Timber Supply Review

Analysis Report – Pacific TSA

Version 1.4

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Prepared for:

BC Timber Sales
Strait of Georgia, Seaward-Tlasta, and Skeena Business Areas

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Executive Summary

This report describes the timber supply analysis for the Pacific Timber Supply Area (TSA). The analysis involves testing and reporting on a variety of assumptions and management strategies. The purpose of this report is to provide the Chief Forester with sufficient information to make an informed Allowable Annual Cut (AAC) determination.

The following are described in this report:

- Base Case harvest forecast - models current management and tree growth in the Pacific TSA;
- Sensitivity analyses - used to assess the risk associated with Base Case assumptions;
- Alternate harvest flows investigating the impacts of alternate initial harvest levels;
- Investigations of harvest forecasts from specific geographic areas.

A portion of the Pacific TSA (56,605 ha) falls under the South-Central Coast Order (SCC), the Central North Coast Order (CNC) and the Great Bear Rain Forest Order (GBR) establishing Ecosystem Based Management (EBM). Under the *Great Bear Rainforest (Forest Management) Act*, the AAC for the portions of the Pacific TSA that fall within the GBR will be established by the Lieutenant Governor in Council by regulation. Following this, the Chief Forester would have authority to determine the AAC, and specify AAC partitions, for the areas of the Pacific TSA that fall outside the GBR. For this reason the GBR is excluded from the Pacific TSA Base Case.

The Base Case harvest forecast is illustrated in Figure 1. The initial harvest level of 688,245 m^3 per year is maintained for 10 years, before the harvest is reduced by 8.5% to 630,080 m^3 per year for another 10 years. The long-term harvest level of 612,520 m^3 per year (2.8% decline) is reached at year 21.

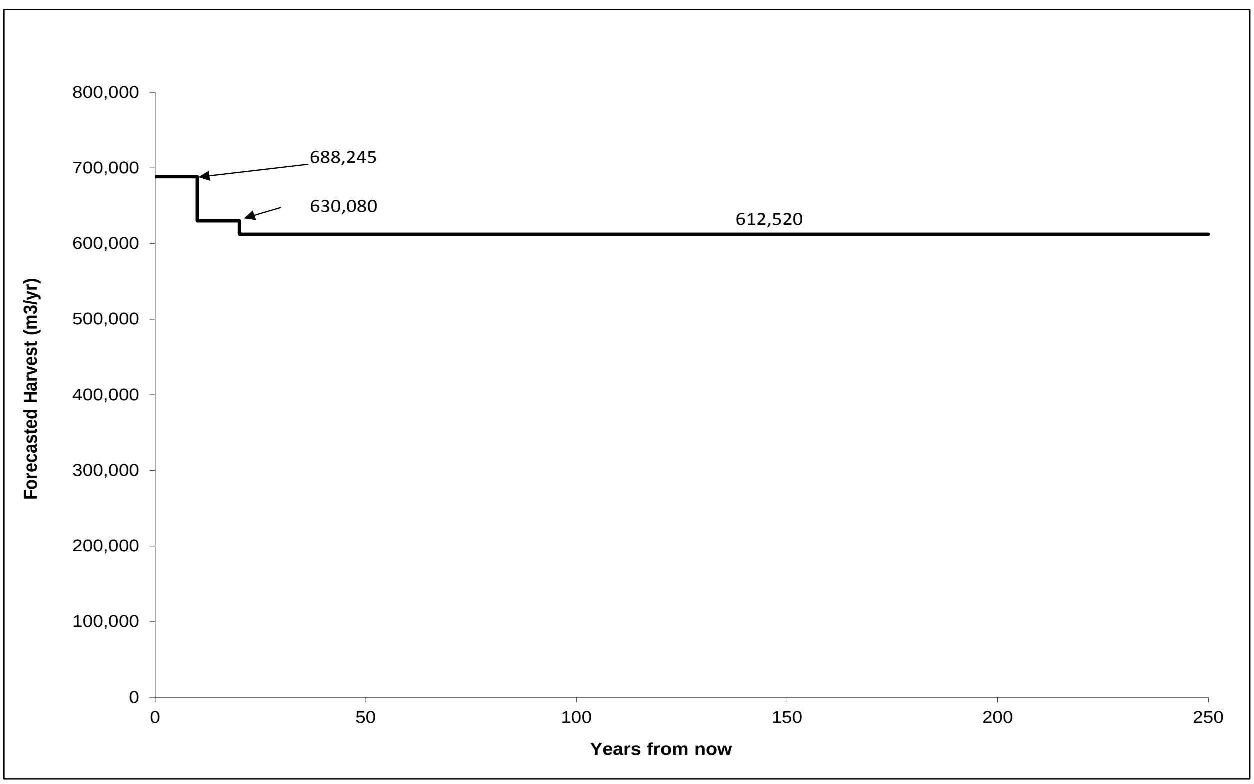

Figure 1: Base Case harvest forecast

The Base Case for this analysis is robust; downward pressures in the short term can be deferred to the medium and long term. The sensitivity analyses and alternate harvest flows demonstrate that timber supply crashes associated with changes to initial harvest level and/or analysis assumptions do not generally occur until late in the planning horizon, if at all. In most cases unsustainable harvest levels are apparent only in the long-term decline of the growing stock. This delayed response reduces the risk associated with a given short-term harvest level, as it allows future AAC determinations to respond to new information and management regimes.

The sensitivity analyses revealed that changes in analysis assumptions had generally small or negligible impacts with a few exceptions:

- As expected, increasing or decreasing managed stand yields had an impact on the long-term harvest level (LTHL) similar to the magnitude of change in stand yields. A 10% yield increase produced an approximately 10 % higher LTHL, while a similar decrease in stand yields reduced the LTHL by approximately 10%.
- Several sensitivity analyses were completed investigating the impact of changes to the size of the economically operable land base. These sensitivity analyses demonstrated that the impact of increasing the economically operable land base on timber supply is significant. This impact is mostly related to the economic operability of the helicopter land base and less to that of the conventional land base.
- The sensitivity analyses demonstrated that harvesting second growth stands at very young ages in lieu of the older stands would impact the long-term harvest level significantly and negatively. Ensuring that the entire harvest profile is harvested in the Pacific TSA is important for the sustainability of timber supply.

Two alternated harvest flows were completed for the Base Case land base: one with the initial harvest level at the current AAC of 1,279,731 m^3 per year (without the GBR contribution) and another where the initial harvest level was set at 950,000 m3 per year.

Maintaining the current AAC for the first 10 years resulted in significant timber supply deficits in the mid-term between years 66 and 135. It was also necessary to lower the LTHL from that of the Base Case somewhat to stabilize the growing stock. The long-term growing stock in this scenario remained significantly lower than that of the Base Case.

With the initial harvest level at 950,000 m^3 per year for the first 10 years, the late mid-term harvest level had to be decreased by 6.1% annually between years 61 and 105 to compensate for the increased harvest in the short-term. The LTHL settled at the same level as in the Base Case; however, the long-term growing stock stabilized at a lower level compared to the Base Case.

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. It is assumed that harvest in these areas is economic only during the market cycles with high log prices, while conventional harvest areas are assumed to be economic in average market conditions. The size of the THLB that falls within the helicopter harvest area in the Base Case is 9,367 ha.

The contribution of the helicopter harvest areas was investigated in this timber supply analysis. In the Base Case, the harvest from these areas fluctuates significantly with the average harvest over the planning horizon from the helicopter land base at 56,285 m3 per year.

When the helicopter land base was analysed independently, it produced a long-term harvest forecast of 56,765 m3 per year with a short-term harvest (10 years only) of 58,450 m3 per year.

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1 Introduction

1.1 Context

British Columbia Timber Sales (BCTS) is preparing a timber supply review (TSR) analyzing the strategic timber supply for the land base in the Pacific TSA. This analysis report is the second of three documents making up the TSR process summarizing the timber supply analysis results. The first document – the Information Package - documents the procedures, assumptions, data and model used in the analysis. The final document - the Rationale for AAC Determination - documents the Chief Forester's AAC determination and the rationale behind it. Section 8 of the *Forest Act* provides the legislative authority for AAC determinations and outlines the factors that must be considered by the Chief Forester during the process.

1.2 Timber Supply Analysis

This report describes the timber supply analysis for the Pacific TSA. Timber supply analysis examines the availability of timber volume for harvesting over time. It involves testing and reporting on a variety of assumptions and management strategies. The timber supply analysis provides the Chief Forester with information about the relationship between current management and timber supply. The purpose of this report is to provide the Chief Forester with sufficient information to make an informed Allowable Annual Cut (AAC) determination.

Timber supply analysis is intended to ensure that current harvest levels do not threaten the availability of future timber volume. Sustainability is therefore the key concept in this report and in timber supply analysis in general. However, the main indicator of sustainability in timber supply analysis is the long-term stability of growing stock, and therefore the continuous availability of timber for harvest. This analysis does not attempt to evaluate sustainability in terms of the wider range of biological, social, or economic values that are affected by timber harvesting. Because of its limited definition of sustainability, timber supply analysis is only one aspect of a larger decision-making process used to set the AAC.

1.3 Timber Supply Forecasts

A single harvest forecast is not sufficient to depict the timber supply dynamics of the Pacific TSA due to the complexity of factors affecting timber supply. There are uncertainties about how well the analysis assumptions reflect the realities of timber supply in the TSA and there are many options for setting harvest levels in response to the timber supply dynamics. Several forecasts are developed in this analysis to account for these uncertainties and options. The purpose of presenting different forecasts is to construct a complete understanding of the timber supply dynamics of the Pacific TSA. The following forecasts are presented in this report:

Base Case: The Base Case is the standard against which other forecasts are compared when assessing the effects of uncertainty on timber supply. In most timber supply analyses, the Base Case reflects the best available knowledge about current management activities and forest development in a management unit.

Sensitivity Analyses: Sensitivity analyses are used to determine the risk associated with uncertainties in the assumptions of the analysis. These forecasts isolate an area of uncertainty and test the implications of using a variety of assumptions.

Alternative Harvest Forecasts: Alternative harvest forecasts explore different decline rates, starting harvest levels, and potential trade-offs between short- and long-term harvests. Alternative forecasts enable the Chief Forester to assess short-, medium-, and long-term trade-offs.

2 Description of the Land Base

The Pacific TSA consists of 30 Blocks on Vancouver Island, the Sunshine Coast, the Mainland Coast, and Douglas Channel. Figure 2 shows the location of the Pacific TSA Blocks. The TSA overlaps parts of five natural resource districts: Coast Mountains (DKM), North Island-Central Coast (DNI), Campbell River (DCR), Sunshine Coast (DSC), and South Island (DSI). The Blocks range in size from 76 ha (Block 4) to over 400,000 ha (Block 28). An area summary of the TSA Blocks is shown in Table 1.

The Pacific Timber Supply Area (TSA) was established In July 2009 from an amalgamation of various tree farm license (TFL) areas taken back by the Province through the Forestry Revitalization Act (Bill 28, 2003). BCTS is the major operator in the Pacific TSA, holding approximately 93% of the AAC, with First Nations tenures making up the remaining cut.

At the time the TSR was initiated, the TSA was spread over three BCTS Business Areas (BA): Strait of Georgia (TSG), Seaward-Tlasta (TST), and Skeena (TSK). BCTS has since initiated a transition of TSA Blocks in the Sunshine Coast (Blocks 21, 22, and 23) from the TSG BA to the Chinook BA (TCH). This transition was completed March 31, 2016, however for the purposes of this analysis; all documentation associated with these Blocks will remain with a reference to TSG.

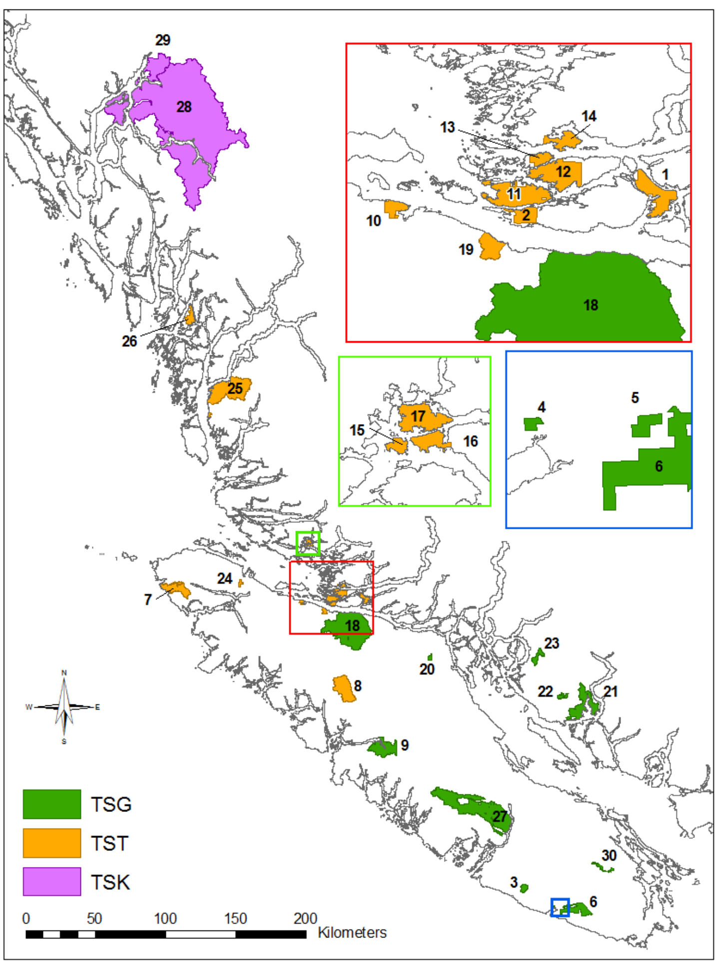

Figure 2: Pacific TSA Blocks, coloured by Business Area

Table 1: Pacific TSA Blocks, Natural Resource Districts, and Business Areas

Block	Block Name	District	Business Area	Total Area (ha)
1	East Cracroft Island	DNI	TST	2,336
2	West Cracroft Island	DNI	TST	1,017
3	Roseander	DSI	TSG	2,294
4	San Juan	DSI	TSG	76
5	San Juan	DSI	TSG	198
6	San Juan	DSI	TSG	10,233
7	Holberg	DNI	TST	11,400
8	Vernon Lake	DNI	TST	18,351
9	Burman/Jacklah	DCR	TSG	16,623
10	Beaver Cove	DNI	TST	798
11	Harbledown Island	DNI	TST	3,459
12	Turnour Island	DNI	TST	3,085
13	Village Island	DNI	TST	645
14	Gilford Island	DNI	TST	1,128
15	Kinnaird Island	DNI	TST	259
16	Burley Bay	DNI	TST	521
17	Watson Island	DNI	TST	1,114
18	Eve/Naka/Tsitika	DCR	TSG	59,145
19	South Kaikash	DCR	TSG	1,350
20	Farewell Lake	DCR	TSG	834
21	Granville/Lois (Hotham Sound)	DSC	TSG	20,604
22	Dodd	DSC	TSG	1,700
23	Theodosia	DSC	TSG	3,719
24	Quatse	DNI	TST	1,015
25	Doc Creek	DNI	TST	37,565
26	Yeo Island	DNI	TST	5,476
27	Sproat Lake	DSI	TSG	64,293
28	Douglas Channel	DKM	TSK	405,279
29	Wathl/Wathlsto	DKM	TSK	21,454
30	Hill 60	DSI	TSG	2,070
Total				**698,041**

2.1 Forest Inventory

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. Each inventory was converted to VRI format by the Forest Analysis and Inventory Branch (FAIB), projected to 2014, and then provided to Forest Ecosystem Solutions Ltd. (FESL). FESL combined all these separate inventories into one consolidated VRI for the entire Pacific TSA. See the Information Package for a more detailed description of the inventory.

2.2 Land Base Classification

2.2.1 Timber Harvesting Land Base

Land base assumptions define the land base classification in the Pacific TSA. The different classes are a result of a land base netdown. The netdown is an exclusionary process. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area of netdown factors (e.g. inoperable) is often greater than the net area removed; a result of overlapping resource issues.

The TSA is classified in the following classes:

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

Crown Forested Land Base (CFLB) – the CFLB is identified as the broader land base that contains forest and can contribute towards meeting both timber and non-timber objectives (i.e. biodiversity).

Timber Harvesting Land Base (THLB) - the THLB is the portion of the CFLB considered to be physically, environmentally, economically and socially available for timber harvesting. It is productive forest land that is harvestable according to current forest practices and legislation.

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

The land base netdown is shown in Table 2. The netdown reductions are described in the Information Package.

Table 2: Pacific TSA netdown summary

Netdown Category	Net Area (ha)	Gross Area (ha)
Total Area		**698,041**
Not Managed by Crown	9,931	9,931
Non-Forest	259,515	264,157
Non-Commercial Brush	30,839	31,199
Roads	4,198	4,598
Crown Forested Land Base Area	**393,559**	
Parks and Protected Areas	9,604	11,050
Ungulate Winter Range	18,777	25,395
Wildlfe Habitat Areas	13,052	30,667
Marbled Murrelet Reserves	2,380	5,253
Class 1 Grizzly Bear Habitat (EBM)	592	725
Clayoquot reserves	3,112	5,526
Old Growth Management Areas	30,832	43,881
Preservation VQO areas	296	728
Terrain and ESA	45,440	70,093
Inaccessible Areas	28,806	244,132
Deciduous-leading Stands	2,932	5,083
Non-merchantable (low volume) Stands	43,740	386,422
Uneconomic Areas	74,708	137,773
Archeological Sites	661	840
Recreation Areas	513	2,840
Riparian Management Areas	5,616	28,313
High Value Fish Habitat (EBM)	64	81
Non-high Value Fish Habitat (EBM)	122	559
Active Fluvial Areas (EBM)	485	813
Red/Blue listed ecosystems (EBM)	475	1,470
Wildlife Tree Retention Areas	9,003	13,126
Karst	14	558
First Nations considerations (EBM)	152	208
Non-Harvesting Land Base Area	**291,372**	
Timber Harvesting Land Base Area	**102,187**	

2.3 Current Forest Conditions

2.3.1 Biogeoclimatic Zones

The climate in the TSA is coastal, with the dominant biogeoclimatic zone being the coastal-western hemlock (CWH), with some mountain hemlock (MH), some Englemann spruce-subalpine fir (ESSF), and alpine areas (BAFA, CMA). Table 3 shows the areas of biogeoclimatic variants in the Pacific TSA.

Table 3: Biogeoclimatic variants in the Pacific TSA

Subzone	CFLB (ha)	% of Total
Alpine	150	0.04%
CWHdm	14,619	3.68%
CWHmm1	15,059	3.79%
CWHmm2	3,786	0.95%
CWHvh1	7,230	1.82%
CWHvh2	43,915	11.04%
CWHvm1	105,865	26.62%
CWHvm2	48,450	12.18%
CWHws1	10	0.00%
CWHws2	84,424	21.23%
CWHxm	794	0.20%
CWHxm1	786	0.20%
CWHxm2	7,376	1.85%
ESSFmk	8,940	2.25%
ESSFmkp	50	0.01%
MHmm1	46,751	11.76%
MHmm2	55	0.01%
MHmmp	697	0.18%
MHwh	55	0.01%
MHwh1	8,652	2.18%
MHwhp	10	0.00%

2.3.2 Species Profile

The CFLB in the Pacific TSA is dominated by western hemlock (Hw) mixed with balsam (Ba), western redcedar (Cw) and Douglas fir (Fd). The hemlock/balsam (HemBal) leading stands constitute approximately 71% of the CFLB. The share of Cw-leading stands is 11% while Fd is the dominant species on 9% of the land base (Figure 3).

HemBal leading stands also dominate the THLB (63% of the area); however the share of Fd leading stands is substantially higher on the THLB at 22% of the area (Figure 4).

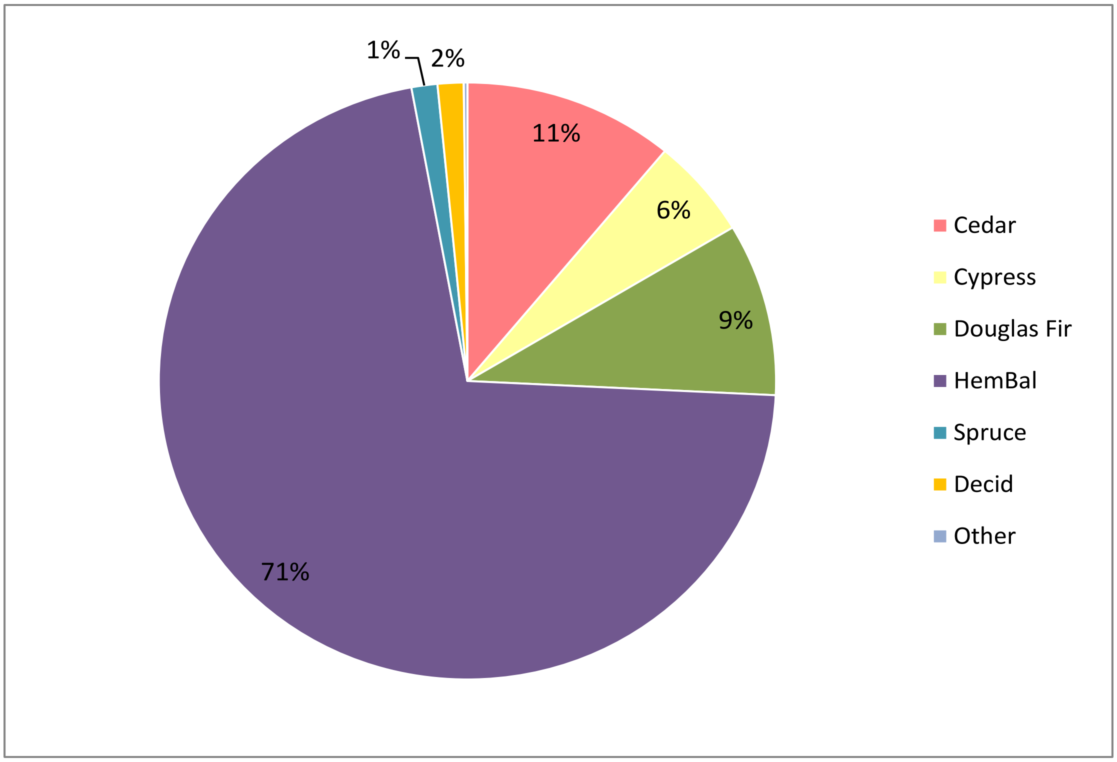

Figure 3: Leading species in the CFLB, Pacific TSA

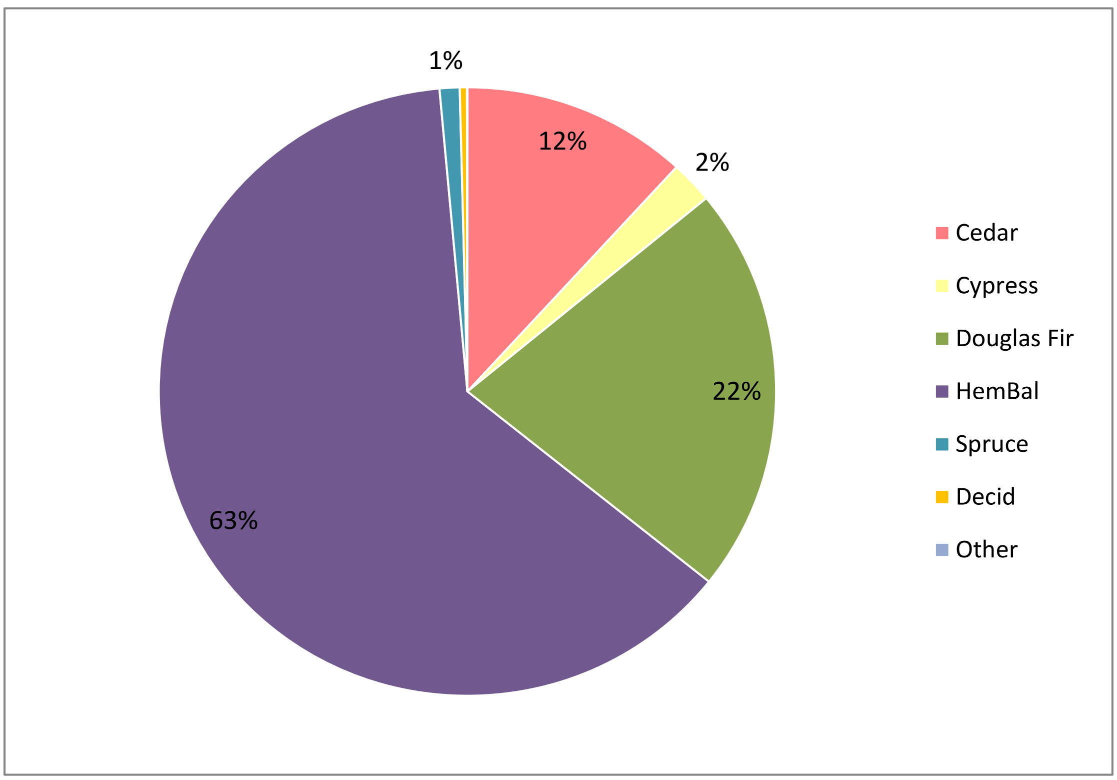

Figure 4: Leading species in the THLB, Pacific TSA

2.3.3 Age Class Distribution

While older age classes dominate the productive forest in the TSA, younger age classes are more prevalent in the THLB. Approximately 64% of the productive forest is older than 140 years; however only 23% of the THLB is older than 140 years. Approximately 50% of the stands in the THLB are younger than 40 years. Figure 5 depicts the distribution of NHLB and THLB by Vegetation Resource Inventory (VRI) twenty-year age classes. Age classes 6 and 7 are not well represented; harvesting in the short and medium term in the TSA will depend on the timber currently in age classes 2, 3, 4 and 5, and available timber in age classes 8 and 9.

The TSA age class distribution in the southern and mid-coast portions of the TSA (Figure 6) mirror that of the entire TSA, while almost all the land base in the TSK BA (83%) consists of age classes 8 and 9 with the majority of the THLB is in age classes 1 and 9 (Figure 7).

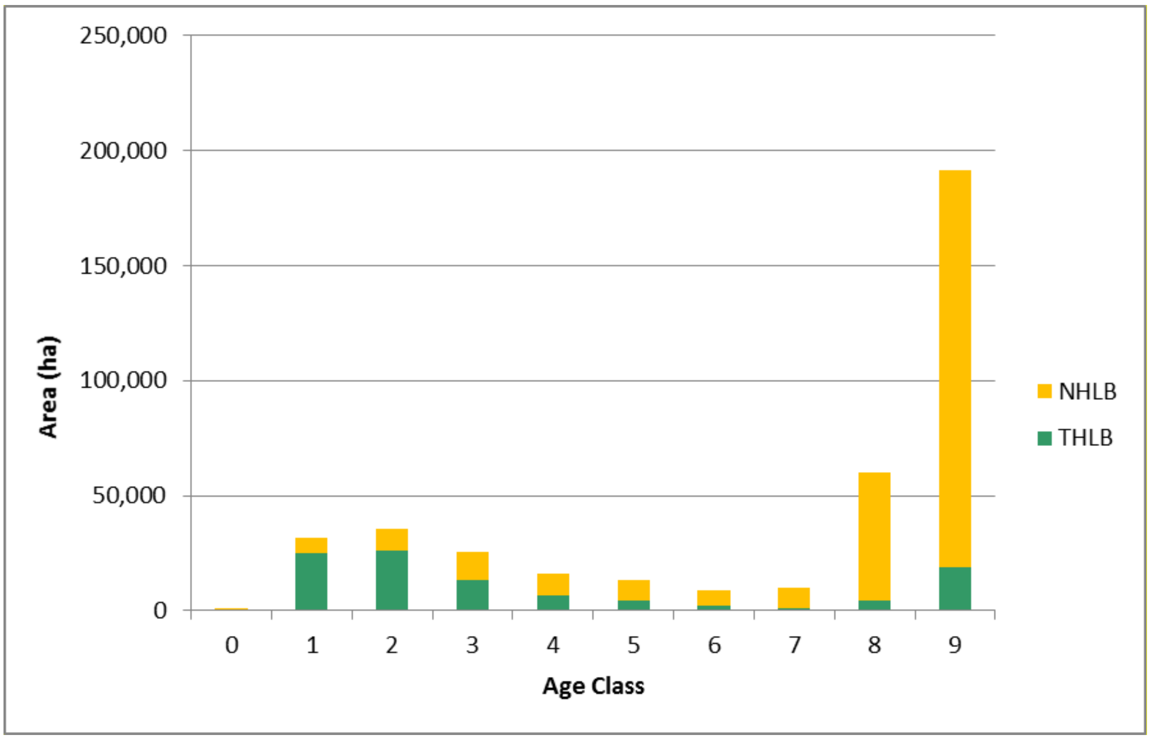

Figure 5: Age class distribution in the Pacific TSA

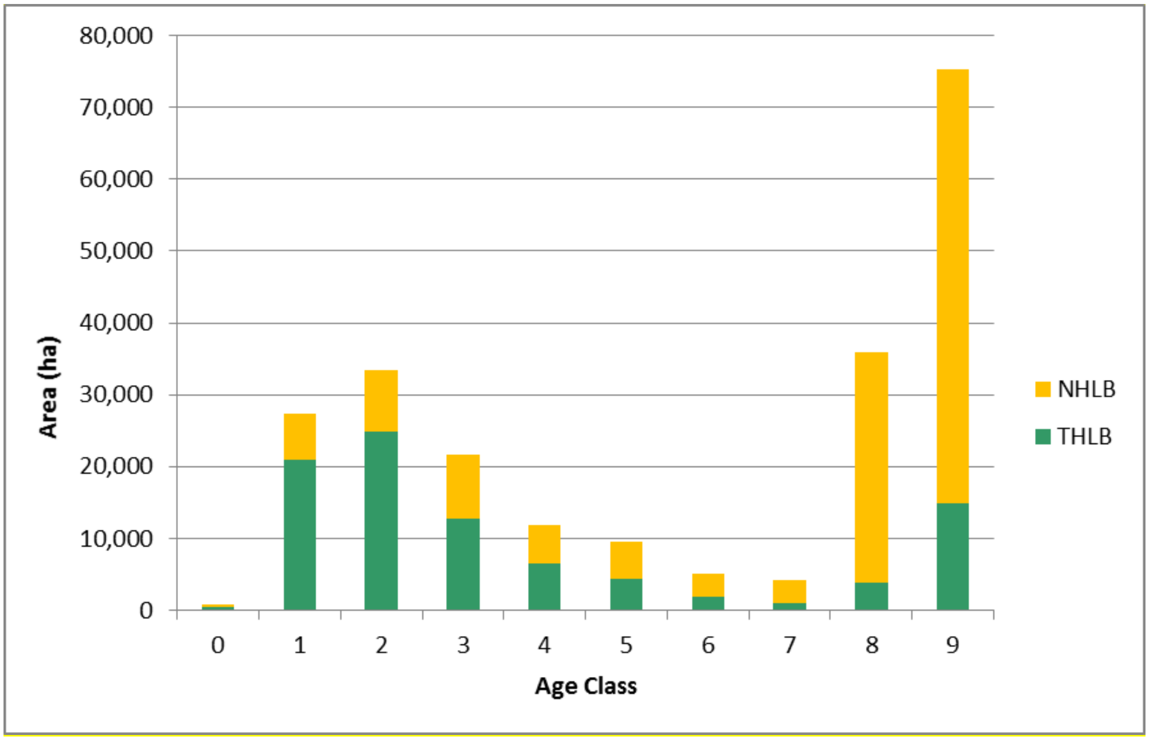

Figure 6: Age class distribution, TSG and TST business areas

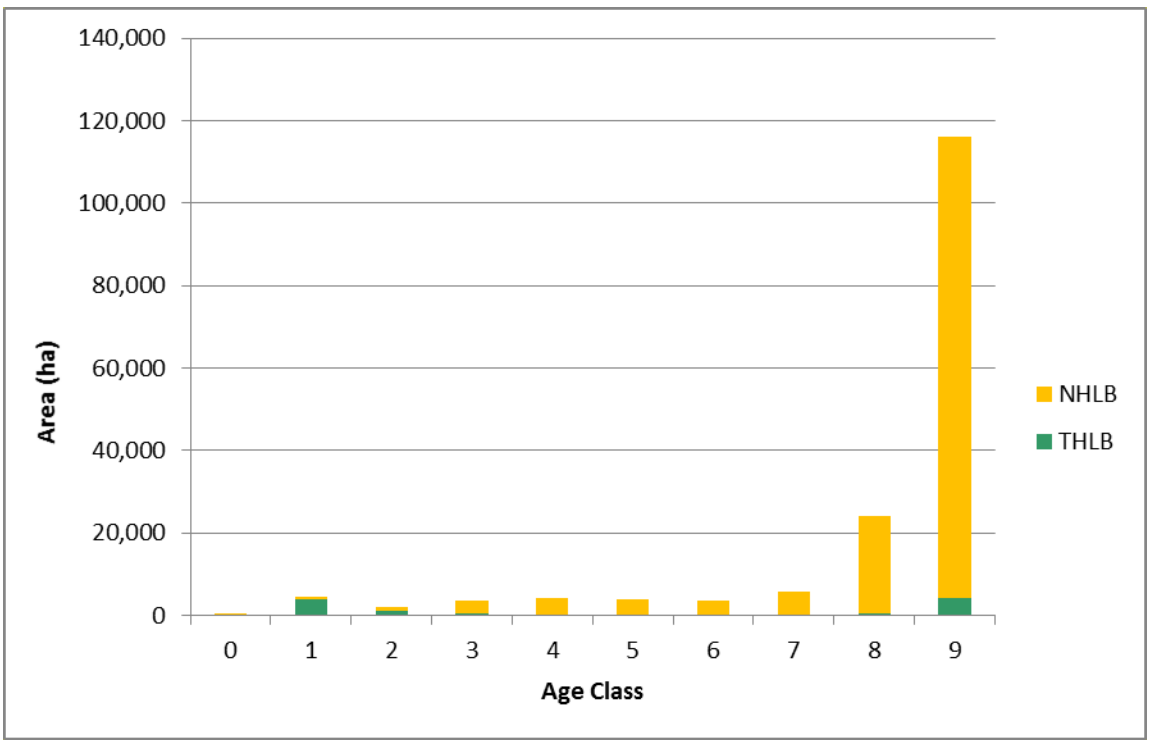

Figure 7: Age class distribution, TSK business area

2.3.4 Growing Stock

The total growing stock in the Pacific TSA is estimated at 27.8 million m^3. Approximately 84% or 23.4 million m^3 of this is currently estimated to be merchantable. HemBal volume forms the majority of the merchantable growing stock at around 13 million m^3 (57%). The shares of Cw/Yc and Fd volume are significant at 4.9 million m^3 (21%) and 4.4 million m^3 (19%) correspondingly (Figure 8).

The majority of the merchantable growing stock is older than 250 years (age class 9, 53%) consisting mostly of HemBal and Cw/Yc volume (Figure 9 and Table 4). Douglas fir is well represented in age classes 2, 3 and 4.

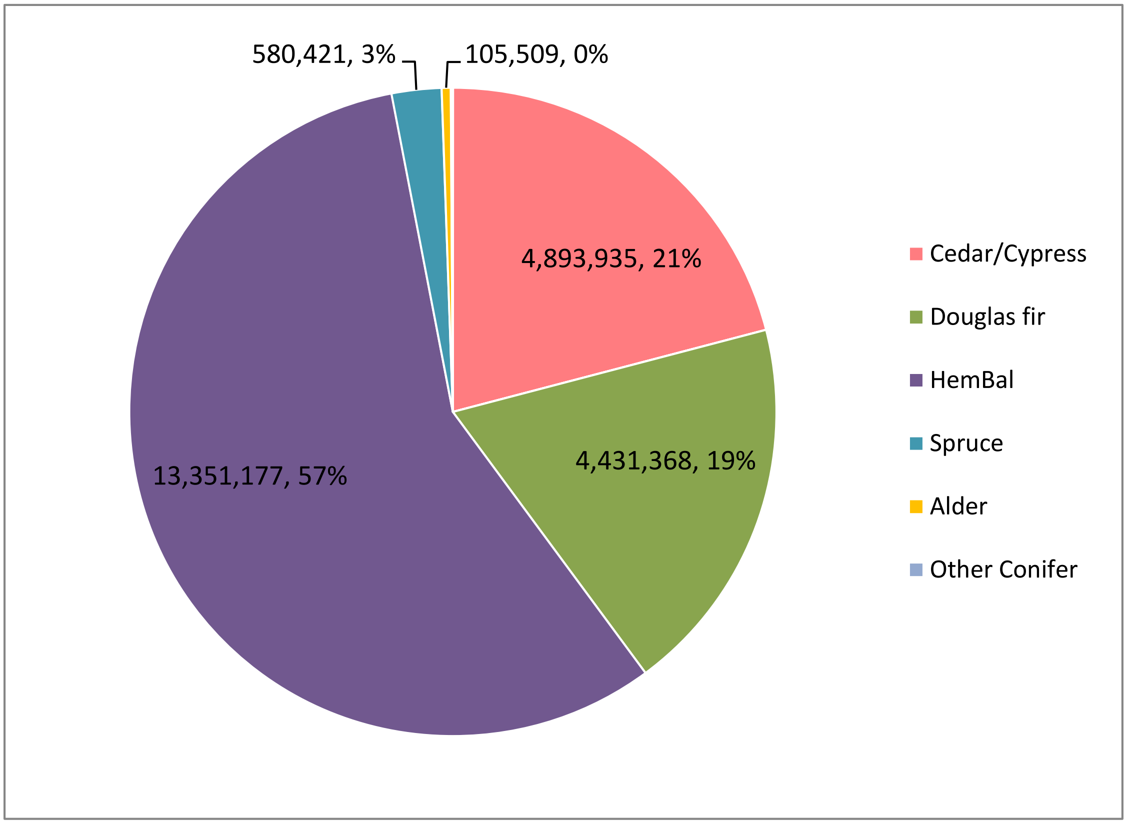

Figure 8: Merchantable growing stock by species in the Pacific TSA

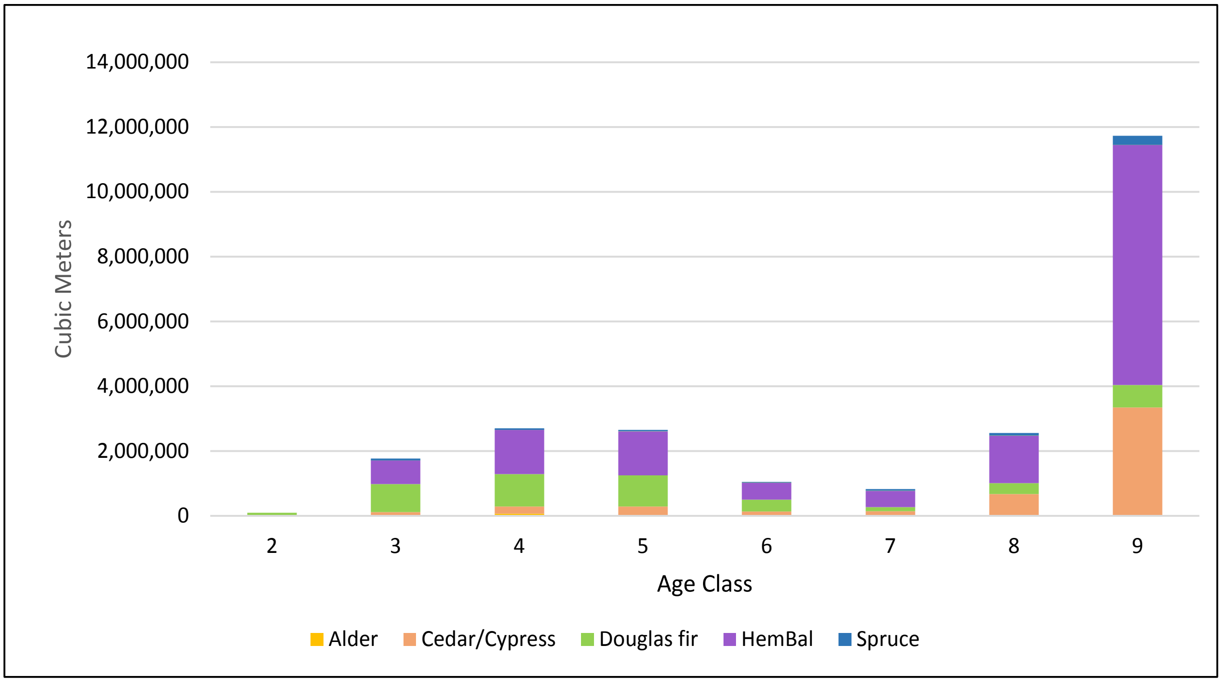

Figure 9: Merchantable growing stock by species and age class in the Pacific TSA

Table 4: Merchantable growing stock by species and age class in the Pacific TSA

Age Class	Alder	Cedar/ Cypress	Douglas Fir	HemBal	Other Conifer	Spruce	Total
2	0	32	95,685	0	0	0	**95,718**
3	10,814	103,930	863,562	736,714	859	55,662	**1,771,541**
4	64,745	221,814	1,002,856	1,360,971	3,172	48,014	**2,701,571**
5	20,264	268,603	962,076	1,354,799	4,330	43,922	**2,653,993**
6	7,724	129,067	368,065	518,874	2,362	23,234	**1,049,325**
7	1,319	145,157	124,172	502,870	885	50,037	**824,441**
8	371	676,875	330,801	1,466,085	4,078	80,387	**2,558,597**
9	272	3,348,456	684,150	7,410,865	8,149	279,165	**11,731,057**
Total	**105,509**	**4,893,935**	**4,431,368**	**13,351,177**	**23,834**	**580,421**	**23,386,243**

3 Assumptions and Methods

This section briefly describes the inputs and assumptions to the timber supply analysis. A full description of these issues is provided in the Pacific TSA Timber Supply Review Information Package.

3.1 Timber Supply Model

All analysis presented in this report was conducted using Forest Simulation and Optimization System (FSOS), a proprietary forest estate model developed by FESL. FSOS has both simulation and heuristic (pseudo-optimization) capabilities. The time-step simulation mode was primarily used in this analysis. Time-step simulation grows the forest based on growth and yield inputs and harvests units of land area based on user-specified harvest rules and constraints that cannot be exceeded.

3.2 Growth and Yield

3.2.1 Site Index

On the recommendation of the Forest Analysis and Inventory Branch (FAIB), the provincial site productivity data layer was used in the analysis to model the growth and yield of managed stands. Where there is no data in the provincial layer, the SIBEC site index for the leading TEM/PEM site series was used. If TEM or PEM data did not exist, or if SIBEC contained no site index, the VRI site index was used.

The growth and yield of natural stands were modeled using the inventory site index. Table 5 compares the average site index values from VRI to those from the provincial site index layer.

Table 5: Average site productivity in the Pacific TSA, (leading species in VRI)

Business Area	Site Index Type	Cedar	Hemlock	Balsam	Douglas Fir	Spruce
TSG, TST	VRI Site Index Average (THLB):	17.5	21.3	16.9	28.5	28.1
	Provincial SI average (THLB):	21.1	25.5	23.4	31.2	28.9
TSK	VRI Site Index Average (THLB):	14.0	14.7	16.6	n/a	19.7
	Provincial SI average (THLB):	22.6	23.1	25.7	n/a	27.4

3.3 Analysis Units

An analysis unit is a grouping of similar forest area with the objective of simplifying the analysis and the interpretation of analysis results.

3.3.1 Natural Stands

Stands established prior to 1966 (>= 50 years old in 2014) are considered natural stands in this analysis. Their growth and yield was modeled using the Variable Density Yield Prediction (VDYP7) yield model. Inventory site index estimates are considered to be the most appropriate in modelling these stands. A more detailed description of the growth and yield modelling of these stands is presented in the Information Package.

The large number of natural stand yield curves (30,883 VRI stands in the FMLB) were aggregated into 1379 analysis unit yield curves. The grouping was completed based on TSA business area, species composition, inventory site index and the volume per ha at ages 75 and 150.

3.3.2 Managed Stands

Stands established after 1965 are considered managed stands in this analysis. Their growth and yield was modeled using Tree and Stand Simulator (TASS). TASS is a three dimensional growth simulator that generates growth and yield information for even aged stands of pure coniferous species of commercial importance in coastal and interior forests of British Columbia. Provincial site productivity layer estimates of site index are considered to be the best estimates of site productivity for modelling managed stands.

Analysis units for managed stands are based on BEC groupings and site index. The aggregation of the data within each analysis unit was completed separately for the TSK business area.

Regeneration assumptions and detailed inputs to TASS are presented in the Information Package.

3.3.2.1 Management Eras (Managed Stands)

3.3.2.1.1 Era 1; Stands established between 1966 and 1978

Stands established between 1966 and 1978 are considered existing managed stands. While some of these stands were planted, their current species composition is often reflective of naturally regenerated stands. These stands were considered naturally regenerated in growth and yield modelling.

3.3.2.1.2 Era 2; Stands established between 1979 and 2003

Stands established between 1979 and 2003 are also considered existing managed stands. These stands were generally regenerated through planting with seedlings of no genetic worth. These stands were modeled as planted with ingress in growth and yield modelling.

In the TSK business area this era extends from 1979 to 2009.

3.3.2.1.3 Era 3; Stands established between 2004 and 2009

Stands established between 2004 and 2009 were generally regenerated through planting with seedlings of modest genetic worth (in TSG and TST). These stands were modeled as planted with ingress in growth and yield modelling.

3.3.2.1.4 Era 4; Stands established after 2009

Stands established after 2009 and those that will be planted in the future are considered future managed stands. These stands are regenerated through planting with seedlings of significant genetic worth (in TSG and TST). These stands were modeled as planted with ingress in growth and yield modelling.

3.4 Integrated Resource Management

3.4.1 Land Use Direction

The Pacific TSA contains several land use plans. The Vancouver Island Land Use Plan (VILUP) covers all of Vancouver Island except Clayoquot Sound. VILUP sets legal objectives for resource management zones (enhanced and general) and special management zones. Resource management in Clayoquot Sound is governed by the Clayoquot Sound Land Use Decision and implemented in the Pacific TSA through the Upper Kennedy Watershed Plan.

The TSG business area Blocks are managed under VILUP with the exception of Blocks 21, 22 and 23, which are managed through local land use plans. Several local sustainable resource management plans (SRMP) also exist in the TSG VILUP areas.

Some of the TST Blocks are managed under VILUP (7, 8, 10, and 24), while the Coast Land Use Decision (South-Central Coast Order (SCC), Central and North Coast Order (CNC), and Great Bear Rainforest Order (GBRO)) provide management direction for the south central and central coast. As with TSG, in the VILUP areas, SRMPs provide additional guidance.

Kalum LRMP, Kalum South SRMP and Kowesas SRMP govern the management of natural resources in the TSK business area.

3.4.2 Management Zones and Multi-Level Objectives

Management zones are geographically specific areas that require unique management considerations. Areas requiring the same management regime or the same forest cover requirements are grouped into management zones. Table 6 lists the management zones for the Pacific TSA and the rationale used to define these zones. Further information on management zones is presented in the Information Package. Multiple resource issues may be present in the same forest area. For example, a management zone that requires a minimum area of mature and old seral forest may also have areas that are visually sensitive and require specific visual objectives. Forest estate models can accommodate multiple overlapping resource layers by establishing target levels for each layer. The models then schedule harvest units which best meet the target levels for all resource layers together.

Table 6: Management Zones –Base Case

Management Zone	Total Area (ha)	CFLB Area (ha)	Criteria Used to Delineate	Notes
VILUP HLPO RMZ: Enhanced Forestry Zones (EFZ) General Management Zones (GMZ) Special Management Zones (SMZ)	 74,759 67,430 33,526	 63,253 52,788 29,513	Legally established in the VILUP HLPO Section 1.	Green-up is applied by RMZ. Green-up and maximum block size are modified in EFZ. SMZ have non-spatial mature and old seral stage targets.
Visual Quality Objectives: Retention (R) Partial Retention (PR) Modification (M) Maximum Modification (MM)	 4,426 97,084 28,058 79	 2,609 69,192 24,575 70	Scenic areas as per VILUP, FRPA, GAR.	Targets are applied to each VQO polygon separately. Visual green-up heights are based on slope.
Clayoquot Sound Scenic Areas: Small-scale alteration Minimal alteration Natural appearing	 931 2,170 143	 866 1,858 125	Clayoquot Sound Scientific Panel Report and Watershed Plans	Mapped and modeled to equivalent VQO class i.e. PR, PR,R.
Clayoquot Sound Sub-Basins Rate of Cut	11,348	9,058	Upper Kennedy Watershed Plan.	Defines a maximum rate of cut.
Clayoquot Sound Biodiversity	11,348	9,058	Clayoquot Sound Scientific Panel Report and Watershed Plans	Target of 40% old forest (>250 years old) by watershed sub-basin.
EBM Important Fisheries Watersheds.	20,841	17,568	SCC and CNC	ECA targets.
EBM Upland Streams	42,978	35,432	CNC	ECA targets for EBM upland stream areas.
EBM Biodiversity	56,006	48,458	GBRO	Current and long-term targets for old forest (>250 years old) by landscape unit and site series grouping.
Kalum Watersheds: Brim Hugh Owyacumish Wahoo Wathlsto	 15,764 5,381 8,322 21,334 5,539	 2,501 3,675 2,191 4,500 3,952	Kalum South SRMP	Targets for old forest (>250 years old) based on PEM site series within undeveloped watersheds.
Sayward Potential Spring Forage	1.3	1.3	Sayward Land Use Plan	Sets cover constraints
Sayward Elk Visual Cover	17	9	Sayward Land Use Plan	Sets cover constraints
Landscape Units: 33 Landscape units in the Pacific TSA			Legally established under FRPA	Landscape units (33) are used to define specific land use objectives outside of VILUP, Clayoquot Sound or the Great Bear Rain Forest. Examples are non-visual green-up and non-spatial old growth objectives (if not achieved through OGMAs)
Fisheries Sensitive (FSW) and Assessed Watersheds: FSW f-1-008 FSW f-1-010	 2,700 9,320	 2,652 7,689	Fisheries sensitive watersheds have been established through GAR order.	Management of FSW is required by law. Current practice is to follow ECA recommendations for other assessed watersheds.
Community Watersheds: 910.012 930.021	 10,988 21,766	 7,475 18,155	Designated community watersheds.	Limit harvest to designated percent of area annually.

3.5 Unsalvaged Losses

Non-recoverable losses provide an estimate of the average annual volume of timber damaged or killed within the THLB and not salvaged or accounted for by other factors. These losses result from natural events such as insects, diseases, wind, wildfires, etc.

Data from on-going and recently completed TSRs that cover the Pacific TSA area were combined and prorated to develop an estimate for non-recoverable losses (NRL). The values shown in Table 7 indicate the estimated annual volume that will not be salvaged. The estimate is for all sources summed up. Non-recoverable losses are removed from the harvest volume for each timber supply forecast.

Table 7: Annual non-recoverable losses

Neighbouring TSA	NRL within THLB (m^3/yr)	THLB area (ha)	Pacific TSA THLB (ha)	THLB Ratio	Pacific TSA NRL (m^3/yr)
Arrowsmith	9,105	58,613	28,342	48%	4,403
Kalum	5,000	80,820	10,618	13%	657
Kingcome	16,666	75,066	20,043	27%	4,450
Mid-Coast	20,102	124,605	3,835	3%	619
Strathcona	43,150	162,873	27,360	17%	7,249
Sunshine Coast	12,650	222,894	11,979	5%	680
Total					**18,057**

3.6 Minimum Harvest Criteria

Minimum harvest criteria is the earliest age, volume per ha or other criterion such as DBH at which stands become eligible for harvest within the timber supply model. Minimum harvest criteria can have a profound effect on modeled harvest levels by creating acute timber supply shortages, or “pinch points”, that constrain the rest of the planning horizon.

For this analysis, the minimum harvestable criteria for stands in each analysis unit is the age at which the stand is predicted to reach a volume of 300 m^3/ha. In practice, most forest stands are harvested beyond the minimum harvest age due to economic considerations and constraints on harvesting, which arise from managing for other forest values. The potential impact of different minimum harvest criteria is explored through sensitivity analyses.

3.7 Minimum Periodic Volume

Minimum volume requirements can be set for an area, when it is known that the financial viability of the harvest from that area requires a minimum harvestable volume. Due to the scattered and isolated nature of the Pacific TSA Blocks, many of them require a minimum harvest volume to reflect the operational reality associated with mobilization and demobilization. The following table shows all the TSA Blocks, or the combinations of Blocks that are subject to minimum volume requirements in the base case. The requirements are applied to a period of 5 years.

Table 8: Minimum 5-year harvest volume requirements

Pacific TSA Block	Area Name	Area (ha)	THLB Area (ha)	Minimum Harvest Volume m^3 over 5 years
1	East Cracroft Island	2,336	1,275	35,000
2	West Cracroft Island	1,017	776	35,000
3	Roseander	2,294	1,168	10,000
4, 5, 6	San Juan	10,507	4,831	10,000
7	Holberg	11,401	6,741	15,000
8	Vernon Lake	18,351	4,178	35,000
9	Burman	10,644	2,502	40,000
	Jacklah	5,979	1,566	40,000
10	Beaver Cove	798	615	20,000
11	Harbledown Island	3,459	1,779	30,000
12	Turnour Island	3,085	2,026	25,000
13	Village Island	645	314	35,000
14	Gilford Island	1,128	553	35,000
15	Kinnaird Island	259	111	35,000
16	Burley Bay	521	244	35,000
17	Watson Island	1,114	632	35,000
19	South Kaikash	1,350	29	35,000
20	Farewell Lake	834	424	10,000
21	Granville	5,855	2,837	20,000
	Lois	5,710	3,642	10,000
	Khartoum	9,038	2,973	30,000
23	Theodosia	3,719	1,325	30,000
24	Quatse	1,016	801	30,000
25	Doc Creek	37,566	2,795	Defer entire Block for 40 years. Minimum volume of 70,000m^3.
26	Yeo Island	5,476	1,040	40,000
30	Hill 60	2,070	1,603	10,000

3.8 Harvest Scheduling Rule

Simulation models are rule-driven, and require harvest scheduling rules to control the order in which stands are harvested. It is important that these rules are able to organize the harvest in a way that realizes the productive potential of the land base in a reasonable manner to understand the impacts of the timber supply assumptions and constraints.

The relative oldest first rule is a commonly used harvest rule that will be used in the base case. In this rule, the age of a stand is related to its minimum harvestable age. Stands that have the greatest proportional difference between their actual age and their minimum harvest age are given priority for harvest, subject to forest cover requirements.

4 Base Case Harvest Forecast

The Base Case is the foundation for comparison between timber supply forecasts. Base Case assumptions are described in the Information Package. The Base Case assumptions determine how the TSA land base is expected to respond to the current management regime over time. The purpose of the Base Case is to understand the implications of current management to future timber supply, including short, medium and long terms. This section describes the Base Case, first by defining the area that the Base Case forecast applies to, then explaining how sustainable harvest levels are determined, and finally by describing the predicted development of selected attributes of the Pacific TSA associated with the chosen sustainable harvest level.

4.1 Base Case Land Base

A portion of the Pacific TSA (56,605 ha) falls under the South-Central Coast Order (SCC), the Central North Coast Order (CNC) and the Great Bear Rain Forest Order (GBR) establishing Ecosystem Based Management (EBM). Blocks within the EBM area are 1, 2, 11-17, 25, and 26. All are located in the Seaward-Tlasta Business Area and the North Island/Central Coast Natural Resource District

Under the *Great Bear Rainforest (Forest Management) Act*, the AAC for the portions of the Pacific TSA that fall within the GBR will be established by the Lieutenant Governor in Council by regulation. Following this, the Chief Forester would have authority to determine the AAC, and specify AAC partitions, for the areas of the Pacific TSA that fall outside the GBR. For this reason the GBR is excluded from the Pacific TSA Base Case. The THLB netdown for the land base outside of the GBR is presented Table 9.

Table 9: THLB netdown for the area outside of the GBR

Netdown Category	Net Area (ha)	Gross Area (ha)
Total Area		**641,436**
Not Managed by Crown	9,929	9,929
Non-Forest	251,741	256,375
Non-Commercial Brush	30,839	30,969
Roads	3,831	4,227
Crown Forested Land Base Area	**345,095**	
Parks and Protected Areas	100	101
Ungulate Winter Range	18,777	25,395
Wildlfe Habitat Areas	13,051	30,667
Marbled Murrelet Reserves	2,380	5,253
Clayoquot reserves	3,112	5,526
Old Growth Management Areas	30,832	43,881
Preservation VQO areas	296	728
Terrain and ESA	37,126	58,083
Inaccessible Areas	28,383	240,413
Deciduous-leading Stands	2,860	4,975
Non-merchantable (low volume) Stands	36,211	360,734
Uneconomic Areas	67,745	122,094
Archeological Sites	583	748
Recreation Areas	513	2,840
Riparian Management Areas	4,991	26,153
Wildlife Tree Retention Areas	7,499	10,767
Karst	14	473
Non-Harvesting Land Base Area	**254,473**	
Timber Harvesting Land Base Area	**90,622**	

4.2 Sustainable Harvest Level

A reliable and objective indicator of sustainability is required to differentiate sustainable harvest levels from unsustainable harvest levels in timber supply analysis. Crashes in timber supply occur at pinch points when there is insufficient merchantable volume to satisfy the target harvest level. Timber supply analysts commonly use these crashes as an indicator of non-sustainable harvest levels. However, pinch points are directly related to how minimum harvest criteria are defined and may not reflect true constraints on timber supply.

Pinch points are only useful as indicators of sustainability if minimum harvest ages are equal or close to the culmination ages of mean annual increment (MAI). When minimum harvest ages are set close to culmination age, pinch points indicate that the model is attempting to harvest stands below culmination age. Pinch points are less effective indicators of sustainability when minimum harvest ages are set using other criteria, such as volume per ha as in this analysis. The stable long-term growing stock is the sole indicator of sustainability in this timber supply analysis. Short- and medium-term harvest levels are considered sustainable if they do not compromise growing stock in the long term.

4.3 Determining the Base Case Harvest Level

Growing stock becomes stable when the rate of harvest equals the rate of growth of the forest. At low harvest levels stands are harvested after their MAI culmination age - provided that they have achieved their minimum harvestable volume - and the growing stock accumulates until an equilibrium is reached, often way into the future. If the harvest level is too high, the stands are harvested below their culmination age. This often causes a rapid decline of the growing stock until it can no longer support the desired harvest level.

Maximum sustainable even flow is the highest harvest level that can sustain a stable growing stock. In the absence of constraints, this harvest rate would equal the average MAI culmination of the land base. However, the presence of forest cover constraints such as VQOs can limit the ability of the model to harvest stands at culmination age. As a result, long-term harvest levels are typically somewhat lower than the maximum possible growth rate of the forest.

In this analysis the maximum sustainable even flow was established first. After this, the short-term harvest was elevated as high as possible without compromising the long-term sustainability of the harvest forecast. The transitions to lower harvest levels were not allowed to exceed 10%.

4.4 Description of the Base Case

The Base Case is the point of comparison for all sensitivity analyses. The purpose of this section is to describe and interpret the attributes of the Base Case in detail.

4.4.1 Harvest Forecast

The Base Case harvest forecast is illustrated in Figure 10. The initial harvest level of 688,245 m^3 per year is maintained for 10 years, before the harvest is reduced by 8.5% to 630,080 m^3 per year for another 10 years. The long-term harvest level of 612,520 m^3 per year (2.8% decline) is reached at year 21. Note that the planning horizon starts at year 2016.

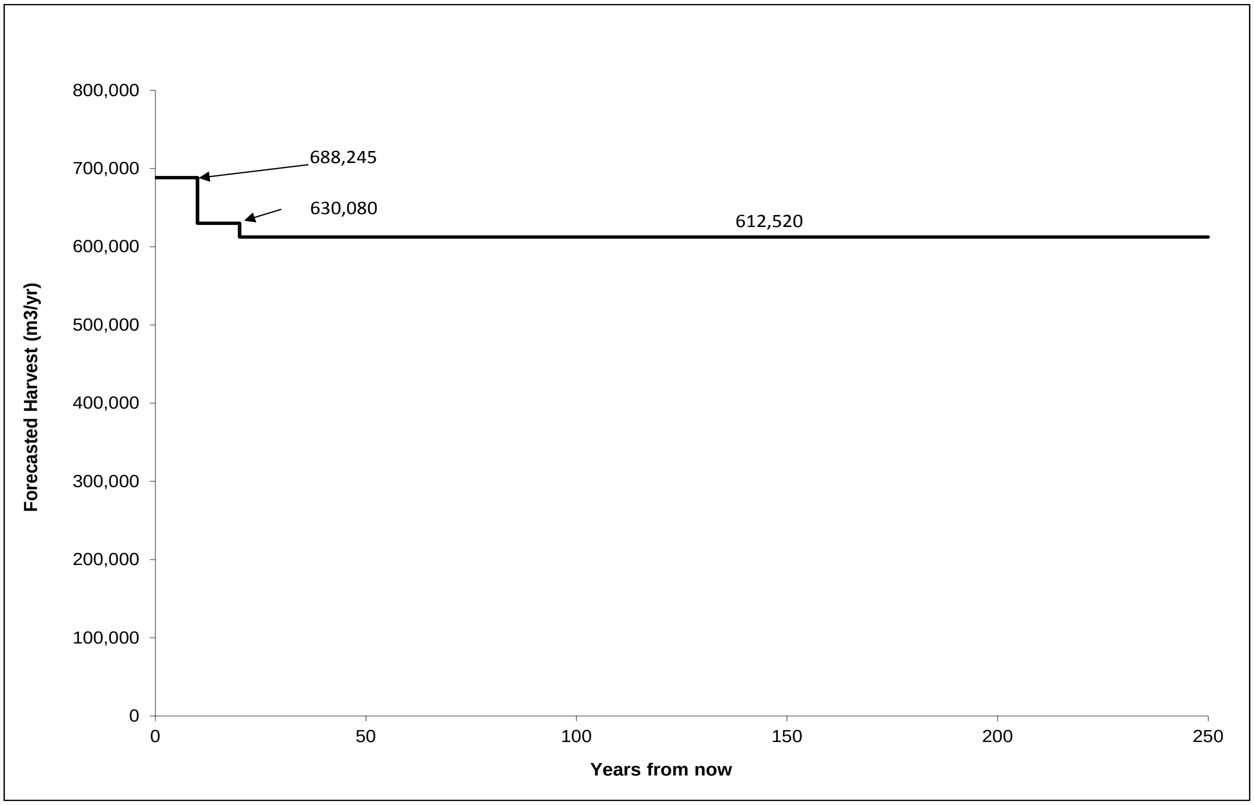

Figure 10: Base Case harvest forecast

4.4.2 Growing Stock

Figure 11 depicts the predicted development of the growing stock. The stable long-term growing stock indicates a sustainable long-term harvest level. Note that the Base Case initial growing stock is based on the entire projected growing stock at the beginning of 2016. No consideration is given to committed unused volumes in Block 18, and Blocks 28 and 29.

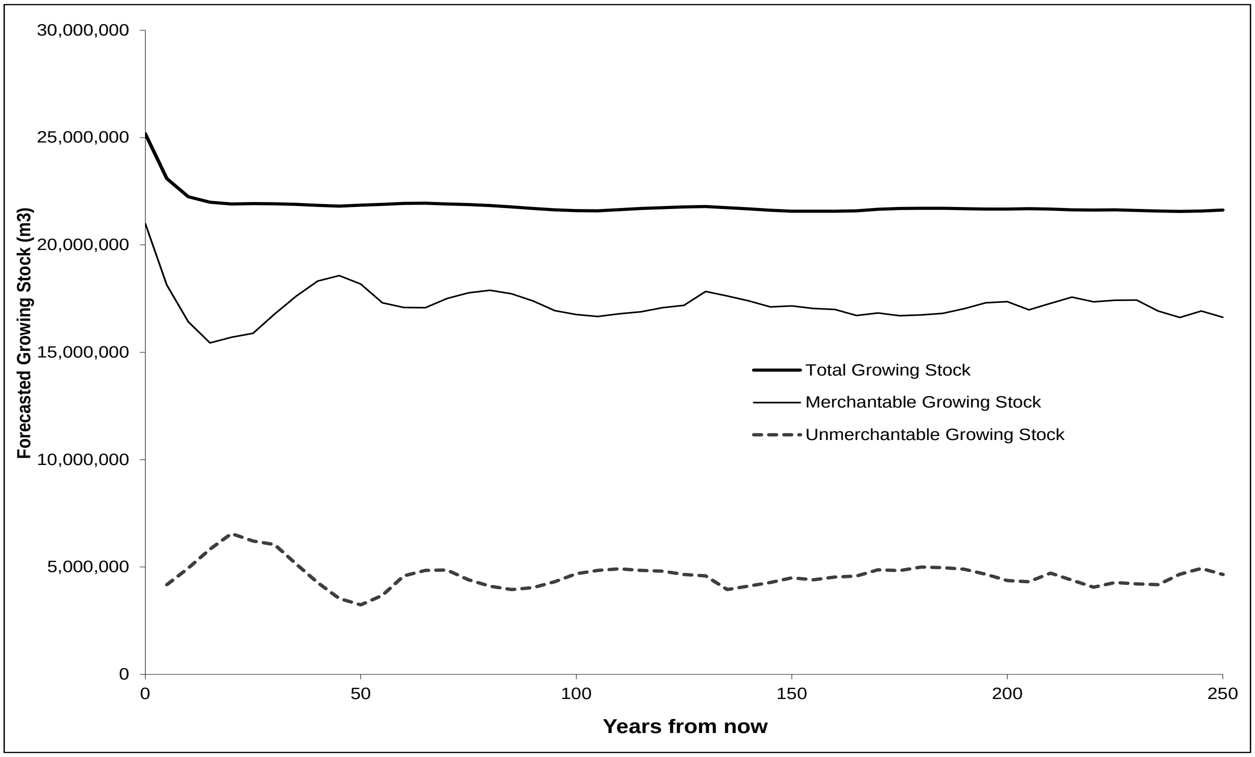

Figure 11: Predicted development of the growing stock; Base Case

4.4.3 Harvest Age, Harvest Volume and Harvest Area

The predicted age class of stands at harvest is shown in Figure 12. Throughout the planning horizon, the majority of the harvest volume comes from stands greater than 60 years old while some harvest in younger stands occurs. The long-term average harvest age is around 80 years (Figure 13).

In the short-term the Base Case harvest forecast consist mainly of age class 9 stands (>250 years). The harvest of older stands continues for approximately 40 years until the transition to younger stands occurs. This trend is the result of the relative oldest harvest rule used in the Base Case; oldest stands in the land base are harvested first.

The harvest of older stands at the beginning of the planning horizon is reflected in Figure 14 illustrating the Base Case harvest forecast by volume per ha class. Older stands usually contain higher volumes and their harvest results in high average harvest volumes also shown in Figure 15; the overall average harvest volume is around 900 m^3 per ha during the first 10 years of the planning horizon, then levelling out to around 600 m^3 per ha in the long run.

The high per ha harvest volumes require less area to be harvested to meet the harvest request. This can be seen in Figure 16 depicting the predicted annual harvest area for the Base Case.

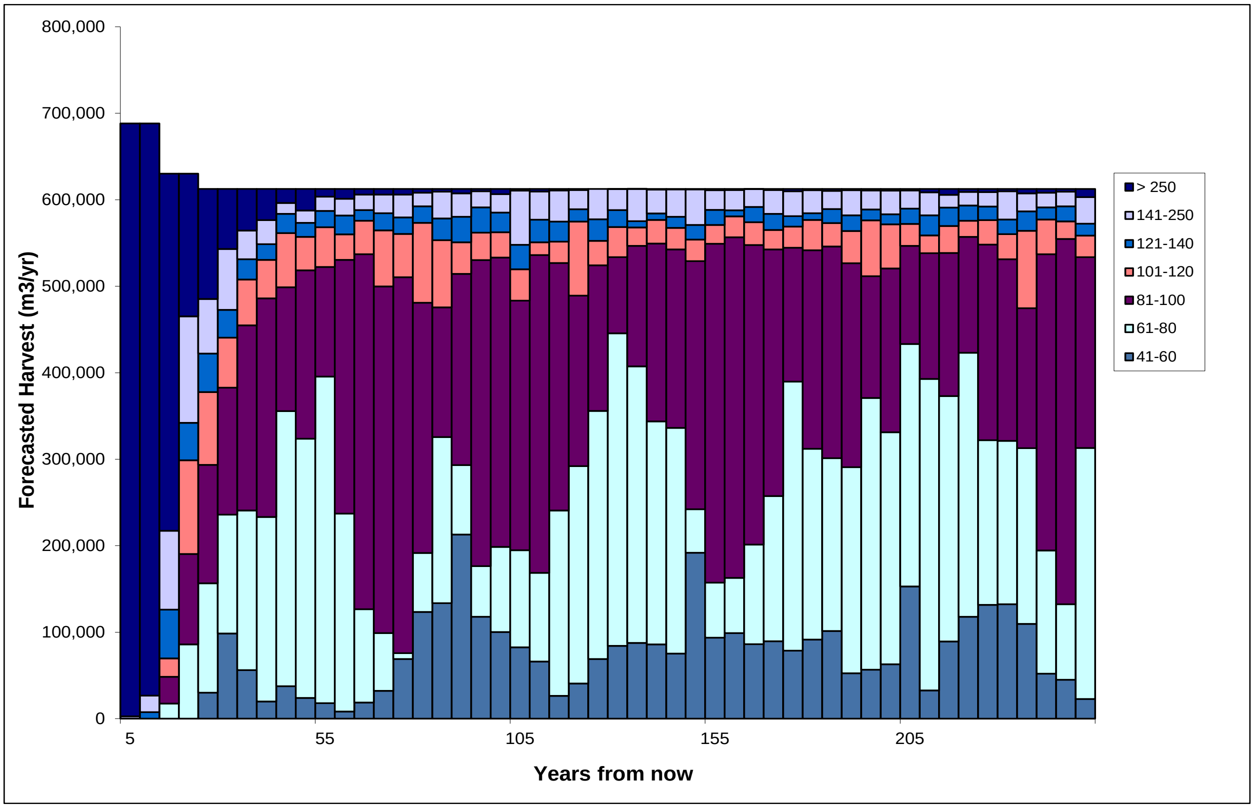

Figure 12: Base Case harvest forecast by age class

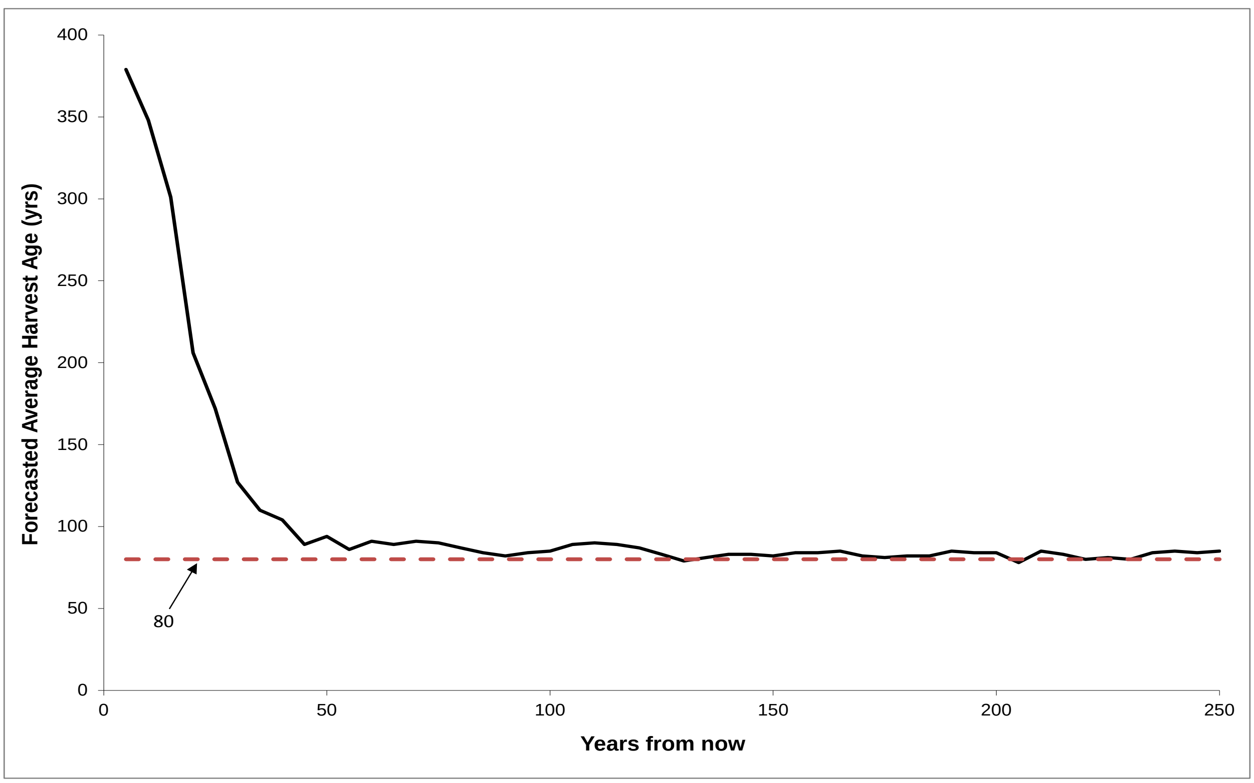

Figure 13: Average harvest age: Base Case

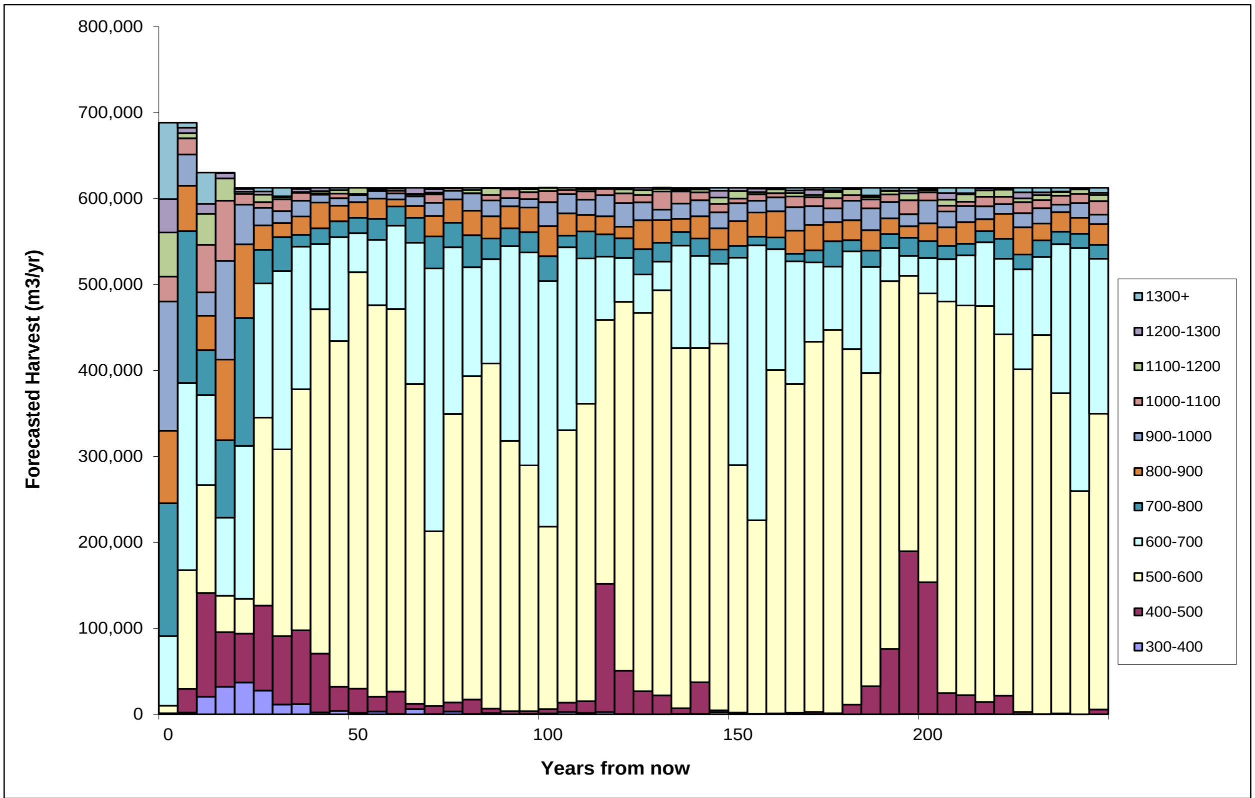

Figure 14: Base Case harvest forecast by volume per ha class

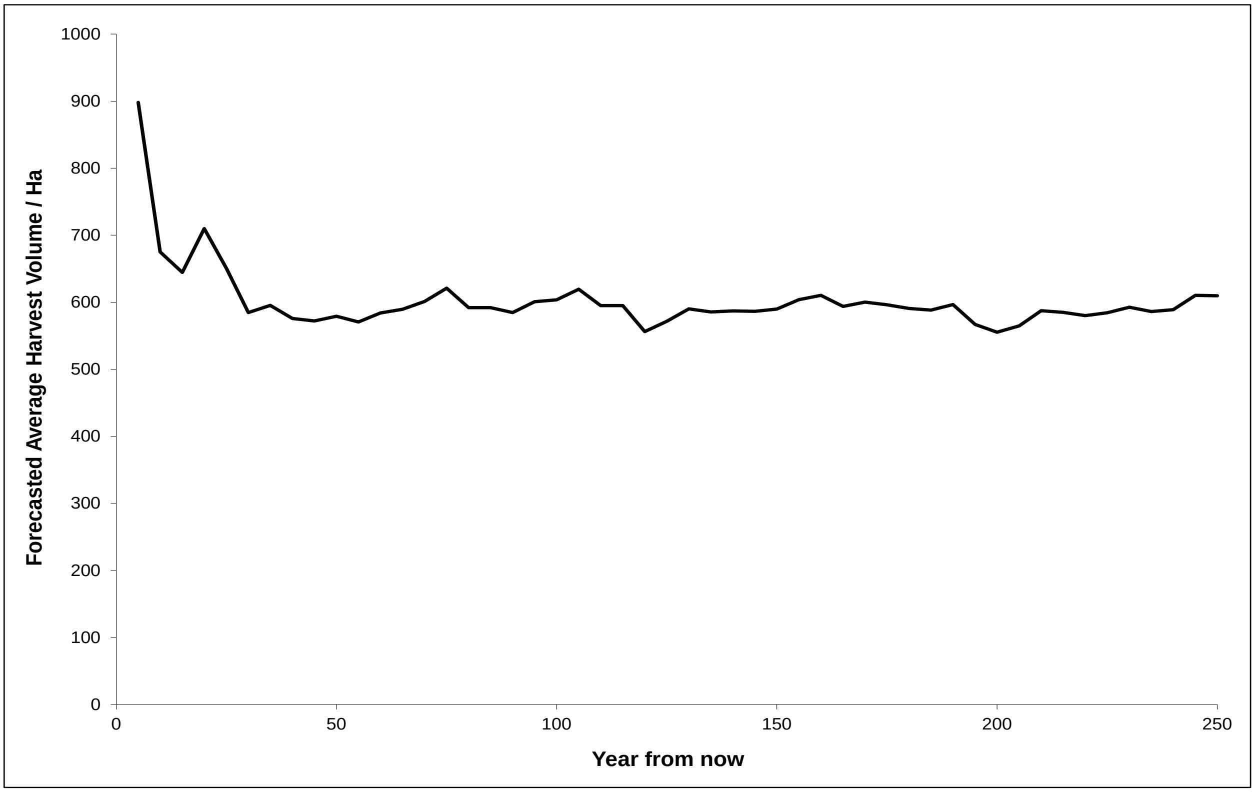

Figure 15: Average harvest volume per ha; Base Case

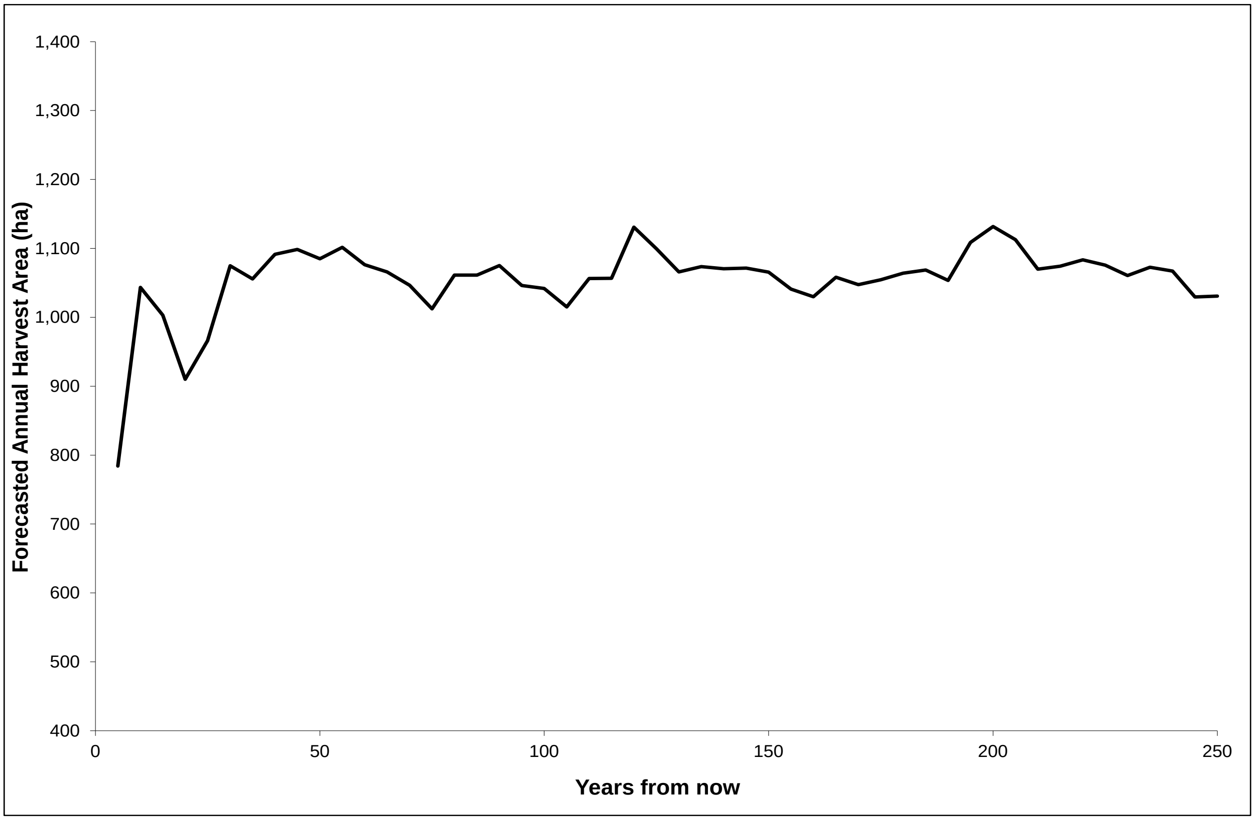

Figure 16: Average annual harvest area (ha); Base Case

4.4.4 Composition of Harvest by Yield Type

The yield tables for this analysis were developed by classifying the stands of the Pacific TSA into yield types. Harvest from these yield types is shown in Figure 17. Old natural stands, which are currently >50 years old, dominate the harvest in the first 30 years. This reflects the current age class distribution on the TSA and is also a result of the relative oldest first harvest scheduling rule prioritizing stands that are old relative to their minimum harvest age.

Existing Managed stands (second growth stands 50 or younger) become a significant source of volume in 25 years and by year 50 contribute approximately 80% of the harvest. They remain a dominant source of volume until year 80 and continue to contribute to harvest into the long-term. By definition, the long-term begins when future managed stands become the dominant source of harvest which occurs at around year 80.

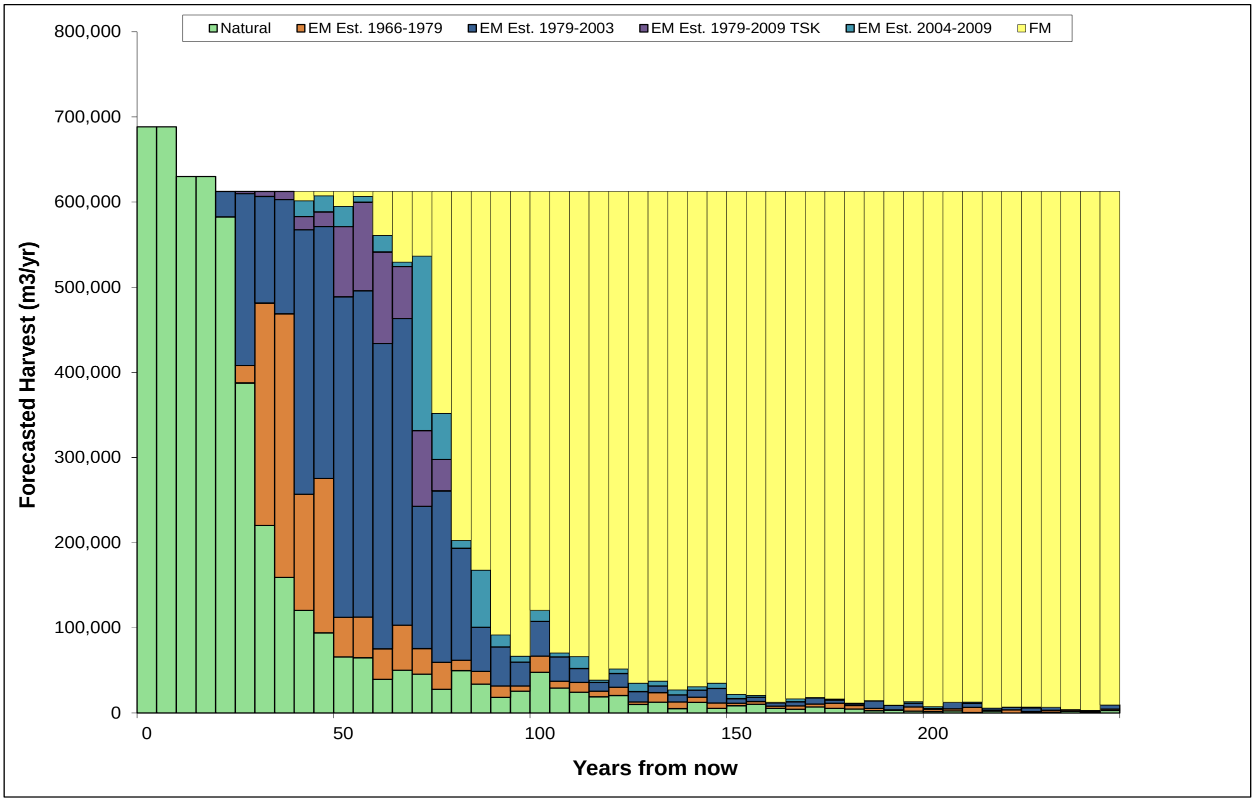

Figure 17: Harvest by yield type; Base Case

4.4.5 Species Composition of Harvest

Figure 18 shows the contribution of major tree species to volume harvested over the planning horizon. The species composition of harvest during the first 15 years more or less reflects the species composition of old stands. The species profile starts to change at year 20 as second-growth Douglas-fir stands (natural age class 4, 5 and 6 stands) become a significant contributor to the total harvest volume.

Eventually, Douglas-fir and western red cedar become the dominant harvest species while the harvest of other species is reduced. Note that while the species composition of the predicted harvest from natural and existing managed stands is based on the forest cover inventory, the future species profile reflects general assumptions about current regeneration and planting practices within the Pacific TSA. The predicted species profile for the first 75 to 80 years of the planning horizon is therefore more reliable than that of the long-term.

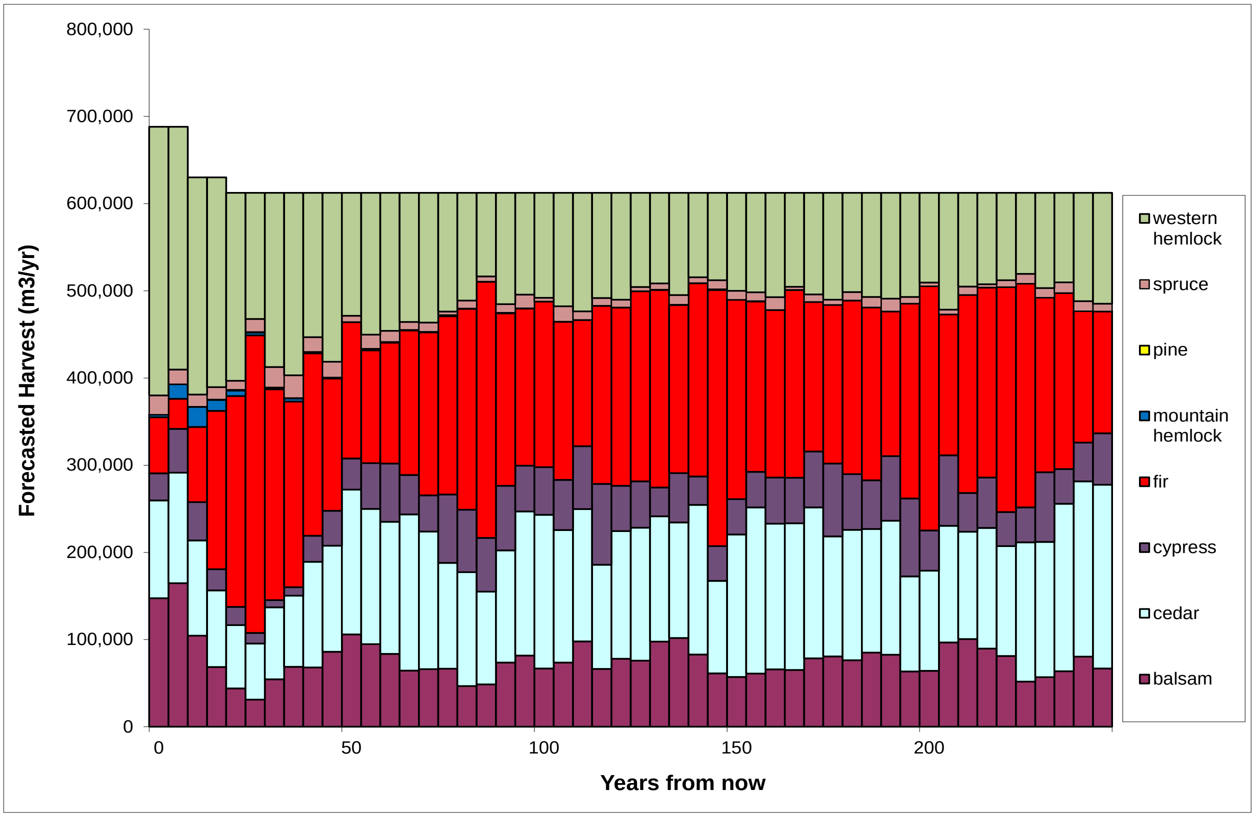

Figure 18: Predicted harvest by species; Base Case

4.4.6 Age Structure

Figure 19, Figure 20, Figure 21, Figure 22, Figure 23 and Figure 24 illustrate the projected age class structure of the forest, should the Base Case harvest schedule be followed. In the course of time, most of the NHLB will become late seral (over 250 years of age). The harvest would occur in the THLB, which would not generally age much beyond 100 years. The majority of the harvest is expected to come from age class 3 and 4 stands in the long run.

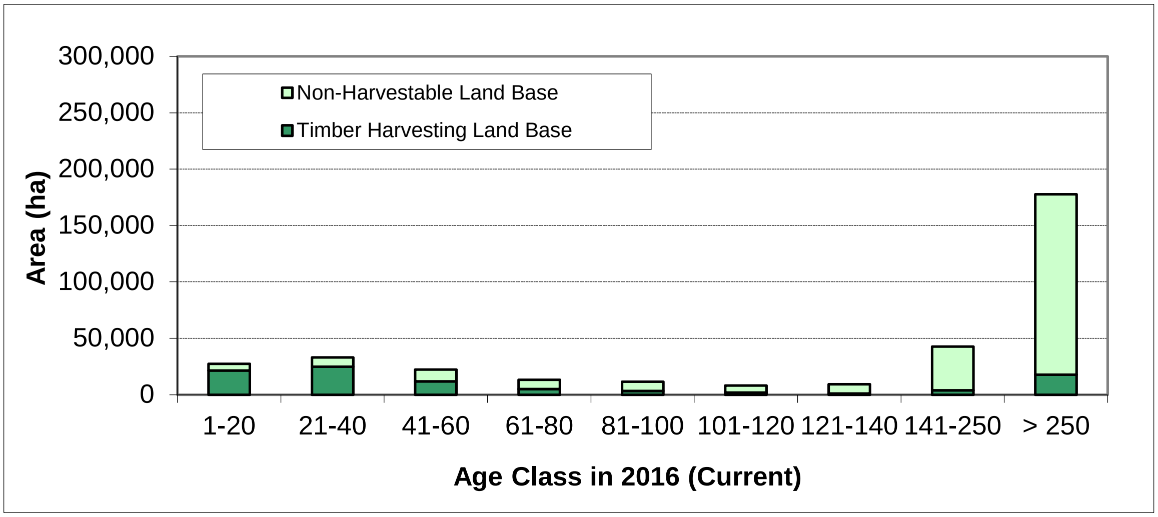

Figure 19: Current age class distribution

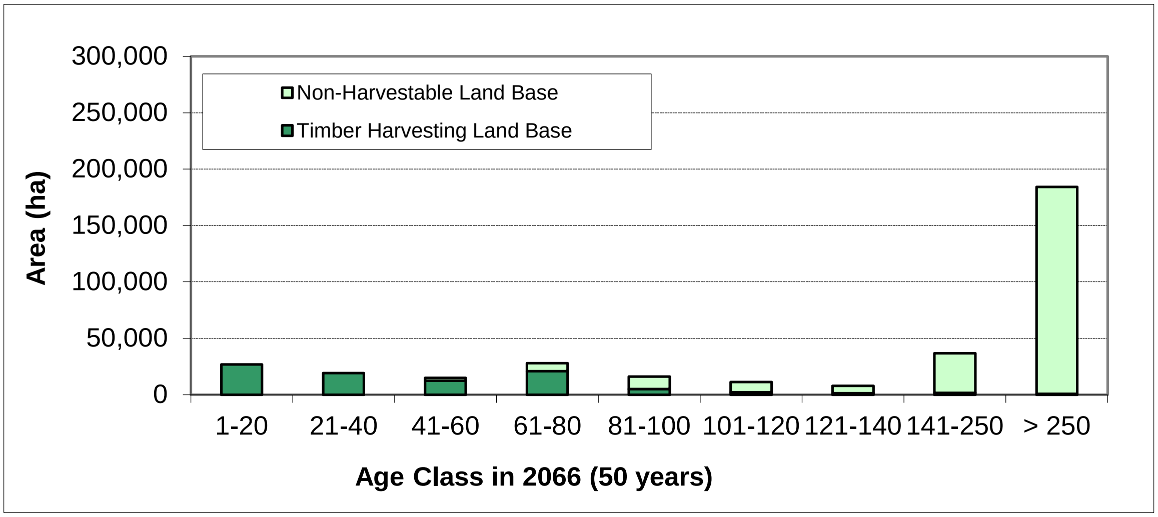

Figure 20: Projected age class distribution in 20 years

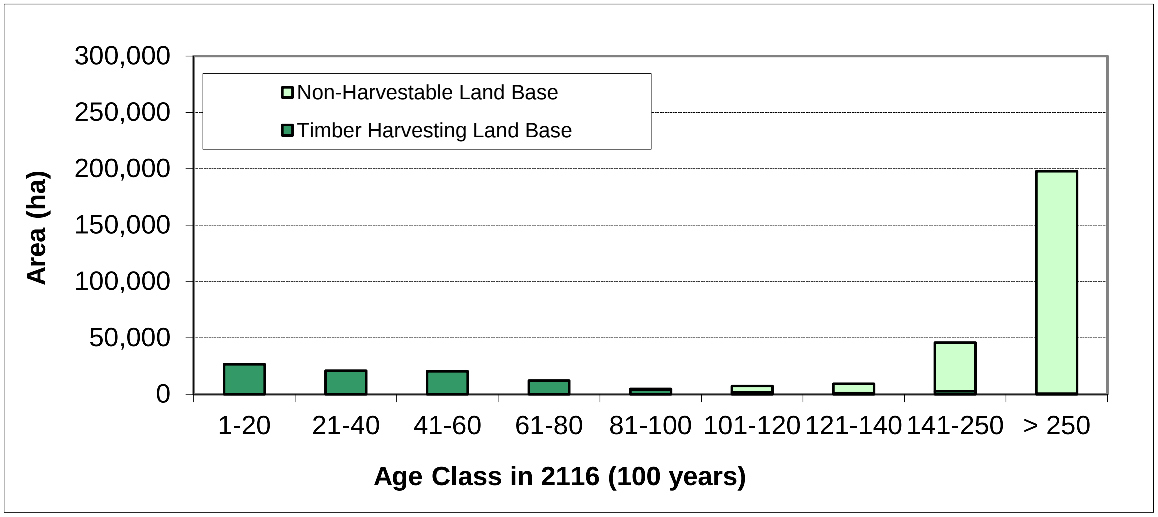

Figure 21: Projected age class distribution in 100 years

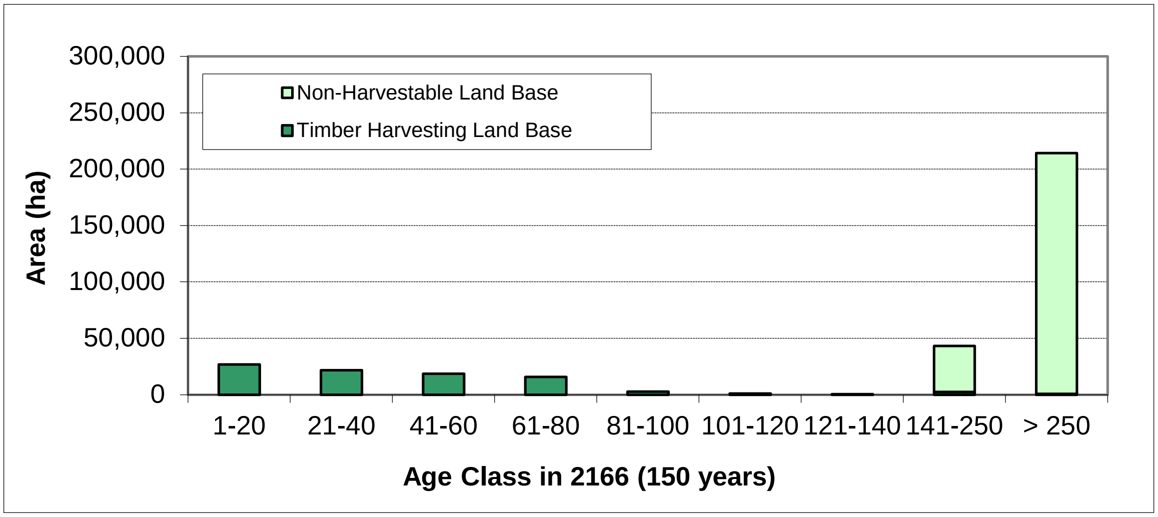

Figure 22: Projected age class distribution in 150 years

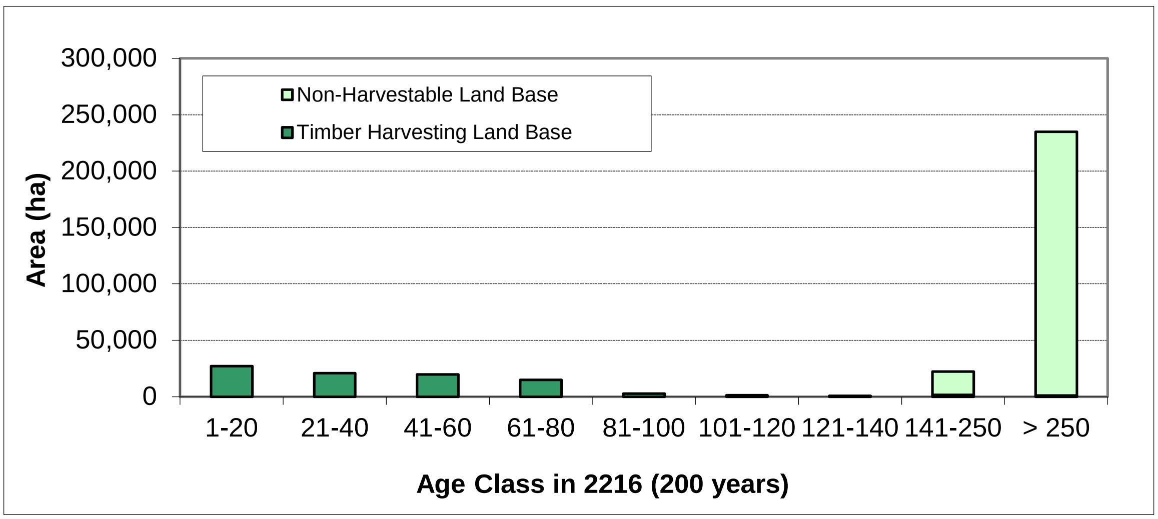

Figure 23: Projected age class distribution in 200 years

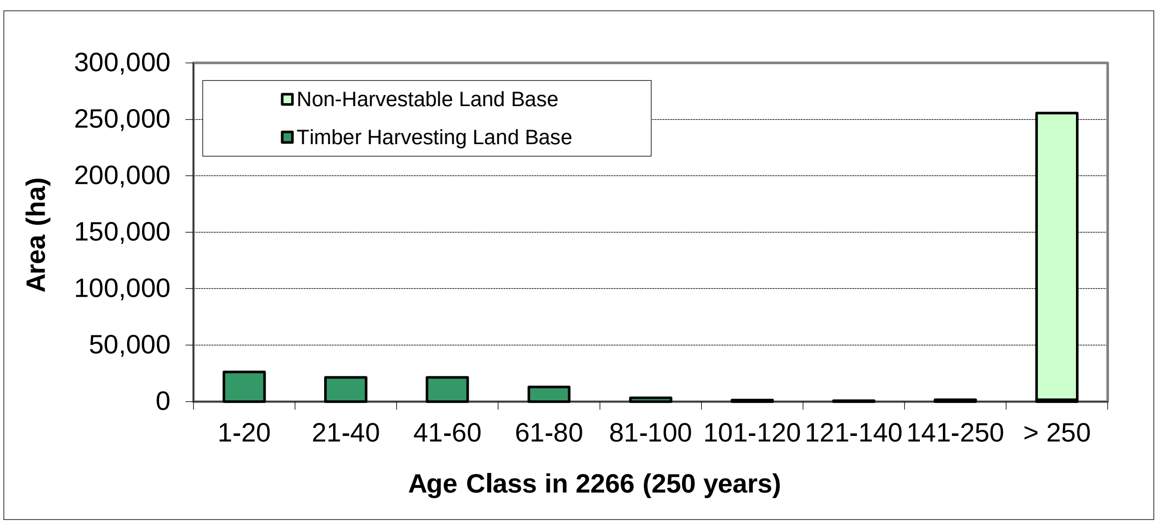

Figure 24: Projected age class distribution in 250 years

5 Sensitivity Analyses

Sensitivity analyses provide an understanding of the contribution of specific data and assumptions to the timber supply dynamics of the Base Case. They also verify that the model is applying the harvest constraints correctly. Table 10 presents a summary of the sensitivity analyses that were carried out to test the various uncertainties that exist in the Base Case data and assumptions.

Table 10: Summary of sensitivity analyses

Issue	Sensitivity Analysis	Result	
Land Base Revisions	Entire TSA land base including GBR. Add 11,544 ha of THLB.	Year 1 to 10 Year 11 to 20 LTHL	+8.6% +11.1% +9.3 %
	Remove draft WHA, goshawk nests, non-legal recreation areas and research installations from the THLB.	LTHL	-1.0%
	Remove areas from the THLB that are currently deferred from harvesting.	LTHL	-1.0%
Management Assumptions	Remove harvest scheduling controls in woodsheds.	No impact	
	Impact of spatial adjacency. Buffer blocks harvested within last 10 years by 250 m and test impact on short-term harvest.	No impact.	
	Apply ECA limits to all watersheds where ECA limits have been recommended by a professional.	No impact.	
	Block 18; 800,000 m^3 committed unused volume licence over the next 5 years. Volume assumed harvested and not available.	LTHL	-0.3%
	Blocks 28 and 29; 252,870 m^3 committed unused First Nations volume. Volume assumed harvested and not available.	No impact.	
	Established non-declining even flow for Block 30. Even flow of 10,000 m^3/yr can be achieved.	No impact.	
Combined Scenario	Combine non-legal netdowns, deferrals, ECA limits, committed unused volumes (Blocks 18, 28 and 29) and even flow for Block 30 in one scenario.	LTHL	-2.9%
Minimum Harvest Criteria	Increase minimum harvest volume to 400 m^3 per ha.	LTHL	-3.0%
	Minimum harvest age 80 for Cw/Yc, 60 for Fd, Hw and Ba	LTHL	-1.0%
Economically Operable Land Base	Increase economically operable land base by using high historical prices for both conventional and helicopter land base.	Year 1 to 10 Year 11 to 20 LTHL	+7.9% +8.3% +4.9%
	Increase economically operable land base by considering all conventional areas economic.	Year 1 to 10 Year 11 to 20 LTHL	+10.7% +11.5% +7.3%
	Increase the economically operable land base by considering all physically accessible timber economic.	Year 1 to 10 Year 11 to 20 LTHL	+70.3% +70.1% +64.6%
Growth and Yield	Adjust yields of existing natural stands (VDYP), increase by 10%	Year 1 to 10 Year 11 to 20 Year 21 to 30 LTHL	+13.8% +13.2% +5.0% No change

	Adjust yields of existing natural stands (VDYP), decrease by 10%, allow LTHL decrease	LTHL	-1.8%
	Decrease managed stand yields by 10%	Year 21 to 30 LTHL	-6.4% -9.8%
	Increase managed stand yields by 10%	Year 11 to 20 LTHL	+6.4% +9.5%
	Adjust future yields for effects of shading in high retention areas (retention > 7%) by -10%	LTHL	-2.0%
Harvest Scheduling	Test the impact of concentrating harvest on young stands. Prioritize harvest of young age class 3 and 4 stands.	LTHL	-1.0%
	Test the impact of concentrating harvest on young stands. Prioritize harvest of stands currently less than 81 years old.	Year 66 to 110 LTHL	-11.0% -9.0%

5.1 Land Base Revisions

5.1.1 Run the Analysis Including GBR in the Land Base

This sensitivity analysis explored the timber supply for the entire TSA and included the GBR in the analysis. The GBR adds 11,544 ha of THLB to the land base and increases the harvest forecast by 8.6% from year 1 to 10, 11.1% from year 11 to 20 and 9.3% in the long term (Figure 25).

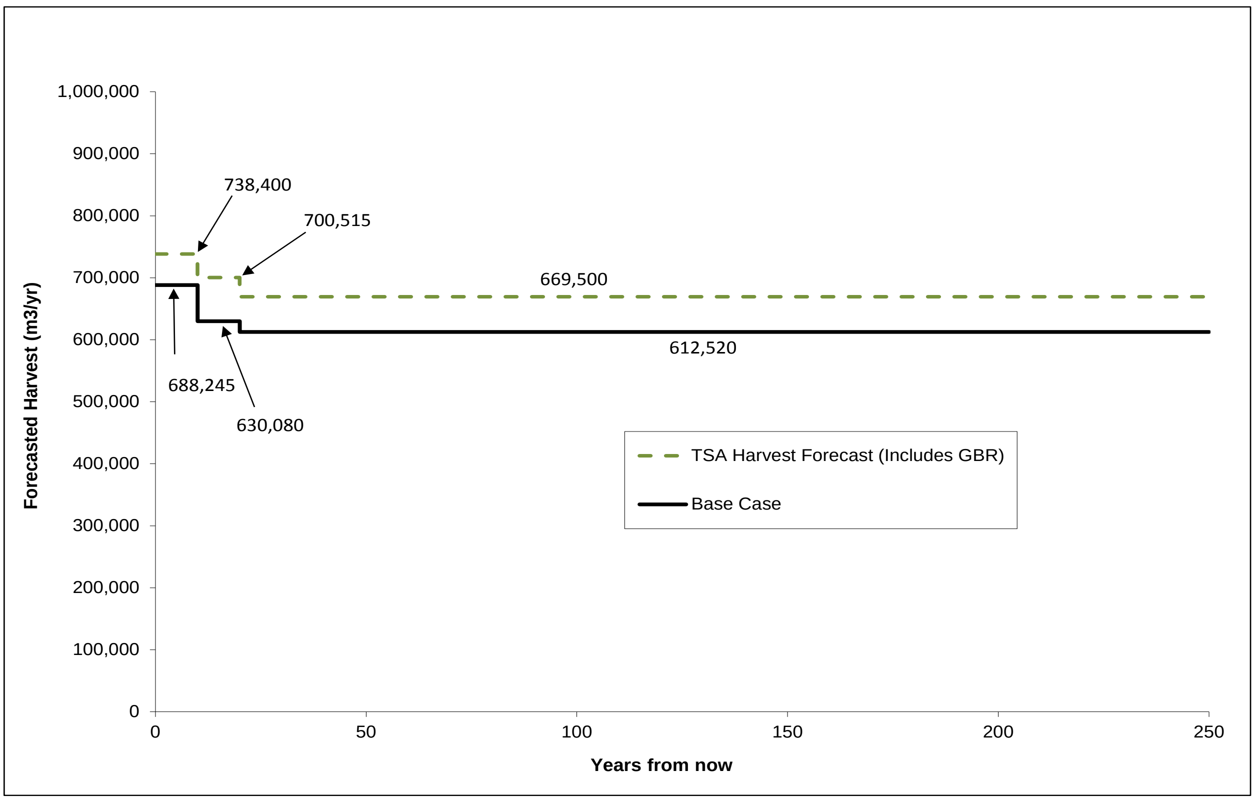

Figure 25: Harvest forecast for the entire TSA, including the GBR

5.1.2 Remove Non-Legal Netdowns and Deferred areas from the THLB

The THLB netdown removes only those areas from the THLB that are directed for removal by legislation or policy. In practise, there are additional areas that are not currently harvestable due to pending legal orders or policy. These areas were removed from the THLB and the impact was tested in this sensitivity analysis.

This removal reduced the timber harvesting land base by 1,160 ha and resulted in a small 1% decrease in the LTHL (Figure 26).

In addition to the non-legal netdowns, there are 969 ha of THLB that is currently deferred from harvest for various reasons. These areas were removed from the THLB and the impact of this removal was tested.

This removal resulted in a small 1% decrease in the LTHL (Figure 27).

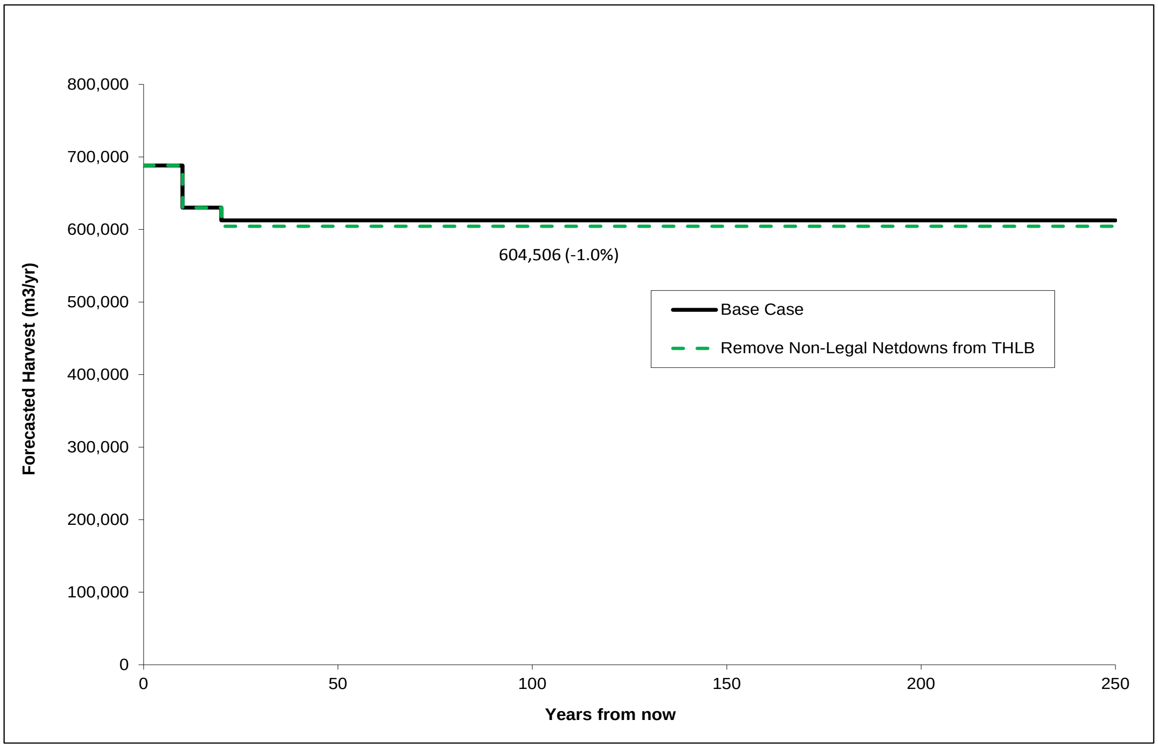

Figure 26: Remove non-legal netdowns from the THLB

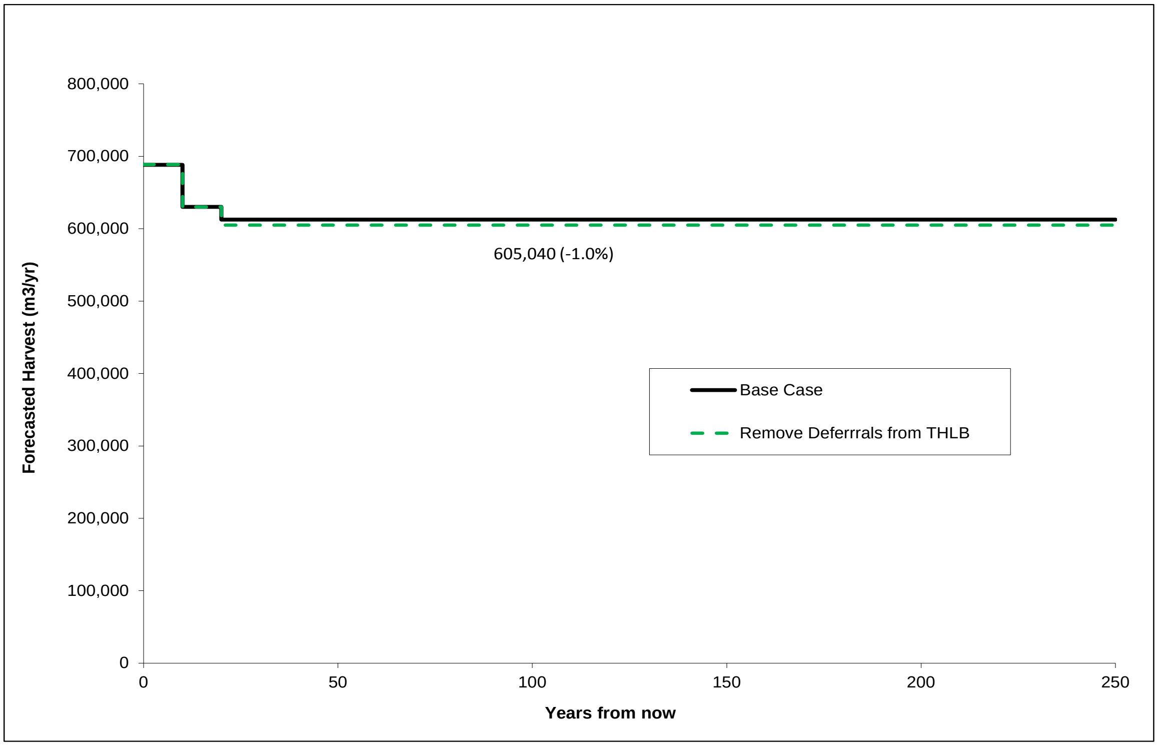

Figure 27: Remove deferred areas from the THLB

5.2 Management Assumptions

5.2.1 Harvest Scheduling Controls in Selected Woodsheds

Minimum volume requirements can be set for an area, when it is known that the financial viability of the harvest from that area requires a minimum harvestable volume. Due to the scattered and isolated nature of the Pacific TSA Blocks, many of them require a minimum harvest volume to reflect the operational reality associated with mobilization and demobilization. Several TSA Blocks, or the combinations of Blocks were subject to minimum volume requirements in the Base Case. These Blocks or combination of Blocks are referred to as woodsheds in this analysis.

This sensitivity analysis tested the impact removing the minimum volume requirements from the analysis. The harvest forecast was not impacted.

5.2.2 Spatial Adjacency

In operations the harvest of timber is constrained by previously harvested areas nearby. Adjacent harvest areas must be greened up before new harvesting can occur in their vicinity. In the Pacific TSA the new harvest areas must meet the *Forest Planning and Practices Regulation* (FPPR) section 65. The section defines “adjacent” as an area that is sufficiently close to a cutblock that, due to its location, could directly impact on, or be impacted by, a forest practice carried out within the cutblock. For the purposes of this analysis we used a minimum distance of 250 m from previously harvested non-greened up blocks to define spatial adjacency.

This timber supply analysis used surrogates to model adjacency constraints. In non-scenic areas a landscape green-up constraint was applied in the Base Case, specifying that no more than 25% of the THLB area in each landscape unit outside of VILUP may be below the green-up height of 3 m at any given time. The same constraint applies to the VILUP SMZ and GMZ; in the EFZ a shorter green-up height of 1.3 m was required. In scenic areas the same approach was used with the required green-up tree heights varying by slope classes and the maximum denudation of the CFLB (not THLB) changing by visual absorption capability.

At times BCTS staff have difficulties locating new harvest areas due to constraints posed by non-greened up adjacent blocks. For this reason they wanted to test the sensitivity of the short-term timber supply to explicit spatial adjacency. This was accomplished by buffering all the blocks harvested within the past 10 years by a 250 m buffer. No harvest was allowed within the buffer for 10 years (until after 2026).

Excluding the harvest within these buffers had no impact on the short-term timber supply.

5.2.3 ECA Limits

There are 67 watersheds in TSG business area where watershed assessments have been carried out. ECA limits ranging from 20% to 40% have been established for these watersheds. Apart from the Fisheries Sensitive Watersheds (FSW) and the Sproat Community Watershed (930.021) - where management observes ECAs through forest stewardship plans - there is no legal requirement to follow these limits.

Eight of the 67 assessed watersheds are within FSWs and were modeled in the Base Case. The Sproat Community Watershed (930.021) sub-basins was also considered in the Base Case

Because operational planning accounts for the ECA limits in the remaining watersheds, their impact on timber supply was tested through a sensitivity analysis.

Applying the ECA limits to watersheds where they have been recommended by a professional had no impact on timber supply.

5.2.4 Committed Unused Volume

Two sensitivity analyses were completed testing the impact of harvesting committed unused volumes in Block 18, and Blocks 28 and 29. In Block 18, the timber supply model was directed to harvest 800,000 m^3 of timber in five years using the relative oldest harvest rule. The harvested blocks were tagged, their ages set to zero and they were placed on future managed stand yield curves. The timber supply model was run again for the Base Case THLB with the harvested blocks considered in the analysis.

The results were compared to the Base Case and the impact of harvesting this volume over the first five years was found to be negligible. The harvest forecast had to be lowered by 0.3% starting at year 21.

The same procedure was repeated for Blocks 28 and 29 for the total 5-year harvest volume of 252,870 m^3. This projected harvest had no impact on the Base Case timber supply.

5.2.5 Non-Declining Even Flow for Block 30

This sensitivity analysis first tested whether a non-declining even flow of 10,000 m^3 could be maintained for Block 30. After this the Base Case harvest forecast was run without Block 30. The results demonstrated that a non-declining even flow of 10,000 m^3 per year could be maintained for Block 30, and the overall Base Case harvest forecast was not impacted.

5.3 Combined Scenario

This sensitivity analysis combined land base revisions and management assumptions into one scenario. BCTS considers this scenario as the most representative of their current practise. The scenario incorporated the following changes from the Base Case:

- Non-legal netdowns were removed from the THLB;
- Deferred areas were removed from the THLB;
- ECA limits were modeled in all watersheds where watershed assessments exist;
- Committed unused volumes were accounted for (Blocks 18, 28 and 29);
- Non-declining harvest flow of 10,000 m^3 per year was imposed on Block 30.

The projected timber supply for the combined scenario is illustrated in Figure 27. Incorporating the above land base revisions and the changes in management assumptions decreased the harvest by 2.9% in the long term. The short term was not impacted.

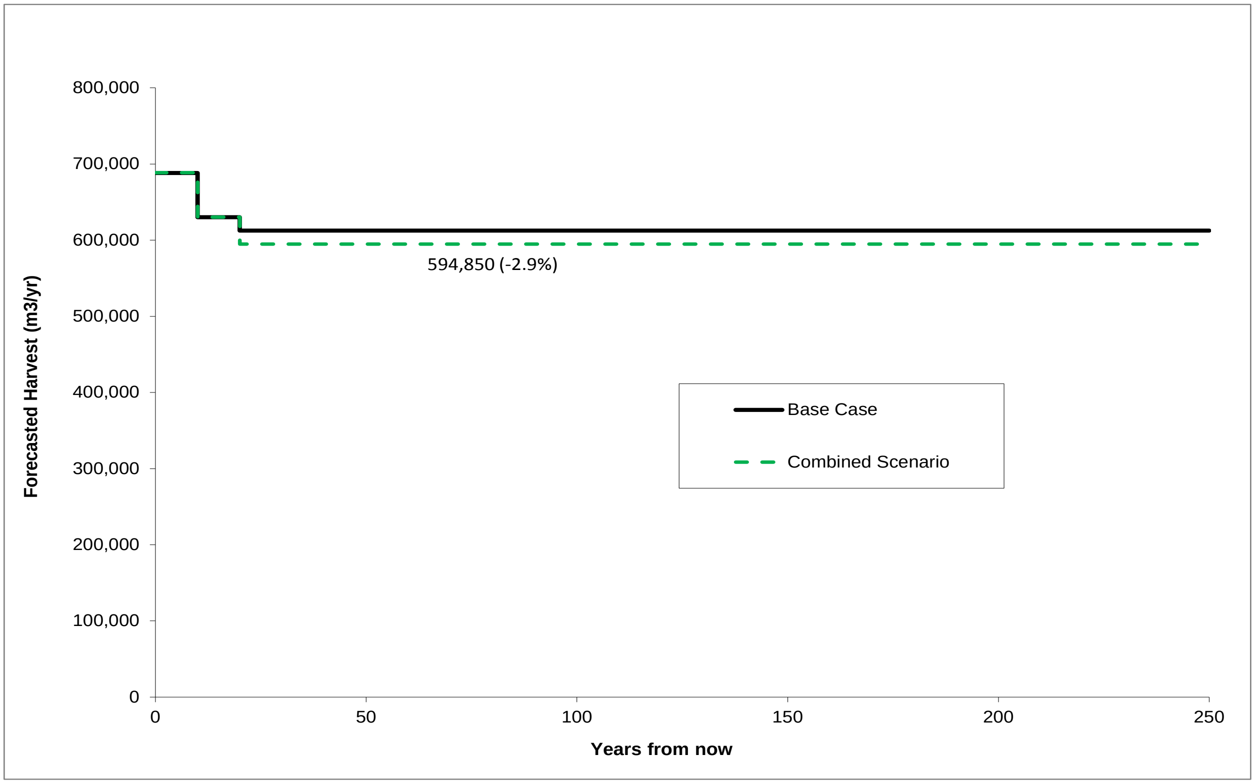

Figure 28: Combined scenario (land base revisions and management assumptions)

5.4 Minimum Harvest Criteria

In the Base Case, the stands can be harvested once they reach a volume of 300 m^3 per ha. This minimum harvestable volume may be low in poor market conditions and at times higher volumes may be required for the harvest to be economic. In this sensitivity analysis the minimum harvest volume was increased to 400 m^3 per ha.

The increased minimum harvest criteria reduced the LTHL by 3%. There was no short or medium-term impact (Figure 28).

In their operations the BCTS would like to ensure that managed stands are not harvested at young ages. If possible they would like to make sure that Cw/Yc leading stands are not harvested before they reach the age of 80, on average. Their desired minimum harvest age for Fd, Hw and Ba leading stands is 60.

A sensitivity analysis testing the impact of setting the minimum harvest ages at 80 for Cw/Yc and 60 for Fd, Hw and Ba shows that there is only a small negative impact (-1%) on the LTHL. The short-term and the mid-term were not impacted (Figure 29).

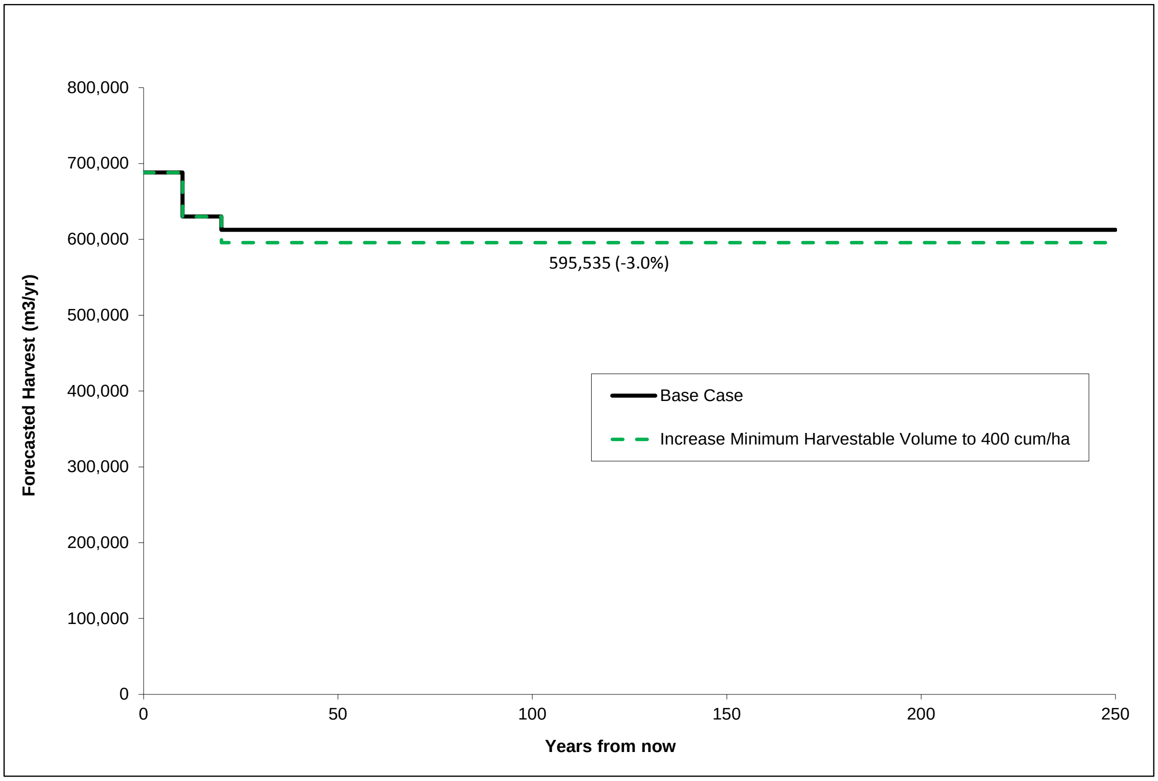

Figure 29: Increase minimum harvest volume to 400 m^3 per ha

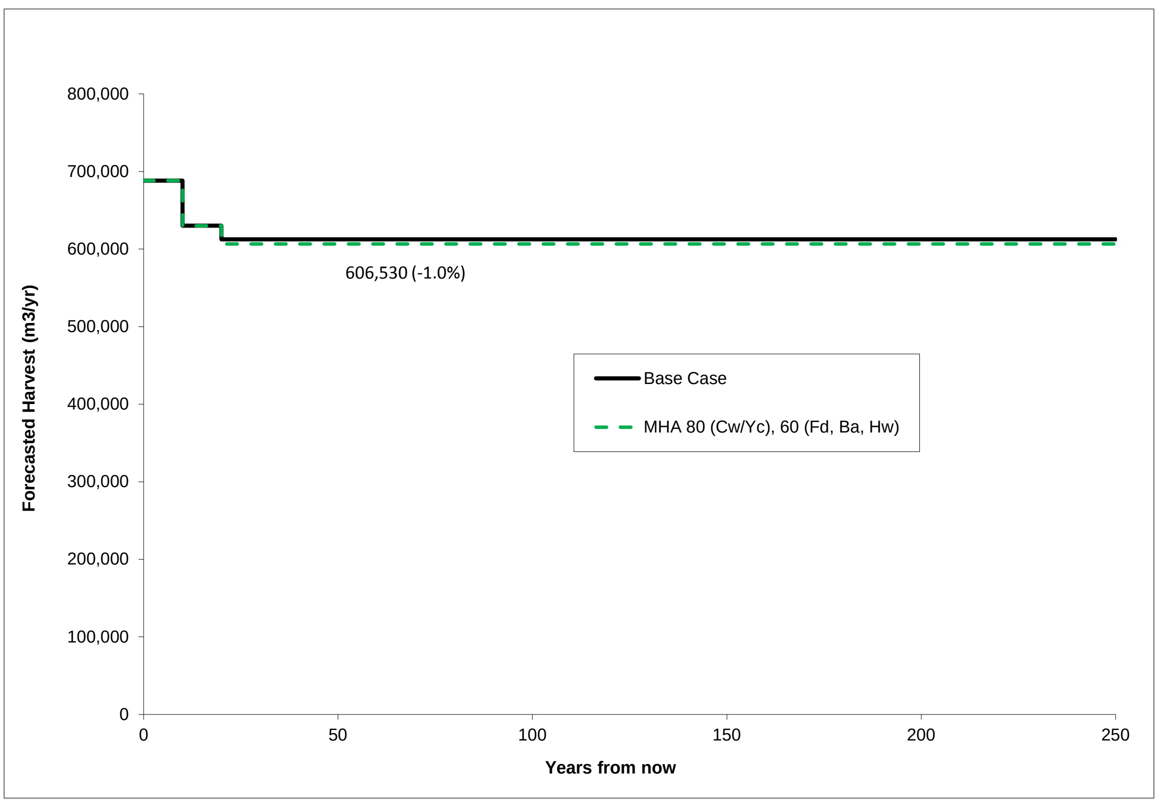

Figure 30: MHA 80 (Cw/Yc), 60 (Fd, Hw, Ba)

5.5 Economically Operable Land Base

An economic operability assessment was completed as part of the Pacific TSA TSR. The economically operable area forms one of the netdown items used to classify the THLB. Areas that are classified as un-economic for harvest operations were removed from the THLB.

The economic operability analysis is a strategic, landscape level analysis of the economically operable land base. The objective of the analysis was to determine the land base where – on average – operations are expected to be economic in average market conditions.

The methodology employed to complete the economic operability analysis relied on value and cost assumptions that are subject to uncertainty. The economically operable land base is sensitive to changes in these assumptions as described in the Economic Operability Assessment, Analysis Report – Pacific TSA. Several sensitivity analyses were constructed to investigate the sensitivity of the timber supply to changes in the economically operable land base.

5.5.1 Increase Economically Operable Land Base by Using High Historic Prices

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. In the Base Case it is assumed that harvest in these areas is economic only during the market cycles with high historic log prices, while conventional harvest areas are assumed to be economic in average market conditions. This sensitivity analysis explored the impact of using high historic log prices for the entire THLB.

Using high historic prices increases the THLB by 5.1% from 90,634 ha to 95,238 ha. The increase in the size of the THLB comes entirely from the conventional land base: 80.4% of the increase is from the TSK (Blocks 28 and 29) business area, while 13.6 % is from the TSG business area (Block 18).

The larger THLB increases the Base Case harvest forecast by 7.9% in the first 10 years, 8.3% between years 11 and 20 and 4.9% in the long term (Figure 30).

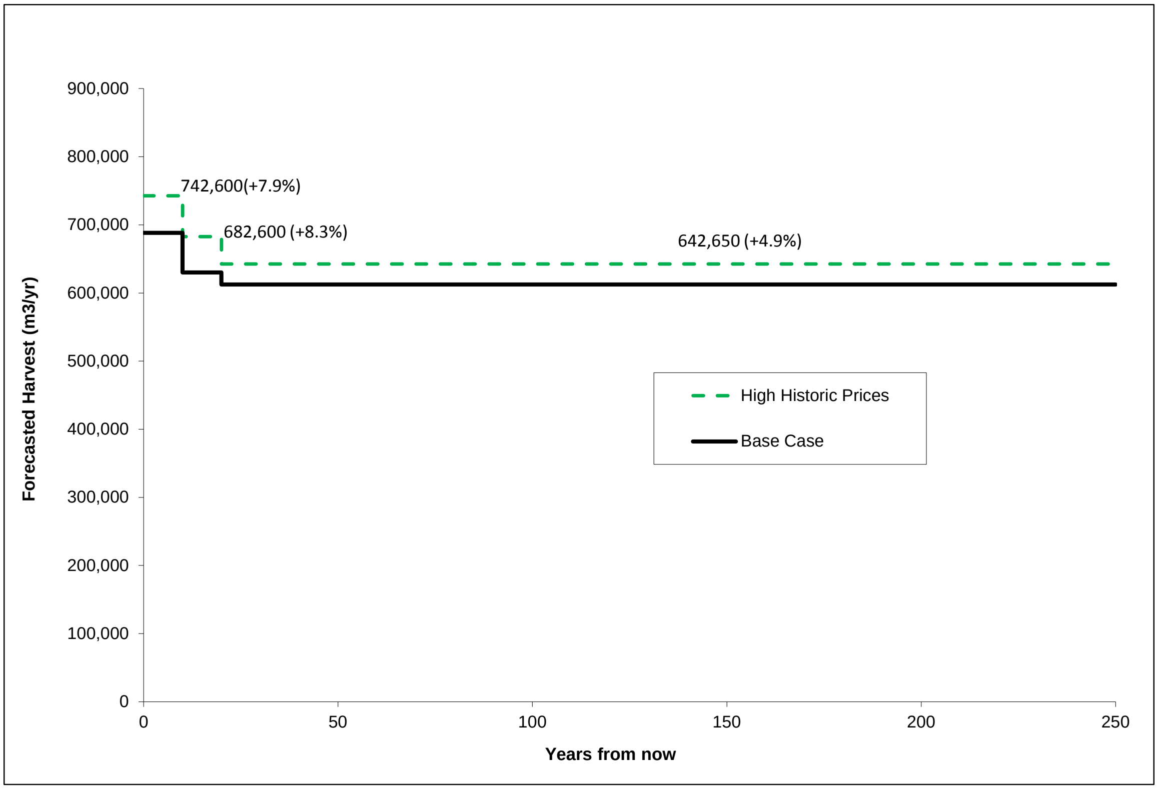

Figure 31: Use high historic prices for the entire land base

5.5.2 Increase Economically Operable Land Base by Considering All Conventional Areas Economic

This sensitivity analysis considered all conventional harvest areas economic. This assumption increases the THLB by 7.5% from 90,634 ha to 97,394 ha. The increase in the size of the THLB comes entirely from the conventional land base: 80.5% of the increase is from the TSK (Blocks 28 and 29) business area, while 12.7 % is from the TSG business area (Block 18).

In this sensitivity analysis the Base Case harvest forecast is increased by 10.7% in the first 10 years, 11.5% between years 11 and 20 and 7.3% in the long term (Figure 31).

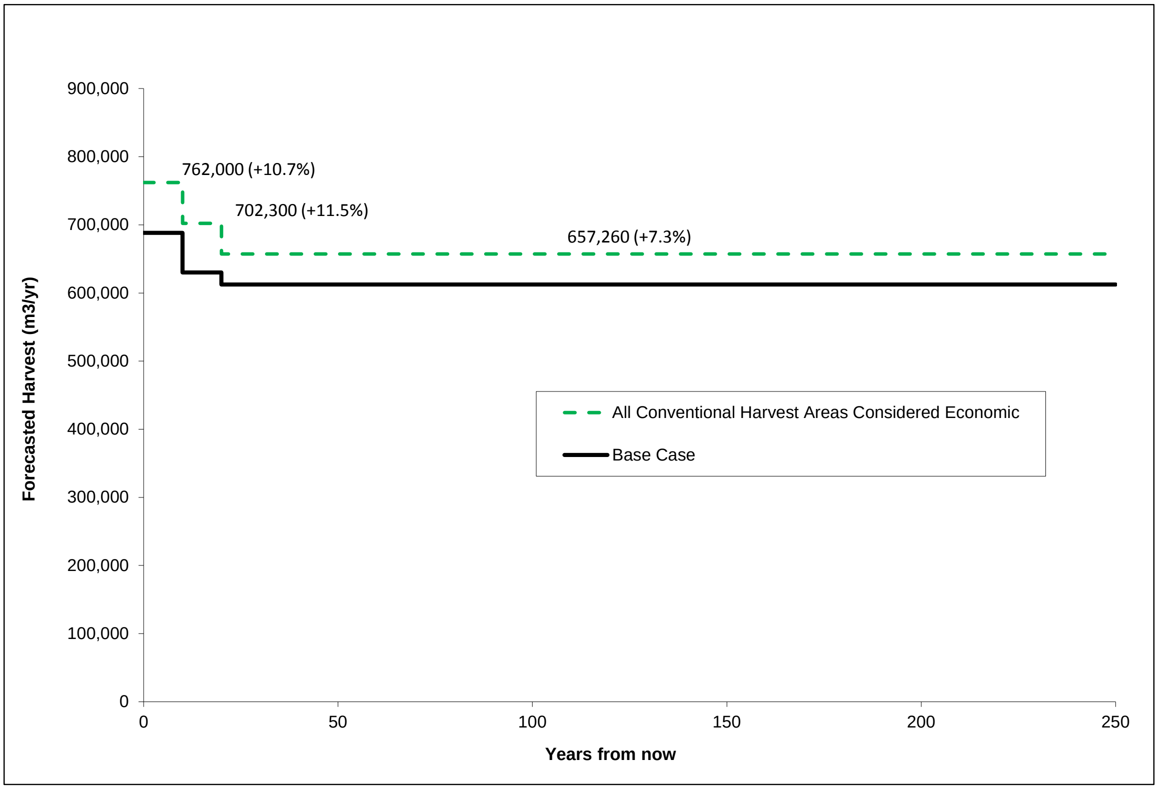

Figure 32: Consider all conventional harvest areas economic

5.5.3 Increase Economically Operable Land Base by Considering All Accessible Areas Economic

This sensitivity analysis considered all physically accessible harvest areas economic. This assumption increases the THLB by 64.7% from 90,634 ha to 153,599 ha. This increase comes mostly from the helicopter land base (89.3%), while 73% of the increased THLB is located in the TSK business area (Blocks 28 and 29).

The larger THLB increases the Base Case harvest forecast by 70.3% in the first 10 years, 70.1% between years 11 and 20 and 64.6% in the long term (Figure 31).

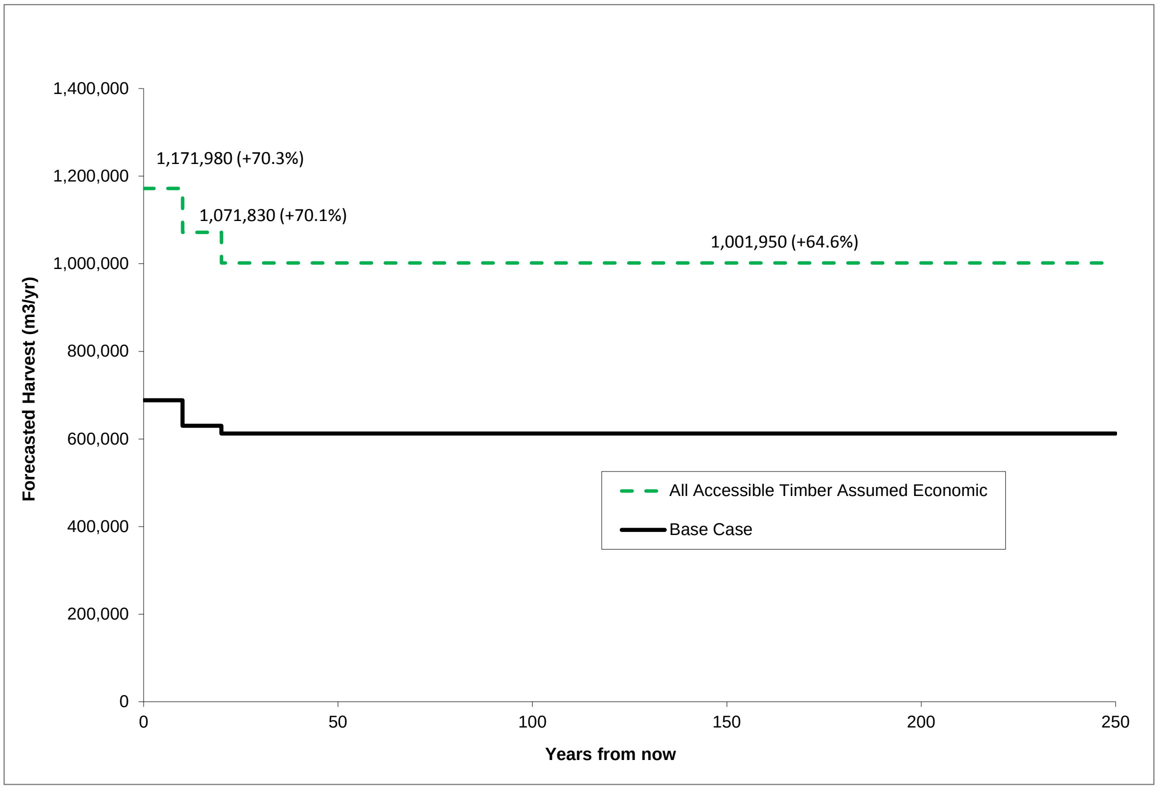

Figure 33: Consider all accessible areas economic

5.6 Inventory Volume, Growth and Yield

5.6.1 Uncertainty of Predicted Inventory Volumes

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. Each inventory was converted to VRI format and projected to 2014. These separate inventories were consolidated to one VRI for the entire Pacific TSA.

The purpose of this sensitivity analysis is to test the risk associated with an overestimation in volumes predicted by the VRI. While underestimation of the inventory volumes poses no risk to timber supply, its impact was tested as well.

Reducing the natural stand yields by 10% decreased the mid and long-term harvest forecast by 1.8%, while the short-term harvest level was not affected (Figure 33).

Figure 34 illustrates the impact increasing the natural stand volumes by 10%. The harvest forecast is increased over the first 30 years of the planning horizon: 13.8% for the first 10 years, 13.3% between years 11 and 20 and 5.0% between years 21 and 30.

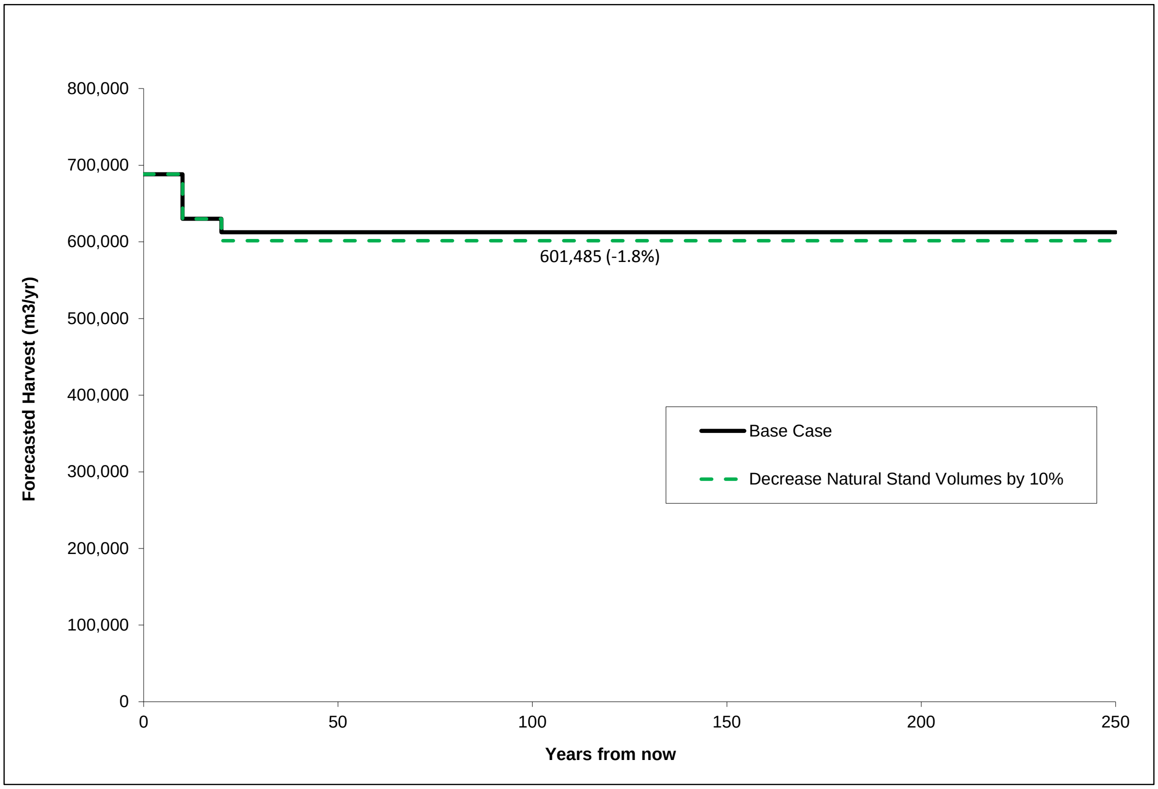

Figure 34: Reduce natural stand volumes by 10%, maintain the short-term harvest level

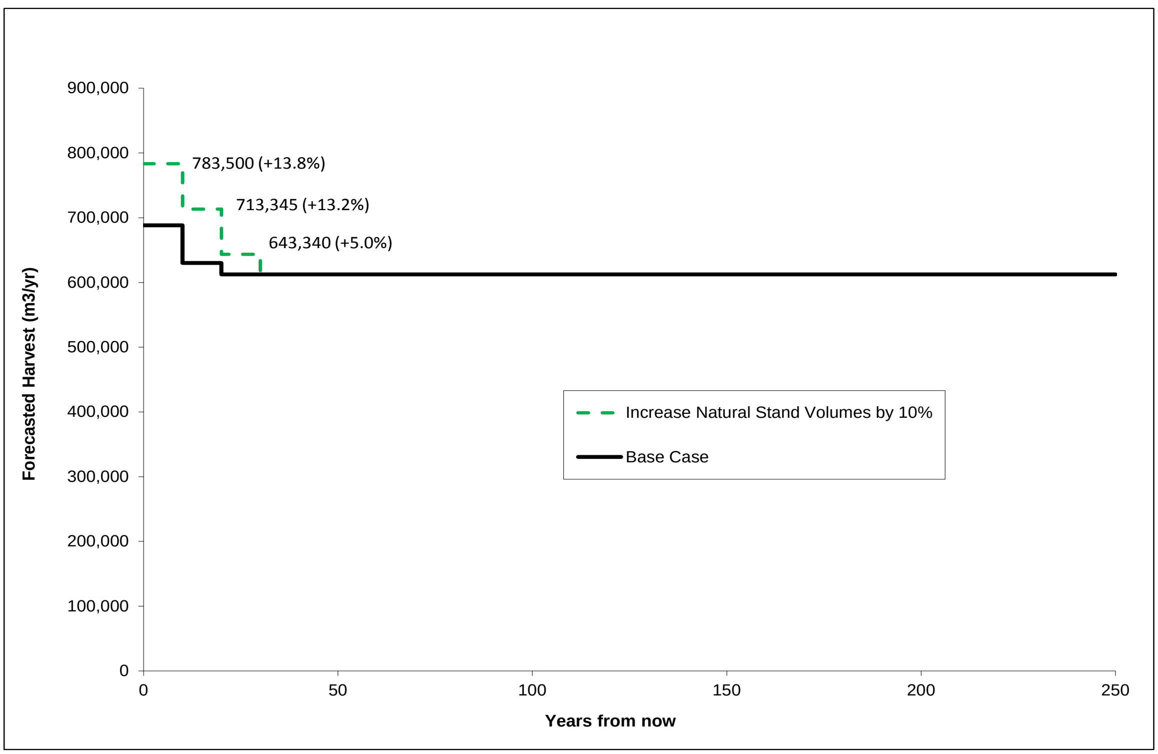

Figure 35: Increase natural stand volumes by 10%

5.6.2 Uncertainty of Predicted Growth and Yield of Managed Stand

Existing and future managed stands are the dominant source of volume in the medium and long terms. The purpose of this sensitivity analysis is to assess the impact associated with an over or underestimation in the growth of existing and future managed stands. The potential impact of high levels of retention on future supply was also explored.

A 10% reduction in the yield of managed stands reduces the medium and long-term harvest level by 9.8% (Figure 35). There is also a 6.4% reduction between years 21 and 30 when the transitioning from natural stands to managed stands begins.

Increasing the managed stand yields by 10 % increased the harvest forecast between years 11 and 20 by 6.4%, while the medium and long-term harvest forecast was 9.5% higher than that of the Base Case (Figure 36).

In the Pacific TSA, the retention levels for wildlife trees and wildlife tree patches are high in some landscape units and management zones. Approximately 39,075 ha of the THLB (43%) is expected to have retention levels higher than 7%. The growth and yield of future stands might be negatively impacted by the shading effects in these areas. Figure 37 shows the result of a sensitivity analysis testing the potential impact of shading on future timber supply. The sensitivity analysis assumed that the growth and yield of future stands would be reduced by 10% in all areas where higher than 7% retention is applied.

The 10% reduction in the growth and yield of future stands in high retention areas resulted in a 3.8% decrease in the long-term harvest forecast. The short term was not impacted.

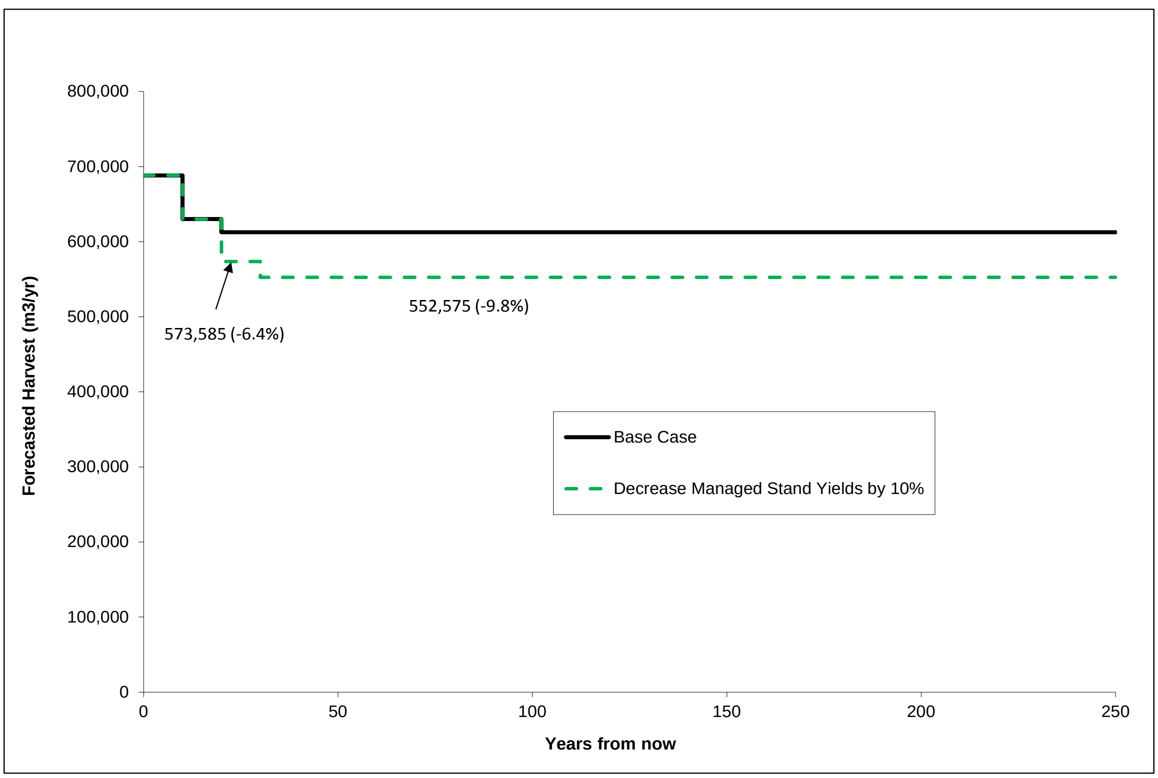

Figure 36: Decrease managed stand yields by 10%

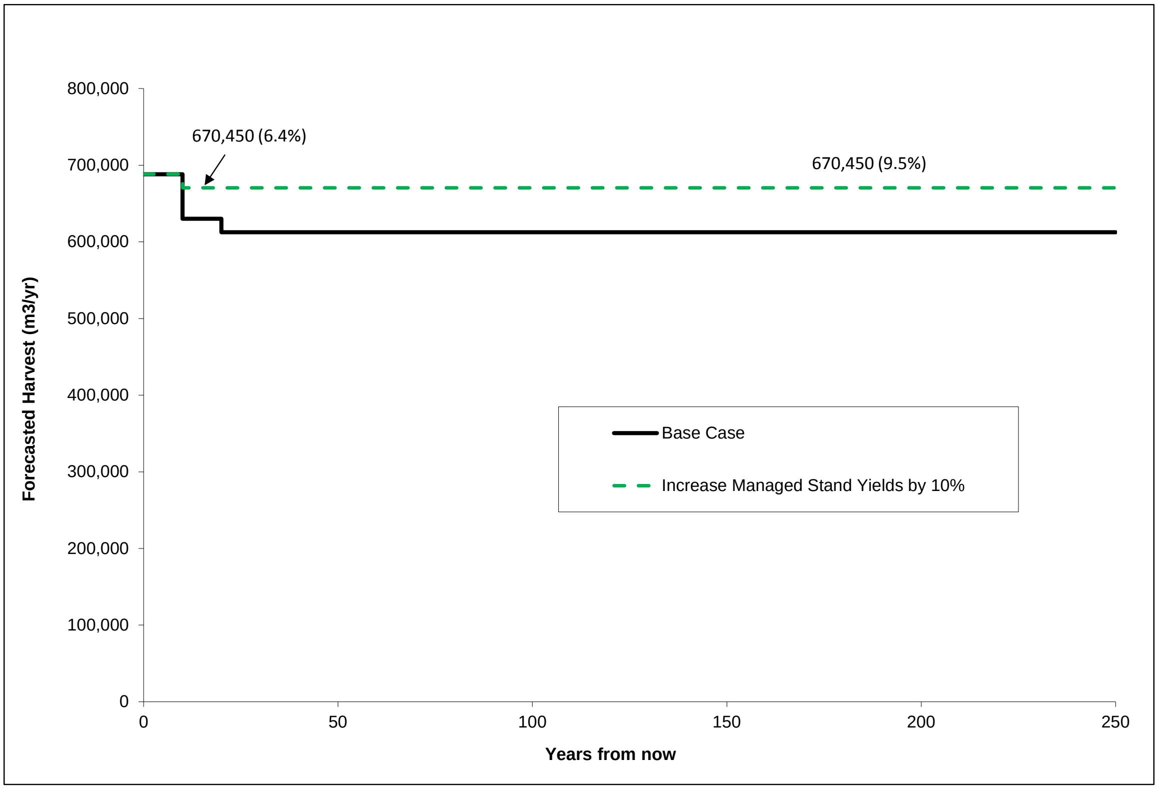

Figure 37: Increase managed stand yields by 10%

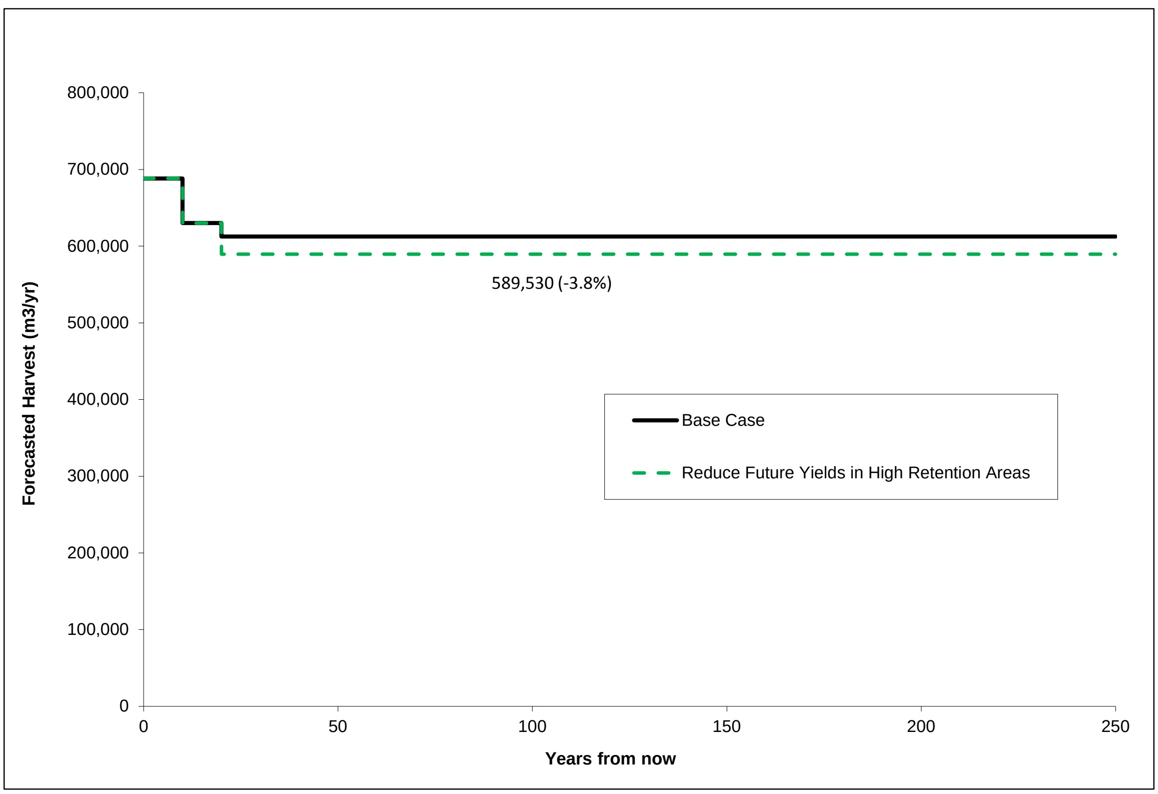

Figure 38: Reduce the future yield of stands in high retention areas by 10%

5.7 Harvest Scheduling

It is likely that the relative oldest harvest rule employed in the Base Case does not fully reflect current management in the Pacific TSA. Due to market conditions and access, second growth stands are harvested in conjunction with older stands. This trend is expected to continue.

The timber supply impact of harvesting younger stands at the beginning of the planning horizon was explored trough two sensitivity analyses. The first one prioritized the harvest of age class 3 and 4 stands (61 to 100 years old). The second sensitivity analysis placed the harvest priority on a larger population and included all stands currently younger than 81. The very young stands could be harvested in the model, as long as they met the minimum merchantability criteria of 300 m^3 per ha.

5.7.1 Prioritize Harvest of Age Class 3 and 4 Stands

Figure 38 illustrates the timber supply impact of prioritizing the harvest of age class 3 and 4 stands. The medium and long term harvest is impacted slightly, as the harvest forecast is decreased by 1%. The short-term harvest is not impacted.

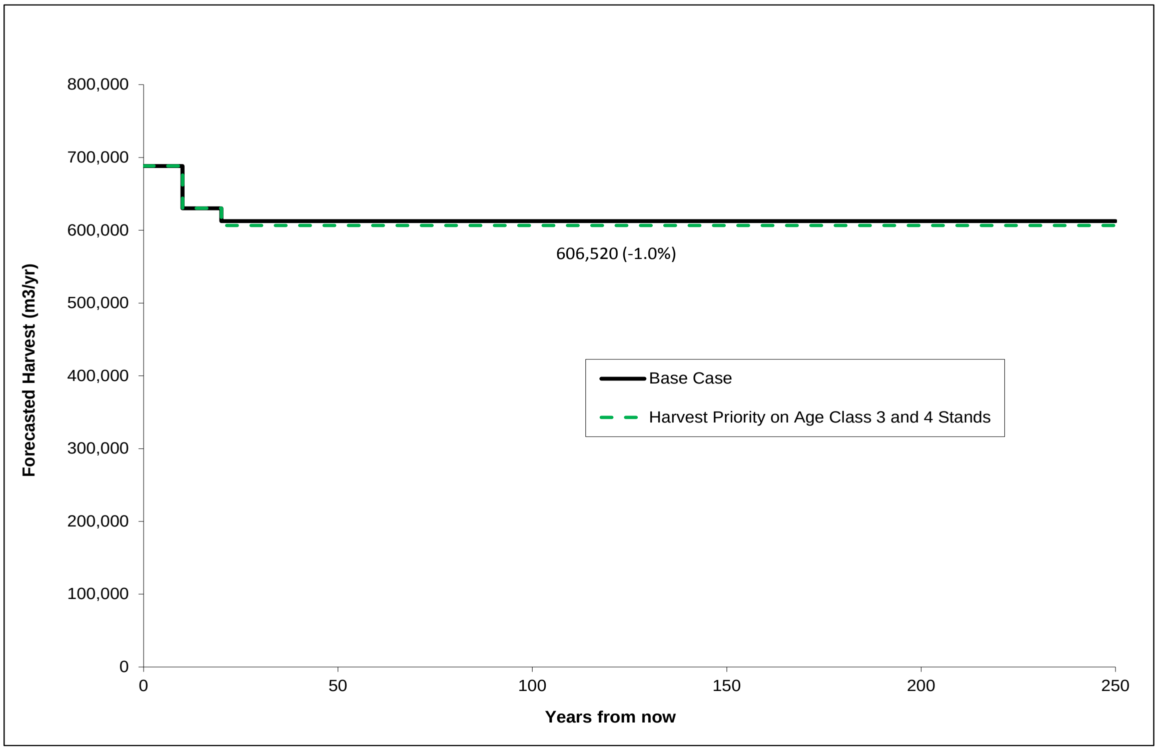

Figure 39: Prioritize the harvest of current age class 3 and 4 stands

5.7.2 Prioritize Harvest of Stands Younger than 81 Years Old

When the harvest priority is set high for all stands currently less than 81 years old, the forest estate model attempts to harvest the high priority stands as soon as they meet the minimum merchantability criteria of 300 m^3 per ha. Many stands are harvested below the culmination of their mean annual increment and the conversion of older, unmanaged stands to managed stands is delayed. This has a significant impact on the medium and long-term timber supply as can be seen in Figure 39. The harvest forecast is reduced by 11% to 545,085 m^3 per year at year 66. The long-term harvest level of 557,500 m^3 per year is 9% lower than that of the Base Case. It is reached at year 111.

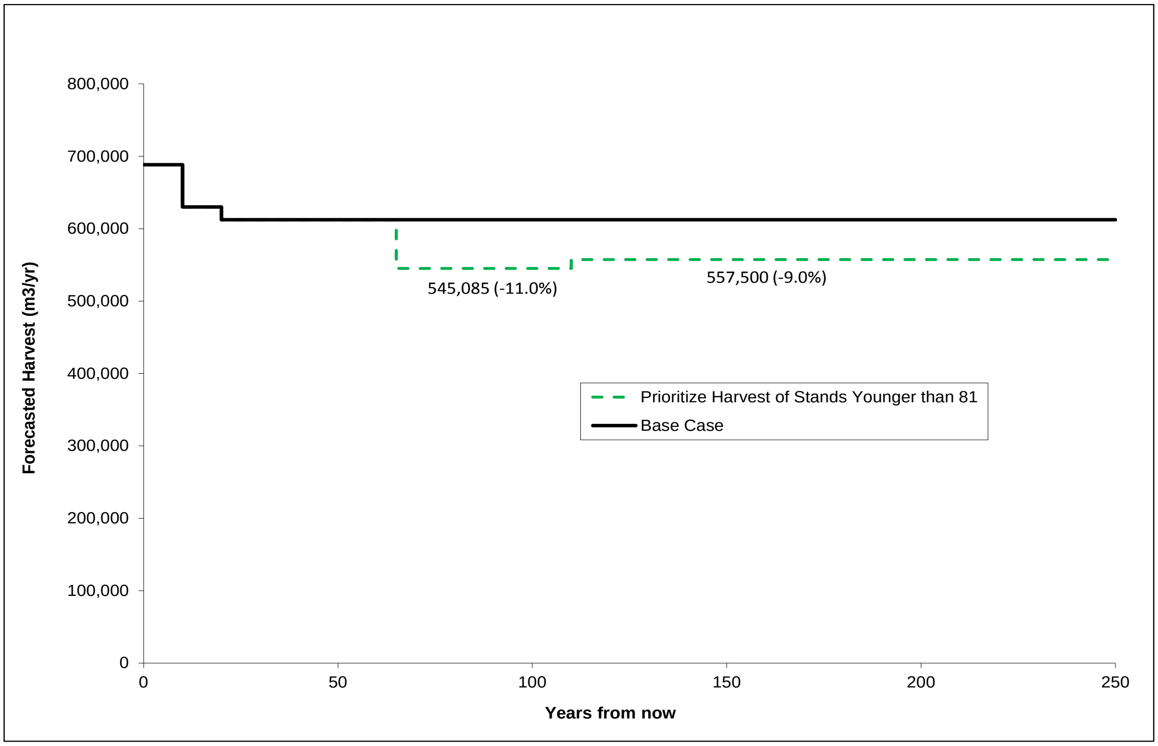

Figure 40: Prioritize the harvest of stands currently younger than 81

6 Partitioned Harvest Flows

6.1 Harvest Contribution from Helicopter Harvest Areas and Clayoquot Sound

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. It is assumed that harvest in these areas is economic only during the market cycles with high log prices, while conventional harvest areas are assumed to be economic in average market conditions. The size of the THLB that falls within the helicopter harvest area in the Base Case is 9,367 ha.

The Clayoquot Sound area is located within Block 27. Resource management in Clayoquot Sound is governed by the Clayoquot Sound Land Use Decision and implemented in the Pacific TSA through the Upper Kennedy Watershed Plan. There has been limited harvesting in Clayoquot Sound in the past. The size of the THLB within the Clayoquot Sound area is 1,769 ha.

The contribution of Clayoquot Sound, the helicopter harvest areas and the conventional harvest areas outside of Clayoquot Sound to timber supply were investigated in this timber supply analysis as illustrated in Figure 40. The harvest from these areas fluctuates significantly with the average harvest over the planning horizon from Clayoquot Sound and the helicopter land base at 14,640 m^3 per year and 56,285 m^3 per year respectively. The average harvest from the conventional area outside of Clayoquot is 545,295 m^3 per year.

When Clayoquot Sound was analysed independently, a long term harvest level of 14,300 m^3 per year was achieved with modestly higher forecasts for the short term: 15,920 m^3 per year for the first 10 years and 14,530m^3 per year for years 11 to 20 (Figure 41).

The helicopter land base alone produced a long-term harvest forecast of 56,765 m^3 per year with a short-term harvest (10 years only) of 58,450 m^3 per year (Figure 42).

Figure 43 illustrates the harvest forecast for the conventional land base outside of Clayoquot Sound. This land base produced a long-term timber supply forecast of 535,410 m^3 per year with the short-term forecast of 560,310 m^3 for the first 10 years.

Figure 44 compares the summed up partition harvest forecasts to the Base Case harvest forecast. The aggregated timber supply forecast (Clayoquot Sound, helicopter land base and the conventional land base outside Clayoquot Sound) is smaller than that of the Base Case. In the first 10 years, 53,565 m^3 (7.8%) less timber is harvested annually and between years 11 and 20 23,605 m^3 (3.7%) less than in the Base Case is harvested. The long term harvest forecast is marginally smaller than that of the Base Case (less than 1% difference).

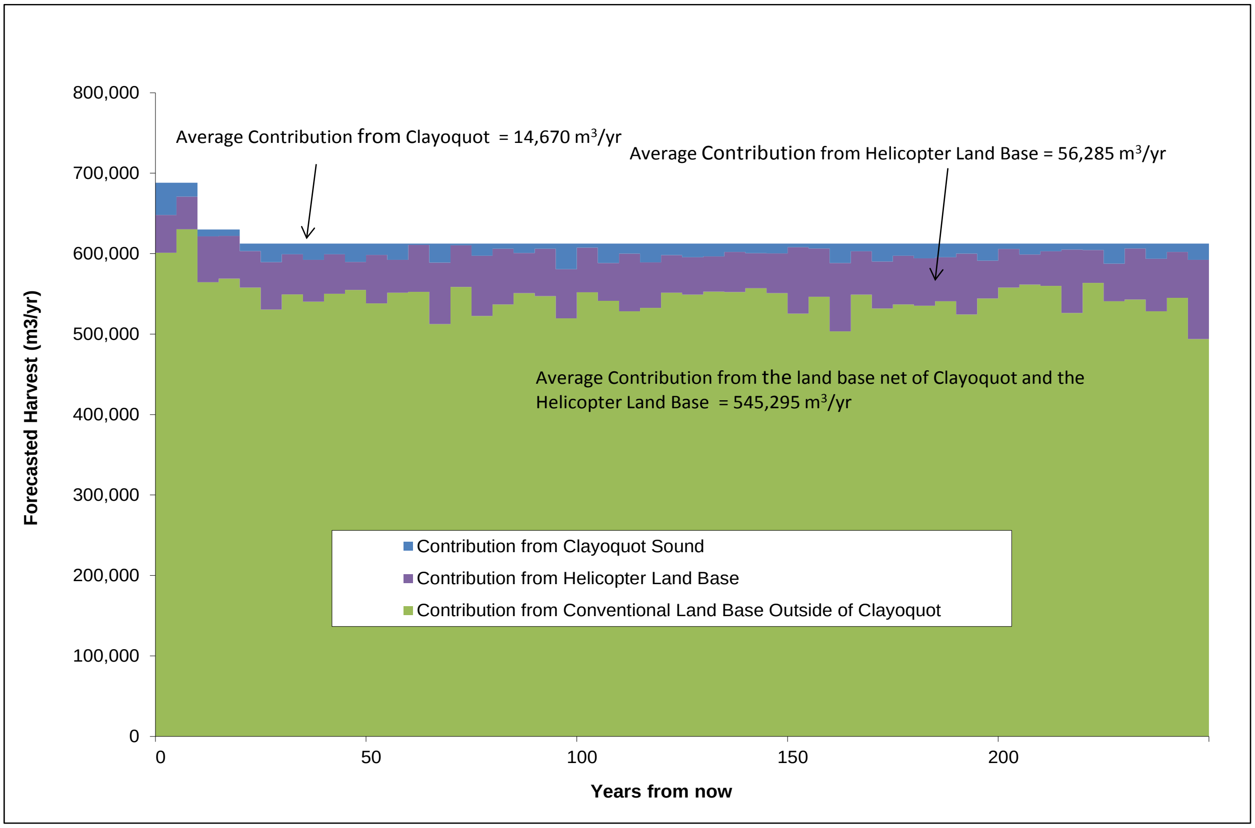

Figure 41: Contribution of Clayoquot Sound and the helicopter harvesting areas to timber supply

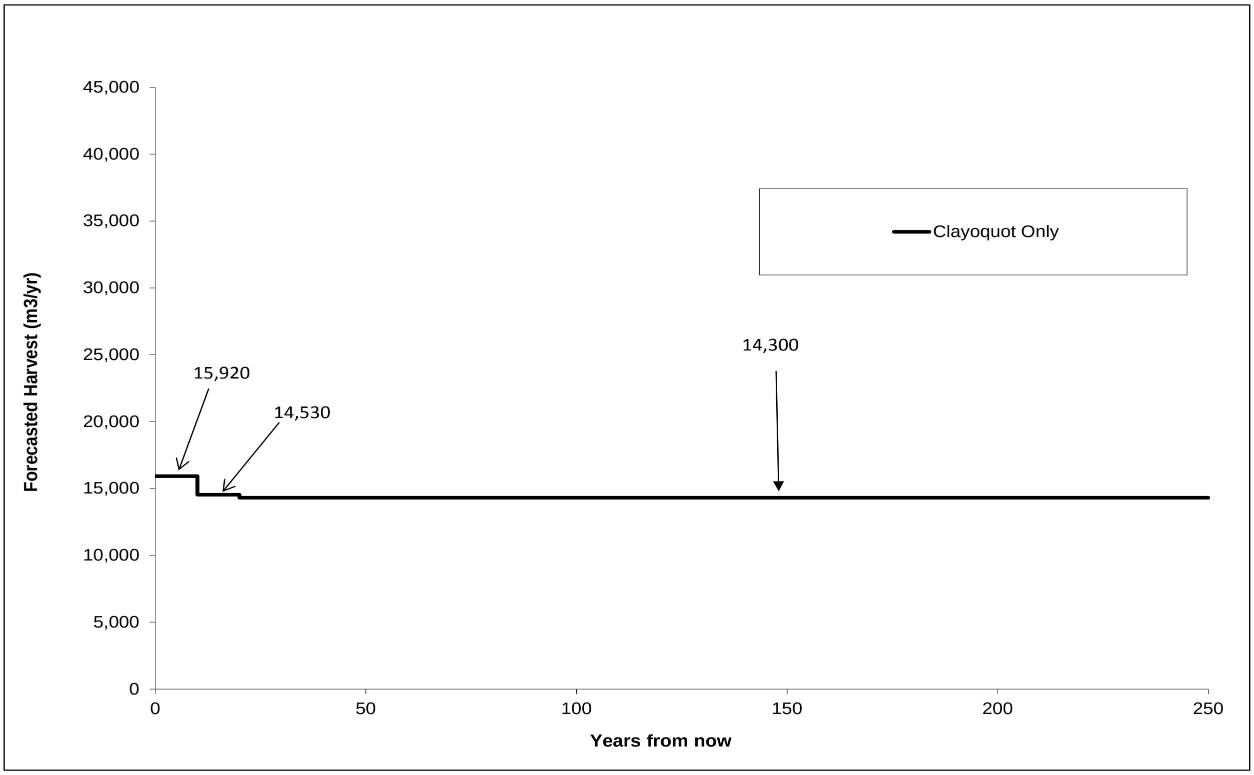

Figure 42: Harvest forecast for Clayoquot Sound

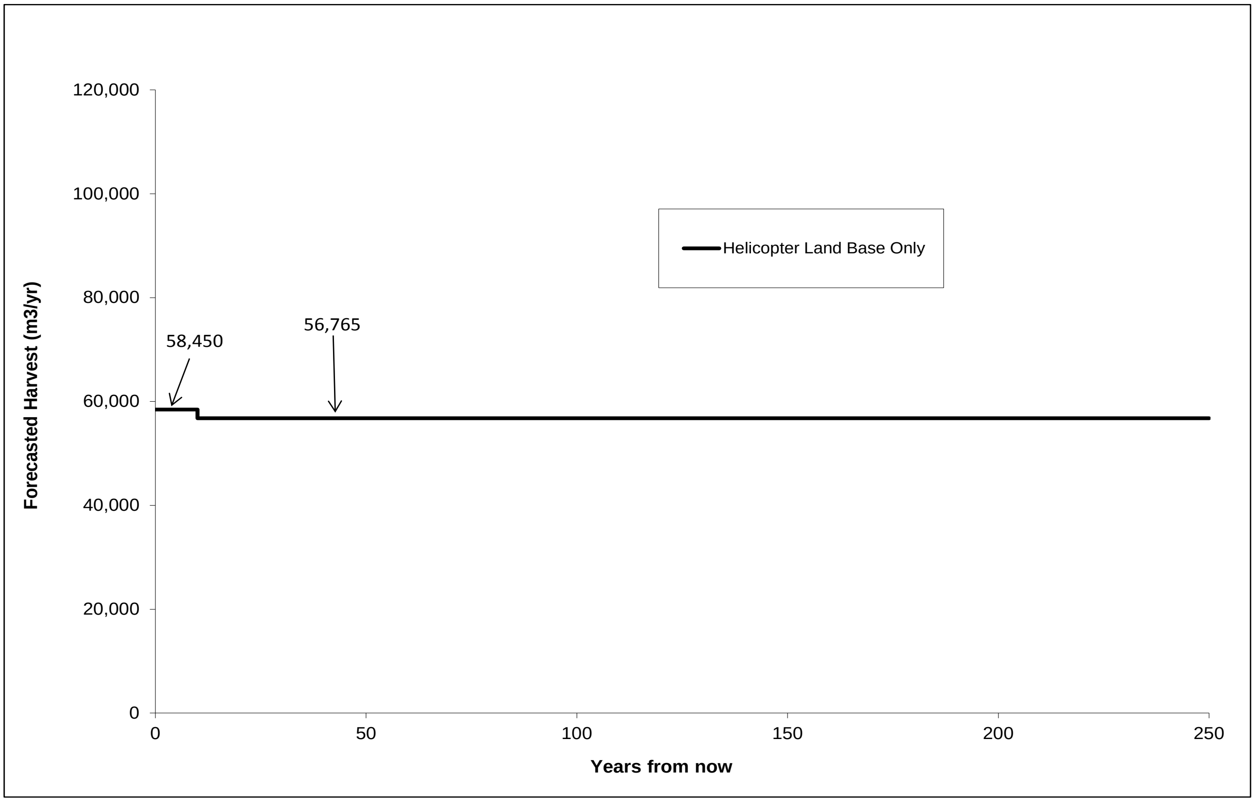

Figure 43: Harvest forecast for the helicopter land base

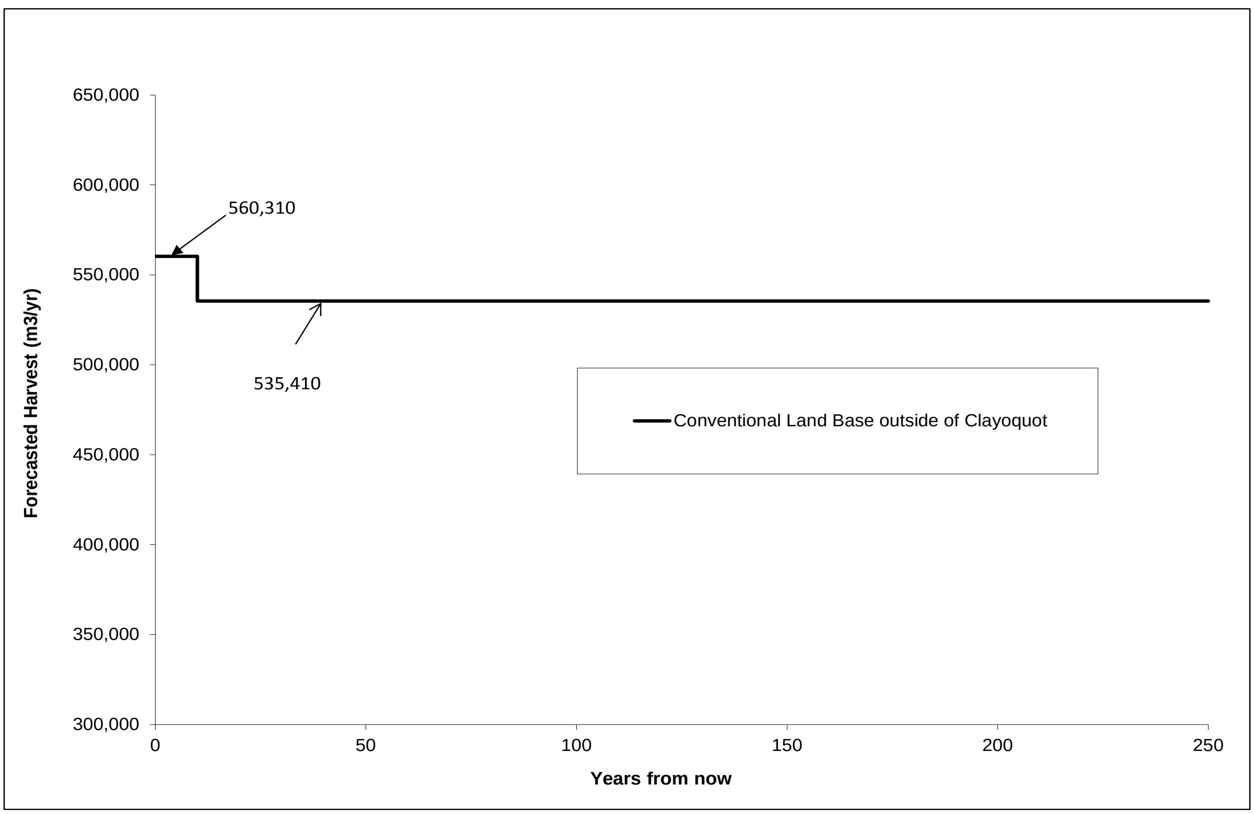

Figure 44: Harvest forecast for the conventional land base outside of Clayoquot Sound

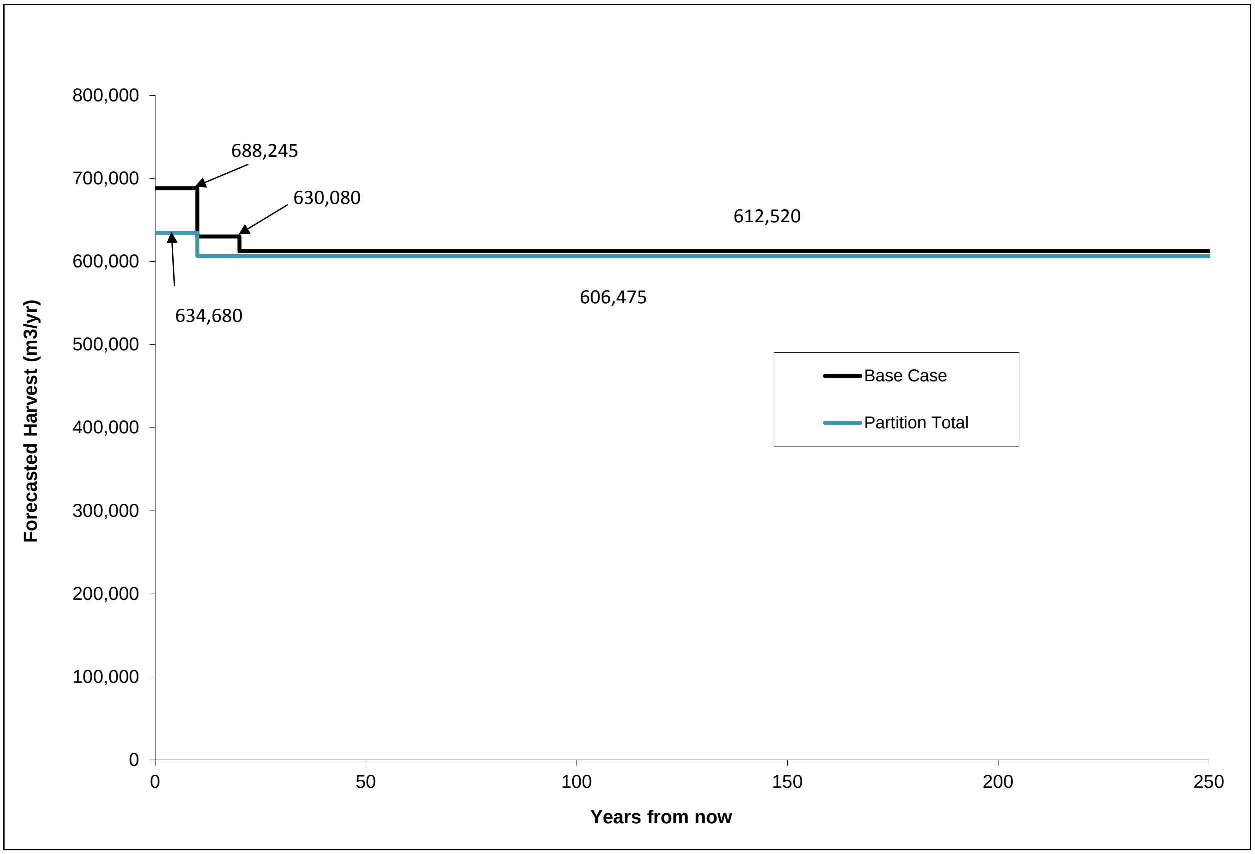

Figure 45: Base Case compared to the partition total

6.2 Business Area Harvest

The contribution of the three business areas to the Base Case harvest forecast is illustrated in Figure 45. The TSG business area is the largest contributor to the harvest with approximately 74% of the total harvest (455,750 m^3 per year average) over the planning horizon. TST contributes approximately 14% (86,700 m^3 per year average) with TSK at 12% (73,350 m^3 per year average).

When TSG was analysed independently, a long term harvest level of 455,750 m^3 per year was achieved with a higher forecast of 502,375 m^3 per year for the first 10 years (Figure 46).

TST alone produced a long-term harvest forecast of 83,350 m^3 per year with a significantly higher short-term harvest level: 112,745 m3 per year for the first 10 years, 101,300 m^3 per year for years 11 to 20 and 91,100 m^3 per year for years 21 to 30 (Figure 47).

Figure 48 illustrates the harvest forecast for the TSK business area. This land base produced a flat-line timber supply forecast of 73,200 m^3 per year.

Figure 49 compares the summed up harvest forecasts of all business areas to the Base Case harvest forecast. The aggregated short-term business area timber supply forecast is marginally greater than that of the Base Case. In the first 20 years the difference is negligible; however between years 21 and 30 7,480 m^3 (1.2%) more timber is harvested. The long term harvest forecast is marginally smaller than that of the Base Case (less than 1% difference).

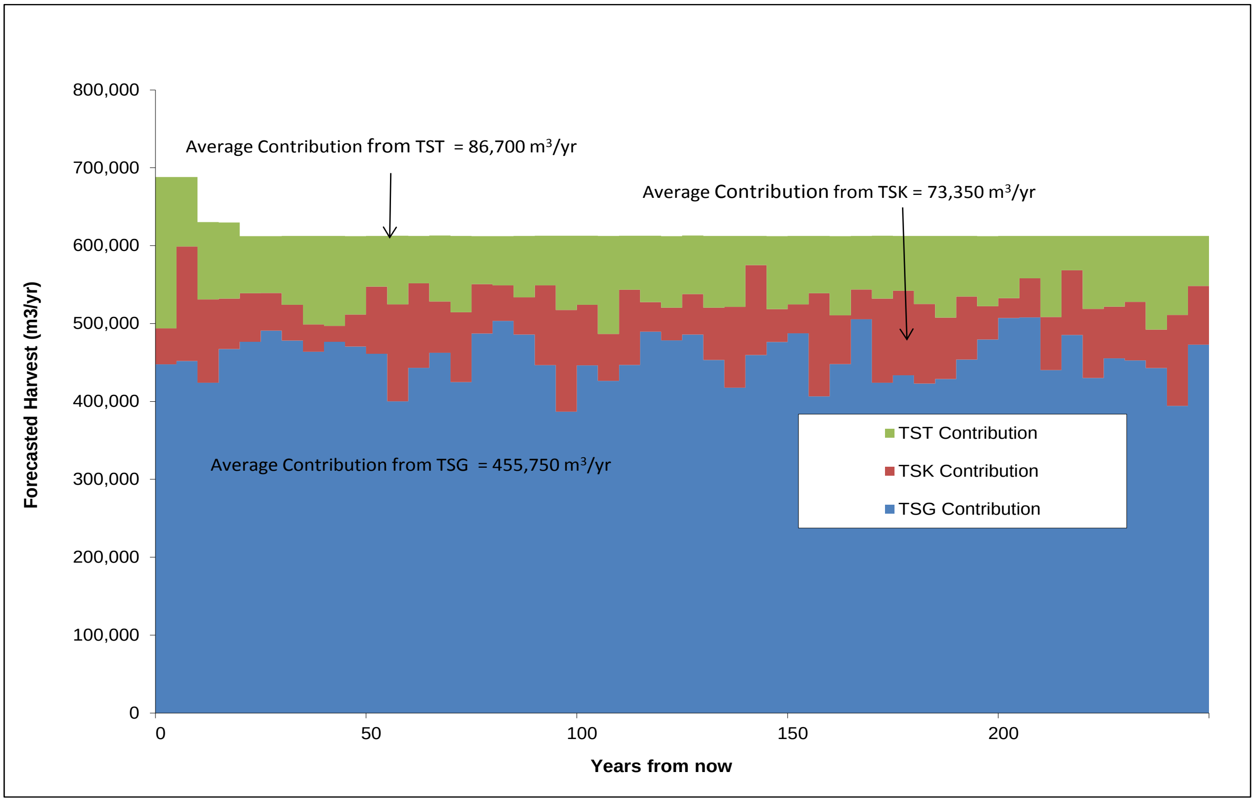

Figure 46: Contribution of business areas to the Base Case harvest forecast

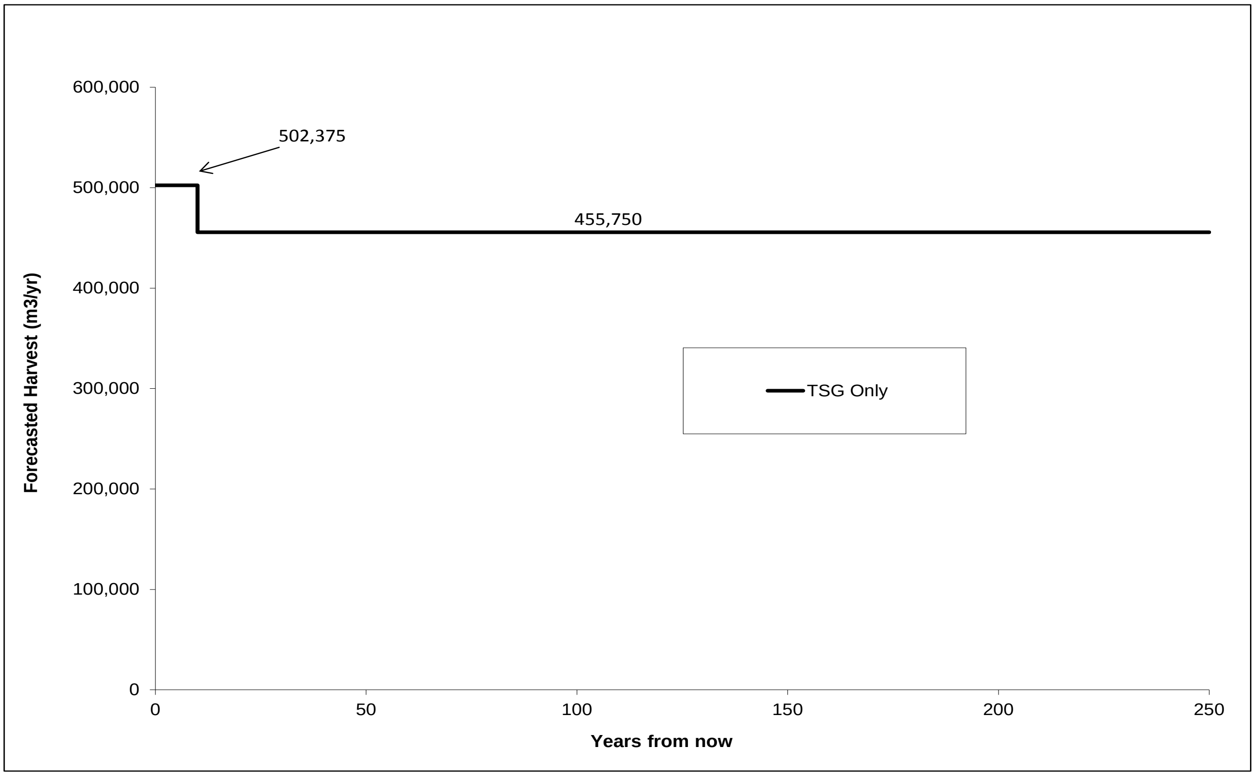

Figure 47: Harvest forecast for the TSG business area

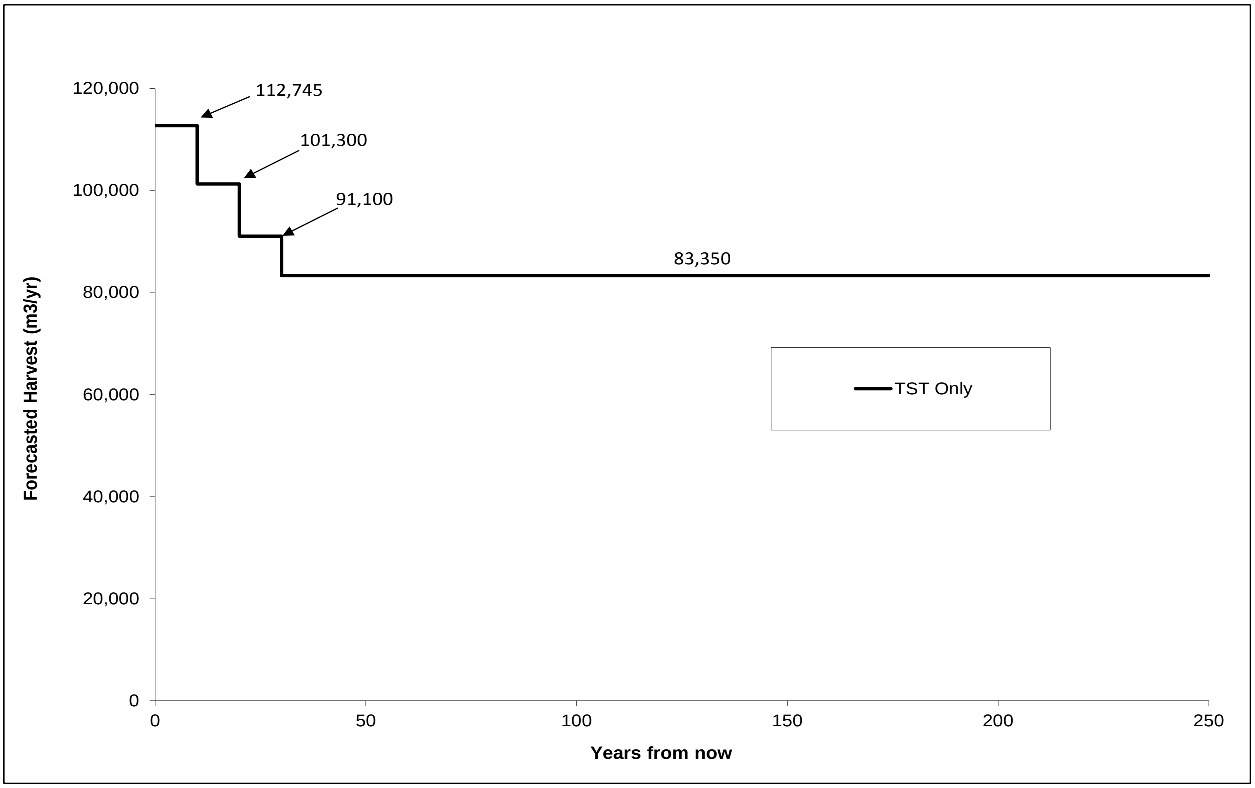

Figure 48: Harvest forecast for the TST business area

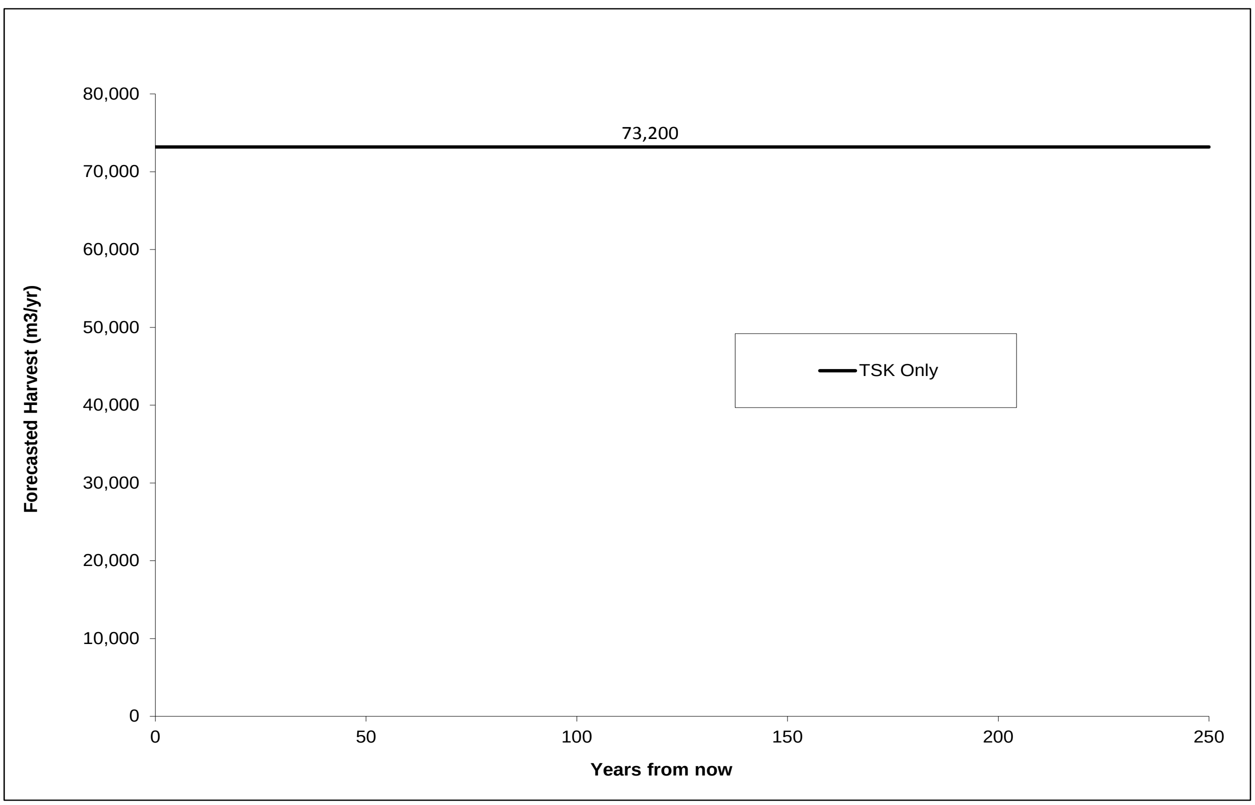

Figure 49: Harvest forecast for the TSK business area

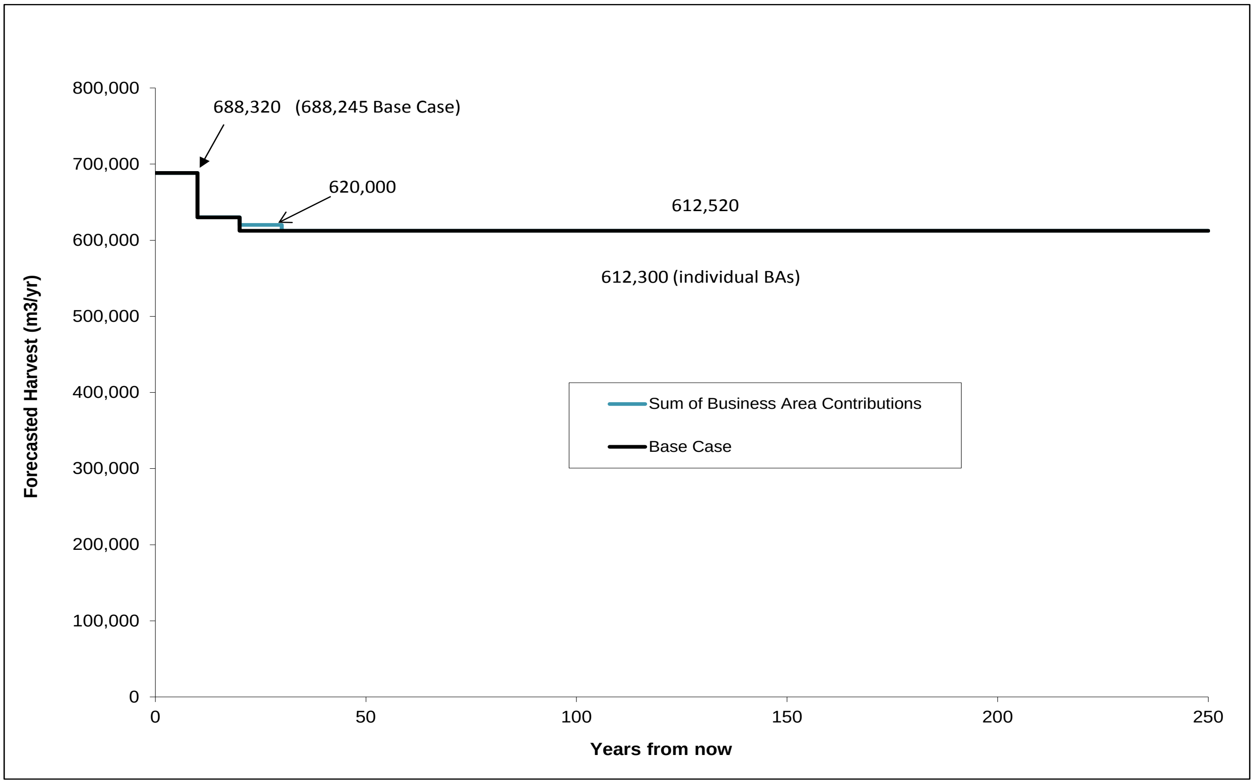

Figure 50: Summed up harvest contribution of business areas compared to the Base Case

7 Alternative Harvest Flows

Many possible harvest flows can exist on any given land base. These flows may have different initial harvest levels and decline rates and include various trade-offs between short- and long-term harvest levels. Two alternated harvest flows were completed for the Base Case land base: one with the initial harvest level at the current AAC and another where the initial harvest level was set at 950,000 m^3 per year.

7.1 Initial Harvest Level at Current AAC

The current AAC for the Pacific TSA without the GBR contribution is 1,279,731 m^3 per year. Maintaining the current AAC for the first 10 years resulted in significant timber supply deficits in the mid-term between years 66 and 135 as depicted in Figure 50. It was also necessary to lower the LTHL from that of the Base Case somewhat (612,120 m^3 per year vs. 597,300 m^3 per year) to stabilize the growing stock. The long-term growing stock remains significantly lower than that of the Base Case as shown in Figure 51.

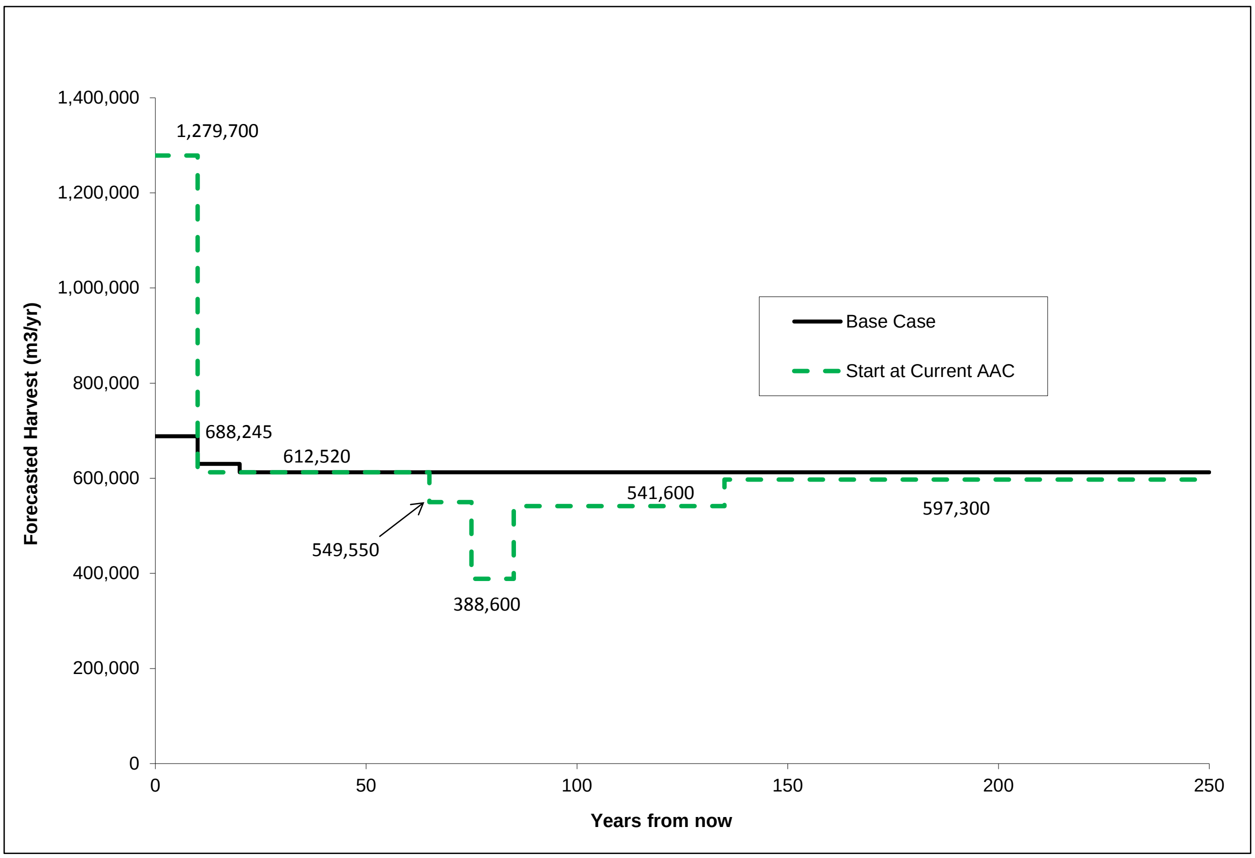

Figure 51: Alternate harvest flow: Initial harvest level at current AAC compared to the Base Case

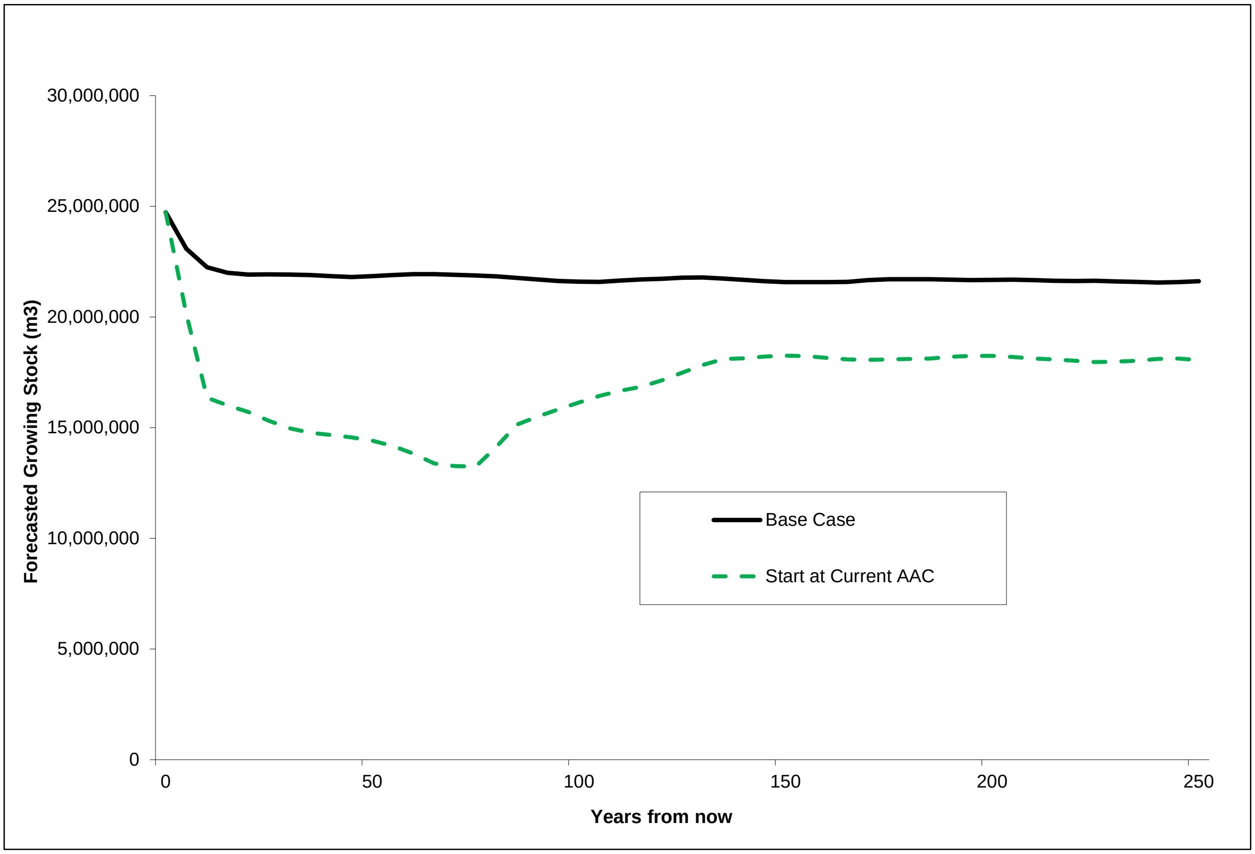

Figure 52: Total growing stock comparison: Initial harvest level at current AAC compared to the Base Case

7.2 Initial Harvest Level at 950,000 m^3 per Year

Figure 52 shows a harvest forecast with the initial harvest level at 950,000 m^3 per year for the first 10 years. The late mid-term harvest level needs to be decreased by 6.1% annually between years 61 and 105 to compensate for the increased harvest in the short-term. The LTHL settles at the same level as in the Base Case. However, the long-term growing stock stabilizes at a lower level compared to the base case as seen in Figure 53.

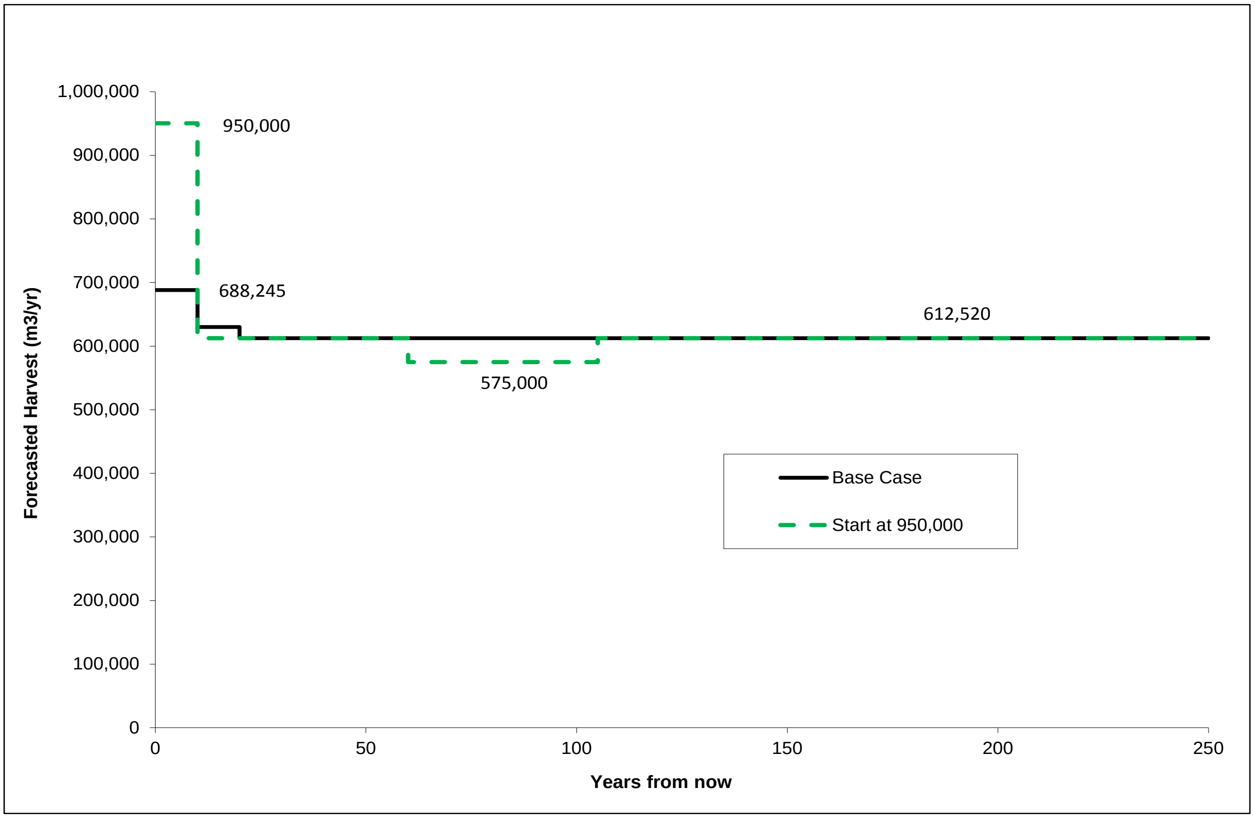

Figure 53: Alternate harvest flow: Initial harvest level at 950,000 m^3 per year compared to the Base Case

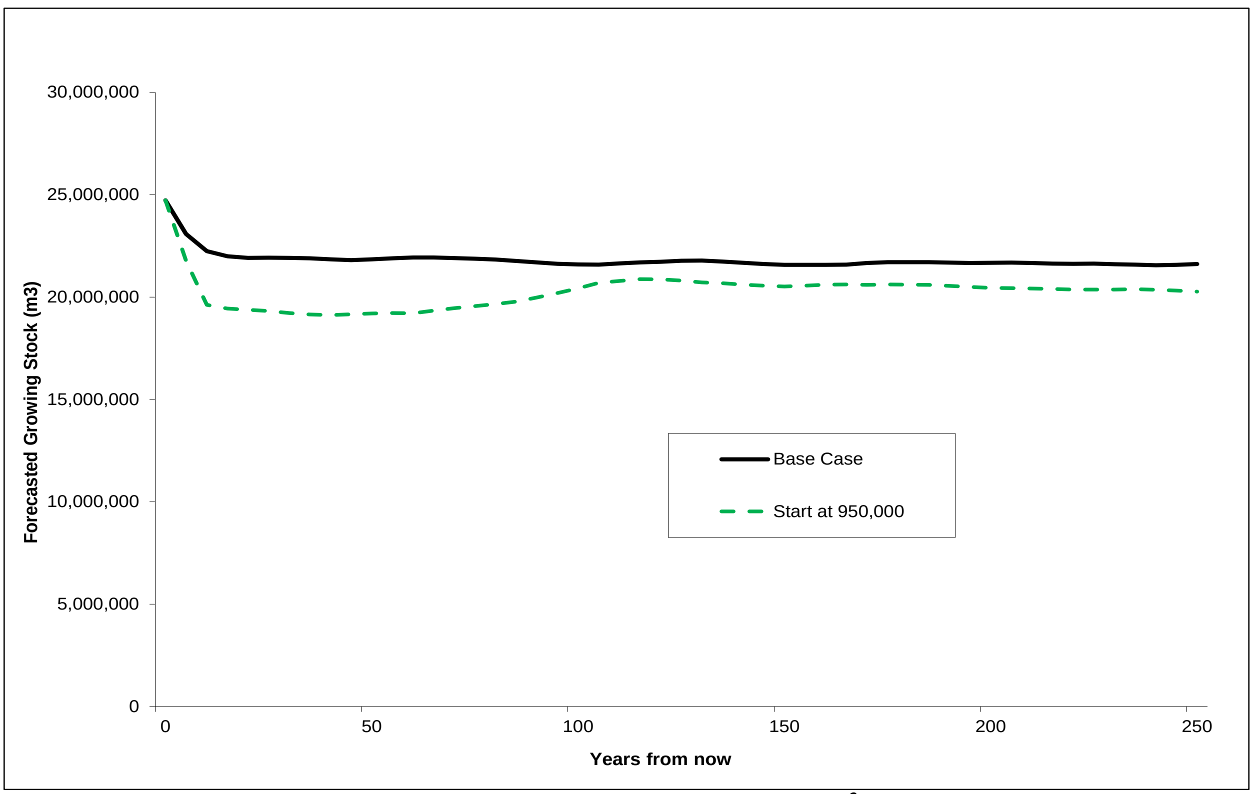

Figure 54: Total growing stock comparison: Initial harvest level at 950,000 m^3 per year compared to the Base Case

8 Conclusions

The Base Case harvest forecast starts at 688,245 m^3 per year. In 10 years the forecast is reduced to 630,520 m^3 per year and the long-term harvest level of 612,520 m^3 per year is reached at year 21. This type of harvest flow, where harvest levels are initially higher than the long-term harvest level, is typical of coastal forest management units that are still harvesting higher volume old growth stands.

The Base Case for this analysis is robust, because downward pressures in the short term can be deferred to the medium and long term. The alternate harvest flows and sensitivity analyses demonstrate that timber supply crashes associated with changes to initial harvest level and/or analysis assumptions do not generally occur until late in the planning horizon, if at all. In most cases unsustainable harvest levels were apparent only in the long-term decline of the growing stock. This delayed response reduces the risk associated with a given short-term harvest level, as it allows future AAC determinations to respond to new information and management regimes.

8.1 Economic Operability

The feedback and comments received from the public regarding the data and analysis assumptions centered on the economic operability assessment that was completed as part of this timber supply review. The consistent theme in these comments was the notion that the economically operable land base might have been underestimated.

Several sensitivity analyses were completed investigating the impact of changes to the size of the economically operable land base. The sensitivity analyses demonstrated that the impact of increasing the economically operable land base on timber supply is significant. However, this impact is mostly related to the economic operability of the helicopter land base and less to that of the conventional land base.

If all physically accessible harvest areas that were classified as uneconomic to harvest were to be classified as economic, the THLB would increase by 62,965 ha or 69.5%. This is turn increases the harvest forecast by 64.6% in the long term. The short term harvest forecast increases by approximately 70%.

Approximately 56,205 ha or 89.3 % of this increased THLB comes from the helicopter harvesting land base and 41,030 ha or 73% from the helicopter harvesting land base in the TSK business area (Blocks 28 and 29).

If physically accessible conventional harvest areas that were classified as uneconomic to harvest were to be classified as economic, the size of the THLB would increase by 10.7% or 6,760 ha. This is turn increases the harvest forecast by 7.3% in the long term. The short term harvest forecast increases by 10.7% to 11.5%.

Harvest performance and how it relates to the economic operability classification needs to be monitored before the next timber supply review. In particular, the harvest performance in helicopter harvest areas in the TSK business area is of interest due to its potential impact on timber supply.

8.2 Harvest Scheduling

The harvest profile in many coastal management units is not desirable. The remaining harvestable old growth often consists of hemlock and balsam stands, many of them in high elevations. This has led to the increased harvest of young, second growth stands, especially during difficult economic times. The sensitivity analyses demonstrated that harvesting second growth stands at very young ages in lieu of the older stands would impact the long-term harvest level negatively. Ensuring that the entire harvest profile is harvested in the Pacific TSA is important and the harvest performance should be monitored.

8.3 Forest Inventory

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. While no formal audit has been completed on the inventory, we believe that the old converted TFL inventories are likely unreliable. This poses only a small risk to timber supply; a sensitivity analysis showed that a significant reduction in the current growing stock had no impact on the short-term harvest and the impact on the mid and long-term harvest level was small.

Some of the uncertainty regarding the forest inventory will be reduced in the future, when the FLNRO completes the new VRI for all the coastal TSAs.

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10 List of Acronyms

Acronym	Description
AAC	Annual Allowable Cut
BCGW	BC Geographic Warehouse
BCLCS	BC Land Classification System
BCTS	BC Timber Sales
BEC	Biogeoclimatic Ecosystem Classification
BMTA	Biodiversity, Mining, and Tourism Area
CDC	Conservation Data Centre
CFLB	Crown Forested Land Base
CNCO	Central and North Coast Order (EBM)
DBH	Diameter at Breast Height
DCR	Campbell River Natural Resource District
DIB	Diameter inside bark
DKM	Coast Mountains Natural Resource District
DNI	North Island Central Coast Natural Resource District
DRS	Draft Recovery Strategy for Northern Goshawk
DSC	Sunshine Coast Natural Resource District
DSI	South Island Natural Resource District
EBM	Ecosystem Based Management
ECA	Equivalent Clearcut Area
ESA	Environmentally Sensitive Area
EXLB	Excluded Land Base
FAIB	Forest Analysis and Inventory Branch, Ministry of Forests, Lands, and Natural Resource Operations
FC1	Former Forest Cover Inventory Standard
FESL	Forest Ecosystem Solutions Ltd.
FLNRO	Ministry of Forests, Lands, and Natural Resource Operations
FMLB	Forest Management Land Base
FPPR	Forest Planning and Practices Regulation
FRPA	Forests and Range Practices Act
FSOS	Forest Simulation and Optimization System (model used for analysis)
FSW	Fisheries Sensitive Watershed
GAR	Government Action Regulation
GBRO	Great Bear Rainforest Order (EBM)
GIS	Geographic Information Systems
HVFH	High Value Fish Habitat
IRM	Integrated Resource Management
LRMP	Land and Resource Management Plan
LU	Landscape Unit
LUOCS	Landscape Unit Order Clayoquot Sound
MAI	Mean Annual Increment
MOE	Ministry of Environment

Acronym	Description
MSYT	Managed Stand Yield Table
NCBR	Non-Commercial Brush
NHLB	Non-Harvesting Land Base
NHVFH	Non-High Value Fish Habitat
NRL	Non-recoverable Losses
NSR	Not Sufficiently Restocked
NTA	No Typing Available
NSYT	Natural Stand Yield Table
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Area
PEM	Predictive Ecosystem Mapping
PSP	Permanent Sample Plot
RMA	Riparian Management Area
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
SCCO	South Central Coast Order (EBM)
SIBEC	Site Index by BEC Site Series
SMZ	Special Management Zone
SRMP	Sustainable Resource Management Plan
SSG	Site Series Grouping
TASS	Tree and Stand Simulator
TEM	Terrestrial Ecosystem Mapping
TFL	Tree Farm License
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation for Stand Yields
TSA	Timber Supply Area or Timber Supply Analysis
TSG	BCTS Strait of Georgia Business Area
TSK	BCTS Skeena Business Area
TSR	Timber Supply Review
TST	BCTS Seaward/Tlasta Business Area
UWR	Ungulate Winter Range
VAC	Visual Absorption Capability
VDYP	Variable Density Yield Projection
VEG	Visually Effective Green-up
VILUP	Vancouver Island Land Use Plan
VRI	Vegetation Resource Inventory
VQO	Visual Quality Objective
WHA	Wildlife Habitat Area
WTRA	Wildlife Tree Retention Area

Appendix 1 – Information Package