Winter Ranges (UWRs), established and proposed Wildlife Habitat Areas (WHAs) are removed from the THLB (Section 6.10 and Section 6.12).
- Netdowns for terrain stability management depending on mapped classification and LiDAR slope model (Section 6.196.18).
- Riparian management based on the FSP results/strategies and a review of riparian management applied on nearly 870 cutblocks harvested or planned between 2012 and 2023.

- Minimum harvest age criteria based on 95% Culmination of Mean Annual Increment (CMAI) and minimum 350 m^3/hectare (Section 10.4.1). Both minimum age and minimum volume requirements must be met before a stand can be harvested.
- The Operational Adjustment Factor 1 (OAF1; designed to capture non-productive areas within a stand) is 15%; Operational Adjustment Factor 2 (OAF2; designed to reflect decay/waste/breakage and some forest health issues within a stand) is 5%. Both values are the provincial default.
- A relatively small area of deciduous leading stands excluded from the THLB and volume in these stands does not contribute to timber supply (Section 6.14).

3.2 Sensitivity Analyses

The Base Case harvest flow will be tested through a series of sensitivity analyses to investigate the potential impact of uncertainties in the assumptions applied. By exploring various sensitivity scenarios, it helps pinpoint the factors that exert the most significant influence on outcomes, facilitating decision-making amid different levels of uncertainty. Patchworks, serving as the simulation and optimization tool for the Base Case, is expected to project changes in outcomes when inputs are altered. To ensure meaningful comparisons, sensitivity analyses only modify the assumption(s) under evaluation in comparison to the Base Case.

Negative impacts in sensitivities aim to maintain short-term harvest levels close to those in the Base Case, while positive impacts involve adjustments that could potentially increase both short-term and mid-term yields, and possibly raise long-term harvesting levels. A summary of sensitivity issues is provided in Table 4, acknowledging that additional scenarios, not covered in the table, may be explored, and reviewed as they emerge during the modelling and public review process.

Table 4 Proposed Sensitivity Analyses

Scenarios To Be Tested	Proposed Sensitivity Analysis
Growth and Yield	Increase natural stand yields by 10%
	Decrease natural stand yields by 10%
	Increase managed stand yields by 10%
	Decrease managed stand yields by 10%
Forest Inventory	Use LiDAR-derived height and Site Index value for Managed Stands
	Use LiDAR-derived Individual Tree inventory
Forest Management / Silviculture	Exclude genetic gain adjustments
Quatsino Integrated Resources Management Plan	Apply desired management strategies from Quatsino Integrated Resources Management Plan[1]
Visual Management	Apply mid-range disturbance limit
Biodiversity	Retain old seral forests to full targets in NSOG Order
	Remove Old Growth Technical Advisory Panel (TAP) Priority Deferral Areas from THLB (vector data)
Minimum Harvest Criteria	Add 10 years to the minimum harvest ages
	Subtract 10 years from the minimum harvest ages
Operability	Exclude helicopter operable landbase
THLB	Increase THLB within all polygons by 10%
	Decrease THLB within all polygons by 10%

[1] As mentioned in Section 1.2, the Quatsino IRMP is underway; however as of April 2024, potential management strategies that will be included in sensitivity analyses are not yet available. Such details will be added in an updated Information Package included as part of draft Management Plan #11. It is expected that the recommended AAC for TFL 6 will reflect elements of the IRMP within the authority of the provincial Chief Forester under Section 8 of the *Forest Act*.

3.3 Alternate Harvest Flows

The harvest level in the Base Case will be periodically adjusted throughout each decade in the short and mid-term to align with the estimated long-term harvest level (LTHL). These adjustments are aimed at minimizing the duration during which harvest levels dip below the LTHL, potentially resulting in alternative harvest flow scenarios based on the outcomes of the Base Case. One potential approach involves maintaining the current AAC for as long as possible while ensuring that harvest levels remain close to or above the LTHL. Another option is to implement a non-declining (even-flow) harvest level.

As the timber supply analysis is being prepared, the need for additional sensitivity analyses or adjustments in harvest flows may become evident. If deemed necessary, these additional analyses will be incorporated into the final timber supply analysis report for the Chief Forester's consideration.

3.4 Climate Change

Climate change represents a notable source of uncertainty. There is substantial consensus within the scientific community that changes in climate will impact forest ecosystems, necessitating adjustments in forest management approaches. Nevertheless, the extent and pace of these changes remain uncertain. Although there is not a precise way to forecast climate change and its outcomes, WFP has incorporated various discussion topics to proactively deal with the potential consequences.

3.4.1 Future Projected Biogeoclimatic Ecosystem Classification (BEC) System and Climatic Variables

The BEC system categorizes the land base in British Columbia based on regional, local, and site conditions, considering climate, vegetation, soils, and topography (Province of British Columbia, 1994). BEC variants are useful indicators of local climate. In the early stages of TFL 6 MP #11, a raster dataset depicting the projected boundaries of 2071-2100 BEC variants was obtained from ClimateBC, developed by Dr. Tongli Wang from the Faculty of Forestry at the University of British Columbia (Wang, Hamann, Spittlehouse, & Carroll, 2016). This BEC projection reflects a climatic scenario of plausible future pathways in the Intergovernmental Panel on Climate Change's sixth assessment report (IPCC AR6) (Intergovernmental Panel on Climate Change, 2021).

While the 2071-2100 BEC projections indicate significant portions of TFL 6 transitioning into a "novel climate" – conditions outside the range currently observed in British Columbia – this information presents challenges for forest modelling. Since BEC zones are a crucial input for these models, directly applying projected BEC shifts may not be suitable for forecasting future forest conditions. Nevertheless, during the Quatsino IRMP development (background refers to Section 1.2), a separate working group is engaging with staff from the Future Forest Ecosystems Centre and the Forest Carbon and Climate Services Branch within the Office of the Chief Forester. There is good agreement that climate shifts upwards in elevation bands, aligning the climate of certain variants, like CWHvm2 for today, more closely with others, such as CWHvm1 in the future (C. Mahony, personal communication, January 10, 2023). However, the exact timing of this shift remains uncertain.

The Province offers a robust climate change projection tool accessible through a Shiny App. This interactive tool was recently used to generate projections for BEC zone shifts and species suitability predictions for the nearby TFL 37 (Province of British Columbia, 2023). The model leverages historical climate data (1961-1990) and recent data (2001-2020) to forecast future temperature and precipitation patterns. It also predicts potential ranges for various tree species under different climate change scenarios extending to 2100. However, using this model for customized runs requires collaboration with provincial government staff. Unfortunately, at the time of preparing this IP, localized projections specific to

TFL 6 are not yet available. This limits the ability to conduct in-depth modelling until the provincial models are completed.

3.4.2 Operational Practices

Beyond the timber supply review process, WFP is actively addressing climate change through various forest management practices, including but not limited to:

- Participating in the provincial forest fertilization program, which includes a carbon sequestration initiative. Specific stands designated for treatment within the THLB are generally targeted for harvested at least 10 years after application to maximize the benefits and carbon absorption potential.
- Adopting the Climate-Based Seed Transfer (CBST) led by the Forest Improvement and Research Management Branch of the Ministry of Forests (Province of British Columbia, 2017). CBST selects seeds based on the current and predicted future climates of regeneration sites. This helps forests adapt to climate change by planting trees that are more likely to thrive in future conditions. While changes in seed transfer limits have been minimal so far, they are anticipated to expand as climate patterns continue to evolve.
- For reforestation species options, the Climate Change Informed Species Selection tool (Province of British Columbia, 2023) is used to provide guidance on suitable species based on climate trajectories.
- Actively managing forest fuels to mitigate wildfire risks. Handling harvesting residues can reduce fire hazards by burning piles along roadsides and creating planting sites. However, as more environmentally friendly methods like prescribed burns or mechanical fuel removal become available, they will be prioritized considering the carbon footprint of pile burning.
- Employing qualified forestry professionals who consider the impacts of climate change when developing planting prescriptions. Species selection is based on their ecological suitability in both the current and projected future climates, as determined by qualified forestry professionals in collaboration with provincial ecologists. Forestry practices will continually evolve to ensure optimal outcomes. These suitable species are taken into account in future forest regeneration assumptions (Section 8.2.7).

Timber supply analyses are performed at least every 10 years. The forest inventory is regularly updated to incorporate the latest disturbances and silviculture practices. Furthermore, the analysis methodology continues to evolve with the integration of new information. Updated modelling is conducted periodically to use new information to inform decision-making in the next update cycle for the TFL.

3.5 Implementation Instructions from Previous AAC Determination Rationale and Postponement Rationale

In the 2012 TFL 6 AAC Determination Rationale, the Chief Forester identified four implementation items of note: 1) fertilization carried out on TFL 6, 2) genetic gain on stocks planted on TFL 6, 3) implementation of retention silviculture system, and 4) actual harvest performance on ground, cable and helicopter harvest systems (Province of British Columbia, 2012).

In the 2021 TFL 6 AAC Postponement Order, the Chief Forester identified two implementation items of note: 1) usage of LiDAR to update forest inventory, and 2) improvement on the information about cultural heritage values by working collaboratively with First Nations (Province of British Columbia, 2021).

In the 2016 TFL 39 AAC Determination Rationale, the Chief Forester identified the need for improved terrain stability mapping for Environmentally Sensitive Areas (ESAs) on unstable terrain, as the existing ESA mapping was outdated (Province of British Columbia, 2016). This requirement applies to TFL 39 Block 4, which was subsequently merged into TFL 6. Actions to address these implementation instructions are detailed below.

3.5.1 Implementation Instructions from 2012 Determination Rationale

3.5.1.1 Fertilization

To account for volume gains from fertilization in yield tables for existing and future managed stands, the Chief Forester requested WFP to monitor fertilizer application on TFL 6. Since the last allowable harvest level was set in 2012, over 6,510 hectares within TFL 6 have been fertilized. This includes over 5,860 hectares receiving an initial treatment, with some areas receiving additional applications (350 hectares for a second treatment and 295 hectares for a third treatment). Figure 2 illustrates the yearly distribution of the fertilized areas. The enhanced yields from fertilized stands will be accounted for in the growth and yield projection (Section 7.3.4).

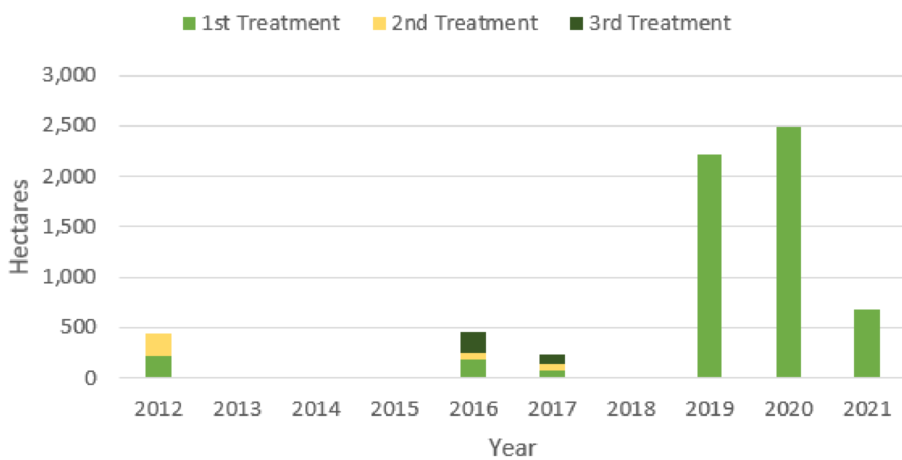

Figure 2 Area Fertilized in TFL 6 by Year Since 2012

3.5.1.2 Genetic Gain

The Chief Forester has instructed WFP to monitor the implementation of planting genetically improved stock on the TFL. This request arises from the integration of volume gains resulting from genetic improvements into the yield tables for future managed stands, and concerns raised about the assumed hemlock planting quantity relative to naturally regenerated hemlock. Between 2012 and 2023, WFP planted a total of 18,547,094 seedlings within TFL 6. The number of seedlings planted by species and the corresponding weighted average genetic gain is detailed in Table 5. The genetic gain values are derived from seedlot numbers and WFP's Saanich Forestry Centre. The average genetic gain values of deployed stock meet or surpass the genetic gain values assumed in the last timber supply analysis for TFL 6, particularly for western redcedar (Cw) and yellow cedar (Yc).

Table 5 TFL 6 Average Genetic Gain by Species (2012 - 2023)

Species	Number of Seedlings Planted	% of Seedlings Planted	Weighted Average Genetic Gain (%)	Genetic Gain (%) used in TFL 6 MP #10
Amabilis Fir	687,166	3.7%	-	
Douglas Fir - Coastal	1,668,977	9.0%	10.6	10.0
Lodgepole Pine - Coastal	18,996	0.1%	-	
Mountain Hemlock	50,710	0.3%	-	
Noble Fir	2,920	0.0%	-	
Red Alder	167,374	0.9%	11.2	
Sitka Spruce	1,087,148	5.9%	-	
Western Hemlock	3,324,803	17.9%	12.8	6 in high elevation sites or 10 in low elevation sites
Western Redcedar	10,381,702	56.0%	17.0	8.0
Western White Pine	86,525	0.5%	-	
Yellow Cedar	1,070,773	5.8%	14.3	7.0
Total	18,547,094	100.0%	13.7	

3.5.1.3 Silvicultural Systems

While implementing Variable Retention through the retention silvicultural system in its early stages during the timber supply analysis of MP #10, the Chief Forester directed WFP to monitor its application in TFL 6. Between 2012 and 2023, 17,000 hectares were harvested in TFL 6. Of these, about 48% used the retention silvicultural system, while rest of 52% employed clearcutting with reserves. The MP #10 TSR assumed a 40% application of the retention silvicultural system, but the past performance on stand-level retention varied between 7% and 30% (averaging 17%), exceeding the TSR's 10.4% assumption. In other words, the variable retention assumptions in MP #10 were conservative. WFP has applied the retention silvicultural system more extensively than assumed in the MP #10 since the last TSR. However, this higher retention may not necessarily reduce the AAC, as it could be designated for other resource values like riparian areas. Figure 3 illustrates the yearly application of the retention silvicultural system.

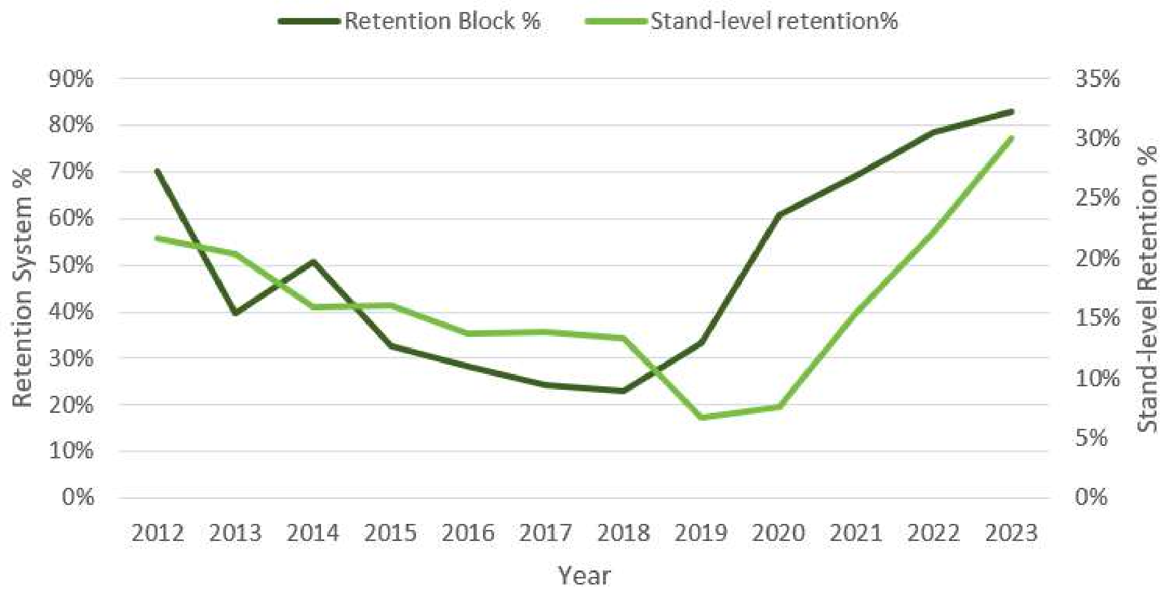

Figure 3 Application of Retention Silvicultural System in TFL 6

3.5.1.4 Harvest Performance

The Chief Forester has requested WFP to monitor the harvesting activities categorized by operability class, namely cable, ground, and helicopter harvest systems. This directive is driven by the overarching goal of ensuring the economic sustainability of the TFL, with a primary focus on avoiding prolonged operations in challenging terrains requiring cable or helicopter systems.

Since the acquisition of LiDAR data for TFL 6 in 2012, the ability to access highly detailed information across the entire land base has significantly improved. Various LiDAR-derived datasets, such as Canopy Height Model (CHM), bare earth hillshade, slope, and streams, empowers WFP foresters to identify productive forests, plan future road locations, and classify potential areas for future harvesting. Professional assessments have been conducted to spatially delineate future blocks and roads, associating them with suitable harvest systems. The post-harvest update of cutblock boundaries and the actual harvest method is also employed. This process is called Land Base Blocking (LBB).

Between 2012 and 2023, the harvested area of 17,000 hectares was distributed across operability classes identified in the LBB (details in Table 6). For comparison, Table 6 also includes harvest area percentages from the first decade of MP #10 timber supply analysis, acknowledging the larger land base in this management plan due to the inclusion of TFL 39 Block 4. Figure 4 further details the yearly harvest area by operability class since 2012. Notably, the actual harvest area proportions align well with MP #10's projections, despite the increased land base.

Table 6 TFL 6 Harvested Area (2012 – 2023) by Operability Class

Operability Class	Harvest Area (Ha)	Harvest Area (%)	Harvest Area (%) for the First Decade in MP #10 TSR (%)
Cable	6,867	40.3%	45%
Ground	9,827	57.6%	51%
Helicopter	203	1.2%	4%
Unknown/Unidentified/Inoperable[1]	161	0.9%	N/A
Total	***17,058***	***100%***	***100%***

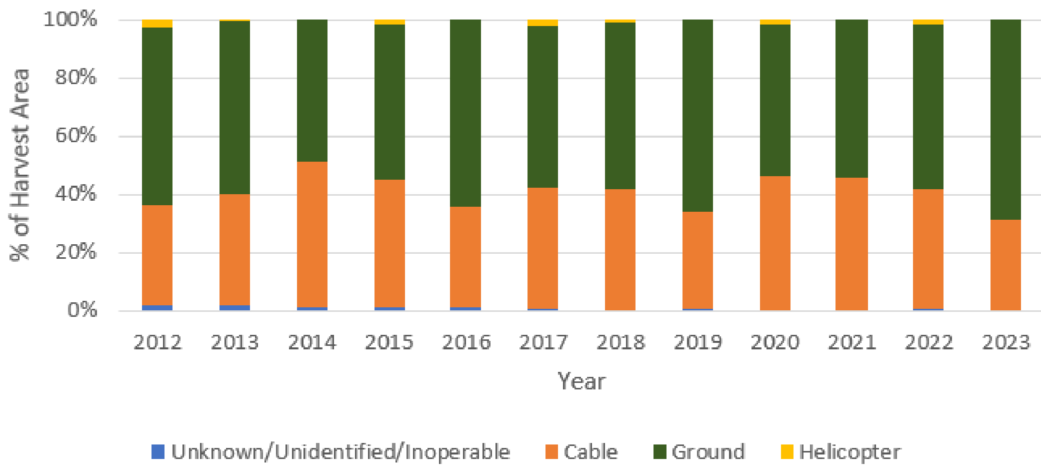

Figure 4 TFL 6 Harvested Area (2012 – 2023) by Operability Class

3.5.2 Implementation Instructions from 2021 TFL 6 AAC Postponement Order

3.5.2.1 LiDAR Forest Inventory

Since 2012, WFP acquired LiDAR data to cover the entire TFL 6. The latest acquisition occurred in 2021 to 2022. The Chief Forester asked WFP to update the forest inventory for the timber supply analysis.

In addition to employing the typical bare earth hillshade dataset and CHM for operational-level planning and mapping, WFP has dedicated resources to leverage LiDAR data for improving inventory datasets related to TFL 6. This investment encompasses various phases, including a thorough LBB process aimed at delineating low productive areas within a stand and identifying opportunities for timber harvesting and road development. LBB forms a basis of a physical operability inventory for TFL 6. Furthermore, WFP also began the creation of an inventory known as the individual tree inventory (ITI) and the creation of additional resource inventory datasets using LiDAR technology.

3.5.2.1.1 Operability Inventory

Briefly mentioned in Section 3.5.1.4, LBB utilizes detailed LiDAR data on ground surfaces and canopy heights across TFL 6, enabling forest professionals to thoroughly assess opportunities for timber harvesting and road development. Specifically, non-productive and low-productive forests, as well as potential areas for future harvesting and road construction, are spatially delineated. Subsequently,

[1] These areas were not identified in any harvest system in LBB but were harvested due to road Right-of-Way clearing, and operability inventory data issues or “slivers.”

appropriate harvesting methods (ground/cable/helicopter) are assigned to these designated areas. The LBB process unveils physically harvestable areas, with LBB polygons and associated roads forming the foundational draft for operational planning. Following the completion of LBB for TFL 6, post-harvest updates are made to the block boundaries, road locations, and the specific harvest systems employed. These adjustments ensure that the LBB dataset accurately reflects the activities and changes that have taken place on the land base. These datasets play a crucial role in determining operability (Section 6.8) in this TSR.

3.5.2.1.2 Individual Tree Inventory

WFP's research and development initiatives in LiDAR technology have also expanded to include the creation of ITI with Forsite Consultants Ltd. The ITI dataset provides detailed information on individual tree locations with estimates of species, diameter at breast height (DBH), tree height, gross and net merchantable volume/piece size, basal area, and other forest stand attributes. However, there are acknowledged limitations in directly utilizing ITI attributes in the TSR, particularly in existing natural stands in old seral stages. This limitation arises from the airborne acquisition method of LiDAR, where laser signals encounter challenges penetrating dominant tree crowns into co-dominant and understory layers, resulting in underestimations of understory basal area, total stems per hectare, and total stand volume per hectare in stands with understory trees (Sparks & Smith, 2022). WFP has made multiple attempts to address these issues. In a study conducted in TFL 44 MP #6 in the South Island District, WFP tested and compared the difference in relative accuracy among three different forest inventories: TFL 44 Forest Cover, the provincial VRI, and Individual Tree Inventory (ITI) based on LiDAR data acquired in 2016 (Western Forest Products Inc., 2021). Subsequently, WFP developed a correction factor for the ITI-derived volume based on blocks harvested since the LiDAR acquisition, using linear regressions fit to the ITI volume estimates. This correction factor was then tested in an independent set of blocks. An internal analysis using the same methodology was also carried out in TFL 6, yielding similar results. However, the absence of ground sampling and the utilization of a training and testing dataset from the more biased (productive) part of the land base presented challenges for the Deputy Chief Forester in accepting this adjustment methodology in TFL 44 (Province of British Columbia, 2023). Since then, WFP has been collaborating closely with FAIB staff to address these concerns. A pilot ground sampling and volume verification program is presently in progress in TFL 6, and other TFLs held by WFP on Vancouver Island. This project aims to compare the ITI volume with the volume measured in the field, in both THLB and the Non-Contributing Land Base (NCLB) forests. WFP is also coordinating with FAIB staff to sample the Young Stand Monitoring (YSM) and Change Monitoring Inventory (CMI) plots, as well as plots for cedar trees aged between 30 and 50 years old for further verification in TFL 6. The insights gained from these programs, along with the finalized adjustment methodology, will facilitate the validated use of ITI in strategic planning projects, such as TSR work, at a future date for TFL 6.

3.5.2.1.3 Riparian Inventory

Since the introduction of LiDAR in TFL 6, the prediction of stream locations has advanced through processes using LiDAR bare earth ground conditions, topology, and flow accumulation information. However, the detailed classification of streams traditionally relies on fieldwork. In a dedicated project for TFL 6, Forsite Consultants Ltd. undertook the task of assigning riparian classes to the LiDAR-derived stream network using machine learning techniques. To accomplish this, a training dataset was created from a subset of LiDAR-derived streams that were spatially matched to the field-verified equivalent. These field-verified streams, with classification and stream channel width information, were then compared to the flow values from the LiDAR flow accumulation raster. This became the basis for stream width classification across the land base. Each stream segment was subsequently categorized as either fish-bearing or non-fish, employing various parameters such as field-verified stream classes (S4 and above), community watersheds, elevation, known fish-bearing lakes, and fish observation points from BC Data Catalogue. Additionally, predicted fish breaks generated from LiDAR slope data were considered in this classification. To ensure the accuracy and integrity of the data, a thorough operational review and calibration were conducted by WFP's forestry professionals, with a specific focus on streams within blocks where the most accurate field-verified streams are located. The resulting LiDAR-classified stream dataset, complete with its assigned classes, serves as the foundational data for land base classification (refer to Section 6.9 for more details).

The aforementioned LiDAR projects exemplify WFP's strong dedication to utilizing LiDAR data across various aspects of forestry planning. It is recognized that certain LiDAR-related initiatives are still in progress and achieving full-scale implementation in TFL 6 MP #11 may not be feasible within the current timeline. However, WFP is committed to integrating the latest available LiDAR advancements into the Base Case, such as incorporating LiDAR-derived streams for riparian areas and LBB for operability. Alternatively, these advancements may be included as part of a sensitivity analysis, as seen in the case of adjusted ITI attributes in other TFLs.

3.5.2.2 Cultural Heritage Value

The Chief Forester has directed WFP to collaborate with First Nations and MoFOR staff to enhance the information pertaining to cultural heritage values for the timber supply analysis and management plan.

Therefore, TFL 6 MP #11 adopts a new communication model for collaborating with the First Nations identified in Section 1.2 within the TFL 6 area. This model offers more opportunities for early engagement and extended timelines to incorporate as much input as possible at the onset of the IP preparation stage. Specifically, a letter marking the commencement of the TSR and inviting early engagement was shared to all First Nations in the TFL 6 area in April 2023. This letter invited these Nations to actively participate in the TSR process. Subsequently, in December 2023, a summary of key assumptions and data for this IP document was shared with all First Nations in the TFL 6 area, providing an overview of the data sources and forest management assumptions across all aspects of this IP document. WFP intends to adhere to this early engagement model during the development of the draft timber supply analysis report and MP in the subsequent stages of the TFL 6 TSR process.

In July 2022, the Quatsino First Nation (Quatsino) and WFP entered into a Bridging Agreement that establishes a shared vision and approach for opportunities related to forest resources in the traditional territory of Quatsino (Western Forest Products Inc., 2022). This agreement paves the way for continuous, meaningful collaboration in planning through an Integrated Resource Management Plan (IRMP), guided by Quatsino’s Land Use Plan and values. Since then, collaborative working sessions have been underway with an interconnected approach to forest stewardship. This planning process aligns with the principles of DRIPA, and the latest amendments to FRPA supporting a significant and transformative change in resource value stewardship in British Columbia. The signatory of the IP document, along with other WFP staff, have consistently participated in the Quatsino IRMP working sessions, sharing the overall TSR framework and processes, reviewing data sources, and proposed forest management assumptions and tactics to be used in the TSR. Concurrently, WFP is working to incorporate Quatsino's traditional land use study to better quantify and assess cultural heritage values within TFL 6.

Since September 2021, ‘Na̲mg̲is First Nation (‘Na̲mg̲is) is collaborating with WFP to jointly develop a Forest Landscape Plan (FLP) and a Forest Operations Plan (FOP) in the nearby TFL 37 (‘Na̲mg̲is First

Nation and Western Forest Products Inc., 2024). This initiative is one of four FLP pilot projects in BC. The indigenous values identified in TFL 37, along with the associated management tactics, will provide valuable insights for the TFL 6 TSR process. Additional details about the collaborative planning between ‘Namgis and WFP can be found in the Winter 2024 edition of the BC Forest Professional Magazine, published by the Forest Professional BC (Svanvik, Davis, Green, Dalton, & Glen, 2024).

The current version of the IP has integrated some of the early feedback from First Nations, demonstrating WFP’s strong commitment to reconciliation and the incorporation of indigenous values. The Quatsino IRMP provides a unique opportunity to ensure that First Nations rights and title holders are full partners in sustainable forest management within the TFL. WFP is committed to effectively coordinating the TSR and Quatsino IRMP throughout the process. The deployment of forest management practices and approaches from the Quatsino IRMP will be incorporated into the TSR, contingent upon the IRMP's progress and approval. Details on how this work is reflected can be found in cultural heritage value (Section 6.16) and karst (Section 6.22) sections.

3.5.3 Implementation Instructions from 2016 TFL 39 AAC Determination Rationale applicable to old TFL39-4 Block

On January 1, 2015, TFL 39 Block 4 (Benson River area) was merged into TFL 6. Given the current TFL 6 AAC determination of February 2012 (Province of British Columbia, 2012), and the current TFL 39 AAC determination of August 2016 (Province of British Columbia, 2016), some implementation of note in the TFL 39 AAC determination is relevant to the old TFL 39 Block 4 portion of the TFL 6.

3.5.3.1 Unstable Terrain

The Chief Forester has instructed WFP to enhance the information on terrain stability mapping in areas where only Environmentally Sensitive Areas (ESA)-based mapping is currently available. This pertains specifically to the former TFL 39 Block 4 section within TFL 6 (about 21% of TFL 6). The rest of the TFL 6 has Detailed Terrain Stability Mapping (DTSM) or Landslide Hazard Mapping (LSHM).

Given LiDAR's ability to reveal detailed terrain information, particularly slope which strongly correlates with stability, LiDAR-derived slope is a logical tool to quantify unstable terrain within TFL 6. An operational review of LiDAR slope data for blocks harvested since 2012 (following Management Plan #10 approval) revealed that only 4.8% fall within the 90+% slope zone (Table 7). This translates to over 95% of harvested areas since the last AAC determination having slopes below 90%. Consequently, LiDAR-derived slope data will replace the outdated ESA-based terrain mapping for TFL 6. Areas exceeding 90% slope will be excluded from the THLB (refer to Section 6.19 for more details).

Table 7 Distribution of Slope for 2012 - 2023 TFL 6 Harvested Area

LiDAR-Derived Slope Ranges (%)	Proportion of TFL 6 2012 - 2023 Harvested Blocks
0 - 10	11.6%
10.1 - 20	17.8%
20.1 - 30	16.2%
30.1 - 40	13.8%
40.1 - 50	11.5%
50.1 - 60	9.3%
60.1 - 70	7.0%
70.1 - 80	4.9%
80.1 - 90	3.1%
90+	4.8%
Total	100.0%

3.6 Major Changes Since the Previous MP

This section outlines the key forest management considerations and data source differences since MP #10. New management practices and enhanced data, classified as part of the current management practices, have been integrated into the Base Case. These modifications have an impact on the timber supply analysis and harvest forecast. Uncertainties arising from other management considerations are explored through sensitivity analyses detailed in Section 3.2.

- The land base of TFL 6 has expanded since MP #10 with the former TFL 39 Block 4 now included in TFL 6. The current THLB and AAC level come from a mathematical summation of the former TFL 39 Block 4, utilizing resource feature datasets and assumptions from TFL 39 MP #9. The lack of interaction and dynamics with the rest of TFL 6 making direct comparisons to previous TSRs challenging.
- The forest inventory of TFL 6 underwent Phase II adjustments compatible with VDYP 7 standards as part of the Pacific TSA TSR project, differing from the VDYP 6 standards used in MP #10. Nevertheless, this change is anticipated to have minimal impact. Additionally, the forest inventory has been further updated based on harvesting, silviculture activities, and survey results up to December 31, 2023 (Section 5.1).
- Site index and ecosystem classification data used in MP #10 were sourced from a local study conducted by Terry Lewis, Ph.D. between 1982 and 1985. For MP #11, the data sources align with provincial sources of Site Index Estimates by BEC Site Series (SIBEC) and Terrestrial Ecosystem Mapping (TEM) based on BEC zone & site series classification system (Section 8.2.1 and Section 7.3.2).
- MP#11 utilizes Patchworks for timber supply modelling, replacing Remsoft's Spatial Planning System (Woodstock) used in MP#10 (Section 4).
- Road widths for existing roads have been slightly reduced in MP #11 based on measurements conducted using recent orthophotos and reviews of road width assumptions in nearby North Island TSA data packages (Province of British Columbia, 2020) with resource roads directly connected to TFL 6 (Section 6.5).
- MP#11 leverages LiDAR for a more precise assessment of productivity (Section 6.7) and physical operability (Section 6.8). Economic operability in MP#11 focuses on helicopter harvest systems, considering factors such as species mix, timber volume, and flight distance (Section 6.13).
- LiDAR-derived classified streams replace the field-verified & TIRM-based streams used in MP #10. The proportions of THLB netdown on riparian management zones are updated based on harvest performance since MP #10 (Section 6.9).
- Additional UWRs, OGMAs (both legally established and proposed), and WHAs (both legally established and proposed) have been established since MP #10 (Section 6.10 to 6.12). Many additional OGMAs and WHAs are designed to comply with the *Marbled Murrelet Order*. Further Marbled Murrelet suitable areas will be reserved to meet the landscape unit Aggregate/ landscape unit targets prescribed by the Order (Section 6.12.3).
- MP #11 incorporates spatial data on registered government archaeological sites for exclusion from the THLB. In addition, a more informed THLB netdown methodology is employed to account for unknown cultural heritage resources in MP #11, thanks to early engagement with Quatsino First Nations (Section 6.16).

- The practice of variable retention has evolved into a more detailed zonal system, considering VILUP resources management zones and wind exposure in MP #11 (Section 10.4.3). This improved variable retention strategies employed by WFP have resulted in more existing WTRAs created (Section 6.17) and modified future WTRAs (Section 6.23) THLB netdown assumptions.
- MP#11 utilizes LiDAR-derived slopes and existing Detailed Terrain Stability Mapping (DTSM) for THLB netdown, replacing the rate-of-harvest restrictions and outdated ESA terrain mapping used in former TFL 39 Block 4. (Section 6.19).
- Additional areas to protect research sites (Section 6.18), permanent sampling plots (Section 6.20), big trees (Section 6.21), and karst features (Section 6.22) are excluded from THLB in MP #11.
- MP#11 utilizes the latest versions of stand-level growth and yield modeling software (VDYP 7.33b and TIPSY 4.5) with updated yield projections compared to MP#10 (VDYP 6.6d and TIPSY 4.1).
- Analysis unit definitions in MP#11 align with provincial BEC zone and site series system, resulting in more analysis units with varying species composition, site indices, and densities (Section 7.3).
- Genetic gains used in MP #11 are based on the latest genetic worth data from the seedlots planted since MP #10 for recently managed AUs (Section 7.3.1.2.2), and current projections for future AUs (Section 8.2.7.2), resulting in higher genetic gain values than MP #10 .
- With the implementation of updated variable retention silvicultural system zones in MP #11, TIPSY-based volume reduction for managed AUs due to shading effects is now implemented. (Section 8.2.8.2).
- A higher proportion of non-recoverable losses due to biotic and abiotic disturbances is implemented in MP #11 compared to MP #10. Additionally, natural disturbances outside of THLB are modeled in MP #11 (Section 9).
- Visual Quality Objectives (VQO) are modelled considering slope, plan-to-perspective ratio, and visual absorption capability at the polygon level in MP #11, as opposed to a broader disturbance rate by each VQO class in MP #10 (section 10.3.1).
- With the spatial capabilities of the Patchworks model, cutblock green-up and adjacency can be spatially modeled (Section 10.3.2).
- Watershed high sensitivity zones and Equivalent Clearcut Area (ECA) limits are prescribed to more watersheds in MP #11, compared to rate-of-harvest restrictions in four watersheds in MP #10 (Section 10.3.6).
- Minimum Harvest Age has evolved from diameter by site productive class to the utilization of 95% culmination Mean Annual Increment Age and a minimum harvest volume of 350 m^3/hectare (Section 10.4.1).

4 HARVEST MODEL

The TFL 6 timber supply analysis will utilize Patchworks™ software, created by Spatial Planning Systems Inc. based in Deep River, Ontario (https://spatial.ca/). Patchworks has been used in various Management Units across British Columbia and is an approved software for TSR by the Province of British Columbia.

Patchworks functions as a spatial model for timber supply, projecting harvesting activities in line with existing forest management practices over time. Employing goal programming, Patchworks schedules activities to effectively balance multiple specified objectives within the planning process. The spatially explicit nature of the model allows the inclusion of locational information in the strategic planning process, accommodating various management objectives measured in different units. These objectives encompass harvest volume (m^3/year), cutblock size (hectare), distributions adjacency (metre), green-up requirements (metre), and patch size targets (% area/size class/period).

In this analysis, optimization within Patchworks will be employed to formulate the Base Case harvest schedule, taking into account all the non-timber objectives such as visual quality, cultural heritage resources, recreation, biodiversity, and wildlife habitat, alongside the primary objective of timber harvest. The aim is to maximize the flow of harvest for long-term timber supply while ensuring the preservation of other values. The timber supply forecast seeks to achieve long-term harvest potential and minimize abrupt changes during the transition from the current harvest level to mid- and long-term sustainable levels. Additionally, the model will project forest growth beyond the timber harvesting land base while accounting for natural disturbances (refer to Section 9.4).

5 FOREST COVER INVENTORY

5.1 Vegetation Resources Inventory

A Vegetation Resource Inventory (VRI) project for TFL 6 was initiated in 1999. The VRI project received funding from Forest Renewal BC (FRBC) and the Forest Investment Account (FIA). Phase I, which involved the delineation of forest cover polygon boundaries and the estimation of attributes using aerial photography, was completed in 2000. This phase utilized 1:15,000 scale color imagery captured in 1995. Phase II, which included ground sampling and the Net Volume Adjustment Factor (NVAF) sampling, was conducted in 2001. The final component, the statistical adjustment for VDYP 6, was completed and reported on by the Timberline Natural Resource Group in 2009 (refer to Appendix A: TFL 6 Vegetation Resources Inventory Statistical Adjustment 2009 for more details). The results, approved by the Forest Analysis and Inventory Branch (FAIB), were utilized in the TFL 6 MP #10 timber supply analysis.

The Phase II adjustments were updated the current VDYP 7 standard by Forest Ecosystem Solutions Ltd. in 2016 as part of a nearby Pacific Timber Supply Area project (details in Appendix B: TFL 6 Vegetation Resources Inventory Statistical Adjustment 2016). This Management Plan incorporates these updated adjustments, and the forest inventory has been further updated based on harvesting, silviculture activities, and survey results up to December 31, 2023.

5.2 LiDAR

As previously illustrated in Section 3.5.2.1, WFP acquired LiDAR data for TFL 6 in multiple phases: initially for a pilot project in early 2012, and subsequently in 2016 and 2021/2022.

In its initial application within the forestry sector, LiDAR primarily served to generate precise Digital Elevation Models (DEMs) of the ground surface and CHMs for forest road engineering and cutblock development. However, advancements in technology and data analysis have transformed LiDAR into a powerful tool for assessing a wide range of forest inventory attributes. These include, but are not limited to, tree height, density, and volume, for both stand level and individual tree level. This transformation highlights the increasing role of technology in enhancing the understanding and management of forest resources within TFL 6.

5.2.1 Land Base Blocking

The LBB process, as referenced in Section 3.5.2.1, was implemented across TFL 6. The purpose of this process was to conduct a comprehensive review of the entire land base, assessing its potential for timber harvesting and road development. WFP's team of forest professionals spatially assign attributes to various aspects of the land base. These included non-forested areas, low productivity forest areas, harvestable areas, harvest systems, and potential road locations. This meticulous process ensures that every hectare of the land base is considered in the planning and management of forestry operations.

The implementation of the LBB process informs the development of the updated operability mapping (Section 6.8), which is then reflected in the Base Case scenario of TFL 6 MP #11.

5.2.2 Stand Heights

LiDAR heights at the stand level were generated by following a simplified version of the MoFOR's LiDAR Enhanced Forest Inventory (LEFI) methodology implementation. The LEFI methodology, originally developed by the FAIB, was designed to update VRI attributes by leveraging available LiDAR datasets (Province of British Columbia, 2019).

For stands in TFL 6, heights were generated using LiDAR CHM data. Tree location points were derived from the LiDAR CHM dataset. A 20m x 20m grid was superimposed over the CHM dataset, and the average height of the top four trees (Ht_top4) was computed. This value was then summarized to the forest cover inventory polygon for the timber supply model. Ht_top4 is the default LiDAR height.

Further verification was conducted by calculating the following indicators: coefficient of variation (CV), roundness index (an index indicating the length to area ratio to identify long, skinny polygons), and the number of grid cells used to calculate the Ht_top4 mean. For stands that are highly variable (CV > 40%), highly irregular (roundness index < 0.05), or too small (number of cells < 20), the tree height value for the 50th percentile of the tree list (sorted in descending order, denoted as PolyHt50) for the polygon becomes the LiDAR tree height.

While it is acknowledged that LEFI has further processes to assign the 5th, 10th, 20th, and 30th percentile of the tree height based on different crown closures, the proportion of these options applied to forest stands is relatively small. In the original analysis that formed the LEFI methodology, 89% of the LiDAR tree heights was determined using Ht_top4 and 10% was using PolyHt50 (C. Robinson personal communication, June 8, 2020). In TFL 44, located within the South Island District, approximately 65% of the THLB area is determined using Ht_top4 (Tsawak-qin Forestry Limited Partnership, 2023). Table 8 provides a breakdown of the LiDAR tree height source for TFL 6.

Table 8 LiDAR Height Source for TFL 6

LiDAR Height Source	Gross Area (Ha)	Percentage of Gross Area (%)	THLB Area (Ha)	Percentage of THLB Area (%)
Ht_Top4	141,773	65.3%	82,399	68.5%
Poly_Ht50	74,159	34.1%	37,516	31.2%
Unclassified	1,267	0.6%	338	0.3%
Total	217,200	100.0%	120,254	100.0%

5.2.3 Site Index

The Site Index (SI) serves as an indicator of forest stand productivity. There are several methods to derive a LiDAR-based SI. One such method involves calculating the SI using LiDAR height and stand age at the time of LiDAR acquisition (2022), utilizing Site Tools version 4.2.

Another method, unique to TFL 6, leverages LiDAR data from two different vintage years available to WFP. In theory, the growth of the forests can be precisely measured in two different timeframes to quantify the growth. These measurements are then grouped at the landscape level to create a LiDAR-based SI at the TFL level. WFP is currently exploring this methodology and working on a report to establish a statistically valid way to implement this LiDAR-based localized SI methodology in a scientifically sound manner. However, due to the timing of TFL 6 MP #11, this localized LiDAR-based SI methodology may not be available for the timber supply analysis.

5.2.4 Individual Tree Inventory Attributes

The Individual Tree Inventory (ITI) data, as detailed in Section 3.5.2.1, was generated for TFL 6 using the Timber Species Identifier software, developed by Object Raku, now part of Forsite Consultants Ltd.. The software segmented and delineated individual tree crowns based on LiDAR point cloud data. This data was then calibrated using field-identified tree data, with trees from the same species grouped by different ecosystems and forest types.

The ITI dataset includes the locations of individual trees, along with estimates of species, DBH, volume/piece size, basal area, and other forest stand attributes. The trees identified by LiDAR can be summarized up to the level of the forest cover polygon to generate a set of LiDAR-based forest stand attributes.

Species composition, from Species 1 to Species 6, at the stand level can be computed using a basal area-weighted method. Stand basal area, DBH, and density can be summarized by adding values from all the individual trees within the stand. Stand volume can also be summed, but an adjustment must be made to account for missing understory trees (discussed in Section 3.5.2.1.2).

WFP is actively collaborating with FAIB to secure full approval for the use of LiDAR in forest inventory and strategic analysis. Until such approval is granted, the attributes derived from LiDAR are intended to be utilized for sensitivity analysis purposes for TFL 6 MP #11. This approach ensures that the potential impacts and benefits of incorporating LiDAR data can be thoroughly evaluated and understood.

5.3 Current Age Class Distributions

Table 9 presents the current age class distribution of the productive forest land base (refer to Section 6.6 for the definition) and the THLB for TFL 6 as of December 31, 2023. It is important to note that areas and volumes listed as zero years old may appear overstated. This is because they include areas that were planted in 2023, for which the species information was not yet available, and areas that were harvested in 2023 but are scheduled to be planted in 2024.

Figure 5 and Figure 6 provide a visual representation of the age class distribution by area for both the productive forest land base and the THLB. Similarly, Figure 7 and Figure 8 display the age class distribution by volume for the productive forest land base and the THLB. These figures offer a clear and comprehensive view of the age class distribution for the current state of the forests across TFL 6.

Table 9 Forest Age Class Distribution for TFL 6

Age range (years)	Area (ha)		Volume ('000 m3)	
	Productive Forest	THLB	Productive Forest	THLB
0-20	32,259	29,360	18	16
21-40	38,230	30,958	5,058	3,970
41-60	38,217	27,962	15,720	11,548
61-80	15,898	10,217	7,709	4,989
81-100	6,380	2,889	4,843	2,093
101-120	3,524	1,622	3,077	1,372
121-140	2,933	1,447	2,846	1,385
141-250	21,032	6,735	13,365	4,181
>250	30,179	9,064	21,043	6,507
Total	***188,652***	***120,254***	***73,678***	***36,061***

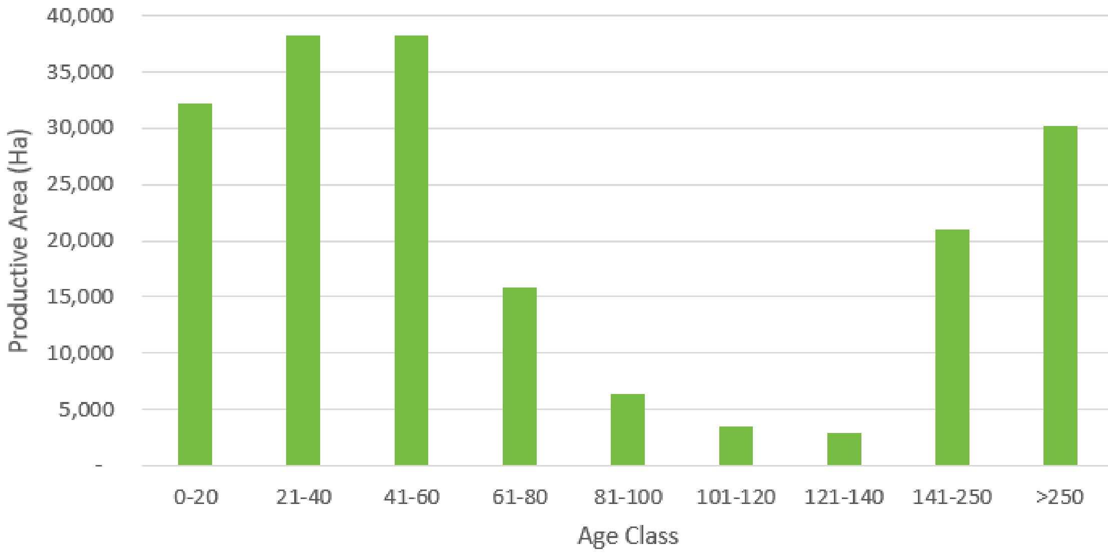

Figure 5 Productive Forest Age Class Distribution - Area

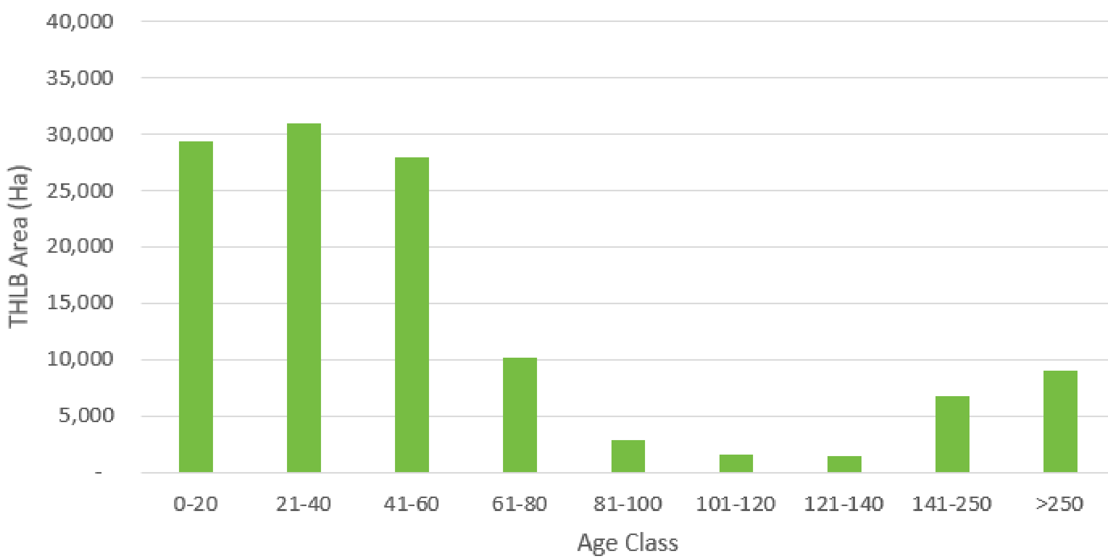

Figure 6 THLB Age Class Distribution – Area

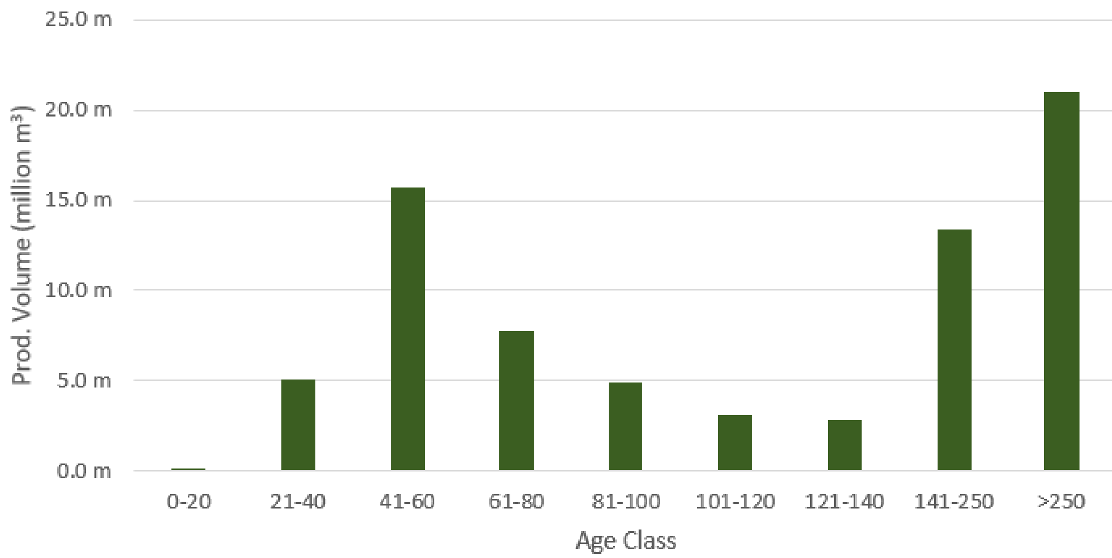

Figure 7 Productive Forest Age Class Distribution – Inventory Volume

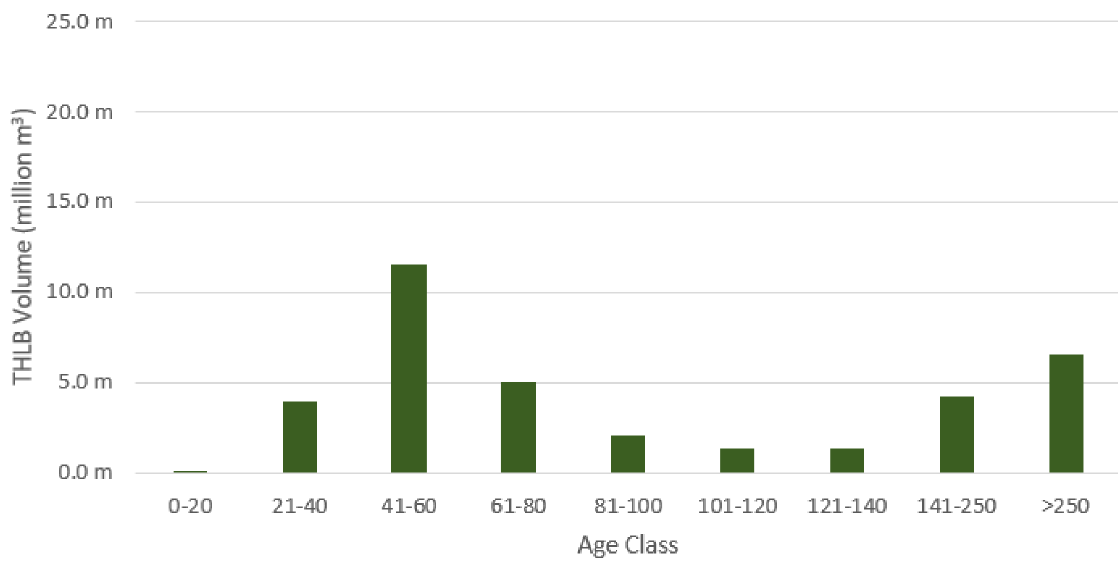

Figure 8 THLB Age Class Distribution - Inventory Volume

5.4 Age and Volume Projections

The Patchworks model will be constructed into five-year planning periods for 300 years. The initial age and volume data in Patchworks are projected to the year 2023, For areas recently harvested and awaiting reforestation, it is assumed that the new stand is established one year after the completion of harvest. For instance, areas harvested in 2023 are expected to be reforested in 2024 with 1-year-old seedlings, following the reforestation assumptions outlined in Section 8.2.7.

6 DESCRIPTION OF LAND BASE

This section provides a detailed description of the TFL 6 land base and outlines the methodologies employed to identify the portion of the land base that contributes to timber harvesting, referred to as the THLB. Despite certain portions of the productive land base not contributing directly to the harvest, they play a vital role in ensuring the sustainability of non-timber resources. These specific areas are categorized as NCLB. It is noted that the areas and volumes presented in all tables within this section may not sum up perfectly due to the rounding of figures to the nearest hectare (area) or 1,000 m^3 (volume).

6.1 AAC Allocation and Land Base Changes

The AAC determined based on TFL 6 MP #10 in February 2012 was 1,160,000 m^3. Following the transfer of TFL 39 Block 4 to TFL 6 as per Instrument #101 in January 2015, the AAC was revised to 1,362,000 m^3. In April 2021, the determination of the AAC was deferred for a period of two years.

Of the current AAC of 1,362,000 m^3, a substantial portion, 1,350,422 m^3 or 99.1%, is allocated to WFP. The remaining 11,578 m^3, which constitutes 0.9% of the AAC, is allocated to the Kwakiutl Forestry GP Corporation, owned by the Kwakiutl First Nation, under forest license A98197.

When the timber supply analysis dataset was compiled, the total area of TFL 6 was 217,200 hectares. This represents a net increase from the total area of 171,441 hectares at the time of the last AAC determination in February 2012. The increase in area is attributed to the addition of areas as documented in Instrument #101 in January 2015 due to addition of TFL 39 Block 4.

6.2 Timber Harvesting Land Base Determination

The Productive Forest Land Base (PFLB) refers to the area of productive forest within the TFL that contributes to landscape-level objectives such as biodiversity and the management of non-timber resources. This excludes non-forested areas, non-productive forest areas, and existing roads and powerlines.

The THLB is the portion of the TFL where timber harvesting is anticipated to occur. It is a subset of the PFLB, excluding areas that are inoperable, uneconomical for harvesting, or expected to be set aside for the management of non-timber resources. In practice, harvesting may occur outside the modelled THLB, as the THLB used in the analysis is a GIS-based estimate of an operational reality. The inclusion or exclusion of a specific site in the THLB does not necessarily dictate its management approach. As such, the estimate of the THLB has limited applicability outside of the timber supply analysis.

The THLB and the total long-term land base in TFL 6 are presented in Table 10, which includes the split between Schedule A (Timber Licence) and Schedule B (Crown land). Merchantable volume estimates are indicated in Table 11. These areas and volumes have been compiled from GIS databases constructed for the preparation of this Information Package. A visual representation of the THLB can be found in Figure 9.

Subsequent sections provide a comprehensive breakdown of the total area/volume categorized in each specific category listed in Table 10 and Table 11. These sections aim to summarize the area/volume that is subtracted from the land base, following the order of categories as depicted in the tables (i.e., addressing overlaps in a hierarchy).

Table 10 Timber Harvesting Land Base Netdown (ha) for TFL 6

Classification	Total Area (Ha)	Net Area (Ha)			% Total	% PFLB
		Schedule A	Schedule B	Grand Total		
		Timber Licence	Crown			
Total Land Base	**217,200**	**23,579**	**193,621**	**217,200**	**100.0%**	**-**
Less Non-forest	15,472	212	15,261	15,472	7.1%	-
Less Existing Roads & Powerlines	5,292	703	4,308	5,010	2.4%	-
Total Forested	**196,435**	**22,664**	**174,053**	**196,717**	**90.4%**	**-**
Less Non-productive	14,940	487	7,578	8,066	6.9%	-
Total Productive	**-**	**22,177**	**166,474**	**188,651**	**83.6%**	**100.0%**
Low Sites	20,485	887	8,631	9,518	4.4%	5.0%
Less Inoperable	52,414	1,730	16,168	17,898	8.2%	9.5%
Total Operable	**-**	**19,560**	**141,676**	**161,236**	**74.2%**	**85.5%**
Reductions:						
Riparian Management	57,173	564	4,857	5,422	2.5%	2.9%
Ungulate Winter Ranges	2,366	1	1,486	1,486	0.7%	0.8%
Old Growth Management Areas	16,145	7	4,987	4,993	2.3%	2.6%
Old Growth Management Areas - Proposed	17,609	389	4,100	4,489	2.1%	2.4%
Wildlife Habitat Areas - Legal	2,759	1	407	408	0.2%	0.2%
Wildlife Habitat Areas - Proposed	676	1	16	17	0.0%	0.0%
Uneconomic	52,500	0	11	11	0.0%	0.0%
Deciduous-leading	4,294	34	1,500	1,534	0.7%	0.8%
Recreation	20	0	7	7	0.0%	0.0%
Known Archaeological Sites	897	186	356	542	0.2%	0.3%
Existing Stand-level Reserves	7,750	576	2,441	3,018	1.4%	1.6%
Research Site	112	-	13	13	0.0%	0.0%
Terrain Stability	19,216	941	9,391	10,333	4.8%	5.5%
Permanent Sampling Plots	180	-	136	136	0.1%	0.1%
Big Tree Reserves	85	18	24	42	0.0%	0.0%
Karst	26,673	569	3,121	3,690	1.7%	2.0%
Unknown Cultural Features within Quatsino TUS Zone	57,910	66	381	447	0.2%	0.2%
Future Stand-level Reserves	-	459	3,943	4,402	2.0%	2.3%
Total Operable Reductions	**-**	**3,812**	**37,177**	**40,989**	**18.9%**	**21.7%**
Current THLB	**-**	**15,749**	**104,505**	**120,254**	**55.4%**	**63.7%**
Less future roads	2,136	160	1,276	1,436	0.7%	0.8%
Long-term Land base	**-**	**15,589**	**103,228**	**118,818**	**54.7%**	**63.0%**

Table 11 Timber Volume[1] Netdown ('000 m³) for TFL 6

Classification	Total Volume ('000 m³)	Net Volume ('000 m³)			% Total	% PFLB
		Schedule A	Schedule B	Grand Total		
		Timber Licence	Crown			
Total Land Base	**76,151**	**6,911**	**69,240**	**76,151**	**100.0%**	**-**
Less Non-forest	161	3	158	161	0.2%	-
Less Existing Roads & Powerlines	1,115	86	1,030	1,115	1.5%	-
Total Forested	**74,875**	**6,822**	**68,053**	**74,875**	**98.3%**	**-**
Less Non-productive	1,370	86	1,111	1,197	1.8%	-
Total Productive	**-**	**6,737**	**66,942**	**73,678**	**96.5%**	**100.0%**
Low Sites	4,428	314	3,317	3,631	4.8%	4.9%
Less Inoperable	18,930	1,164	10,396	11,560	15.2%	15.7%
Total Operable	**-**	**5,259**	**53,229**	**58,487**	**76.8%**	**79.4%**
Reductions:						
Riparian Management	2,107	181	1,926	2,107	2.8%	2.9%
Ungulate Winter Ranges	1,679	0	1,163	1,164	1.5%	1.6%
Old Growth Management Areas - Legal	8,455	6	3,515	3,521	4.6%	4.8%
Old Growth Management Areas - Proposed	9,069	274	2,836	3,110	4.1%	4.2%
Wildlife Habitat Areas - Legal	2,233	1	230	231	0.3%	0.3%
Wildlife Habitat Areas - Proposed	556	0	14	14	0.0%	0.0%
Uneconomic	18,952	0	3	3	0.0%	0.0%
Deciduous-leading	1,608	11	543	555	0.7%	0.8%
Recreation	10	0	4	4	0.0%	0.0%
Known Archaeological Sites	10	82	132	213	0.3%	0.3%
Existing Stand-level Reserves	5,684	425	1,808	2,233	2.9%	3.0%
Research Site	7	0	7	7	0.0%	0.0%
Terrain Stability	9,940	581	5,347	5,928	7.8%	8.0%
Permanent Sampling Plots	81	0	49	49	0.1%	0.1%
Big Tree Reserves	56	10	12	22	0.0%	0.0%
Karst	10,853	146	1,159	1,305	1.7%	1.8%
Unknown Cultural Features within Quatsino TUS Zone	22,868	28	182	211	0.3%	0.3%
Future Stand-level Reserves	-	162	1,592	1,754	2.3%	2.4%
Total Operable Reductions	**-**	**1,908**	**20,522**	**22,430**	**29.5%**	**30.4%**
Current THLB	**-**	**3,351**	**32,710**	**36,061**	**47.4%**	**48.9%**

[1] Data updated to the December 31, 2023 for harvest history and ages; therefore, volumes listed represent estimates at the end of 2023.

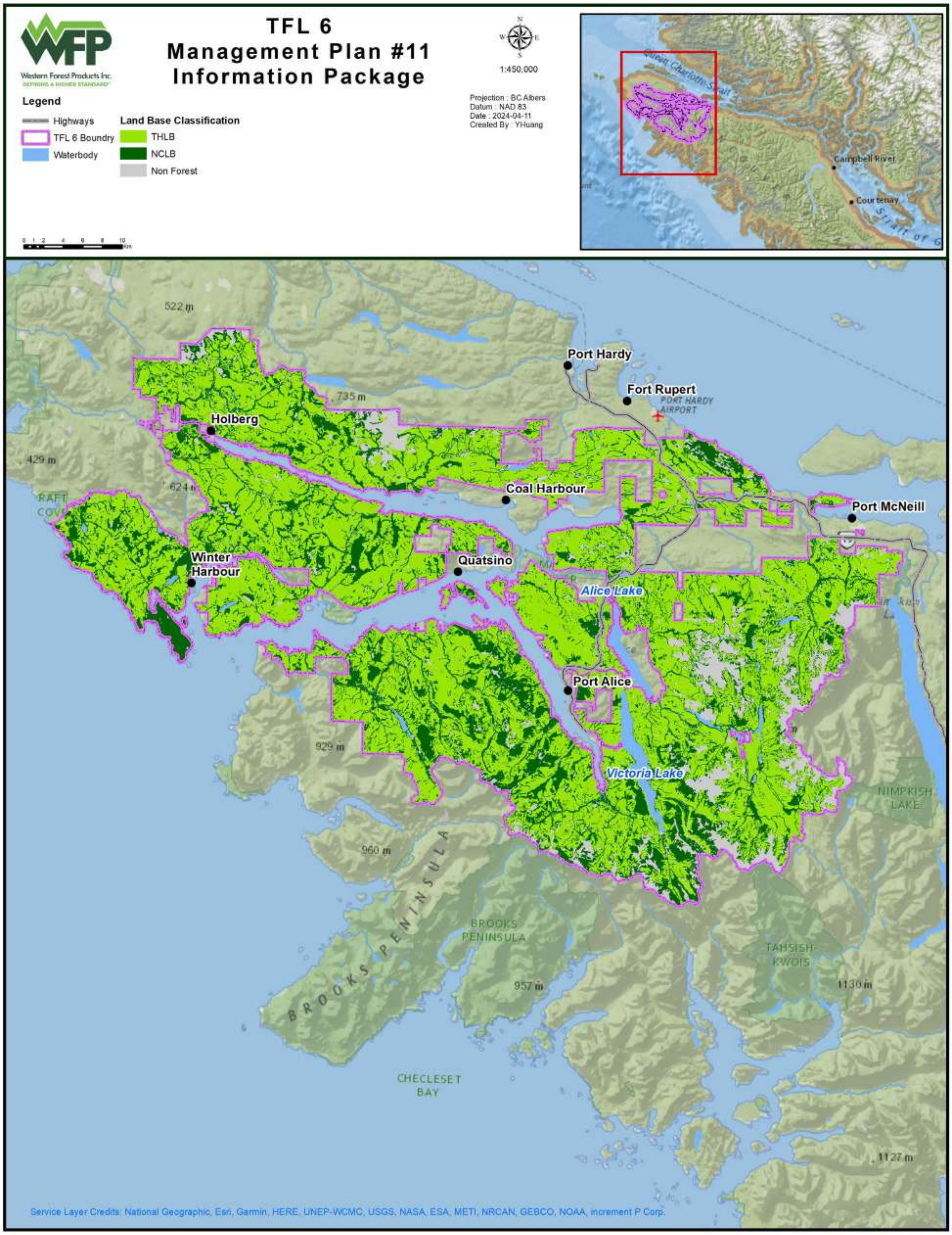

Figure 9 TFL 6 Land Base Classification

For TFL 6 MP #10 in 2011, land base reductions amounted to 37.1% of the total area of the TFL. However, forest cover constraints and aspatial netdowns were applied, further reducing the effective

THLB. For MP #11, the reductions are 96,946 hectares or 44.6% of the total area, resulting in a THLB area of 120,254 hectares. Apart from increased forestry and land regulations since MP #10, the most significant changes are due to the utilization of LiDAR to identify non-productive patches, low productivity patches, inoperable areas, and a full riparian network. Additionally, old growth management areas (rather than being an aspatial forest cover constraint as was done in MP #10), and more draft wildlife habitat areas have been spatially defined.

In order to assess the sensitivity regarding potential over or under-estimation of THLB for timber supply impact, sensitivity analyses will be performed by increasing and decreasing THLB values in all polygons by 10%.

6.3 Recently Harvested Cutblocks

For cutblocks that were harvested or planned between 2001 and 2023, and for which Site Plan Standard Unit (SU) spatial data is available, the productive forest area, also known as the net area to reforest (NAR), will be designated as 100% THLB. The roads and reserves associated with these cutblocks, including Wildlife Tree Patches (WTPs), Wildlife Tree Retention Areas (WTRAs), retention patches, and others, will be designated as 0% THLB. The year 2001 was chosen as the starting point to align with recently managed stand era (see Section 7.3.1.2.2 for more details).

For the remaining land base, specific deductions will be applied in a sequential order to establish the THLB. These deductions account for the cumulative impact of each factor, ensuring that the final THLB value reflects the combined effect of all exclusions. Detailed tables outlining each THLB deduction factor are provided in later sections. This sequential approach ensures a comprehensive and systematic determination of the THLB. While some factors may encompass large areas within TFL 6 individually, the actual reduction in THLB area may be less significant due to overlapping exclusions being considered.

6.4 Non-Forest Areas

The areas within TFL 6 that are not forested primarily consist of the land base where commercially viable tree species are largely absent. These non-forested areas do not contribute to the timber supply objectives outlined in the timber supply analysis and are therefore excluded from the THLB. A detailed breakdown of the area reduction due to non-forested areas can be found in Table 12. Additionally, Figure 10 offers a visual representation of these areas within TFL 6.

Table 12 Non-forest Area in TFL 6

Description	Gross Area (ha)	Area Reduction (ha)
Non-Forest	14,789	14,789
Waterbody	683	683
Total	***15,472***	***15,472***

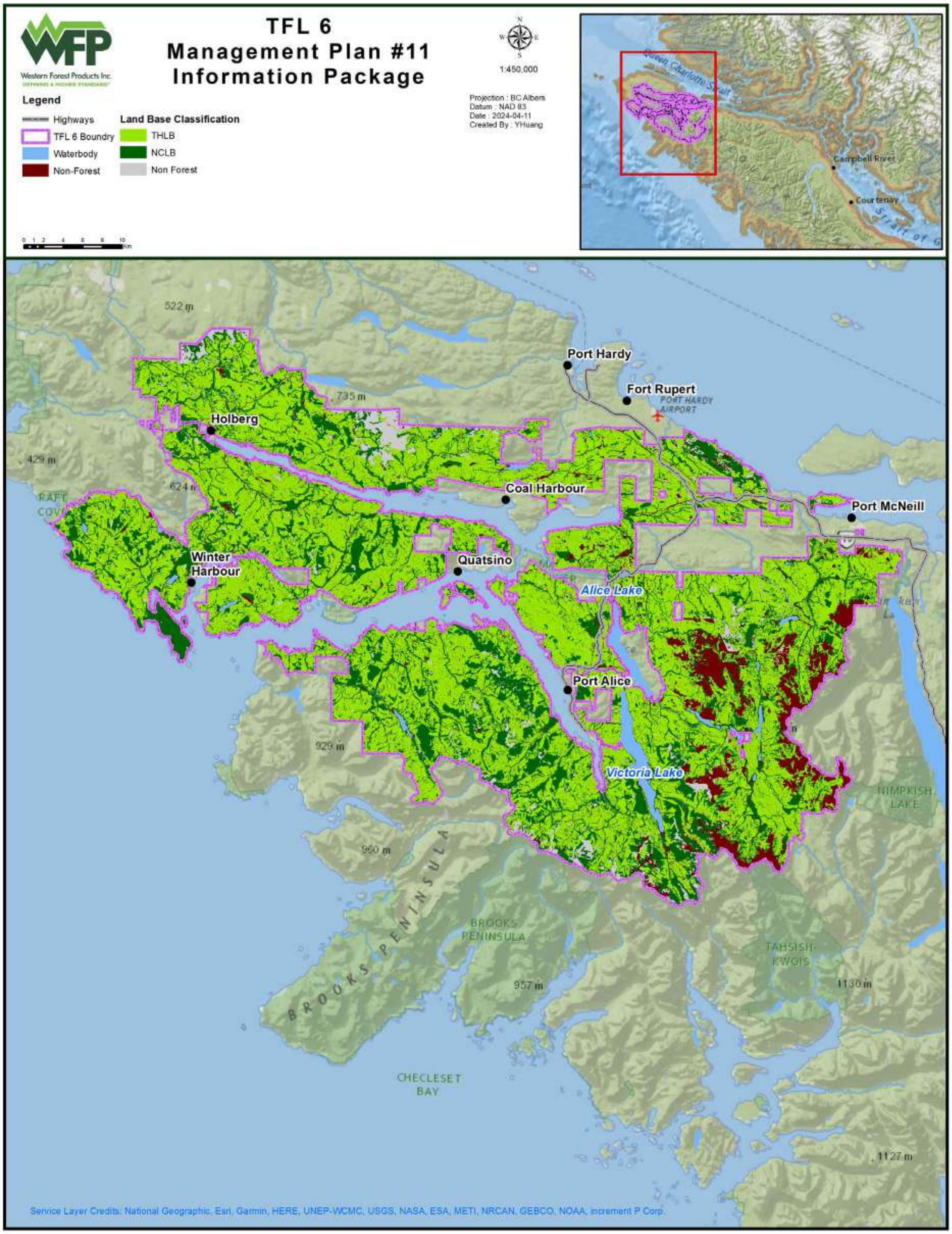

Figure 10 Non-forest Area in TFL 6

6.5 Existing Roads and Powerlines

Existing roads and powerlines are not included as part of the THLB. This exclusion encompasses both classified and unclassified roads. Classified roads are those that are distinctly delineated as forest cover areas, separate from adjacent polygons. Notably, sections of Highway 19, Highway 30, and Coal Harbour Road are incorporated within the TFL. In contrast, unclassified roads are represented as polyline features in the GIS database. For the purposes of determining the area of features represented by a line, varying total widths are applied depending on the class.

- Highway – 16m
- Mainlines – 10m
- Spurs and Unclassified – 8m
- Powerlines – 15m

The buffer widths for various road classes were established through a review of past MPs for TFL 6 (Western Forest Products Inc., 2011) and the TSR Data Package (Province of British Columbia, 2020) for the surrounding North Island Timber Supply Area (TSA) which encompasses roads linked to TFL 6.

As for trails and the majority of landings, they are typically replanted following harvesting. Consequently, the reduction in area associated with these features is considered negligible in the modelling process. Table 13 provides a summary of the areas covered by existing roads and powerlines within the TFL. It is noted that this table also defines the hierarchy for attributing overlapping roaded areas in the land base. For example, a mainline takes precedence over powerlines for attribution in buffered areas.

Table 13 Existing Roads and Powerlines in TFL 6

Feature Class	Total Buffer Width (m)	Gross Area (ha)	Area Reduction (ha)
Highway	16	66	47
Mainline	10	999	930
Branch/Spurs/Unclassified	8	3,966	3,890
Powerlines	15	262	144
Total		***5,292***	***5,010***

6.6 Non-Productive Forests

TFL 6 includes 14,940 hectares of non-productive forest, as detailed in Table 14. These areas are primarily composed of forests situated on sites of inferior quality. The categorization of these non-productive areas originates from two primary sources:

- Forest Cover Inventory: These areas are identified based on specific inventory parameters. Mature stands are defined as those having an inventory volume of less than 200 m^3/ha, or immature stands with a site index (SI) of less than 5m.
- LiDAR-Based LBB Process: This process involves the use of various LiDAR-derived data to assess the productivity of stands.

As outlined in Section 5.2.1, the LBB utilizes high-resolution LiDAR data on ground surfaces and canopy heights. This data empowers forest professionals to evaluate potential areas suitable for timber harvesting and road development. More specifically, non-productive forests, low productive forests, and potential areas for future harvesting and road construction were spatially delineated. Subsequently, appropriate harvesting methods are assigned to the designated areas. Non-productive forest areas are identified as part of the LBB process. Examples include small, low-height tree crowns within old-growth forest stands.

While non-productive forests are not directly included in formal biodiversity calculations, they contribute to the overall landscape biodiversity by providing a buffer zone around areas with critical biodiversity requirements.

Table 14 Non-Productive Area in TFL 6

Description	Gross Area (ha)	Area Reduction (ha)
Non-productive / Scrub Forest - Inventory	7,699	6,791
Non-productive / Scrub Forest - LBB	7,241	1,275
Total	***14,940***	***8,066***

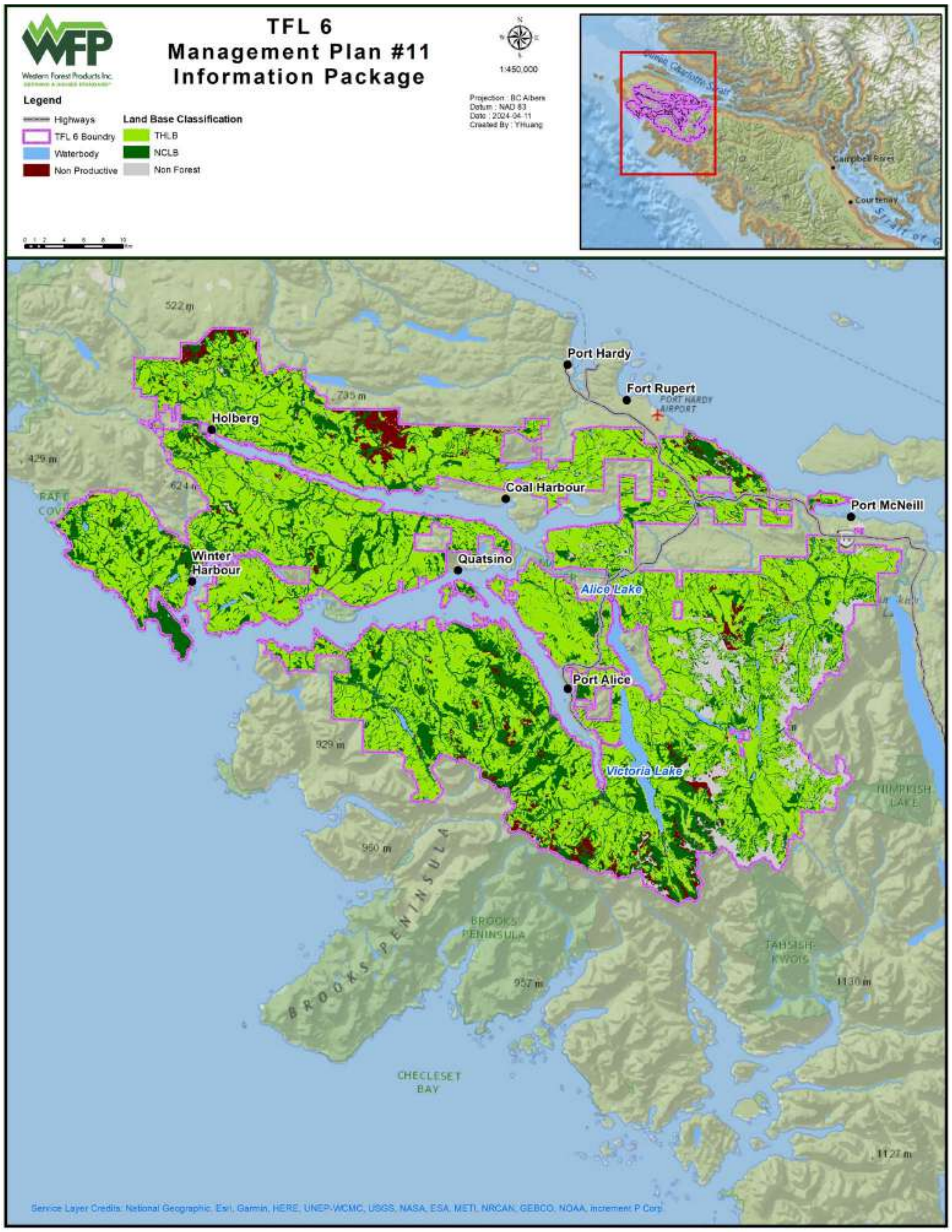

Figure 11 Non-Productive Forest Area in TFL 6

6.7 Low Productivity Sites

Low-productivity sites are currently deemed inoperable due to their limited timber volume, making harvesting economically or practically infeasible. They can be identified through either:

- Forest cover inventory: old seral forests with a standing timber volume of less than 300 m³/ha.
- LiDAR-Based LBB Process: This process involves the use of various LiDAR-derived data to enable efficient identification of low-volume stands.

Table 15 provides details regarding the total area and the impact on the THLB of these low-productivity sites within the TFL.

Table 15 Low Productivity Sites in TFL 6

Description	Gross Area (ha)	Area Reduction (ha)
Low Sites - Inventory	4,332	1,678
Low Sites - LBB	16,153	7,840
Total	***20,485***	***9,518***

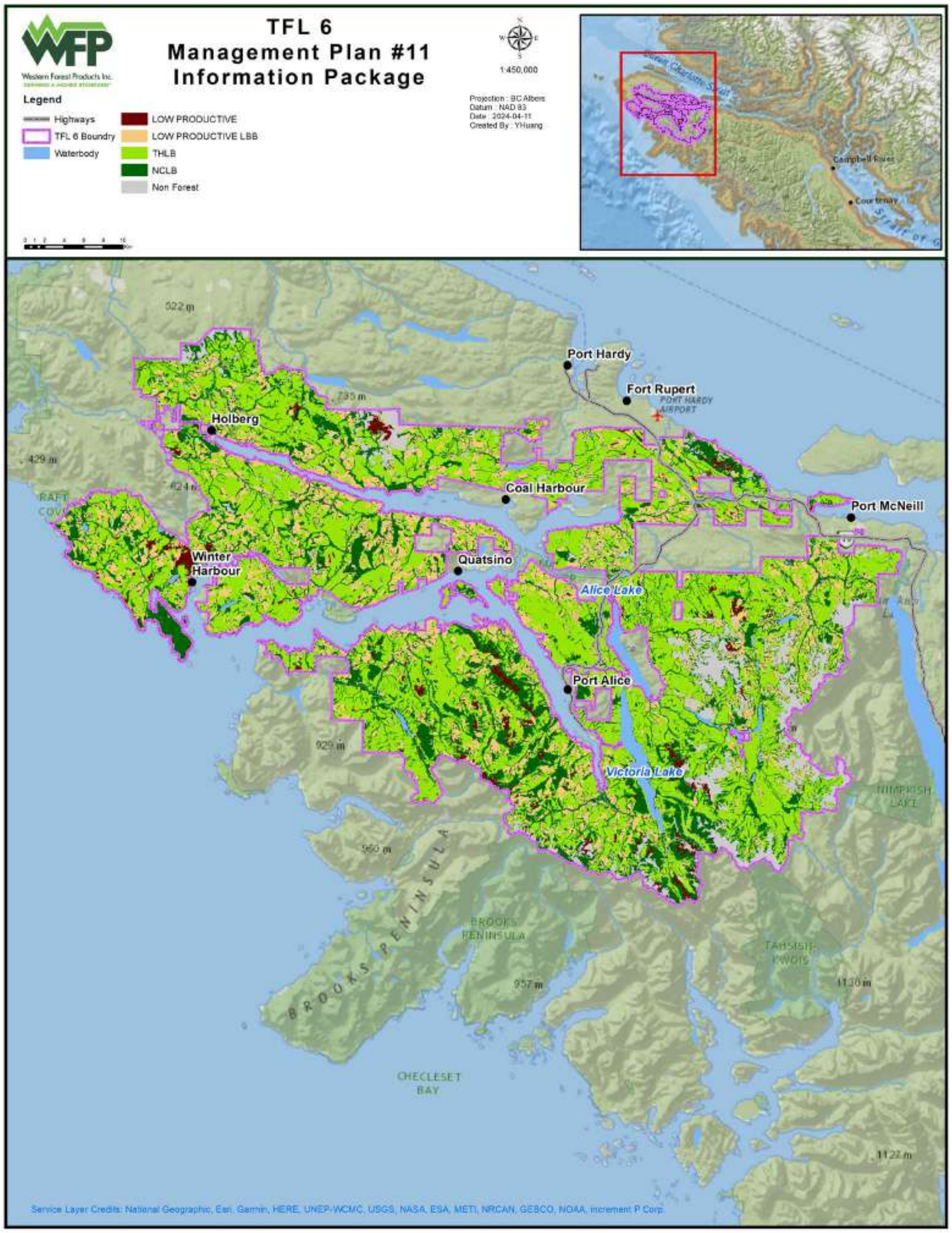

Figure 12 Low Productivity Sites in TFL 6

6.8 Physical Operability

Physical operability mapping categorizes areas based on their suitability for timber harvesting using different methods:

- Conventional: These areas are accessible for ground-based harvesting systems like skidders, feller bunchers, and cable systems.
- Non-conventional: These areas have access limitations that necessitate aerial harvesting systems like helicopters.

- Inoperable: These areas are deemed unsuitable for harvesting due to various factors.

The most recent update to the physical operability map for MP #11 utilized LiDAR data obtained through the LBB process (described in Section 5.2.1). Areas were designated as inoperable based on a comprehensive evaluation, considering safety factors, operational efficiency, environmental sensitivity, and local knowledge. Harvesting in these areas is unfeasible due to issues related to accessibility, soil sensitivity, or risks to worker safety.

Table 16 summarizes the productive area and productive timber volume within each physical operability class.

Table 16 Area and Volume by Physical Operability Types in TFL 6

Harvest System	Productive Area (ha)	Volume (000 m^3)	% of Productive Area	% of Productive Volume
Conventional	147,956	49,918	78%	68%
Non-conventional	9,234	6,171	5%	8%
Operable (subtotal)	**157,190**	**56,089**	**83%**	**76%**
Inoperable + Low Sites	31,462	17,590	17%	24%
Total	***188,652***	***73,678***	***100%***	***100%***

Only inoperable areas are removed from the THLB (see Table 17).

Table 17 Inoperable Areas in the TFL 6

Description	Gross Area (ha)	Area Reduction (ha)
Inoperable	52,414	17,989

A comparison between the harvested area from 2012 to 2023 by different harvest systems and the overall TFL 6 THLB area is shown in Table 18.

Table 18 2012-2023 Harvest Area by MP #11 Operability Type

Harvest System	% of Harvest Area	% of THLB Area
Ground	57.6%	56.8%
Cable	40.3%	39.9%
Conventional (subtotal)	**97.9%**	**96.8%**
Non-conventional	1.2%	3.2%
Inoperable + Low Sites	0.9%	N/A
Total	***100.0%***	***100.0%***

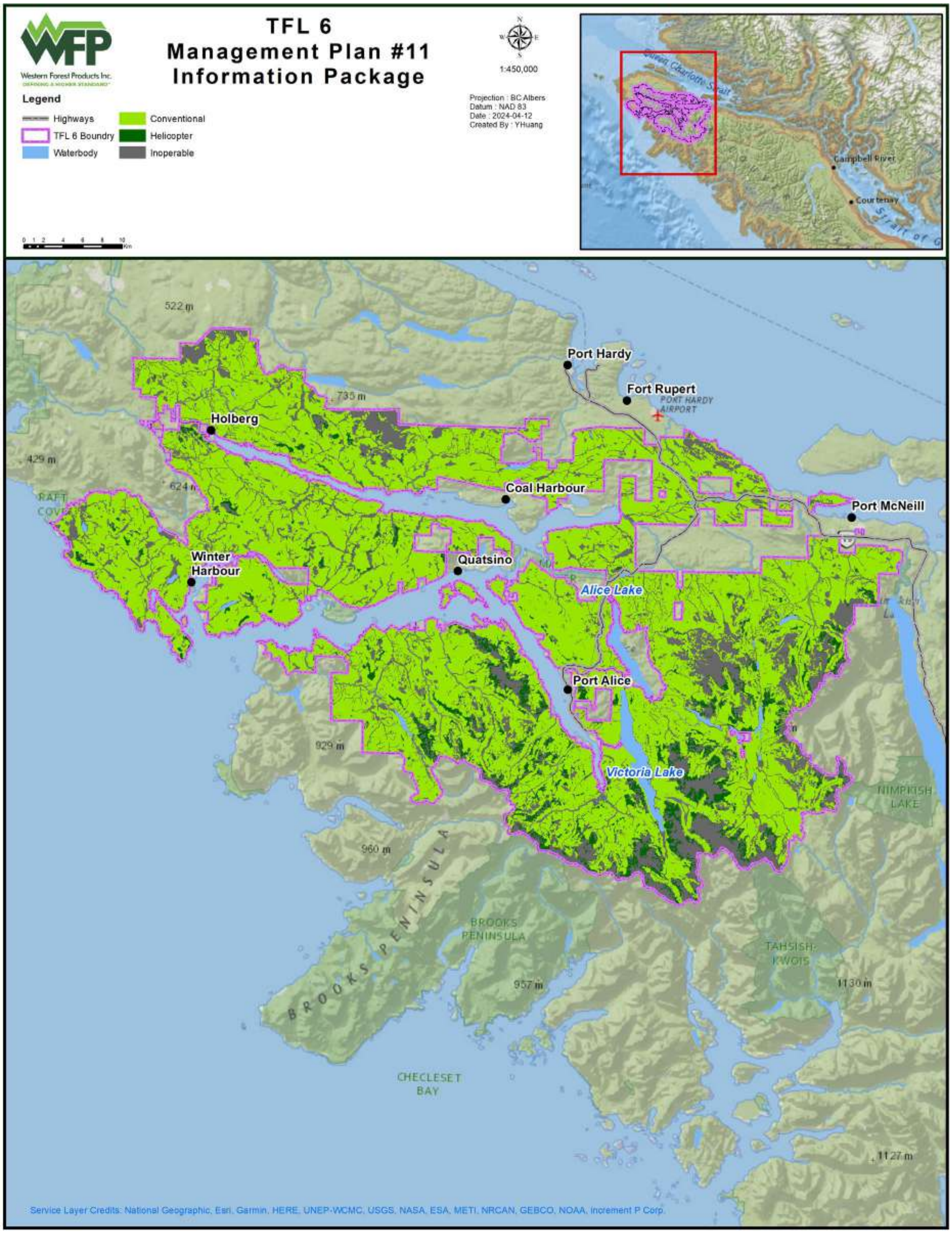

Figure 13 Physical Operability Classes in TFL 6

6.9 Riparian Management Areas

WFP continuously maps and classifies detailed riparian features through forestry operations and cutblock development in TFL 6. Operational stream inventories associated with development planning have been conducted since 1988 (with the introduction of the *Coastal Fisheries Forestry Guidelines*) and various reconnaissance (1:20,000) fish and fish habitat inventory projects have been completed. This combination of 1:5,000 scale (operational) and 1:20,000 scale (strategic) stream data provide the basis for estimating riparian classes and reserve areas for waterbodies.

Since LiDAR became available in the TFL 6, stream locations can be predicted based on LiDAR bare earth ground conditions, topology, and flow accumulation information. But traditionally, the detailed stream classification still relies on fieldwork. For MP #11, a separate project was completed by Forsite Consultants Ltd. to assign stream riparian classes to the LiDAR derived stream network via supervised classification. This involved:

1. Building a training dataset: Using verified streams with known classifications, a subset of LiDAR-derived streams was chosen to train the model and obtain the parameter values.
2. Developing stream channel width classes: using LiDAR data and GIS geo-processing tools. stream flow was predicted and then each stream segment was categorized based on predicted width.
3. Classifying streams as fish-bearing or non-fish-bearing: combining various data sources, including verified stream classes, community watersheds, elevation, slope, and known fish presence information, fish presence in each stream segment was predicted.
4. Data verification: GIS and forestry professionals conducted a thorough review, comparing field-verified streams to LiDAR-classified streams in cutblocks areas with detailed field data. Whenever discrepancies arose, adjustments to parameters or riparian classes were implemented. This review ensured data accuracy and integrity.

The resulting LiDAR-classified stream dataset, with assigned classes, serves as the foundation for land-use classification. The MP #11 utilizes this LiDAR classified dataset to Riparian Management Areas (RMAs) to streams, lakes, and wetlands. These RMAs are based on the widths outlined in the FRPA Riparian Reserve Zone (RRZ) regulations and assumed levels of tree retention within the Riparian Management Zones (RMZs). Details on these assumed retention levels and effective RMA widths are listed in Table 19. Retention levels were estimated based on a review of 871 cutblocks harvested between 2012 and 2023. Additionally, as most S2-S6 streams are represented by lines on maps, the effective management area width accounts for the actual stream waterbody width.

LiDAR technology has revolutionized our understanding of the riparian network in TFL 6. It has revealed a significant number of previously undetected smaller S4 and S6 streams, traditionally identified through fieldwork. It is crucial to acknowledge, however, that LiDAR can struggle with accurately predicting smaller channels and may potentially overestimate the true extent of S4 and S6 RMAs as documented in peer-reviewed studies (James, Watson, & Hansen, 2007; Solomons, Mikhailova, Post, & Sharp, 2015). Therefore, to ensure consistency with observed conditions, the retention level within S4 RMZs has been adjusted to match that of field-verified S4 RMZs. For S6 streams, due to the limitations of LiDAR, management currently occurs at the stand level during operations, and no buffer is applied in the timber supply modelling. Further details regarding the enhanced stand-level retention strategy for S6 streams can be found in Section 6.23 and Section 10.4.3.

Finally, a 40-meter reserve zone will be applied along the entire TFL 6 ocean shoreline. This zone accounts for managing visual quality, operational considerations, and the presence of wildlife and cultural features within this important coastal shoreline area.

Riparian management areas are defined by slope distance in the field. However, modelling these zones in GIS typically uses horizontal distance. This discrepancy leads to a slight over-estimation of the actual area removed from the THLB for riparian management in the timber supply analysis.

Compared to MP #10, the reduction in THLB area due to RMAs in this section is less than half. This is because a detailed operability review using LiDAR data (referred to as the LBB process in Section 5.2.1) has already identified and excluded non-productive areas from the land base. Consequently, the remaining area specifically impacted by riparian buffers is smaller. A similar situation also applies in TFL 44, where LBB is also used for operability mapping (Tsawak-qin Forestry Limited Partnership, 2023).

Table 19 Riparian Management Areas in TFL 6

Riparian Feature Class	Size Class	Riparian Reserve Zone (m)	Riparian Management Zone		Effective Management Area (m)[1]	Gross Area (ha) RRZ + RMZ	Area Reduction (ha)
			Width (m)	Netdown (%)			
Ocean	*N/A*	40	0	100	40	1,088	-
Streams	*Width (m) / Fish Source*						
S1	>20.0	50	20	85	67	1,193	107
S2	>=5.0 - 20.0	30	20	65	43	4,309	917
S3	>=1.5 - 5.0	20	20	50	30	8,615	2,939
S4	<1.5 - fish bearing	0	30	25	7.5	2,153	299
S5	>3.0 - non-fish bearing	0	30	60	18	4,180	895
S6	<3.0 - non-fish bearing	0	20	Captured at Stand Level	No Buffer	29,871	-
Lakes	*Area (ha)*						
L1-A	>=1000	0	40	100	40	233	71
L1-B	>5.0 - 1000	10	0	100	10	112	23
L2	1.0 - 5.0 When located in CDF or CWH xm, dm, ds, or mm	10	20	25	15	-	-
L3	1.0 - 5.0	0	30	65	20	143	17
L4	0.5 - 1.0 When located in CDF or CWH xm, dm, ds, or mm	10	20	25	15	-	-
Wetlands	*Area (ha)*						
W1	>=5.0	10	40	50	30	267	56
W2	>=1.0 - 5.0 When located in CDF or CWH xm, dm, ds, or mm	10	20	50	20	-	-
W3	>=1.0 - 5.0	0	30	50	15	489	85
W4	>=0.5 - 1.0 When located in CDF or CWH xm, dm, ds, or mm	10	20	25	15	-	-
W5	Wetland complex	10	40	50	30	105	12
Total						***52,758***	***5,422***

6.10 Ungulate Winter Ranges

An Ungulate Winter Range (UWR) is a designated habitat area critical for the winter survival of ungulate species, such as Columbian black-tailed deer and Roosevelt elk in TFL 6 (U-1-006 and U-1-010).

[1] Effective Management Area = RRZ + (RMZ *(netdown %/100)). This width is applied to both sides of streams and to the perimeter of lakes and wetlands.

These UWRs, like most landscape-level reserves, were initially designed based on broad-scale data. Consequently, as more detailed field data becomes available, discrepancies in UWR boundaries may arise at the operational level, requiring potential adjustments. Such adjustments necessitate government approval, as exemplified by the amendment made and approved for U-1-006 in 2021.

Due to inconsistencies in tenure information, a small portion of UWRs KLA-02 and NAH-08 from the North Island TSA (U-1-011) falls within the boundaries of TFL 6. These areas are included in the analysis dataset, and they will be excluded from the THLB.

Table 20 and Figure 14 provide details regarding the current UWR area designations and their associated reductions to the THLB.

Table 20 Ungulate Winter Ranges in TFL 6

UWR ID	Species	Gross UWR Area (ha)	Productive UWR Area (ha)	Area Reduction (ha)
u-1-006	Black-tailed Deer / Roosevelt Elk	489	417	259
u-1-010	Black-tailed Deer	1,876	1,845	1,227
u-1-011	Black-tailed Deer / Roosevelt Elk / Mountain Goat / Moose	1	1	1
Total		***2,366***	***2,262***	***1,487***

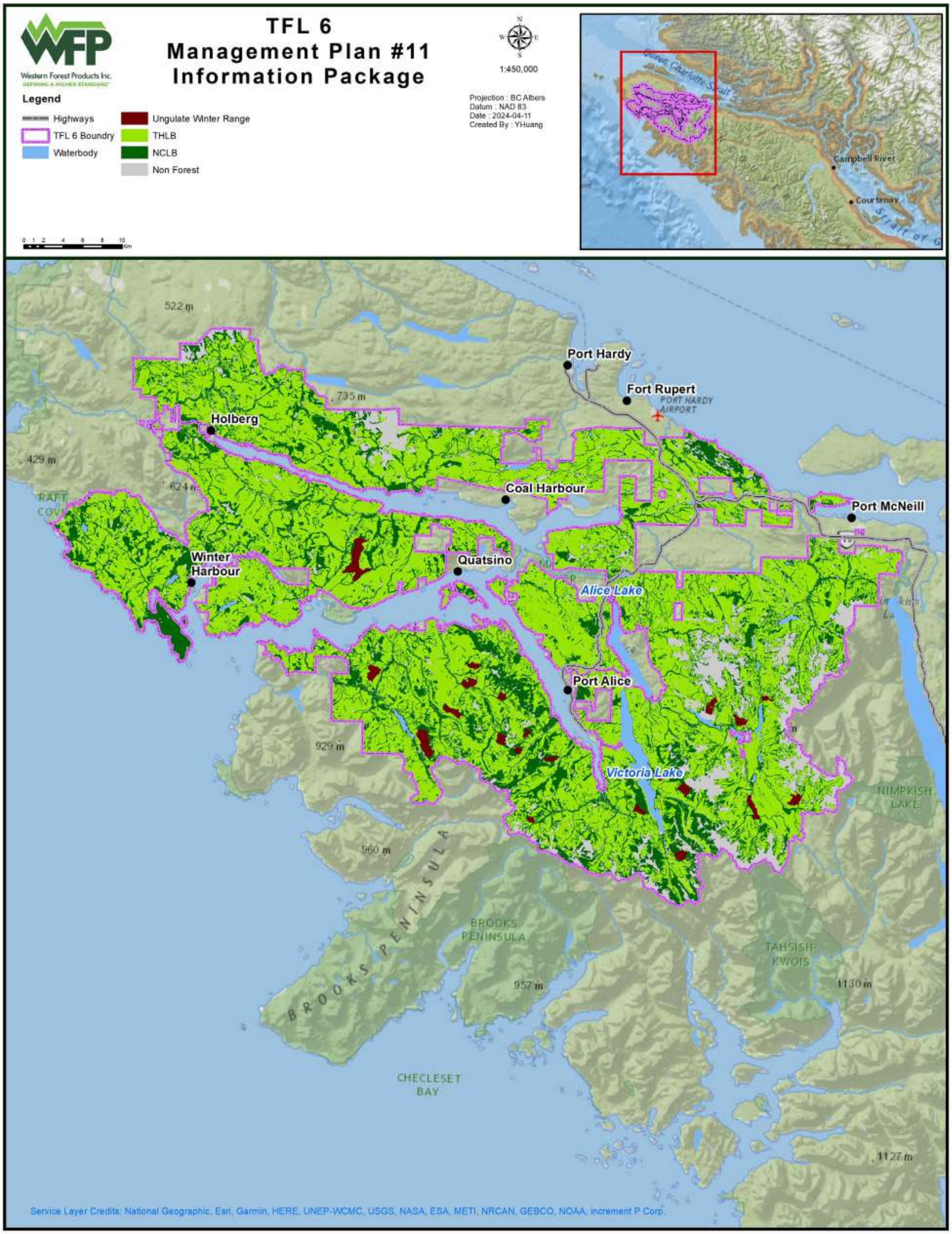

Figure 14 Ungulate Winter Ranges in TFL 6

6.11 Old Growth Management Areas

Landscape Units (LUs) are designated land areas used for long-term resource management planning in British Columbia. These units typically encompass 50,000 to 100,000 hectares in size.

On June 30, 2004, the *Order Establishing Provincial Non-Spatial Old Growth Objectives* (NSOG order) assigned Biodiversity Emphasis Options (BEOs) and old forest conservation targets to LUs. This order remains in effect until Old Growth Management Areas (OGMAs) are established through individual Landscape Unit planning processes. The NSOG order allows reducing old forest retention targets by up to two-thirds in LUs with a Low BEO, aiming to balance conservation with timber supply needs.

TFL 6 has legally established OGMAs within the San Josef (2005) and Marble (2010) landscape units. In the Marble Enhanced Forestry Zone (EFZ), VILUP Objective #10 was applied to reduce the total old growth retention target by one-third within the Marble LU. However, this was conditional upon identifying suitable younger second-growth forests for future recruitment. Lower Nimpkish LU also has legally established OGMAs, but due to minimal overlap, none fall within TFL 6 boundaries. A small portion of Nahwitti LU's legally established OGMAs is, however, included within TFL 6.

Proposed OGMAs have been identified in the Holberg, Keogh, Mahatta, and Neroutsos LUs (only covering both TFL 6 and unregulated Timber Licences that WFP holds). These proposed OGMAs aim to meet the NSOG order requirements and are currently included in the timber supply analysis. However, these proposed OGMAs are subject to a public and First Nations' review process before they become legally binding.

The proposed OGMAs in LUs with a Low BEO are of sufficient size to meet old forest seral targets for the first rotation (80 years) across all BEC variants. In some cases, enough area has been identified to meet the full target. Goals for the second (160 years) and third (240 years) rotations are addressed based on landscape level biodiversity old seral targets (see details in Section 10.3.3).

The legal and proposed OGMA are excluded from contributing to THLB in the model. Table 21 illustrates the total, productive areas, and the corresponding reductions in THLB area per LU. A spatial overview is provided in Figure 15.

Table 21 Old Growth Management Areas in TFL 6

Landscape Unit	BEO	OGMA Status	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Marble	Intermediate	Legal	9,703	6,255	2,194
Nahwitti	Intermediate	Legal	2	2	1
San Josef	Intermediate	Legal	6,440	6,065	2,798
Established OGMAs (subtotal)			***16,145***	***12,321***	***4,993***
Holberg	Low	Proposed	4,708	2,913	934
Keogh	Low	Proposed	4,455	2,946	1,365
Mahatta	Low	Proposed	3,490	3,148	772
Neroutsos	Low	Proposed	4,956	4,304	1,418
Draft OGMAs (subtotal)			***17,609***	***13,311***	***4,489***
OGMAs Total			***33,754***	***25,632***	***9,482***

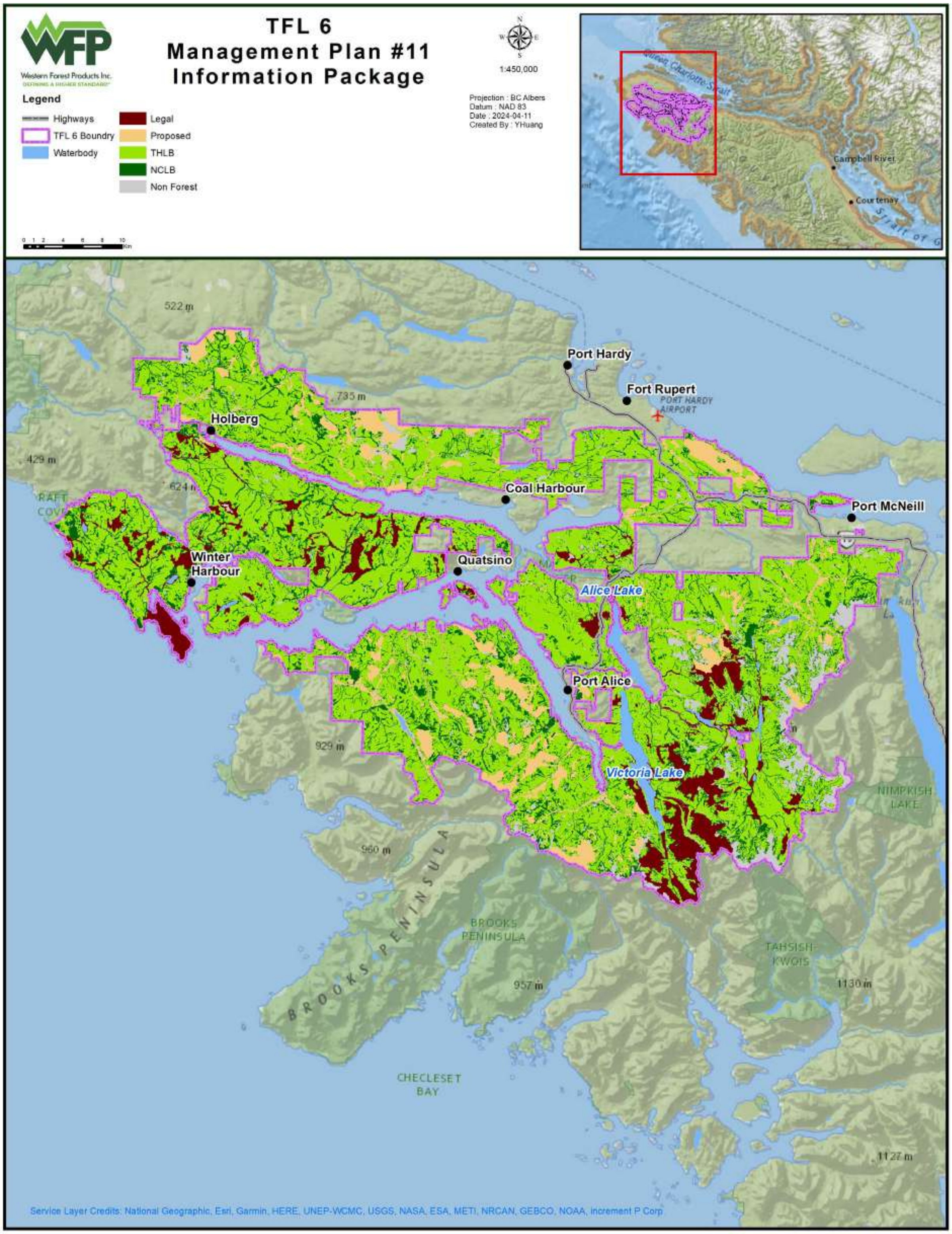

Figure 15 Legally Established and Proposed Old Growth Management Areas in TFL 6

6.12 Wildlife Habitat Areas

Wildlife Habitat Areas (WHAs) are designated areas established to protect the habitat of species at risk. When no WHAs are present, the *Forest Planning and Practices Regulation* (FPPR) Section 7 requires Forest Stewardship Plan (FSP) holders to address species at risk habitat through specific results and strategies.

6.12.1 Legally Established WHAs

At the time of the timber supply analysis dataset compilation, 40 approved WHAs encompassed 2,759 hectares within TFL 6 (Figure 16). These WHAs comprise 2,679 hectares of productive forest (Table 22). Four WHAs (1-089, 1-721, 1-722, and 1-723) are established for Northern Goshawk and the rest of the WHAs are established for Marbled Murrelets. Notably, most WHAs are also OGMAs, minimizing the amount of incremental change to the THLB.

Table 22 Legally Established Wildlife Habitat Areas in TFL 6

Description	WHA Status	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Wildlife Habitat Area - Marbled Murrelet	Legal	2,054	2,000	15
Wildlife Habitat Area - Northern Goshawk	Legal	705	679	393
Legal WHAs Total		***2,759***	***2,679***	***408***

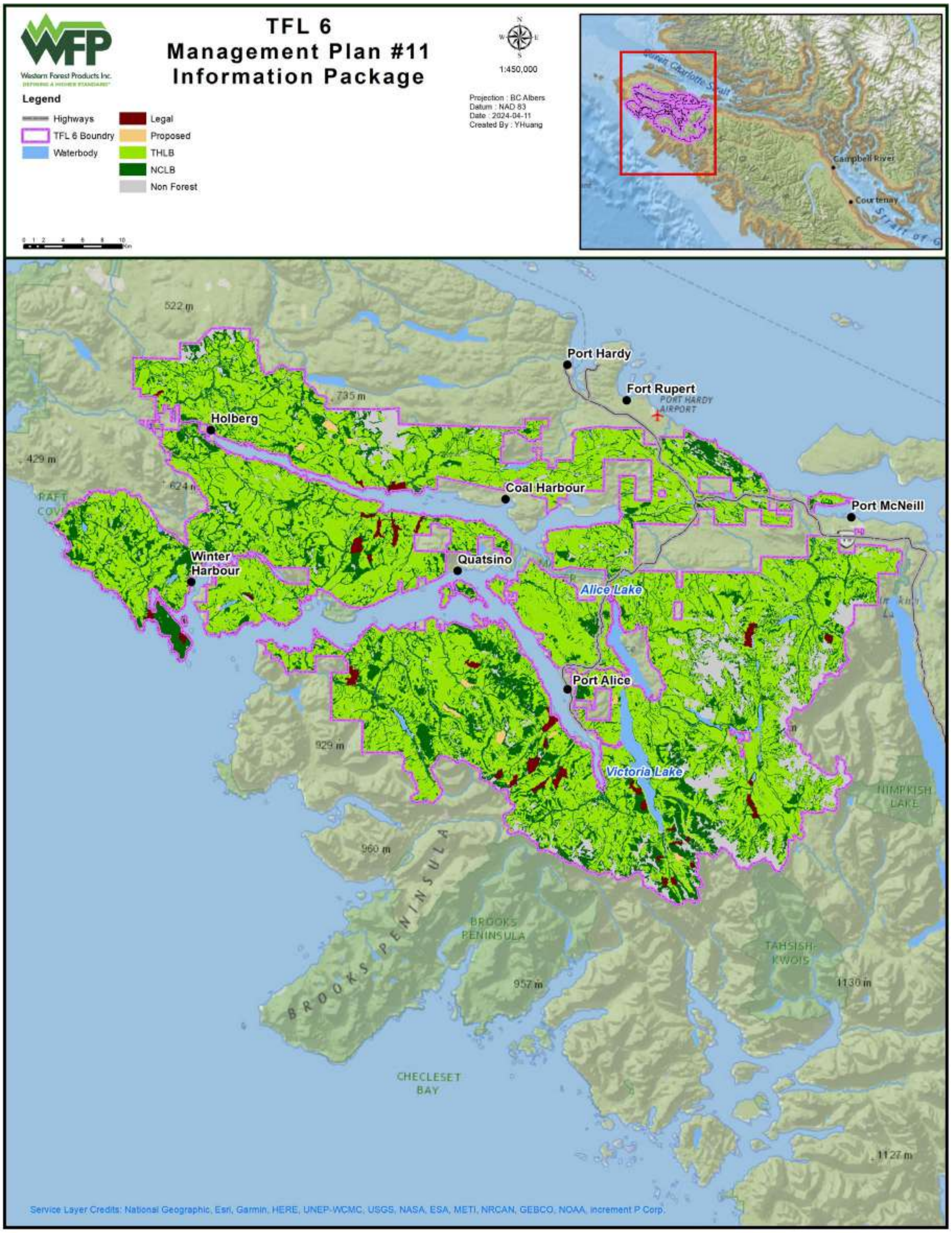

Figure 16 Legally Established and Proposed Wildlife Habitat Areas in TFL 6

6.12.2 Proposed WHAs

The TFL 6 modelling dataset included over 676 hectares of proposed WHAs primarily dedicated to Marbled Murrelet conservation within the TFL (Table 23 and Figure 16).

Table 23 Proposed Wildlife Habitat Areas in TFL 6

Description	WHA Status	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Wildlife Habitat Area - Marbled Murrelet	Proposed	676	660	17
Proposed WHAs Total		***676***	***660***	***17***

The BC Northern Goshawk Implementation Plan (February 2018) emphasizes expanding Vancouver Island's WHAs by 30% as a short-term goal. Similarly, the *Marbled Murrelet Order* (December 2, 2021) identifies suitable habitat and mandates specific conservation targets within WHAs.

These proposed WHAs are undergoing the approval process and are expected to be formally established in the future. Like existing WHAs, most have already been factored into previous netdown assessments, resulting in limited new additional impact on the THLB.

Although the FPPR Section 7 notice for North Island – Central Coast Natural Resources District (NICCNRD or District) identifies other species at risk such as coastal tailed frogs, grizzly bears, and great blue herons, no immediate reductions to the THLB are planned. While WHAs may be established within TFL 6 in the future to address their habitat conservation needs, or for the previously mentioned species, the uncertain allotment of additional areas to Identified Wildlife Management Strategies (IWMS) necessitates no further reductions to be made at this time.

6.12.3 Marbled Murrelet Order

The BC Marbled Murrelet Implementation Plan was released in February 2018. One of the key actions is issuing an Order under the Land Use Objectives Regulation for suitable Marbled Murrelet habitat protection. The BC *Marbled Murrelet Order* was effective on December 2, 2021 (Province of British Columbia, 2021). This order aims to protect suitable habitat for the Marbled Murrelet, a species primarily found within old seral forests.

Table 2 of Schedule 7 in the *Marbled Murrelet Order* outlines specific habitat targets for each LU and LU aggregates. The Order also identifies suitable Marbled Murrelet areas protected within WHAs and in both WHAs and OGMAs. Table 24 summarizes these targets based on information from the NICCNRD, Ministry of Forests. Existing proposed OGMA and WHA designs have already addressed a significant portion of these habitat targets. Importantly, the suitable habitat targets by LU will be maintained in the timber supply model to account for any potential gaps and ensure long-term conservation planning to achievement of the targets.

Table 24 Suitable Marbled Murrelet Habitat Areas for TFL 6 (From North Island – Central Coast Natural Resources District)

LU Aggregate	LU	Suitable Habitat Target	WHA and OGMA Suitable Habitat Target	WHA Suitable Habitat Target
Cape Scott	Holberg	1,091	521	308
	Nahwitti	3	2	0
	San Josef	1,734	1,210	546
McNeill	Keogh	159	62	38
	Marble	977	763	276
	Neroutsos	1,055	679	545
Quatsino	Klaskish	3	2	1
	Mahatta	968	386	244
Total		***5,991***	***3,625***	***1,960***

6.13 Economic Operability

The physical operability mapping of TFL 6 was refined in 2023/2024, building upon the LBB process outlined earlier (see Section 5.2.1). The resulting map classifies areas into two categories:

- Economic: These areas are commercially viable for harvesting based on their stand value exceeding harvesting costs.
- Uneconomic: These stands are not expected to generate sufficient value to cover harvest expenses.

Leveraging LiDAR-derived physical operability data (refer to Section 6.8), this analysis assumes all conventionally operable areas become economically viable for harvest at some point in the market cycle, provided they meet minimum harvest criteria.

Table 25 summarizes the minimum forest inventory attributes and flight distances required for areas harvested using helicopters. These figures represent the lowest-value merchantable stands (70+ years old) that may be harvested with non-conventional systems under different market conditions.

Table 25 Inventory Thresholds for Non-conventional Economic Operability

Flight Distance (m)	Economic Definition (Age > 80 years)	
	Minimum Volume (m3/ha)	Minimum Cw+Fd+Yc component
0 - 499	350	15%
500 – 999	370	25%
1000 +	400	30%

Stands failing to meet these minimum requirements are classified as uneconomic and excluded from the THLB. Their areas are detailed in Table 26 and their locations visually represented in Figure 17. Since most uneconomic areas have already been accounted for in previously discussed netdown categories, this category results in a minimal net reduction to the THLB.

Table 26 Area and Volume by Economic Operability Type

Harvest System & Operability	Productive Area (ha)	Volume Reduction ('000 m^3)	Area Reduction (ha)	Volume Reduction ('000 m^3)
Conventional Economic	147,956	49,918		
Non-conventional Economic	9,160	6,171		
Economic (Subtotal)	***157,116***	***56,089***		
Uneconomic or Inoperable	31,536	17,590	11	3
Total	***188,652***	***73,678***	***11***	***3***

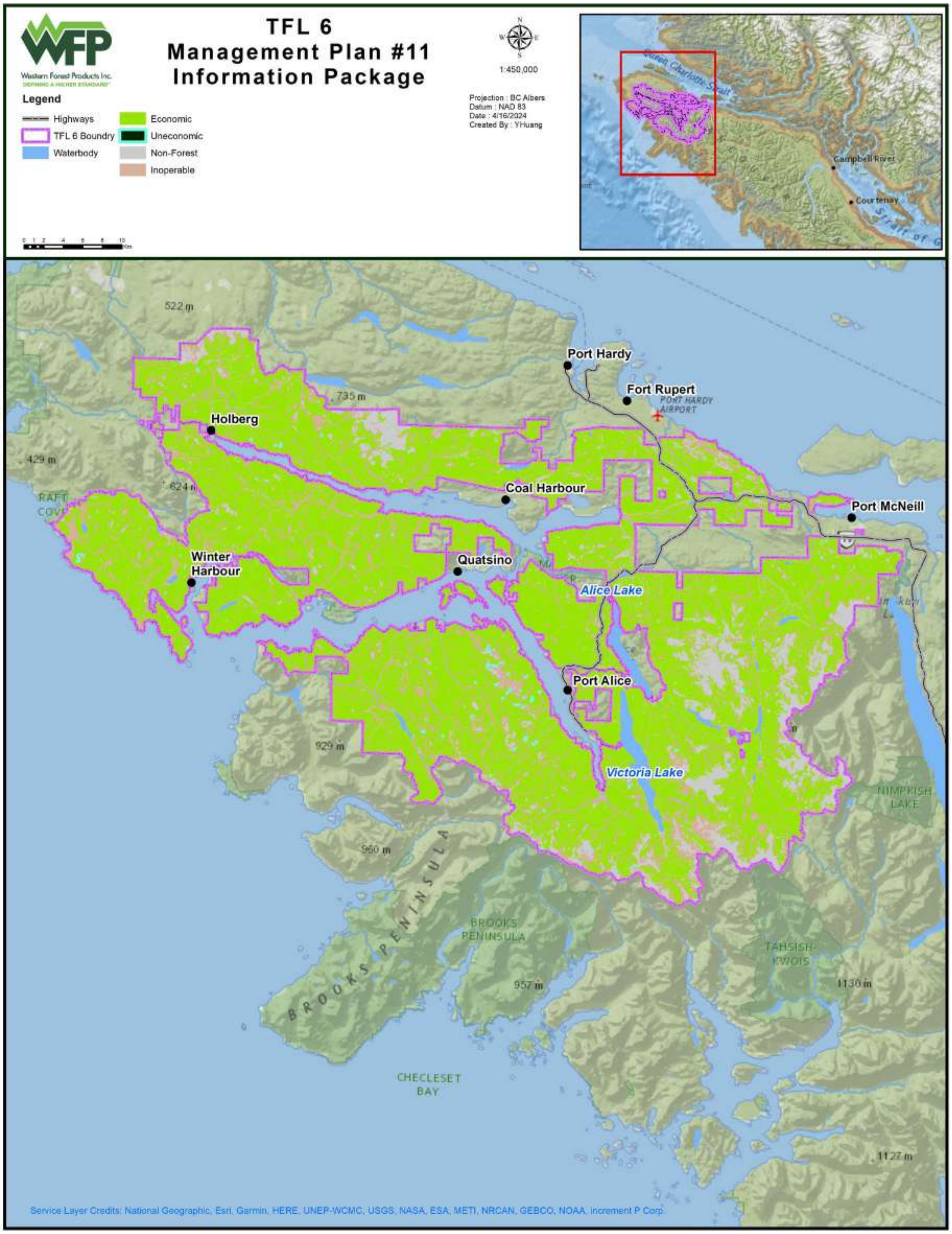

Figure 17 Economic Operability in TFL 6

6.14 Deciduous-leading Stands

Table 27 and Figure 18 identify areas within the forest inventory dominated by deciduous tree species. These stands comprise roughly 2.1% of the productive forest. A review from Harvest Billing System (HBS) from 2002 to 2023 revealed that the deciduous harvested volume in TFL 6 accounts for less than

0.2% of the total harvested volume. Given the minimal historical harvest activity targeting deciduous species in TFL 6, these areas are currently excluded from the THLB. However, a small portion of TFL 6 has been reforested with genetically improved red alder seedlings following established deciduous stocking standards since the last AAC determination. These young deciduous stands are included in the THLB, and their growth and yield are factored into the relevant analysis units detailed in Section 7.3.

Table 27 Area of Deciduous Forest Types in TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Deciduous-leading stands	4,294	3,997	1,534

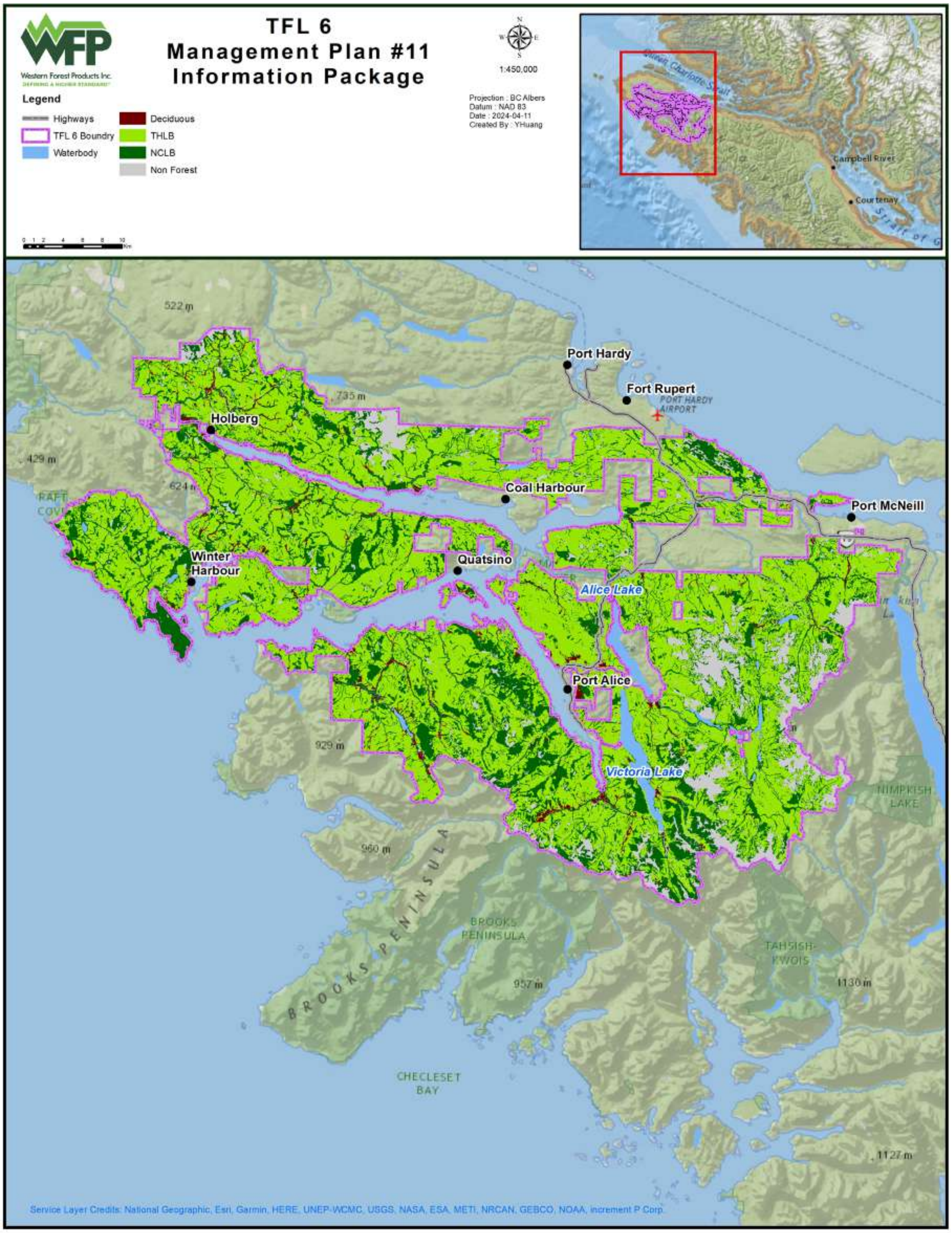

Figure 18 Deciduous-leading Stands in TFL 6

6.15 Recreation Features

Unlike other Vancouver Island Districts where Government Actions Regulation (GAR) Orders formally identify recreation resource features, the TFL 6 recreation inventory identifies extensive areas of moderately significant recreation resource features. These features are primarily associated with non-forested areas (Section 6.4), non-productive forests (Section 6.6), riparian features (Section 6.9) and visual resources (Section 10.3.1). Existing management practices are assumed to address these features.

More significant features requiring special forest management are identified as Recreation Sites, and Trails. These features are removed from the THLB by applying a 10 m buffer zone to the features.

Table 28 lists the recreation sites and trails identified during the process for TFL 6.

Table 28 Recreation Sites and Trails in TFL 6

Recreation Sites	Recreation Trails
Clint Beek Rec Site	Hecht Area
Devils Bath	Grant Bay Trail (REC16102)
Eternal Fountain	Lady Ellen Point (REC6250)
Kathleen Lake	Marble River Trail
Lac truite (trout lake)	Hecht Trail
Marble River Campsite	Lac Truite (REC3243)
Marble River Hatchery	Topknot Trail
Marble River Rec Site	Beaver Lake (REC3202)
Maynard Lake	Clint Beek Park
Maynard Lake	Merry Widow Mountain (REC260693)
Merry Widow Mountain Trail	Old Wagon Road
O'Connell Lake Recreation Area	Hecht Cabin Access
Spruce Bay	Quatsino Story Trail (REC262804)
Three Isle Lake	Cluxewe Beach Trail (REC16078)
	Hecht Beach (REC16079)
	Spruce Bay Old Growth Trail (REC16082)

Table 29 and Figure 19 shows the areas and spatial locations for the above-mentioned recreation features.

Table 29 Recreation Features in TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Recreation Features	20	12	7

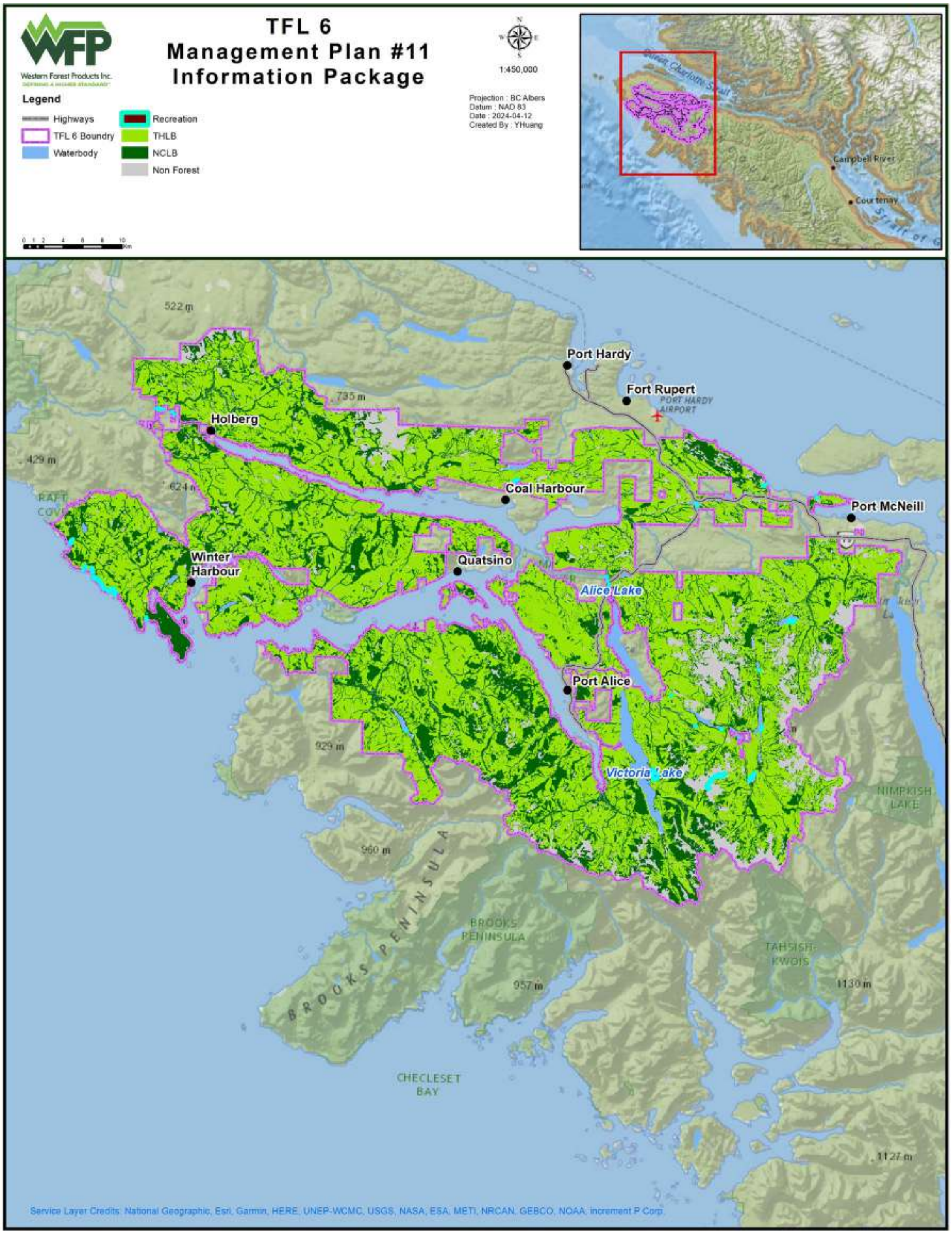

Figure 19 Recreation Features in TFL 6

6.16 Cultural Heritage Resources

The First Nations of British Columbia possess diverse cultures, histories, and traditions. The *Heritage Conservation Act* safeguards archaeological sites containing evidence of human activity before 1846. Under this Act, damaging, excavating, or altering these sites requires a permit from the responsible minister or designate. Data on archaeological sites, provided by the Archaeology Branch of the MoFOR, is excluded from THLB.

The broader term "cultural heritage resources" encompasses various elements defined by the *Forest Act* as "objects, sites, or locations of traditional societal practices significant to British Columbia, a community, or an Aboriginal people." FRPA outlines government objectives for conserving or protecting these resources, focusing on:

a) Locations of ongoing traditional use by Aboriginal peoples, and

b) Sites not regulated by the *Heritage Conservation Act*.

An archaeological overview assessment (AOA) for the former Port McNeill Forest District, completed in 1995 by I.R. Wilson Consultants Ltd., helps identify and assess archaeological resource potential. The AOA predicts archaeological site characteristics and distribution, providing a framework for evaluating site significance.

The Quatsino First Nation (Quatsino) conducted a Traditional Use Study (TUS) for their territory in 1996, which has been maintained. Additionally, the Galgalis Traditional Use Study, compiled in 1998 for the Kwakiutl Territorial Fisheries Commission, gathered input from various Kwakwaka'wakw Nations on northern Vancouver Island, the central coast, and intervening islands. First Nations with TUS information hold detailed records on traditional use sites and values within their asserted territories. While TUS information is not typically shared with forest licensees, decision-makers consider it when making statutory decisions.

The Quatsino (TFL 6) IRMP process (discussed in Section 3.5.2.2) is very helpful in informing the TSR with the best available cultural heritage information within TFL 6. Through this collaboration, WFP gained valuable geographical insights into a Quatsino TUS zone, a confidential area with high concentration of cultural significance encompassing approximately 58,000 hectares (27%) of the total TFL area. This knowledge facilitated a deeper understanding of the Quatsino Nation's interests in land and resources within their traditional territory. Consequently, WFP is better positioned to integrate these interests into its resource management and planning processes.

Culturally modified trees (CMTs) are the most prevalent cultural heritage resource found within TFL 6. These trees bear modifications made by Indigenous peoples during traditional forest use practices. Examples include bark removal, stumps and felled logs, trees tested for soundness, and scars from plank extraction. Western redcedar is the most commonly used and culturally significant species for CMT.

WFP conducts extensive surveys for CMTs within proposed cutblocks across TFL 6. This detailed stand-level information is recorded in WFP's GIS database and informs forest management planning (see Sections 6.17 and 6.23 for details on existing and future stand-level retention netdowns, respectively). Additionally, landscape-level netdowns, such as those outlined in the riparian management plan (Section 6.9), also contribute to overall cultural heritage protection. Archaeological sites registered with the provincial government will be entirely removed from the THLB (see Table 30 and Figure 20), even if permits allow for limited alterations.

To address the potential for unidentified cultural heritage resources as part of the TSR, WFP collaborated with the IRMP technical team. This collaboration involved a joint review of recently harvested areas within the Quatsino TUS zone. The review specifically focused on areas where adjustments were made to boundaries or retention levels due to confirmed archaeological or cultural findings. Notably, existing retention levels within cutblocks in the Quatsino TUS zone were demonstrably higher than the average across the entire TFL 6. This suggests that increased retention can be an effective way to account for the potential presence of unidentified cultural features for the timber supply modelling projections.

Based on this finding, an updated netdown to account for an average of 28% stand level retention has been established for all of WFP's variable retention management zones within the Quatsino TUS zone (see Section 6.23 and Section 10.4.3 for details). This level of retention is accounted for through an aspatial netdown approach, to reflect the potential presence of unknown cultural features. This updated netdown represents a significant increase from the current area-weighted average target of 12.5% retention in the Quatsino TUS zone.

It is important to emphasize that the measures outlined above do not supplant the on-ground practice of the retention silvicultural system as described in Section 10.4.3, nor do they serve as a substitute for archaeological surveys in targeted areas during the operational planning phase.

Table 30 summarizes the combined area reduction for the government-registered archaeological sites and Quatsino TUS zone within the TFL.

Table 30 Cultural Heritage Resources in TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Government Archaeological Sites	897	852	542
Unknown Cultural Features within Quatsino TUS Zone	57,910[1]	53,230	447
Total	***17,190***	***16,493***	***989***

[1] This is the gross area of the confidential Quatsino TUS zone.

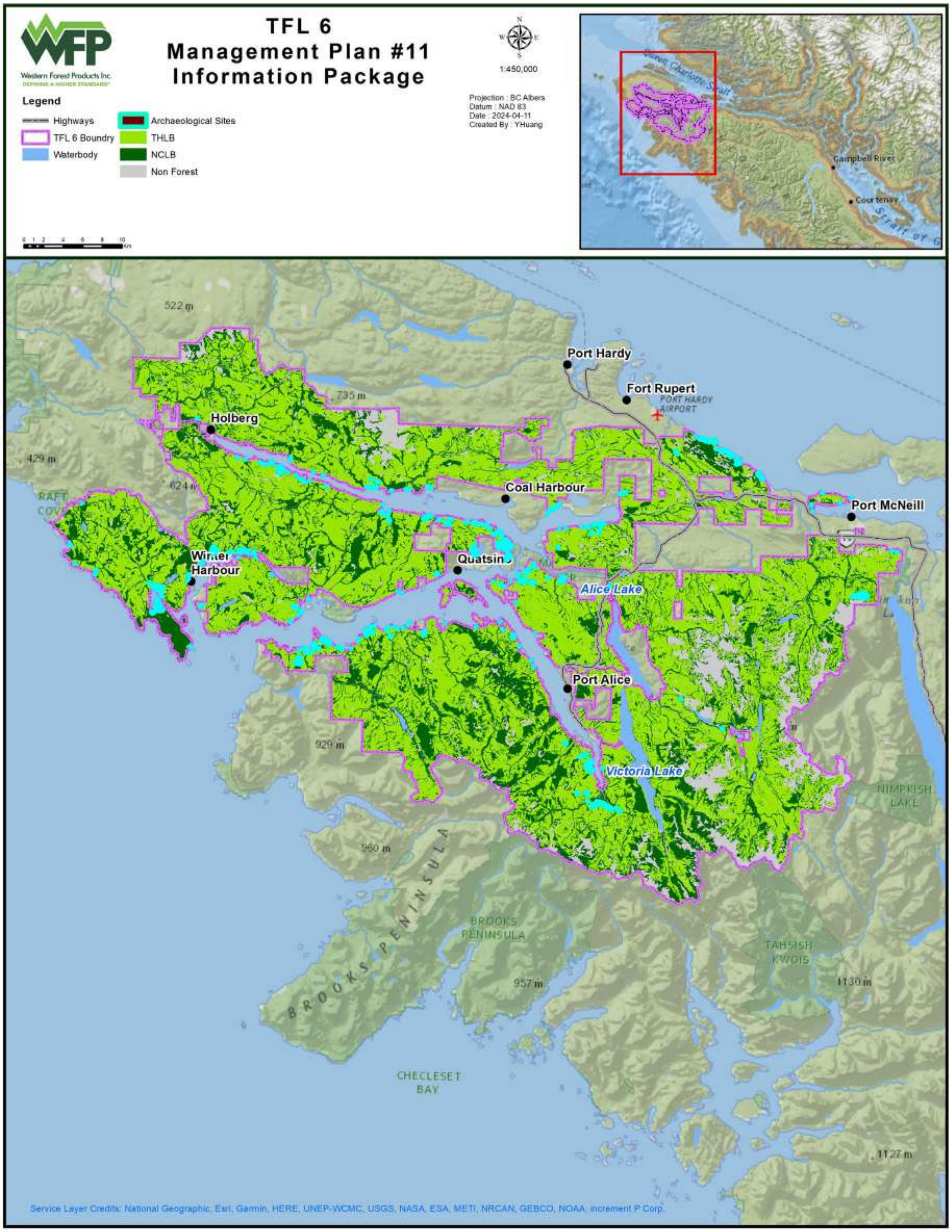

Figure 20 Registered Archaeological Sites in TFL 6

6.17 Existing Stand-level Reserves

Stand-level reserves play an important role in maintaining biodiversity and providing wildlife habitat. Policy direction for wildlife tree management began in 1985 with the release of *Protection of Wildlife*

Trees policy. This was further developed in 1995 with the introduction of the *Forest Practices Code of British Columbia* and the associated *Biodiversity Guidebook*. Under these guidelines, wildlife tree patches (WTPs) were designated for nearly every harvested cutblock. The FRPA continued this requirement, replacing WTPs with wildlife tree retention areas (WTRAs). Landscape Unit Plans typically establish WTRA objectives based on biogeoclimatic variants.

Forestry licensees may implement additional stand-level retention measures beyond those mandated by legislation, based on their own management policies and strategies. For further details on this, refer to Sections 6.23 and 10.4.3.

For MP #11, existing long-term stand-level retention areas will be excluded from the THLB as shown in Table 31 and Figure 21. This reflects the assumption that these areas will be retained again during future harvesting operations.

Table 31 Existing Stand-level Retention in TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Existing stand-level retention	7,850	7,388	3,018

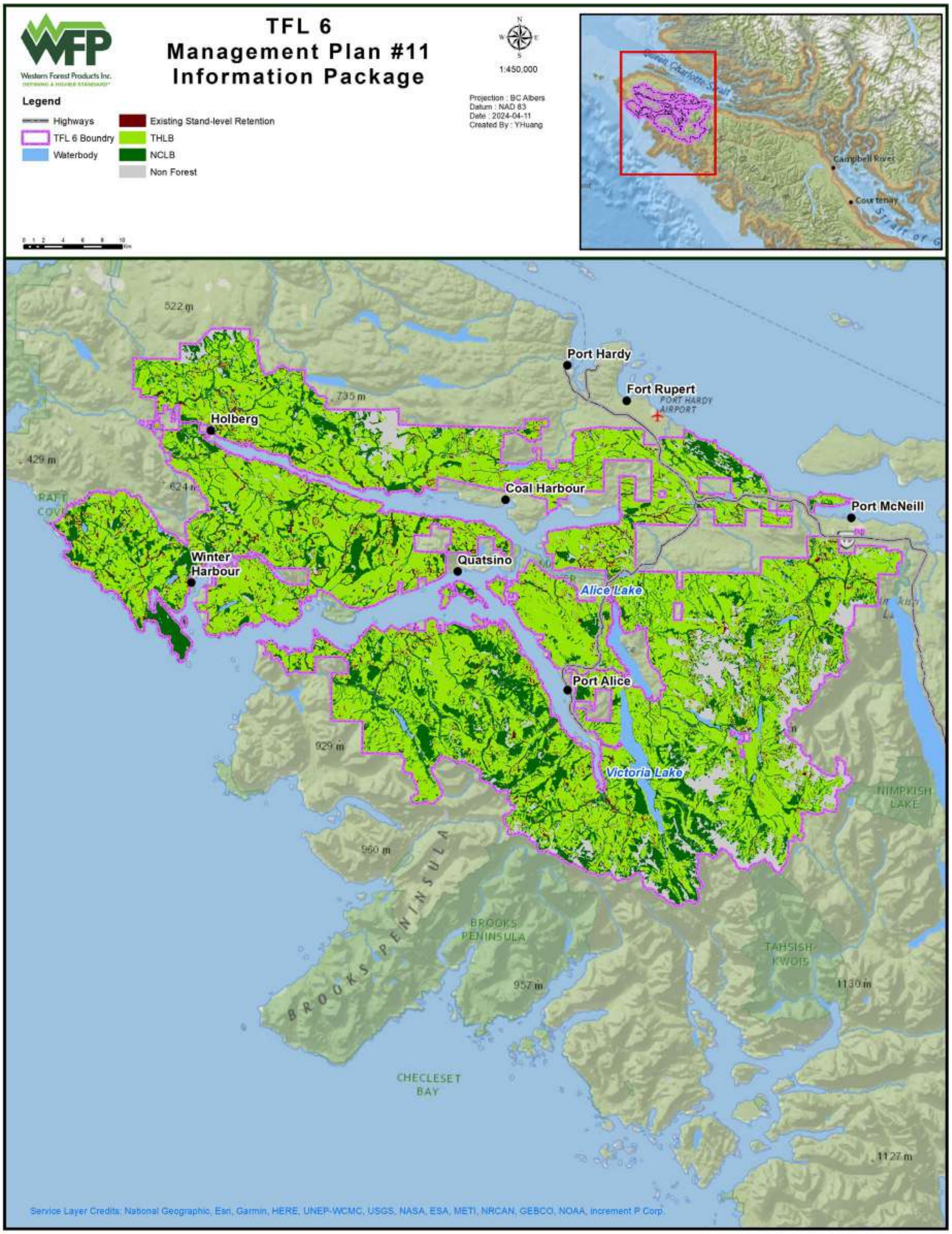

Figure 21 Existing Stand-level Reserves in TFL 6

6.18 Research Sites

TFL 6 includes 51 active research installations with diverse objectives, such as testing experimental silvicultural treatments, genetics, and genecology. The Forest Improvement and Research Management

Branch and the Forest Science Planning & Practices Branch establishes variable-width buffers (5 to 100 metres) around these sites in the spatial data obtained from the BC Data Catalogue.

To prioritize research integrity, most installations will be deferred from harvesting in the timber supply model for 70 years after establishment. This timeframe reflects the researchers' intent to potentially produce merchantable timber within these trials. Additionally, a portion of EP703-56, due to its long-term research focus, will be excluded from the THLB. This approach has been endorsed by staff from both Forest Improvement and Research Management Branch and the Forest Science Planning & Practices Branch. Table 32 and Figure 22 summarize the area and spatial location of the research installation excluded from THLB within TFL 6. It is noted that most area of this particular research site has already been excluded from the THLB, as per the proposed OGMA discussed in Section 6.11.

Table 32 Research Site Excluded from THLB

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Research Sites	112	112	13

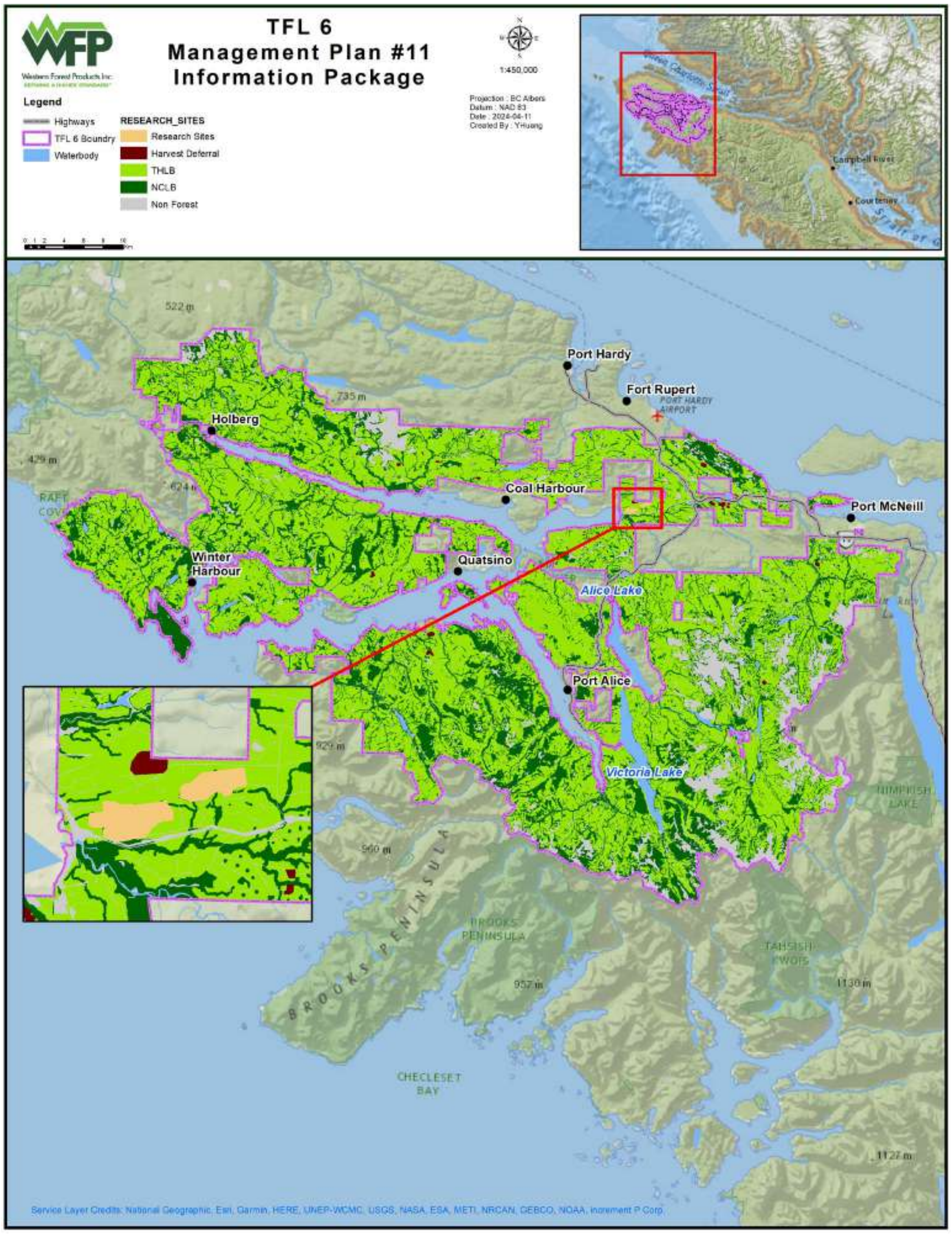

Figure 22 Research Sites within TFL 6

6.19 Terrain Stability

There are two primary terrain stability mapping methods within TFL 6:

- Detailed terrain stability mapping (DTSM or 5-class): originally conducted by T. Lewis in 1992 and 1995, with subsequent updates to meet Ministry standards in 1998 across the majority of TFL 6 at a 1:20,000 scale. This mapping categorizes areas into five classes, indicating the probability of post-harvest instability.
- Environmentally Sensitive Area (ESA) Mapping (Es1/Es2): mapped for the eastern portion of TFL 6, originally part of TFL 39 Block 4. This mapping standard was applied during a project in the 1970s. ESA mapping has known limitations and was deemed outdated by the Chief Forester in

the TFL 39 AAC determination (Province of British Columbia, 2016). Consequently, ESA-based terrain stability mapping is no longer considered valid for MP #11.

Given the availability of a LiDAR-derived slope dataset and its strong correlation with landslide risk, an operational review was conducted. This review assessed harvest performance and opportunities based on different LiDAR slope gradients. For areas harvested between 2012 and 2023, analysis showed that 95% of the net harvested areas occurred in < 90% LiDAR-derived slope data (Section 3.5.3.1). Therefore, areas with LiDAR-derived slopes exceeding 90% are deemed too risky for the environment and excluded from the THLB for the entire TFL.

The same operational review revealed that only 1.8% of the area harvested between 2012 and 2023 was DTSM Class 5 terrain (highest instability risk). Consequently, Class 5 terrain, other than in recently harvested cutblocks, will also be excluded from the THLB.

Table 33 and Figure 23 indicate the unstable terrain area indicates the areas removed from the THLB based on the above netdown methodology.

Table 33 Terrain Stability Netdowns

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
DTSM Class 5 (high)	9,257	9,254	8,748
LiDAR 90+% Slope	9,959	8,216	1,585
Total	***19,216***	***17,470***	***10,333***

Table 34 compares the 2012-2023 harvest area by terrain class against the MP #11 THLB area. A similar table for the same set of previously harvested blocks by LiDAR slope band is shown in Table 7 in Section 3.5.3.1. A small area of terrain class 5 is included within the THLB due to the THLB incorporating recently harvested areas (as described in Section 6.3).

Table 34 2012-2023 Harvested Area by Terrain Stability Class

Terrain Class	% of Harvested Area	% of THLB Area
1	6.8%	8.2%
2	8.9%	8.0%
3	77.4%	76.0%
4	5.1%	7.3%
5	1.8%	0.5%
Total	***100%***	***100%***

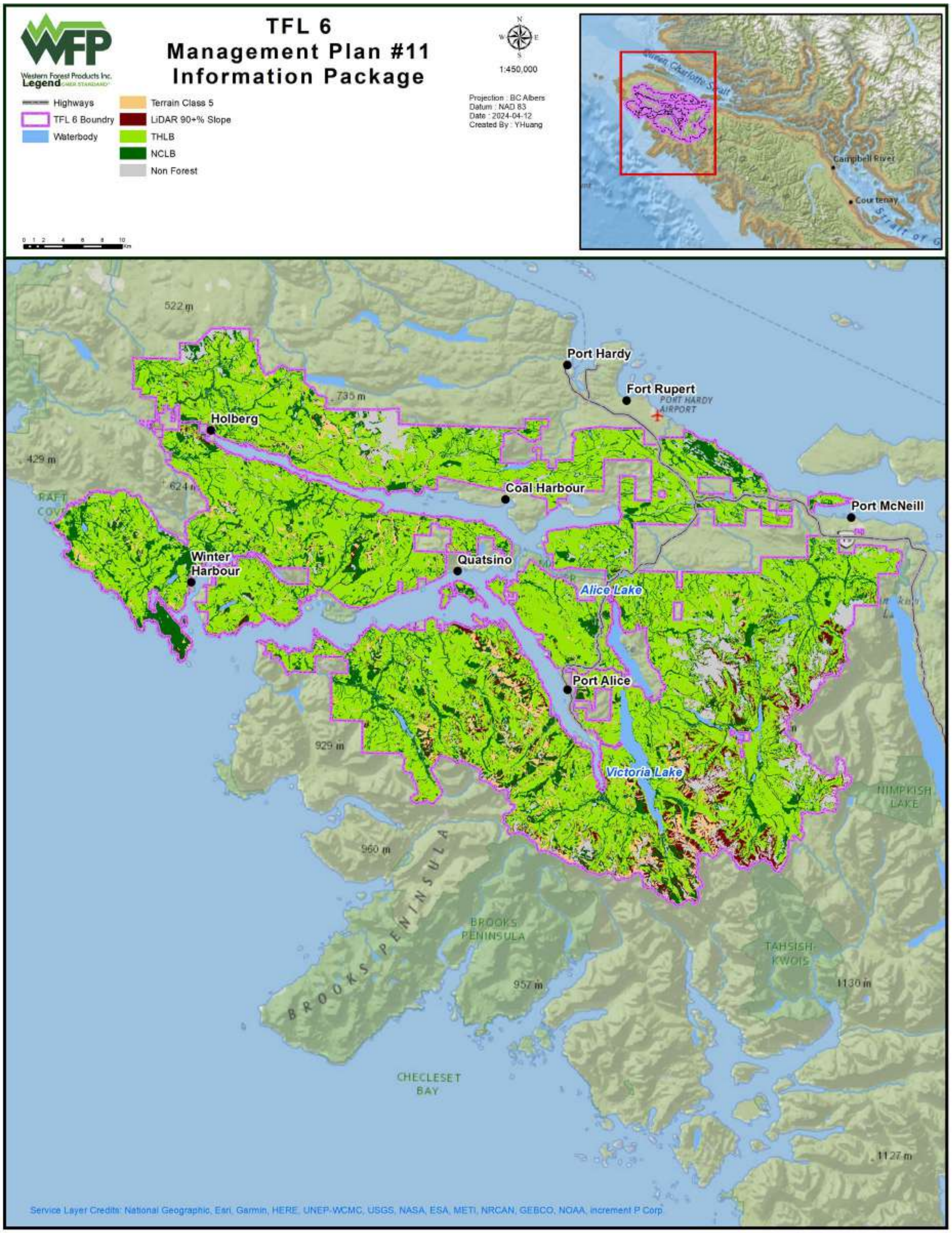

Figure 23 Terrain Stability Classes and 90+% Slope in TFL 6

6.20 Permanent Sampling Plots

The MoFOR's Forest Improvement and Research Management Branch maintains a province-wide network of Permanent Sample Plots (PSPs) to monitor forest growth and calibrate growth and yield models. While the objectives for these plots have not been formally established through legislation, an operational review of harvest practices reveals that active plots (including their buffers) are currently avoided during harvesting activities.

To ensure the long-term viability of the PSP program, all active plots within TFL 6 (total of 65 plots) will be excluded from the THLB. A standardized buffer distance of 100 metres will be applied to all plots. Table 35 summarized the area excluded from THLB.

Table 35 Permanent Sampling Plots in TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Permanent Sampling Plots	180	180	136

6.21 Big Tree Reserves

British Columbia recognizes the importance of big trees through the *Special Tree Protection Regulation* implemented on September 11, 2020 (Province of British Columbia, 2020). Under this regulation, big trees on the BC Big Tree Registry, generally defined by height and diameter-at-breast-height (DBH), are considered protected under Part 13 of the *Forest Act*. Additionally, specified trees, a standing live or dead tree meeting the criteria of the *Special Tree Protection Regulation*, require additional reserves and protections.

WFP's Big Tree Retention Policy goes beyond provincial requirements, retaining standing live trees exceeding 80 metres in height or meeting minimum DBH standards outlined in the WFP big tree standard (Western Forest Products Inc., 2019). For example, under this policy, a western redcedar with a DBH of 300 centimetres and a yellow cedar with a DBH of 210 centimetres in TFL 6 would qualify as big trees.

LiDAR data and field verification work together to locate and retain big trees. LiDAR-generated treetop points identify potential candidates (over 80 metres tall). Measurements of these potential big trees initially utilize LiDAR point cloud data, followed by on-site verifications and evaluations. This two-step approach broadens the definition of significant trees by including height, which is difficult to assess using traditional ground-based methods. However, ground-truthing of all potential big tree candidates is ongoing.

As of this timber supply analysis, 406 big trees have been identified using both the provincial regulation and WFP's big tree retention policy. Specified trees receive a one-hectare retention area, while other big trees receive a 0.25-hectare retention area. The impact on the THLB for these big trees in TFL 6 is detailed in Table 36.

Table 36 Big Tree Reserve Area in TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Specified Big Tree	40	39	22
WFP Big Tree	45	44	20
Total	85	83	42

6.22 Karst

Karst landscapes, characterized by fluted rock surfaces, sinkholes, caves, and underground drainage systems, are sensitive to logging impacts due to safety concerns, the intrinsic value of cave systems, and the presence of unique flora and fauna. These landscapes are formed by the dissolving action of water on limestone bedrock (Quatsino formation) underlying portions of TFL 6.

In 2007, the District Manager of the NICCNRD established a GAR order identifying karst caves, important features and elements within very high and high vulnerability karst and significant surface karst features as resource features requiring management under FRPA.

During early engagement for this IP in spring 2024, Quatsino First Nation highlighted the traditional significance of karst features on the land base.

To assist with quantifying an appropriate netdown to the THLB for the management of karst features within TFL 6, the area reserved as WTRAs since the GAR order within primary and secondary karst likelihood zones, identified by the provincial inventory data, was analyzed. WTRAs are designated areas identified for harvest blocks where trees are left standing for a variety of reasons including wildlife habitat, biodiversity, and to mange for other values at the site-level including karst features. The analysis revealed that on average, 17% of the area of each cutblock in these karst likelihood zones is currently reserved as WTRA. To ensure adequate accounting for karst features, a netdown to account for 20% WTRA is used. (see Section 6.23 and Section 10.4.3 for details). If the overall THLB netdown percentage is below 20% in these karst zones (e.g., Enhanced Windy zone with 15% retention target), additional areas will be excluded aspatially from the THLB to achieve the 20% level. Conversely, if the overall THLB netdown percentage exceeds 20%, it is considered that karst features have been adequately accounted for in the WTRAs established by the stand-level retention allowances.

Figure 24 shows the primary and secondary karst likelihood area within TFL 6. Table 37 presents the productive forest area by karst likelihood class and the resulting area removed from the THLB.

Table 37 Karst Inventory Likelihood Classes and THLB Netdowns in TFL 6

Karst Likelihood	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Primary	15,654	14,634	2,209
Secondary	11,019	10,235	1,481
Total	26,673	24,869	3,690

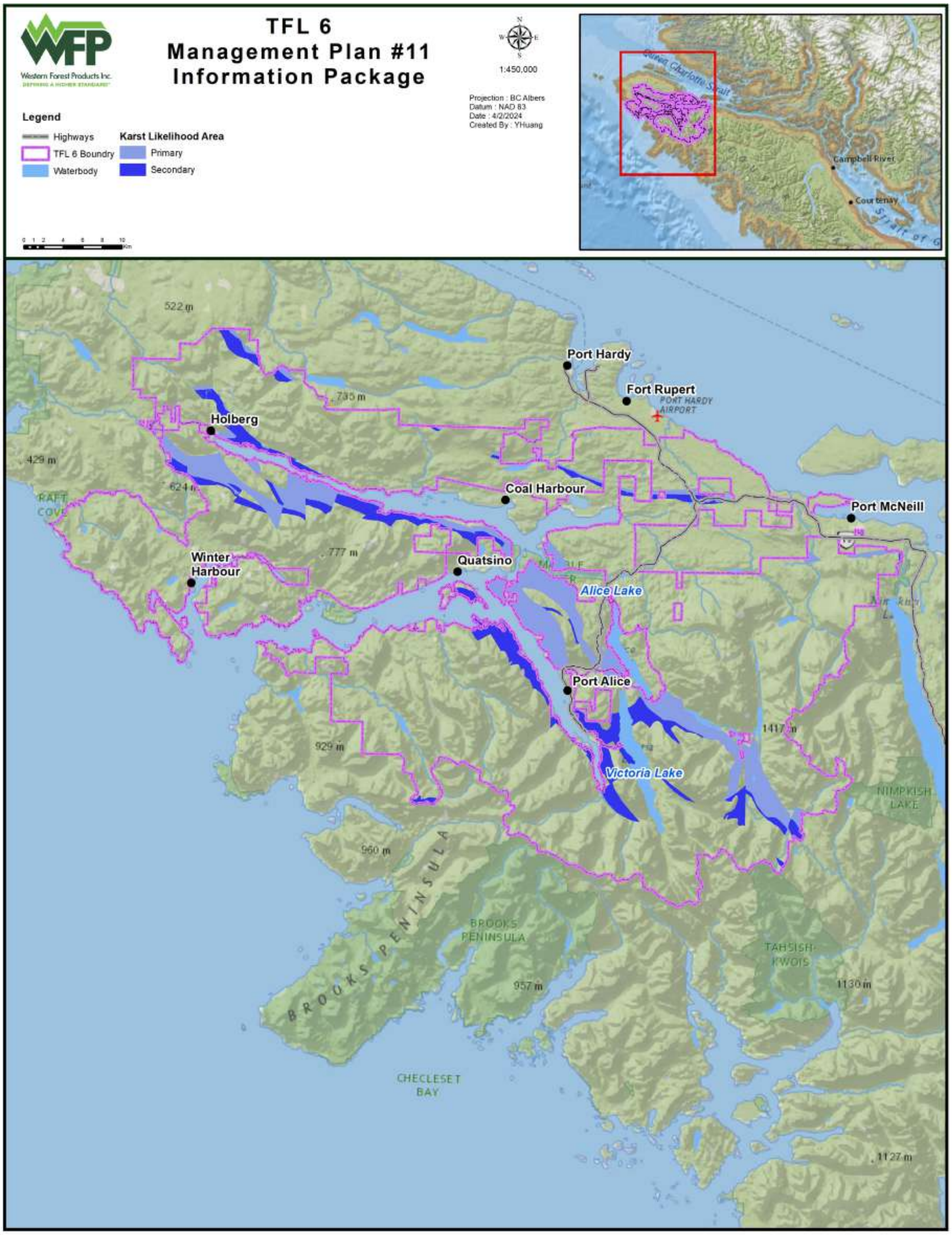

Figure 24 Karst Likelihood Area in TFL 6

6.23 Future Stand-level Retention

6.23.1 Wildlife Tree Retention Areas

When possible and compatible with wildlife objectives, WTRAs are prioritized in areas with limited harvesting options, such as riparian zones, inoperable stands, or steep and unstable terrain (Class 5 or 90+% slope). In the absence of specific WTRA objectives set by land-use orders or landscape unit plans, the FPPR Section 66 applies, requiring a minimum of 7% WTRA retention for TFL 6.

To account for WTRAs located in harvestable areas, an aspatial THLB area reduction is applied. A review of harvested areas from 2018 to 2023 revealed that 46.8% of the WTRA placements occurred within harvestable areas. This means that 53.2% of the WTRAs were situated in areas already excluded from harvest, such as riparian zones, cultural heritage sites, or areas with terrain stability concerns.

Since the proportion of WTRA placement in harvestable areas can vary based on the specific retention zones defined in WFP's Stewardship and Conservation Plan (WSCP) (see Section 6.23.2 and Section 10.4.3), a zone-specific adjustment factor has been applied to the provincial 7% minimum WTRA target to account for future WTRA requirements within the THLB (details in Table 38).

Table 38 Zone-Specific Provincial WTRA Netdown Adjustment Factors for TFL 6

Western Stewardship & Conservation Zones	Provincial WTRA Target (%)	Retention Factor Excluding Other Netdown Categories (%)	Retention Factor% x Provincial WTRA Target (%)
Enhanced Basic	7	42.9	3.0
Enhanced Windy	7	46.9	3.3
General Basic	7	47.5	3.3
General Windy	7	40.8	2.9
Special	7	49.2	3.4

6.23.2 Additional Stand-level Retention

Section 10.4.3 details how applying the retention silvicultural system under WSCP results in at least 41.3% of the harvest area within TFL 6 falling under retention silvicultural system cutblocks (the remaining area being clearcut-with-reserves). WSCP retention requirements vary by WSCP zones created to account for VILUP resource management zone management goals and windthrow risk levels. Consequently, different netdown factors are applied to ensure the total THLB reduction aligns with the findings of the review discussed in Section 6.23.1.

Table 39 outlines the collective stand-level retention targets, combining provincial WTRA and retention silvicultural system targets for each LU.

Table 39 Stand-level Retention Targets by LU in TFL 6

Landscape Unit	Western Stewardship & Conservation Zones	Provincial WTRA (%)	Weighted Average Retention Target with WSCP (%)
Holberg	Enhanced Windy	7	9.4
Keogh	Enhanced Basic	7	11
	Enhanced Windy	7	9.4
	General Basic	7	14.8
	General Windy	7	12.2
Klaskish	Enhanced Windy	7	9.4
Lower Nimpkish	Enhanced Basic	7	11
	Enhanced Windy	7	9.4
Mahatta	Enhanced Windy	7	9.4
Marble	Enhanced Basic	7	11
	Enhanced Windy	7	9.4

Landscape Unit	Western Stewardship & Conservation Zones	Provincial WTRA (%)	Weighted Average Retention Target with WSCP (%)
	General Basic	7	14.8
	General Windy	7	12.2
Nahwitti	Enhanced Windy	7	9.4
Neroutsos	Enhanced Windy	7	9.4
	General Basic	7	14.8
	General Windy	7	12.2
San Josef	Enhanced Windy	7	9.4
	Special	7	23.2
Tsulquate	Enhanced Windy	7	9.4

Table 40 illustrates the resulting THLB area reduction due to these targets for future retentions.

Table 40 Total THLB % Netdowns for Future Stand-level Retention

Western Stewardship & Conservation Zones	Area Subject to this netdown (ha)	Provincial WTRA Target (%)	Provincial WTRA Target Implementation (%)	WSCP Long-Term Variable Retention Target (%)	WSCP Long-Term Variable Retention Target Implementation (%)	Total Retention Target (%)	Retention Factor x Total WTRA Target (%)	THLB reduction for WTRA (%)	THLB reduction for WSCP (%)	Area reduction (ha)
Enhanced Basic	6,191	7	50	15	50	11.0	4.7	3.0	1.7	291
Enhanced Windy	51,935	7	70	15	30	9.4	4.4	3.3	1.1	2,285
General Basic	15,351	7	40	20	60	14.8	7.0	3.3	3.7	1,075
General Windy	1,616	7	60	20	40	12.2	5.0	2.9	2.1	81
Special	5,884	7	10	25	90	23.2	11.4	3.4	8.0	671
Total	***80,977***	-	-	-	-	-	-	-	-	***4,402***

6.24 Future Roads

LiDAR data was used to refine the physical operability inventory within TFL 6 through the LBB process (detailed in Section 5.2.1). A key element of this update involved projecting future roads to support conventional harvesting activities. The goal is to minimize road construction for future harvests; therefore, these projected roads represent the most practical and anticipated network. These projections are then integrated into the modelling dataset. When harvest areas overlap with these future roads, the available timber volume within the designated road right-of-way will be reduced.

Table 41 details the projected road network required for accessing conventionally harvested blocks within TFL 6.

Table 41 Future Roads Projected for TFL 6

Description	Gross Area (ha)	Productive Area (ha)	Area Reduction (ha)
Future Roads	2,136	2,050	1,436

7 INVENTORY AGGREGATION

This section outlines the process for delineating the TFL land base for this analysis. It covers two key aspects:

1. Landbase Delineation: Dividing the TFL area into distinct management zones. These zones accommodate diverse forest management strategies and consider various forest cover constraints, such as those related to landscape-level biodiversity.
2. Stand Type Definition: Grouping forest stands with similar characteristics into Analysis Units (AUs). Stand similarities are based on leading species composition, historical context, and productivity.

Please note that due to rounding to the nearest hectare, totals within tables in this section may not add up precisely.

7.1 Resource Management Zones

Unique forest cover objectives will be modelled across VILUP Resource Management Zones (RMZs):

- Special Management Zones (SMZs),
- General Management Zones (GMZs),
- Enhanced Forestry Zones (EFZs)

Table 42 and Figure 25 identify the VILUP RMZs within the TFL. These zones define specific forest cover requirements, detailed in Section 0.

To streamline the dataset and reduce the number of unique resource management zones, minor revisions were made:

- 301 hectares of productive forest (149 hectares of THLB) that is marked as Settlement in the RMZ within Neroutsos LU around the village of Port Alice was assigned to the Mahatta-Neroutsos EFZ. 132 hectares of productive forest (95 hectares of THLB) that is marked as Settlement in the RMZ within Keogh and Lower Nimpkish LU around the Town of Port McNeill was assigned to the Keogh-Cluxewe EFZ.
- 11 hectares of productive forest (10 hectares of THLB) originally identified within the Brooks Bay SMZ were assigned to the Mahatta-Neuroutsos EFZ due to GIS data discrepancies between Mahatta LU and the RMZ data.
- 12 hectares of productive forest (4 hectares of THLB) originally identified within the Kashutl GMZ but within Marble LU were assigned to the Marble GMZ; 5 hectares of productive forest (2 hectares of THLB) originally identified within the Kashutl GMZ but within Neroutsos LU were assigned to the Mahatta-Neuroutsos EFZ. This is due to discrepancies between the TFL 6 boundary and the RMZ data.
- 106 hectares of productive forest (71 hectares of THLB) originally identified within the Klaskish GMZ were assigned to the Mahatta-Neroutsos EFZ due to a different height-of-land interpretation.
- 137 hectares of productive forest (98 hectares of THLB) originally identified within the Nahwitti-Tsulquate GMZ were assigned to the Holberg EFZ. The boundary between these two RMZs is intended to be the TFL 6 boundary.

- 41 hectares of productive forest (13 hectares of THLB) originally identified within the Marble River Protected Area but within Marble LU were assigned to the Marble GMZ; 31 hectares of productive forest (17 hectares of THLB) originally identified within the Marble River Protected Area but within Neroutsos LU were assigned to the Mahatta-Neuroutsos EFZ; 2 hectares of productive forest (1 hectares of THLB) originally identified within the Marble River Protected Area but within San Josef LU were assigned to the San Josef-Koprino EFZ. This revision is the result of different boundaries for the Marble River Park between the provincial park data and the RMZ data.
- 24 hectares of productive forest (22 hectares of THLB) originally identified within the Nimpkish EFZ but within the Lower Nimpkish LU were assigned to the Keogh-Cluxewe EFZ. The Nimpkish EFZ boundary is intended to be the TFL 6 boundary. 14 hectares of productive forest (5 hectares of THLB) originally identified within the Nimpkish EFZ but within the Marble LU were assigned to the Marble GMZ due to a different height-of-land interpretation.
- 3 hectares of productive forest (3 hectares of THLB) originally identified within the Quatsino Protected Area were assigned to San Josef-Koprino EFZ. This is due to discrepancies between the TFL 6 boundary and the RMZ data.
- 12 hectares of productive forest (7 hectares of THLB) originally identified within the Raft Cove Protected Area were assigned to West Coast Nahwitti Lowlands SMZ. This is due to discrepancies between the TFL 6 boundary and the RMZ data.
- 11 hectares of productive forest (7 hectares of THLB) originally identified within the Tahsish EFZ were assigned to the Marble GMZ due to a different height-of-land interpretation.
- 178 hectares of productive forest (35 hectares of THLB) that is marked as Ocean in the RMZ within Holberg LU were assigned to the Holberg EFZ due to a different land mass interpretation.
- 17 hectares of productive forest (9 hectares of THLB) that is marked as Ocean in the RMZ within San Josef LU were assigned to the San Josef-Koprino EFZ due to a different land mass interpretation.
- 4 hectares of productive forest (0.1 hectare of THLB) within Keogh LU, 101 hectares of productive forest (19 hectares of THLB) within Mahatta and Neroutsos LUs, and 161 hectares of productive forest (61 hectares of THLB) within San Josef LU, are not covered by a SMZ, GMZ or EFZ. They are assigned to their corresponding RMZs: Keogh – Cluxewe EFZ, Mahatta – Neroutsos EFZ, and San Josef – Koprino EFZ, respectively.

Table 42 Area by VILUP Resource Management Zone

Mgmt Zone	Mgmt Unit	Seral Stage[1]	Productive Forest (ha)	THLB Area (ha)	Management Considerations (from Vancouver Island Summary Land Use Plan (Province of British Columbia, 2000))
EFZ 5	Holberg	Early	12,415	10,889	***Enhanced Forestry Zone** suited for enhanced timber harvesting and production, while maintaining fish values and watershed integrity.*
		Mid	9,560	6,820	
		Mature	7,278	2,606	
		Old	942	375	
		Total	**30,195**	**20,691**	
EFZ 6		Early	9,258	8,080	

[1] Early seral is <40 years old; Mid seral is 40-80 years old in CWH zone and 40-120 years old in MH zone; Mature seral is 81-250 years old in CWH zone and 121-250 years old in MH zone; Old seral is >250 years old.

Mgmt Zone	Mgmt Unit	Seral Stage[1]	Productive Forest (ha)	THLB Area (ha)	Management Considerations (from Vancouver Island Summary Land Use Plan (Province of British Columbia, 2000))
	Keogh-Cluxewe	Mid	10,225	7,566	***Enhanced Forestry Zone*** *suited for enhanced silviculture, with limited opportunity for enhanced timber harvesting; integration of visual values along coastline and highway corridor, as well as recreational opportunities along Keogh River.*
		Mature	3,207	1,112	
		Old	3,313	960	
		Total	**26,002**	**17,718**	
SMZ 4	Koprino	Early	2,450	2,196	***Special Management Zone*** *should be focal area (within the landscape unit) for the retention of old forest and associated wildlife habitat, as well as for mature and old forest connectivity.*
		Mid	605	425	
		Mature	1,792	463	
		Old	712	137	
		Total	**5,560**	**3,220**	
EFZ 8	Mahatta-Neuroutsos	Early	16,012	13,730	***Enhanced Forestry Zone*** *suited for enhanced timber harvesting and silviculture; wildlife values in Mahatta system and marbled Murrelet values in noted drainages require specific integration through maintenance of old seral forest; objectives for other resources are to be integrated at the basic stewardship level.*
		Mid	11,321	7,689	
		Mature	8,646	3,733	
		Old	10,583	3,290	
		Total	**46,562**	**28,442**	
GMZ 7	Marble	Early	13,194	10,543	***General Management Zone*** *particularly suited for enhanced silviculture in second growth stands; high fisheries values, wildlife values/capability, as well as ecosystem representation and connectivity functions result in intermediate biodiversity significance; integration of recreational values associated with lakes.*
		Mid	16,166	11,430	
		Mature	2,944	756	
		Old	9,018	2,388	
		Total	**41,322**	**25,118**	
EFZ 4	San Josef-Koprino	Early	13,957	12,145	***Enhanced Forestry Zone*** *suited for enhanced timber harvesting and production, while maintaining fish values and watershed integrity.*
		Mid	5,738	4,042	
		Mature	6,618	2,710	
		Old	2,984	1,033	
		Total	**29,297**	**19,930**	
SMZ 2	West Coast Nahwitti Lowlands	Early	3,204	2,735	***Special Management Zone*** *with main focus on special management for significant scenic and recreational values which are concentrated along narrow coastal strip; additional consideration should be on maintenance of the high riparian fish and coastal wildlife values.*
		Mid	523	207	
		Mature	3,360	1,313	
		Old	2,628	881	
		Total	**9,715**	**5,136**	
Grand Total			**188,652**	**120,254**	

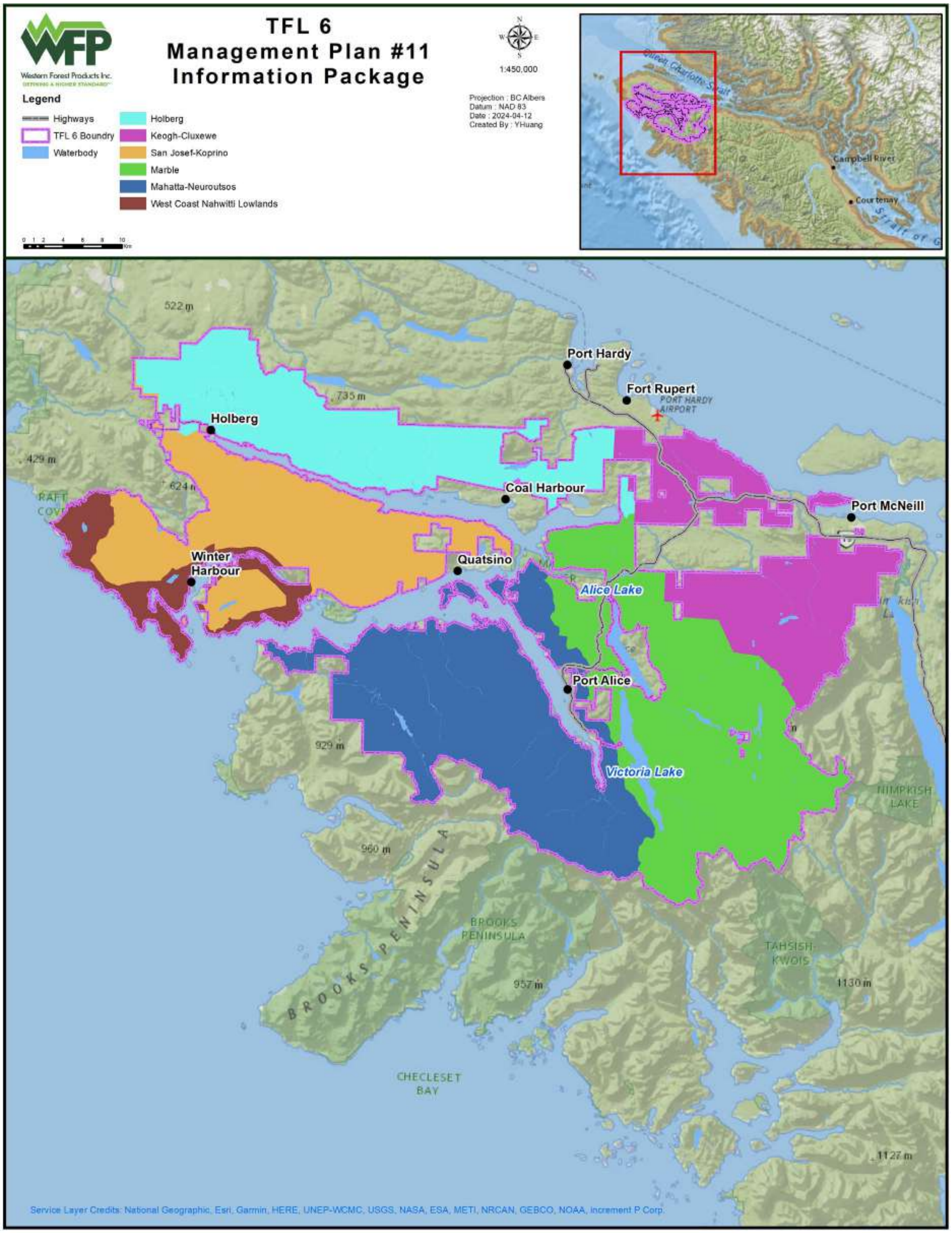

Figure 25 Resource Management Zones in TFL 6

It is important to note that some areas designated as LUs or RMZs only partially overlap with the TFL 6 boundaries. Additionally, while boundaries might differ slightly between the GIS data used for the modelling database and other sources, they ultimately represent the same geographical features. This discrepancy can make it difficult to enforce certain management restrictions associated with RMZs on small and isolated areas ("slivers"). Note that the list of RMZs in this section excludes those with a relatively small portion within the TFL. This is because activities and management efforts on the non-TFL portion of these RMZs will have a more significant impact than any constraints applied solely to the TFL portion.

7.2 Landscape Units

As discussed in Section 1.3, eight landscape units are found within TFL 6:

- Holberg
- Keogh
- Klaskish
- Lower Nimpkish
- Mahatta
- Marble
- Nahwitti
- Neroutsos
- San Josef
- Tsulquate

To improve the clarity of the dataset, some minor consolidations were made, resulting in a reduction of total number of LUs. Specifically, 16 hectares of productive forest (including 10 hectares of THLB) originally classified within the Nahwitti LU, and 19 hectares of productive forest (including 13 hectares of THLB) originally classified within the Tsulquate LU, were reclassified as belonging to the Holberg LU.

The specific targets for old seral forests and designated old-growth management areas depend on two factors: LU and BEC variant, as per description in Section 10.3.3.

Table 43 details the distribution of forest seral stages within each landscape unit, categorized by BEC variant. For a visual reference, Figure 26 illustrates the boundaries of these landscape units.

Table 43 Seral Stage Area by Landscape Unit and BEC Variant for TFL 6

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)	Non Contributing Area		THLB Area	
				ha	%	ha	%
Holberg	CWHvh1	Early	2,429	241	10%	2,187	90%
		Mid	1,567	551	35%	1,015	65%
		Mature	3,516	1,932	55%	1,585	45%
		Old	251	179	71%	72	29%
	CWHvh1 Total		7,763	2,903	37%	4,860	63%
	CWHvm1	Early	9,483	1,264	13%	8,219	87%
		Mid	7,647	2,169	28%	5,478	72%
		Mature	3,269	2,369	72%	900	28%
		Old	567	355	63%	211	37%
	CWHvm1 Total		20,966	6,158	29%	14,808	71%
	CWHvm2	Early	645	46	7%	599	93%
		Mid	377	45	12%	332	88%
		Mature	579	374	65%	205	35%
		Old	110	51	46%	59	54%
	CWHvm2 Total		1,711	516	30%	1,195	70%
	MHmm1	Early	15	2	12%	13	88%
		Mid	71	68	95%	3	5%
		Mature	0	0	56%	0	44%
		Old	6	4	61%	2	39%
	MHmm1 Total		92	73	79%	19	21%
Holberg Total			**30,532**	**9,650**	**32%**	**20,882**	**68%**
Keogh	CWHvm1	Early	7,647	1,015	13%	6,632	87%
		Mid	9,884	2,675	27%	7,209	73%
		Mature	2,776	1,865	67%	911	33%

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)	Non Contributing Area		THLB Area	
				ha	%	ha	%
		Old	1,901	1,419	75%	481	25%
	CWHvm1 Total		22,208	6,975	31%	15,233	69%
	CWHvm2	Early	1,346	142	11%	1,204	89%
		Mid	1,567	259	17%	1,308	83%
		Mature	42	19	45%	23	55%
		Old	1,236	861	70%	376	30%
	CWHvm2 Total		4,191	1,280	31%	2,911	69%
	MHmm1	Early	183	21	11%	162	89%
		Mid	36	4	10%	32	90%
		Mature	5	5	83%	1	17%
		Old	335	234	70%	101	30%
	MHmm1 Total		560	263	47%	297	53%
	MHmmp	Early	8	1	14%	7	86%
		Mid	13	2	18%	11	82%
		Mature	5	5	97%	0	3%
		Old	37	34	93%	3	7%
	MHmmp Total		63	42	67%	21	33%
Keogh Total			**27,022**	**8,560**	**32%**	**18,461**	**68%**
Klaskish	CWHvm1	Early	1	0	35%	0	65%
		Mid	-	-	N/A	-	N/A
		Mature	-	-	N/A	-	N/A
		Old	1	0	83%	0	17%
	CWHvh1 Total		1	1	56%	0	44%
	CWHvm2	Early	44	6	13%	39	87%
		Mid	-	-	N/A	-	N/A
		Mature	31	15	48%	16	52%
		Old	19	7	38%	12	62%
	CWHvm2 Total		94	28	29%	67	71%
	MHmm1	Early	2	1	51%	1	49%
		Mid	-	-	N/A	-	N/A
		Mature	0	0	84%	0	16%
		Old	7	3	39%	4	61%
	MHmm1 Total		9	4	42%	5	58%
Klaskish Total			**104**	**32**	**31%**	**72**	**69%**
Lower Nimpkish	CWHvm1	Early	305	48	16%	256	84%
		Mid	290	44	15%	246	85%
		Mature	315	149	47%	166	53%
		Old	158	75	47%	83	53%
	CWHvm1 Total		1,068	316	30%	752	70%
	CWHvm2	Early	50	11	23%	39	77%
		Mid	-	-	N/A	-	N/A
		Mature	2	1	41%	1	59%
		Old	74	55	75%	18	25%
	CWHvm2 Total		125	67	54%	58	46%
	MHmm1	Early	0	0	15%	0	85%
		Mid	-	-	N/A	-	N/A
		Mature	-	-	N/A	-	N/A
		Old	0	0	91%	0	9%
	MHmm1 Total		0	0	50%	0	50%
Lower Nimpkish Total			**1,194**	**383**	**32%**	**810**	**68%**
Mahatta	CWHvh1	Early	7	3	47%	4	53%
		Mid	-	-	N/A	-	N/A
		Mature	3	1	37%	2	63%
		Old	1	0	43%	1	57%
	CWHvh1 Total		10	5	44%	6	56%
	CWHvm1	Early	6,417	883	14%	5,534	86%
		Mid	7,795	2,427	31%	5,367	69%
		Mature	1,832	1,161	63%	670	37%

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)	Non Contributing Area		THLB Area	
				ha	%	ha	%
		Old	2,734	1,951	71%	782	29%
	CWHvm1 Total		18,777	6,423	34%	12,354	66%
	CWHvm2	Early	1,472	102	7%	1,369	93%
		Mid	394	49	12%	345	88%
		Mature	451	287	64%	164	36%
		Old	1,382	878	64%	504	36%
	CWHvm2 Total		3,698	1,316	36%	2,382	64%
	MHmm1	Early	32	6	19%	26	81%
		Mid	0	0	100%	-	0%
		Mature	118	84	71%	34	29%
		Old	261	215	82%	46	18%
	MHmm1 Total		411	305	74%	106	26%
	MHmmp	Early	1	-	0%	1	100%
		Mid	-	-	N/A	-	N/A
		Mature	-	-	N/A	-	N/A
		Old	3	1	40%	2	60%
	MHmmp Total		3	1	34%	2	66%
Mahatta Total			**22,900**	**8,049**	**35%**	**14,851**	**65%**
Marble	CMA 0	Early	7	7	100%	-	0%
		Mid	-	-	N/A	-	N/A
		Mature	1	1	100%	-	0%
		Old	1	1	100%	-	0%
	CMA 0 Total		9	9	100%	-	0%
	CWHvm1	Early	9,559	1,949	20%	7,610	80%
		Mid	13,268	4,125	31%	9,144	69%
		Mature	1,900	1,346	71%	555	29%
		Old	3,891	3,144	81%	747	19%
	CWHvm1 Total		28,619	10,564	37%	18,055	63%
	CWHvm2	Early	2,886	446	15%	2,440	85%
		Mid	1,303	250	19%	1,053	81%
		Mature	830	643	77%	187	23%
		Old	3,892	2,556	66%	1,335	34%
	CWHvm2 Total		8,910	3,895	44%	5,015	56%
	MHmm1	Early	354	113	32%	241	68%
		Mid	24	15	62%	9	38%
		Mature	169	158	94%	11	6%
		Old	841	587	70%	254	30%
	MHmm1 Total		1,388	873	63%	515	37%
	MHmmp	Early	73	61	84%	12	16%
		Mid	14	12	88%	2	12%
		Mature	125	112	89%	13	11%
		Old	111	84	75%	27	25%
	MHmmp Total		323	269	83%	54	17%
Marble Total			**39,250**	**15,611**	**40%**	**23,639**	**60%**
Neroutsos	CMA 0	Early	17	17	100%	-	0%
		Mid	0	0	100%	-	0%
		Mature	4	4	100%	-	0%
		Old	0	0	100%	-	0%
	CMA 0 Total		21	21	100%	-	0%
	CWHvm1	Early	6,446	1,108	17%	5,338	83%
		Mid	2,415	944	39%	1,471	61%
		Mature	4,233	2,250	53%	1,983	47%
		Old	3,823	2,657	70%	1,165	30%
	CWHvm1 Total		16,918	6,959	41%	9,959	59%
	CWHvm2	Early	1,458	110	8%	1,347	92%
		Mid	640	142	22%	497	78%
		Mature	1,294	714	55%	580	45%
		Old	2,036	1,326	65%	711	35%

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)	Non Contributing Area		THLB Area	
				ha	%	ha	%
	CWHvm2 Total		5,427	2,292	42%	3,136	58%
	MHmm1	Early	60	33	56%	26	44%
		Mid	24	23	95%	1	5%
		Mature	178	148	83%	30	17%
		Old	230	184	80%	45	20%
	MHmm1 Total		491	388	79%	103	21%
	MHmmp	Early	7	6	86%	1	14%
		Mid	9	9	98%	0	2%
		Mature	93	66	71%	27	29%
		Old	22	13	61%	9	39%
	MHmmp Total		131	94	72%	37	28%
Neroutsos Total			**22,989**	**9,755**	**42%**	**13,234**	**58%**
San Josef	CWHvh1	Early	3,030	386	13%	2,644	87%
		Mid	728	281	39%	447	61%
		Mature	2,982	1,910	64%	1,072	36%
		Old	2,374	1,536	65%	838	35%
	CWHvh1 Total		9,114	4,114	45%	5,001	55%
	CWHvm1	Early	15,816	2,114	13%	13,702	87%
		Mid	6,028	1,915	32%	4,114	68%
		Mature	8,394	5,118	61%	3,276	39%
		Old	3,630	2,540	70%	1,090	30%
	CWHvm1 Total		33,869	11,687	35%	22,182	65%
	CWHvm2	Early	687	27	4%	660	96%
		Mid	112	17	15%	95	85%
		Mature	585	310	53%	275	47%
		Old	204	123	60%	82	40%
	CWHvm2 Total		1,589	476	30%	1,112	70%
	MHmm1	Early	6	0	7%	6	93%
		Mid	-	-	N/A	-	N/A
		Mature	42	40	96%	2	4%
		Old	41	39	97%	1	3%
	MHmm1 Total		89	80	90%	9	10%
San Josef Total			**44,661**	**16,357**	**37%**	**28,304**	**63%**
TOTAL			**188,652**	**68,398**	**36%**	**120,254**	**64%**

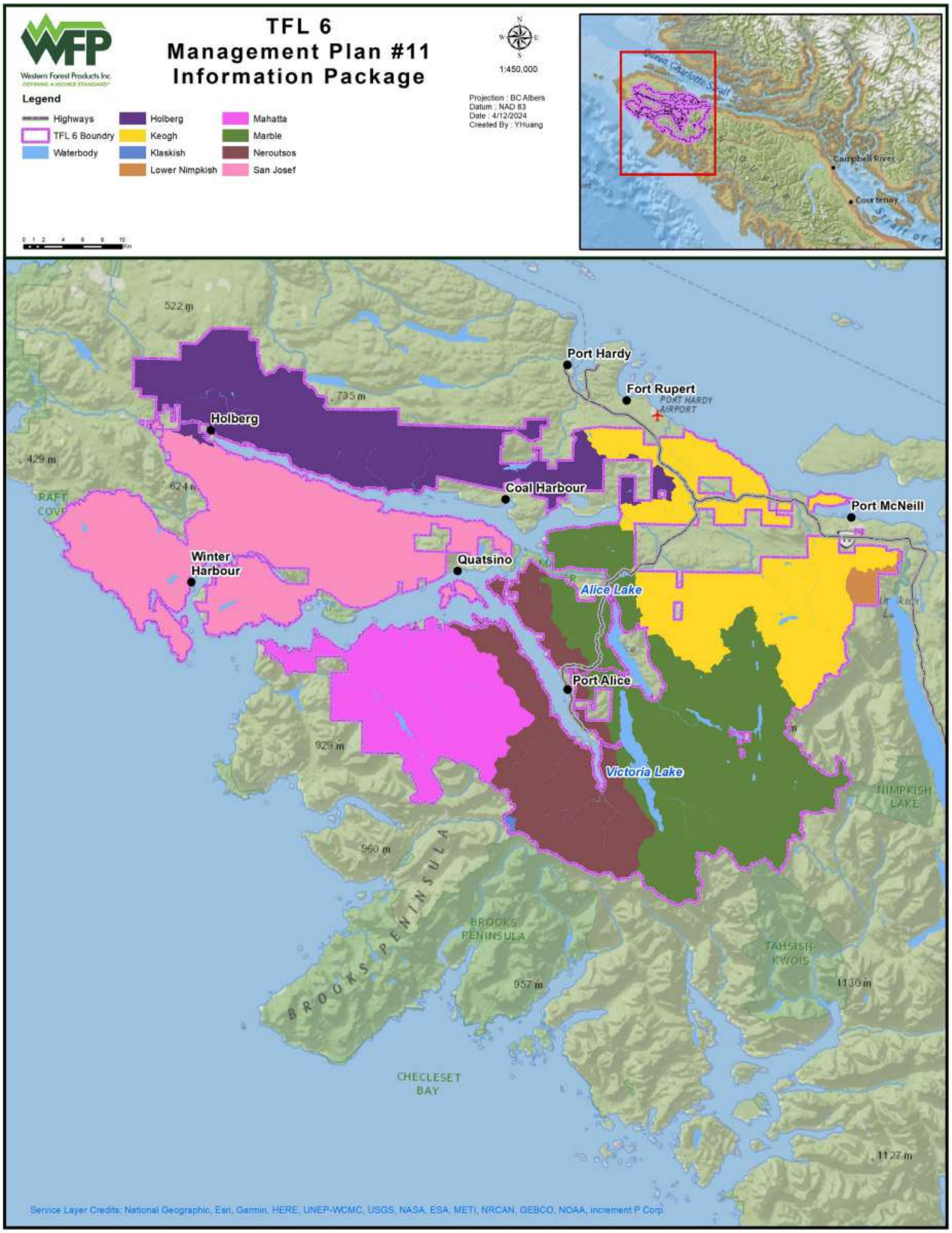

Figure 26 Landscape Units in TFL 6

7.3 Analysis Units

The timber supply modelling dataset uses forest cover stand polygons as its fundamental building block. Stands older than 62 years (established before 1961) are considered natural and will have individual growth and yield information developed for each polygon for projection and growth simulation. For managed stands, the area is grouped into units with similar characteristics called Analysis Units (AUs). These AUs are assigned growth and yield information suitable for modelling landscape-level forest growth and harvests. The specific characteristics used to define AUs are:

1. AU era
2. BEC zone/subzone/variant
3. Site series
4. Leading species
5. Silvicultural treatments

These grouping are described in more detail in the following sections.

7.3.1 AU Era

Stand age is a key factor in assigning stands to AUs. AU eras are based on the management practices prevalent during the stand's establishment period. Stand ages are determined using either known or estimated establishment dates, with all ages reported as of December 31, 2023. The AU era classifies forest cover into two main categories: natural stands and managed stands. Each category uses a different volume estimation approach.

7.3.1.1 *Natural Stands (> 62 years old, established before 1961)*

These stands are assumed to have resulted from natural regeneration following disturbances or harvesting. Their volume is estimated using the MoFOR’s Variable Density Yield Projection (VDYP) version 7.33b for each individual forest cover polygon.

7.3.1.2 *Managed Stands (established since 1961)*

Managed stands encompass those established after detailed silviculture records began in 1961. While most originated from planting, some natural regeneration exists, particularly in older stands within this category. MoFOR's Table Interpolation Program for Stand Yields (TIPSY) v4.5 (sindex33.dll version 1.54) is used to estimate volume in these stands.

7.3.1.2.1 Early Managed (EM) Stands (1961-2000, Age 23-62 years)

Established during the initial phase of active forest management, these stands have minimal genetic gain and predate the implementation of the retention silvicultural system. Post-harvest planting was dominant, although natural regeneration becomes more frequent with increasing age within this category.

7.3.1.2.2 Recent Managed (RM) Stands (2001-2023, Age 1-22 years)

These recently established stands exhibit slightly higher planting density, incorporate genetic improvements, and reflect the influence of the retention silvicultural system with increased stand-level retention (refer to Sections 8.2.8.2 and 10.4.3 for details on yield modelling considerations).

7.3.1.2.3 Future Stands

This category includes stands yet to be established, including areas classified as "not satisfactorily restocked" (NSR). They are expected to have higher genetic gain compared to the 1-22 year old stands and benefit from the continued application of the improved retention silvicultural system, leading to higher levels of stand-level retention following harvest. Eventually, after one rotation, the entire forests in the THLB will transition into future AUs. Table 44 shows all the three AU Eras in TFL 6.

Table 44 Analysis Units AU Era

AU Era
E – early managed (23 to 62 years old)
R – recent managed (1 to 22 years old)
F – future stands

7.3.2 BEC Variant and Site Series Assignment

Terrestrial Ecosystem Mapping (TEM) was used to assign BEC variants and site series for the majority of TFL 6. However, there are small data gaps primarily located along the edges of private land parcels and watershed height-of-land slivers. To fill these gaps, the provincial BEC mapping along with soil moisture and nutrient regime data from the provincial VRI were utilized. This process ensured that each stand within the TFL was assigned to a unique combination of BEC variant and site series at the AU level. A summary of the BEC variant and site series assignments can be found in Table 45, while the spatial distribution of BEC variants across the TFL is depicted in Figure 27. For analysis purposes, BEC variants smaller than 30 hectares are merged with the larger neighboring variant within the edatopic grids.

Table 45 Analysis Units BEC Variant and Site Series

BEC Variant	Site Series[1]
1 - CWHvh1	00
	01
	03
	04
	04s
	06
	08
	10
	13
2 - CWHvm1	00
	01
	01s
	03
	04
	05
	06
	06s
	07
	09
	10

[1] Smaller BEC variants are consolidated to the most similar BEC variants: CWHvh1 15/31/32/33/OW/PO/RI/SC/SM; CWHvm1 02/13/32/LA/PO/RI/RC/ZZ; CWHvm2 02/04/06/09/10/20/32/33/51/AC/PO/RM/RO/SA/SC/ZZ; MHmm1 00/02/03/05/06/07/08/09/21/22/27/32/51/AC/OW/PO/RO/SA/SC/TS/YB/YR/ZZ; MHmmp 21/23/51/RO/SC/ZZ/MHmmp1 AC/KC/LM/MH/RO/SS

BEC Variant	Site Series[1]
	11
	14
	31
	33
3 - CWHvm2	00
	01
	03
	05
	07
	08
	11
4 - MHmm1/MHmmp/MHmmp1	01
	22

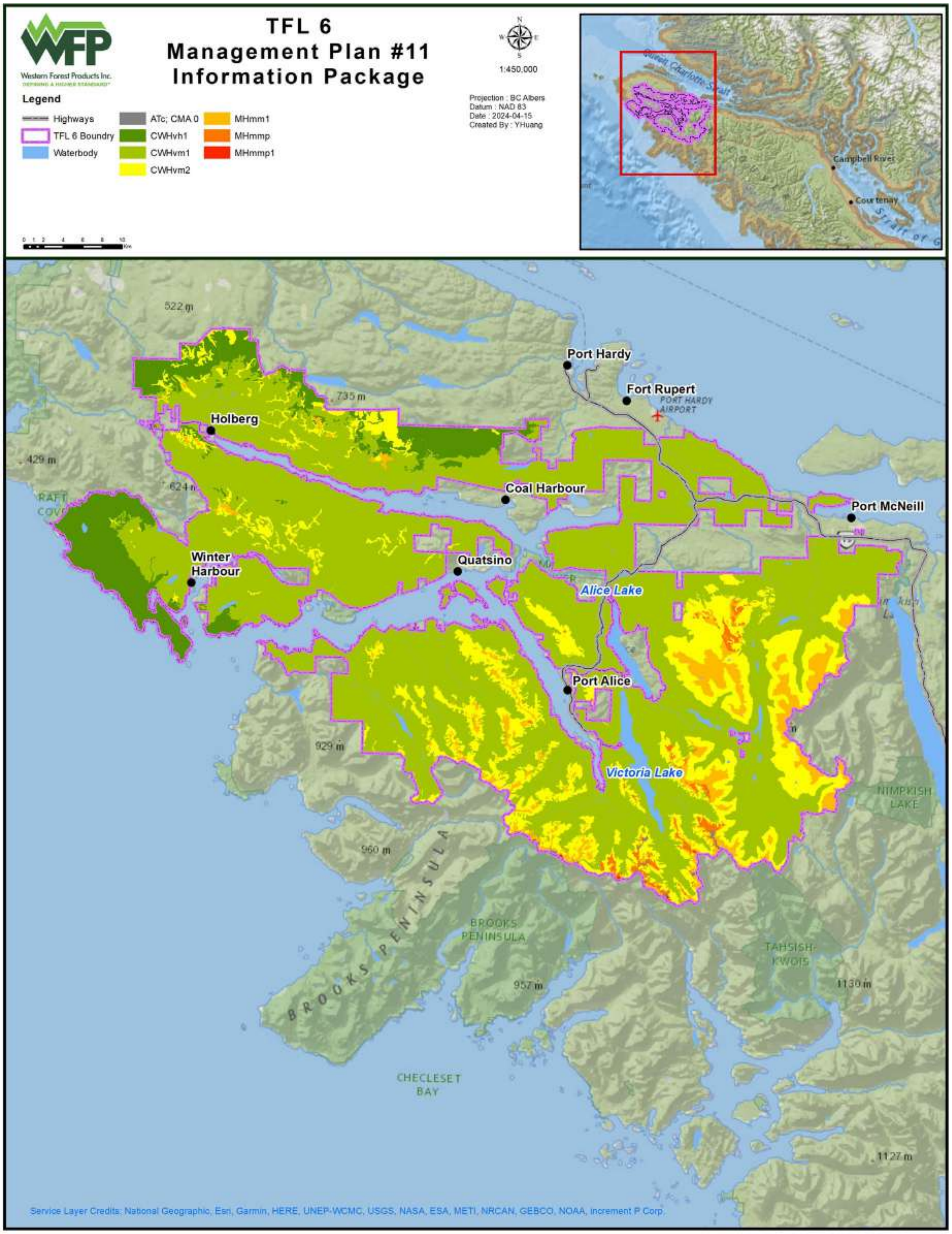

Figure 27 BEC Variants in TFL 6

7.3.3 Leading species

Existing forest cover data is used to group stands into AUs. Since BEC variant and site series represent microsite conditions, many AUs can be defined solely based on era, BEC variant, and site series.

For larger existing managed AUs (e.g., CWHvm1 01), a further level of differentiation is applied by leading species:

- h: Western hemlock is the leading species.
- c: Western redcedar is the leading species.
- f: Douglas-fir is the leading species.
- b: Amabilis Fir is the leading species.
- s: Sitka Spruce is the leading species.
- y: Yellow cedar is the leading species.
- d: Red Alder is the leading species.

For future stands, reforestation assumptions are based on BEC variant and site series. As a result, only one leading species group is required per BEC variant-site series combination. This leading species will be the most dominant species used in the reforestation strategies.

A summary of the leading species assignments can be found in Table 46.

Table 46 Analysis Units for Leading Species

Leading Species
h – Hw leading
c – Cw leading
f – Fd leading
b – Ba leading
s – Ss leading
y – Yc leading
d – Dr leading

7.3.4 Silvicultural Treatments

For managed stands, fertilization and juvenile spacing treatments are used to differentiate analysis units in order to better reflect the differences in expected growth rates in stands following these treatments.

Approximately 15,000 hectares within TFL 6 have undergone post-establishment nitrogen fertilization since 1986. Some areas have received multiple fertilizer applications. To account for this fertilization in TIPSY yield tables, AUs located within the treated areas will be assigned an "F" marker. The default TIPSY fertilization response, which is currently only available for Douglas-fir in TIPSY version 4.5 for BC Coast, will be applied to reflect the yield impact. Since past fertilization relied on government funding programs, it is assumed that no fertilization will be included in the modelling of future stands.

Over 9,700 hectares within TFL 6 have undergone juvenile spacing treatments. However, some early managed stands received spacing in the 1970s and have since been harvested. Consequently, only Early Managed AUs within the spatial area of these remaining juvenile spacing treatments will be assigned an "S" marker in the TIPSY yield tables. The growth and yield assumptions for these stands will reflect an initial establishment density of 1,600 stems per hectare, followed by a pre-commercial thinning to 900 stems per hectare in TIPSY to account for the juvenile spacing treatments.

Table 47 defines silvicultural treatments used in AU assignments.

Table 47 Analysis Units for Silvicultural Treatments

Silvicultural Treatments
F – Fertilized
S - Spaced

7.3.5 Analysis unit codes

A five-part code identifies the AU era, BEC variant, site series, species group and silvicultural treatments for each analysis unit (Table 48).

Table 48 Analysis Units Legend

First Part	Second Part	Third Part	Fourth Part	Fifth Part
AU Era	**BEC Variant**	**Site series**	**Leading Species**	**Silvicultural Treatments**
E – Early Managed (23 to 62 years old)	1 - CWHvh1	00	h – Hw leading	F – Fertilized
R – Recent Managed (1 to 22 years old)	2- CWHvm1	01	c – Cw leading	S - Spaced
F – Future	3- CWHvm2	02	f – Fd leading	
	4- MH	03	b – Ba leading	
		04	s – Ss leading	
		05	y – Yc leading	
		Etc.	d – Dr leading	

For example, code E201cF identifies the Early managed/CWHvm1/01/Cw leading/fertilized analysis unit.

8 GROWTH AND YIELD

This section outlines the approach for developing yield tables for both managed and natural stands within TFL 6. These tables will forecast growth and yield for existing and future stands, categorized as follows:

1) Existing natural stands;
2) Existing managed stands (Early managed and Recently managed); and
3) Future managed stands.

Table 49 provides a detailed breakdown of how growth and yield information will be generated for each category.

Table 49 Growth & Yield Generation for TFL 6

Stand Type	AU Label	Age Criteria	Growth & Yield Source
Existing Natural	Nat + Forest Cover Polygon ID	Age > 62	VDYP 7.33b
Existing Managed	AU Era + BEC + Site Series + Leading Spp. + Silv Treatment	Age <= 62	BatchTIPSY/TIPSY 4.5 (2023)
Future Managed	F + BEC + Site Series + Leading Spp. + Silv Treatment	N/A	BatchTIPSY/TIPSY 4.5 (2023)

8.1 Yield for Natural Stands

Stands older than 62 years of age (established prior to 1961) are classified as natural stands, likely regenerated following harvesting or natural disturbances. Volume estimation for these stands is conducted using VDYP version 7.33b. The process incorporates stand attributes from the forest cover inventory, accounting for adjustments based on VRI Phase II ground samples (details in Appendices A and B). Natural stand yield curves for each forest cover polygon within the productive forest land base will be generated.

The initial gross stand volumes (close utilization less decay) are adjusted to account for estimated waste and breakage using factors within VDYP 7 version 7.33b.

To gauge the sensitivity of TFL 6's timber supply to variations in natural stand volume estimates, sensitivity analyses will be performed by increasing and decreasing estimated natural stand volumes by 10%.

8.2 Yield for Managed Stands

8.2.1 Site Index

Site index (SI) is a key metric used to assess the productivity of a forest stand. It is calculated based on the average height of dominant trees at a specific age, typically 50 years. A higher SI indicates a more productive site, influencing several factors in the forests:

- Seedling establishment: Higher SI sites generally favor faster seedling growth and shorter green-up time.
- Timber yield: Higher SI sites have the potential to produce a greater volume of timber per hectare.
- Rotation age: Higher SI sites reach merchantable size faster compared to those on lower SI sites.

Managed stands, both existing and future, will have their site index assigned based on biogeoclimatic site series from the MoFOR's "Site Index Estimates by BEC Site Series (SIBEC)". SIBEC is a long-term research project that provides average growth potential estimates for different tree species within specific forested site series across British Columbia. SIBEC assigns site index values to all available tree species within a stand. If a site index value is missing for a particular species, conversion equations within TIPSY software will be used. The site series data for TFL 6 is obtained from the TEM project, which is described in Section 7.3.2.

Table 50 summarizes the site index distribution within the productive forest area of TFL 6, categorized by BEC variants. The table categorizes stands into three productivity classes: poor, medium, and good. These classes are generally defined as the average SI (23.3 metres for TFL 6) plus or minus one standard deviation. As for the THLB area, the area-weighted average SI is 24.5 metres.

Table 50 Area-weighted Average Site Index Values for TFL 6

BEC Variant	Productive Area (Ha)	Site Class		
		Poor	Medium	Good
		Weighted Average - 1 Standard Deviation	Weighted Average	Weighted Average + 1 Standard Deviation
CWHvh1	16,888	10.4	16.5	22.6
CWHvm1	142,425	17.9	24.7	31.4
CWHvm2	25,746	13.7	20.7	27.8
MH	3,592	8.9	16.0	23.0
Total	***188,652***	***16.0***	***23.3***	***30.5***

8.2.2 Stocking density

TFL 6 has implemented a significant planting program since 1961. For the past two to three decades, most harvested areas have been replanted, typically at a density of around 1,200 stems per hectare (sph). However, many areas also contain a substantial amount of natural regeneration. TIPSY software cannot directly model planted stands with natural regeneration. Therefore, managed stand yields are simulated based on the planting success alone. However, the species composition of the modelled stands reflects the natural regeneration of western hemlock, a common natural ingress species in BC Coast.

The following density assumptions with regeneration delay of 1 year will be used in TIPSY. These densities are supported by recent practice and a review of free-growing stands.:

- Recently Managed Stands (1-22 years old): Modelled as planted at 1,000 sph.
- Early Managed Stands (23-62 years old): Modelled as planted at 900 sph.
- Future Stands: Modelled as planted at 1,200 sph for most sites, except for CWHvm1 33/33 and MHmmp22. These low-productivity sites have lower free-growing density requirements and will be modelled with a planting density of 800 sph.

8.2.3 Fertilization

Since 1986, nitrogen fertilization (post-establishment) has been applied to roughly 15,000 hectares in TFL 6. This fertilization primarily targeted Douglas-fir leading stands on high-quality sites where the TIPSY model predicted minimal volume growth. These mid- to late-rotation stands typically received urea or a combination of urea and phosphorus at free-growing. The program relied on government funding.

The impacts of this fertilization treatment, along with the potential benefits of fertilizing late-rotation Douglas-fir stands, will be factored into the TIPSY yield tables for treated areas within analysis units. The standard TIPSY fertilization response will be used for this adjustment.

8.2.4 Spacing

Since 1965, over 9,700 hectares within TFL 6 have undergone juvenile spacing treatments. However, some early managed stands received spacing in the 1970s and have since been harvested. Consequently, only Early Managed AUs within the spatial area of these remaining juvenile spacing treatments will be assigned an "S" marker in the TIPSY yield tables. The growth and yield assumptions for these stands will reflect an initial establishment density of 1,600 stems per hectare, followed by a pre-commercial thinning to 900 stems per hectare in TIPSY to account for the juvenile spacing treatments.

8.2.5 Volumes for Early Managed Stands (1961-2000, Age 23-62 years)

Silviculture assumptions for managed stands established between 1961 and 2000 (aged 23-62 years) includes a plantation regeneration method for all stands, species composition from the inventory database, establishment density based on inventory and free-growing stand data considering expected relative stocking success. These assumptions, along with SIBEC site index estimates by species, were used as inputs for Batch TIPSY 4.5 (see Table 51). Genetic gain was not applied to stands in this age range. Areas that received fertilization and juvenile spacing are addressed separately.

Table 51 TIPSY Inputs for Early Managed Stands Aged 23 – 62 Years

Existing AU	SPH	Spp%	Spp1 SI	Spp2 SI	Spp3 SI	Spp4 SI	Spp5 SI	Prod. Area (ha)
E100	900	hw55 ba17 ss10 dr10 cw8	26.1					8
E101	900	cw46 hw33 yc14 ba6 dr1	16.0	16.0	16.0	12.0		109
E101F	900	cw67 hw20 yc12 ba1	16.0	16.0	16.0	12.0		132
E103	900	hw50 cw26 ss13 ba8 dr3	12.0	12.0	10.0	9.9		41
E104	900	hw63 cw17 ss9 ba8 dr3 fd2	24.0	20.0	24.0	24.0		1,343
E104F	900	hw54 cw35 ba6 ss3 yc2 dr2	24.0	20.0	24.0	24.0	20.0	577
E104S	1,600	hw79 ss7 cw7 ba5 dr2	24.0	24.0	20.0	24.0		139
E104sc	900	cw69 hw19 fd4 ss4 dr4 yc3	20.0	24.0	27.1	24.0		246
E104scF	900	cw79 hw17 yc2 dr1 ss1	20.0	24.0	20.0		24.0	675
E104sh	900	hw72 cw14 ss6 dr5 ba3 fd3	24.0	20.0	24.0		24.0	179
E104shF	900	hw68 cw21 ss5 dr4 yc2 ba1	24.0	20.0	24.0		20.0	236
E106c	900	cw78 hw15 ss5 yc1 ba1	24.0	24.0	32.0	24.0	24.0	113
E106h	900	hw63 dr18 cw9 ba5 ss5	24.0		24.0	24.0	32.0	363
E106s	900	ss64 hw24 cw8 ba3 dr1	32.0	24.0	24.0	24.0		110
E108	900	ss30 hw28 cw20 dr20 ba2	28.0	28.0	24.0		28.0	93
E110	900	dr49 hw37 cw7 ss7	21.2					24
E113	900	cw46 hw30 ss17 dr4 ba3	16.0	16.0	20.0		13.8	247
E200	900	hw61 ba13 cw12 dr10 ss4 fd3	25.4					352
E200F	900	hw46 ss35 cw9 fd9 ba1	28.3					15
E201b	900	ba60 hw20 cw10 ss6 fd4 yc2	29.1	27.7	22.6	30.8	35.8	849
E201c	900	cw69 hw24 fd4 ba2 yc1 dr1	22.6	27.7	35.8	29.1	22.6	1,264
E201cF	900	cw73 hw23 fd2 yc1 ba1	22.6	27.7	35.8	22.6	29.1	707
E201d	900	dr86 hw12 ss1 cw1	23.2	27.7	30.8	22.6		493
E201f	900	fd66 hw23 cw6 ss3 ba2 pl1	35.8	27.7	22.6	30.8	29.1	735
E201fF	900	fd76 hw22 cw1 ss1	35.8	27.7	22.6	30.8		924
E201fS	1,600	fd71 hw29	35.8	27.7				182
E201h	900	hw79 ba9 cw8 ss2 fd2 dr1	27.7	29.1	22.6	30.8	35.8	26,793
E201hF	900	hw75 cw15 ba6 fd3 ss1 dr1	27.7	22.6	29.1	35.8	30.8	1,916
E201hFS	1,600	hw71 cw12 fd8 ss5 ba4	27.7	22.6	35.8	30.8	29.1	119
E201hS	1,600	hw82 ba7 ss4 cw4 fd3 dr1	27.7	29.1	30.8	22.6	35.8	3,739
E201sc	900	cw52 hw23 ss19 dr3 ba3 fd2	22.6	27.7	30.8		29.1	2,563
E201scF	900	cw78 hw18 ss2 dr1 ba1 yc1	22.6	27.7	30.8		29.1	3,673
E201scS	1,600	ss46 hw27 cw24 dr2 ba1	30.8	27.7	22.6		29.1	105

Existing AU	SPH	Spp%	Spp1 SI	Spp2 SI	Spp3 SI	Spp4 SI	Spp5 SI	Prod. Area (ha)
E201sh	900	hw72 cw16 ba5 ss5 dr2 fd2	27.7	22.6	29.1	30.8		1,418
E201shF	900	hw68 cw19 ba6 ss5 dr2 yc1	27.7	22.6	29.1	30.8		829
E203c	900	cw68 hw23 fd6 ba2 dr1 yc1	16.0	17.4	32.2	15.2		295
E203cF	900	cw77 hw19 fd3 dr1	16.0	17.4	32.2			200
E203f	900	fd65 hw18 cw9 ss5 pl3	32.2	17.4	16.0	16.8	16.0	84
E203fF	900	fd84 hw9 cw7	32.2	17.4	16.0			298
E203h	900	hw76 cw12 ba7 fd3 ss2 dr1	17.4	16.0	15.2	32.2	16.8	1,616
E203hF	900	hw69 fd14 cw10 ba4 ss3	17.4	32.2	16.0	15.2	16.8	113
E204	900	hw81 cw8 ba6 dr3 ss2 fd1	26.2	22.5	24.0		24.0	133
E205b	900	ba68 fd12 hw10 ss5 cw5 yc1	30.9	36.0	28.6	32.7	24.0	216
E205c	900	cw73 hw22 ba2 dr2 fd1 yc1	24.0	28.6	30.9		36.0	283
E205cF	900	cw77 hw19 fd2 ba1 yc1 ss1	24.0	28.6	36.0	30.9	24.0	300
E205d	900	dr85 hw12 ss2 cw1	24.5	28.6	32.7	24.0		466
E205f	900	fd64 hw29 ss4 ba2 cw1 dr1	36.0	28.6	32.7	30.9	24.0	107
E205fF	900	fd62 hw28 ss4 cw3 dr3	36.0	28.6	32.7	24.0		170
E205h	900	hw76 ba9 cw8 ss4 dr3 fd1	28.6	30.9	24.0	32.7		4,294
E205hF	900	hw77 cw13 ba4 fd3 ss3 dr2	28.6	24.0	30.9	36.0	32.7	271
E205hS	1,600	hw79 ba7 cw7 ss5 dr2 fd1	28.6	30.9	24.0	32.7		349
E205s	900	ss70 hw22 cw5 dr2 ba1 fd1	32.7	28.6	24.0		30.9	631
E206	900	hw44 cw34 yc11 fd7 ss4 dr2	25.2	23.3	23.3	28.5	24.0	119
E206s	900	cw57 hw34 dr4 yc3 ba2 pl2	23.3	25.2		23.3	29.1	106
E206sF	900	cw48 hw43 ba5 yc2 pl2 ss2	23.3	25.2	29.1	23.3	23.3	211
E207	900	hw60 ss15 cw11 fd8 ba6 dr3	32.6	32.0	24.0	36.7	28.0	1,180
E207F	900	fd55 hw36 cw4 ba3 dr2 ss1	36.7	32.6	24.0	28.0		153
E209d	900	dr90 hw7 ss2 cw1	25.0	28.0	28.0	24.0		182
E209h	900	hw47 ss35 ba9 cw6 dr3 fd1	28.0	28.0	28.0	24.0		655
E210	900	hw39 dr26 ss16 cw10 fd9 ba3	30.4		32.0	24.0	34.2	140
E211	900	hw66 cw14 fd8 ss7 dr5 ba5	30.4					67
E214c	900	cw51 hw21 ss14 dr10 pl4 fd2	19.4	21.0	26.0		19.4	809
E214cF	900	cw79 hw12 ss4 yc3 pl2 dr1	19.4	21.0	26.0	19.4	19.4	875
E214h	900	hw66 cw16 ss9 ba5 dr4 fd2	21.0	19.4	26.0	18.7		564
E214hF	900	hw67 cw16 ba11 ss5 dr1	21.0	19.4	18.7	26.0		374
E231	900	cw61 hw30 ba5 pl2 ss2 dr1	21.0					43

Existing AU	SPH	Spp%	Spp1 SI	Spp2 SI	Spp3 SI	Spp4 SI	Spp5 SI	Prod. Area (ha)
E233	900	hw44 cw36 dr13 ba4 ss3 fd2	23.6					67
E300	900	hw62 ba22 cw9 dr5 ss2 yc1	24.7					67
E301	900	hw57 ba25 yc9 cw7 fd2 dr1	28.0	25.7	20.0	20.0	31.6	6,347
E301F	900	hw51 cw39 ba7 ss2 fd1	28.0	20.0	25.7	30.0	31.6	122
E301S	1,600	hw75 ba22 cw3	28.0	25.7	20.0			269
E303	900	hw48 cw35 ba12 yc4 dr1 fd1	16.0	16.0	13.8	16.0		350
E305	900	hw61 ba18 yc9 cw9 fd3 dr1	28.0	28.0	24.0	24.0	31.6	152
E307	900	hw52 yc22 ba20 cw3 ss3 dr2	28.0	24.0	28.0	24.0	28.0	85
E308	900	hw65 ba16 dr9 cw8 yc2	28.0	28.0		24.0	24.0	110
E311	900	hw64 ba20 cw9 yc7	16.0	13.8	16.0	16.0		152
E401	900	hw44 ba30 yc20 cw5 dr1	16.0	12.0	14.1	14.1		155
E422	900	hw57 ba21 cw11 yc9 dr2	23.8					41

8.2.6 Volumes for Recent Managed Stands (2001-2023, Age 1-22 years)

Silviculture assumptions for recently established stands (aged 1-22 years; 2001-2023) includes planting for all stands, species composition from the inventory database and stand assessments, establishment density reflecting stocking success. Genetic gain for Cw, Fd, Hw and Yc are incorporated for stands in this age range. Values are based on averages for seedlots planted in TFL 6 since 2012. The tree types were determined using forest cover data, and genetic improvements were sourced from WFP's Saanich Forestry Centre that produced the seedlings. Similar to older managed stands, areas that received fertilization are grouped separately to assess growth impacts. All details for these recently managed forests are documented in Table 52 and serve as inputs for the TIPSY model.

For the timber supply model, yields for these stands will be adjusted downward to account for the growth reduction caused by trees retained during the previous harvest (see Sections 8.2.8.2 and Section 10.4.3 for details).

Table 52 TIPSY Inputs for Recently Managed Stands Aged 1 – 22 years

Existing AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain %					Prod. Area (ha)
								Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	
R100	1,000	hw45 ba28 cw20 yc6 ss1	23.2							17.0	14.3		13
R101	1,000	cw52 yc24 hw22 pl1 ba1	16.0	16.0	16.0	16.0	12.0	17.0	14.3				425
R103	1,000	hw49 cw39 ss8 ba4	12.0	12.0	10.0	9.9			17.0				57

Existing AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain %					Prod. Area (ha)
								Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	
R104c	1,000	cw74 hw21 ss3 yc2	20.0	24.0	24.0	20.0		17.0			14.3		465
R104h	1,000	hw64 cw20 ss10 ba5 yc1	24.0	20.0	24.0	24.0	20.0		17.0			14.3	735
R104s	1,000	cw65 hw23 yc9 ba2 ss1	20.0	24.0	20.0	24.0	24.0	17.0		14.3			782
R106	1,000	hw42 cw39 ss13 yc3 ba3	24.0	24.0	32.0	24.0	24.0		17.0		14.3		180
R113	1,000	cw68 hw19 ss12 yc1	16.0	16.0	20.0	16.0		17.0			14.3		129
R200	1,000	hw53 cw33 ba7 yc5 fd2	27.1						17.0		14.3	10.6	111
R201c	1,000	ss2 cw72 hw20 ba3 ss3 fd2 yc1	22.6	27.7	29.1	30.8	35.8	17.0	12.8			10.6	2,655
R201h	1,000	hw75 cw11 ba7 ss4 fd3 dr1	27.7	22.6	29.1	30.8	35.8	12.8	17.0			10.6	15,827
R201sc	1,000	cw72 hw22 yc4 ba1 ss1 pl1	22.6	27.7	22.6	29.1	30.8	17.0	12.8	14.3			1,518
R201sh	1,000	hw64 cw22 ba10 ss2 yc2	27.7	22.6	29.1	30.8	22.6	12.8	17.0			14.3	899
R203c	1,000	cw71 hw25 yc2 ba1 fd1	16.0	17.4	16.0	15.2	32.2	17.0		14.3		10.6	244
R203h	1,000	hw70 cw14 ba10 fd4	17.4	16.0	15.2	32.2	16.8		17.0		10.6		379

Existing AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain % Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Prod. Area (ha)
		ss2 yc2											
R204	1,000	hw74 cw14 fd7 ba3 ss2 dr2	26.2	22.5	32.0	24.0	24.0		17.0	10.6			112
R205	1,000	hw62 cw20 ba7 fd7 ss4 dr1	28.6	24.0	30.9	36.0	32.7		17.0		10.6		3,641
R206s	1,000	cw58 hw30 ss10 pl1 ba1	23.3	25.2	24.0	23.3	29.1	17.0					42
R207	1,000	hw68 cw15 dr7 fd7 ss3 ba2	32.6	24.0		36.7	32.0		17.0	11.2	10.6		312
R209	1,000	hw56 ss18 cw16 ba6 dr4 fd4	28.0	28.0	24.0	28.0				17.0			161
R214	1,000	cw65 hw29 ss3 pl2 ba1 yc1	19.4	21.0	26.0	19.4	18.7	17.0					675
R233	1,000	hw56 cw24 fd10 ss6 ba4 dr1	25.9						17.0	10.6			21
R300	1,000	hw59 ba25 cw8 ss5 yc3 fd2	26.8							17.0		14.3	9
R301b	1,000	ba51 hw33 yc13 cw3	25.7	28.0	20.0	20.0				14.3	17.0		983
R301c	1,000	cw65 hw19 yc9 ba6 fd1 ss1	20.0	28.0	20.0	25.7	31.6	17.0		14.3		10.6	406
R301h	1,000	hw62 ba23	28.0	25.7	20.0	20.0	31.6			17.0	14.3	10.6	2,288

Existing AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain % Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Prod. Area (ha)
		cw7 yc7 fd1											
R301y	1,000	yc60 hw19 ba13 cw7 fd1	20.0	28.0	25.7	20.0	31.6	14.3			17.0	10.6	636
R303	1,000	hw43 cw26 ba20 yc10 fd1	16.0	16.0	13.8	16.0	24.0		17.0		14.3	10.6	236
R305	1,000	hw41 ba26 yc22 cw11	28.0	28.0	24.0	24.0				14.3	17.0		104
R308	1,000	hw51 ba29 cw10 yc10	28.0	28.0	24.0	24.0				17.0	14.3		53
R311	1,000	hw42 cw22 ba18 yc17 fd1	16.0	16.0	13.8	16.0	18.2		17.0		14.3	10.6	65
R332	1,000	hw36 cw29 yc27 ba8	16.9						17.0	14.3			20
R401	1,000	ba44 hw32 yc22 cw2	12.0	16.0	14.1	14.1				14.3	17.0		410
R422	1,000	hw41 ba31 yc17 cw11	22.2							14.3	17.0		42

8.2.7 Future Stand Volumes

WFP staff has developed ecologically-based silviculture strategies for future stands, drawing from current practices and a review of surveys conducted on stands established between 2001 and 2023. The species composition predominantly reflects the natural ingress of hemlock on most sites (refer to Table 54). Species and stocking levels are portrayed at a broad average level to each unique AU combination described above.

Planting densities will vary depending on site productivity. The majority of the AU will be planted at a density of 1,200 sph to reflect the continued practice of planting most harvested areas. This excludes areas designated for permanent road construction, which will be replanted only after rehabilitation and reclamation are complete. Low-productivity sites, such as CWHvm1 33/33 and MHmmp22, will be modelled with a planting density of 800 sph due to lower free-growing density requirements.

While planting conifers is the primary strategy, specific exceptions may exist. Red alder may be established on a small portion of the land base, following the prescriptions outlined in CHWvm07 (including application of genetic gain). In addition, increased reliance on natural regeneration may be considered in some areas. For further details on alder management, please refer to *Hardwood Management in the Coast Forest Region* (Province of British Columbia, 2009).

8.2.7.1 Regeneration Delay

Regeneration delay pertains to the average duration between harvesting and the establishment of the subsequent rotation. In the TFL, it remains standard practice to promptly plant nearly all harvested areas. Typically, planted seedlings are one year old, and on certain sites, their early growth is aided by fertilization at the time of planting. The actual time between harvest and seed germination for the next generation of forests is generally less than one year. To account for establishment processes beyond germination, a one-year regeneration delay is incorporated into TIPSY modelling.

8.2.7.2 Genetic Gain

Projections for genetic gain are based on seed inventory and development plans from WFP's Saanich Forestry Centre seed inventory and development plans. These projections indicate a modest increase in genetic gain from 2016 to 2036.

Since very little Hw is to be planted, the expected gain values for Hw in low-elevation (e.g., CHWvm1) and high-elevation (e.g., CHWvm2) stands are significantly reduced to 1.7% and 1.1%, respectively (representing a 90% decrease). This reflects the anticipated natural regeneration for Hw in harvested areas of these AUs. Consequently, genetic gains for Hw are not applied in other AUs.

For Yc, it is noted that only half of the seeds at the Saanich Forestry Centre are genetically improved. Therefore, the initial projection of 20% gain has been adjusted to a weighted average of 10.0%.

Table 53 provides average genetic gain values by species. These values will be applied to future managed stands.

Table 53 Genetic Gain% for Future AUs

Species	Genetic Gain% for Future AUs
Cw	21.0
Fd low elevation (e.g. CHWvh1 and CWHvm1)	16.0
Fd high elevation (e.g. CHWvm2 and MH)	11.0
Hw low elevation (e.g. CHWvh1 and CWHvm1)	17.0
Hw high elevation (e.g. CHWvm2 and MH)	11.0
Yc	10.0[1]
Dr in CHWvm1	32.0[2]

A sensitivity analysis excluding the genetic gains will be conducted to evaluate the impact.

8.2.7.3 Yields

Future stand yield tables for the Base Case can be found in Table 54.

[1] The genetic gain of Yc comprises a combination of 50% genetically improved seeds, possessing a genetic worth of 21%, and 50% wild seeds. As a result, the weighted average genetic gain for Yc stands at 10.0%.
[2] Dr planting is exclusive to CWHvm1 07

However, within the timber supply model, these yields are adjusted downward to account for the reduced growth caused by trees retained during the previous harvest to meet stand-level retention targets (see Sections 8.2.8.2 and Section 10.4.3 for details).

Table 54 TIPSY Inputs for Future Managed Stands

Future AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain %					THLB Area (ha)
								Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	
Fvh101	1,200	Cw75 Yc15 Hw10	16.0	16.0	16.0	-	-	21.0	10.0	-	-	-	3,017
Fvh103	1,200	Cw40 Yc30 Hw20 Ba5 Plc5	8.0	8.0	9.6	7.5	12.0	21.0	10.0	-	-	-	729
Fvh104	1,200	Cw60 Hw30 Ba5 Ss5	20.0	24.0	24.0	24.0	-	21.0	-	-	-	-	5,527
Fvh104s	1,200	Cw75 Hw15 Yc10	20.0	24.0	20.0	-	-	21.0	-	10.0	-	-	3,984
Fvh106	1,200	Cw50 Yc25 Hw15 Ss5 Ba5	24.0	24.0	24.0	32.0	24.0	21.0	10.0	-	-	-	2,048
Fvh108	1,200	Ss30 Hw25 Cw20 Dr20 Ba5	28.0	28.0	24.0	26.0	28.0	-	-	21.0	-	-	231
Fvh113	1,200	Cw70 Yc15 Hw10 Plc5	16.0	16.0	16.0	16.0	-	21.0	10.0	-	-	-	1,353
Fvm101	1,200	Hw40 Cw30 Fdc20 Ba5 Ss5	27.7	22.6	35.8	29.1	30.8	1.7	21.0	16.0	-	-	84,702
Fvm101s	1,200	Cw85 Hw15	22.6	27.7	-	-	-	21.0	-	-	-	-	14,935
Fvm103	1,200	Cw50 Fdc25 Hw20 Yc5	16.0	32.2	17.4	16.0	-	21.0	16.0	-	10.0	-	6,268
Fvm104	1,200	Hw70 Cw20 Ba5 Ss5	26.2	22.5	24.0	24.0	-	-	21.0	-	-	-	497
Fvm105	1,200	Cw40 Fdc30 Hw20 Ss10	24.0	36.0	28.6	32.7	-	21.0	16.0	-	-	-	23,323
Fvm106	1,200	Cw50 Hw40 Ba5 Ss5	23.3	25.2	29.1	24.0	-	21.0	-	-	-	-	190

Future AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain % Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	THLB Area (ha)
Fvm106s	1,200	Cw85 Hw15	23.3	25.2	-	-	-	21.0	-	-	-	-	436
Fvm107	1,200	Hw45 Cw25 Fdc15 Ss10 Dr5	32.6	24.0	36.7	32.0	26.0	-	21.0	16.0	-	32.0	2,715
Fvm109	1,200	Hw45 Cw25 Ss20 Dr5 Fdc5	28.0	24.0	28.0	26.0	31.6	-	21.0	-	-	16.0	2,044
Fvm111	1,200	Hw45 Ss30 Cw20 Dr5	30.4	32.0	24.0	26.0	-	-	-	21.0	-	-	273
Fvm114	1,200	Cw80 Hw10 Yc5 Ss3 Plc2	19.4	21.0	19.4	26.0	19.4	21.0	-	10.0	-	-	6,566
Fvm131	800	Cw80 Hw10 Dr4 Plc3 Ss3	19.4	21.0	26.0	19.4	26.0	21.0	-	-	-	-	229
Fvm133	800	Cw70 Plc20 Hw5 Ss5	19.4	19.4	21.0	26.0	-	21.0	-	-	-	-	247
Fvm201	1,200	Hw30 Yc25 Ba20 Cw20 Fdc5	28.0	20.0	25.7	20.0	31.6	1.1	10.0	-	21.0	11.0	20,792
Fvm203	1,200	Hw30 Cw30 Ba20 Yc20	16.0	16.0	13.8	16.0	-	-	21.0	-	10.0	-	2,247
Fvm205	1,200	Hw40 Cw30 Ba15 Yc15	28.0	24.0	28.0	24.0	-	-	21.0	-	10.0	-	429
Fvm207	1,200	Hw40 Cw30 Ba20 Yc10	28.0	24.0	28.0	24.0	-	-	21.0	-	10.0	-	194
Fvm208	1,200	Hw40 Cw30 Ba20 Yc10	28.0	24.0	28.0	24.0	-	-	21.0	-	10.0	-	1,634
Fvm211	1,200	Hw40 Cw30 Yc20 Ba10	16.0	16.0	16.0	13.8	-	-	21.0	10.0	-	-	450
FMH01	1,200	Hw40 Ba30 Yc30	16.0	12.0	14.1	-	-	-	-	10.0	-	-	2,618

Future AU	SPH	Spp %	Spp 1 SI	Spp 2 SI	Spp 3 SI	Spp 4 SI	Spp 5 SI	Genetic Gain %					THLB Area (ha)
								Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	
FMH22	800	Hw40 Ba30 Yc30	16.0	12.0	14.1	-	-	-	-	10.0	-	-	975

8.2.8 Managed Stands Volume Reduction

8.2.8.1 Operational Adjustment Factors

Yield tables account for adjustments made to the volumes of managed stands. The initial TIPSY model output does not consider these adjustments because it relies on growth patterns observed in research plots. These plots typically represent evenly-aged, fully-stocked stands with uniform site conditions and minimal pest activity.

To address these limitations and reflect real-world conditions, Operational Adjustment Factors (OAFs) are incorporated. OAF 1 accounts for unproductive areas within a stand, such as voids or gaps in canopy cover. OAF 2 addresses potential volume reductions due to forest health issues. The standard provincial values for OAF 1 and OAF 2 are 15% and 5%, respectively. These default values will be used for the yield projections in this analysis.

8.2.8.2 Shading from Retained Trees

Recently established stands (1-22 years old; 2001-2023) and all future stands will have their volume estimates reduced in the TIPSY model to account for the growth impact of trees left for variable retention silvicultural systems.

TIPSY initially estimates volume assuming regeneration in clear-cut areas. However, keeping trees in harvested areas reduces the yield of the regenerating stand due to shading. To address this, a Variable Retention Adjustment Factor (VRAF) is applied. The VRAF has two components: the removal of area from future timber production and the competition influence (shading) of retained areas on the adjacent regenerating portions of the cutblock. As the area impact is addressed as a THLB netdown (Section 6.23), only the effect of shading needs to be considered for these stands.

VRAF relies on three key factors: tree crown cover percentage, length of the edge (perimeter) of retained trees, and top height of retained trees. To determine VRAF adjustments for the TFL, various TIPSY simulations were conducted Fd and Hw across different site productivities and retention levels: 0% (baseline), 15%, 20%, and 25% (relevant to Enhanced Basic/Enhanced Windy/Special Zones; see Section 10.4.3). Top height was based on approximate rotation ages (95% Cumulation Mean Annual Increment Age; see Section 10.4.1) in scenarios without VRAF applied. Retention is typically implemented in groups of varying shapes and sizes. In VRAF calculations concerning perimeter length, TIPSY simulations adopt 0.25-hectare rectangular groups (approximately 22m x 113m) to replicate retention along streams. Additionally, a "square" group of 0.25-hectare retention is simulated for reference purposes.

Table 55 details the range and average yield impacts observed in the TIPSY scenarios in a 1x5 rectangular shape. The average VRAF is applied proportionally to the expected harvest area using the retention system, considering the corresponding retention level to generate the average yield impact. This reduction is applied when individual stands are harvested within the model, without altering the overall yield curves.

Table 55 Yield Component of Variable Retention Adjustment Factor

Description	WFP Stewardship and Conservation Plan Zones				
Zone	Enhanced Windy	Enhanced Basic	General Windy	General Basic	Special
Retention Level	15%	15%	20%	20%	25%
Range in VRAF in TIPSY scenarios	2% - 6%	2% - 6%	3% - 7%	3% - 7%	4% - 8%
Average VRAF	3.4%	3.4%	4.8%	4.8%	6.0%
Percent of harvest area	30%	50%	40%	60%	90%
Average yield impact to be applied	1.0%	1.7%	1.9%	2.9%	5.4%

8.2.9 Not Satisfactorily Restocked Areas

The dataset utilized for analysis consists of 1,167 hectares of productive forests categorized as not satisfactorily restocked (NSR; see Table 56). The "NSR" area encompasses a larger area compared to operational records, including areas where planting occurred in 2023, but planting data was not accessible during compilation of the modelling dataset. Additionally, it includes areas harvested in 2023, designated for planting in 2024. These NSR zones are designated for regeneration within the model and allocated to suitable future AUs during the initial planning period.

Table 56 NSR Area in TFL 6

Description	Productive Area (ha)	THLB Area (ha)
NSR Areas	1,167	1,095

To assess how variations in managed stand volume estimates might affect the timber supply of TFL 6, sensitivity analyses will be conducted by increasing and decreasing the estimated managed stand volumes by 10% to simulate potential fluctuations.

8.3 Utilization Levels

TFL 6 adheres to the timber merchantability specifications outlined in the Provincial Logging Residue and Waste Measurements Procedure Manual (Province of British Columbia, 2019). Table 57 summarizes these utilization standards.

For stands younger than 121 years and future managed stands, the minimum usable diameter is 12.5 cm. The stump height for these stands is 30 cm, and the minimum top diameter inside bark (DIB) is 10 cm. Mature stands have a higher minimum usable diameter of 17.5 cm, with the same stump height and top DIB requirements.

Table 57 Utilization Levels

Age Class	Utilization			Firmwood Standard
	Minimum DBH (cm)	Stump Height (cm)	Top DIB (cm)	
Mature (>120 years old)	17.5	30.0	10.0	50%
Immature (<=120 years old)	12.5	30.0	10.0	50%

9 NON-RECOVERABLE LOSSES

Natural disturbances, such as wind, insect outbreaks, diseases, fires, and other events, can cause widespread tree mortality in the TFL, leading to the loss of entire stands. The impacts of these natural causes of loss can be estimated and incorporated into forest management models. In British Columbia, some of the dead or dying timber from these disturbances may still be salvageable if it falls within merchantable stands (Province of British Columbia, 2006). These natural disturbance events are considered in the forecast of the modelling exercise.

9.1 Windthrow

Historically, windthrow in TFL 6 has primarily affected individual trees or small clusters. These losses are typically accounted for in two ways: through OAFs (see Section 8.2.8.1) applied to managed stands, and through existing timber yield estimates that consider windthrow during inventory sampling. While many windthrow areas can be salvaged, meaning the timber can be harvested and the area replanted using silvicultural techniques, some areas are unrecoverable.

MP #9 and MP #10 estimate a non-recoverable loss of around 7,000 m^3/year due to windthrow. A recent study used 15cm high-resolution imagery acquired in 2022 to quantify the windthrow impact on TFL 6. The study focused on 2015 harvest blocks (1,957 hectares) that had been exposed to wind for six years by the time the imagery was acquired. Results showed that seven percent (138 hectares) of the reviewed area exhibited signs of windthrow. However, not all windthrow events result in fallen or broken trees; the actual impact was estimated to be less than a third of the observed area. Additionally, with favorable economic conditions, roughly half of the timber within windthrow areas is considered salvageable. Consequently, the estimated non-recoverable loss due to windthrow is around one percent of the 2015 AAC, or 13,600 m^3/year.

Over the past decade, many research studies have focused on understanding factors that increase windthrow along cutblock edges after harvesting. These research studies have also evaluated the effectiveness of various edge treatments (e.g., pruning, topping, and feathering) in mitigating windthrow. Findings from these studies have significantly influenced cutblock design and silvicultural treatment prescriptions, leading to a noticeable reduction in windthrow from regular winds. Furthermore, the adoption of the retention silviculture system (as described in Section 10.4.3) is expected to further reduce windthrow in TFL 6.

9.2 Insects and Diseases

The forests of TFL 6 have been fortunate to experience minimal insect and disease outbreaks, resulting in negligible timber losses. No major infestations have caused significant unsalvageable mortality or volume reduction.

The primary insect in the TFL has been the spruce weevil (*Pissodes strobi*), which has heavily impacted second growth Sitka spruce. As a result, spruce is now a minor component in reforestation programs. WFP has established a weevil-resistant seed orchard producing seedlings with an average 86% resistance. This translates to an estimated 7% of seedlings being susceptible to weevil attack in a given year. These highly resistant seedlings are prioritized for planting wherever spruce is a suitable species, and the risk of weevil infestation is high. From 2012 to 2023, spruce seedlings accounted for roughly 5.9% of all planted seedlings.

The most recent major insect outbreak in the TFL, including the surrounding North Island TSA area, occurred between 2010 and 2013. This outbreak involved the western black-headed budworm (*Acleris gloverana*) and affected roughly 28,000 hectares of forest across the entire District. It was a larger-scale recurrence of an outbreak that occurred in the late 1980s, which impacted approximately 7,000 hectares. The western black-headed budworm primarily targets western hemlock, Sitka spruce, and true firs for defoliation. To monitor this outbreak, WFP and MoFOR staff implemented a multi-year comprehensive forest health monitoring program. This program utilized aerial surveys, field surveys, and a technique called "branch beating" to collect insect samples. The budworm population began to decline in 2013, and no further occurrences were observed since 2015. While the 2013 aerial survey identified that about 12% of the affected area in NICCNRD experienced severe defoliation, fortunately, most of the damage appeared temporary with new foliage emerging.

Hemlock dwarf mistletoe is prevalent throughout merchantable stands. While occasional sanitation treatments are needed to prevent its spread in newly regenerated western hemlock stands, established stands typically experience minimal impact.

Root diseases can cause isolated pockets of tree mortality. These losses are likely accounted for by the OAFs applied to yield curves. Notably, the impacts of *Armillaria ostoyae* and *Phellinus weirii* are less severe compared to other regions, and no additional OAF adjustments are necessary.

9.3 Fire

The TFL benefits from a relatively low risk of fire due to its predominantly wet climate with cool, wet summers. Effective fire suppression efforts further minimize the threat. However, a lightning-caused fire event in 2018 impacted approximately 940 hectares (750 hectares of productive forest, 600 hectares of THLB). An active reforestation program successfully replanted a significant portion of the burned area. To assess the impact on timber supply, forest inventories from 2017 (pre-fire) were compared with forest inventory in the timber supply model. Accounting for reforestation efforts, fire intensity (many trees still survived within the fire perimeter), and five years of subsequent growth, an estimated 59,000 m³ of THLB volume was lost. As no major fires have occurred since the last AAC determination, and the next TSR will incorporate post-fire forest conditions, the estimated annual timber loss due to fire activity is set at 5,900 m³/year.

9.4 Natural Disturbance in Non-Contributing Land Base

While the previous sections discussed specific natural disturbances, existing methods can estimate the time it takes for forests within different BEC variants to fully regenerate after a major disturbance. This information is crucial because the model schedules activities within the THLB, but natural disturbances can also occur outside these areas. Therefore, it is appropriate to simulate a reasonable rate of natural disturbance in NCLB forests.

For TFL 6 MP #11 modelling, the most recent data sourced from the Old Growth Technical Advisory Panel report on disturbances was used (Old Growth Technical Advisory Panel, 2021). This data incorporated updated age definitions and disturbance intervals provided by provincial experts. Table 58 outlines the annual area affected by disturbances for each BEC variant within the TFL. Based on the combined area of the THLB and NCLB in MP #11, an annual disturbance of approximately 31.0 hectares is projected for the NCLB.

Table 58 Natural Disturbance Rate in NCLB for TFL 6

Variant	Area (ha)			Age of Old	Stand-initiating Return Interval	% of Area Expected Old	Annual Disturbance (Ha)
	Productive Forest	THLB	NCLB				
CWHvh1	16,888	9,867	7,021	250	10,000	98%	0.7
CWHvm1	142,425	93,344	49,082	250	2,000	88%	24.5
CWHvm2	25,746	15,876	9,870	250	2,000	88%	4.9
MHmm1[1]	3,592	1,168	2,425	250	3,000	92%	0.8
Total	**188,652**	**120,254**	**68,398**				**31.0**

9.5 Total Non-recoverable Losses

Natural disturbances, such as fire and insect outbreaks, can exert downward pressure on TFL 6's long-term sustainable timber supply. As outlined in this section, the total quantifiable, non-recoverable losses attributable to these disturbances amount to an estimated 19,500 m³/year. To account for these losses, a 1.5% annual deduction will be applied to the allowable harvest volume. This deduction removes the lost volume from the THLB and effectively transitions the affected stand area to age zero for modelling purposes. Timber volume deemed unrecoverable due to natural disturbances will not be included in reported harvest totals. Furthermore, to ensure accurate forecasting, natural disturbance events within the NCLB will be integrated into the model, reflecting their impact on long-term landscape-level biodiversity.

[1] Includes MHmmp, MHmmp1 and CMA 0 that do not have a prescribed disturbance rate.

10 INTEGRATED RESOURCE MANAGEMENT

This section provides an overview of resource inventories used for the timber supply review of TFL 6. It also describes other resource management information that informs planning within the TFL.

10.1 Forest Resource Inventories

Table 59 summarizes the key forest resource inventories maintained specifically for TFL 6. Additional inventories managed by the provincial government can be accessed periodically through the BC Data Catalogue.

Table 59 Forest Resource Inventory Status

Item	Status
Forest Inventory	Vegetation Resource Inventory (VRI) completed between 2000 and 2001 (photo interpretation and field sampling) with final phase (statistical adjustment) completed in 2009 for VDYP 6, and 2016 for VDYP 7. Updated for growth, harvesting and silviculture to December 31, 2023.
Ecosystems	TEM project completed and distributed by Ministry of Environment in 2016 as part of the Terrestrial Ecosystem Information (TEI) Spatial Data Non Predictive Ecosystem Mapping (PEM) distribution package for BC coast
Terrain Stability	Various inventories to different standards. Completed by T. Lewis in 1992 (Block 2) and 1995 (Block 1). Block 2 inventory was updated to Ministry standards in 1998. LiDAR-based slope mapping based on 2022/2023 LiDAR acquisition for TFL 6
Recreation Inventory	Updated in January 2004 by RRL Recreation Resources Ltd. to 1998 Ministry standards.
Visual Landscape Inventory	VLI updated between 2003 and 2005 to 1997 Ministry standards by RRL Recreation Resources Ltd. Accepted by NICCNRD in June 2010 and is being used as basis for GAR Order to establish Visual Quality Objectives for TFL 6 and Block 7 of the Pacific TSA.
UWRs	UWRs for Columbian black-tailed deer and Roosevelt elk in TFL 6 (U-1-006 and U-1-013)
WHAs	Legal WHAs established for Marbled Murrelets and Northern Goshawk; and proposed WHAs for Northern Goshawk and Marbled Murrelet.
OGMAs	OGMAs have been established in the San Josef and Marble LUs. Refinement of proposed OGMAs is proceeding for Holberg, Keogh, Mahatta, and Neroutsos LUs.
Stream Classification	LiDAR-derived stream inventories classified to riparian standards.
Archaeological and Cultural Resources	Registered archaeological features and sites from the Archaeology Branch (updated in 2023) were included. And Quatsino TUS layer for high frequency of culturally significant sites
Operability	LiDAR-based LBB process as described in Section 6.8.
Big Tree Reserves	BC Big Tree Registry big trees and LiDAR-derived tree top points greater than 80 metres.

10.2 Other Resource Inventories

Table 60 lists the spatial datasets used in this analysis. The "Source" field indicates whether the data originated from WFP or external sources like the BC Data Catalogue (https://catalogue.data.gov.bc.ca/).

Table 60 Spatial Data Source for TFL 6 MP #11

Data Name	Source
TFL 6 Boundary and Schedules	WFP
Forest Cover	WFP
LBB Harvest System	WFP
LBB Non-Productive	WFP
LBB Low Productivity	WFP
Flight Distance	WFP
Watershed	WFP
Watershed High Sensitivity Zones	WFP
Landscape Unit	BC Data Catalogue
Biodiversity Emphasis Options	BC Data Catalogue
Community Watershed	BC Data Catalogue

Data Name	Source
WSCP Variable Retention Zones	WFP
TEM BEC variant and Site Series	WFP
VILUP Resource Management Zones	BC Data Catalogue
DTSM Terrain Mapping	WFP
LiDAR Slope 90+%	WFP
Visual Landscape Inventory	BC Data Catalogue
Recreation Inventory	WFP
Research Sites	BC Data Catalogue and Forest Science Planning & Practices Branch, MoFOR
WHA (Legal)	WFP
WHA (Proposed)	WFP
UWR	WFP
OGMA (Legal)	WFP
OGMA (Proposed)	WFP
Existing Roads	WFP
LBB Projected Roads	WFP
Powerlines	WFP
Existing WTRAs	WFP and BC Data Catalogue (RESULTS)
Fertilization Treatment Area	WFP and BC Data Catalogue (RESULTS)
Juvenile Spacing Treatment Area	WFP and BC Data Catalogue (RESULTS)
Waterbodies	WFP
LiDAR-derived Riparian Reserve Zones	WFP
LiDAR-derived Riparian Management Zones	WFP
Marbled Murrelet Suitable Habitats	Marbled Murrelet Order Attachment
Marbled Murrelet LU Aggregate	Marbled Murrelet Order Attachment
Big Trees	BC BigTree Registry
WFP Big Trees	WFP
Registered Archaeological Sites	Archaeology Branch, MoFOR
Quatsino TUS Zone	Quatsino First Nations
Reconnaissance Karst Potential Mapping	BC Data Catalogue
Permanent Sampling Plots	Forest Analysis & Inventory Branch, MoFOR

10.3 Forest Cover Requirements

10.3.1 Visual Quality

On September 24, 2010, the District Manager signed the GAR Order to establish Visual Quality Objectives (VQO) for Tree Farm Licence 6 and Block 7 of the Pacific TSA within the North Island Central Coast Forest District. The established VQO classes, Visual Absorption Capability (VAC), and VQO polygons are used in this analysis.

There are currently 139 VQO polygons, totaling 21,884 hectares of productive forests and 12,877 hectares of THLB within TFL 6. A visual representation of these VQO polygons is depicted in Figure 28.

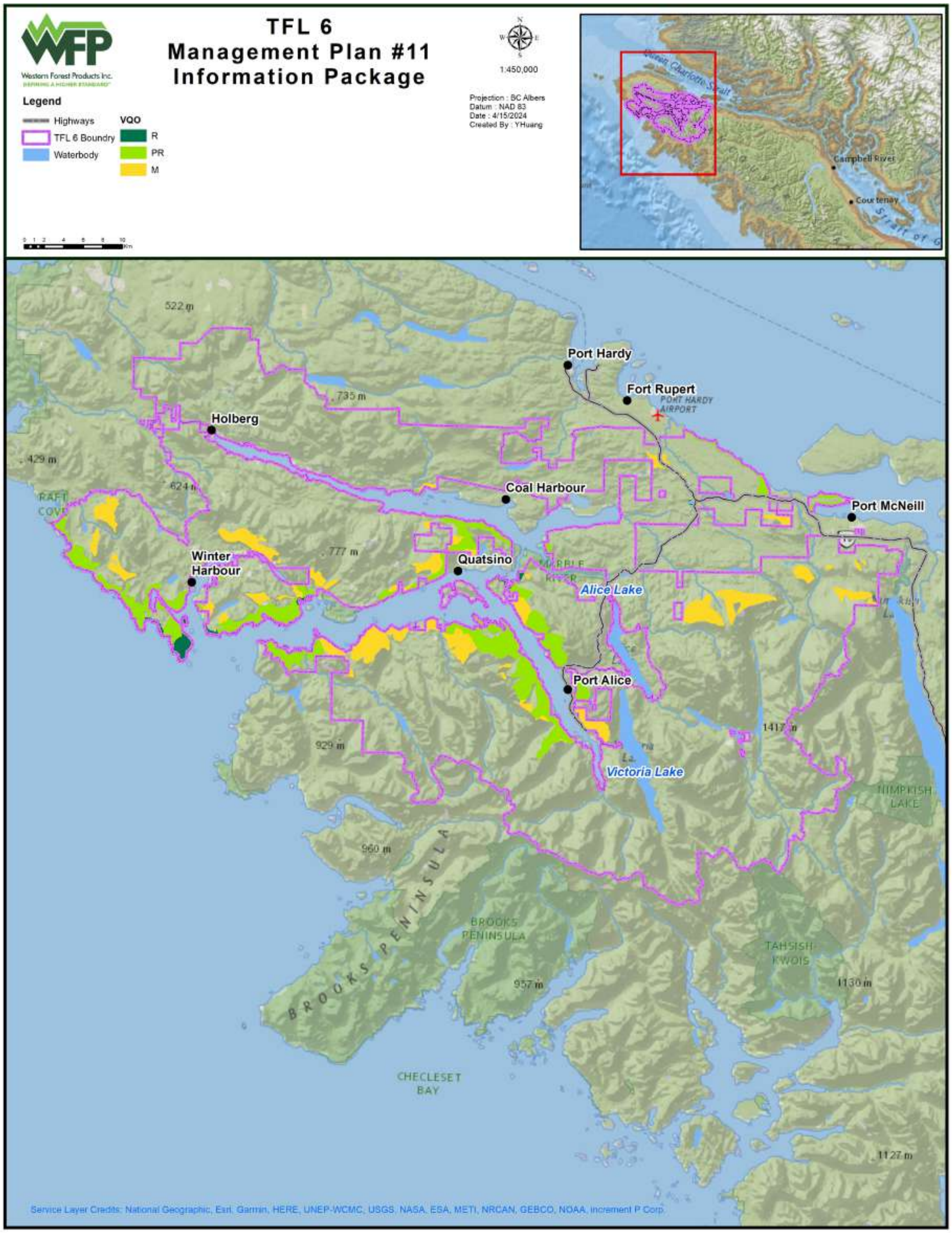

Figure 28 VQO Polygons within TFL 6

The *Procedures for Factoring Visual Resources into Timber Supply Analyses* (Province of British Columbia, 1998) and an updated bulletin (Province of British Columbia, 2003) guide the modelling of visual management in this analysis. The following VQO classes present in TFL 6 are considered:

- Retention (R): Activities are difficult to see within the landscape.

- Partial Retention (PR): Activities are visible but visually subordinate to the surrounding environment.
- Modification (M): Activities are visually dominant but designed to appear natural.

The procedures document specifies visually effective green-up (VEG) heights, ranging from 3 metres to 8.5 metres depending on slope class. A plan-to-perspective ratios (P2P) is also defined based on slope class (as shown in Table 61). Given the availability of LiDAR-based slope data for TFL 6, the VEG height, VAC value, permissible percentage alterations (Table 62) and area-weighted LiDAR-based slope will be used to manage visual quality for each VQO polygon. The permissible percentage alteration for each slope class is calculated by multiplying the P2P ratio by the maximum percentage alteration in the perspective view. For instance, the lowest maximum percentage alteration (excluding instances where it is already 0) for TFL 6 occurs for slope class ≥70%, VQO class R, and medium VAC, resulting in 1.04 x 0.75 = 0.78%. The highest percentage alteration is observed for slope class <5%, VQO class M, and high VAC, calculated as 4.68 multiplied by 18, resulting in 84.24%. TIPSY height curves by analysis unit will be used to track the total area within each VQO polygon that falls below the associated VEG height.

Table 61 VEG Heights and P2P Ratios by Slope (Province of British Columbia, 2003)

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
VEG (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
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

Table 62 Visual Quality Management Assumptions

Visual Quality Objective (VQO)	VAC	Permissible % Alteration in Perspective View (Province of British Columbia, 2003)	VLI #	Productive Forest (ha)	THLB Area (ha)
Retention (R)	Low	0.0	2	432	37
	Medium	0.75	9	337	102
	High	1.5	1	54	37
Partial Retention (PR)	Low	1.6	11	941	406
	Medium	4.3	47	9,442	5,031
	High	7	11	1,634	892
Modification (M)	Low	7.1	1	23	18
	Medium	12.55	47	7,970	5,555
	High	18.0	10	1,051	799
Total			139	21,884	12,877

10.3.2 Adjacent Cutblock Green-up

Legislation requires trees within regenerated cutblocks to reach specified heights before the adjacent timber can be harvested. Forest harvesting practices within the TFL adhere to both provincial forestry regulations and higher-level plans such as VILUP.

FRPA mandates specific tree heights in reforested areas before harvesting can resume in adjacent cutblocks.

FPPR sets a maximum cutblock size of 40 hectares along the BC coast. However, larger openings are permitted if they resemble natural disturbances. Additionally, the FPPR stipulates a "green-up" requirement, where at least 75% of reforested areas in adjacent cutblocks must reach a height of three metres before harvesting can occur in a new area.

VILUP establishes three management zones: General, Enhanced Forestry, and Special (refer to Section 7.1). Enhanced Forestry Zones allow for more flexibility in forestry operations. Therefore, a stricter green-up height of three metres will apply to areas without specific VQOs within General and Special Management Zones. In Enhanced Forestry Zones (outside VQO polygons), a reduced green-up requirement of 1.3 metres will be used in the modelling exercise.

The Patchworks model enforces limitations on cutblock size and adjacency. It regulates green-up height based on patch attributes, with support from stand age for green-up requirements defined above. For managing cutblocks separated by linear features like roads or riparian reserves, the MP #11 adopts a similar approach used in the Sunshine Coast TSA to handle cutblock size and adjacency (Province of British Columbia, 2021). Grouped openings harvested within a 10-year period (green-up height can be reached by Year 10) and within 20 metres of each other will be considered a single unit, with a maximum size of 40 hectares (refer to "X" in Figure 29 for the maximum distance between grouped blocks). The model allows for flexibility in the spatial design of these grouped cutblocks over time to accommodate various management objectives, such as meeting VQOs. To better reflect operational practices, the model avoids creating cutblocks smaller than one hectare, as these can be impractical to manage. However, it allows for some openings between one and five hectares. Occasionally, the model may permit cutblocks exceeding 40 hectares. This is to avoid situations where leaving a small residual area would make future harvesting economically unviable. To comply with adjacency regulations, the model maintains a minimum distance of 100 metres between adjacent grouped cutblocks (refer to "Y" in Figure 29). The assignment of size limits within the timber supply model will be informed by analyzing historical cutblock data from the past five years.

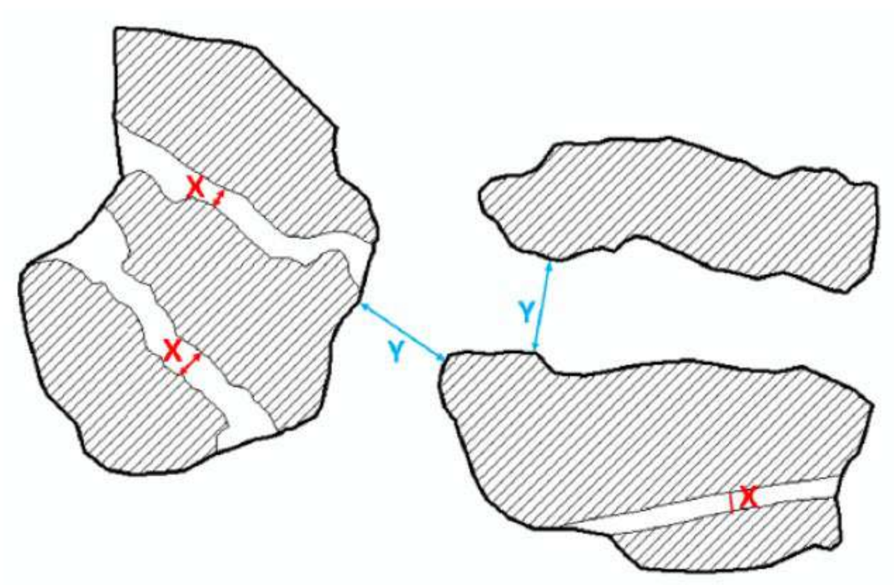

Figure 29 An Example of Cutblock Adjacency and Harvest Openings (Province of British Columbia, 2021)

10.3.3 Landscape Level Biodiversity

LUs and BEOs within the TFL originated from the NSOG order, effective June 30, 2004. This order remains in place until Landscape Unit planning determines the designation of OGMAs. The specific BEO class and proposed OGMA status for each LU are detailed in Section 6.11 and Table 21. For TFL 6, old forests are defined as stands older than 250 years. OGMAs have been established within the San Josef (Intermediate BEO) LU and the Marble (Intermediate BEO) LU. These two LUs with intermediate BEO will be subject to the full approved OGMA areas throughout the analysis period in the model.

Proposed OGMAs in the Holberg (Low BEO), Keogh (Low BEO), and Neroutsos (Low BEO) LUs have been identified. For the Mahatta (Low BEO) LU, proposed OGMAs have been identified for the WFP tenure (TFL 6 and unregulated Timber Licences) portion of the LU only. These proposed OGMAs meet the old seral target within TFL 6 drawn down to 1/3 for the first rotation (80 years). The target for the end of the second rotation (160 years) will be 2/3 of the full target, with the full old seral target being achieved by the end of the third rotation (240 years). It is important to note that these proposed OGMAs will be incorporated into the MP #11 model, but they still require public and First Nations' review before becoming legally binding.

The TFL 6 boundary overlaps with a small portion of several Landscape Units (LUs): Klaskish (High BEO), Lower Nimpkish (Low BEO), Nahwitti (Intermediate BEO), and Tsulquate (Intermediate BEO). Notably, Lower Nimpkish, Nahwitti, and Tsulquate already have legally established OGMAs.

Due to Klaskish LU's High BEO classification, the full old seral targets will be applied. As for Lower Nimpkish LU, since these legally established OGMAs are designed to meet the full targets without contribution from TFL 6, there will be no old seral requirements in this modelling exercise. Regarding Nahwitti (Intermediate BEO) and Tsulquate LUs (Intermediate BEO), applying old seral targets would not be effective given the minimal area of these LUs within TFL 6 (less than 20 hectares). Forestry activities on the portions of these LUs outside the TFL boundary would likely outweigh any targets implemented within the TFL.

In situations where a BEC variant within the TFL might not meet the old seral forest target, the Patchworks model will postpone harvesting activities within portions of those LUs until the forests naturally mature into old seral stages. In addition, The NSOG Order does not specify targets for CMA 0, MHmmp, and MHmmp1 BEC zones.

Table 63 outlines the specific landscape biodiversity targets applied to old seral forests within the TFL 6 MP #11 timber supply model. For reference, Table 43 provides a breakdown of the current forest age class distribution across landscape units and BEC variants.

Table 63 Old Seral Targets in TFL 6

Landscape Unit	BEO	NDT	BEC	Area (ha)		Old Seral Targets (% of productive)		
				Productive	THLB	1st rotation	After 2nd rotation	After 3rd rotation
Holberg	Low	1	CWHvh1	7,730	4,838	OGMAs	8.7	13
			CWHvm1	20,966	14,808	OGMAs	8.7	13
			CWHvm2	1,710	1,195	OGMAs	8.7	13
			MHmm1	92	19	OGMAs	12.7	19
Keogh	Low	1	CWHvm1	22,208	15,233	OGMAs	8.7	13
			CWHvm2	4,191	2,911	OGMAs	8.7	13
			MHmm1	560	297	OGMAs	12.7	19
			MHmmp	63	21	Old Seral Target Not Applicable: No Targets in NSOG Order		
Klaskish	High	1	CWHvm1	1	0	19	19	19
			CWHvm2	94	67	19	19	19
			MHmm1	9	5	28	28	28
			MHmmp1	0	0	Old Seral Target Not Applicable: No Targets in NSOG Order		

Mahatta	Low	1	CWHvh1	10	6	OGMAs	8.7	13
			CWHvm1	18,777	12,354	OGMAs	8.7	13
			CWHvm2	3,698	2,382	OGMAs	8.7	13
			MHmm1	411	106	OGMAs	12.7	19
			MHmmp	3	2	Old Seral Target Not Applicable: No Targets in NSOG Order		
Marble	Intermediate	1	CMA 0	9	-	Old Seral Target Not Applicable: No Targets in NSOG Order		
			CWHvm1	28,619	18,055	OGMAs	OGMAs	OGMAs
			CWHvm2	8,910	5,015	OGMAs	OGMAs	OGMAs
			MHmm1	1,388	515	OGMAs	OGMAs	OGMAs
			MHmmp	321	54	Old Seral Target Not Applicable: No Targets in NSOG Order		
			MHmmp1	2	0	Old Seral Target Not Applicable: No Targets in NSOG Order		
Neroutsos	Low	1	CMA 0	21	-	N/A	N/A	N/A
			CWHvm1	16,918	9,959	OGMAs	8.7	13
			CWHvm2	5,427	3,136	OGMAs	8.7	13
			MHmm1	491	103	OGMAs	12.7	19
			MHmmp	122	37	Old Seral Target Not Applicable: No Targets in NSOG Order		
			MHmmp1	9	-	Old Seral Target Not Applicable: No Targets in NSOG Order		
San Josef	Intermediate	1	CWHvh1	9,114	5,001	OGMAs	OGMAs	OGMAs
			CWHvm1	33,869	22,182	OGMAs	OGMAs	OGMAs
			CWHvm2	1,589	1,112	OGMAs	OGMAs	OGMAs
			MHmm1	89	9	OGMAs	OGMAs	OGMAs
Lower Nimpkish	Low	1	CWHvm1	1,069	752	Old Seral Target Not Applicable: Due to Existing Legal OGMAs Outside TFL 6		
			CWHvm2	125	58			
Nahwitti	Intermediate	1	CWHvh1	15	10	Old Seral Target Not Applicable: Due to Small Overlap		
			CWHvm2	1	0			
Tsulquate	Intermediate	1	CWHvh1	19	13			
Total				***188,652***	***120,254***			

A sensitivity analysis will be conducted for all LUs to adhere to their full old seral targets for the entire analysis period.

10.3.4 Community Watersheds

FRPA defines a community watershed as the entire or a designated portion of an area where water drains. This uphill area is located upstream from the point where water is diverted for human consumption by an authorized waterworks system. Community watersheds are designated to protect these vital sources of drinking water.

TFL 6 includes one designated community watershed (CWS): Calbick Creek (930.003), located between Quatsino Lake and Coal Harbour (Table 64). While the watershed is no longer used for drinking water by Quatsino First Nation (water licence holder), a rate-of-harvest limit ensures no more than 10% of the productive area within the watershed is covered by stands younger than 10 years. This approach aligns with TFL 6 MP #10.

Table 64 Calbick Creek Community Watershed Area

Total Area (ha)	Forested Area (ha)	Productive Forest Area (ha)	THLB Area (ha)
64	62	62	44

10.3.5 Fisheries Sensitive Watersheds

There are no fisheries sensitive watersheds within TFL 6.

10.3.6 Other Watersheds

Beyond the Calbick Creek CWS, forest planning and activities within other TFL 6 watersheds follow the Watershed Management Strategies (WMS) introduced in 2007 (Horel, 2007). The WMS development incorporates data-driven risk control measures based on physical watershed processes. These strategies guide on-site decision-making through the Terrain Risk Management Strategy (TRMS).

The WMS undergoes periodic updates by subject matter experts. The 2019 update incorporated updated forest development data, new stream channel disturbance information, and improved understanding of risk control options. Additionally, various watersheds received sensitivity class designations (Horel, 2019). The latest TFL 6 WMS (2023) includes spatially defined high sensitivity zones within specific watersheds (Figure 30). These zones, often associated with landslide initiation and potential fish habitat impacts, require a cautious harvesting approach to minimize sediment delivery risks. Specific Equivalent Clearcut Area (ECA) limits were recommended for each sensitivity zone by watershed to limit the amount of harvest through time to support hydrological recovery. Table 65 details the area, ECA recovery curves and corresponding ECA limits for each watershed with available sensitivity zones.

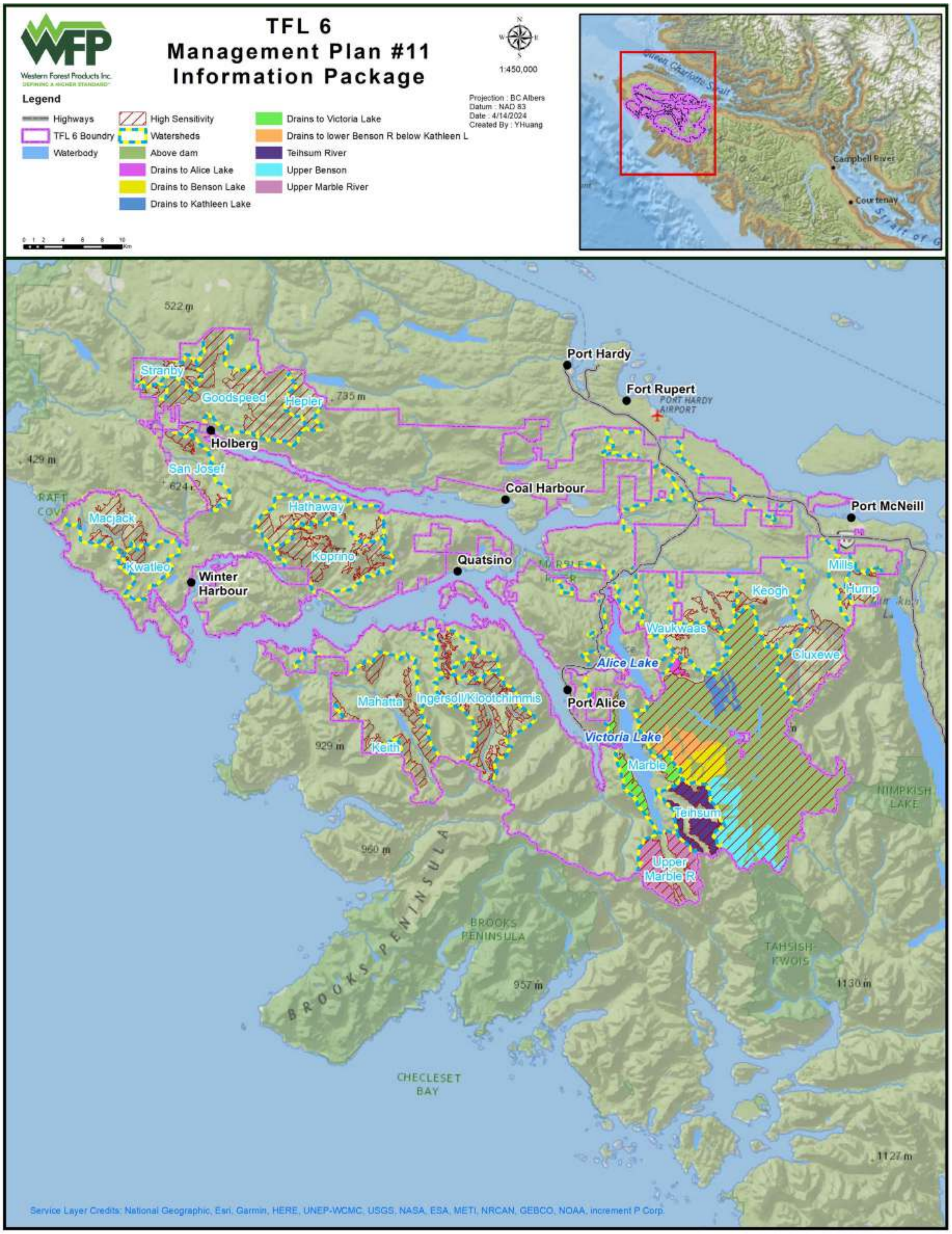

Figure 30 TFL 6 Watershed Zones of Sensitivity Overview

Table 65 ECA Limits for Zones of Sensitivity for TFL 6 Watersheds

Watershed Unit	Regional Landslide Frequency Zone (High/Moderate/Low)	Productive Forest Area (ha)	THLB Area (ha)	Modelling Tactic (ECA%)	R1b curve Implementation
Cluxewe	H	2,682	1,661	25%	T of 4 m curve on high sensitivity zone
	M, L	3,270	2,304	35%	T of 3 m curve on normal zone
Goodspeed	H	5,503	3,957	20%	T of 4 m curve
Hathaway	H	1,418	896	25%	T of 4 m curve
Hepler	H	1,279	756	25%	T of 4 m curve
Ingersoll/Klootchimmis	H	2,358	1,265	30%	T of 4 m curve
Keith	H	421	330	20%	T of 4 m curve
Keogh	H, M, L	516	327	30%	T of 3 m curve
Koprino	H	1,978	925	25%	T of 4 m curve
Kwatleo	H	288	182	25%	T of 4 m curve
Macjack	H	1,453	929	25%	T of 4 m curve
Mahatta	H	2,655	1,583	25%	T of 4 m curve
Marble Regional Watershed					
Above Maynard Lake dam	H	15,788	10,260	30%	T of 4 m curve
Upper Benson (drains to Benson Lake)	H	740	455	25%	T of 4 m curve
Other drainages to Benson Lake	H	1,664	936	30%	T of 4 m curve
Draining to Kathleen Lake	H, M	622	351	35%	T of 4 m curve
Draining to Alice Lake	H, M	233	168	35%	T of 4 m curve
Draining to lower Benson R below Kathleen L	M	968	491	35%	T of 3 m curve
Draining to Marble River below Alice Lake	M			n/a	Very low landslide frequency, limited steep terrain
Draining to Victoria Lake (except Teihsum & Upper Marble)	H	1,207	393	35%	T of 4 m curve
Upper Marble (above Victoria Lake)	H	1,712	428	30%	T of 4 m curve
Teihsum	H	1,584	339	30%	T of 4 m curve
Mills	H, M, L	116	86	35%	T of 3 m curve
Pink/Hump	H, M, L	433	288	25%	T of 4 m curve
San Josef	H	718	452	25%	T of 4 m curve
Stranby	H	639	455	25%	T of 4 m curve
Waukwaas including Basin 1	H, M, L	757	428	25%	T of 4 m curve

ECA calculations utilize the ECA recovery factors outlined in Table 66 and TIPSY height projections. These recovery factors are based on the methodology detailed in MoFOR's Technical Report TR-032 (Hudson & Horel, 2007). Specifically, the R1b T of 4 m recovery curve is used in watersheds with a High Regional Landslide Frequency (RLF) zone, while the R1b T of 3 m curve applies to applicable low and moderate RLF zones on Table 65. Some watersheds straddle multiple RLF zones, and specific ECA recovery curve application measures are developed based on expert recommendations (G. Horel, personal communication, March 20, 2024). Areas that have been harvested and are regenerating will contribute to the ECA until stands reach a height of 33 metres for T of 3 m curve or 34 metres for T of 4 m curve. At this point, it is assumed that the stands will have reached hydrological green-up. Appendix C:

Hydrologic Recovery Method Review provides further details on the development of the hydrologic recovery method.

Table 66 Recovery and ECA Factors for TFL 6 Watersheds (Hudson & Horel, 2007)

Stand Height (m)	R1b T of 4 m Curve		R1b T of 3 m Curve	
	Recovery Factor (RF)	ECA Factor (1 – RF)	Recovery Factor (RF)	ECA Factor (1 – RF)
1	-	1.00	-	1.00
2	-	1.00	-	1.00
3	-	1.00	-	1.00
4	-	1.00	0.11	0.89
5	0.11	0.89	0.24	0.76
6	0.24	0.76	0.35	0.65
7	0.35	0.65	0.45	0.55
8	0.45	0.55	0.54	0.46
9	0.54	0.46	0.62	0.38
10	0.62	0.38	0.68	0.32
11	0.68	0.32	0.73	0.27
12	0.73	0.27	0.78	0.22
13	0.78	0.22	0.81	0.19
14	0.81	0.19	0.85	0.15
15	0.85	0.15	0.87	0.13
16	0.87	0.13	0.89	0.11
17	0.89	0.11	0.91	0.09
18	0.91	0.09	0.93	0.07
19	0.93	0.07	0.94	0.06
20	0.94	0.06	0.95	0.05
21	0.95	0.05	0.96	0.04
22	0.96	0.04	0.97	0.03
23	0.97	0.03	0.97	0.03
24	0.97	0.03	0.98	0.02
25	0.98	0.02	0.98	0.02
26	0.98	0.02	0.98	0.02
27	0.98	0.02	0.99	0.01
28	0.99	0.01	0.99	0.01
29	0.99	0.01	0.99	0.01
30	0.99	0.01	0.99	0.01
31	0.99	0.01	0.99	0.01
32	0.99	0.01	0.99	0.01
33	0.99	0.01	1.00	-
34	1.00	-	1.00	-

Sensitivity zone identification for the Allen, Hushamu, and Youghpan watersheds is ongoing with the Quatsino IRMP (refer to Section 3.5.2.2). These watersheds received a sensitivity rating in the 2019 WMS due to high landslide frequency. While this Information Package does not currently define ECA limits for these three watersheds, any updates will be incorporated if zone delineation becomes available before the submission of TFL 6 MP #11.

10.3.7 Terrain Stability

Similar to the terrain stability measures implemented during the THLB netdown process (Section 6.19) using terrain stability mapping and LiDAR-derived slope data, the assessment of TFL 6 watersheds and hydrologic recovery methods (refer to Appendix C: Hydrologic Recovery Method Review) revealed a valuable co-management benefit. Managing ECA within high-sensitivity zones addresses both hydrologic and geomorphic concerns at the watershed level, further enhancing hillslope stability. Consequently, mitigating concerns regarding slopes prone to landslides or steep terrain in areas where landslides frequently occur can be achieved by avoiding terrain classified as class 5 and areas with LiDAR slopes exceeding 90%, as well as by imposing restrictions on ECA within the timber supply model.

10.3.8 VILUP Higher Level Plan

The Vancouver Island Land Use Plan, implemented on December 1, 2000, established Resource Management Zones with specific objectives. One objective for Special Management Zones (SMZs) is to maintain seral forest over one quarter to one third of the forested area (Section II 1(a)(i)). Landscape unit planning will determine the final target within this range.

As detailed in Table 42, portions of two SMZs are present within TFL 6:

- SMZ 2 – West Coast Nahwitti Lowlands;
- SMZ 4 – Koprino.

For this analysis, a restriction will be implemented to maintain at least 25% of the productive forest land base in either mature or old seral stages within these SMZs.

10.4 Timber Harvesting

10.4.1 Minimum Harvestable Age

Minimum harvestable ages (MHA) are key inputs in the timber supply model. While harvesting may occur below these minimums for specific forest-level objectives (e.g., maintaining timber flow, addressing forest health, and market conditions), many stands remain unharvested until well past the minimum age due to other resource value considerations.

Previous MPs for TFL 6 set MHAs based on tree size thresholds and harvest systems or site productivity classes. Stands were considered harvestable by the model when their average DBH reached a threshold that varied by harvest system (30cm/37cm/42cm for ground/cable/helicopter system in MP #10). This selection considered current harvesting and manufacturing systems.

However, average harvested stand DBH can be variable due to external factors such as equipment capacity, seasonality, and market conditions. Additionally, operational staff noted that ground and cable systems are often used at the same time within the same operating area. Therefore, the 7cm DBH difference between these systems in the previous criteria may not be realized in operational planning.

To ensure sustainable long-term harvesting and optimize yield, the timing of harvest generally targets stands when they are approaching their peak average growth rate, referred to as the culmination Mean Annual Increment (CMAI). This age represents the optimal biological rotation for maximizing long-term timber volume (Province of British Columbia, 2008). However, achieving this age for every area might not be feasible due to broader landscape objectives and values. As a result, reaching 95% of the culmination age is often considered a reasonable target. This approach of using 95% CMAI age aligns with recent timber supply analyses in other BC coastal regions with similar forest profiles and topography, such as the surrounding North Island TSA (Province of British Columbia, 2020) and nearby TFL 47 (using 90% CMAI & 300 m^3/ha) (Mosaic Forest Management Corp., 2024).

TFL 6 MP #11 analysis sets the minimum harvest age at 95% of CMAI, along with a minimum volume requirement of 350 m^3/ha. If the minimum volume is not met within 250 years, a minimum harvest age of 250 years applies. Existing natural stands over 62 years old have stand-level minimum ages determined for each polygon. Managed stands between 1-62 years old follow the minimum harvest ages outlined in

Table 67 for their analysis units. The weighted average minimum harvest age for these early and recently managed stands is approximately 69 years old with an average volume of 628 m^3/hectare.

Table 67 Minimum Harvest Ages for Managed AUs

Analysis Unit	Current THLB Area (ha)	95% Culmination	
		MHA	Volume at MHA
Early Managed Stands Aged 23 - 62 Years (established 1961 - 2000)			
E100	5	63	508
E101	84	102	367
E101F	118	101	380
E103	35	174	351
E104	1,062	78	581
E104F	499	81	588
E104S	118	78	601
E104sc	175	82	517
E104scF	593	83	526
E104sh	143	78	573
E104shF	200	78	565
E106c	67	75	659
E106h	154	61	422
E106s	67	61	736
E108	22	59	532
E110	1	101	352
E113	149	98	403
E200	215	65	492
E200F	10	62	713
E201b	735	63	647
E201c	991	73	611
E201cF	602	74	612
E201d	-	N/A	N/A
E201f	576	56	601
E201fF	723	54	590
E201fS	134	55	601
E201h	22,035	67	672
E201hF	1,684	67	655
E201hFS	106	66	663
E201hS	3,225	66	672
E201sc	1,887	67	608
E201scF	3,220	74	602
E201scS	87	62	683
E201sh	1,097	66	639
E201shF	717	66	635
E203c	217	92	380
E203cF	167	95	379

Analysis Unit	Current THLB Area (ha)	95% Culmination	
		MHA	Volume at MHA
E203f	54	61	441
E203fF	202	56	474
E203h	1,223	97	415
E203hF	87	87	414
E204	100	70	608
E205b	140	58	670
E205c	137	71	638
E205cF	212	73	664
E205d	-	N/A	N/A
E205f	68	56	631
E205fF	116	55	612
E205h	2,432	62	648
E205hF	175	64	674
E205hS	241	63	670
E205s	409	58	786
E206	97	74	612
E206s	79	73	584
E206sF	180	74	618
E207	568	58	732
E207F	89	53	636
E209d	-	N/A	N/A
E209h	177	63	651
E210	13	54	563
E211	22	58	664
E214c	404	82	478
E214cF	706	86	513
E214h	325	85	523
E214hF	294	87	532
E231	29	80	542
E233	17	68	431
E300	47	74	553
E301	5,470	69	625
E301F	113	72	612
E301S	233	67	650
E303	266	103	365
E305	104	66	644
E307	51	67	653
E308	31	62	577
E311	121	107	374
E401	114	116	351
E422	22	79	561
Recently Managed Stands Aged 1 - 22 Years (established 2001 - 2023)			

Analysis Unit	Current THLB Area (ha)	95% Culmination	
		MHA	Volume at MHA
R100	10	79	559
R101	404	93	384
R103	55	163	350
R104c	444	76	543
R104h	717	76	596
R104s	750	76	540
R106	165	69	656
R113	122	91	414
R200	106	68	667
R201c	2,477	66	616
R201h	14,561	61	668
R201sc	1,425	67	616
R201sh	833	62	650
R203c	224	90	391
R203h	353	92	405
R204	92	69	630
R205	3,089	61	657
R206s	38	71	643
R207	265	53	652
R209	131	62	627
R214	575	78	501
R233	13	69	630
R300	8	69	644
R301b	943	69	608
R301c	392	72	544
R301h	2,184	67	630
R301y	600	73	558
R303	226	99	371
R305	93	65	646
R308	49	65	654
R311	58	99	372
R332	19	95	361
R401	377	117	352
R422	38	82	527

Table 68 outlines the minimum harvest ages for future stands by analysis unit. The weighted average minimum harvest age across these units is 64 years old with an average volume of 584 m^3/hectare.

Table 68 Minimum Harvest Ages for Future Stands

Analysis Unit	Current THLB Area (ha)	95% Culmination	
		MHA	Volume at MHA
Fvh101	1,601	87	385
Fvh103	305	250	302

Analysis Unit	Current THLB Area (ha)	95% Culmination	
		MHA	Volume at MHA
Fvh104	3,867	73	550
Fvh104s	2,737	73	523
Fvh106	781	67	647
Fvh108	58	56	526
Fvh113	517	87	377
Fvm101	62,642	59	615
Fvm101s	10,984	67	613
Fvm103	3,699	64	362
Fvm104	299	68	625
Fvm105	10,266	55	623
Fvm106	126	68	631
Fvm106s	334	68	643
Fvm107	1,284	52	627
Fvm109	391	59	597
Fvm111	74	56	666
Fvm114	3,122	74	496
Fvm131	75	75	466
Fvm133	47	77	471
Fvm201	14,216	68	571
Fvm203	900	95	373
Fvm205	249	63	630
Fvm207	70	63	634
Fvm208	196	63	634
Fvm211	246	94	377
FMH01	950	108	350
FMH22	217	117	350

The impact of minimum harvestable age will be evaluated through sensitivity analyses by simulating a 10-year increase and decrease in the minimum harvestable age for each AU.

10.4.2 Harvest Rules

The Patchworks model will be used for this analysis, leveraging its ability to consider spatial distribution of stands to optimize and forecast harvest schedules. Unlike simulation models that set harvest priority rules, optimization models like Patchworks determine the sequence of harvests to achieve specific goals. Harvest rules will be incorporated to illustrate the transition from harvesting old-growth stands to second-growth stands. Additionally, the harvest schedule will take into account performance within the non-conventional portion of the THLB.

10.4.2.1 Second-growth Stands Contribution

Recent data on harvesting and short-term plans show a consistent trend of harvesting second growth stands (i.e., <121 years old) in TFL 6. Therefore, second-growth harvest in the Base Case option will commence at least 20% and will gradually increase over time until the transition to second-growth harvest is largely complete, though small volumes of old-growth harvest may continue to be harvested because of the scheduling impacts of forest cover class constraints.

10.4.2.2 Non-conventional Harvesting Contribution

Recent harvest performance in the non-conventional (helicopter) portion of the THLB, as discussed in Table 6 in Section 3.5.1.4, has been approximately 1.2% of the total harvested area from 2012 to 2023. Non-conventional operable land base represents 3.2% of the THLB area and 6.3% of the THLB volume (Table 69), as determined by physical operability classes defined through the LBB process using LiDAR data (Section 5.2.1). Considering the historically low harvest rate and projected limited future contribution from the non-conventional harvesting area, the Base Case will predict a harvest level within a reasonable range that considers the contribution from non-conventional harvest systems. This approach reflects the expectation of minimal contribution from the non-conventional harvesting system.

Table 69 THLB Breakdown by Harvest System

Harvest System	THLB Area (ha)	THLB Volume (000 m3)	% of THLB Area	% of THLB Volume
Ground	68,705	19,197,965	57.1%	53.2%
Cable	47,748	14,603,252	39.7%	40.5%
Non-conventional	3,801	2,259,842	3.2%	6.3%
Total	**120,254**	**36,061,059**	**100.0%**	**100.0%**

WFP is particularly interested in understanding the economic impact of accessing this economically challenging timber source. Therefore, a sensitivity analysis will be conducted by excluding the helicopter operable land base from the timber supply analysis.

10.4.3 Silvicultural Systems

The application of Variable Retention and the retention silvicultural system is a key component of WFP's Stewardship and Conservation Plan (WSCP). This plan aims to maintain various landscape values over time, including biodiversity, timber, water resources, carbon, and climate change resilience. Stand-level retention specifically helps address biodiversity elements by:

- Maintaining ecosystem representation: Ensuring a variety of habitat types are present across the landscape.
- Preserving legacies: Protecting old-growth characteristics like large trees and snags for future generations.
- Influencing both above and below ground: Providing habitat for a range of species that depend on both the forest canopy and understory.
- Protecting rare ecosystems: Prioritizing the conservation of unique and rare habitats.
- Conserving old forests: Maintaining areas with mature and old-growth trees for their ecological value.
- Safeguarding big trees: Retaining large or tall trees that provide crucial wildlife habitat value.

The utilization of the retention silvicultural system and the extent of retention within TFL 6 are based on RMZs outlined in VILUP by ecosections (refer to Section 7.1). Ecosection is a provincial classification system that categorizes the complexity of terrestrial and marine ecosystems in British Columbia. Figure 31 provides the geographical extent of various Stewardship and Conservation Zones in within TFL 6.

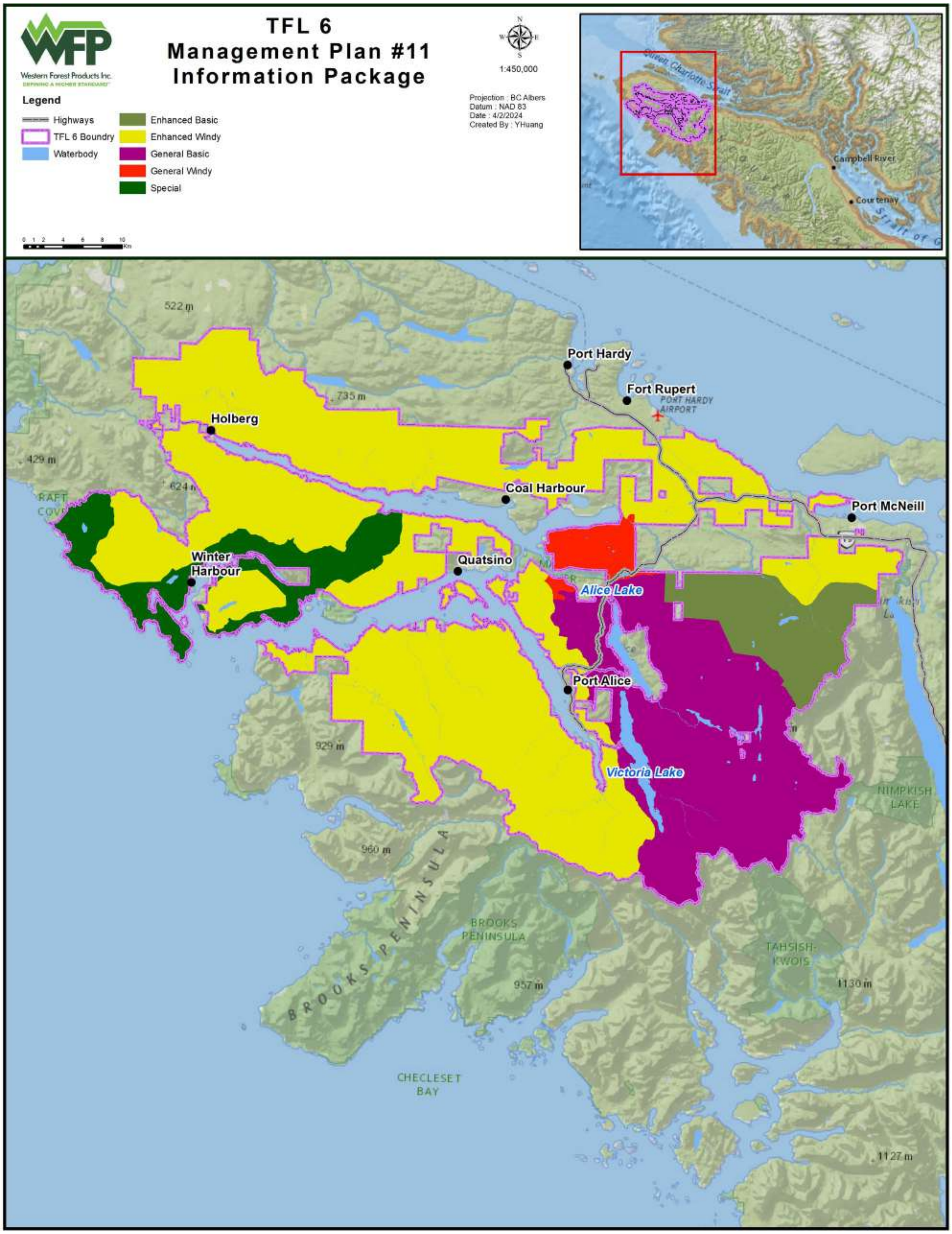

Figure 31 Stewardship and Conservation Zones within TFL 6

The specific percentage of trees retained after harvest depends on several factors:

- Ecosection: Retention levels are generally lower in windy coastal areas and higher in sheltered inland regions.
- VILUP Zone: Retention levels are higher in SMZs to prioritize resource values and more flexible in EFZs for operational planning.
- BEC Variant: Drier variants require higher minimum long-term retention targets (not applicable to TFL 6).

Here is a breakdown of the retention levels for different WSCP zones:

- Enhanced Basic: 50% of the harvested area will use the retention silvicultural system, with a minimum long-term target of 15% stand-level retention.
- Enhanced Windy: Due to increased wind exposure from the Pacific Ocean, only 30% of the harvested area will use the retention silvicultural system, while maintaining a minimum long-term target of 15% stand-level retention.
- General Basic: 60% of the harvested area will use the retention silvicultural system, with a minimum long-term target of 20% stand-level retention. The increased harvested area subject to retention silvicultural system and retention level than the EMZ reflects a more restricted operating land base.
- General Windy: 40% of the harvested area will use the retention silviculural system, with a minimum long-term target of 20% stand-level retention. The reduced retention level is reflective of larger exposure of winds from the Pacific.
- Special: Following the VILUP Higher Level Plan Order, this special management zone area will utilize various silvicultural systems (clearcut, clearcut with reserves, seed tree, shelterwood, selection, or retention) with a maximum cutblock size of 5 ha (except for shelterwood, selection, or retention which can be up to 40 ha). To achieve the long-term stand-level retention objective, the WSCP mandates a minimum of 25% retention across 90% of the harvested area.

For any remaining area harvested within each zone, the provincial requirement of a minimum 7% WTRA will still apply. Table 70 summarizes these retention targets.

Table 70 WSCP Retention Targets

Western Stewardship & Conservation Zones	Ecosection	VILUP Resource Management Zone	BEC Variants	THLB Area (ha)	Retention Strategy Use (% of harvest area)	Long Term Retention (% of harvest area)
Enhanced Basic	Northern Island Mountains	Enhanced	CWHvm1, CWHvm2, MHmm1, MHmmp	8,100	50%	15.0%
Enhanced Windy	Nahwitti Lowland	Enhanced	All	78,673	30%	15.0%
General Basic	Northern Island Mountains	General	CWHvm1, CWHvm2, MHmm1, MHmmp	22,032	60%	20.0%
General Windy	Nahwitti Lowland	General	CWHvh1, CWHvm1, CWHvm2	3,080	40%	20.0%
Special	Nahwitti Lowland	Special	CWHvh1, CWHvm1, CWHvm2	8,369	90%	25.0%
Total				**120,254**	**41.3%**	**16.7%**

Variable Retention is a long-term strategy for the Ecosection/VILUP Management Zone/BEC variant combinations within TFL 6. Stand level retention must remain in place for at least one rotation. Under this strategy, 41.3% of the total harvest area will be managed using retention silvicultural systems. The remaining area will be subject to clearcutting or clearcutting with reserves. Across the TFL 6, the area-weighted average minimum stand level retention requirement is at 16.7%.

10.4.4 Initial Harvest Rate

The current AAC for TFL 6 is set at 1,362,600 m^3 per year. This volume is divided between WFP with 1,350,422 m^3 and First Nations with 11,578 m^3.

Prior to consolidation with the former TFL 39 Block 4, the TFL 6 MP #10 timber supply analysis indicated a potential 5% decline in AAC over the next decade. In contrast, the portion of TFL 6 that originated from TFL 39 Block 4 (reflected in TFL 39 MP #9) projected a stable timber supply for the next 40 years. Due to changes in THLB netdowns and estimates of future timber growth, the timber supply dynamics for TFL 6 may differ from the historical forecasts. Therefore, various initial harvest rates will be analyzed through modelling. This will help determine a Base Case harvest schedule that aligns with the established harvest flow objectives outlined in Section 10.4.5.

10.4.5 Harvest Flow Objectives

The harvest level forecasts are designed to optimize timber harvesting for a 300-year planning horizon while adhering to key sustainability principles:

- Gradually adjust harvest levels to approach the best estimate of the long-term sustainable yield;
- Minimize periods where the harvest level falls below the long-term sustainable yield level; and
- Maintain a consistent and sustainable long-term growing stock.

11 Glossary

Allowable Annual Cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres per year.
Analysis Unit (AU)	A grouping of forest types – for example, by biogeoclimatic zone, site productivity, leading tree species, and age - done to simplify analysis and the generation of timber yield tables.
Base case harvest forecast (Current Management Option)	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Biodiversity (biological diversity)	The diversity of plants, animal and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic zones and variants (BEC)	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested cutblocks must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested.
Equivalent Clearcut Area (ECA)	An indicator that quantifies the percentage of the productive forest area within a watershed where the hydrologic response resulting from disturbance is equivalent to the hydrologic response of a clearcut.
Forest inventory	An assessment of timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and wildlife habitat.
Forest and Range Practices Act	Legislation that governs forest and range practices and planning, with a focus on ensuring management of all forest values.

Forest type	The classification or label given to a forest stand, usually based on tree species composition.
Free-growing	An established seedling of an acceptable species that is free from growth-inhibiting brush, weeds and excessive tree competition.
Geographic Information System (GIS)	A geographic information system, also known as a geographical information system or geospatial information system, is a system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the Earth.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually expressed as a specific height) - to ensure maintenance of water quality, wildlife habitat, soil stability, or aesthetics – before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The potential flow of timber harvest over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and a set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Inoperable areas	Areas defined as unavailable for timber harvest for terrain-related or economic reasons. Operability can change over time as a function of changing harvesting technology and economics.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs in resource planning and decision-making.
Karst features	Karst is a distinctive topography that develops as a result of the dissolving action of water on carbonate bedrock (usually limestone, dolomite or marble). Karst features include fluted rock surfaces, vertical shafts, sinkholes, sinking streams, springs, complex sub-surface drainage systems and caves.

Landscape-level biodiversity	The *Landscape Unit Planning Guide* and the *Order Establishing Provincial Non-Spatial Old Growth Objectives* provide objectives for maintaining biodiversity at the landscape level and stand level. At the landscape level, objectives are provided for the maintenance of old growth.
Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100,000ha), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
Lorey height	Basal area weighted average stand height: Sum of tree height multiplied by tree basal area for all trees, then divided by the basal area of the stand.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specifications for minimum harvestable ages, utilization levels, and integrated resource management and silviculture and pest management programs.
Model	An abstraction and simplification of reality constructed to help understand an actual system. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help management activities.
Natural disturbance type (NDT)	An area that is characterized by a natural disturbance regime, such as wildfires and wind, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more old forests.
Non-recoverable losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.

Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Riparian habitat	The stream bank and flood plain area adjacent to streams or water bodies.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed and the results are compared to a baseline or the Base Case.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground).
Site Index by Biogeoclimatic Ecosystem Classification site series (SIBEC)	Site index estimates for tree species according to site units of the Biogeoclimatic Ecosystem Classification system of British Columbia.
Site Series	Sites capable of producing similar late seral or climax plant communities within a biogeoclimatic subzone or variant.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
TIPSY (Table Interpolation Program for Stand Yields)	A BC Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Timber harvesting land base (THLB)	Forest land within the TFL where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and harvesting technology.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.

Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Ungulate	A hoofed herbivore, such as a deer.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds (basins).
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for wildlife.

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APPENDICES

Appendix A: TFL 6 Vegetation Resources Inventory Statistical Adjustment 2009

Appendix B: TFL 6 Vegetation Resources Inventory Statistical Adjustment 2016

Appendix C: Hydrologic Recovery Method Review

Appendix A: TFL 6 Vegetation Resources Inventory Statistical Adjustment 2009

WESTERN FOREST PRODUCTS INC.
TFL 6
VEGETATION RESOURCES INVENTORY
STATISTICAL ADJUSTMENT

Prepared for:

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Project Number: BC0108834

December 2009

EXECUTIVE SUMMARY

Western Forest Products Inc. (Western) initiated a Vegetation Resources Inventory (VRI) program in 2001 on Tree Farm License (TFL) 6 to Ministry of Forests and Range (MFR) inventory standards. The Phase II program was completed in the 2001 field season.

In May 2007, Timberline Natural Resource Group Ltd. was asked to complete the inventory adjustments in TFL 6 in preparation for Timber Supply Review (TSR). Height, age, and total live net merchantable volume (17.5+ cm) were adjusted following MFR inventory methods.

The target population, where the adjustment was applied, is the Vegetated Treed (VT) (BC Landcover Classification Scheme) portion of the TFL over 30 years of age (in 2001), excluding private lands, parks and other officially protected areas. The target population covers 137,688 ha.

Following adjustment, the TFL 6 inventory **volume increased by approximately 14%. Height and age increased by 1% and 12%,** respectively and **site index decreased by 0.4%**. The recommendations from this report are that Western apply the adjusted estimates of height, age, and volume into the upcoming TSR.

This version of the report incorporates the comments provided by MFR on July 27, 2009.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Vegetation Resources Inventory Overview

The Vegetation Resources Inventory (VRI) is the Ministry of Forests and Range's (MFR) forest inventory standard on public lands in BC. Where possible, forest licensees must use the VRI standard in their Data Package submission for Timber Supply Review (TSR).

The VRI is a four-step process (Figure 1):

1. Phase I (unadjusted inventory data) – Estimates of polygon attributes are derived for the target population, usually from photo-interpretation.
2. Phase II (ground sample data) – Measurements are taken from randomly located ground samples in the target population.
3. Net Volume Adjustment Factor (NVAF) sampling – Random trees are selected for stem-analysis from the Phase II samples to develop adjustment ratios that correct taper and decay estimation bias.
4. Adjustment Phase – The Phase I estimates are adjusted using the NVAF-corrected Phase II ground samples to provide an adjusted unbiased estimate of forest inventory attributes. The final product is an adjusted VRI database (Section 3.4).

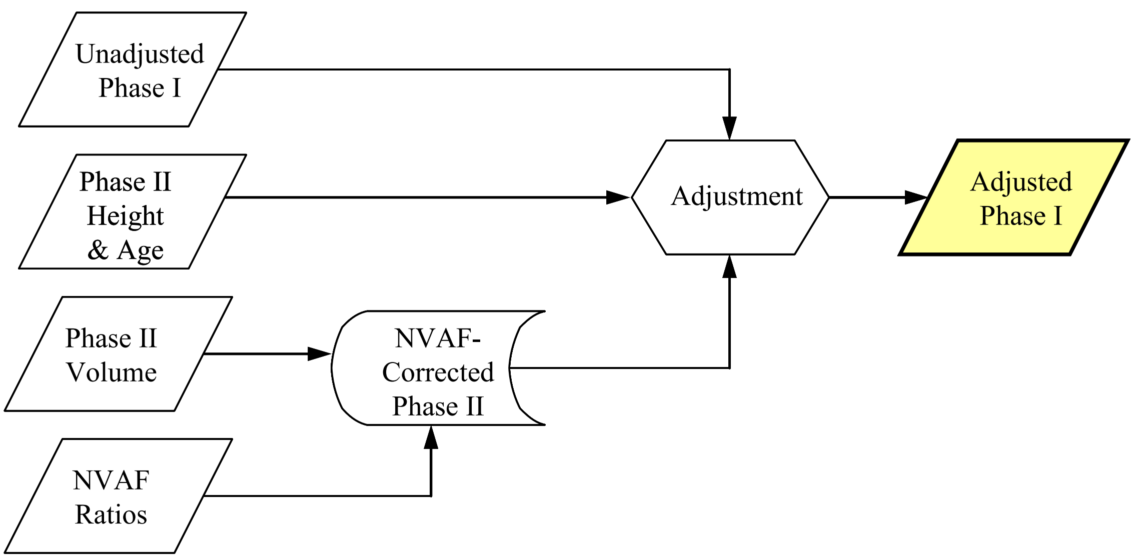

Figure 1: VRI program overview

1.1.2 VRI Program Background

Dave Byng, *RPF* led implementation of Western Forest Products Inc. (Western) Tree Farm Licence (TFL) 6 VRI Phase II program. In March 2006, Guillaume Thérien, *PhD* of Timberline Natural Resource Group Ltd. (Timberline) assisted Dave by completing statistical analysis of the data and developing preliminary adjustment factors for TFL 6.[1] Patrick Bryant, *RPF* of Western approached Timberline in March 2008 seeking to update the inventory with NVAF data, readjust the inventory according to the most current VRI statistical adjustment standards (i.e. only adjust polygons greater than 30 years), and to document the adjustment results.

1.2 Project Objectives

The objective of this project was to complete a statistical adjustment of the TFL 6 Phase I VRI to the most recent MFR standards using Phase II and NVAF data and report on the results.[2]

1.3 Terms of Reference

Timberline prepared this report for Patrick Bryant of Western. Stephanie Ewen, *RPF* was the lead analyst and prepared the report. Technical support was provided by Guillaume Thérien and the project manager was Hamish Robertson, *RPF*. This report will be provided to the MFR Forest Analysis and Inventory Branch (FAIB) for review and comment prior to its use in TSR.

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[1] J.S. Thrower & Associates Ltd. 2005 Contract for Western Forest Products Ltd. (Project no. WPC-006).

[2] This analysis was completed in the spring of 2008 using VDYP (version 6.6d).

2.0 DATA

2.1 Landbase

TFL 6 covers 205,839 ha in the northern portion of Vancouver Island (Figure 2). The TFL is administered by the North Island – Central Coast Forest District, which is part of the Coast Forest Region. TFL 6 is predominantly within the Coastal Western Hemlock biogeoclimatic zone. Western hemlock (Hw)-leading forests are most common in the TFL; also present are western redcedar (Cw), balsam (Ba), Sitka spruce (Ss), Douglas-fir (Fd) and red alder (Dr).

TFL 6 is bordered by the Kingcome Timber Supply Area (TSA), Strathcona TSA, TFL 39 and Cape Scott Provincial Park. A forest management license covering the TFL area was originally issued in 1950. In 1998, a portion of TFL 25 (Block 4 near Port McNeill) was added to TFL 6.

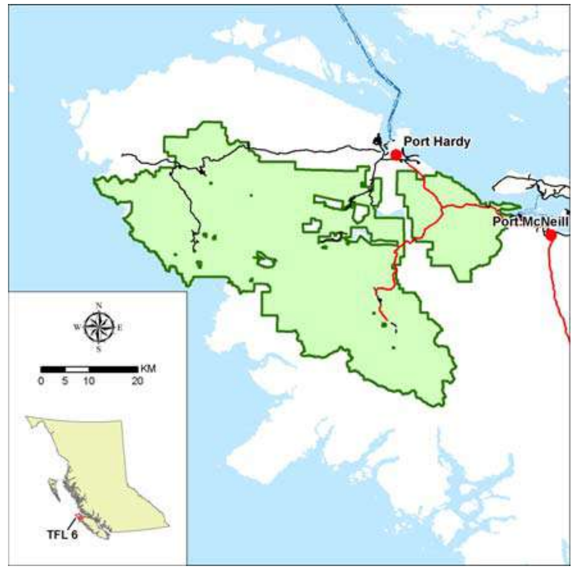

Figure 2: Location of TFL 6

2.2 Target Population

The TFL is 205,839 ha of which 137,688 ha are in the target population (Table 1).[3] The target population is the Vegetated Treed (VT) (BC Landcover Classification Scheme) portion of the TFL over 30 years of age (in 2001), excluding private lands, parks and other officially protected areas. The Phase I data provided the basis of units to be sampled. The main tree species in the target population are Hw (64%) and Cw (23%), reported by area as a leading species.

Table 1: TFL 6 netdown summary

Landclass	Area (ha)	%
Total Area	205,839	100
Leading Species Unknown	6,174	3
Productivity Group Unknown	5,477	2.7
Under 30 Years Old	56,500	27.4
Target Population	***137,688***	***66.9***

[3] The target population was identified from the 2006 Forest Cover database where records existed in the "treelayer" table, an age (at time of sampling) in the inventory ≥ 30 years, a populated leading species attribute (spp1), and a populated productivity group (prod_group) with a value ≤ 4. The assumption is made that all private lands, parks and other officially protected areas were excluded from the total area of the TFL in the initial GIS data.

2.3 Stratification

2.3.1 Area

The Phase I population was stratified based on age class (Table 2). "Young" stands were established after 1861 (< 140 years in 2001), while "Old" stands were established in or before 1861 (≥ 140 years in 2001). Each strata was sub-stratified into species groups based on Phase I leading species.[4]

Adjustment ratios were calculated at the strata level. Sub-strata were used to distribute samples.

Table 2: TFL 6 stratification summary

Stratum	Sub-Stratum	Area (ha)	% Pop.	% Stratum
Young	Hw	52,969	38.5	87.6
Young	Cw	7,472	5.4	12.4
Young	*Total*	*60,441*	*43.9*	*100*
Old	Hw	42,054	30.5	54.4
Old	Cw	35,193	25.6	45.6
Old	*Total*	*77,247*	*56.1*	*100*
Total	***Total***	***137,688***	***100***	

2.3.2 Phase I (Photo-Interpretation) Inventory Statistics

Overall average net merchantable volume (17.5 cm utilization) in the unadjusted Phase I population was 507.7 m^3/ha as projected to 2001 (Table 3). Average site index (SI) was approximately 26 m and 15 m in the "Young" and "Old" strata, respectively. Average age was approximately 59 years and 285 years for the "Young" and "Old" strata, respectively.

Table 3: Unadjusted inventory statistics for the TFL 6 target population

Stratum	Area (ha)	Mean Age (yrs)	Mean Height (m)	Mean SI (m)	Mean Vol. 17.5cm+ (m^3/ha)
Young	60,441	59	25.4	25.5	382.3
Old	77,247	285	35.0	15.2	605.8
Total	***137,688***	***186***	***30.8***	***19.7***	***507.7***

Note: Phase I (photo-interpretation) volume is net merchantable volume as predicted from VDYP version 6.6d.

[4] The "Cw" species group includes stands that are Cw, Yc (yellow cedar), Dr (red alder), Pl (shore pine), Pw (white pine) or Ac (black cottonwood) leading. The "Hw" species group includes stands that are Hw, Ss, Ba, Hm (mountain hemlock), or Fd (Douglas-fir) leading.

2.4 Phase II (Ground Sampling)

2.4.1 Actual Sample Size

One hundred (100) plots were intended to be established in TFL 6.[5] Ninety-eight (98) plots were installed after 2 were dropped because they were unsafe.[6] Of the 98 plots, 4 were established outside the initial target population and 14 were located inside the target population, but were less than 30 years of age (Phase I). The total actual sample size was 80 plots (Table 4).

Table 4: Plot distribution by land class

Land Class	n	(%)
Harvested post-2001	3	3.1
Productivity Group Unknown	1	1.0
Under 30 Years Old	14	14.3
Target Population	*80*	*81.6*

The plots covered the entire target population and their distribution is shown in Figure 3.

2.4.2 Sampling Weights

Sampling weights were calculated using the total actual number of plots sampled from within the target population. The sample plan[7] notes that samples were selected at the sub-stratum level, and therefore weights were also calculated at the sub-stratum level (Table 5).

Table 5: Sampling weights for Phase II plots

Stratum	Sub- Stratum	Area (ha)	n	Area/n
Old	Cw	35,192.5	18	1,955.1
Old	Hw	42,054.4	23	1,828.5
Young	Cw	7,472.0	5	1,494.4
Young	Hw	52,969.4	34	1,557.9

[6] Plots 69 and 93 were dropped because they were unsafe.

[7] Western Forest Products Limited. 2001. Tree Farm Licence 6 Quatsino Sound – North Vancouver Island Timber Emphasis VRI Ground Sampling Plan. Unpublished Report, February 2001. 16 pp.

2.4.3 Sample Statistics

The Phase II plot statistics showed that on average, the "Young" stands were 27 m tall, 62 years of age, had a site index of 28 m, and produced approximately 400 m^3/ha of merchantable volume. Conversely, on average, the "Old" stands were 33 m tall, 326 years of age, had a site index of 15 m, and produced approximately 740 m^3/ha (Table 6). In general, the average unadjusted Phase I heights appear similar to the average Phase II heights, and ages appear under-predicted (Table 7). In the "Young" stratum, the site index is under-predicted while volumes are slightly over-predicted. In the "Old" stratum, the site index is slightly over-predicted, while volumes are under-predicted. The Phase I and Phase II data for each sample is provided in Appendix II.

Table 6: Phase II statistics for the TFL 6 samples

Stratum	Sub-Stratum	Height (m)	Height Sample Size (n)	Age (yrs)	Age Sample Size (n)	SI (m)	SI Sample Size (n)	Vol. 17.5cm+ (m^3/ha)	Vol. Sample Size (n)
Young	Cw	29.8	4	67.3	4	28.0	4	242.5	5
Young	Hw	27	32	61.8	30	28.5	30	426.1	34
Young	*Total*	*27.3*	*36*	*62.4*	*34*	*28.4*	*34*	*403.4*	*39*
Old	Cw	23.6	14	370.2	16	10.9	14	589.6	18
Old	Hw	40.8	18	288.2	20	18.5	16	868.7	23
Old	*Total*	*33*	*32*	*326*	*36*	*14.9*	*30*	*741.6*	*41*
Total		***30.5***	***68***	***210.3***	***70***	***20.9***	***64***	***593.1***	***80***

Note: Phase II (ground sampling) volume was whole-stem volume less tops, stumps, NVAF-corrected cruiser-called decay, waste, and breakage.

Table 7: Phase I statistics for the TFL 6 samples

Stratum	Sub-Stratum	Height (m)	Age (yrs)	SI (m)	Vol. 17.5cm+ (m^3/ha)
Young	Cw	28.8	58.8	27.4	345.9
Young	Hw	23.9	55.1	24.8	421.1
Young	*Total*	*24.4*	*55.5*	*25.1*	*411.8*
Old	Cw	26.8	310.8	12.8	416.5
Old	Hw	41	276	17.7	729.1
Old	*Total*	*34.5*	*292.1*	*15.5*	*586.7*
Total		***30.1***	***188.2***	***19.7***	***509.9***

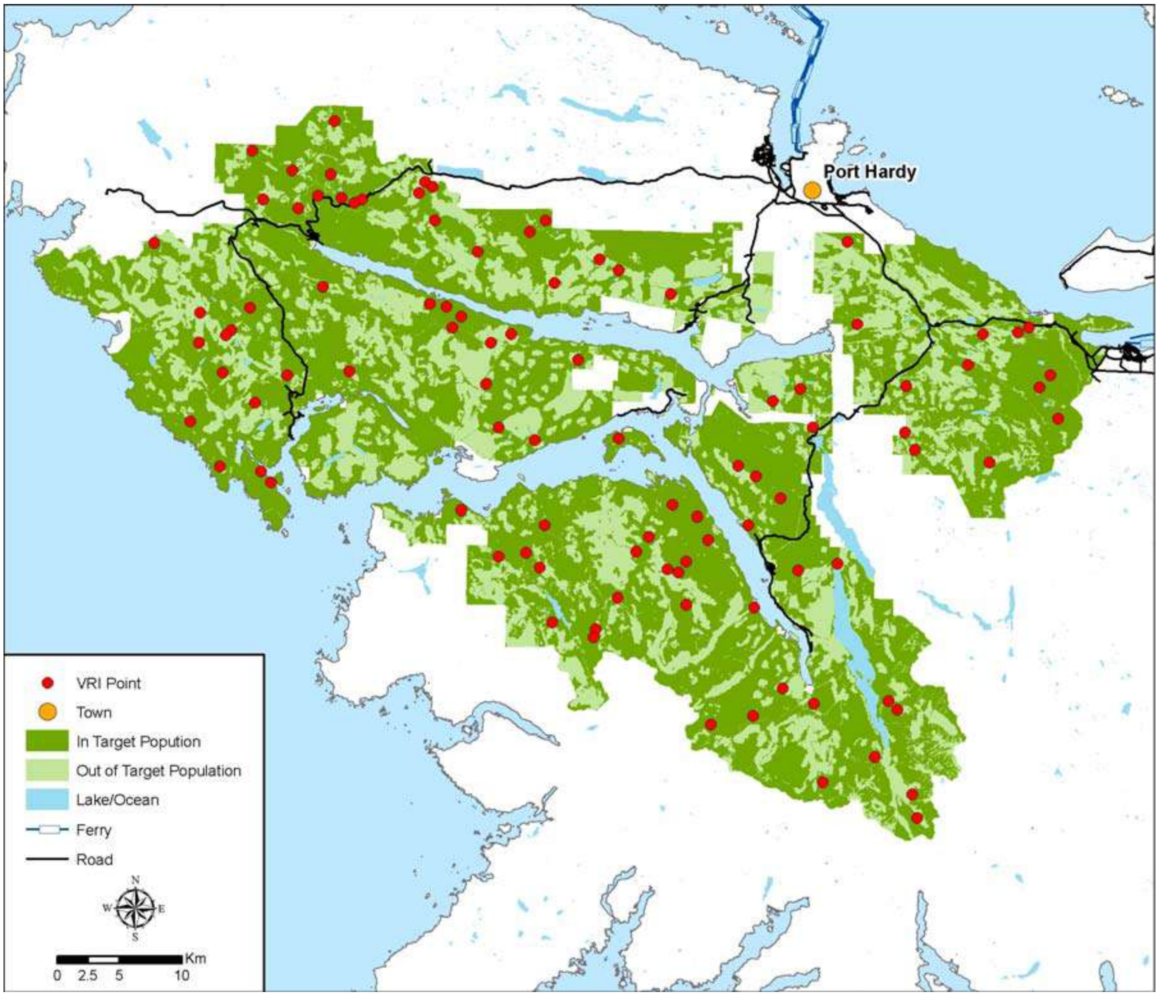

Figure 3: VRI plot locations in the target population for TFL 6

3.0 METHODS

3.1 Unadjusted Phase I Population

The last full-scale inventory completed for TFL 6 was based on photos taken in 1967 and standardized in 1970. The inventory was partially updated for second growth stands in 1998. The Phase I data used in this analysis also includes denudation and regeneration updates up to and including 2004. The photo-interpreted age was projected to 2001[8] by adding or subtracting the required number of years. The photo-interpreted height, stocking class, and corresponding net merchantable volume were projected to 2001 using VDYP *version 6.6d*. All other VDYP inputs (species composition, crown closure, forest inventory zone, and public sustained yield unit) were not modified.

3.2 NVAF

NVAF ratios were generated by Will Smith, MFR and provided to Western for the adjustment analysis (Table 8).[9]

Table 8: NVAF ratios as supplied by Western

Live / Dead	Maturity	Species Group	NVAF Ratio
Live	Immature	All	0.94064
Live	Mature	Cw	1.29029
Live	Mature	Hw	0.94511
Dead	All	All	0.92527

3.3 Phase II Compilation and Data Screening

The Phase II data was compiled using the MFR SAS VRI Phase II compiler (June 27, 2002 version). Dead trees (standing and fallen) were recorded in all auxiliary plots. The received NVAF ratios were then applied to the compiled Phase II volumes. The SAS compiler has built-in error checking and validation routines to identify potential problems in the Phase II field data. No outstanding errors were encountered in the compilation.

3.4 Statistical Adjustment

The most recent MFR VRI statistical adjustment standards[10] were used to adjust height, age, and live net merchantable volume. The MFR adjustment procedures assume that the unadjusted (Phase I) inventory volume is biased due to two sources of error:

[8] 2001 was the year of sampling.

[9] Downloaded from Western's FTP site March 17, 2008.

1. An attribute bias associated with the photo-interpreted height and age; and
2. A model bias inherent to the growth and yield model used to estimate volume (*VDYP version 6.6d*).

Three attributes needed for volume prediction are not directly adjusted in this process. A new stocking class is derived by *VDYP* using adjusted age, while there are no acceptable standards for species composition and crown closure adjustment. Leaving these attributes unadjusted is assumed to create a negligible bias.

The attribute adjustment procedure (Figure 1) is a two-step process called the Fraser method (Figure 4) and is described as follows:

Step 1: Phase I height and age bias are corrected using an adjustment ratio of means (ROM) calculated from the Phase I (height or age) and the Phase II plots. An attribute-adjusted volume is then estimated using VDYP with the adjusted height and age.

Step 2: An adjustment ROM estimated from the attribute-adjusted volume and the NVAF-corrected Phase II volume is calculated, and this ratio is used to correct the model bias in the attribute-adjusted volume.

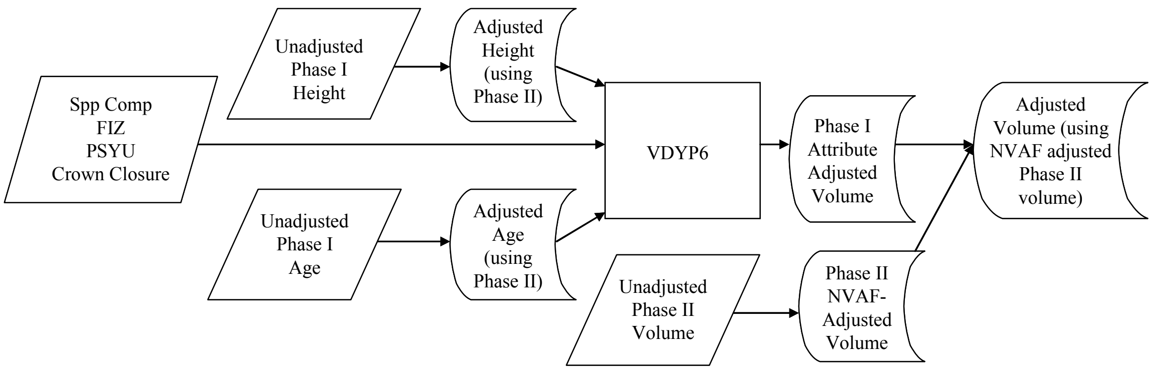

Figure 4: Fraser method

Although the ratios below are shown for each species sub-strata, the adjustment ratios were applied at the strata level that is maturity.

[10] VRI Procedures and Standards for Data Analysis Attribute Adjustment and Implementation of Adjustment in a Corporate Database, Version 2.0, March 2004. The statistical adjustment was completed in May 2008, prior to the release of VDYP7 as a MFR standard.

4.0 RESULTS

4.1 Height

Twelve (12) plots were dropped from the analysis because their top height tree measurements did not match the sample leading species in the inventory, leaving 68 plots for analysis. Of these 68 plots, 36 and 32 plots were in the “Young” and “Old” strata, respectively. On average, inventory height was slightly biased (under-estimation of 1%, Table 9). Inventory height was under-estimated in the “Young” stratum (12%) and over-estimated in the “Old” stratum (5%). The 95% sampling error was 3.9% (Figure 5).

Table 9: Height adjustment statistics for the TFL 6 target population

Stratum	Sub-Stratum	Unadj. Pop.		Sample				Adj. Population		
		Area (ha)	Avg. (m)	n	Phase I (m)	Phase II (m)	ROM	Adj. Avg. (m)	95% E (m)	95% E (%)
Young	Cw	7,472	19.1	4	28.8	29.8	1.036	19.7		
Young	Hw	52,969	26.3	32	23.9	27.0	1.130	29.7		
Young	*Total*	*60,441*	*25.4*	*36*	*24.4*	*27.3*	*1.118*	*28.4*	*1.8*	*6.2*
Old	Cw	35,193	29.6	14	26.8	23.6	0.881	26.1		
Old	Hw	42,054	39.5	18	41.0	40.8	0.994	39.3		
Old	*Total*	*77,247*	*35.0*	*32*	*34.5*	*33.0*	*0.955*	*33.4*	*1.7*	*5.2*
Total	***Total***	***137,688***	***30.8***	***68***			***1.014***	***31.2***	***1.2***	***3.9***

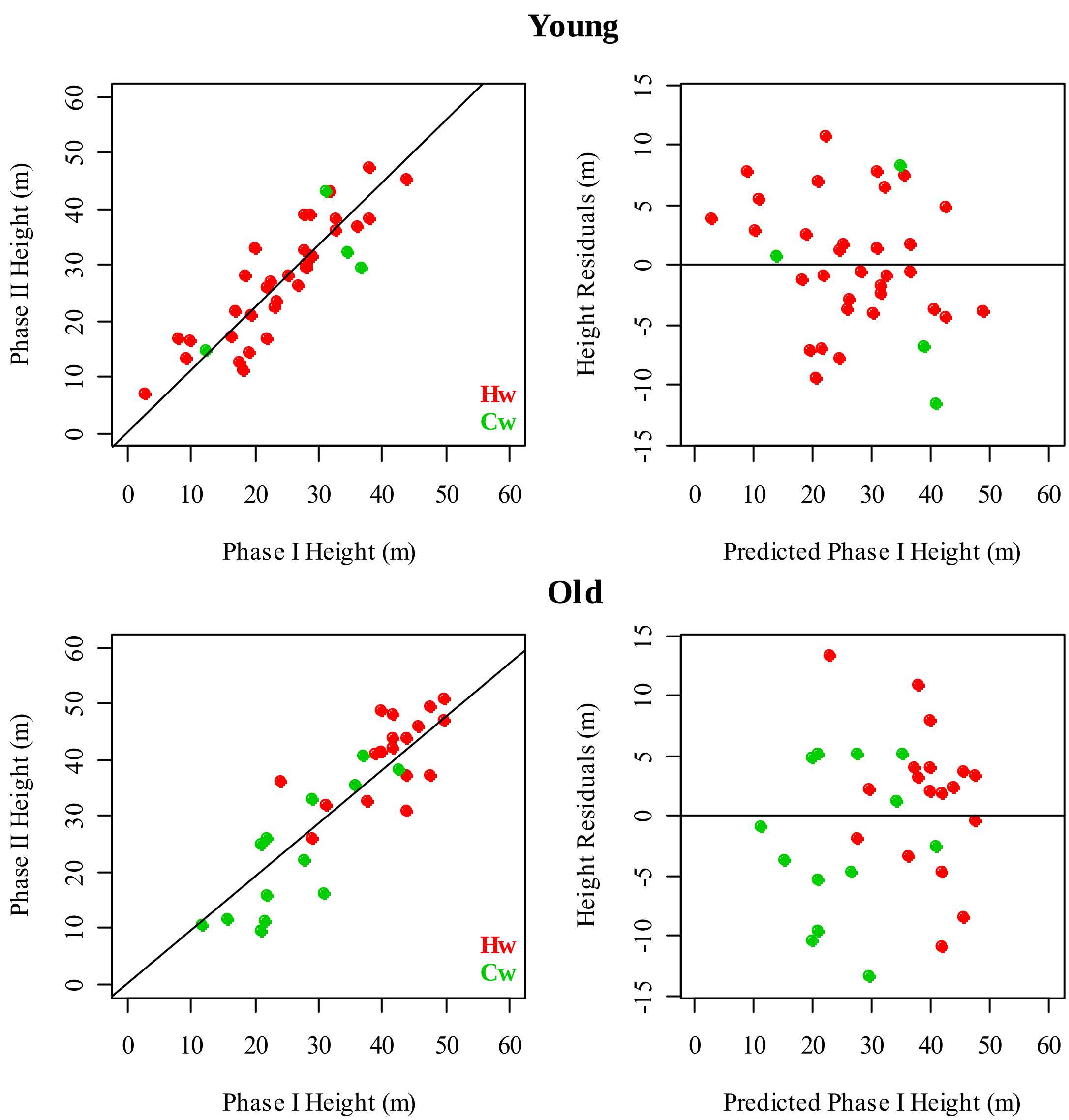

Figure 5: Height scatterplots

4.2 Age

Ten (10) plots were dropped from the analysis because their top height tree measurements did not match the sample leading species in the inventory, leaving 70 plots for analysis. Of these 70 plots, 34 and 36 plots were in the "Young" and "Old" strata, respectively. On average, inventory age was under-estimated by approximately 12% (Table 10). This under-estimation was common to both strata. There is one outlier[11] in the "Old" stratum; however, it only contributes to 1.1% of the sampling error. The 95% sampling error was higher than the sampling error for height (11.2% vs 3.9%). This may be associated with age class mid-pointing in the Phase I age estimation process. Figure 6 shows the same Phase I age estimate for a range of measured Phase II ages in the "Old" stratum.

Table 10: Age adjustment statistics for the TFL 6 target population

Stratum	Sub-Stratum	Unadj. Pop.		Sample			Adj. Population			
		Area (ha)	Avg. (yrs)	n	Phase I (yrs)	Phase II (yrs)	ROM	Adj. Avg. (yrs)	95% E (yrs)	95% E (%)
Young	Cw	7,472	44.2	4	58.8	67.3	1.146	50.7		
Young	Hw	52,969	61.6	30	55.1	61.8	1.121	69.1		
Young	*Total*	*60,441*	*59.5*	*34*	*55.5*	*62.4*	*1.124*	*66.8*	*5.0*	*7.5*
Old	Cw	35,193	310.2	16	310.8	370.2	1.191	369.4		
Old	Hw	42,054	263.8	20	276.0	288.2	1.044	275.5		
Old	*Total*	*77,247*	*284.9*	*36*	*292.1*	*326.0*	*1.116*	*318.1*	*41.9*	*13.2*
Total	***Total***	***137,688***	***186.0***	***70***			***1.117***	***207.8***	***23.2***	***11.2***

[11] Inventory age for the leading species (Yc) was recorded as 161 years old, with a field-observed age of 560 years for the ground leading species (Yc).

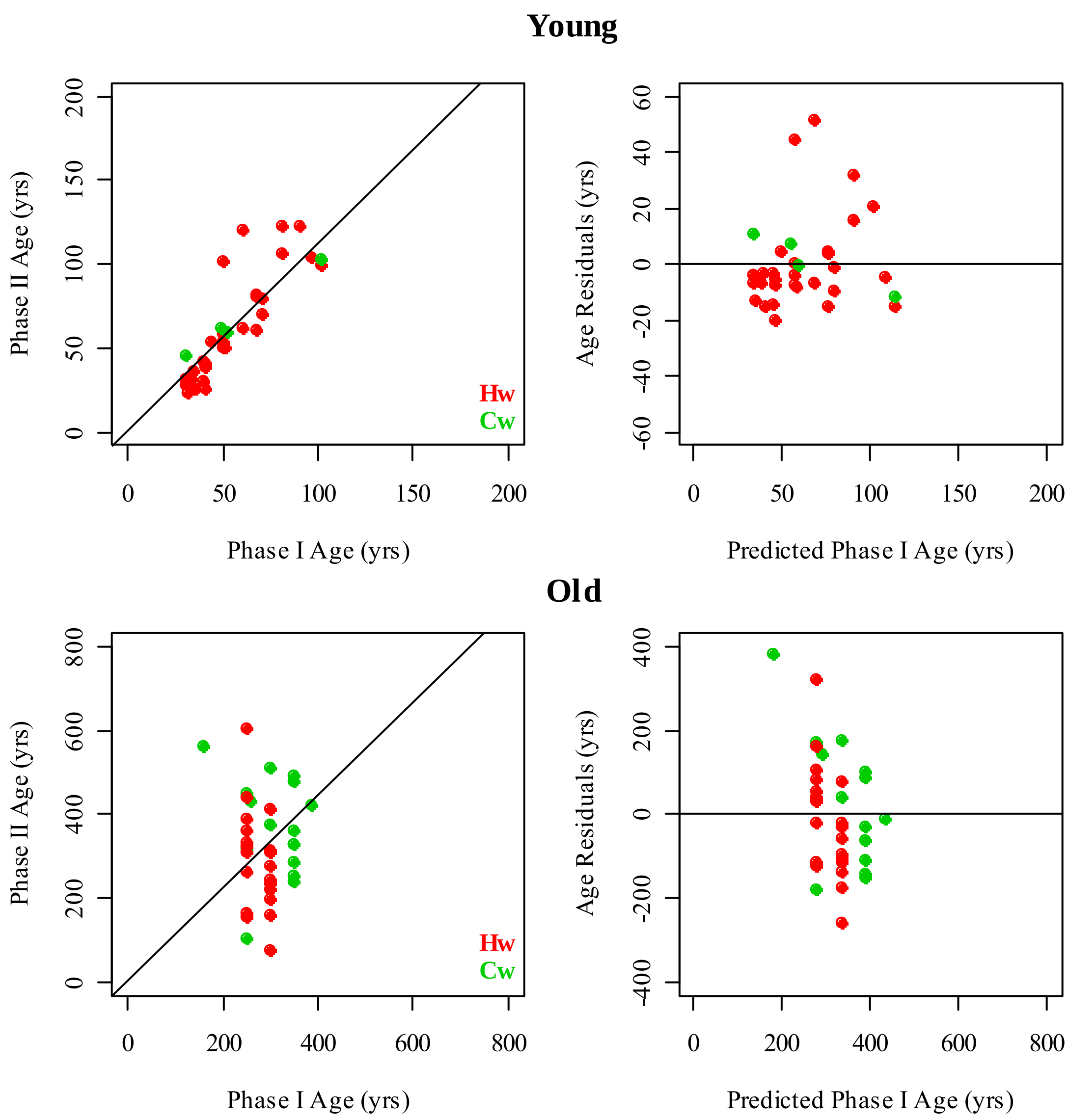

Figure 6: Age scatterplots

4.3 Attribute–Adjusted Volumes for the TFL 6 Target Population

VDYP volumes were re-estimated using the adjusted height and age inputs. Attribute-adjusted volumes increased by 15% and decreased by 9% in the "Young" and "Old" strata, respectively, when compared to the Phase I volumes (Table 11). Overall, volumes increased by 0.5% relative to the unadjusted volumes. The reduced volume in the "Old" stratum reflects a decrease in height averaging 1.6 m (the main driver of volume) and an average age increase of 33 years. The increased volume in the "Young" stratum reflects the increased heights and ages.

Table 11: Volume change in the TFL 6 target population due to attribute adjustments

Stratum	Area (ha)	Unadjusted Inventory	Attribute-Adjusted Inventory	Difference (m)	(%)
Young	60,441	382.3	451.8	69.5	15.4
Old	77,247	605.8	556.3	-49.5	-8.9
Total	***137,688***	***507.7***	***510.4***	***2.7***	***0.5***

4.4 Site Index

Site index is not directly adjusted in the VRI standard statistical adjustment. Instead, an adjusted site index is derived from the adjusted height and age. The average inventory site index decreased by approximately 0.4% after attribute-adjustment (Table 12). The minimal overall change in site index is due to the site index decreasing in the "Old" stratum, while increasing in the "Young" stratum. Site index increased in the "Young" stratum because of the proportionally higher increases in height than age. Similar to the volume changes described in Section 4.3, site index decreased in the "Old" stratum because of increased ages and decreased heights.

Table 12: Site index change due to input attribute adjustment

Stratum	Area (ha)	Site Index (m)	Adj. Site Index (m)	Difference (%)
Young	60,441	25.5	26.2	0.7
Old	77,247	15.2	13.9	-1.3
Total	***137,688***	***19.7***	***19.3***	***-0.4***

4.5 Live Net Merchantable Volume

All Phase II observations were used to compute the volume ratios. The live net merchantable volume increased by 15% after adjustment (Table 13). The target sampling error (10%) was met for the overall target population at the 17.5 cm utilization levels (Figure 7).

Table 13: Live merchantable volume (17.5+ cm) adjustment statistics for the TFL 6 target population

Stratum	Sub-Stratum	Attr.Adj. Vol.		Sample				Adj. Population		
		Area (ha)	Avg. (m^3/ha)	n	Phase I (m^3/ha)	Phase II (m^3/ha)	ROM	Adj. Avg. (m^3/ha)	95% E (m^3/ha)	95% E (%)
Young	Cw	7,472	191.4	5	345.9	242.5	0.701	134.2		
Young	Hw	52,969	488.5	34	421.1	426.1	1.012	494.3		
Young	*Total*	*60,441*	*451.8*	*39*	*411.8*	*403.4*	*0.980*	*442.6*	*68.8*	*15.5*
Old	Cw	35,193	434.5	18	416.5	589.6	1.416	615.1		
Old	Hw	42,054	658.3	23	729.1	868.7	1.191	784.3		
Old	*Total*	*77,247*	*556.3*	*41*	*586.7*	*741.6*	*1.264*	*703.2*	*83.5*	*11.9*
Total	***Total***	***137,688***	***510.4***	***80***			***1.153***	***588.8***	***54.9***	***9.3***

Note: Phase I volume is the attribute-adjusted net merchantable volume as predicted from VDYP version 6.6d using adjusted heights and ages. Phase II volumes have been adjusted with the appropriate NVAF ratios to remove bias from cruiser-called decay values.

4.6 Unadjusted vs. Adjusted Volume

After adjustment, the live inventory volume increased by approximately 14% when compared to the unadjusted inventory for the TFL 6 target population (Table 14).

Table 14: Volume change due to input attribute adjustment

Stratum	Area (ha)	Unadjusted Inventory (m^3/ha)	Adjusted Inventory (m^3/ha)	Difference	(%)
Young	60,441	382.3	442.6	60.4	13.6
Old	77,247	605.8	703.2	97.4	13.9
Total	***137,688***	***507.7***	***588.8***	***81.2***	***13.8***

Note: calculated at the 17.5 cm utilization level

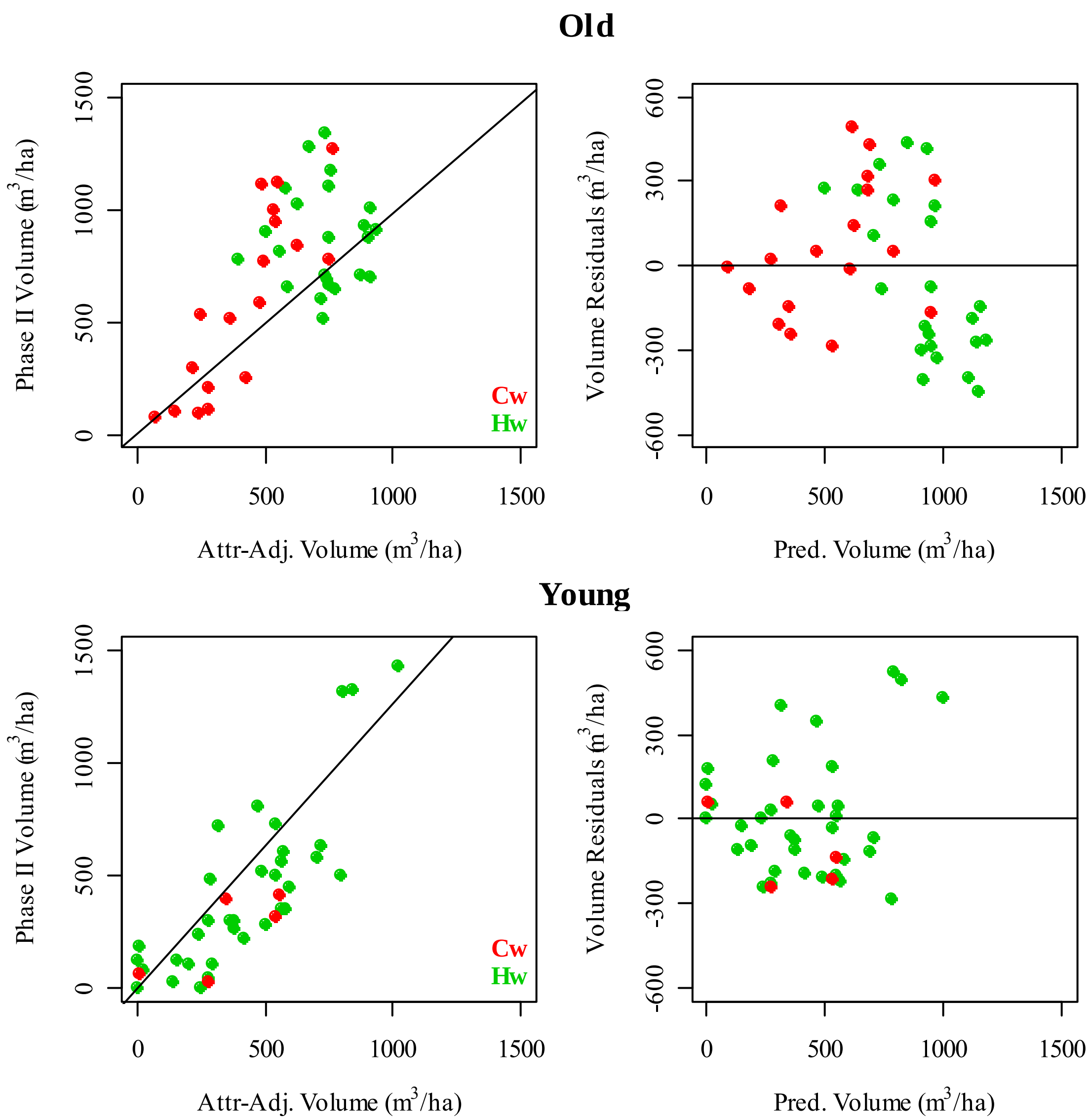

Figure 7: Volume scatterplots (Phase II vs. Attribute-Adjusted Phase I)

5.0 DISCUSSION

5.1 Accuracy and Precision

The inventory adjustment provides unbiased estimates for the TFL 6 target population. This means unbiased estimates at the stratum level. There is always a possibility that local bias exists within a stratum. It would be inappropriate to try to estimate sub-stratum bias given the small sample size provided at a smaller scale.

The MFR-recommended precision for adjusted average volume at the management unit level is a sampling error of ±10% (95% probability). The overall sampling errors achieved in this project were smaller than this target (9.3%, Table 13). This means that the inventory adjustment provides the appropriate level of confidence for timber supply analysis.

5.2 Risks and Uncertainties

5.2.1 Age Trend

The statistical adjustment removes the bias in each stratum. In other inventory programs, age-related trends have existed within the VRI data that have led to concerns in the TSR process. To determine whether this is the case for TFL 6, residual errors for each adjusted attribute were plotted against stand age to identify any age-related trends. None of the attributes of interest showed an age-related trend in the residuals. Volume, the most important attribute, did not show any age-related trend in the residuals.

5.2.2 Age Adjustment

The age adjustment of the "Old" stratum was done using input data where Phase I ages had been mid-pointed (i.e., all stands within a given age class were assigned the appropriate mid-point age). Ages of the "Old" stratum increased by approximately 33 years and reflect the fact that the stands sampled had a higher average age than the mid-points used to represent the age classes. The adjustment process does not allow for ranges to be computed, only for existing ages to be updated. Therefore, the resulting adjusted database will still have a single adjusted age to represent each age class.

6.0 CONCLUSIONS & RECOMMENDATIONS

A statistical adjustment was completed for TFL 6 using standard MFR methodology. Unbiased estimates of height, age, and volume were obtained due to the design of the VRI statistical adjustment methods. These estimates represent the best estimates available at present. Therefore, we recommend that

Western apply the adjusted estimates of height, age, and volume in the upcoming TSR.

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Appendix B: TFL 6 Vegetation Resources Inventory Statistical Adjustment 2016

forest ecosystem solutions ltd.

MEMO

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From: Rueben Schulz

Date: September 9, 2016

Subject: TFL 37 and TFL 6 Inventory Adjustment

Introduction

This document describes the application of a new adjustment, using VDYP 7, for Western Forest Products (WFP) TFL 37 and TFL 6 forest inventories. Both inventories had Phase 2 adjustments completed for them in 2004 and 2009 (respectively). The original inventory adjustments were applied using VDYP 6 and an older adjustment methodology.

The original adjustments are described in the following reports:

- J.S. Thrower & Associates Ltd., Vancouver-Kamloops, BC, June 2004, Tree Farm Licence 37 Vegetation Resources Inventory Statistical Adjustment Version 3.0

- J.S. Thrower & Associates Ltd., Vancouver-Kamloops, BC, June 2004, Tree Farm Licence 37 Net Volume Adjustment Factor Analysis Version 2.0

- Ewen, Stephanie, Timberline Natural Resources Group Ltd., Kamloops, BC, Dec 2009, Western Forest Products Inc. TFL 6 Vegetation Resources Inventory Statistical Adjustment

Both TFLs had take back areas removed and added to the Pacific TSA. During the 2015 TSR for the Pacific TSA, the adjustments for Pacific Block 7 (formerly part of TFL 6) and Pacific Block 8 (formerly in TFL 37) were re-calculated for VDYP 7 and applied to the Pacific TSA inventories and growth and yield curves. Since the re-calculated adjustments used all of the ground plots in the original TFL areas, the new adjustments can also be applied to the TFL inventories.

The re-calculation of the Pacific TSA block 7 and 8 inventory adjustments are described in the following reports:

- Forest Ecosystem Solutions Ltd., April 2015, Pacific TSA Supply Block 8 Vegetation Resources Inventory Statistical Adjustment Version 1.0

- Forest Ecosystem Solutions Ltd., May 2015, Pacific TSA Supply Block 7 Vegetation Resources Inventory Statistical Adjustment Version 1.0

This memo details the application of the new adjustments calculated for the Pacific TSA to the TFL 37 and TFL 6 inventories.

Data

WFP provided original forest inventories for TFL 37 and TFL 6 to apply the adjustment to. The TFL 6 inventory was projected to 2000 and the TFL 37 inventory had a 1996 reference year. Both inventories include take back areas that are no longer part of the TFLs.

Methods

The original VDYP 6 based adjustment had two stages. In the first stage age and height ratios were computed between the inventory and plot values. The inventory stands were then adjusted with these ratios and projected with VDYP 6 to generate an attribute adjusted volume. A volume adjustment ratio (VAF) was then calculated between the attribute adjusted volume and ground volume (NVAF). The application of the linear VAF completed the adjustment.

The new adjustment methodology with VDYP 7 is similar and adds an adjustment for basal area, density and lorey height. Age, height, basal area, and tree density adjustment ratios are calculated between the inventory and plot values. The adjustment factors are applied to the stand inputs and an attribute adjusted output is calculated. Ratios for the VAF and for lorey height are calculated. The main difference with the application of the volume adjustment in VDYP 7 is that it applies the volume and lorey height adjustments internally. Rather than just a linear adjustment, the adjustment is applied at the year plots were measured and then tappers over time.

The application of the new adjustments calculated for the Pacific TSA required the adjustment population and strata for each TFL inventory to be determined. For both TFLs the adjustment was only applied to the rank 1 inventory layer.

TFL 37

The total area of TFL 37 is 190,669 ha, with 163,895 ha having a rank 1 tree species (forested). The adjustment population was the economic and marginally economic, vegetative treed area where the 1996 stand age was greater than or equal to 36 years.

The TSR economic classification was not available; however a TSR dataset with an adjusted inventory was available. The old (>= 36 years in 1996) areas that were not adjusted in the TSR dataset were cut out and rated into the TFL 37 inventory. These uneconomic older areas, and stands younger than 36 years (1996) were excluded from the adjustment population. Additionally, non-productive areas were also excluded from the adjustment, as they were found to be unadjusted in the TSR dataset.

The adjustment population was split into two strata: old and young. The old strata consisted of stands greater than or equal to 300 years (1996), while the young strata comprised stands from 36 to 299 years old. In the original inventory, all stands older than 300 years were assigned an age of 300 years. The old stratum was 71,245 ha and the young stratum was 27,270 ha.

TFL 6

The original TFL 6 adjustment was applied to a 2006 VRI and the adjustment used FOR_PID as the unique link between the adjustment table and inventory. The inventory adjusted here is a 2000 VRI, which lacked a FOR_PID identifier. The 2000 VRI also includes the take back area, which is no longer part of the TFL and was excluded from the 2009 adjustment.

The total area of the 2000 TFL 6 VRI is 287,537 ha, of which 273,407 ha is forested with a rank 1 tree species. The adjustment population was the vegetated portion of the TFL with an age greater than or equal to 30 (in 2001), excluding private lands, parks or other protected areas.

The original adjustment table and a 2006 VRI were used to restrict the adjustment population for the 2000 VRI. The 2006 VRI was rated into the older inventory to provide the FOR_PID link. This excluded the take back, private land, parks and protected areas from the population.

The adjustment population was separated into two strata: the old strata comprised stands greater than or equal to 140 years (2001) and the young strata included stands between 30 and 139 years old (2001). The old stratum was 76,541 ha and the young stratum was 60,120 ha.

Results

TFL 37

The inventory adjustment applied to TFL 37 increased the overall TFL volumes in both 2001 (the base year of the adjustment) and 2016 (Table 1). The adjustment to the old strata increased the volumes, though the increase was reduced by 2016. The slight decrease in the old unadjusted volumes from 2001 to 2016 resulted from VDYP 7 dropping the volume of mature stands as they age. The young strata has a slight downward adjustment in 2001, which is further increased in 2016. Between 2001 and 2016 the young strata gained volume, both adjusted and unadjusted. The upward adjustment to the entire forest was lessened in 2016 by the drop in the adjusted young volumes.

Table 1: TFL 37 average adjusted and un-adjusted volumes (12.5 cm untilization, net decay waste and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2016 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	683	748	678	702	71,245
Young Strata	493	490	616	575	27,270
Entire Forested VRI	422	450	487	491	163,716

When running the entire forest in VDYP 7, 179 ha of stands failed to run. These stands were too young for VDYP to process and were excluded from the Entire Forested VRI summary.

TFL 6

The adjustment to the TFL 6 inventory increased the average volumes in both 2001 and 2016 (Table 1). Both the old and young strata volumes were adjusted upwards. The slight drop in the old strata volumes between 2001 and 2016 is due to VDYP 7 lowering the volume of old stands as they age. The 2001 adjustment impact is only slightly diluted by 2016.

Table 2: TFL 6 average adjusted and un-adjusted volumes (12.5 cm untilization, net decay waste and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2016 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	553	660	549	629	76,541
Young Strata	406	463	535	600	60,120
Entire Forested VRI	333	375	383	420	273,407

The 2006 TFL 6 inventory that was originally adjusted included depletions that were young and therefore outside of the adjustment population. In the 2000 TFL 6 inventory, adjusted in this project, these stands were old. Since they were not part of the original adjustment population these older stands remained unadjusted in this analysis. When the 2000 inventory is updated for depletions, these unadjusted older stands will once again be young.

One 30 year old stand in the adjustment population, TL_LINK 17719 (KEYID 851_092L064), failed to run in VDYP 7 and has no adjustment output. This stand is 8.6 ha.

Pacific TSA Supply Block 7

Vegetation Resources Inventory Statistical Adjustment

Version 1.0

May 25, 2015

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1 Introduction

As part of the current timber supply review (TSR) for the Pacific TSA, the best available inventory and growth and yield data is being compiled. Supply Block 7 of the Pacific TSA was formerly part of Tree Farm Licence (TFL) 6. The TFL 6 phase 1 inventory that provided the basis for the Supply Block 7 Vegetation Resource Inventory (VRI) was originally completed in 1970 and then regularly updated for denudations and regeneration. The majority of the TFL 6 was re-inventoried in 2000 and further depletion updates were applied up to 2004.

As part of the 2000 re-inventory of TFL 6, an inventory adjustment to Age, Height and Volume (net volume adjustment factor) was completed in 2009. Ninety eight phase 2 ground plots were established in 2001 as part of that statistical adjustment. The original inventory adjustment and sampling was described in the following reports:

- Western Forest Products Inc. TFL 6 Vegetation Resources Inventory Statistical Adjustment, December 2009, Timberline Natural Resource Group Ltd.
- Tree Farm Licence 6: Quatsino Sound – North Vancouver Island Timber Emphasis VRI Ground Sampling Plan, February 2001

The original VRI phase 2 inventory adjustment was completed with VDYP 6. The growth and yield modeling for natural stands for the Pacific TSA TSR will use VDYP 7, the current Ministry of Forests, Lands and Natural Resource Operations (FLNRO) standard. Adjustment procedures for VDYP 7 require adjustment ratios to be calculated for age, height, density, basal area, lorey height and volume. This necessitated a re-calculation of the adjustment ratios so that they could be applied to the Supply Block 7 VRI for the Pacific TSA.

2 Methods

The methodology used for this adjustment was based on the following documents:

- Vegetation Resources Inventory, Interim Procedures and Standards for Statistical Adjustment of Baseline VRI Timber Attributes. Jan 2008
- Procedure for Adjusting VRI Attributes for VDYP7 Projection

Additional help was provided by Sam Otukol and his staff at the Forest Analysis and Inventory Branch (FAIB) of FLNRO.

2.1 Study Area

The Supply Block 7 has a total area of 11,401 ha, of which 11,239 ha is classified as forest management land base (FMLB). The adjustment population was the vegetated treed (BC Landcover Classification) portion of the Supply Block with an age greater than or equal to 30 (in 2001), excluding private lands, parks or other protected areas.

The Supply Block 7 VRI was composed of three sources: former TFL 6 inventory, some depletions and non-forest areas from BC Geospatial Warehouse (BCGW), and another inventory used to fill in some gaps between the new Block 7 boundary and old TFL 6 boundary. The adjustment was only applied to the VRI derived from the former TFL 6 inventory, which covered 10, 821 ha of Supply Block 7 (10,687 ha FMLB). The location of the Pacific TSA Block 7 is shown in Figure 1

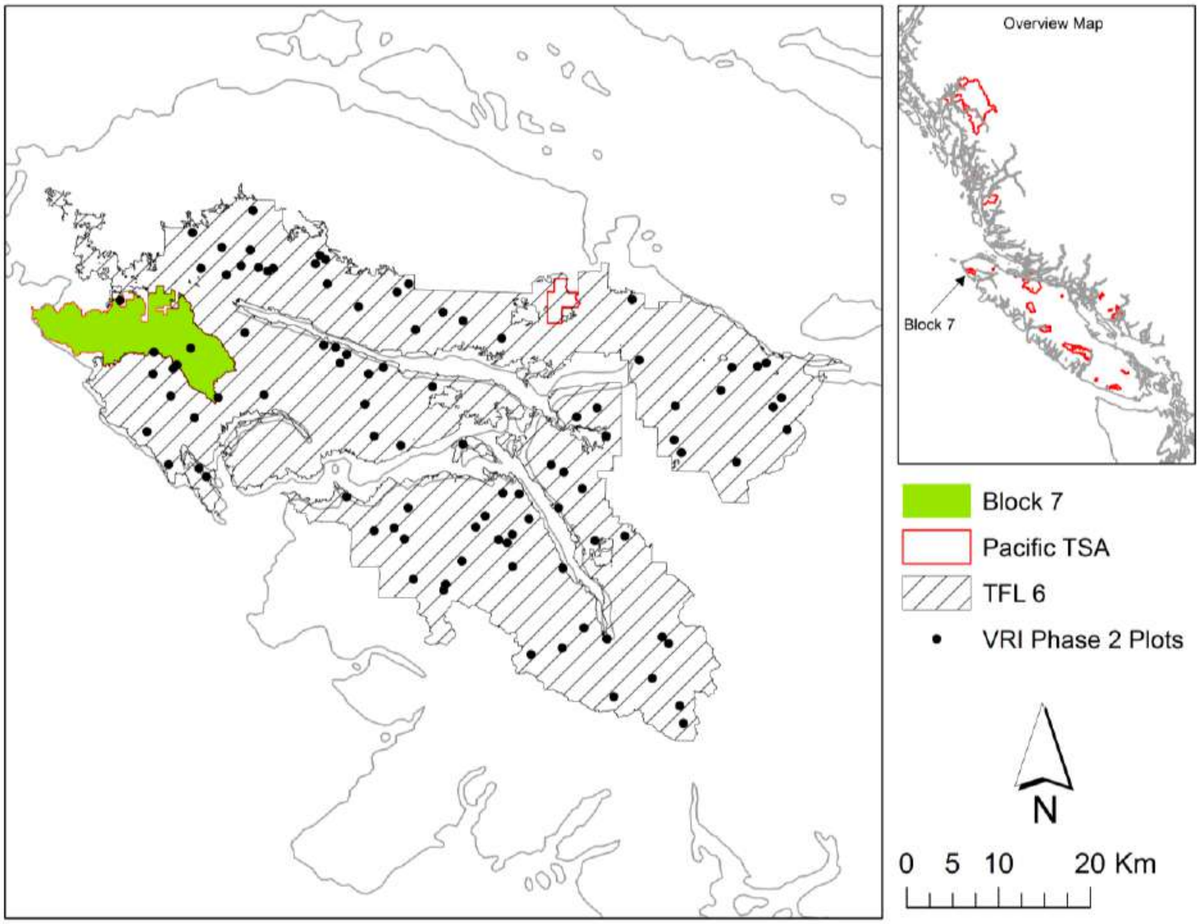

Figure 1: Location of the Pacific TSA Block 7, relative to TFL 6 and phase 2 ground plots.

The adjustment population was separated into two strata. The old strata were stands greater or equal to 140 years (2001) and the young strata included stands from 30 to 139 years old (2001).

The location of private lands and parks that was excluded from the adjustment population was not available, however a table of the previous adjustment that listed all adjusted inventory stands was available. This adjustment table was used to define the adjustment populations and their strata.

The Block7 VRI was updated with recent depletions. These areas were removed from the adjustment population as they are now young.

The Pacific TSA Block 7 VRI areas and adjustment population are described in Table 1.

Table 1: Pacific TSA Block 7 VRI Areas

Description	FMLB Area (ha)	Non-FMLB Area (ha)	Total Area (ha)
Block 7 VRI	11,239	162	11,401
Block 7 VRI Treed	10,879	42	10,922
Block 7 VRI Former TFL 6 inventory	10,687	134	10,821
Block 7 VRI former TFL 6 inventory, treed	10,340	33	10,373
Old Adjustment Strata	4,485	0	4,485
Young Adjustment Strata	1,788	0	1,788

2.2 Ground Sampling Data

Compiled data for the 98, 2001 phase 2 plots was provided by Bob Krahn of FAIB. The plot data contained 81 Timber Emphasis plus CWD plots and 17 Timber Emphasis plots. These plots consisted of a central plot and up to 4 satellite plots. The plot data was compiled to provide stand level values at 4, 7.5, 12.5, 17.5 and 22.5 cm utilization levels.

2.3 VRI Data

Only two of the phase 2 ground plots were located within Supply Block 7 and the rest fell within the current TFL 6 boundary.

Most of the Supply Block 7 VRI consisted of a TFL 6 inventory that had a projection year of 2005. Input VDYP 7 data from FAIB with a 2005 reference year provided the inventory data for these stands. This data only contained one rank 1 layer per stand with age and height data for only the leading species.

An inventory projected to 2006 was provided by Western Forest Products Limited that covered the remaining area of TFL 6. This inventory contained two layers and ages and heights for the leading and secondary species in each layer.

2.4 Plot Matching

The phase 2 plots were linked to the Supply Block 7 and TFL 6 inventories based on their UTM coordinates. A comparison to the adjustment table from the previous adjustment, which recorded the stands that linked to plots, showed that four plots linked to a different stand than in the previous adjustment. An examination of these plots showed that their UTM coordinates published in the previous adjustment were different than the UTM coordinates for plots in the new data. For these four plots, a link was made to the same inventory stand as in the previous adjustment.

Three plots where located in stands where the second layer was rank 1 and the plot was linked to layer 2.

Of the 98 plots, 14 were located in young stands (< 30 years old in 2001) and were excluded for being outside the adjustment population. A further four plots were located outside the target population and also excluded. After these exclusions, there were 80 plots left to use for the adjustment.

After the plots were linked, the match between the plot leading species and the inventory stand species was examined. Fifty nine of the plots matched the leading inventory species and were linked to the leading species age and height. Fifteen plots matched the secondary species of the inventory stands and were linked to the secondary species age and height. Finally, six plots had a leading species that did not match the leading or secondary species of the inventory stand. However, as all of these plots and the remaining inventory stands had a coniferous leading species, the plots were linked to the inventory using the plot leading conifer and the leading conifer in the inventory

2.5 Statistical Adjustment

The adjustment calculation involved the following steps:

1. Project the original 2005/2006 inventory stands with VDYP 7 to 2001 to match the ground plot date.
2. Project the inventory secondary species ages and heights with SiteTools to 2001 for the 15 inventory stands where the plot leading species matched the inventory secondary species.

3. Calculate adjustment ratios between the projected 2001 inventory values and phase 2 plot values for age, height, density and basal area
4. Apply the adjustment ratios to the 2001 age, height, density and basal area and project these values (at both 7.5cm and 12.5cm utilization levels) with VDYP 7 to produce attribute adjusted volumes (7.5cm and 12.5cm utilization levels) and lorey height (7.5cm utilization level).
5. Calculate adjustment ratios between the attribute adjusted volume and lorey height and the Net Volume Adjusted Factor (NVAF) plot volume and lorey height.
6. Project the Supply Block 7 inventory using the adjusted 2001 age, height, density and basal area. The adjustment ratios were applied to the volumes and lorey height; these adjusted values were included as inputs to VDYP 7, which applied the volume adjustment to the output.

The BEC zone used in the VDYP7 projections came from the two sources. Projections of the stands linked to plots used the BEC zone value from the plot data. The final application of the adjustment to the Supply Block 7 VRI used the BEC zone from the VRI.

Detailed adjustment procedures are provided in an Appendix at the end of this document.

3 Results

Of the 80 inventory plots established within the adjustment population for the original adjustment, 76 had ages and 74 had tree heights.

Table 2 details the statistics for the age, height, density, basal area, lorey height and volume adjustment. The phase 1 inventory underestimated the stand age slightly. The height was slightly overestimated in the old strata and underestimated in the young strata.

Table 2: Table of adjustment values

Attribute	*Stratum*	*n*	*Mean weighted Phase II value, by stratum*	*Mean weighted Phase I value, by stratum*	*Ratio of means adjustment factors*	*Sampling error %*
Age of 1st sp	Old	37	309.4	288.9	1.0708	14.1%
	Young	39	59.7	57.2	1.0450	14.1%
Height of 1st sp	Old	35	32.4	34.3	0.9465	8.0%
	Young	39	26.6	24.9	1.0662	8.2%
Trees/ha @7.5cm+ dbh	Old	41	619.8	343.0	1.8070	27.0%
	Young	35	1,101.8	847.5	1.3001	25.1%
Basal area/ha @7.5cm+ dbh	Old	41	70.6	68.2	1.0345	10.5%
	Young	35	52.7	46.9	1.1235	12.3%
Lorey height @7.5cm+ dbh	Old	41	29.6	30.3	0.9782	8.9%
	Young	38	23.5	23.3	1.0101	8.4%
Volume/ha net top, stump, decay & waste @12.5cm+ dbh	Old	41	783.2	669.6	1.1697	14.1%
	Young	38	452.4	478.6	0.9453	15.7%

Figure 2 to Figure 7 provide scatter graphs of the phase 1 inventory and phase 2 plot values for each stratum.

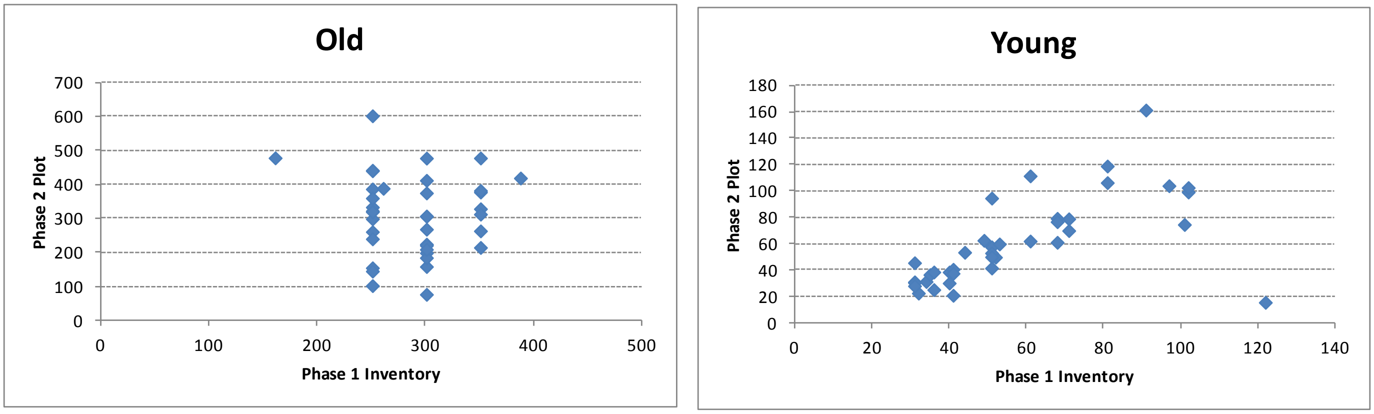

Figure 2: Phase 2 vs. Phase 1 age (yrs), by stratum.

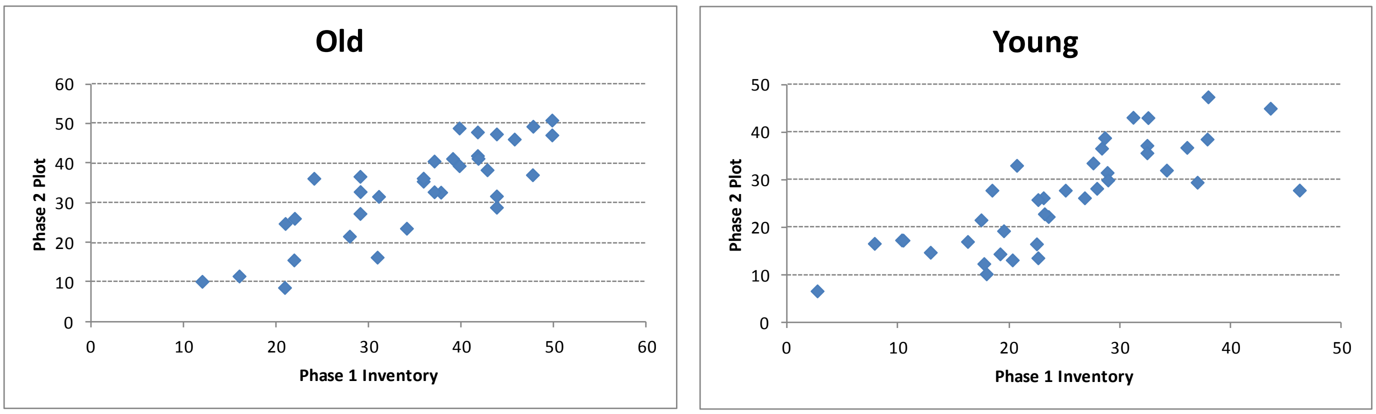

Figure 3: Phase 2 vs. Phase 1 height (m), by stratum.

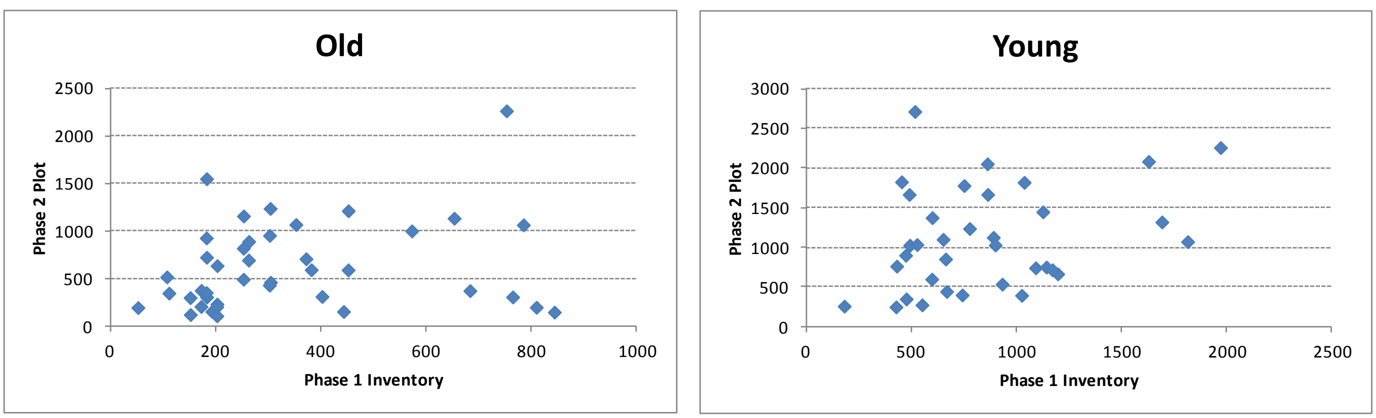

Figure 4: Phase 2 vs. Phase 1 density (stems/ha), by stratum.

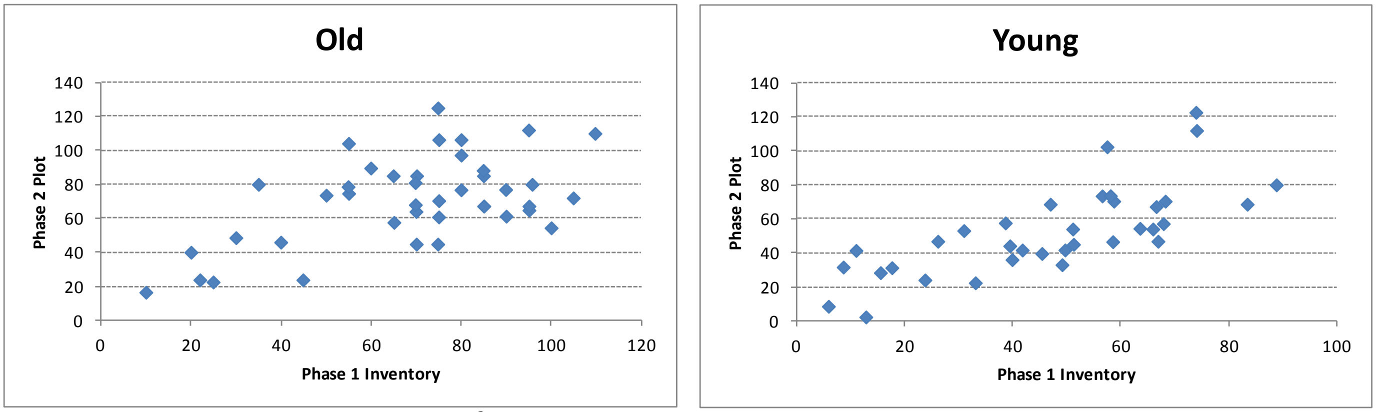

Figure 5: Phase 2 vs. Phase 1 basal area (m^2/ha), by stratum.

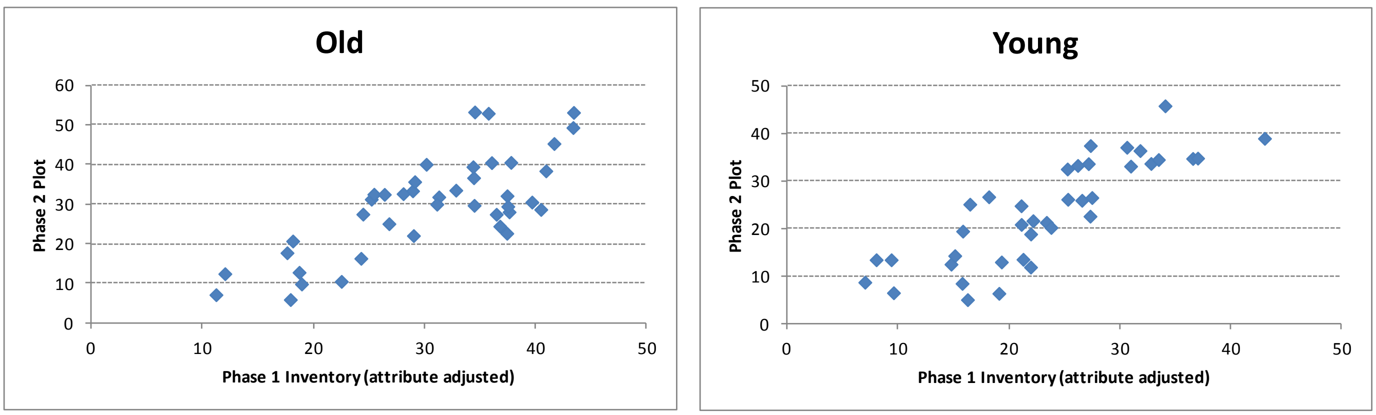

Figure 6: Phase 2 vs. Phase 1 (attribute adjusted) lorey height (m), by stratum.

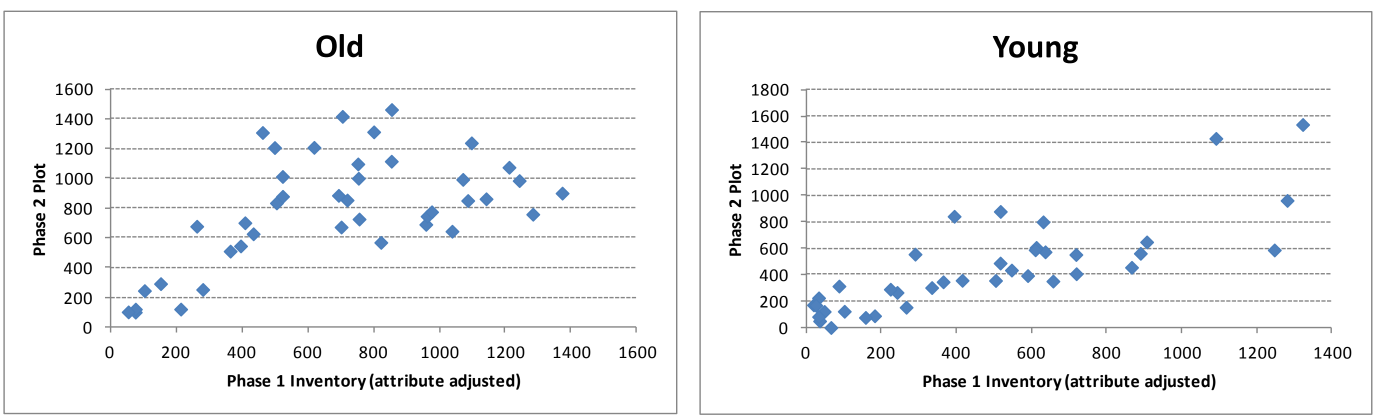

Figure 7: Phase 2 NVAF vs. Phase 1 (attribute adjusted) close utilization decay and waste volume (m^3/ha), by stratum.

The inventory adjustment increases the overall Supply Block 7 VRI volumes, as seen in Table 3 and

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	669	808	667	775	4,485
Young Strata	355	406	446	506	1,788
Entire VRI (updated with depletions)	405	470	436	490	10,922

Table 4. The increase comes from the upward adjustment to both the young and old strata. The slight downward volume adjustment to the young stratum was offset by an increase to stand height (and site index).

The largest impact of the adjustment is to the 2001 reference year. As the inventory is projected farther from the reference year (2014), the adjustment effect is diluted. Also, the projected volume of old stands in VDYP 7 drops slightly over time, which further leads to a slight decrease in old stratum volumes.

Table 3: Block 7 VRI average adjusted and un-adjusted volume (12.5 cm utilization, decay waste and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	669	808	667	775	4,485
Young Strata	355	406	446	506	1,788
Entire VRI (updated with depletions)	405	470	436	490	10,922

Table 4: Block 7 VRI average adjusted and un-adjusted volume, FMLB only (12.5 cm utilization, decay waste and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	669	808	667	775	4,485
Young Strata	355	406	446	506	1,788
Entire VRI (updated with depletions)	407	472	437	490	10,879

4 Discussion

There were a few differences between this adjustment and the previous 2009 adjustment.

The original adjustment excluded plots where the plot leading species did not match the leading or secondary species in the inventory stand (conifer/deciduous rule). This resulted in the original adjustment only using 68 plots for the height adjustment and 70 plots for the age adjustment. The six plots that only matched the inventory species at the coniferous level were included in this adjustment calculation.

A comparison of the phase 2 plot ages and heights, published in the original adjustment, showed that they are slightly different from the plot ages and heights used in this adjustment. This difference likely resulted from the plot data being compiled in a different manner than in the original adjustment.

The different number of plots used and different compilation of plots resulted in slightly different age and height adjustment ratios for this adjustment compared to the original adjustment. The basal area, trees per ha, and lorey height adjustment ratios were not part of the original adjustment done with VDYP 6 and therefore cannot be compared. The volume ratio in this adjustment was also different from the original adjustment, but they cannot be directly compared due to the change from VDYP 6 to VDYP 7.

The adjusted inventory values provide an unbiased estimate of the inventory attributes and volumes for the Supply Block 7 VRI and should be used in the preparation of growth and yield curves for the Pacific TSA TSR analysis.

Appendix: Detailed Methodology

The following procedure describes re-calculating the adjustment for TFL 6 and applying it to the inventory. The original adjustment was done for VDYP 6.

1) Obtained plot data from FLNRO. The data was in TFL6_VRIgroundData.xlsx and contained 4 worksheets:

- Samples – includes plot locations
- SMY_NCS – compiled plot data by species for 5 utilization levels (4, 7.5, 12.5, 17.5, and 22.5)
- SMY_NC - compiled plot data for 5 utilization levels (4, 7.5, 12.5, 17.5, and 22.5).
- Data_dictionary

The 98 plots include (separated by TYPE_CD): Timber Emphasis + CWD (D01) and Timber Emphasis (Q01) plots. Additionally the data contained 20 Net Volume Adjustment (N01) plots which we did not use.

Each plot included 4 satellite plots (total of 5). A call was made on the ground to determine which 4 satellite plots were within the inventory stand (some were in neighbouring stands). Outside plots were excluded.

The data has already been compiled to give per ha plot information (and the NVAF was applied). The following fields were required:

- CLSTR_ID - unique ID
- TYPE_CD - plot type (D01 was used)
- UTIL
- BGC_ZONE – BEC Zone
- SPB_CPCT – species composition – used for matching plots to inventory stands
- BA_HA - basal area live
- STEMS_HA - density live
- HT_MEAN1 - weighted mean ht (incl. broken top) - used for Lorey Ht adjustment
- HT_M_TLS - mean height of top, site, and second spp site height trees (T,L,S).
- AT_M_TLS - mean age of (T,L,S trees)
- NVL_NW2 - NVAF * Whole stem vol/ha less Top, Stump, Cruiser Decay and Waste (live)

2) Plots were linked to an original 2006 TFL 6 inventory and the supply block 7. Points were created from the UTM coordinates data and intersected with the inventories.

A list of inventory stands that linked to plots in the previous adjustment was available and showed that four plots linked to different stands than in the previous analysis. An examination of the plot coordinates showed that the plot data had slightly different UTM coordinates than those published in the 2009 adjustment. For consistency with the 2009 adjustment, the plots were linked to the same inventory stands as before.

3) Species attributes were compared to determine if inventory and plot layers match (4 cm utilization).

The result was that:

- 59 plot leading species matched to the inventory species 1
- 15 plot leading species matched to the inventory species 2

- 6 plots had a leading species that did not match inventory species 1 or 2 but the plots and inventory did match at the conif/decid level.

All plots linked to the rank 1 layer of the inventory. The block 7 VRI only had one rank 1 layer, but the TFL 6 inventory had up to two layers, and in three cases the second layer was the rank 1 layer.

Of the 98 plots, 14 were in young stands and a further 4 were in stands outside the target population. This left 80 plots for the adjustment.

Six plots were lacking height data and could not be included in the height ROM calculation, while 4 plots lacked age information and were not included in the age ROM.

The original adjustment stated that 12 plots did not have height information and 10 did not have age information. Most likely the 2009 analysis excluded the 6 plots that had a leading species that did not match the species 1 or 2 in the inventory. This adjustment is using different procedures and included these 6 plots.

4) Inventory is 2005/2006 and plots were measured in 2001. First the inventory needs to be projected to 2001 so it can be properly compared to the plots (also missing SPH and BA needs to be filled in by the VDYP7 FIP module).

The inventory values for the 80 plots were inserted into a VDYP 7 input template. Inv_Standard_Cd of "F" was used since the inventory is closer to an FC1 (with BA added) than a VRI. Reference year was 2005/2006.

BEC Zone was taken from the BEC Zone of the phase 2 plots.

This input file was run in VDYP 7 ("Step 1") at a 7.5 cm utilization. Multiple years (2001-2015) were run but only 2001 is needed.

Four plots in the young strata were too young/small for VDYP 7 to project. While they had age and dominant height generated, there was no basal area, density or volume for them.

5) 15 of the plots that linked to the second inventory species required the second species age and height in 2001 to compare the plot values to.

These stands had the site index of the second species calculated in SiteTools from the age and height of the second species at the stands reference year. The second species site index was then used to generate the height at the age in 2001.

6) Compute Age, Height, Basal Area, and SPH adjustment ratios.

There were two strata: young (30 to 139 yrs) and old (140 yrs +).

Adjustment ratio of means (ROM) were calculated for each strata between:

- 2001 inventory (VDYP 7) age and plot AT_M_TLS
- 2001 inventory (VDYP 7) PRJ_DOM_HT(7.5) and plot HT_M_TLS(7.5).
- 2001 inventory (VDYP 7) PRJ_BA(7.5) and plot BA_HA(7.5)
- 2001 inventory (VDYP 7) PRJ_TPH(7.5) and plot STEMS(7.5)

For the 15 stands linking to the inventories second species, the second species age and height was used instead of the VDYP 7 projected stand age and height.

The Ministry Excel Marco VRI Analysis1_Original.xlsm was used to calculate sampling error.

Sample weights were provided for each plot and were input into the adjustment spreadsheet.

7) Calculate attribute adjusted volumes (and Lorey Ht).

VDYP 7 was run a second time ("Step 2") with the same species composition and other fields, however the age, height, basal area and stems/ha (output from the "step 1" run) were adjusted using the calculated adjustment ratios. The Inv_Standard_Cd was set to "V" so that VDYP will use the basal area and SPH. The reference year was set to 2001.

The 4 young stands that lacked basal area and density from the “Step 1” output were run with a null basal area and density. VDYP 7 estimated BA and SPH for these stands. With the age and height adjustment, 3 of these young stands were now big enough for VDYP 7 to generate a basal area, sph, lorey height and volume.

VDYP 7 output is needed at both 7.5 and 12.5 cm utilizations (same input file is run twice with different util parameters).

8) Calculate volume and lorey height adjustment ratios.

Adjustment ratios for each strata were calculated between:

- Inventory (VDYP 7 Step 2) PRJ_LOREY_HT(7.5) and plot HT_MEAN1(7.5)
- Inventory (VDYP 7 Step 2) PRJ_VOL_DW(12.5) and plot NVL_NW2 (12.5)

The lorey height ROM is used to adjust the lorey height, while the same volume ROM gets applied to WSV7.5, WSV12.5, CUV12.5, VOL_NET_D12.5, and VOL_NET_DW12.5.

9) Calculate final adjusted volumes ("Step 3")

The same "Step 2" VDYP input file is run (which has adjusted age, ht, BA, sph), but the following fields are also filled in:

- R1_ADJ_INPUT_ID - id based on strata (must be non null)
- R1_LOREY_HEIGHT - adjusted PRJ_LOREY_HT (7.5)
- R1_BASAL_AREA_125 - **un**adjusted PRJ_BA (12.5)
- R1_VOL_PER_HA_75 - adjusted PRJ_VOL_WS (7.5)
- R1_VOL_PER_HA_125 - adjusted PRJ_VOL_WS (12.5)
- R1_CLOSE_UTIL_VOL_125 - adjusted PRJ_VOL_CU (12.5)
- R1_CLOSE_UTIL_DECAY_VOL_125 - adjusted PRJ_VOL_D (12.5)
- R1_CLOSE_UTIL_WASTE_VOL_125 - adjusted PRJ_VOL_DW (12.5)

The above values came from the "Step 2" output multiplied by the adjustment ROM.

When this input is run in VDYP 7, it will use the adjusted lorey height and volumes to apply a final volume adjustmet to the output values.

10) Apply the final adjustment to the supply block 7 inventory. Only the portions of the supply block that consisted of VRI from the TFL 6 inventory were adjusted.

The same steps need to be done:

a) project inventory to 2001 ("Step 1")

b) apply calculated age, height, BA, sph ROM to 2001 values and re-run VDYP to generate attribute adjusted values ("Step 2").

c) apply calculated lorey ht and volume ROM to attribute adjusted lorey ht and volumes. Input these as adjusted values and re-run VDYP to generate final adjusted volumes ("Step 3").

The adjustment population and strata was determined by linking the supply block 7 VRI to the adjustment table from the 2009 adjustment. This table already excluded private lands and parks which were outside of the adjustment population.

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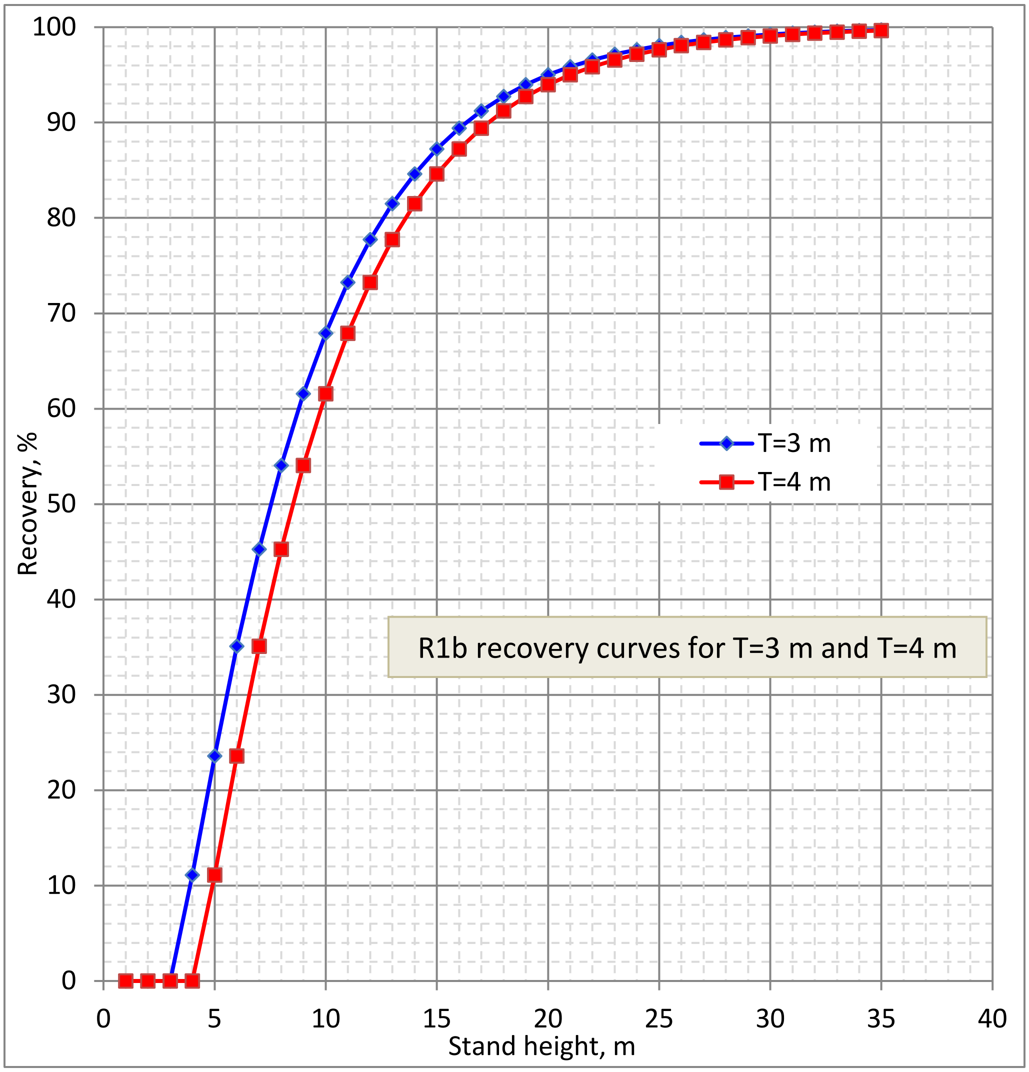
Appendix C: Hydrologic Recovery Method Review

Applying hydrologic recovery curves in coastal BC watersheds

Hydrologic recovery means the extent to which a regenerating forest stand compares to a reference stand (typically old growth) with respect to rainfall interception, snowpack development and ablation. TR032[1] presents the current method in the scientific literature for estimating hydrologic recovery in coastal watersheds. TR032 provides a suite of recovery curves for different kinds of runoff events. For most purposes in coastal BC watersheds, it is suggested to assume a rain-on-snow event for the full elevation range of a watershed for tracking hydrologic recovery and equivalent clearcut area (ECA) and applying the R1b recovery curve using a threshold T=3 m (lower elevations or drier climate zones) or T=4 m (higher elevations or wetter climate zones).

	R1b rain-on-snow	
Stand ht, m	R % T=3 m	R % T=4 m
1	0	0
2	0	0
3	0	0
4	11	0
5	24	11
6	35	24
7	45	35
8	54	45
9	62	54
10	68	62
11	73	68
12	78	73
13	81	78
14	85	81
15	87	85
16	89	87
17	91	89
18	93	91
19	94	93
20	95	94
21	96	95
22	97	96
23	97	97
24	98	97
25	98	98
26	98	98
27	99	98
28	99	99
29	99	99
30	99	99
31	99	99
32	99	99
33	100	99
34	100	100



R1b recovery curve:
$R=100(1-e^{-0.189(Ht-T)})^{1.25}$

R=hydrologic recovery in percent
Ht=stand height in metres
T= tree height threshold in metres

[1]Hudson,R.,and G.Horel. 2007. An operational method of assessing hydrologic recovery for Vancouver Island and south coastal BC. Res. Sec., Coast For.Reg., BC Min. For., Nanaimo, BC. Technical Report TR-032/2007.

Regenerating stands from harvested cutblocks are represented spatially as polygons in the forest cover layer.

After hydrologic recovery R has been determined for each regenerating stand using the above recovery equations, equivalent clearcut area (ECA) is then determined for each regen stand as follows:

$$ECA = A(1-R/100)$$

Where:
ECA = equivalent cut area in ha
A = area of regen stand in ha
R = hydrologic recovery in percent

ECA for the zone of interest is then determined by summing the ECA's for the regen stands and dividing by the total area of the zone.

Explanatory notes

The zone of interest depends on the purpose for tracking ECA. Purposes can include:

- indicator of potential for stream flow change resulting from harvesting, wildfire or forest mortality (e.g., beetle kill)
- monitoring the disturbance footprint in a particular zone (e.g., upland forest in land use orders)
- constraining harvesting in zones with specific sensitivities (e.g., combined factors of terrain susceptible to landslides, steep gullied slopes with high rates of runoff, elevations that receive higher precipitation)
- a trigger for conducting a more detailed hydrologic/geomorphic assessment in a watershed unit

Examples of zones for which ECA is often tracked:

- For potential stream flow change from harvesting:
  - Total watershed area
  - Elevation bands within a watershed unit
  - Portions of watershed units more likely to have increased runoff response (e.g., high elevation areas or headwater basins)
- Portions of watershed units with legally constrained harvest (upland forest in land use orders)
- A specific area for which ECA is tracked as a management indicator (e.g., zones of sensitivity)
- Timber harvesting land base (THLB)
- Forest managed land base (FMLB)

Applying hydrologic recovery:

- Hydrologic recovery is not applied to natural stands such as scrub, or non-vegetated sites such as rock slopes or natural non-treed areas such as wetlands.

- Hydrologic recovery is applied to regenerating harvested forested stands, typically those less than 60 years old.

- For forest conditions where no recovery curves have been developed, hydrologic recovery values can be assigned from "best estimates", e.g., for:
  - Stands regenerated to deciduous (alder Dr leading species)
  - Wildfire, windthrow areas, or forest mortality such as beetle-kill with partial standing trees

- Permanent clearings such as roads or hydro rights of way, agricultural lands or other human development are assigned a hydrologic recovery value of 0%. The extent to which these can be distinguished for ECA calculations depends on the level of detail in the mapping.

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