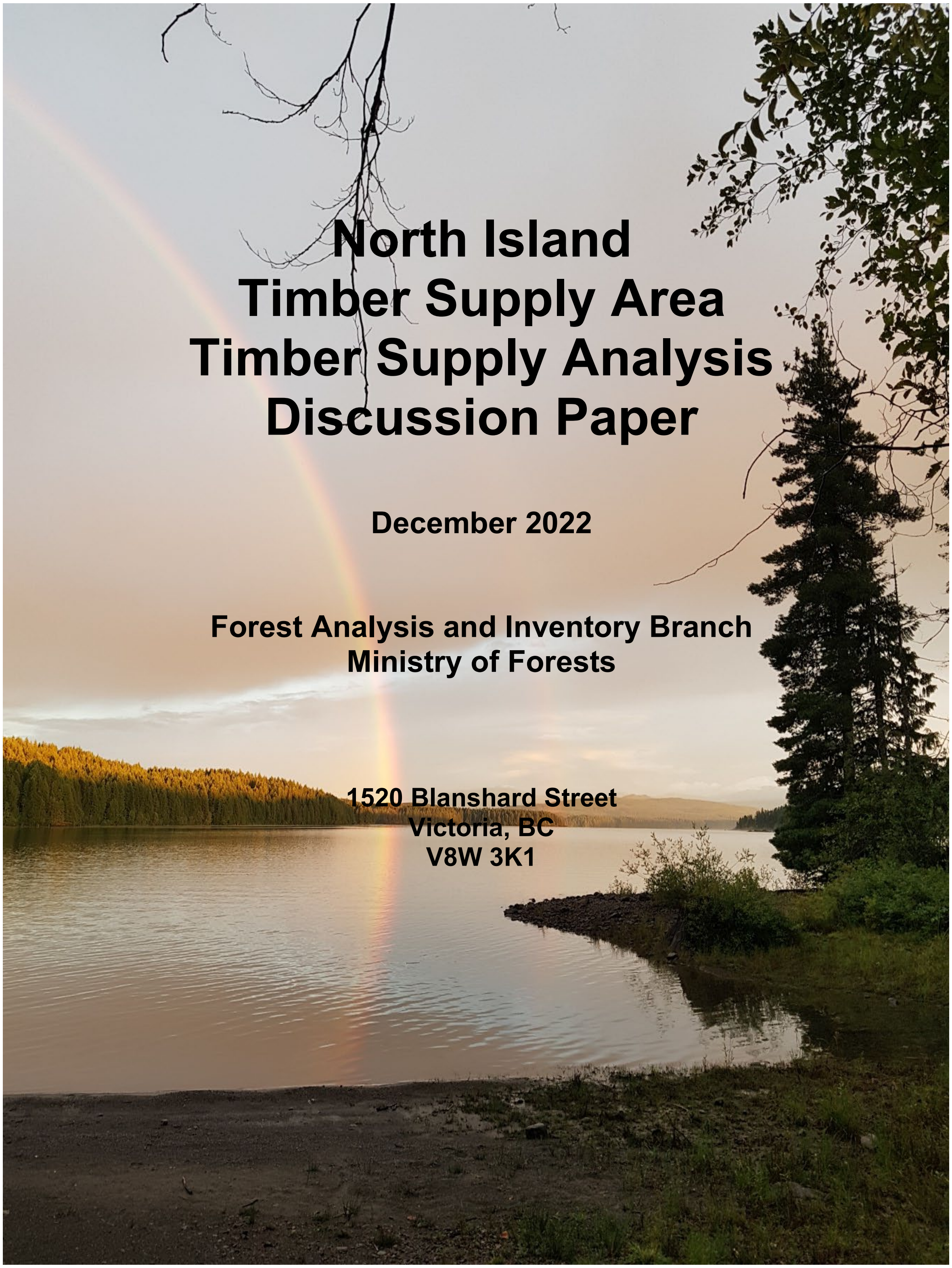

North Island Timber Supply Area Timber Supply Analysis Discussion Paper

December 2022

Forest Analysis and Inventory Branch
Ministry of Forests

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BRITISH COLUMBIA | Ministry of Forests

Cover photograph: Campbell Lake, North Island TSA

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Introduction

The British Columbia Ministry of Forests (FOR) regularly reviews the timber supply[a] for all timber supply areas[b] (TSA) and tree farm licences[c] (TFL) in the province. This review, the first for the North Island TSA in its current configuration, examines the impacts of current legal requirements and demonstrated forest management practices on the timber supply, economy, environment and social conditions of the local area and province. Based on this review the chief forester will determine a new allowable annual cut[d] (AAC) for the North Island TSA.

According to Section 8 of the *Forest Act* the chief forester must regularly review and set new AACs for all 37 TSAs and 33 TFLs in the Province of British Columbia (BC).

The objectives of the timber supply review (TSR) are to:

- examine relevant forest management practices, environmental and social factors, and input from First Nations, forest licensees and the public;
- set a new AAC; and,
- identify information to be improved for future timber supply reviews.

This *Discussion Paper* provides a summary of the results of the timber supply analysis for the timber supply review of the North Island TSA. Details about the data and assumptions used in the analysis were provided in a *Data Package* (July 2020). Updates to the information used and technical details regarding the analysis are available on request from the Forest Analysis and Inventory Branch. The timber supply analysis should be viewed as a "work in progress". Prior to the chief forester's AAC determination for the TSA, further analysis may need to be completed and existing analysis reassessed as a result of input received on this *Discussion Paper*.

Timber supply reviews undertaken in support of AAC determinations are based on the current resource management objectives established by government in legislation and by legal orders. For the purposes of the North Island TSA timber supply review, forest management objectives are provided by the *Forest and Range Practices Act* (FRPA), the Vancouver Island Land Use Plan (VILUP), which made legal specific objectives pursuant to the *Forest Practices Code* (FPC) Sections 3(1) and 3(2), Landscape Unit Plans (LUPs) providing

[a]**Timber supply**
Timber supply is the amount of timber available for harvesting over a specified period of time.

[b]**Timber supply areas (TSAs)**
Timber supply areas are integrated resource management unit established in accordance with Section 7 of the Forest Act.

[c]**Tree farm licences (TFLs)**
Tree farm licences are tenures that grant exclusive rights to harvest timber and manage forests in a specific area; may include private land.

[d]**Allowable annual cut (AAC)**
Allowable annual cut is the maximum volume of timber available for harvesting each year from a specified area of land, usually expressed as cubic metres of wood.

more specific direction by landscape unit (LU), and additional legal objectives established under the *Forest and Range Practices Act* for specific objectives. The information compiled to support this timber supply review can be made available to support land use planning as required. However, land use planning and land use decisions are outside the scope of the chief forester's AAC determination. In the event that resource management objectives and practices change, these changes can be reflected in future timber supply reviews.

Timber supply review in the North Island TSA

The current AAC for the North Island TSA, effective January 1, 2017, is 1 248 100 cubic metres.

In July 2020, a *Data Package* documenting the data and forest management assumptions to be used in this timber supply analysis was released for public review and to assist with First Nations consultation. This *Discussion Paper* is released in order to provide an overview of the timber supply review and to highlight the key findings of the timber supply analysis for the North Island TSA. Before setting a new AAC, the chief forester will review all relevant information, including the results of the timber supply analysis and input from government agencies, First Nations, the public, and licensees. Following this review, the chief forester's determination will be outlined in a *Rationale Statement* that will be publicly available. The actual AAC that is determined by the chief forester during this timber supply review may differ from the harvest projections, including the base case, presented in this *Discussion Paper* as the chief forester must consider a wide range of information, some of which is not quantifiable. Ultimately, the chief forester's AAC determination is an independent, professional judgment based on the legal requirements set out in Section 8(8) of the *Forest Act.*

Once the chief forester has determined a new AAC, the Minister of Forests will apportion the AAC to the various licence types and programs as per Section 10 of the *Forest Act*. Based on the minister's apportionment, the regional executive director will establish a disposition plan that identifies how the available timber volume is assigned to the existing forest licences and, where possible, to new opportunities.

Description of the North Island TSA

The North Island TSA, located on the northern half of Vancouver Island, was created in January 2017 when the *Great Bear Rainforest (Forest Management) Act* (GBRFMA) and regulations came into effect. Under the regulations, this new TSA was created from the Vancouver Island portions of the former Kingcome and Strathcona TSAs. Segments of the Pacific TSA are interspersed throughout the TSA, as well as TFLs 6, 19, 37, 39 and 47. The total TSA land base area is approximately 1 749 460 hectares and it is administered by the Campbell River Natural Resource District (DCR) office in Campbell River, and the North Island-Central Coast Natural Resource District (DNI) office in Port McNeill.

The western and northern Vancouver Island areas are characterized with rugged marine coastlines, steep mountainous terrain, and deep river valleys and inlets that extend into the Pacific Ocean. The eastern TSA and some interior northern areas have terrain ranging from rugged mountains to poorly drained lowlands. The TSA overlaps three biogeoclimatic zones: the Coastal Western Hemlock (CWH) located between sea level and 1000 metres of elevation, and the higher elevation zones of Mountain Hemlock (MH) and Coastal Mountain-heather Alpine (CMA). Dominant tree species are western hemlock (Hw) and amabilis fir (more often called balsam (Ba) – HwBa together referred to as "hembal"), western redcedar (Cw) and yellow-cedar (Yc), mountain hemlock (Hm), Douglas-fir (Fd) and small amounts of red alder (Dr) and spruce (Ss).

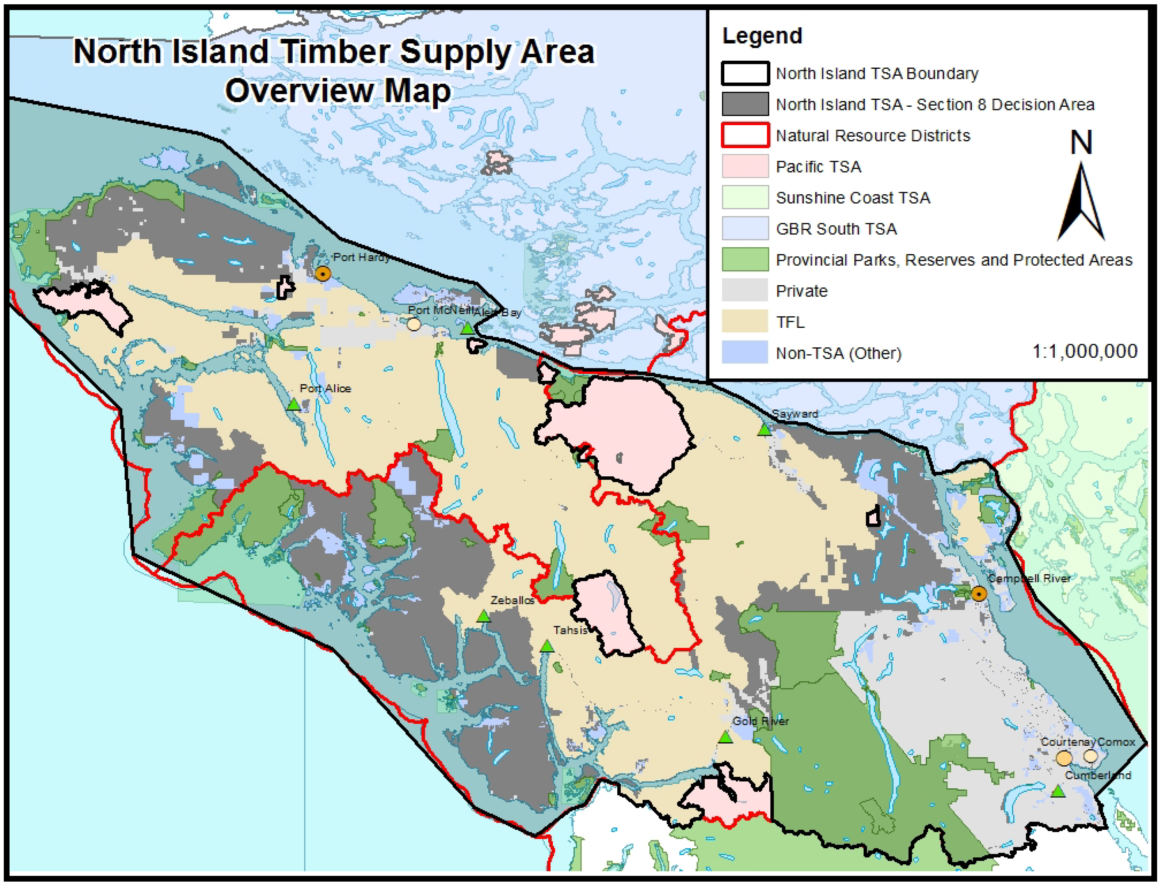

Figure 1. Overview map of the North Island TSA.

This is the first TSR to be completed on the North Island TSA. The initial AAC was set in the Great Bear Rainforest (Forest Management) Regulation. The GBRFMA specifies that subsequent AAC determinations outside of the Great Bear Rain Forest must be made by the chief forester. Contributions to the initial AAC from former TSAs are shown in Table 1.

Table 1. Historic AAC

Management unit	AAC effective date	AAC (total) m^3/year	AAC (North Island TSA) m^3/year
Strathcona	December 17, 2015	1 138 000	986 000 (partitioned)
Kingcome	February 2, 2010	1 100 000 m^3 (14 000 m^3 deciduous)	262 100 (GBRFM Regulation)
North Island	**January 1, 2017**	**1 248 100**	**1 248 100 (legislated)**

The TSA's varied topography and climate support a rich variety of wildlife. Of particular importance are the old-growth forests of the CWH zone and the protected, nutrient-rich estuaries that provide critical habitat for over-wintering water birds, many species of mammals, and young salmon. More than 300 species of migratory and resident birds, 45 species of mammals and 13 species of amphibians and reptiles occur in the TSA. Native mammals include black-tailed deer, Roosevelt elk, black bear, wolf, beaver, pine marten, wolverine and weasel. Native and migratory birds in the forests of the area include species identified as being at risk, such as marbled murrelets, northern goshawks, and great blue herons.

The marine habitats and estuaries support populations of red-legged and coastal tailed frog, Peale's peregrine falcons, bald eagles, trumpeter swans, harlequin ducks and over-wintering birds. Some of the major drainages within the TSA include the White River, Artlish River, Kaouk River, Salmon River, Nimpkish River, Elk River, Ououkinsh River, Kashutl River, Malkesope River, Tahsish River, Kauwinch River, Nahwitti River, San Joseph River, Stranby River, Mahatta Creek and East Creek.

Environmental values

Protection and management of environmental values are addressed under provincial and federal legislation. The FRPA is the primary provincial legislation regulating forestry practices. Under FRPA, the Forest Planning and Practices Regulation (FPPR) identifies objectives set by government for environmental values including fish, wildlife, biodiversity, soils and water that are to be addressed within forest stewardship plans. Orders may be established under the Government Actions Regulation (GAR) or the Land Use Objectives Regulation for specific land uses such as ungulate winter ranges, wildlife habitat areas, critical habitat for fish, and old growth management areas (OGMA).

Natural resources

Numerous natural resources are associated with the forest land base. Forest products, recreation and tourism, and wildlife highlight the wide range of resources and values found in the North Island TSA.

The North Island TSA has 27 642 hectares of lakes and wetlands with a large network of streams interspersed. These water features are partially protected by 21 532 hectares of riparian reserve zones and riparian management zones. Additional features that offer further protection include wildlife tree retention areas (WTRA), community watersheds, lakeshore management zones, parks, ungulate winter ranges, wildlife habitat areas and scenic areas.

There are 13 522 hectares of wildlife habitat area (WHA) and 13 456 hectares of ungulate winter range (UWR) designed to protect mammals, birds, reptiles, amphibians and plant communities. The UWRs protect habitat for Black-tailed deer and Roosevelt elk while the WHAs protect habitat for Northern goshawks, Marbled murrelet and Red-legged frogs. Wildlife and their habitat are partially protected by old growth management areas, recreations sites and reserves and the retention of deciduous stands as well as those measures protecting riparian features.

There are 275 500 hectares of provincial parks, protected areas and ecological reserves within the TSA with the six largest being Strathcona, Brooks Peninsula (Muqqiwn), Cape Scott, Tahsish-Kwois, Schoen Lake and Woss Lake parks. There are also 11 507 hectares of active and pending recreation sites, reserves and crown use, recreation and enjoyment of the public (UREP) reserves along with 492 kilometres of recreation trails. These areas along with water features and wildlife provide for a range of recreational activities such as hiking, canoeing, camping, horse tours, fishing, hunting, snowmobiling, and downhill and cross-country skiing.

First Nations

Multiple First Nations assert Aboriginal Interests within the North Island TSA. These First Nations include: Cowichan Tribes, Ehattesaht Chinehkint First Nation, Gwa'sala-'Nakwaxda'xw Nation, Halalt First Nation, Xwemalhkwu (Homalco) First Nation, Ka:'yu:k'tkh_Che:k:tles7et'h' First Nation, Klahoose First Nation, K'omoks First Nation, Kwakiutl First Nation, Lake Cowichan First Nation, Lyackson First Nation, Mamalilikulla First Nation, Mowachaht/Muchalaht First Nation, Ma'amtagila First Nation, 'Namgis First Nation, Nuchatlaht First Nation, Penelakut Tribe, Qualicum First Nation, Quatsino First Nation, Stz'uminus First Nation, Tla'amin Nation, Tlatlasikwala First Nation, Tlowitsis First Nation, Tseshaht First Nation, We Wai Kai Nation and the Wei Wai Kum First Nation.

Overlapping with the North Island TSA are two modern-day treaties, the *Maa-nulth Treaty* and the *Tla'amin Treaty*.

On April 1, 2011, the *Maa-nulth Treaty* came into effect. The Maa-nulth Treaty Nation that overlaps the North Island TSA is the Ka:'yu:k'tkh_Che:k:tles7et'h' First Nation. The terms of the *Maa-nulth Final Agreement* provide self-government, 24 550 hectares of land, and various monetary components. It also defines each Maa-nulth First Nation's rights to resources such as wildlife, fish, timber, and sub-surface minerals. On May 22, 2014, the Maa-nulth Nations and the Province signed a *Reasonable Opportunity Agreement* with the objective of defining the collaborative process to evaluate the impact of authorized uses or dispositions of Crown land on each Maa-nulth First Nation's reasonable opportunity to harvest fish and aquatic plants, wildlife, and migratory birds in the Maa-nulth Harvest Areas.

On April 5, 2016, the *Tla'amin Treaty* came into effect. The North Island TSA overlaps the Tla'amin Nation Final Agreement Areas on Quadra Island. Vancouver Island overlap areas remain outside of the area contributing to the timber supply. The Tla'amin Nation and the Province signed a *Reasonable Opportunity Agreement* with the objective of ensuring that the Tla'amin Nation continues to have a reasonable opportunity to exercise their right to harvest fish and aquatic plants, wildlife and migratory birds and to gather plants within the areas identified in the *Tla'amin Final Agreement*.

There are also two Douglas Treaties that overlap with the North Island TSA. The Kwakiutl First Nation are signatory to both, signed in 1851, and they have the right to hunt over unoccupied lands and to carry on their fisheries as formerly. Moreover, in *Chartrand v. The District Manager (2013)*, the BC Supreme Court found that the Kwakiutl First Nation have a credible claim to unextinguished Aboriginal rights and title in addition to their Treaty Rights.

There are several Nations in Stage 5 treaty negotiations, including: K'omoks First Nation, Laich-Kwil-Tach Treaty Society, Wei Wai Kum Kwiakah Treaty Society, and Hul'qumi'num Treaty Group. The Mamalilikulla First Nation, K'omoks First Nation, Tlowitsis First Nation and Wei Wai Kum First Nation are signatory to the *Nanwakolas/British Columbia Framework Agreement (2016 Amending Agreement)*. These same Nations are also signatory to the *Nanwakolas Reconciliation Protocol*. The *Nanwakolas/British Columbia Framework Agreement (2016 Amending Agreement)* outlines the process by which consultation is undertaken with the signatories under various pieces of legislation, including the *Forest Act*. Under the *Nanwakolas Reconciliation Protocol* the Province and the signatories have agreed to undertake discussions on shared decision-making measures for land and natural resource management.

Many of the First Nations that assert Aboriginal Interests within the North Island TSA have signed Forest Consultation and Revenue Sharing Agreements. This type of agreement outlines consultation engagement expectations, as well as provides First Nation communities with economic benefits returning directly to their community based on harvest activities in their traditional territory. See Table 2 for a list of Nations that are signatory to Forest Consultation and Revenue Sharing Agreements, and a summary of other agreements described above.

In addition to the agreements listed below, several First Nations have obtained area or volume-based forest tenures within the North Island TSA increasing their participation in the forest sector.

Table 2. Summary of First Nations in the North Island TSA

First Nation	Agreement or Treaty (or Other)
Cowichan Tribes	Member of the Hul'qumi'num Treaty Group
Ehattesaht Chinehkint First Nation*	
Gwa'sala-'Nakwaxda'xw Nation	Gwa'sala-'Nakwaxda'xw Nation Consultation Engagement Framework
Halalt First Nation	Member of the Hul'qumi'num Treaty Group
Xwemalhkwu (Homalco)	Xwemalhkwu (Homalco) Forest Consultation and Revenue Sharing Agreement
Klahoose First Nation*	
K'omoks First Nation	Nanwakolas/British Columbia Framework Agreement (2016 Amending Agreement)
	Nanwakolas Reconciliation Protocol
Kwakiutl First Nation	Kwakiutl Forest Consultation Revenue Sharing Agreement, Douglas Treaties
Ka:'yu:k'tkh_Che:k:tles7et'h' First Nation	Maa-nulth Treaty
Lake Cowichan First Nation	Member of the Hul'qumi'num Treaty Group
Lyackson First Nation	Member of the Hul'qumi'num Treaty Group
Ma'amtagila First Nation*	
Mamalilikulla First Nation	Nanwakolas/British Columbia Framework Agreement (2016 Amending Agreement)
	Nanwakolas Reconciliation Protocol
Mowachaht/Muchalaht First Nation	Mowachaht/Muchalaht Forest Consultation and Revenue Sharing Agreement
'Namgis First Nation	Namgis Consultation Engagement Framework Agreement (CEFA), Namgis Forest Consultation Revenue Sharing Agreement
Nuchatlaht First Nation	Nuchatlaht Forest Consultation Revenue Sharing Agreement
Penelakut Tribe	Member of the Hul'qumi'num Treaty Group
Qualicum First Nation*	
Quatsino First Nation*	
Stz'uminus First Nation	Member of the Hul'qumi'num Treaty Group
Tla'amin Nation	Tla'amin Final Agreement Act; Tla'amin Nation (Sliammon) Forest Consultation and Revenue Sharing Agreement
Tlatlasikwala First Nation*	Tlatlasikwala First Nation Forest & Range Consultation and Revenue Sharing Agreement (under renewal)
Tlowitsis First Nation	Nanwakolas/British Columbia Framework Agreement (2016 Amending Agreement)
	Nanwakolas Reconciliation Protocol
Tseshaht First Nation	Tseshaht First Nation Forest & Range Consultation and Revenue Sharing Agreement
Wei Wai Kum First Nation	Nanwakolas/British Columbia Framework Agreement (2016 Amending Agreement)
	Nanwakolas Reconciliation Protocol
We Wai Kai Nation	We Wai Kai Forest Consultation and Revenue Sharing Agreement

*Several First Nations that assert Aboriginal Interests within the North Island TSA do not have a consultation agreement with the Province. The *Interim Updated Procedures for Meeting Legal Obligations When Consulting First Nations* guides consultation with these First Nations. These First Nations include: Ehattesaht Chinehkint

First Nation, Klahoose First Nation, Qualicum First Nation, Quatsino First Nation and the Tlatlasikwala First Nation.

Regional economy

The major communities and corresponding populations (2016 census data) include Campbell River (32,588), Courtenay (25,599), Comox (14,028) and smaller communities of Port Hardy (4,132), Cumberland (3,753), Port McNeill (2,337), Gold River (1,212), Port Alice (664), Sayward (311), Tahsis (248), Kyuquot (200) and Zeballos (107). Economic activity includes forestry, mining, commercial and recreational fishing, aquaculture, public sector and tourism.

The most recent economic dependency estimates provided by BC Stats show the main sources of employment in the North Island TSA area are health care and construction. Forestry and logging, support activities and wood product and paper manufacturing account for 3,055 local jobs. Permanent closures of several wood product manufacturing facilities in the TSA area have reduced the number of direct jobs over time.

Currently, within the North Island TSA there is a small processing sector consisting of 10 small lumber mills, 2 chip facilities, 5 shake and shingle mills, and a utility pole facility. The current capacities of these facilities are as follows:

Table 3. Wood processing facilities in the North Island TSA

Facility type	Estimated annual capacity	Units
Chip	144	Thousand bone dry units (bdu)
Lumber	19	Million board feet (mmbf)
Shake and Shingle	126	Thousand of squares
Utility/Poles	14	Thousand pieces

Most of these facilities are not associated with the tenure holders. The volume produced by the North Island TSA AAC surpasses the volume the local facilities can process. Beyond what is supplied locally, wood is transported out of the TSA primarily to processing facilities along the Fraser River. A lesser amount is moved on Vancouver Island to South Island processing facilities. In addition, a proportion of the volume from some of the larger licensees is sold on the export market.

The current AAC is apportioned to Replaceable Forest Licences (64 percent), Non-replaceable Forest Licences (four percent), First Nations Woodlands Licence (one percent), First Nations Non-replaceable Forest Licence (one percent), BC Timber Sales Licences (29 percent), and Forest Service Reserve (one percent).

Land use planning

The Vancouver Island Land Use Plan is a strategic Crown land use plan for Vancouver Island (excluding Clayoquot Sound area). The plan covers all of the Crown land and resources, including lakes and rivers in the plan area, nearshore coastal zone and some offshore islands. The plan contains land and resource management objectives and strategies that apply to the Crown land base and to identified mapped resource management zones (including special management, enhanced management, and general management zones).

Effective December 1, 2000, an order establishing objectives set by government with respect to the VILUP made legal specific objectives from VILUP pursuant to the *Forest Practices Code* (FPC) Sections 3(1) and 3(2). Landscape unit plans (LUPs) for certain landscape units (LUs) were subsequently completed providing direction for managing old growth forest, wildlife trees and other values important to sustaining biological diversity. Some of the plans have associated legal orders specifying requirements for objectives such as old growth, biodiversity, and wildlife, among others.

Forest development in the TSA is required to be consistent with those legally established objectives of this higher level plan. The timber supply analysis assumed that forest management and timber harvesting will be consistent with the VILUP and associated LUPs.

Land base and forest management changes since last TSR(s)

There have been a number of changes since the last TSRs, with the biggest change being the reconfiguration of the portions of the former Kingcome and Strathcona TSAs to create the North Island TSA. The remainder of the two former TSAs was included in the Great Bear Rainforest South TSA. Major data sets used in this TSR are either a combination of a portion of the former Kingcome TSA data and a portion of the former Strathcona TSA data or a new contiguous dataset (not previously used). Either way, comparison of areas to previous TSR assumptions is difficult.

Where consistent data were available for both the former Kingcome and Strathcona TSAs, or data were not a base requirement, a consistent assumption was applied through the whole North Island TSA, as described in the data package. In some cases data sets varied between the two former TSAs and different assumptions were required based on the data available. Even in cases where the same type of data were available for both former TSAs, they may have been completed under separate projects and had separate uncertainties.

The main differences in data used from this TSR to the previous ones are:

- For the areas of the former Kingcome TSA, the unadjusted Vegetation Resource Inventory (VRI) is used in this analysis, in comparison to using the Phase II adjusted VRI in the previous analysis. The previously used adjustment resulted in an overall increase of nine percent in volume and decrease of 10 percent in site index.
- The VRI in a portion of the North Island TSA has certain attributes updated based on Light Detection and Ranging (LiDAR) data. Approximately 4.7 percent of the AFLB was updated.
- The provincial site productivity layer (PSPL) is used in this TSR for all managed stands. In the previous Kingcome analysis, inventory site index was adjusted based on a site index adjustment (SIA) study, while in the previous Strathcona analysis, VRI site index was used. Overall, the PSPL and SIA have higher site index values than the VRI.
- An overall dataset of roads with non-forested right-of-ways categorized by width (semi-spatially). Previously, the Strathcona analysis used an general aspatial reduction, while the Kingcome analysis used a road dataset with non-forested right-of-ways based on two side slope classes.
- A slope-based approach for the terrain stability netdown is used for the former Kingcome TSA, in combination with past harvest performance, as opposed to using older environmentally sensitive area (ESA) soil sensitivity data. For the former Strathcona areas, terrain stability mapping was more recent and is used again.
- Two different approaches were used in the previous TSRs to exclude stands with low site productivity (Strathcona used a low site minimum threshold of 300 cubic metres per hectare and site index less than 10 metres, while Kingcome used a species-based site index limit). For the North Island, a consolidated approach, based on past harvest performance is used, removing those stands that do not reach 300 cubic metres per hectare by the age of 150 years, and 450 cubic metres per hectare for helicopter operable areas.
- An adjusted stand-level biodiversity approach for WTRAs is used that will unify the approach across the TSA, based on past harvest performance and accounting for other forested reserves. Previously, the Kingcome applied LU targets where they existed, and six percent everywhere else. Strathcona applied an approach of the LU targets reduced by 50 percent.
- A contiguous data set for semi-spatial riparian netdowns is used, with buffers applied based on FRPA targets and licensee practice. Previously the Strathcona used an aspatial netdown based on operational inventory extrapolation, while the Kingcome used a spatial netdown.

- Managed stand Table Interpolation Program for Stand Yields (TIPSY) yield tables for individual forest stands have been generated from forest opening level silviculture data in the ministry Reporting Silviculture Updates and Land Status Tracking System (RESULTS) database. Future stands will be modelled on aggregate average tables. Historically, existing managed and future stands were modelled on aggregate TIPSY tables by analysis unit (species, SI and biogeoclimatic ecosystem classification (BEC) based).

History of the allowable annual cut

The table below shows the AAC history of the two former management units that were reconfigured to create the North Island TSA. Both previous units contained portions of the central coast remote operating areas within the new Great Bear Rainforest South TSA (Ecosystem-based management (EBM)).

Table 4. History of the AAC – North Island TSA

Year	North Island AAC (m^3)	Strathcona AAC (m^3)	Non-EBM partition	Deciduous partition	Kingcome AAC (m^3)	Deciduous partition	Low site partition
1980					1,700,000		
1986		1,645,745			1,632,500		
1988					1,769,500	25,000	112,000
1989		1,661,745		16,000			
1992		1,693,745		16,000			
1993		1,505,745		16,000	1,798,270	25,000	112,000
1996		1,420,000		16,000	1,399,000	25,000	130,000
2000		1,278,000					
2002					1,284,000	20,340	
2006					1,232,000	20,340	
2010					1,100,000	14,000	
2015		1,138,000	986,000				
2017	**1,248,100**						

The former Strathcona TSA was created in 1986 with an initial AAC of 1 645 745 cubic metres per year. Until 1992 the AAC was increased twice, before being lowered in 1993. TSR 1, in 1996, set the AAC at 1.42 million cubic metres per year, including a deciduous partition[e]. TSR 2, in 2000, set the AAC at 1.278 million cubic metres per year, and eliminated the deciduous partition based on performance. TSR 3, in 2015, set the AAC at 1.138 million cubic metres per year, with a partition for the Vancouver Island portions, outside of EBM areas, of 986 000 cubic metres per year.

The former Kingcome TSA was created in 1980 with an initial AAC of 1.7 million cubic metres per year. The boundary was adjusted in 1986 when the Loughborough supply block was moved into the Strathcona TSA, resulting in an AAC reduction. The AAC was then increased when special (partition) licenses were allocated in 1988, and increased again with an area addition in 1993. TSR 1, in 1996, set the AAC at 1.399 million cubic metres per year, which continued to include partitions for low productivity stands and deciduous.

[e]**Partition**
Under Section 8(5) of the Forest Act *the chief forester in determining an AAC can specify a portion of the AAC that is attributable to certain types of timber, terrain, or areas of the TSA.*

The AAC was temporarily reduced in 2002 when the Central Coast Designated Area was created. TSR 2, in 2002, set the AAC at 1.284 million cubic metres per year, while the temporary reduction still applied, making the effective AAC 1.24 million cubic metres per year. Only the deciduous partition was maintained. In 2003 the designated area was renewed, with the AAC set at 1.232 million cubic metres. TSR 3, in 2010, set the AAC at 1.1 million cubic metres with a deciduous partition of 14 000 cubic metres per year. The Vancouver Island portions were not partitioned but consisted of 19 percent of the timber harvesting land base[f] (THLB).

The North Island TSA was created from the Vancouver Island portions of the former Kingcome and Strathcona TSAs in January 2017 when the *Great Bear Rainforest (Forest Management) Act* (GBRFMA) and regulations came into effect. The initial AAC was set by legislation, at 1 248 100 cubic metres per year.

The figure below shows the annual harvest volume since the creation of the TSA. The Harvest Billing System (HBS) is the Ministry of Forest's scale data management and invoicing system, showing actual harvest volume.

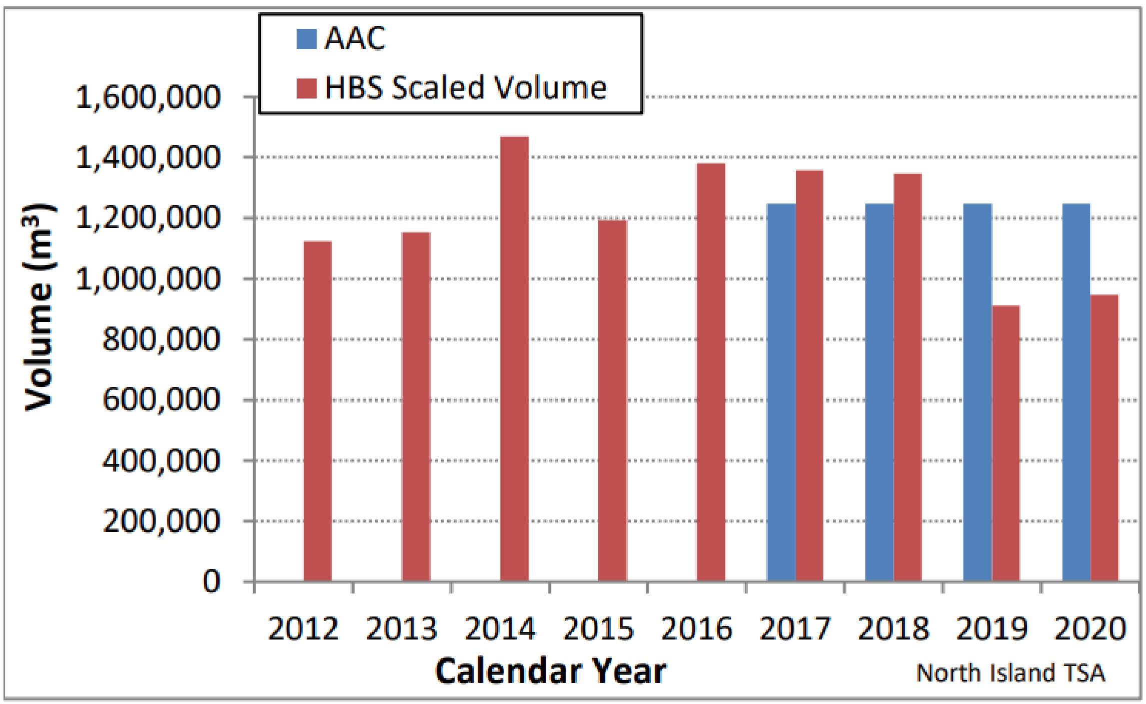

Figure 2. Historic harvest volume in the North Island TSA.

[f]**Timber harvesting land base (THLB)**
The THLB is an estimate of the land where timber harvesting is considered both acceptable and economically feasible, given the objectives for all relevant forest values, existing timber quality, market values and applicable technology. The THLB is derived from the data, forest management practices and assumptions described in the data package. It is a theoretical, strategic-level estimate used for timber supply analysis and could include areas that may never be harvested or may exclude areas that will be harvested.

Forest management

Timber harvesting land base

As part of the process used to define the modelled timber harvesting land base (THLB) in the timber supply analysis, a series of deductions were made from the TSA land base. Table 2 shows categories of land that were considered not to contribute to the THLB. The table presents the area of the categories within the gross TSA boundary and the area for each factor that was uniquely (i.e., no overlaps with other factors) considered excluded from timber harvesting.

After accounting for land base exclusions for ocean, non-provincial lands, and lands not managed within the TSA timber supply, 714 726 hectares of the land base is Section 8 Decision Area (the area to which this AAC decision is applied). Further reductions for surface water, non-forest and roads result in approximately 73 percent (522 557 hectares) of the Section 8 Decision Area classified as analysis forest land base[g] (AFLB). About 33 percent of the AFLB (172 388 hectares, or approximately 24 percent of the Section 8 Decision area) is considered THLB.

[g]**Analysis forest land base (AFLB)**
The forested area of the TSA that the provincial government manages for a variety of natural resource values. This excludes non-forested areas (e.g., water, rock and ice), non-productive forest (e.g., alpine areas, areas with very low productivity), and non-commercial forest (e.g., brush areas). The analysis forest does include federally-protected areas because of their contribution to biodiversity.

Table 5. Land base classification – North Island TSA

Netdown factor	Within gross land base (ha)	Within TSA Section 8 decision area (ha)	Percent of Section 8 decision area (%)	Unique area excluded from THLB (ha)
North Island TSA boundary area	2 426 749			
Ocean	677 289			
North Island TSA gross area	1 749 460			
Non-provincial lands	244 982			
Not managed within TSA AAC	789 755			
Section 8 Decision Area[1]		714 726		
Non-forest[2]		184 783	25.9	184 783
Roads, trails, landings*		8 180	1.1	7 386
Analysis forest land base (AFLB)		522 557		
Provincial parks & reserves		275 500	38.5	137 685
Recreation sites		11 507	1.6	8 067
Recreation trails*		35	0.0	33
Inoperable		110 023	15.4	72 256
Terrain stability[3]		70 829	9.9	37 289
Sites with low growing potential		145 501	20.4	56 050
Problem forest types		8 116	1.1	401
Landscape-level biodiversity - old growth management areas (OGMA)		47 828	6.7	14 008
Stand-level biodiversity - wildlife tree retention areas (WTRA)		1 166	0.2	777
Stand-level biodiversity - future wildlife tree retention areas (future WTRA)*		9 609	1.3	8 594
Wildlife habitat areas and wildlife management areas		13 345	1.9	2 059
Ungulate winter range		13 456	1.9	335
Riparian reserves & management areas*		21 532	3.0	8 733
Archaeological sites		3 908	0.5	1 968
PSP & research installations		827	0.1	702
Karst		3 542	0.5	1 212
Current timber harvesting land base		172 388	0.24	
Future roads		TBD		
Future timber harvesting land base		TBD		

*These factors (roads, trails, and landings; riparian reserves and management areas; lakeshore management zone reserves; and stand-level biodiversity) are to be modelled by a semi-spatial netdown given the raster format used for the analysis.

Data source and comments:

1. Section 8 Decision Area includes Timber Licence areas which will revert to TSA once harvested (70C).
2. Non-forest gross area is exluding ocean area.
3. Terrain stability includes a variety of netdowns from 100 percent netdown for unstable and environmentally sensitive areas and 40 percent netdown for potentially unstable areas; the netdown areas have been reduced to reflect these values.

Land base description

The following graphs describe the current characteristics of the land base in the North Island TSA in more detail.

The North Island TSA is predominantly within the CWHvm1 biogeoclimatic subzone/variant, where forests on zonal sites are dominated by western hemlock, amabilis fir, and lesser amounts of western redcedar. CWHvm2 occurs in higher elevations above the vm1 and contain similar species. Wetter coastal areas in the CWHvh1 are dominated by western hemlock, accompanied by amabilis fir, western redcedar, and minor amounts of yellow-cedar, while the drier, more southern areas of the TSA that fall within the CWHxm are dominated by Douglas-fir and western hemlock, accompanied by western redcedar.

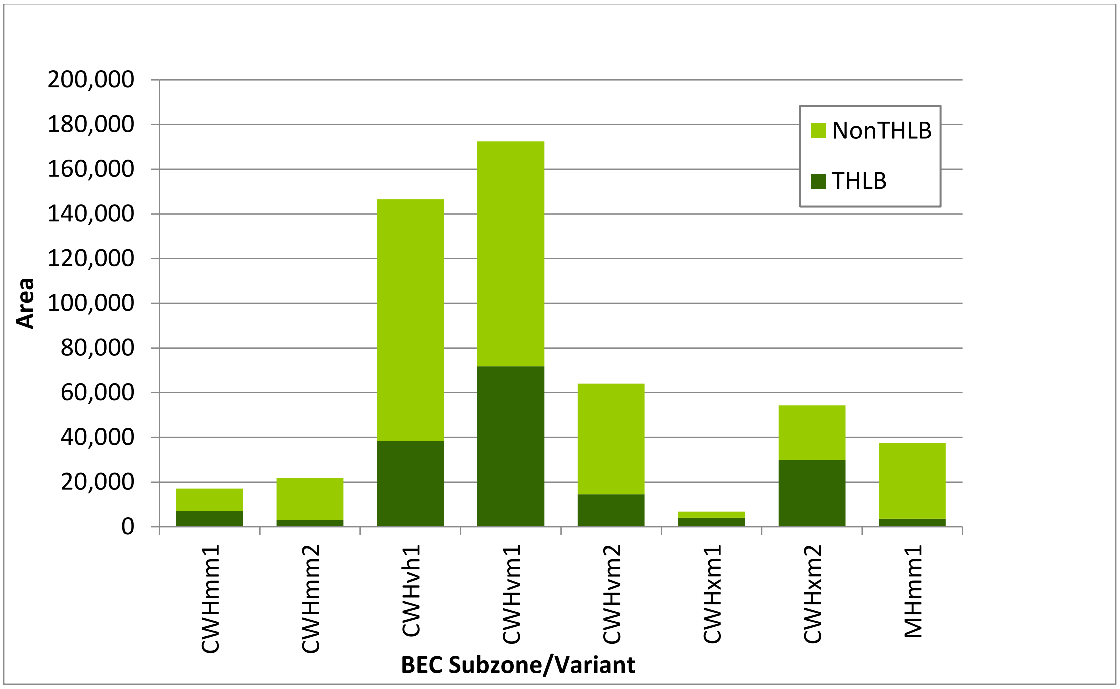

Figure 3. Biogeoclimatic ecosystem classification in the North Island TSA.

Forests within the North Island TSA have a varying site index[1]; the majority of the THLB is within the 20-30 metres range, with more productive sites reaching higher than 35 metres site index. It is rare in this management unit to see harvest in site index less than 10 metres. Null is where there is no leading species in the VRI and/or no species match in the provincial site productivity layer (PSPL) data for leading species. A site index conversion is used where there is no species match in the PSPL.

[1] Site index is a measure of site productivity based on the top height (m) of a stand at breast-height age 50.

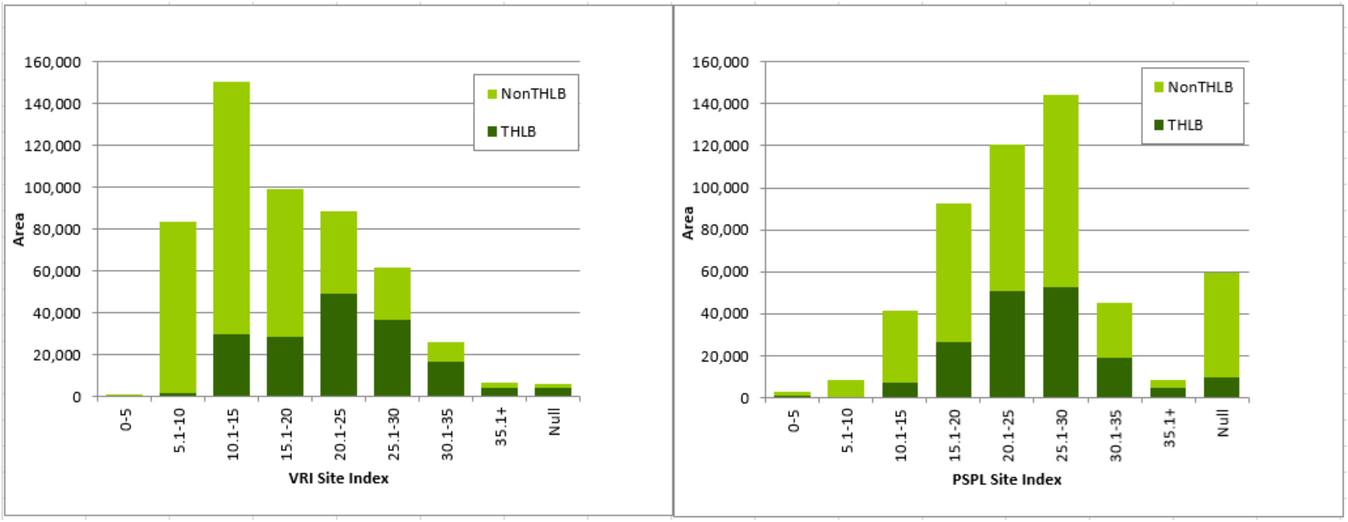

Figure 4. Site index (VRI and Provincial Site Productivity Layer) in the North Island TSA.

The figure below shows the current age class distribution for stands in the AFLB separated by THLB and non-THLB. The age class distibution contains a large component of forested area greater than 250 years, with the non-THLB greater than 250 years being predominantly contained in park areas. The older second growth (30-100 years) is concentrated in the Sayward supply block (east side of DCR) while the remainder of the TSA is predominantly old stands, or young regenerating stands.

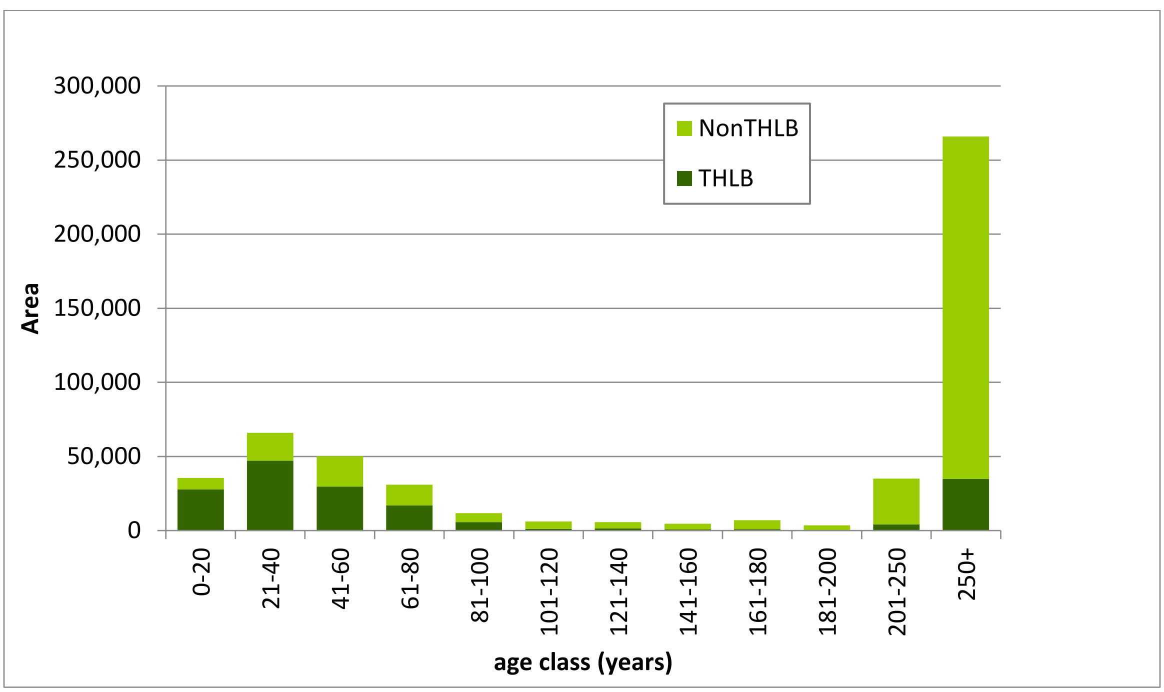

Figure 5. Age class distribution in the THLB and non-THLB in the North Island TSA.

These figures show the leading species breakdown in the forested areas of the TSA. The main species in both the AFLB and THLB is western hemlock with a minor western redcedar component. Drier areas are dominated by Douglas-fir. Higher elevations have a component of yellow-cedar.

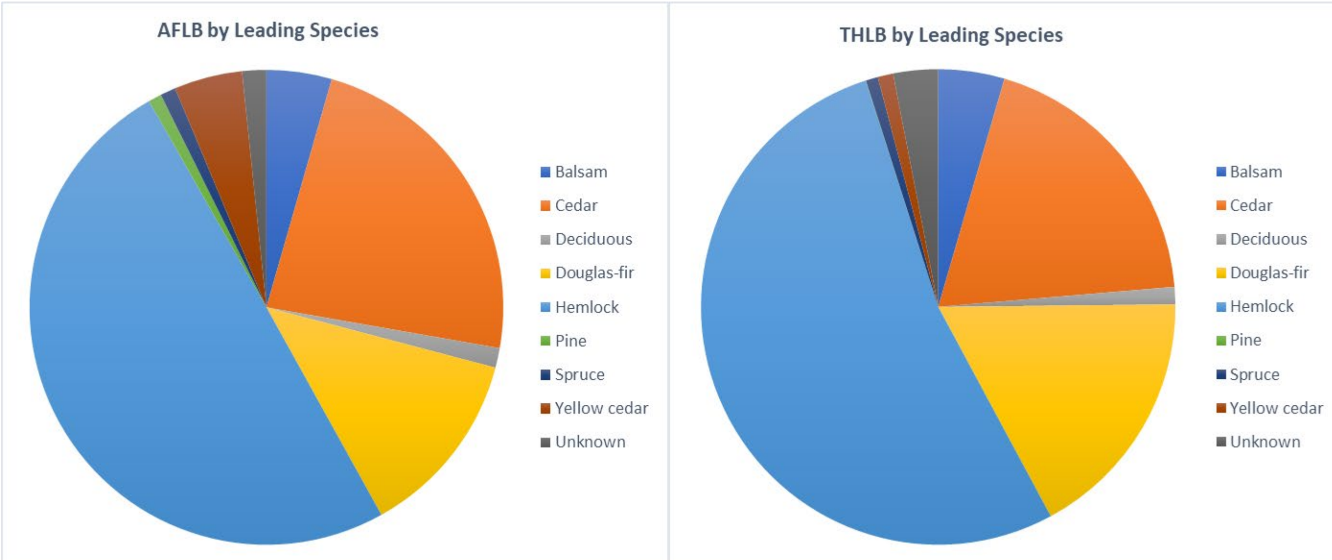

Figure 6. Land base area by species in the North Island TSA.

The figure below shows the species breakdown by volume, within the THLB, in the North Island TSA. The breakdown by area (above) shows the species components, which include younger stands, in comparison to the volume by species graphs (below) in which young stand volumes make little contribution. The volume in the TSA is predominantly western hemlock, while amabilis fir is usually a secondary species. Western redcedar and yellow-cedar occur as a minor component within these stands. Douglas-fir dominates drier sites.

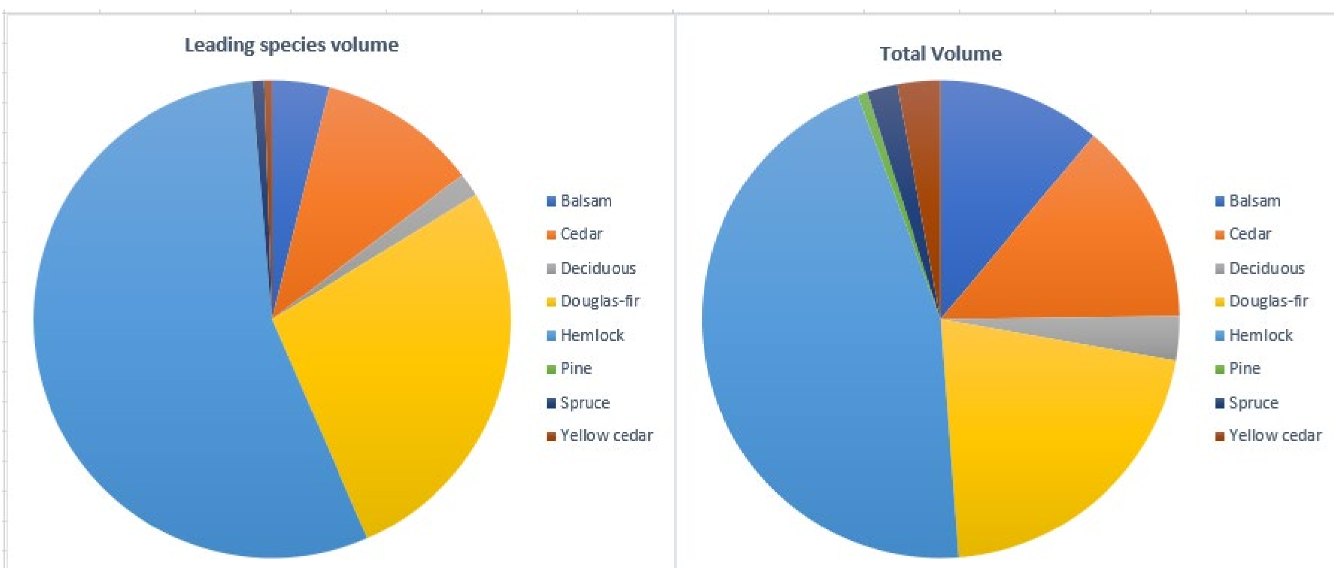

Figure 7. Land base volume by species within the THLB in the North Island TSA.

Timber supply analysis

For most AAC determinations, a timber supply analysis is carried out using three categories of information: land base inventory, timber growth and yield, and management practices. Using this information and a computer model, a series of timber supply projections are produced to reflect different starting harvest levels, rates of decrease or increase, and potential trade-offs between short- and long-term harvest levels.

From a range of possible projections, one was chosen which attempts to avoid both excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This is known as the 'base case' and forms the basis for comparison when assessing the effects of uncertainty of the information modelled on timber supply. The base case is designed to reflect current management practices.

Because it represents only one in a number of possible projections, and because it incorporates information and modelling assumptions about which there may be some uncertainty, the base case is not an AAC recommendation. Rather, it is one possible timber supply projection, whose validity - as with all the other projections provided - depends on the validity of the data and assumptions incorporated into the computer model used to generate it.

Due to the existence of uncertainty in the timber supply analysis, additional projections are usually prepared to test the effect of changing some of the assumptions or data used in the base case. These additional projections are either 'alternative harvest projections' or 'sensitivity analyses'. Alternative harvest projections test the feasible alternatives to the base such as partitioning the existing land base while the sensitivity analyses test the uncertainties that affect timber supply to varying degrees. The base case, alternative harvest projections and sensitivity analyses are prepared using a computer model that projects the future availability of timber for harvesting based on the growth of the forest and the level of harvesting, while staying within the legal land use objectives established by the provincial government.

The base case

The base case for the North Island TSA projects a harvest level of 1 248 100 cubic metres per year for 30 years before decreasing to a long-term harvest level of 1 170 000 cubic metres per year for the remainder of the projection. Included in the first 10 years of the projection is an additional harvest of 75 000 cubic metres per year to account for licences to be issued to harvest past accumulated volume. This base case initial harvest rate is the same as the current AAC (1 248 100 cubic metres per year), set by the GBRFM Regulation, in 2017.

It is difficult to compare the harvest flow over time to previous TSRs, though it is clear that both TSAs were initially declining to the maximum mid-term harvest level, similar to the current base case. The North Island TSA was created from the more operable and accessible Vancouver Island areas of the former Kingcome and Strathcona TSAs with a greater history of harvesting, which explains why, in comparison to the other two TSA projections, the mid-term level is achieved sooner. When an attempt was made to raise the harvest level in later years of the projection, the result was a decline in long-term growing stock.

In this analysis, the base case was constructed first by determining the long-term even-flow harvest level, which is 1.17 million cubic metres per year, as shown in Figure 8. The short term was then increased to the current AAC (1.248 million cubic metres per year) and maintained as long as the metrics (e.g., harvest cutblock size, stand types) reflected current practice (30 years). Harvest cutblock size was one of the key metrics.

The transition between the short- and long-term occurs at the end of the third decade when a long-term sustainable harvest flow is achieved. The long-term harvest level ensures the growing stock and other metrics are steady after an initial decline due to the step down. Scenarios showing other possible short- and long-term harvest levels are provided as alternate harvest projections.

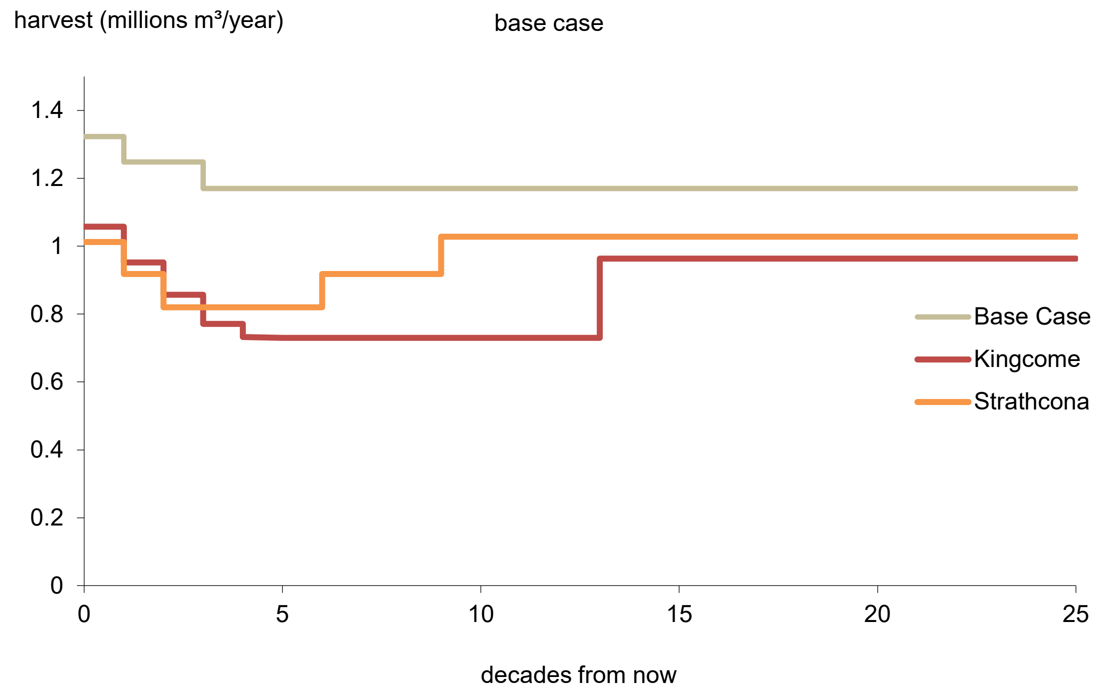

Figure 8. Base case harvest flow – North Island TSA.

In the base case, the highest volume stands are prioritized for harvest. While there is recognition that substitution of stands with different characteristics is often operationally feasible without affecting the harvest flow, it is important to reflect on the timing of the contribution of different stand types to the harvest flow in the base case *versus* current operational expectations. Figures 9 to 13 present the characteristics of the stands harvested in the base case and the trends observed are discussed below.

Figure 9 shows the growing stock over time for the base case. This metric was assessed for all harvest projections, ensuring sustainability in meeting the harvest request. The growing stock for the base case drops initially, consistent with the transition to thrifty and managed stands, and remains stable averaging 48 million cubic metres in the THLB, with an average of 23 million cubic metres of growing stock available for harvest.

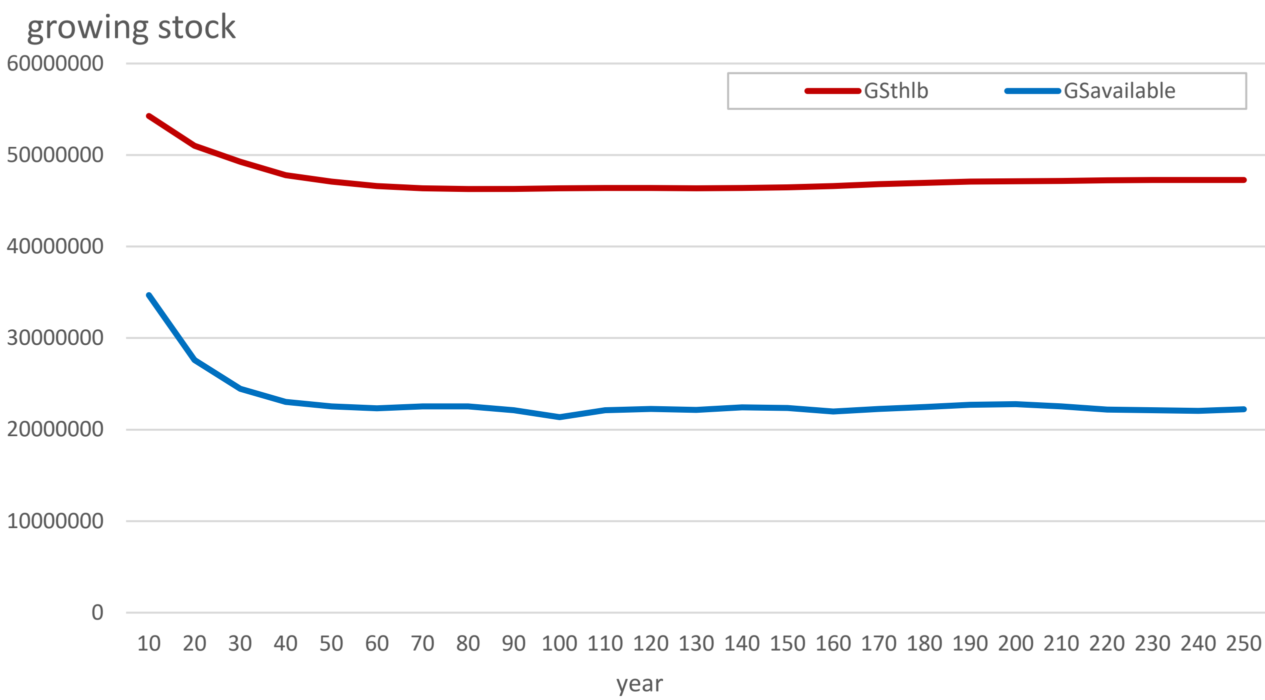

Figure 9. Total and THLB growing stock for the base case - North Island TSA.

Figure 10 presents the projected harvest of stand types over time. Managed stands are those equal to or less than 30 years of age, thrifty stands are greater than 30 years and less than 250 years, while old stands are greater than or equal to 250 years. The harvest projection begins with 43 percent old volume, and 57 percent thrifty volume, that transitions at decade four to include managed stands. The thrifty and old continue to drop gradually over time as the managed volume becomes increasingly available. Managed stands increase until they make up the majority of the harvest by year 60; and by year 120, both thrifty and old stands make negligible contributions to the harvest.

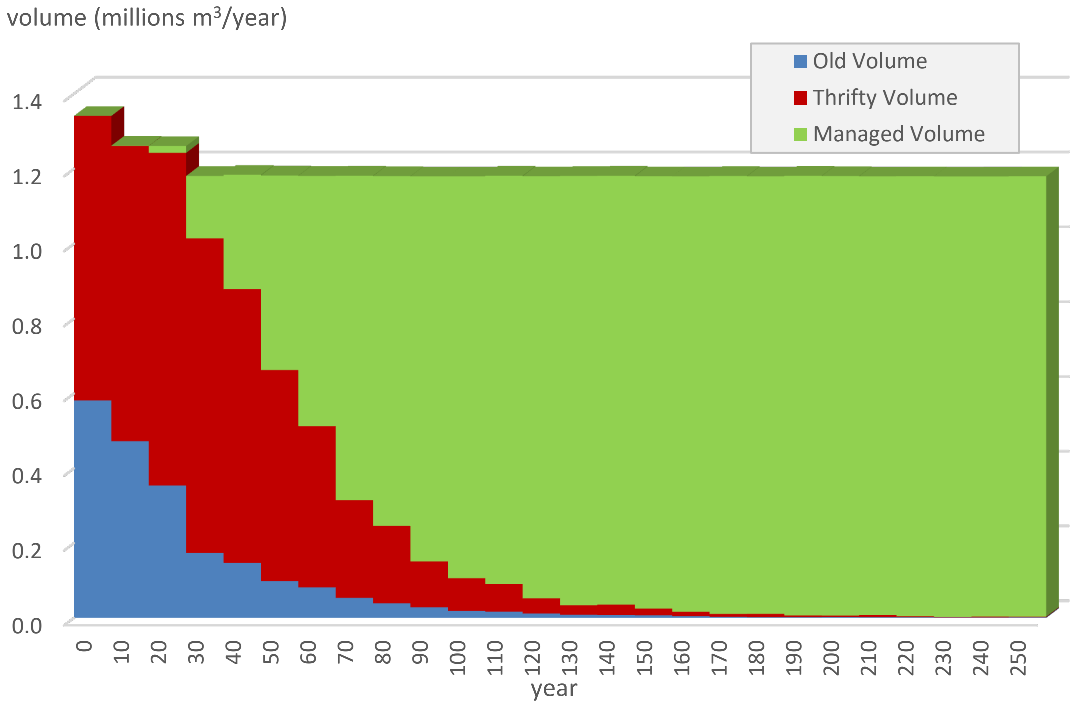

Figure 10. Volume by old, thrifty and managed stand types for base case – North Island TSA.

Figure 11 presents a proportionalized view of the previous figure, showing the timing of the transition from old and thrifty stands to managed stands at decade three and the gradual decline of both old and thrifty stands to decade twelve.

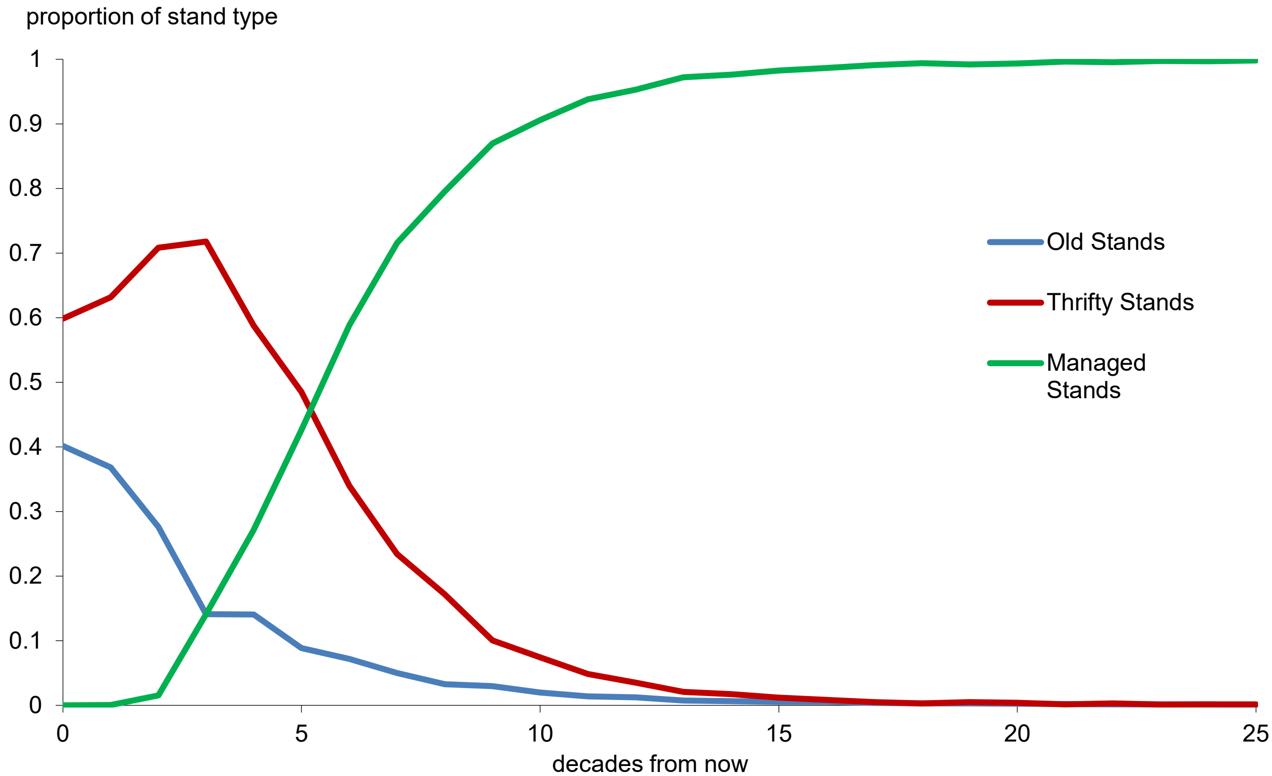

Figure 11. Contribution from stand types – North Island TSA.

Figure 12 presents the changes in mean volume per hectare and the mean harvest age over time. The mean harvest volume remains around 650 cubic metres per hectare until year 40 after which it declines to fluctuate around 590 to 600 cubic metres per hectare and remains constant through the rest of the time horizon, averaging 595 cubic metres per hectare. These changes are consistent with the timing of the transition between old, thrifty and managed stands.

The mean harvest age begins at 191 years and declines by year 40 to 116 years. This is followed by a more gradual decline over time until a consistent average harvest age of 80 is reached. Managed stands have younger ages and lower volumes than thrifty and old stands; however, managed stands will have more consistent size and grade.

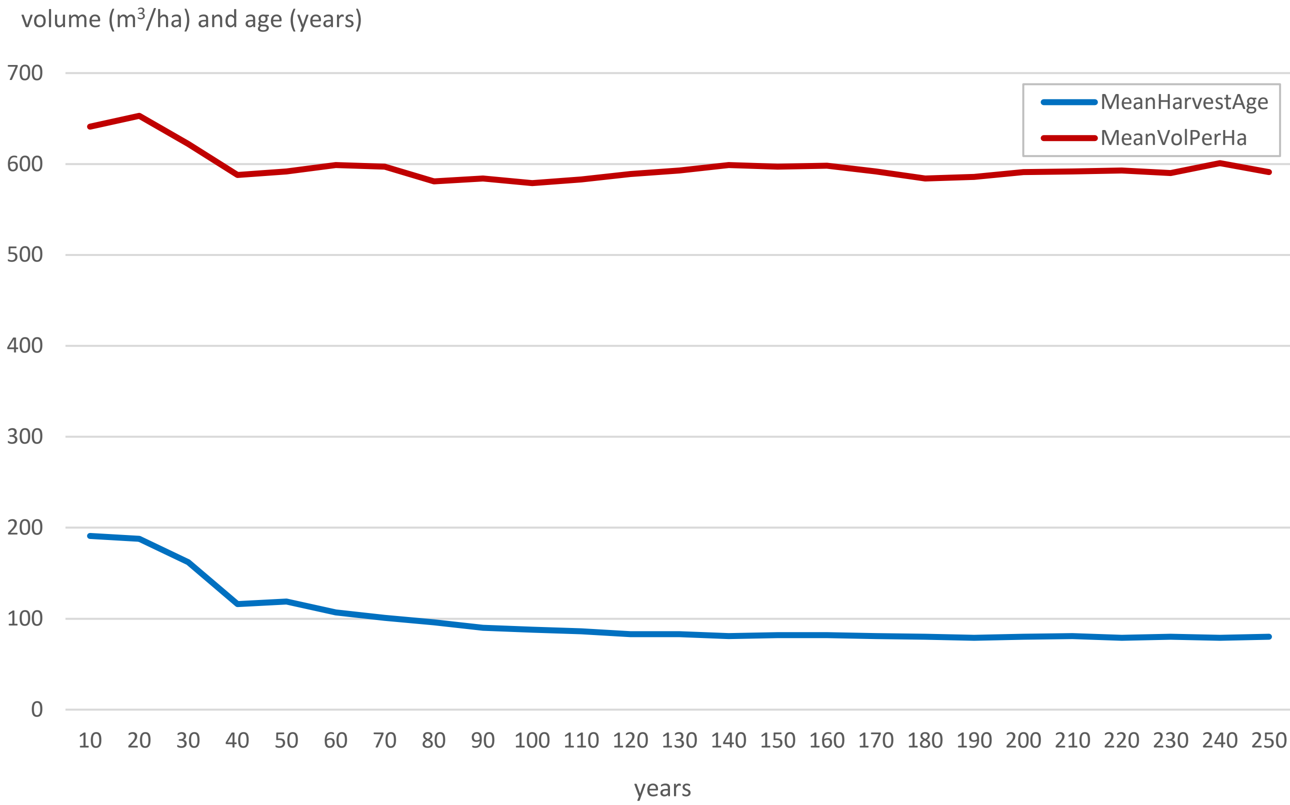

Figure 12. Mean volume per hectare and mean harvest age for base case – North Island TSA.

Figure 13 shows the average area harvested over time in the base case. The area harvested is at its highest point in the first decade (2092 hectares) followed by a low of 1930 hectares in the second decade. After that point, the average area harvested varies less around the average area of 2000 hectares per year.

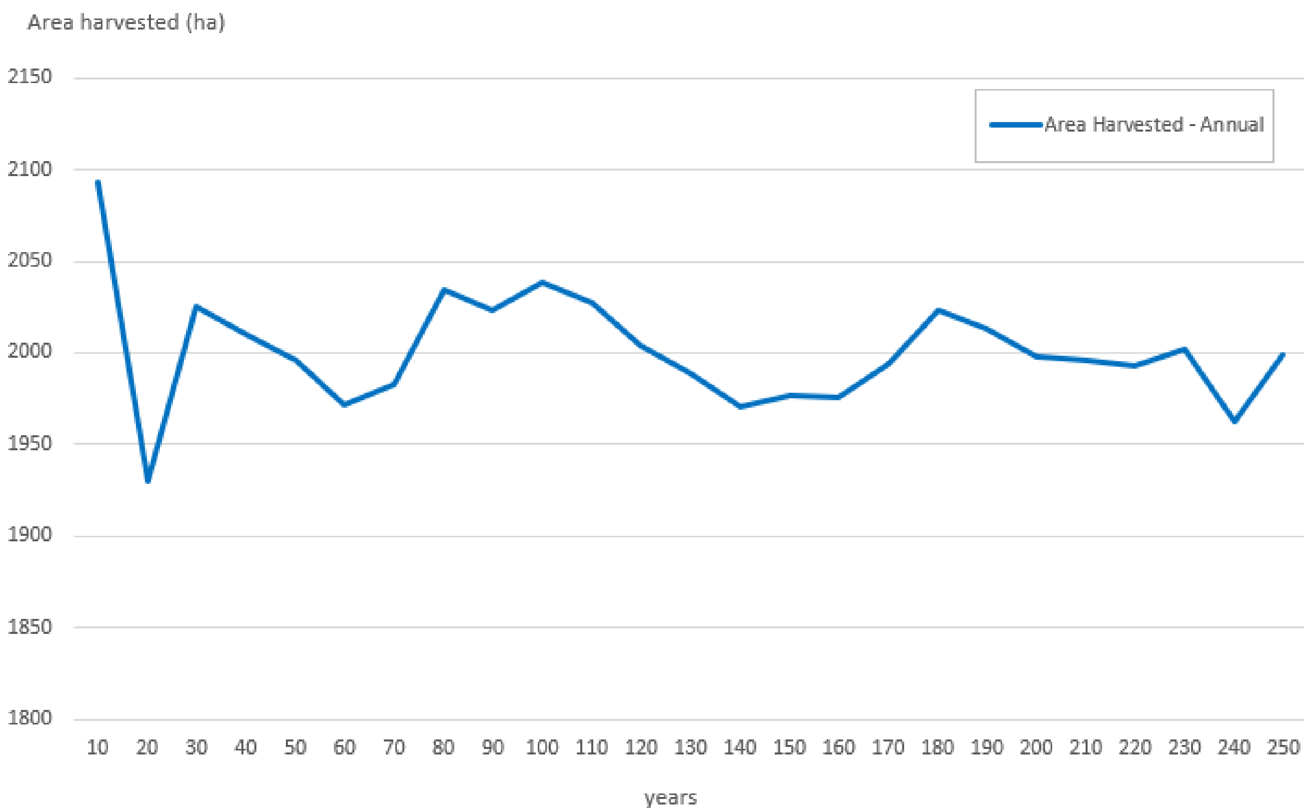

Figure 13. Area harvested over time for the base case - North Island TSA.

Figure 14 shows the average harvest block size contributing to the base case. The average block size in the North Island TSA, based on a summary from Reporting Silviculture Updates and Land Status Tracking System (RESULTS), is 16.8 hectares. In the base case, the modelled block size is initially above 20 hectares but drops at year 30 as the old and thrifty stands are declining and the managed stands are not yet available. It stabilizes over time at an average of 16 hectares.

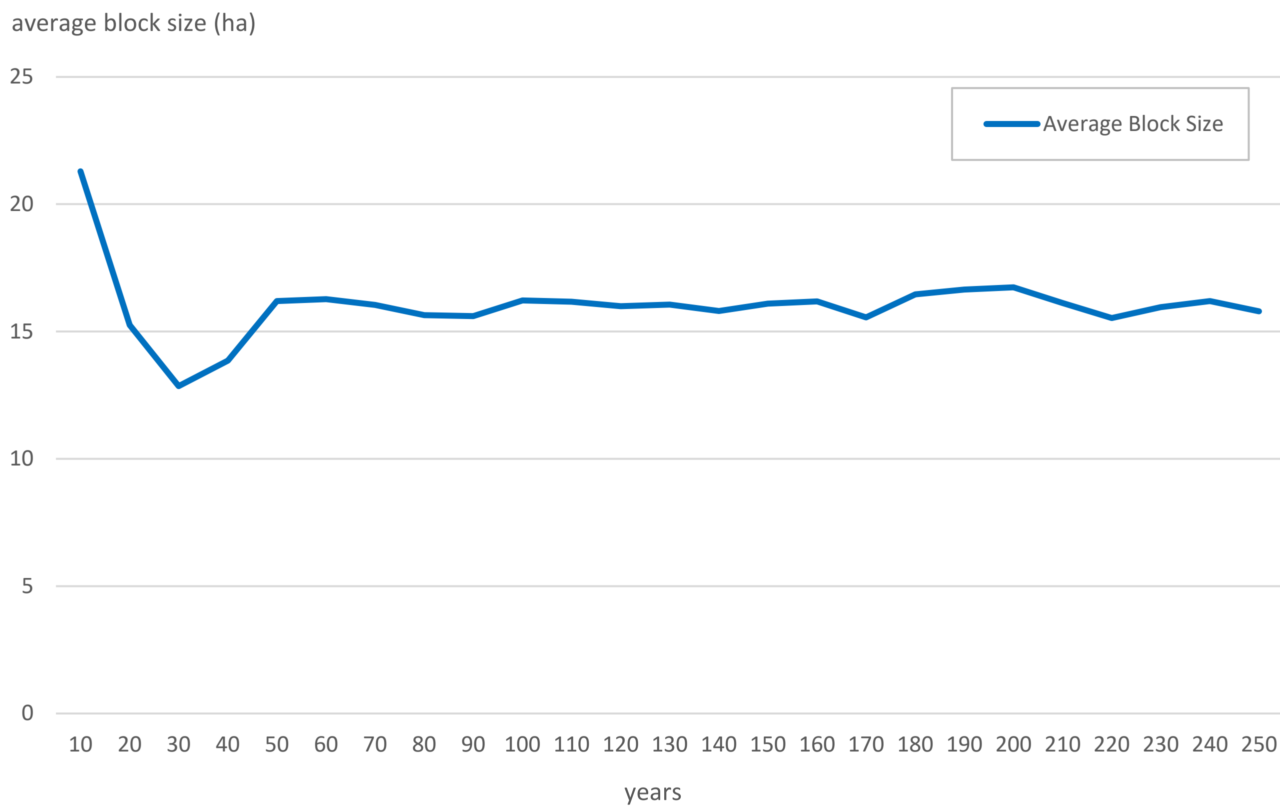

Figure 14. Average block size for the base case - North Island TSA.

Alternative harvest projections

The base case is one of many alternative harvest projections possible. Presented below are four alternatives that demonstrate how changing the initial harvest level or changing the assumptions regarding partitioning the land base can affect the projected harvest levels in the following decades. Five alternative harvest projection groupings explore the implications of 1) highest short-term harvest vs. longest term at the current AAC, 2) partition of all helicopter stands vs. partition of only high value helicopter stands (western redcedar >30%), 3) natural resource district partition, 4) East, West, North area-based partition and 5) red alder partition.

Highest short-term harvest versus longest term at the current AAC

When testing alternative projections and sensitivity analysis impacts, just the harvest level and growing stock were evaluated to ensure the harvest level did not dip below the maximum even-flow for the scenario and the growing stock did not decline over time. For the base case, a more detailed review was done to ensure all other metrics, including harvest block size over time, were reflective of current practice.

These two scenarios provide a base of reference, had the base case been pushed to the maximum without looking beyond harvest level and growing stock. In both cases the average block size falls significantly over time as the model tries to achieve the higher request. These provide a better baseline reference for comparison to the sensitivity analyses, in terms of percent impacts, because the same metrics were being considered.

In the highest short-term harvest scenario, the short-term increase is 6.3 percent, while the long-term increase is 0.9 percent. The long-term harvest level increase resulted from increased short-term harvest which established additional area growing as managed stands. These extra managed stands accumulate volume faster than natural stands and eventually support a small increase to the long-term harvest level.

In the longest term at the current AAC scenario there is no increase or decrease in harvest level but the current AAC is maintained for 80 years before dropping to the long-term harvest level.

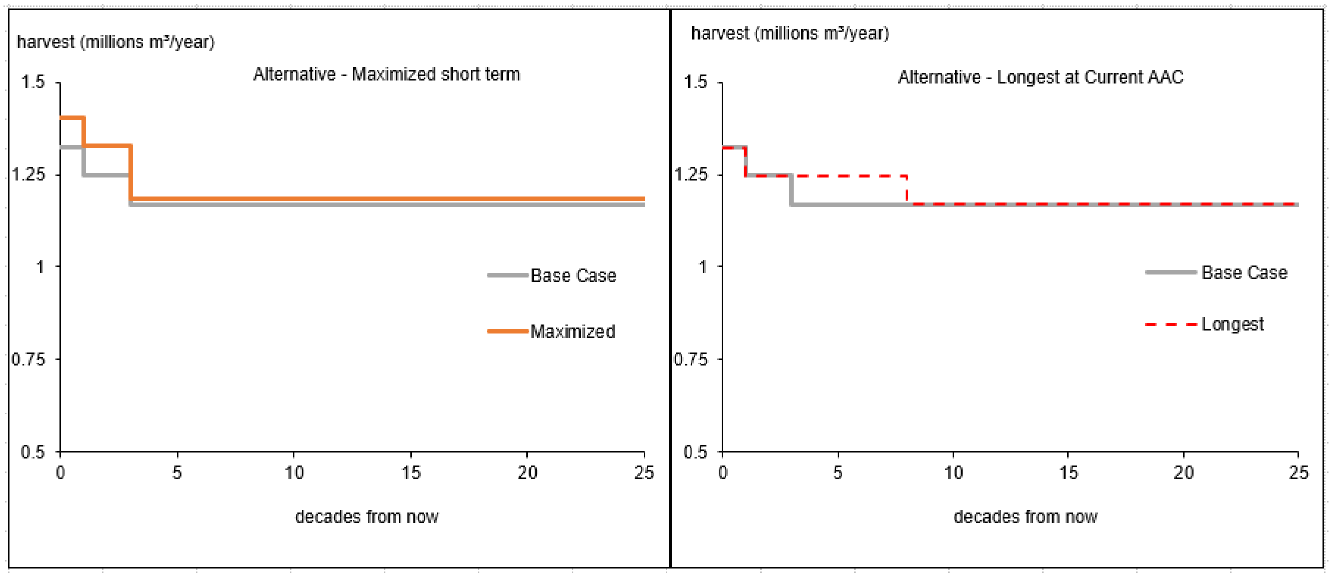

Figure 15. Alternative flows - highest short-term harvest versus longest term at the current AAC for the North Island TSA.

Partition of all helicopter stands versus partition of only high value helicopter stands (western redcedar >30%)

The ability of licensees to operate in areas that are only accessible by helicopter varies with the log values, due to the high cost of helicopter yarding in comparison to other methods. Western redcedar has a higher value and has been more consistently harvested by helicopter over time. Mixed hemlock and balsam stands have been less consistently harvested because of lower log value. There is a risk of overharvesting the core (conventionally accessible) land base if the helicopter accessible areas contributing to the base case are not harvested.

The contribution of helicopter accessible areas to the base case, based on the harvest system mapping, is 10 percent in the first decade, dropping to seven percent in the following two decades and then averaging four percent for the remainder of the time period. It is difficult to summarize historic harvest levels utilizing helicopters as it is not reported. Based on the harvest system mapping, updated for this TSR, the proportion of historic harvesting within helicopter accessible areas is less than five percent, while the helicopter accessible areas accounts for approximately five percent of the land base.

Sensitivity analyses tested the effect on timber supply of regulating the harvest from areas only accessible by helicopter using a partition. When a partition is implemented for helicopter accessible areas (all stand types), 56 000 cubic metres per year of volume can be harvested annually from the partition. There is no impact on the overall harvest in this scenario. If a partition is implemented for helicopter accessible areas with greater than 30 percent western redcedar in the stand (according to the current inventory), while the remaining helicopter accessible areas are considered uneconomic and excluded from harvesting, 18 000 cubic metres per year of volume can be harvested from the partition. There is no impact in the first three decades of this scenario, while the long-term harvest is reduced to 1.13 million (from 1.17 million) cubic metres per year of harvest. This long-term reduction is due to the helicopter accessible areas with less than 30 percent western redcedar being excluded from harvesting.

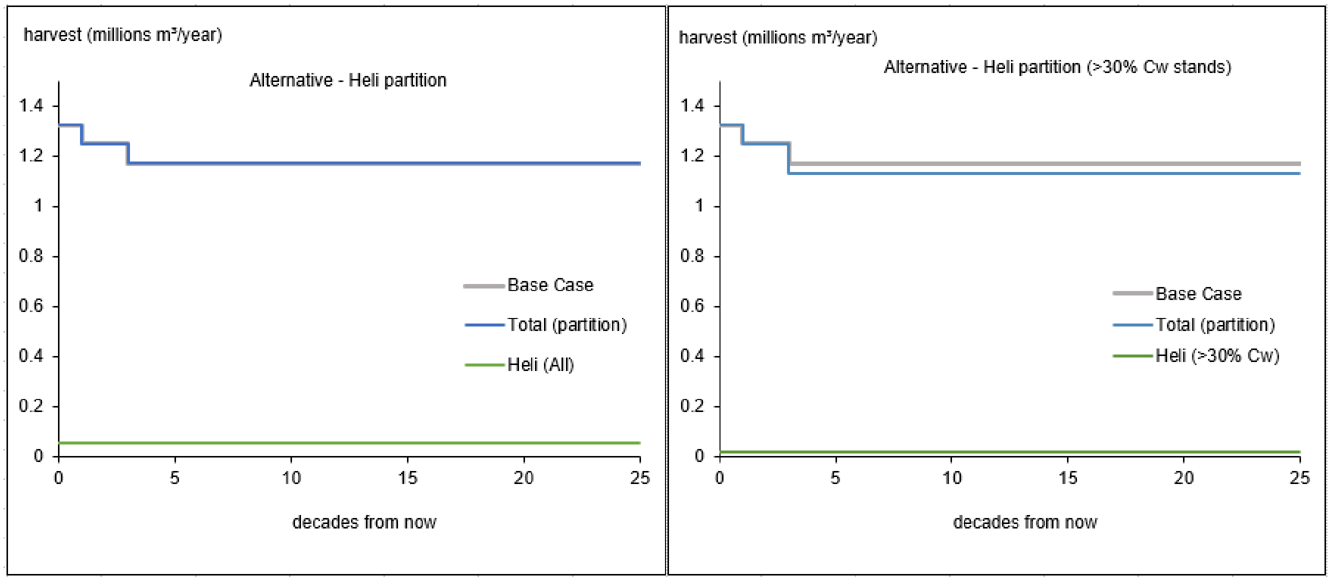

Figure 16. Alternative flows – partition of all helicopter stands versus partition of only high value helicopter stands (western redcedar >30%) for the North Island TSA.

Natural resource district partition

It is unusual for a TSA boundary to span different natural resource districts. Administration of harvested volume is processed through each district consistently, based on AAC apportionment and licences allocated, and licensee chart areas linked to those licences. Current apportionment is based on volumes outlined in the Great Bear Rainforest (Forest Management) Regulation, and chart areas were carried over without adjustment when the North Island TSA was created. AAC contributions were 986 000 cubic metres per year for the DCR areas (79 percent; former Strathcona non-Ecosystem Based Management partition) and 262 100 cubic metres per year for the DNI areas (21 percent).

In the base case, the average harvest contribution from DNI was 21 percent, varying between 16 percent (4th decade) and 25 percent (1st decade). The current contribution of harvest from DNI is 262 100 cubic metres per year, while to achieve the 25 percent contribution in the first decade of the base case, a harvest of 331 000 cubic metres per year from DNI would be required. In the case of DCR, 992 000 cubic metres per year would be required to achieve the full volume, including the committed volume, in comparison to the current harvest contribution of 986 000 cubic metres per year.

The ability to meet the harvest level in the base case is heavily dependent on the balance of harvest profile between districts during the initial 30 years. Between years 20 to 30, approximately 70 percent of the harvest volume is made up of existing thrifty stands (greater than 30 years and less than 250 years while old). This is the most constrained time step. The contribution of thrifty stands then declines until the future managed stands make the largest contribution by year 50. Any adjustments made to the contribution and availability of existing managed stands, comprised mainly from stands on the east side of DCR, significantly affects the short-term harvest level.

If a partition was implemented to regulate the harvest from both DCR and DNI, the contribution of DNI to the overall harvest would be 250 000 cubic metres per year in the long term with a small uplift in the short term. The long-term contribution of DCR to the overall harvest would be 920 000 cubic metres per year. The total long-term harvest level relative to the base case would drop 0.8 percent to 1.16 million cubic metres per year, while the short term would drop 6.2 percent to 1.17 million cubic metres per year, while still allowing the committed accumulated volume of 75 000 cubic metres per year in the first decade.

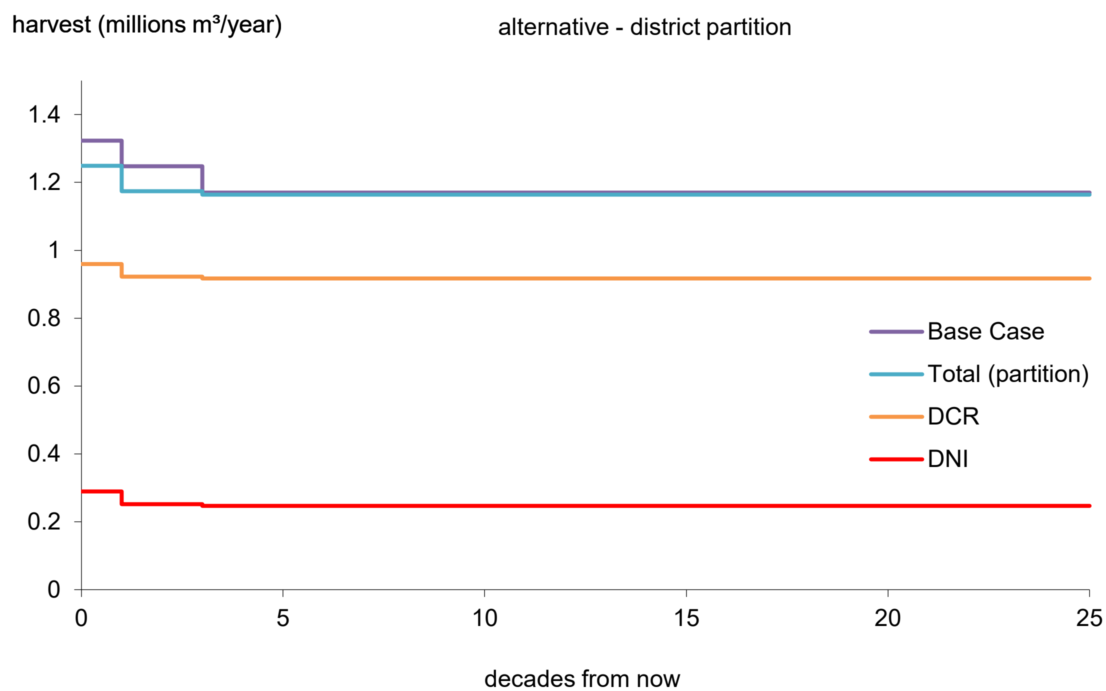

Figure 17. Alternative flow: natural resource district partition for the North Island TSA.

East, west, north area-based partition

In addition to the TSA spanning two separate districts, there are two zones within DCR which have very different timber profiles, which contribute significantly to the harvest at different times in the harvest sequence. The west side of the district is primarily composed of older natural stands, while the east side is primarily composed of existing managed (thrifty) stands which play a critical role in supporting the timber supply until regenerating stands reach minimum harvestable criteria.

As noted in the analysis discussed in the previous section, the average contribution from DNI was 21 percent, varying between 16 percent (4th decade) and 25 percent (1st decade). The average contribution from the west side of DCR was 47 percent, varying between 29 percent (1st decade) and 52 percent (5th decade). The average contribution from the east side of DCR was 32 percent, varying between 29 percent (24th decade) and 46 percent (1st decade).

If a partition were implemented to regulate the harvest from these zones, the contribution of DNI to the overall harvest would be 245 000 cubic metres per year in the long term with a small uplift in the short term. The long-term contribution of the west side of DCR to the overall harvest would be 547 500 cubic metres per year with a small decrease in the short term. The long-term contribution of the east side of DCR to the overall harvest would be 372 500 cubic metres per year with a small reduction in the short term. The overall long-term harvest level relative to the base case would drop 0.8 percent to 1.16 million cubic metres per year, while the short term would drop 6.2 percent to 1.17 million cubic metres per year, while still allowing the committed accumulated volume of 75 000 cubic metres per year in the first decade.

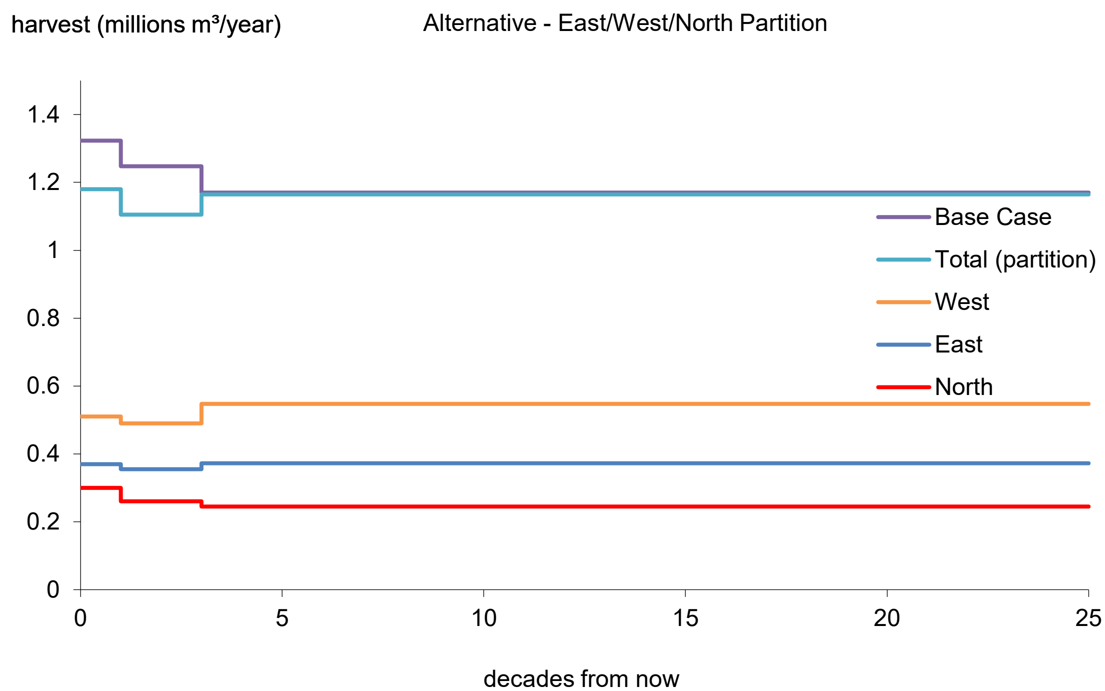

Figure 18. Alternative flow: east, west, north area-based partition for the North Island TSA.

Red alder partition

There have been historic red alder licences in the TSA. This scenario explores what harvest volume could be achieved as an even-flow harvest level, from red alder-leading stands. Based on the current VRI and yields for red alder the highest harvest level of red alder that could be achieved was an even-flow of 9000 cubic metres per year. There is no reduction to the base case if this partition were applied.

The current contribution of harvest from red alder-leading stands in the base case fluctuates between a high of 21 000 cubic metres per year in the first decade, and a low of 4500 cubic metres per year in the fifth decade, averaging 12 000 cubic metres per year over the rest of the time horizon.

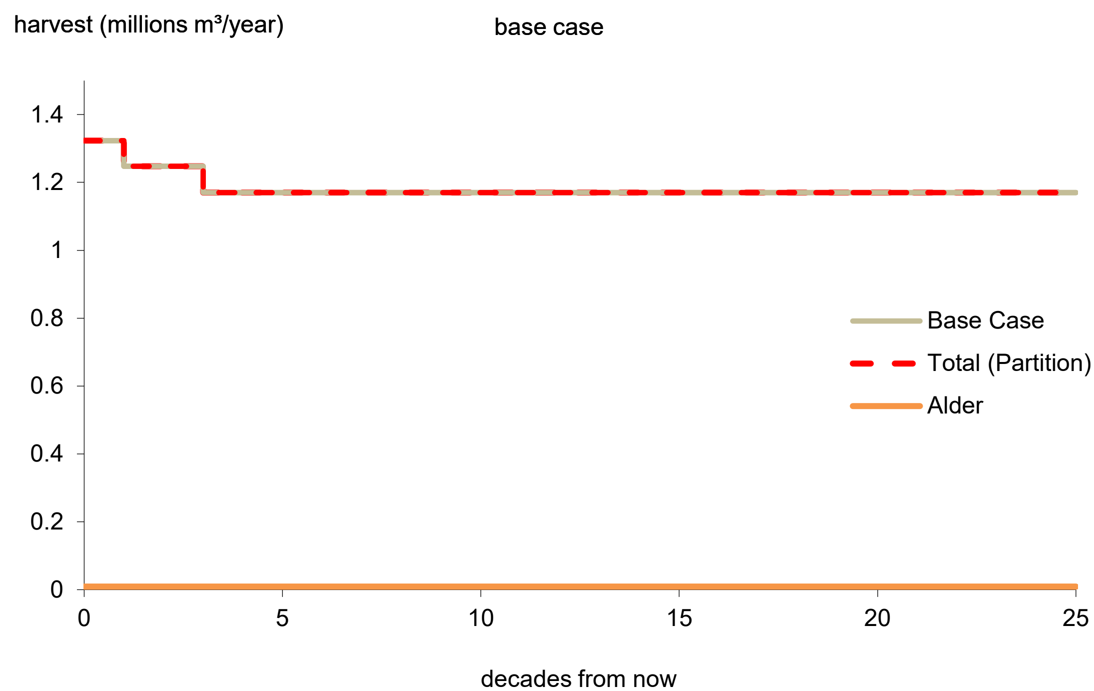

Figure 19. Alternative flow: red alder partition, for the North Island TSA.

Sensitivity analyses

The base case uses a specific set of data and assumptions that are intended to reflect forest composition and growth, legally-established land use objectives and current forest management practices. However, while the base case is designed to reflect current management in the North Island TSA, there is uncertainty about some management information and the modelling framework. Therefore, sensitivity analyses are used to provide further understanding by examining the effect on timber supply of uncertainty in data and assumptions.

The table below shows the sensitivity analyses completed on the North Island TSA and the short- and long-term impact of each in comparison to the base case. The short term is from 0 to 30 years while the long term is from 30 to 250 years. In general, any issue tested that relates to natural stand impacts had the largest effect on the short term, as the proportion of natural stands contributing to the harvest is limited after 30 years. Issues relating to managed stands had the most effect on the long term, with limited effect on the short term.

An important note is that these sensitivity analyses were assessed based on the harvest level achieved and growing stock not declining over time. Other metrics used to set the base case (i.e., block size, area or age harvested, distribution) were not evaluated. A comparison to the alternative harvest flow ‘Highest short term’ can provide more context in terms of increases and decreases in these scenarios, as it was evaluated in the same way. That alternative harvest flow showed a short-term increase of 6.3%, and a long-term increase of 0.9%.

Table 6. Sensitivity analyses – North Island TSA

Issue tested	Sensitivity levels	Percent impact	
		Short term	Long term
Timber harvesting land base	+ 10%	+ 16.8	+ 10.2
	- 10%	- 5.8	- 12.8
Natural stand yields	+ 10%	+ 16.0	0.0
	- 10%	- 7.4	- 1.3
Managed stand yields	+ 10%	+ 2.9	+ 9.8
	- 10%	0.0	- 10.2
Minimum harvest criteria	Minimum age + 10 years	-7.8	+ 3.4
	Minimum age - 10 years	+ 13.2	- 4.3
	Minimum volume only	+14.5	-5.5
	Minimum age only	+1.6	0.0
	CMAI	-11.0	+4.3
Harvest scheduling priority	Most productive stands first	- 11.0	+4.3
	Prioritize stands with greatest age relative to CMAI	-17.4	+4.7
Low site cutoffs	Remove low site cutoffs (apply minimum harvest criteria with no time limit)	+8.9	+ 1.7
Operability	Remove operability layer	+ 22.1	+ 9.8
Other reserves	Removal of all from THLB	+3.7	-2.1
Wildlife habitat	Remove proposed WHAs	0.0	0.0
	Remove marbled murrelet suitable habitat	-1.0	-3.0
Non-spatial old growth order	Drawdown to 1/3 target in low BEO	+2.4	+ 0.6
Natural disturbance	Apply natural disturbance	-5.4	-1.7
Non-legal ECA limits	Apply current practice ECA limits	0.0	0.0
Operational adjustment factors	Remove the Fd-specific OAF	+0.6	+0.4
Commercial thinning	Reduction of 180 m^3/ha in areas where CT has occurred	+2.9	+0.4

Timber harvesting land base sensitivity analysis

Two sensitivity analyses explored increasing the size of the THLB by first increasing the THLB numerical factor by 10 percent (except where it was zero) and the second by decreasing the THLB numerical factor by 10 percent. If THLB was increased by 10 percent, short-term and long-term timber supply would be 16.8 percent and 10.2 percent higher, respectively. If the THLB was reduced by 10 percent, short- and long-term timber supply would be 5.8 and 12.8 percent lower.

Where the THLB is increased, the short term shows a larger percentage increase because the older stands are more heavily constrained. When the THLB is decreased, the short term shows a smaller percentage decrease, while the long term shows a larger decrease because the managed stands are less constrained, resulting in a bigger impact to the harvest projection.

Natural stand yield

Two sensitivity analyses were run to test the effect on timber supply of changing natural stand yields. The first analysis increased the yield by 10 percent by utilizing an existing stand volume multiplier in the model, while the second analysis decreased the yield by 10 percent. If yield was increased by 10 percent, short- and long-term timber supply would be 16 percent and 0 percent higher, respectively. If yield was decreased by

10 percent, short- and long-term timber supply would be 7.4 and 1.3 percent lower. These numbers correspond to the timing of the transition from old and thrifty stands to managed stands.
The short-term impacts are higher than the long-term impacts because natural stand yields are only applied to existing natural stands greater than 120 years. These stands contribute, in the greatest percentage, to the short term, contributing 43 percent in the first decade, dropping to below 15% by the fourth decade. The contribution declines gradually from there to year 120, after which the contribution of these stands is negligible.

Managed stand yield

Two sensitivity analyses were run to test the effect on timber supply of changing managed stand yields. The first analysis increased the yield by 10 percent by utilizing an existing stand volume multiplier in the model, while the second analysis decreased the yield by 10 percent. If yield was increased by 10 percent, short- and long-term timber supply would be 2.9 percent and 9.8 percent higher, respectively. If yield was decreased by 10 percent, short- and long-term timber supply would be 0.0 and 10.2 percent lower.

The long term is more influenced by the adjustment of managed stand yields due to their greater contribution to the harvest projection in the long term compared to the short-term contribution of natural stands described in the natural stand yield sensitivity analysis.

Minimum harvestable criteria

Two sensitivity analyses were run to test the effect on timber supply of changing minimum harvestable age. The first analysis increased the age by 10 years by changing the minimum harvestable age in the model, while the second analysis decreased the age by 10 years. If age was increased by 10 years, short- and long-term timber supply would be 7.8 percent lower and 3.4 percent higher, respectively. If age was decreased by 10 years, short- and long-term timber supply would be 13.2 percent higher and 4.3 percent lower.

An increase in minimum age reduces the short term because it delays the time step at which the managed stands can contribute to the harvest levels. It subsequently increases the long term because stands acquire more volume before they become available to harvest. Decreasing minimum age by 10 years increases the short term because managed stands become available to contribute to the harvest sooner, allowing more old volume to be harvested over a shorter period. The long term is subsequently decreased because stands are harvested at younger rotation ages resulting in less volume being available over time.

An additional three sensitivity analyses were run to test the effect on timber supply of changing minimum harvest criteria from the base case assumptions that applied both a minimum volume and the age at which 95 percent of culmination of mean annual increment (CMAI) is achieved. If the minimum volume criteria is applied alone, short- and long-term timber supply would be 14.5 percent higher and 5.5 percent lower, respectively. If the age criteria (95 percent of CMAI) is applied alone, short- and long-term timber supply would be 1.6 percent higher and no change, respectively. If volume and the age at which full CMAI is achieved are applied, short- and long-term timber supply would be 11 percent lower and 4.3 percent higher.

The minimum volume only sensitivity analysis has the effect of removing the requirement for stands to achieve 95 percent of culmination before becoming available for harvest (they only need to meet the minimum volume). Managed stands on the coast tend to very productive and they generally surpass the minimum volume well before the base case culmination age requirement. The result is that stands are harvested at younger rotation ages similar to the scenario which reduced minimum age by 10 years.

The minimum age criteria only sensitivity analysis results in minimal impacts because it is the most limiting constraint for managed stands. There is a small harvest level increase in the short term likely because more low volume old stands become available for harvest by removing the minimum volume requirement.

The last scenario requires stands to achieve 100 percent of CMAI instead of the 95 percent requirement of the base case. This extends the rotation age which has a similar effect as the scenario which increases the minimum ages by 10 years.

Harvest scheduling priority

Two sensitivity analyses were run to look at the effect on timber supply of adjusting the harvest scheduling priority from highest volume first priority that was used in the base case. The first sensitivity analysis prioritized most productive stands first and the second prioritized stands with the greatest age relative to the age at which CMAI is achieved. When harvest scheduling priority is changed to most productive stands first, the result is the same as adjusting the minimum harvest criteria to CMAI, short- and long-term timber supply would be 11 percent lower and 4.3 percent higher, respectively. When harvest scheduling priority is changed to prioritize stands with the greatest age relative to the age at CMAI, short- and long-term timber supply would be 17.4 percent lower and 4.7 percent higher.

The second scenario had a similar effect on the long-term harvest level, but more pronounced short-term reduction. This scenario brings forward stands that are the farthest past the age at CMAI which are the oldest stands on the land base. The old stands tend to be not as productive as the managed stands, but are very old relative to the CMAI, so when these are prioritized the initial harvest drops substantially.

Low site productivity exclusions

A sensitivity analysis was run to assess the effect on timber supply of removing the THLB exclusions for areas of low site productivity which were identified in the base case as stands that are not able to achieve a minimum volume of 300 cubic metres per hectare for conventional harvest system stands and 450 cubic metres per hectare for helicopter access only stands, within the time frame of 150 years. Although the low site productivity stands were included in the THLB, harvesting was still restricted by the minimum harvestable volume requirements (which are aligned with the volumes above). With the low site productivity netdown removed, short- and long-term timber supply would be 8.9 percent higher and 1.7 percent higher, respectively.

In this scenario, since many stands are never able to achieve the minimum harvestable volume requirements (even beyond 150 years), the unlogged THLB increased significantly from 2655 hectares in the base case, to 41 884 hectares. The increase in harvest volume comes from those stands that achieve a volume of 300 cubic metres per hectare (450 cubic metres per hectare in helicopter accessible stands) in a time frame greater than 150 years that were previously excluded from the THLB.

Operability

One sensitivity analysis was run to assess the effect on timber supply of removing the THLB exclusions for operability. All areas classified as inoperable (physical and economic, as defined by the operability assessments in each of the former TSAs) were considered operable. As a result, the short- and long-term timber supply would be 22.1 percent higher and 9.8 percent higher, respectively.

This mirrors the results observed in the increased THLB sensitivity analysis which similarly increased the amount of forested area available for harvest. Both this, and the previous low site productivity scenario, provide conceptual bounds of the available timber supply in the TSA with no consideration of access and/or economics of the stand.

Additional discussion

There are several key themes important to this TSR that warrant discussion in further detail. These are items that affect all the scenarios and will need to be considered by the chief forester in terms of understanding the management of the TSA and data used for the analysis. They include the topics of western hemlock ingress and the effect ingress has on species reporting and volumes, along with adjacency and harvest block size in the TSA.

Growth and yield – managed stands

BC is in the process of streamlining and standardizing the approach to modelling tree growth and yield in the province. This is the first time the new, RESULTS-based, standardized method for producing yield tables for managed stands (as described in the *Data Package*) is being used in one of the coastal TSAs.

Yield tables for managed stands were created using TIPSY. This stand-level model is derived from volume tables generated from the individual tree process model Tree and Stand Simulator (TASS). These are the available growth and yield models in BC for managed stands.

Stand development, or stand dynamics is the process of structural change that occurs in stands over time. Stand development begins at the earliest point of stand establishment and influences the pattern of tree growth, stand structure and timber production throughout the stand life. The rate and tree-to-tree variability of height growth are the principal mechanisms driving the processes of stand development. While individual tree growth for different species is available in current growth and yield models, stand dynamics can be more challenging to replicate in a modeling environment. It can be even more challenging for mixed species stands where tree growth, nutrient competition, and shade tolerance are involved, and may be different by species.

TIPSY provides mixed-species yield tables (without stand dynamics) by using simple, area-weighted averaging of single-species yields. TIPSY is the user-friendly table interpolation program responsible for most TASS operational applications. TASS II includes individual tree crown dynamics while TASS III allows for modelling of complex stand dynamics and structures with multiple-species and age cohorts. TASS III is in initial release stage only and does not yet support coastal species.

To create the yield tables, data is extracted from RESULTS and synthesized to derive species composition and density for both planted and natural components. For the purposes of TSR, all RESULTS data is aggregated and validated to the individual opening level. Whereas the purpose of the RESULTS data is to track licensee obligation, for TSR purposes, the data is validated for the purpose of creating an individual yield table for each harvest opening.

Planted species composition is derived from initial planting survey data and the species composition is adjusted using free growing survey total stems data to account for ingress and mortality. The following data is derived from the RESULTS data for use in TIPSY:

- planted species composition;
- planted density (total by species);
- genetic worth (by species);
- planting delay;
- percent of the opening that is planted;
- natural species composition;
- natural density (total by species);
- stand age.

Species (Western Hemlock Ingress)

In the CWH vm1 and 2 biogeoclimatic subzones (which comprise approximately 50 percent of the THLB), and to a lesser extent, in other subzones, there can be a substantial amount of western hemlock ingress after a stand has been planted. These areas are primarily planted with western redcedar. There is generally good survival of the planted species and a lot of natural western hemlock ingress after planting. Almost no western hemlock is planted in the TSA, though at the time of harvest, western hemlock is the dominant species.

Key inputs into the existing and available growth and yield models include species, density (number of stems per hectare), spacing (natural/clumped, planted/even), and site index, among other variables. In planted stands, density and spacing are consistent and managed in a way that maximizes site productivity. In natural stands, density and spacing can be quite variable resulting in lower volumes per hectare. In stands with western hemlock ingress, the consistent density and spacing of the planted stems exists, with the addition of a variable density and spacing of western hemlock interspersed with the planted stems. Stand dynamics between the planted stems and the natural stems occurs over the rotation and affects the volume and species available for final harvest.

The provincial managed stand yield projection process was developed to be used across the province in conjunction with field survey data collected, validating inputs to most accurately reflect final stand species and volumes. Because of the variety of forests across the province, the process results in uncertainties in specific locations that have unique circumstances (i.e., ingress), based on the model capability. For the provincial yield tables, if the planted stems per hectare varies by 20 percent or more between the regeneration survey and the survey at free growing, an adjustment is made to account for ingress. If planted stems remain relatively unchanged at free growing, just the planted stems and distribution are used for yield projections. A typical scenario in the CWHvm would be as follows:

- Planting: Cw 1000 stems per hectare;
- Forest Cover Survey: Cw:Hw 850:3500 stems per hectare;
- TIPSY final inputs for species and density: Cw 1000 stems per hectare.

The base case harvest profile is summarized using the species composition from the yield tables in the figure below. It is clear that once the transition to future stand yields is complete, the proportion of western redcedar is showing as vastly overestimated, and western hemlock vastly underestimated, due to lack of accounting for ingress in stands where planting survival is high.

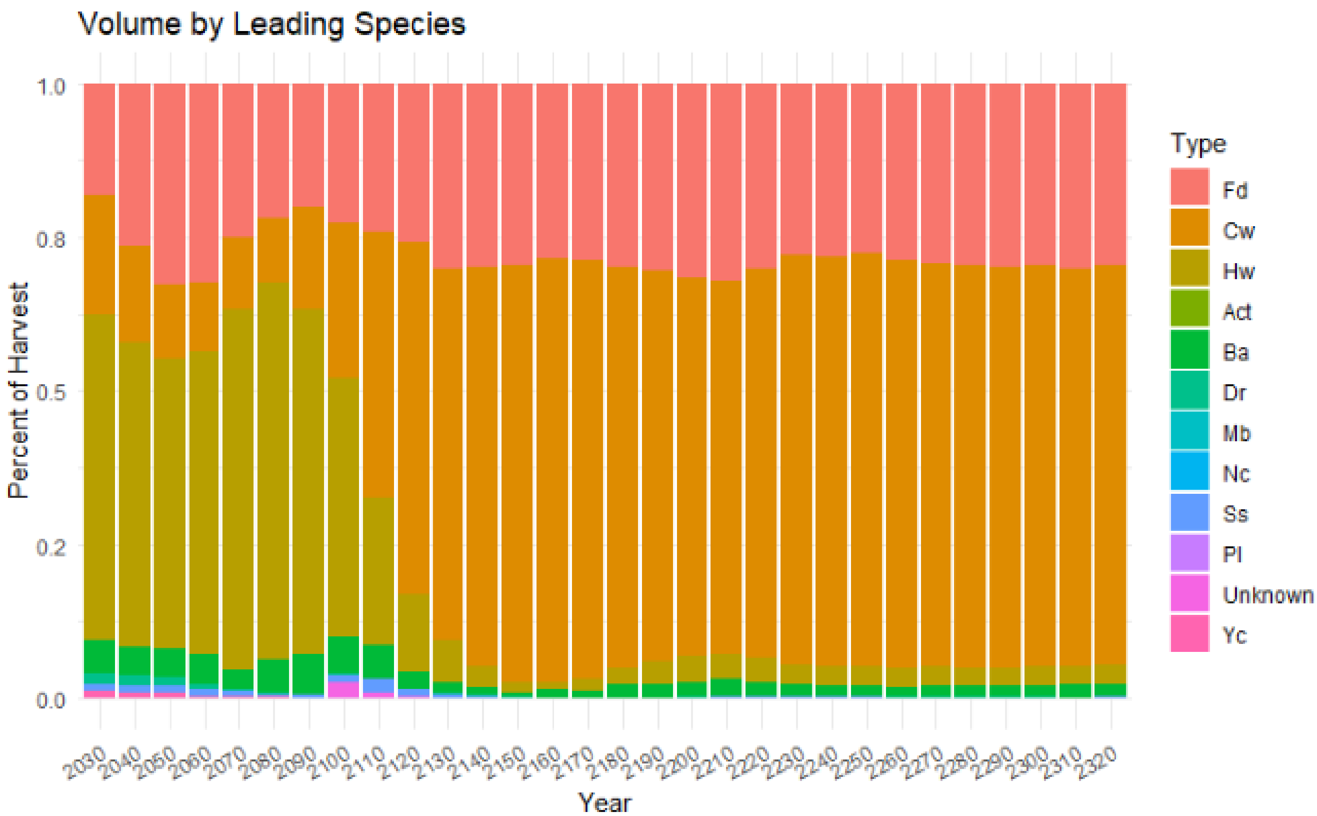

Figure 20. Base case species contribution, using yield table species.

A more reasonable summary of the harvest species profile was prepared using the total species information from RESULTS data for the TSA. The following figure shows the harvest profile when species are summarized to include both planted and natural regeneration from the free-growing survey. This better aligns with the current THLB species distribution and harvest profile, along with known conditions in the TSA. In this scenario there is likely a minor overestimation of the western hemlock component, due to clumpy distributions resulting from ingress and more variable survival over time in comparison to the planted species.

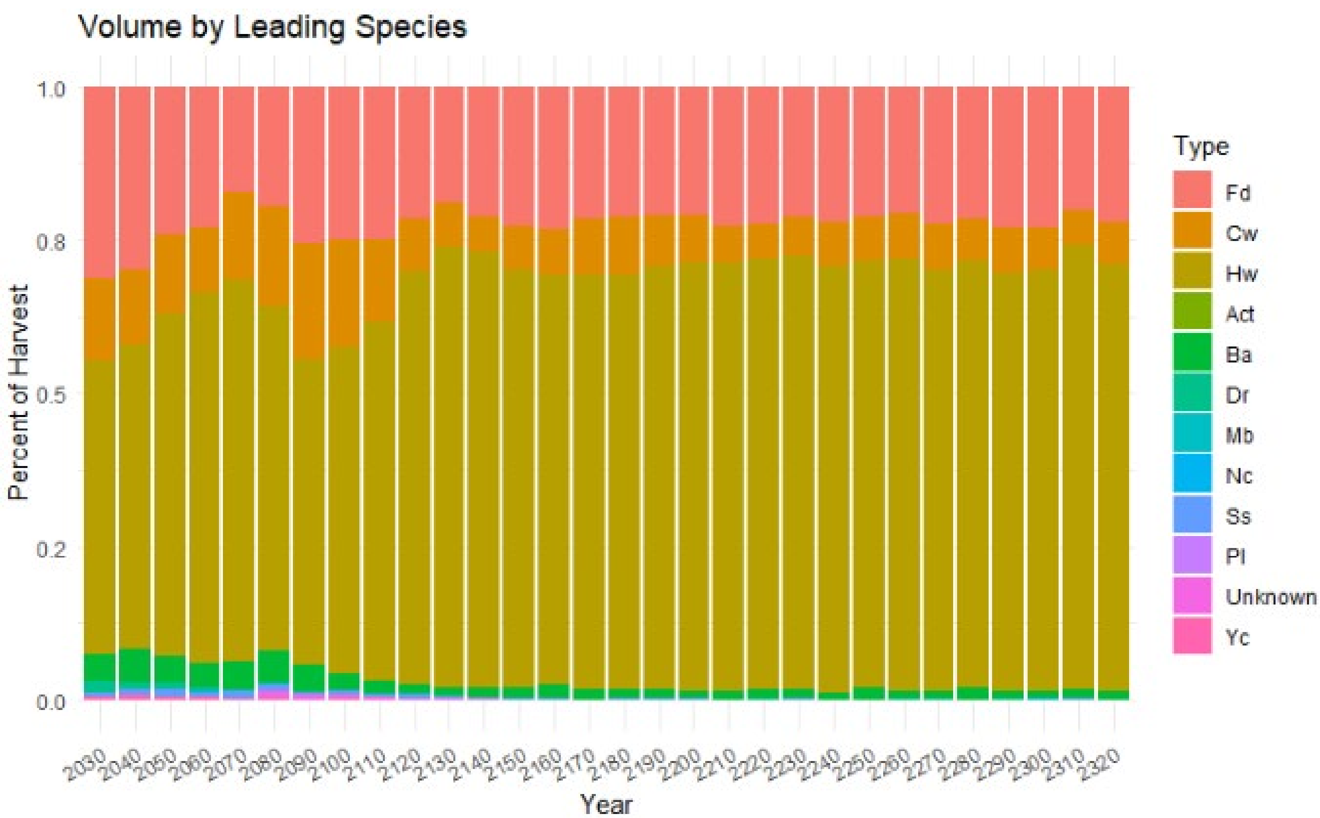

Figure 21. Base case species contribution, using total surveyed species.

Both the former Kingcome and Strathcona TSAs had implementation instructions provided in the last AAC rationales to monitor volumes harvested by species profile. The figure below shows the species profile comparison between the scaled (harvested) volume data and the RESULTS survey data for planted stems and stems at free growing. It is clear there is substantial ingress of western hemlock, demonstrated by the complete absence in the planted stems yet significant levels recorded in the free-growing and scaled volume components.

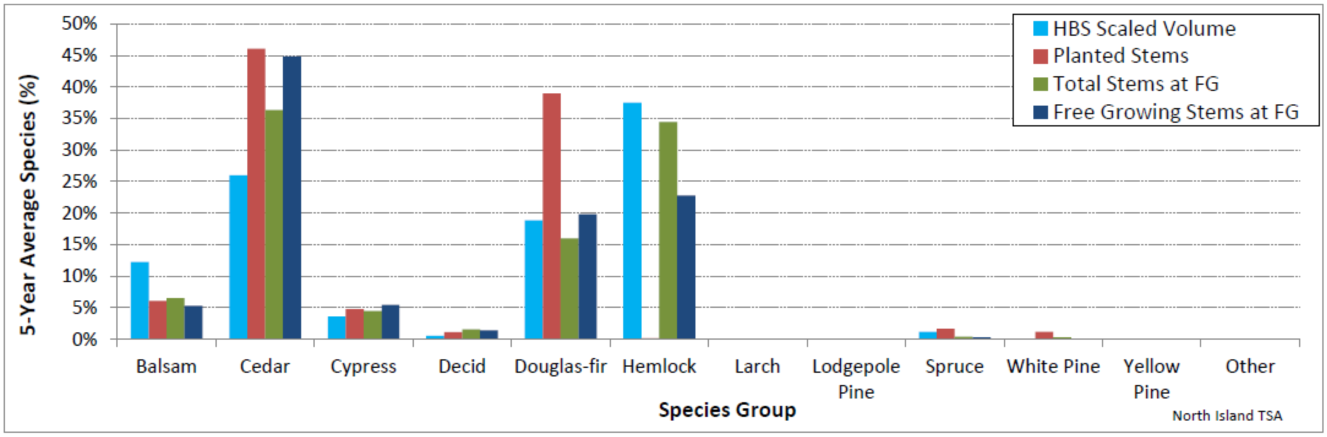

Figure 22. Planted and free-growing stems and scaled volume by species in the North Island TSA.

Western redcedar is an important cultural species for First Nations, and an important species in terms of estimating stand economic value. The challenge in projecting the amount of western redcedar in the future is a concern if there is a need to regulate the species harvest profile through an AAC partition, or set management objectives to ensure the maintenance of a desired component of western redcedar (or other species).

Volume (Western Hemlock Ingress)

The effect of the uncertainty in species composition and ingress on volume projections was examined as well. Using the example stand provided in the previous section, the yield tables account for 1000 stems per hectare of planted western redcedar, when in fact on the ground, there may be an additional 3500 stems per hectare of western hemlock in the stand.

The most suitable way to model stands with ingress would be to use TASS III which is able to model competition through shading and considers inter-species stand dynamics. Ideally, the model would account for the fact that planted western redcedar often survives in the understory where there is substantial western hemlock ingress. Unfortunately, TASS III is not yet able to support coastal species. The managed stand yield tables used in the base case were produced using TIPSY, using simple, area-weighted averaging of single-species yields.

The young stand monitoring (YSM) program produces analyses that target stands 50 years and younger, and provide stand information on growth, species composition, stand density, mortality and forest health incidence which may be used to compare actual stand performance to predicted stand performance once re-measurement data becomes available. When reviewed using TIPSY, for stands similar to the example used, it was expected that not accounting for the amount of ingress may lead to an underestimate of stand volume. However, when YSM plots were reviewed, it appears that TIPSY yield projections result in an overestimation of volume observed on the ground, though there are only 22 plots in the TSA and so the difference is not considered statistically significant.

The best option to understand both the species and volume issues described above, until TASS III is available for coastal species, would be to increase the number of YSM plots in the North Island TSA. Additional plot data would help to better understand the impacts of ingress on volume and could clarify the differences from the TIPSY yield estimations. However, it is currently difficult to quantify the likely impact of the actual over or underestimation of projected yields. It is worth noting that the impacts of the managed stand yield sensitivity analyses are negligible on the short-term timber supply, and more impactful in the long term. These issues do not directly affect the current AAC decision but they would be important to resolve prior to the next TSR.

Isolated THLB, adjacency and block size

As the TSA moves closer to the most constrained point in the timber supply projection (in approximately 30 years), when natural stands are less available, thrifty stands are limited, and managed stands are only just reaching minimum harvestable criteria, the ability of licensees to spatially locate harvest blocks of an economic size which also meet adjacency and other legal requirements, will become more challenging. Isolated THLB is land that contributes to the THLB but cannot be harvested economically at the time it reaches minimum harvestable criteria. This may be due to small patch size, timing of availability in comparison to surrounding forests, size of surrounding timber, or access cost. These stands are anticipated to become economic once certain criteria are met but would be delayed from being harvested at the time that is specified as the minimum harvestable criteria in the model. Isolated THLB is an operational-level concern that may not be adequately represented in strategic-level modelling applied in TSR.

In the timber supply model, harvest block size and adjacency requirements were applied with the intent of replicating current practice. The average block size in the North Island TSA, based on a summary from RESULTS, is 16.8 hectares. Reflecting the block size and adjacency current practice in the base case resulted in a long-term harvest level reduction by approximately 35 000 cubic metres per year, to the base case value of 1.17 million cubic metres per year.

The parameters applied resulted in a range of harvest block sizes, with a higher proportion of smaller blocks as the projected land base gets closer to the most constrained point (30 years) in the projection, but still maintains an average size over time that reflects current practice (see Figure 14). All stands within the THLB were assumed to become available for harvest when they achieve the minimum harvestable criteria. There is a risk that some of the areas the model harvests as small blocks are actually isolated timber that are not economic to harvest until certain additional operational-level conditions are met. This presents an additional uncertain downward pressure on the timber supply, beyond what is accounted for in the base case.

The magnitude of the potential downward pressure is unknown because it is difficult to predict the proportion of the THLB that is isolated. Any size of harvest block could potentially be isolated, depending on localized operational conditions, but generally the smaller the harvest block in the model, the more likely it may be isolated THLB. The following table summarizes the projected blocks harvested in the base case for the first four decades in comparison to actual harvest block size data available in RESULTS (current practice). Only harvest blocks less than 10 hectares are compared.

Table 7. Modelled harvest blocks

Modelled harvest blocks	Decade 1	Decade 2	Decade 3	Decade 4	RESULTS (current practice)
Total block area (ha)	20 985	19 427	20 190	20 352	36 781
% total area in harvest blocks < 5 ha	3	7	9	9	3
% total area in harvest blocks 5-10 ha	9	10	12	10	7

Conclusion

The base case produced for the North Island TSA projects a harvest level of 1 248 100 cubic metres per year that can be maintained for 30 years before decreasing to a long-term harvest level of 1 170 000 cubic metres per year for the remainder of the projection. Included in the first 10 years of the projection is an additional 75 000 cubic metres per year that is committed accumulated volume. Five alternative harvest flow projections explored the implications of increased initial rates of harvest, regulating the contribution from areas on accessible by helicopter, regulating the contribution by natural resource districts, regulating the contribution from east, west, north area-based partitions, and regulating the contribution from red alder stands.

Although the above timber supply analysis is a significant source of information provided to the chief forester for consideration, the chief forester's AAC is not a calculation solely based on this strategic-level analysis. The AAC determination of the chief forester is an independent judgment based on professional experience and consideration of the broad range of social, economic and environmental factors required under Section 8 of the *Forest Act* in addition to the timber supply analysis.

Your input is needed

Public input is a vital part of establishing the allowable annual cut. Feedback is welcomed on any aspect of this *Discussion Paper*, the *Data Package* or any other issue related to the timber supply review and the allowable annual cut determination for the North Island TSA.

Ministry staff would be pleased to answer questions to help you prepare your response. Please send your comments to the Natural Resource Districts at the addresses below.

Your comments will be accepted until February 20, 2023.

You may identify yourself on the response if you wish. If you do, you are reminded that responses will be subject to the *Freedom of Information and Protection of Privacy Act* and may be made public. If the responses are made public, personal identifiers will be removed before the responses are released.

For more information or to send your comments, contact:

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Further information regarding the technical details of the timber supply analysis is available on request by contacting Forests.ForestAnalysisBranchOffice@gov.bc.ca

Visit the Timber Supply Review & Allowable Annual Cut web site:
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