

Arrowsmith Timber Supply Area Timber Supply Analysis Discussion Paper

November 2016

**Forest Analysis and Inventory Branch
Ministry of Forests, Lands and
Natural Resource Operations
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Ministry of
Forests, Lands and
Natural Resource Operations

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Introduction

The British Columbia (BC) Ministry of Forests, Lands and Natural Resource Operations (FLNRO) 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 fourth for the Arrowsmith TSA, 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 the province. Based on this review the chief forester will determine a new allowable annual cut^d (AAC) for the Arrowsmith TSA.

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

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

- examine relevant legal requirements, 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 Arrowsmith TSA. Details about the data and assumptions used in the analysis were provided in a data package (September 2015). Updates to the information used and technical details regarding the analysis are available on request from the FLNRO 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 Arrowsmith TSA timber supply review, forest management objectives are provided by the *Forest and Range Practices Act* (FRPA), the Vancouver Island Land Use Plan (VILUP) and the Clayoquot Sound Watershed Plans. 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.

Public comments are encouraged and will be accepted until the end of the 60-day review period, on January 16, 2017.

^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 units 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.

Timber supply review in the Arrowsmith TSA

In 2009 the chief forester set the AAC for the Arrowsmith TSA at 420 000 cubic metres effective July 22, 2009. The AAC included the following partitions^c:

- 6300 cubic metres from red alder-leading stands with at least 50 percent deciduous species by volume; and,
- 13 700 cubic metres from the Clayoquot Sound area.

After a number of administrative adjustments between 2009 and 2011 because of land transfers between the TSA and area-based tenures, the AAC settled at the rate originally set in 2009.

In September 2015, 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 being 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 Arrowsmith 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, the public, licensees and First Nations. 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 the new AAC, the Minister of Forests, Lands, and Natural Resource Operations 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.

^cPartition

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.

Description of the Arrowsmith TSA

The Arrowsmith TSA is located on the southern half of Vancouver Island, south of the Strathcona TSA (Campbell River) and bordering on TFLs 44, 46, 54, 57, and 61. In contrast to other TSAs in British Columbia, this TSA is made up of many disconnected parcels of land ranging in size from a few hectares to a few thousand hectares. These parcels are interspersed with private land, urban and sub-urban areas, rural agricultural lands, and with parks and reserves. Although the TSA encompasses 1 560 851 hectares, the actual productive forest land managed by FLNRO is only 114 940 hectares.

The Arrowsmith TSA is administered by the South Island Natural Resource District (SINRD) office located in Port Alberni. It is the second most densely populated TSA in the province, encompassing the Capital Regional District, including the City of Victoria, as well other major population centres such as Duncan, Ladysmith, Nanaimo, North Cowichan, Parksville, Qualicum Beach and Port Alberni, Tofino, Ucuelet.

The mountainous terrain, marine shorelines, and many lakes and rivers of the Arrowsmith TSA provide a wide range of recreational opportunities. The majority of the TSA is easily accessible to local residents and to other visitors, including direct ferry routes to Vancouver and Washington. Within the Arrowsmith TSA are the Carmanah Walbran, Strathcona and Clayoquot Arm Provincial Parks as well as the Pacific Rim National Park. The TSA is home to many smaller parks, ecological reserves, recreational areas and trails including the West Coast Trail. Marine recreation is significant throughout many areas in the Arrowsmith TSA including Clayoquot Sound, Barkley Sound and the Gulf Islands.

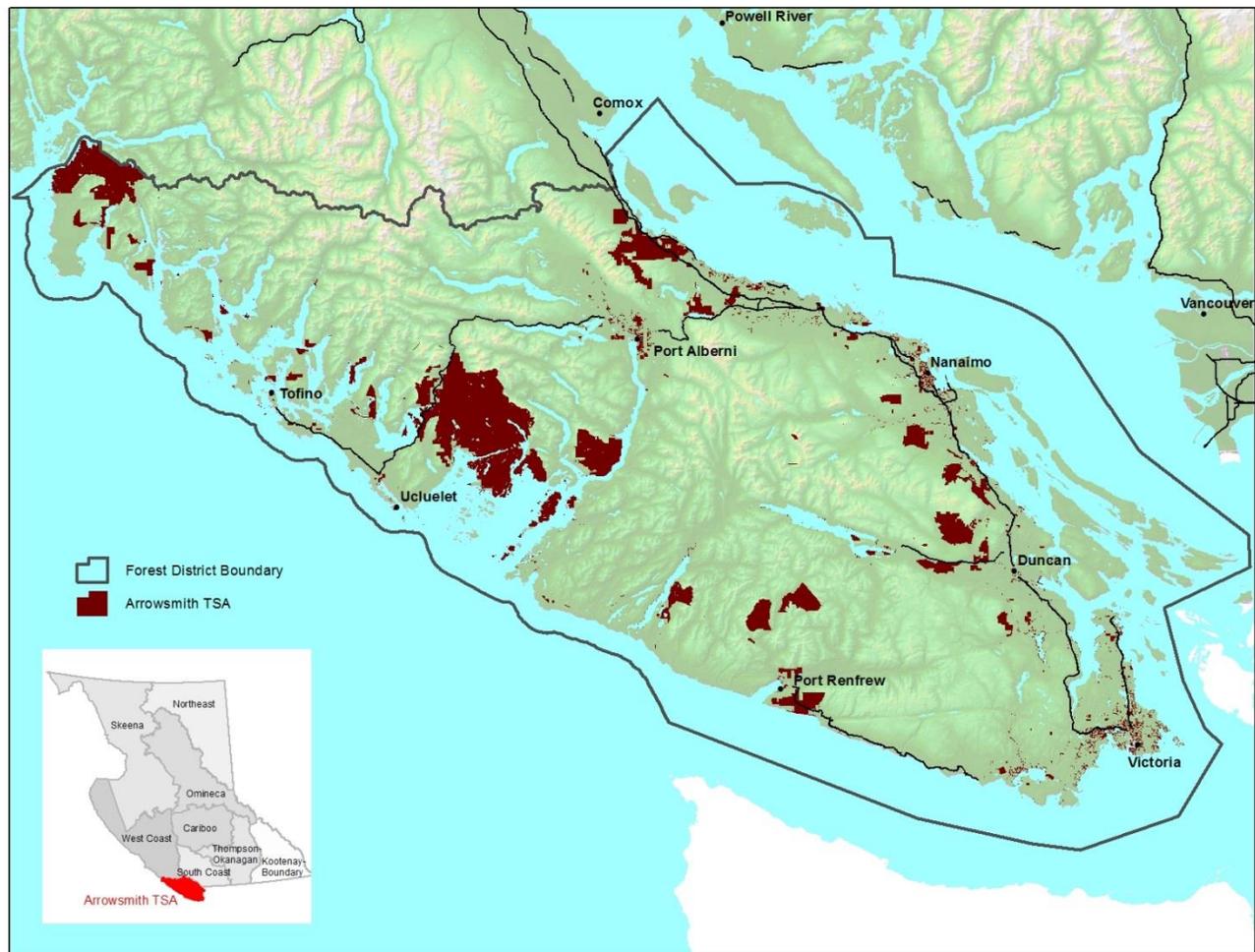


Figure 1. Arrowsmith Timber Supply Area.

First Nations

Thirty-seven First Nations have asserted and/or established Aboriginal Interests within the traditional territories within the SINRD that overlap the Arrowsmith TSA, including: the Ahousaht Band, Cowichan Tribes, Ditidaht First Nation, Esquimalt First Nation, Halalt First Nation, Hesquiaht First Nation, Homalco First Nation, Huu-ay-aht First Nation, Ka:'yu:k'tkh_Che:k:tlis7et'h' First Nations, Komoks First Nation, Lake Cowichan First Nation, Lyackson First Nation, Malahat Nation, Mowachaht/Muchalat First Nations, Pacheedaht First Nation, Pauquachin First Nation, Penelakut Tribe, Qualicum First Nation, Scia'new First Nations, Sliammon First Nation, Snaw-naw-as First Nation, Snuneymuxw First Nation, Songhees First Nation, Stz'uminus First Nation, Toquaht Band, Tla-o-qui-aht First Nation, Tseshaht First Nation, Tsartlip First Nation, Tsawout First Nation, T'Sou-ke First Nation, Tseycum First Nation, Tsawwassen First Nation, Uchucklesaht First Nation, Ucluelet First Nation, We Wai Kai Nation, and Wei Wai Kum First Nation.

There are several First Nations within the Arrowsmith TSA that are in treaty negotiations and there are two signed modern-day treaties, the Tsawwassen First Nation Treaty and the Maa-nulth Treaty. In addition there are nine Douglas Treaty Nations.

On April 3, 2009, the Tsawwassen First Nation Treaty came into effect. It is the first urban treaty in British Columbia and the first treaty negotiated under the British Columbia Treaty Commission (BCTC) process. The treaty brings certainty with respect to all of Tsawwassen First Nation's Aboriginal rights throughout the Tsawwassen First Nation claimed traditional territory, which covers approximately 279 600 hectares including the waters of the southern Strait of Georgia.

On April 1, 2011, the Maa-nulth Treaty came into effect. The Maa-nulth Treaty includes five First Nations, the Huu-ay-aht First Nation, Ka:'yu:k'tkh_Che:k:tl'es7et'h' First Nations, Toquaht Band, Uchucklesaht Tribe and Ucluelet 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.

The K'omoks First Nation is in Stage 5 negotiations. The Agreement-in-Principle was signed on March 24, 2012. The Te'mexw Treaty Association recently signed their Agreement-in-Principle, moving them forward to Stage 5 in the treaty process.

Many of the nations are currently in Stage 4 negotiations: Ditidaht First Nation, Homalco First Nation, Hul'qumi'nun Treaty Group, Hupacasath First Nation, Laich-Kwil-Tach Nations Treaty Society, Nuu-chah-nulth Tribal Council, Pacheedaht First Nation, Stz'uminus First Nation, and the Tla-o-qui-aht First Nation.

The Esquimalt First Nation, Scia'new First Nations, Pauquachin First Nation, Snuneymuxw First Nation, Songhees First Nation, Tsartlip First Nation, Tsawout First Nation, Tseycum First Nation, and T'Sou-ke First Nation are Douglas Treaty Nations, signed in 1852. The Douglas Treaty granted the nations the rights to hunt over the unoccupied lands, and to carry on their fisheries as formerly.

Environmental values

Current forest management must be consistent with the requirements of the *Forest and Range Practices Act* (FRPA) and associated regulations, which are designed to maintain a range of biodiversity and wildlife values. All forest lands, whether they contribute to timber supply or not, help to maintain critical habitats for many species. The timber supply analysis includes forest resource values or cover requirements for biodiversity, visual quality, wildlife habitat, community watersheds, recreation features, riparian management and protection of environmentally sensitive areas. These requirements are applied to the Crown forest management land base^f (CFMLB). In the Arrowsmith TSA, about 43 percent of the CFMLB is neither suitable nor available for timber harvesting given the various forest resource values or cover requirements.

Spanning Vancouver Island from the west to east coast, the terrain of the TSA varies from lowland valleys, with nutrient rich, moist sites to mountainous areas, with poorer, drier sites. Most of the productive forest land lies within the Coastal Western Hemlock (CWH) biogeoclimatic zone, where cool, wet summers and mild winters support stands with a significant proportion of western hemlock. The Coastal Douglas-fir (CDF) zone occurs on the eastern side of the southern portion of the TSA, which is comparatively drier with gentler topography than the western portions of the TSA. Here warm, dry summers and cool, wet winters result in stands dominated by Douglas-fir. At higher elevations, the Mountain Hemlock (MH) zone occurs and at the highest elevations, isolated occurrences of Coastal Mountain-heather Alpine (CMA) zone.

^fCrown forest management land base (CFMLB)

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. Under the direction of the VILUP-HLPO and Land Use Objectives for Clayoquot Sound, parks and small area-based tenures contribute to the accounting for biodiversity targets and are therefore included in the CFMLB.

The forests of the TSA are diverse, and slightly more than three quarters of the forests on the land base contributing to timber supply are considered to have medium or good site productivity. Major tree species include: Douglas-fir, western redcedar, western hemlock and true firs, while other species such as cypress, spruce, red alder, and maple also occur. The forests of the TSA have a relatively long history of harvesting, and as a result there are rapidly maturing second-growth forests on the lower elevation sites that are accessible and highly productive. Almost half of the stands on the timber harvesting land base[§] (THLB) are between 21 and 100 years of age.

The Arrowsmith TSA is part of the West Coast Natural Resource Region, spanning the southern half of Vancouver Island. This area is known for its high biodiversity values, containing a range of ecosystems from west coast rainforests, to mountainous terrain, to the dry woodlands of the southeast coast. These diverse ecosystems provide habitat for a wide range of species, many of which have economic and cultural importance to the region, such as black-tailed deer and Roosevelt elk. Large predators in the region include cougar, wolf, and black bear, and small furbearers include beaver, mink, river otter, marten, and raccoon. Fishing is popular recreationally throughout the Arrowsmith TSA and fisheries resources are culturally integral to many First Nations – the rivers and lakes in this region contain all five species of salmon, as well as cutthroat trout, rainbow trout, and Dolly Varden char. Birdwatching is a popular pursuit in this region, with a range of migratory, resident and endemic species. Sightings at some of the important bird areas within the Arrowsmith TSA include oystercatchers, gulls, cormorants, grebes, murrelets and albatross in Barkley Sound, and white-tailed ptarmigan, red crossbill, pine siskin, gray jay, pacific wren and golden-crowned kinglet and near Mount Arrowsmith.

There are a number of red- and blue-listed species and subspecies in the Arrowsmith TSA, several of which are endemic to Vancouver Island. Notable avian fauna on these lists include Northern goshawk (*laingi* subspecies), great blue heron (*fannini* ssp.), marbled murrelet, olive-sided flycatcher, and several owls including the western screech-owl (*kennicottii* ssp.), northern pygmy-owl (*swarthy* ssp.), and barn owl. The diversity of habitats also provides for a range of red- and blue-listed herpetofauna, such as western toad, wandering salamander, painted turtle (Pacific coast population), sharp-tailed snake, and northern red-legged frog. Mammals on the lists include Townsend's big-eared bat, Keen's myotis, Vancouver Island marmot, American water shrew (*brooksi* ssp.), ermine (*anguinae* spp.), as well as Roosevelt elk. Freshwater fish species include the *clarkii* ssp. of the cutthroat trout, as well as endemic lamprey and stickleback species. The red- and blue-lists also include 24 insect species, most of which are butterflies, as well as 27 moss species, 7 lichens, and 141 flowering plants within the South Island District. In addition, there are 92 red- or blue-listed ecological communities, 44 of which occur in the CDFmm BEC zone. A full list can be found on BC Species and Ecosystem Explorer (the above search constrained to SINRD, completed 2016-09-29).

This timber supply analysis reflects the current legal land use objectives and legislation designed to maintain biodiversity, wildlife habitat, visual quality, water quality, recreation areas, riparian areas, and protection of unstable terrain.

§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.

Land-use planning in the Arrowsmith TSA

The Arrowsmith TSA lies within the area covered by the Vancouver Island Land Use Plan (VILUP) and the Clayoquot Sound Land Use Decision. The VILUP Higher Level Plan Order was signed on October 2000 establishing legally binding objectives for resource management zones. The Ministerial Order Establishing Land Use Objectives for Clayoquot Sound took effect on May 28, 2008. Forest development in the TSA is required to be consistent with the legally established objectives of these higher level plans. The timber supply analysis assumes that forest management and timber harvesting will be consistent with both the VILUP Higher Level Plan Order and the Objectives for Clayoquot Sound.

Regional economy

In 2014, the population of the SINRD was 638,000 people, of which about 58 percent reside within the Capital Regional District, including the City of Victoria. Other major population centres include Duncan, Ladysmith, Nanaimo, North Cowichan, Parksville, Qualicum Beach and Port Alberni; smaller communities include Tofino, Ucluelet, Lake Cowichan, Nanoose, Chemainus, Union Bay and Fanny Bay.

The current AAC of 420 000 cubic metres supports a total of 1,004 full-time jobs in forest sector related employment, including forestry and logging, wood processing, and pulp and paper processing. (See Table 1a).

Table 1a. Arrowsmith TSA Forest Economic Impacts

Input information	
Harvest volume impacted per year (m ³)	420,000

Output: Economic impacts												
\$ millions	Forestry & logging			Wood processing			Pulp & paper processing			Regional Forest Sector total		
	Direct	Indirect & induced	Total	Direct	Indirect & induced	Total	Direct	Indirect & induced	Total	Direct	Indirect & induced	Total
Employment (#FTEs)	159	101	260	243	142	385	168	190	358	570	434	1,004
Household income	12	6	19	18	9	27	18	13	31	49	28	77
GDP	18	10	28	22	13	35	26	22	48	66	44	111
Government Tax Revenue (Federal, Provincial & Municipal Tax)	4	2	6	4	3	7	5	5	9	12	9	22

Source: Forest Sector Economic Multiplier-BC Coast Recently updated by BC Stat; Harvest Billing System, FLNRO.

Due to the fragmented nature of the Arrowsmith TSA, interspersed with area-based tenures, private managed forest land, and population centers, it is difficult to relate the total Arrowsmith TSA related jobs as a percentage of the SINRD population. According to the National Household Survey Profile for 2011, forestry and manufacturing is a significant component of the labour force in communities such as Port Alberni, as is fishing and agriculture, retail, finance, transportation, and professional services.

Land base and forest management changes since the last timber supply review (TSR)

The timber supply analysis presented in this discussion paper differs from the analysis used for the previous (2009) AAC determination. Some of the significant changes include:

- The Maa-nulth Treaty lands and the Barkley Community Forest were removed from the Crown forest management land base.
- An Order establishing land use objectives for the Coastal Douglas-fir (CDF) moist maritime biogeoclimatic subzone came into effect in 2010 removing 1600 hectares of CDF from the Crown forest management land base.
- Crown forest land on the Gulf Islands removed from the timber harvesting land base.
- An economic operability assessment using an empirical approach was completed in April 14, 2014 and was used in determining the timber harvesting land base.
- Site productivity estimates from the provincial site productivity layer were used to project growth rates of contemporary plantations and future managed stands in place of the site index site adjustment project information used in the previous timber supply review (TSR 3).
- Old growth management areas (OGMA) area reductions were used in the analysis for old growth biodiversity requirements in 24 landscape units as compared to three landscape units in the last analysis. Like the last analysis forest cover constraints were applied where area reductions were not used.
- Community interface zones were identified for the timber supply review and rate-of-cut constraints were applied to them.
- Objectives for mature forest were applied in the Barkley Sound, Alberni Canal, Upper Qualicum, San Juan Ridge and Nahmint special management zones (SMZs).
- Scenic areas and visual quality objectives (VQOs) continued for the South Island Natural Resource District in 2005 under Section 17 of the Government Action Regulation were updated in 2011.
- In very constrained areas where cutblock size is limited to five hectares and there is significant retention within cutblocks, harvest volumes from contemporary plantations and future stands were reduced by 18 percent to account for the effects of shading and competition.
- Large increase in unsalvaged loss estimate from 2000 to 8038 cubic metres per year. Most unsalvaged mortality due to Douglas-fir beetle and Armillaria root diseases.

History of the allowable annual cut

In 1986, the Arrowsmith TSA was formed from portions of the former Nootka and Quadra TSAs. At that time, the AAC was set at 392 890 cubic metres. An additional allocation of 3870 cubic metres was made in 1989 for deciduous species. In 1992, the AAC was increased to 498 250 cubic metres to account for a transfer of land from TFL 46 to the TSA.

In December 1996, the chief forester set the AAC at 400 000 cubic metres, a decrease of 17 percent from the previous level. This AAC was partitioned as follows: 380 000 cubic metres for areas outside of Clayoquot Sound, 13 700 cubic metres for areas inside Clayoquot Sound, and 6300 cubic metres for red alder-leading stands.

September 1, 2002 the AAC was set at 373 300 cubic metres and the partitions for Clayoquot Sound and deciduous tree species continued. Since 2002, the AAC for the Arrowsmith TSA increased to 393 496 cubic metres due an additional transfer of land from TFL 46. A Part 13 Order for the Hill 60 Designated Area issued April 1, 2004, reduced the AAC to 391 796 cubic metres. On April 22, 2004 transfer of land from TFL 44 resulted in an increase in the AAC to 418 796 cubic metres.

On July 22, 2009, a new AAC for the Arrowsmith TSA was set at 420 000 cubic metres, a slight increase from the previous AAC. Of this total, 413 700 cubic metres is attributable to the conventional land base and Clayoquot Sound, and 6300 cubic metres is attributable to deciduous-leading stands.

Figure 2 shows the harvest performance in the Arrowsmith TSA since the 2009 AAC determination. Presented in the graphs that make up Figure 2 are data from the Harvest Billing System (HBS) summarized for the last seven years. The graphs indicate that the actual harvest which averaged 323 928 cubic metres per year between 2009 and 2015 is below the current AAC. Harvest performance before 2015 on the east side of the TSA was consistent with the level anticipated in the last TSR which was around 100 000 cubic metres per year. Under performance largely occurred on the west side of the TSA, especially in stands located in the Clayoquot area where little harvesting occurred. The species profile of the harvest is what one might expect when looking at the species composition of the forest (see Figure 3).

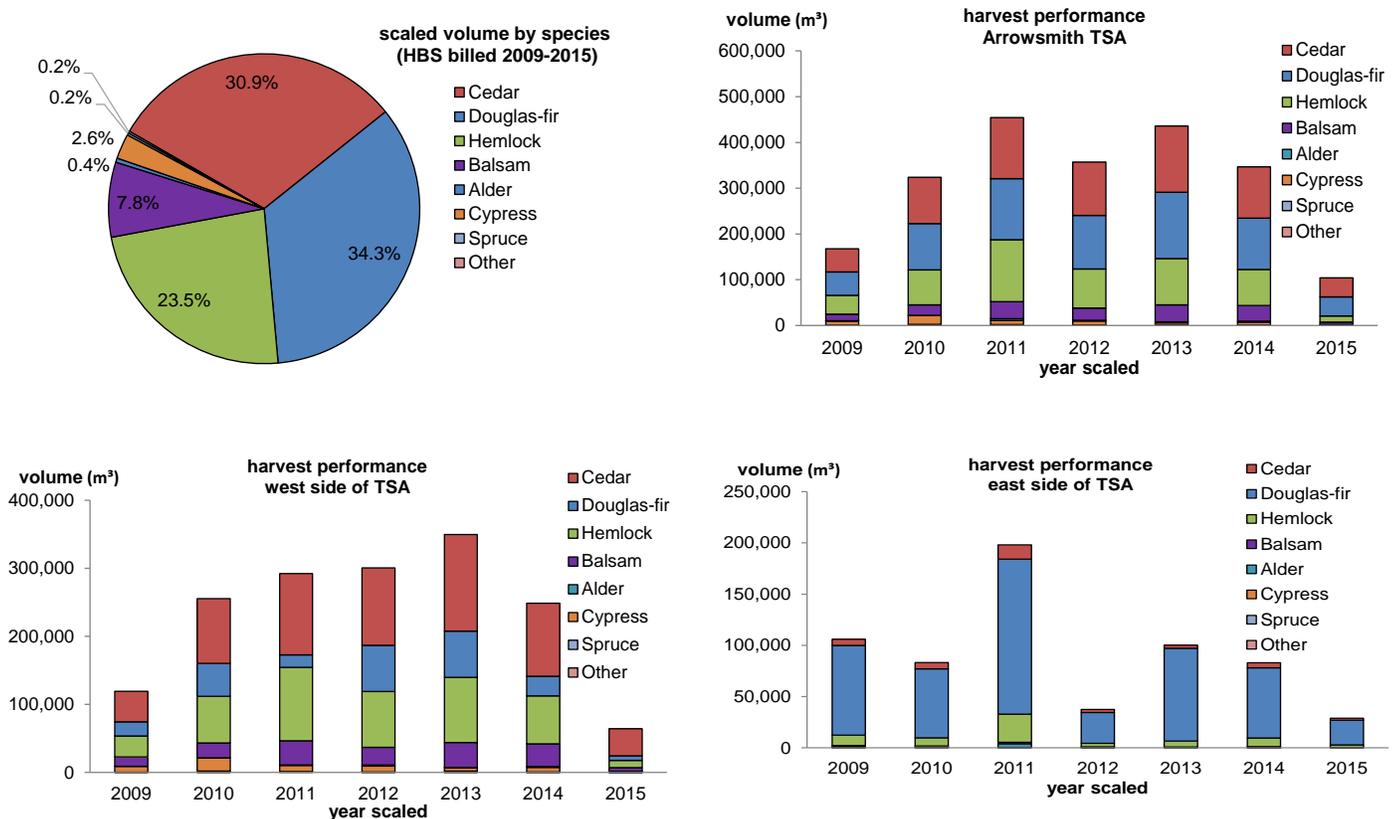


Figure 2. Harvest summary for the Arrowsmith TSA by species and year.

Forest management

Area available for timber harvesting

As part of the process used to define the timber harvesting land base (THLB) in the timber supply analysis, a series of deductions are made from the TSA (see Table 2). The total area of the TSA is 1 560 851 hectares. After accounting for large water bodies, park and protected area, area administered under separate area-based tenures, not Crown land or forested, the Crown forest management land base (CFMLB) is 114 940 hectares.

After further reductions for areas not suitable or available for timber harvesting because of ecological, economic, or social considerations, the THLB is 59 721 hectares. After reverted timber licences are factored in, the long-term THLB this is eight percent smaller than in the 2008 timber supply analysis. The difference is largely attributed to removal of the Maa-nulth Treaty Settlement Lands and the Barkley Community Forest Area.

About 44 percent of the CFMLB area is not available for timber harvesting. Areas excluded from harvest include land base designated for the protection of wildlife, riparian reserves, old growth values and archaeological sites, inoperable conditions and uneconomic stands or areas otherwise unsuitable for timber harvesting.

The THLB is a strategic-level estimate of the area available for timber harvesting for the purposes of modelling timber supply. However, inclusion or exclusion of an area in the THLB does not imply a change in operational management and consultation must occur before any operational decisions are made. Operationally, there may be areas that were not included in the THLB where harvesting does occur. Likewise, there may be areas within the THLB that never actually get harvested. Where government is expected to issue a land use order or the ownership classification of an area may change prior to the AAC determination, a sensitivity analysis may be prepared to assess what, if any, effect it may have on timber supply.

Current forest management must be consistent with the requirements of the FRPA and associated regulations that are designed to maintain a range of biodiversity and wildlife values. All forested lands, whether they contribute to timber supply or not, help to maintain critical habitat for many species. Therefore, the timber supply analysis includes constraints or forest cover requirements for biodiversity, visual quality, wildlife habitat, community watersheds, recreation features, riparian management and protection of environmentally sensitive areas. These requirements are applied to the CFMLB in the timber supply analysis.

The various land base classes including the THLB assumed in the analysis are listed in Table 2.

Table 2. Arrowsmith TSA netdown table

Classification	Gross area (hectares)	Net area		
		Area (hectares)	Percent (%) of TSA	Percent (%) of CFMLB
Arrowsmith TSA (timber supply blocks A,B,C)	1,560,851			
Ocean or large waterbody	720,495	720,495	46.16%	
Private and municipal land, Indian and military reserves and treaty land	582,776	582,776	37.34%	
Area-based tenures having separate AAC	17,690	17,690	1.13%	
Parks and protected areas	92,723	92,723	5.94%	
Non-forest (including classified roads)	32,227	32,227	2.06%	
Crown forest management land base (CFMLB)	114,940		7.36%	
Miscellaneous Crown lands not contributing to AAC	4,187	4,187		3.64%
Archaeological sites	1,479	1,471		1.28%
Wildlife habitat areas	2,524	2,395		2.08%
Ungulate winter range	1,922	1,623		1.41%
Old growth management areas	8,845	5,883		5.12%
Clayoquot Sound Study Area reserve network	7,806	7,657		6.66%
Coastal Douglas-fir order	1,365	1,337		1.16%
Riparian management reserve	2,398	1,648		1.43%
Permanent sample plots and research installations	558	426		0.37%
Recreation values (sites, trails, UREP reserve)	807	213		0.19%
Gulf Islands	810	809		0.70%
Economically inoperable areas	19,568	12,611		10.97%
Environmentally sensitive areas	4,440	1,135		0.99%
Low stocking	9,533	1,882		1.64%
Non-commercial forest types	141	41		0.04%
Sites with low timber growing potential	9,662	276		0.24%
Timber Licences (ones reverting back to TSA)	8,533	5,101		4.44%
Partially economically inoperable areas	4,602	1,533		1.33%
Unclassified roads, trails and landings		1,451		1.26%
Trees left standing within cutblocks (wildlife trees and patches)		2,265		1.97%
Retention within riparian management zones	10,878	1,275		1.11%
Retention within recreation features	3,267	1		0.00%
Timber harvesting land base (THLB)	59,721			51.96%
Timber licences reverting to TSA by 2025		(5,101)		(4.44%)
Research installations and PSPs expiring by 2115		(426)		(0.37%)
Future roads		482		0.42%
Long-term timber harvesting land base	64,766			56.35%

Forest composition

Figure 3 illustrates the distribution of timber volume and area of stands within the THLB grouped by dominant tree species. Cedar, Douglas-fir, hemlock and balsam are the major species found within the THLB and account for over 93 percent of the timber volume and stand area.

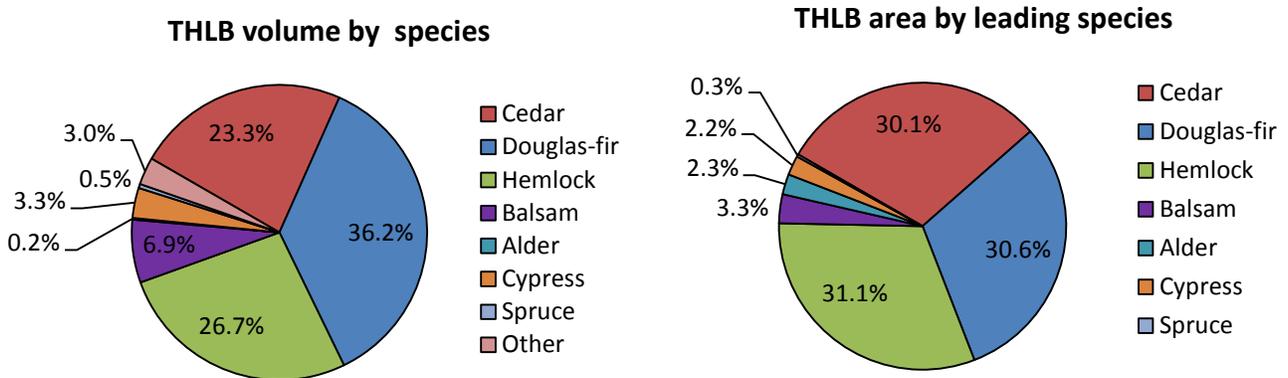


Figure 3. Tree species composition in the Arrowsmith TSA by area and volume.

Age class distribution

Figure 4 shows the current age class distribution of stands in the forested land base. The area within the THLB is indicated separately from the non-THLB area. Within the THLB, managed stands, which were generally established by planting, are younger than 65 years old. Stands older than 65 years generally originate from natural regeneration and are considered unmanaged in the analysis. Stands greater than 140 years occupy about 30 percent of THLB and are mostly cedar, hemlock and balsam located on the west side of the TSA (Figure 5).

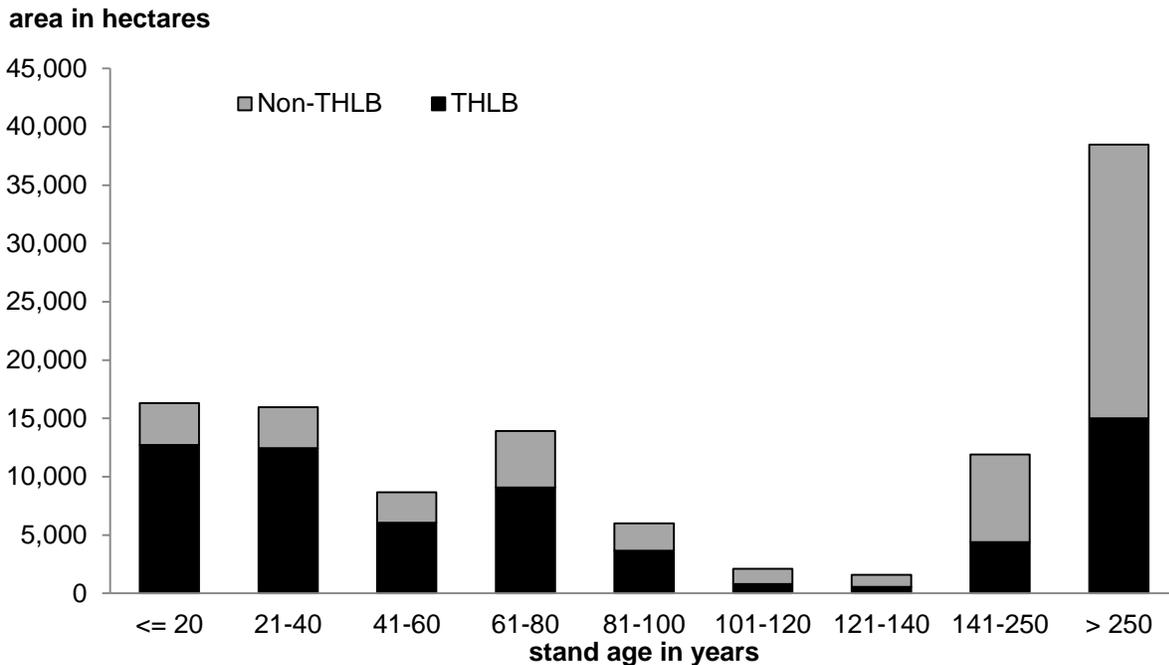


Figure 4. Age class distribution for the Crown forest management land base in the Arrowsmith TSA showing THLB and non-THLB portions.

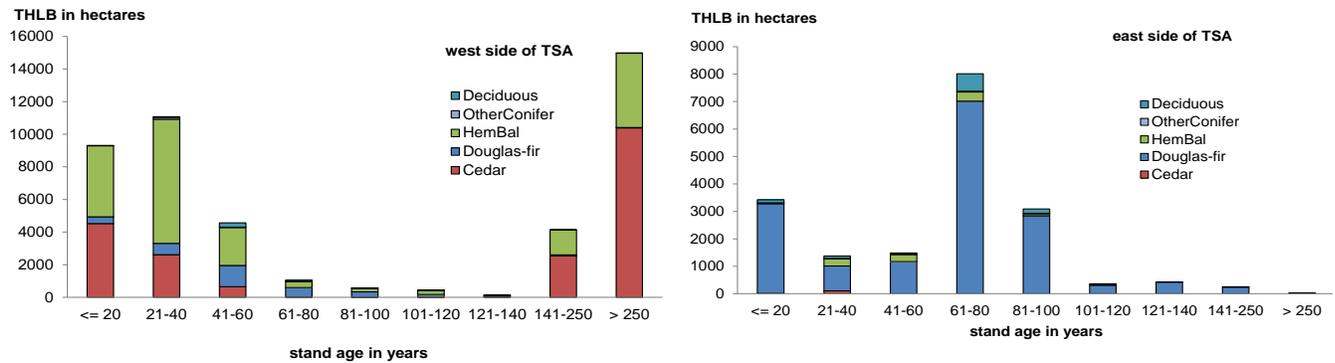


Figure 5. Age class distribution on timber harvesting land base for the east and west side of Arrowsmith TSA.

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 is 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’ projection 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 harvest projections are referred to as ‘sensitivity analyses’. Both the base case 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

In the base case selected for this AAC determination, a harvest level of 420 000 cubic metres per year can be maintained for one decade before declining to 392 000 cubic metres per year. This harvest level is projected to remain at 392 000 cubic metres per year for the next 130 years before slightly increasing to 399 000 cubic metres a year for the remainder of the projection period.

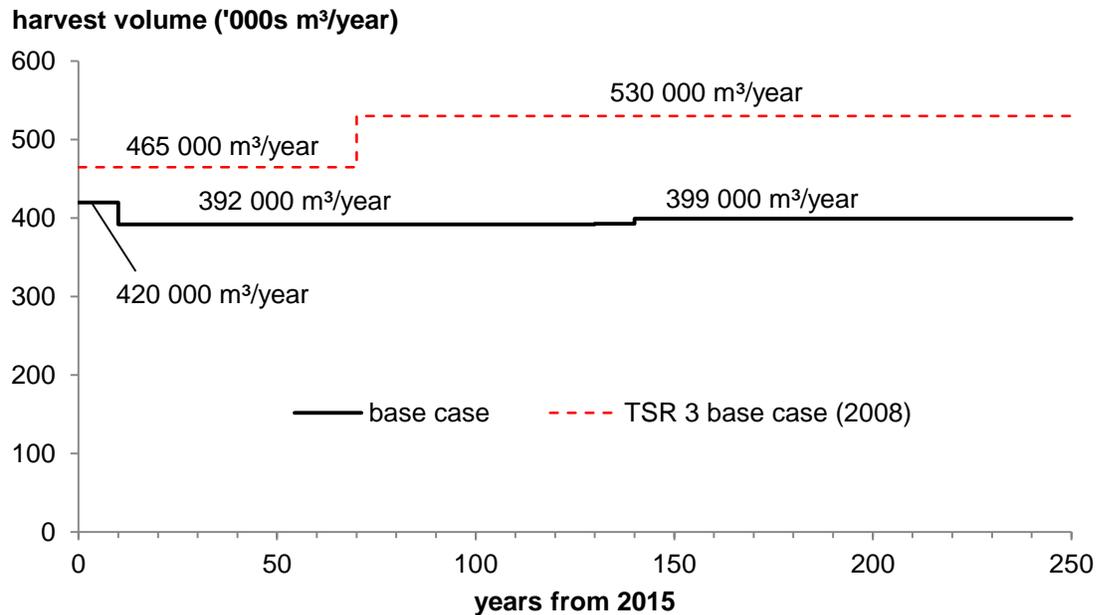


Figure 6. Base case projection - Arrowsmith TSA.

An important assumption in the base case is the amount of volume that will be harvested from different geographic areas in the TSA. From the Clayoquot Sound area, 13 700 cubic metres per year is targeted for harvest and from the east area of the TSA, 100 000 cubic metres per year is targeted. In addition, 6300 cubic metres per year of red alder will be harvested if possible. These amounts are consistent with the partitions described by the chief forester in his 2009 AAC determination. The amount targeted for the east area of the TSA is also consistent with the harvest performance between 2009 and 2014 (Figure 2) when an average of 101 273 cubic metres a year was harvested.

Alternative harvest flows

The base case is one of many possible harvest flows. Three alternative projections are shown in Figure 7 below. In the alternative harvest projections, the harvest flow takes into account the effect of changing the harvest rule from that assumed in the base case.

The following harvest rules were used to develop the base case and alternative harvest flows:

- Harvest rule 1 (base case) – Harvest the oldest stands in each period using minimum harvest volume criteria to identify eligible stands. Minimum volume criteria are specified separately for areas harvestable by conventional and helicopter logging methods, and for red alder stands.
- Harvest rule 2 – Same as harvest rule 1 but add minimum age criteria. Minimum age criteria are the ages at which stands reach 90% of their maximum mean annual increment or growth rate.
- Harvest rule 3 – Harvest stands with the highest volume per hectare in each period using only minimum volume criteria.
- Harvest rule 43 – Same as harvest rule 2 but add minimum age criteria.

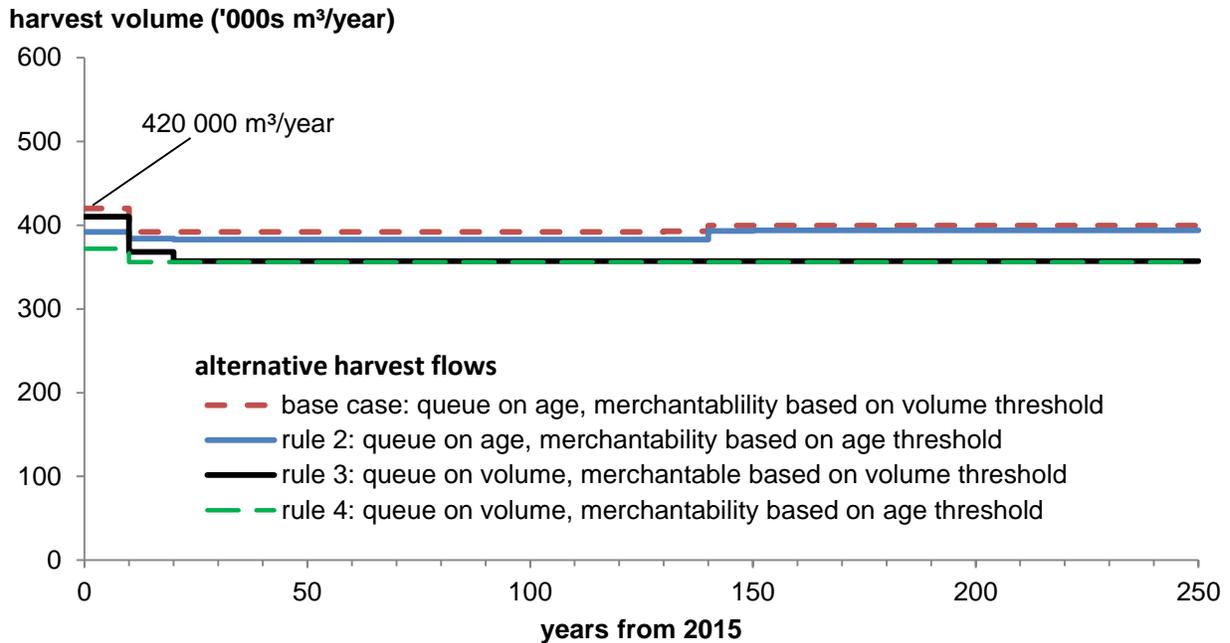


Figure 7. Alternative harvest projections based on alternative harvest rules – Arrowsmith TSA.

The following table shows the percent impact in the short-, mid- and long-term for the alternative harvest projections. All three projections fall below the base case harvest level. The largest decreases occur when the flow takes into account the effect of harvesting highest volume stands first, as in rules 3 and 4, rather than harvesting oldest stands first as in rule 2 and in the base case.

Table 3. Alternative harvest projections – Arrowsmith TSA

	Change from base case	Initial harvest (m ³ /year)	Percent (%) impact		
			Short term	Mid term	Long term
Harvest rule 2	Merchantability based on age and volume threshold	392 000	-6.5%	-2.2%	-1.7%
Harvest rule 3	Harvest blocks with highest volume first	410 000	-2.3%	-8.3%	-9.8%
Harvest rule 4	Merchantability based on age and volume threshold, harvest blocks with highest volume first	372 000	-11.2%	-9.0%	-10.1%

Note: Short-term = decade 1; mid-term = decades 2-8; long-term = decades 9-25.

Attributes of the base case projection

The graphs in Figure 8 show attributes of the base case harvest projection. In the top left graph growing stock volume over time is stable under the base case harvest level. The initial total growing stock volume starts at approximately 19.5 million cubic metres, declines to 17.0 million by year 35 before gradually increasing back to 20 million by the end of the projection. Available growing stock over time is much less than total growing stock due to a heavily constrained timber supply. The harvest transitions from natural stands to mostly managed stands by 70 years into the future (top right graph). The annual harvest area increases over this transition (bottom left graph) as more younger second-growth stands make up the harvest. After year 110 the annual harvest area stabilizes at around 746 hectares per year. In the bottom right graph, the average harvest age drops over the first 90 years from 150 years to 44 years before leveling off. The mean harvest volume per hectare declines from 673 cubic metres per hectare to a minimum of 502 cubic metres per hectare, before rising to 543 cubic metres per hectare and remaining around that level from the remainder of the projection.

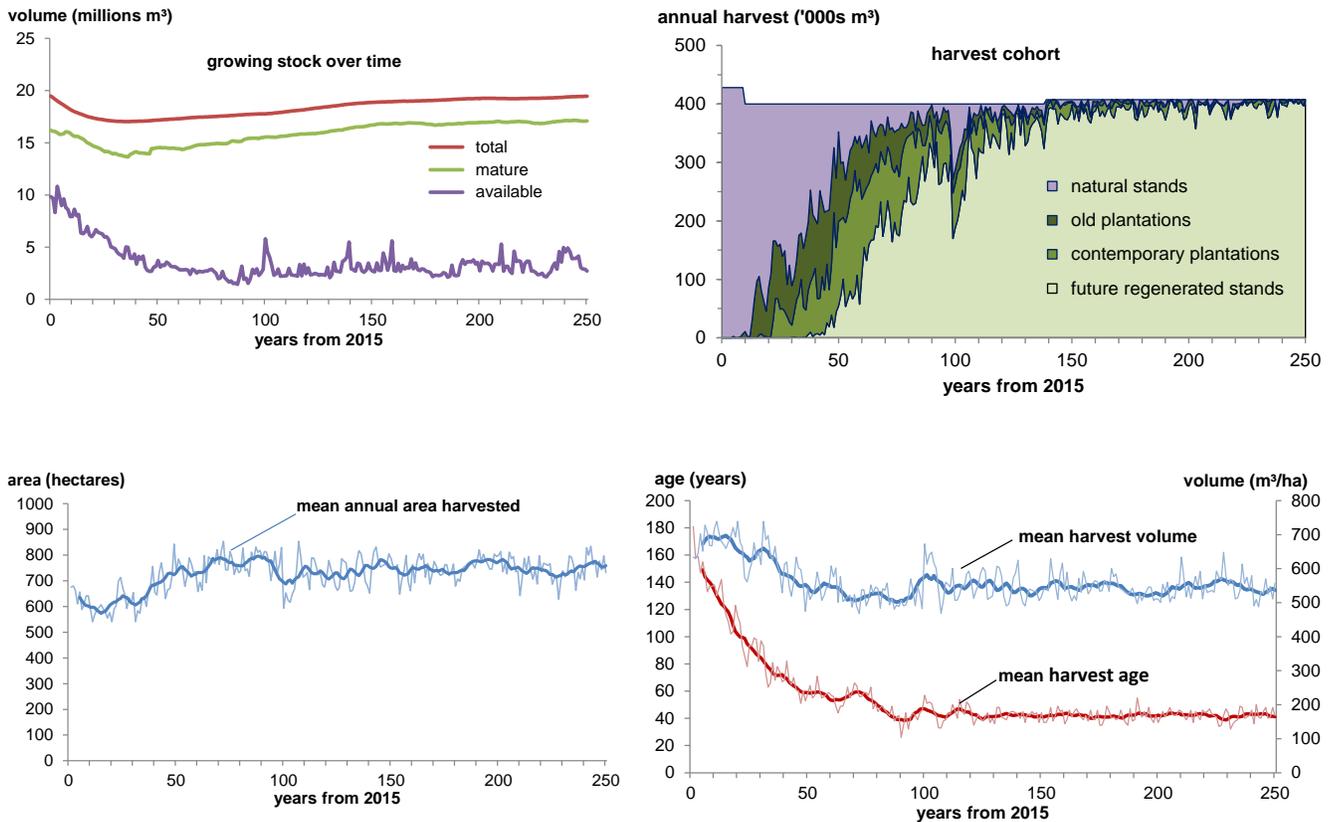


Figure 8. Attributes of the base case projection – Arrowsmith TSA.

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 Arrowsmith 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 key issues for the Arrowsmith TSA timber supply review are:

Economic operability of Heli-hemlock/balsam stands

Harvest records consistently indicate under performance in heli-hemlock/balsam stands on the west side of the TSA. Licensees suggest that stands without a significant component of cedar - 20 percent or more - are not economical to harvest under current market conditions. There are 653 hectares of such stands representing one percent of the timber harvesting land base.

Sensitivity analysis shows that removing the heli-hemlock/balsam stands would reduce the timber supply over the first 10 years of the projection by 6.6 percent. Mid- and long-term timber supply decreased by 1.5 percent and 1.2 percent respectively (Table 4).

Managing Crown land within the CDFmm biogeoclimatic subzone

The Province is committed to managing Crown land within the Coastal Douglas-fir moist maritime (CDFmm) biogeoclimatic subzone in a manner that provides protection for rare and endangered plant communities. On July 30, 2010 an Order establishing land-use objectives for CDF came into effect. The land-use order identified 1600 hectares for protection, mostly in the Arrowsmith TSA.

In this timber supply review all the area identified in the Order was removed from the timber harvesting land base. After other forest management constraints are considered, such as those for wildlife habitat and landscape-level biodiversity, 900 hectares or 1.4 percent of the timber harvesting land base, of CDFmm remain in areas eligible for harvesting. However, additional small areas of CDFmm areas are being proposed for inclusion in an Order. Moreover, BC Timber Sales, who holds the majority of the chart area in the CDFmm, has currently committed to do no further harvesting in the CDFmm.

Sensitivity analysis shows that removing the remaining CDFmm stands from the timber harvesting land base would reduce the timber supply over the first 10 years of the projection by 9.6 percent. Mid- and long-term timber supply would decrease by 3.3 percent and 2.0 percent respectively (Table 4).

Uncertainty around minimum harvestable age and volume

In the simulation model either a minimum harvestable volume or minimum harvestable age is applied to prevent the model selecting stands with less volume or younger than the minimums specified. In the base case a minimum harvestable volume was used. Volume thresholds are: 350 cubic metres per hectare for conifer stands accessible by road, 450 cubic metres for conifer stands accessible by helicopter and 200 cubic metres per hectare for deciduous-leading stands.

As a sensitivity analysis the minimum harvestable volume was replaced with minimum harvestable criteria based on volume and age. For this analysis, in addition to reaching a minimum volume, a stand must reach 90 percent of the age when it would have had its optimal growth. Minimum harvestable age was then adjusted by plus or minus 10 years.

Both an increase and decrease of 10 years both resulted in about a 10 percent decrease in short-term timber supply and around a 4.5 percent decrease in mid-term timber supply. Long-term timber supply increased by about 3.2 percent when ages were increased by 10 years but decreased by 6.6 percent when ages were decreased by 10 years.

The change in minimum harvestable age can have different effects depending on the timing of the harvest. For example, the effect of an increase in minimum harvestable age in the mid-term may reduce the amount of stands eligible for harvest at a time when availability is low. Alternatively, in the long term, a decrease in minimum harvestable age could result in volume lost as managed stands are harvested before their optimal rotation ages.

Uncertainty around stand-level retention

Stand-level biodiversity is managed in part by retaining mature trees or mature tree patches within cutblocks to provide structural diversity and wildlife habitat. Stand-level biodiversity is a requirement under the FRPA and is done in accordance with Section 66 of the Forest Planning and Practices Regulation. For several landscape units within the TSA land-use objectives for the Renfrew Sustainable Resource Management Plan set out more specific requirements.

In this analysis about 3.5 percent of the area within cutblocks on average is left unharvested to meet stand-level biodiversity requirements. This amount takes into account contributions to biodiversity from mature trees near or adjacent to cutblocks and retention within cutblocks attributable to other reasons.

In practice retention levels are often higher than the prescribed requirement. Some of this retention may eventually be harvested over time but some likely will never be harvested.

As a sensitivity analysis the amount of in-block retention was doubled from that assumed in the base case harvest projection, increasing the amount of area left unharvested within cutblocks to seven percent on average. This increase resulted in an 8.9 percent decrease in timber supply over the first 10 years of the harvest projection. Mid- and long-term timber supply decreased by 3.7 percent and 4.0 percent respectively (Table 4).

Table 4 provides a summary of the key issues and other areas of uncertainty that were explored using sensitivity analysis. It provides the percent change in the short-, mid- and long-term harvest levels compared to the base case harvest projection.

Table 4. Sensitivity analysis results - Arrowsmith TSA

Key issue or area of uncertainty	Change	Initial harvest (m ³ /year)	Percent (%) impact		
			Short term	Mid term	Long term
Economic operability of hemlock/balsam stands	Exclude the stands located on west side of TSA slated for helicopter harvest having <20% cedar.	392,000	-6.6%	-1.5%	-1.2%
Managing Crown land within the CDFmm biogeoclimatic subzone	Exclude remaining CDFmm from THLB.	379,000	-9.6%	-3.3%	-2.0%
Minimum harvestable age	Increase by 10 years.	382,000	-8.9%	-3.5%	+3.2%
	Decrease by 10 years.	370,000	-11.7%	-5.5%	-6.6%
Amount of stand-level retention within cutblocks	Increase in-block retention to 7% from 3.5%.	382,000	-8.9%	-3.7%	-4.0%
Uncertainty around volumes from existing natural stands (VDYP)	Increase volume by 10%.	420,000	0.0%	+3.7%	+2.5%
	Decrease volume by 10%.	369 000	-11.9%	-5.8%	-2.3%
Uncertainty around volumes from existing old plantations	Use potential site index values rather than inventory site index values.	420,000	0.0%	+6.8%	+0.6%
Uncertainty around minimum volume threshold (i.e., 350 m ³ /ha)	Increase minimum volume by 20%.	380,000	-9.4%	-3.0%	-1.0%
	Decrease minimum volume by 20%.	385,000	-8.2%	-3.0%	-0.2%
Uncertainty around modelling green-up of adjacent cutblocks	Increase maximum disturbance by five percentage points.	393,000	-6.3%	0.2%	-0.5%
	Decrease maximum allowable disturbance by five percentage points.	394,000	-6.1%	-0.8%	-0.3%
Effects of shading and competition in small cutblocks with variable retention	Adjust yields by - 18% in recent plantations and all future regenerated stands, not just in very constrained areas.	420,000	0.0%	-10.6%	-12.8%
	No adjustment.	395,000	-5.8%	0.7%	1.0%

Note: Short-term = decade 1, mid-term = decades 2-8, long-term = decades 9-25.

Summary

The 2016 TSR base case initial harvest level starts at 420 000 cubic metres and steps down over the first decade to a level of 392 000 cubic metres. This level is maintained for 13 decades before slightly increasing in the long term to 399 000 cubic metres per annum.

The base case and key sensitivity analyses prepared for this timber supply review indicate that operationally it is necessary to be cognizant of the timber harvesting land base, the harvest profiles and stand growth. The base case projection is a simulation based on the data and expectations modelled, if the expectations are optimistic the harvest projection will be optimistic and *vice versa*.

The provincial chief forester's AAC determination is a judgment based on professional experience and consideration of a wide range of information as required under Section 8 of the *Forest Act*. An AAC is neither the result of a calculation nor limited to the results of timber supply analysis; therefore, the new AAC may not be the same as the harvest level in the base case.

Your input is needed

Public input is a vital part of establishing the allowable annual cut. The information and comments received from this review will be provided to the chief forester prior to determination of the new allowable annual cut. Feedback is welcomed on any aspect of this discussion paper or any other issues related to the timber supply review for the Arrowsmith TSA. Ministry staff would be pleased to answer questions to help you prepare your response. Please send your comments to the Resource District Manager at the address below.

Your comments will be accepted until January 16, 2016.

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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If you have any comments or questions, contact:

Tracy Andrews, Senior Licensed Authorizations Officer, South Island Natural Resource District,
Electronic mail: Tracy.Andrews@gov.bc.ca

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

Visit the Forest Analysis and Inventory Branch web site at <http://www.for.gov.bc.ca/hts>