X̲aayda Haida First Nation Woodland Licence N1G Management Plan

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Submitted by:

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"I certify that the work described herein fulfills the standards expected of a member of the Association of British Columbia Forest Professionals and that I did personally supervise the work."

27/10/20

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This Management Plan (FNWL MP) is prepared in support of the First Nation Woodland Tenure application to replace Forestry Licence to Cut A97524. The Management Plan is required under the *Forest Act section 43.55* and under the terms of the License Agreement, section 6.00.

The FNWL MP applies to the timber harvesting rights issued under the authority of the licence and is consistent with the Forest Tenure Opportunity Agreement, the licence, legislation, Regional Executive Director direction, higher level plans and Taan Forest Ltd's Forest Stewardship Plan.

1.0 Introduction

Taan Forest Ltd (Taan Forest) by its General Partner Taan Forest Limited Partnership is a forestry company established by the Haida Enterprise Corporation (HaiCo) a company wholly owned by the Xaayda *Haida* through the Secretariat of the Haida Nation, a society fully controlled by the Xaayda Laas *Haida people*. Taan Forest has a mandate to generate sustainable benefits from forest resources on Xaayda Gwaay.yaay *Haida Gwaii* for the Xaayda *Haida.*

Taan Forest's management objectives and strategies support the implementation of HaiCo's Strategic Plan which is based on four overarching goals:

1) to generate revenue, meaningful employment and career opportunities for Xaayda Laas *Haida people*;
2) conduct responsible management practices;
3) develop operational capacity and ensure well managed, profitable and integrated businesses;
4) to produce a thriving, sustainable community that enhances the lives of people on Xaayda Gwaay.yaay.

Consistent with HaiCo's Strategic Plan, Taan Forest is committed to create a successful forest economy on Xaaydaa Gwaay.yaay *Haida Gwaii* based on the management principles of the *Haida Gwaii Strategic Land Use Agreement* with the goal of maximizing the benefits from the forest resource for the Xaaydaa *Haida* and balance the interests of all communities. Specifically:

- manage for long term sustainability
- increase the number of local logging and manufacturing jobs on Xaayda Gwaay.yaay *Haida Gwaii*
- extract the best value possible from the areas harvested
- manage the business prudently and effectively

Acquisition of Tenures

This management plan and associated licence for FNWL N1G will replace Forest Licence to Cut A97524 and its preceding licence A87661. A97524 is currently under the Council of the Haida Nation management through Taan Forest

License Area History

- April 22, 2005 Letter of Understanding, British Columbia committed to the Xaayda *Haida* to provide a replaceable area-based tenure with an annual harvest of 120,000m3

- December 11, 2009, the Kunst'aa Guu – Kunst'aayah Reconciliation Protocol was signed. The Xaaydaa *Haida* negotiated an area of Forest Land Base to support a harvest rate of 120,000m^3 annually.
- July 29, 2010 Taan Forest and the Province on behalf of British Columbia Timber Sales sign a Cooperative Management Agreement to establish a coordinated forestry planning process in the Cooperative Area known as the ""The Xaayda *Haida* Tenure" led by Taan Forest.
- September 30, 2010 Taan Forest and the Province enter into Forestry Licence to Cut A87661 as a transitional measure to provide an interim tenure opportunity until a First Nation Woodland Licence is available.
- September 21, 2012 a draft Forest Tenure Opportunity Agreement was provided to the Council of Haida Nation for 120,000m3 annually within a First Nation Woodland Licence.
- February 20, 2014 the Forest Tenure Opportunity Agreement is signed by the Council of the Haida Nation and on March 5, 2014 by the Minister of Forests, Lands and Natural Resource Operations for the Area Based Xaayda *Haida* "First Nation Woodland Tenure".
    - The tenure agreement provided 120,000m3 to the Haida Nation and 14,210 to BCTS when the AAC for the FNWL is = to 134,210m3
- June 23, 2016 Taan and BCTS sign agreement for BCTS to follow Taan's FSC® certification requirements and to not advertise additional volume until BCTS volume allocation is available.
- September 14, 2020 FLTC A97524 is executed. A97524 is a 190,000m3 two year license intended as a bridge license while the FNWL N1G Management Plan is approved, FNWL N1G License issued and FLTC A87661 Licence expires
- September 29, 2020 FLTC A87661 expires.
- October 2nd to present – Taan and BCTS progressing towards a new Cooperative Management Agreement for coordinated forestry planning led by Taan Forest.

Licence Area

The licence and management plan area cover the entire First Nation Woodland Licence tenure area.

The licence area is comprised of 'Schedule B' crown land portions only (no 'Schedule A' or private land is included). The licence is located on:

- Xaayda Gwaay.yaay Linagwaay *Graham Island* between Dajing Giids *Queen Charlotte Village* and the Yaagun Gandlaay *Yakoun River* as the North West boundary to Gamadiis *Port Clements*
- Gwaay.yaay Linagwaay *Moresby Island* North of Gawu Kuns Siiwaay *Mosquito Lake*, around Kaasda Siiwaay *Skidegate lake* and along Hlkinul Kaahlii *Cumshewa Inlet* to Diinal GawGa *Gray Bay*

Tenure	Total Area (Ha)	Timber Harvesting Land-base (ha)
Xaayda FNWL N1G	58,606	34,545

A full 1:65,000 map is provided in the appendices. An overview map is provided below

British Columbia Timber Sales Surplus Area

The FNWL has a non-discrete area that supports a volume that is surplus to that provided within the Kunst'aa Guu – Kunst'aayah Reconciliation Protocol of 120,000m^3 per year. The surplus area provides an AAC of 14,210m^3 when the AAC for the licence area is 134,210m^3. This surplus area is reserved for BC Timber Sales for the purpose of meeting the market pricing mandate. Through Taan Forest Led joint planning between BCTS and Taan Forest blocks will be selected for BCTS to advertise for sale.

Taan Forest and BCTS have entered into a Cooperative Management Agreement in 2010 and are in the process of renewing that agreement at the time of signing this Management Plan. Amendments to the agreement or other agreements may be entered into between BCTS and Taan Forest provided BCTS has access to the "surplus area".

Section 2.0 "AAC for FNWL N1G" addresses changing volume to the surplus area when the licence AAC changes.

Term

The term of the FNWL MP commences on the date of the approval by the Regional Executive Director and remains effective until the plan is replaced by a new, approved management plan, as requested by the Regional Executive Director or when it expires as per notice provided under 6.0 of the licence document.

An amendment to the plan for purposes of management redirection, change to legislation or as requested by the Regional Executive Director may be submitted.

2.0 Annual Allowable Cut

Under the authority of the 2009 *Kunst'aa Guu – Kunst'aayah Reconciliation Protocol (2009 Protocol)*, *Haida Gwaii Reconciliation Act* the Haida Gwaii Management Council (HGMC) was formed. The HGMC includes representatives of the X̱aayda *Haida* and the provincial government. One of the responsibilities and authorities of the HGMC is to determine the AAC for X̱aayda Gwaay.yaay *Haida Gwaii* (as a whole unit). The Chief Forester for B.C. then has the responsibility and authority under the Forest Act S 8(9)(10)&(11) to determine the AAC in the different licences in X̱aayda Gwaay.yaay *Haida Gwaii*.

As a result of the 2020 Haida Gwaii Management Council (HGMC) Draft Timber Supply Review, Taan Forest has not completed a full Timber Supply analysis. Taan Forest's analysis, supporting inventories and data packages are from the 2020 TSR public review documents and were utilized to propose an AAC under this Management Plan.

A copy of the HGMC Public Discussion Paper, Data Package and Analysis Package is provided in the Appendices for easy reference. All documents are available on the Haida Gwaii Management Council web site.

The HGMC timber supply review considers many factors, including but not limited to the following:

1) Current inventories
    a. growth and yield, site indices and analyzing existing and future managed stands
    b. updated Vegetative Resource Inventory
    c. utilization of LiDAR and Enhanced Forest Inventory
    d. administrative areas (Municipalities, Tenure boundaries, Private Land
    e. updated and current ecosystems
2) Operational constraints
    a. Minimum harvestable age
    b. Minimum harvest volume and low productive stands
    c. Silviculture Systems
    d. Max Cut Block size and Adjacency
    e. Economic operability
3) Spatial data defining the Timber Harvest Land Base (THLB)
    a. reductions necessary to facilitate management and conservation of timber and non-timber resource
    b. Haida Gwaii Land Use Objectives Order known and predicted exclusions from THLB
4) Resource management
    a. Visual Quality Management
    b. Wildlife Habitat Areas

c. Community Watersheds
d. Wildlife Tree Retention Areas
e. Permanent Sample Plots
f. Recreation Sites and Trails
g. Terrain Stability
h. Roads, Trails and Landings
i. Haida Gwaii Land Use Objectives Order
    i. Active Fluvial Units
    ii. Type I and Type II Fish Habitat
    iii. Upland Stream Areas and Sensitive Watersheds
    iv. Forested Swamps
    v. Blue and red Listed Ecosystems
    vi. Common and Rare Ecosystems
    vii. Forest reserves
    viii. Marbled Murrelet habitat
    ix. Northern Goshawk
    x. Saw-whet owls
    xi. Blue heron
    xii. Cedar Stewardship Areas
    xiii. Haida Traditional Heritage Features
    xiv. Culturally Modified Trees
    xv. Monumental Cedar
    xvi. Haida Traditional Forest features
    xvii. Yew Trees
    xviii. Black Bear Dens
j. Archaeological Resources
k. FPPR requirements for streams and wetlands not described in the HGLUOO
l. Cedar Partition
m. Natural Disturbances
n. Climate Change

The Draft TSR data Package completed several sensitivity analyses taken into consideration for the proposed AAC including:

1) *"Ts'uu – Ts'uu sgiid, Sgaahlaan – Sgaahlaang (red cedar and yellow cedar)"* TSR Draft Data Package
2) Community Forest
3) First Nations Woodland Licence
4) Mosquito Lake Protection
5) Full Monumental cedar protection
6) Net downs from former monumental identification standards
7) Increased estimate of monumental cedar
8) Stad's Kun (Northern Goshawk) foraging and Nesting Habitat

A list of the data sources and description of inventories utilized in the HGMC Draft Timber Supply review is included within the TSR Data Package (refer to Appendix 2).

AAC for FNWL N1G

134,210m^3 annually from the FNWL Area

The “Surplus Area” proposed AAC reserved for BCTS will equal:

14,210m^3

Taan’s proposed AAC within the FNWL Area will equal:

120,000m^3

When the AAC is equal to 134,210m^3 120,000m^3 is Taan Forest’s through the Kunst’aa Guu – Kunst’aayah Reconciliation Protocol and 14,210m^3 is surplus area reserved for BC Timber sales.

Should the licence AAC exceed 134,210m^3 per year, the Surplus area will be increased by the product of 14,210m^3 divided by 134,210m^3 multiplied by the amount by which the AAC exceeds 134,210m^3

Should the licence AAC drop below 134,201m^3 per year, the Surplus area will be decreased by the product of 14,210m^3 divided by 134,210m^3 multiplied by the amount by which the AAC falls below 134,210m^3

<u>AAC Rationale</u>

Within the draft TSR the FNWL area was run as a sensitivity analysis. The FNWL sensitivity analysis included Taan Forest’s TFL 60 and FLTC A87661. This sensitivity analysis was run as it is Taan Forest’s and the Council of the Haida Nation’s intent to combine TFL 60 into the FNWL when a new Haida Forest Tenure Opportunity Agreement can be agreed to by the Council of Haida Nation and Province of BC to incorporate TFL 60.

The sensitivity analysis shows under section 2.2 of the TSR Result Report Nov 14 final (appendix 3) that combined the AAC for TFL 60 and the FNWL area would be 484,375m^{3}as shown in section 2.2.

TFL 60 run separately has a volume of 295,275m^3 shown in section 2.2 however the difference in volume 484,375m^3 – 295,275m^3 =189,100m^3 is not the FNWL volume. When combined, TFL 60 and FNWL has greater flexibility in harvest options allowing for a small increase in timber supply as noted in section 2.2.

To find the conservative volume of the FNWL the TSA volume from Figure 1.1.7 *non-declining flow base case across all three management units* must be utilized. In this figure TFL 60 and the FNWL are not combined, but the FNWL volume is within the TSA volume of 452,287m^3. Subtracting Figure 1.1.7 TSA volume from section 2.2 TSA volume in the FNWL sensitivity run will give the FNWL proposed AAC.

$$452{,}287m^3 – 271{,}763m^3 = 180{,}524m^3$$

Technical staff from the Council of the Haida Nation and the Province of BC working on the TSR were engaged and they recommended the Non-declining flow base case across all three management units (Figure 1.1.1 of the TSR Result Report Nov 14 final) less the TSA volume in section 2.2 of the TSR Result Report as a conservative determination of the expected AAC to be finalized by the HGMC. The technical staff are expecting a higher volume than the 134,210m^3 for the FNWL of 180,524m^3.

Factoring the 8 sensitivity analysis listed above, Taan is taking a conservative approach and estimating the sensitivities may affect the AAC by 46,314m^3. Since the release of the TSR documents in November of 2019 Taan has been working with the Council of the Haida Nation to address and incorporate many of the sensitivities into planning, particularly the Mosquito Lake Protection. A 46,314m^3 reduction would be a conservative measure for proposing an AAC within this management plan.

$$180{,}524m^3 – 46{,}314m^3 = 134{,}210m^3$$

Should the final AAC determined for the FNWL area be less than the 134,210m^3 the Regional Executive Director can request an amendment or new management plan to reflect the new AAC when released.

Should the final AAC determined for the FNWL area be significantly more than 134,210m^3 and the sensitivities noted above resolve, a new AAC can be proposed when TFL 60 is added to the FNWL area.

Accessible Resource Inventories and Assessments

Taan Forest maintains, or has access to, the most current information available for the following resource inventories to support the AAC and forest planning in general:

Table 1: Resource Inventories & Assessments

Inventory Type	Source	Date	Summary
Vegetation Resource Inventory	Government	2011	Haida Gwaii - A VRI Strategic Inventory Plan was completed in June 2011 to provide complete, seamless and current inventory. Taan does yearly depletions
Riparian Classification (Stream, Lake and Wetland)	LUO Taan Forest	2010 2020	Spatial updates and inventory from field works, LiDAR updates, reserve and management zone establishment
Ecosystems	Terrestrial Ecosystem Mapping (TEM)	2010	Haida Gwaii – amalgamated inventory information from several data sources (industry & government), mapping scales and years
	Predicted Ecosystem Mapping (PEM)		Site Plan and spatial updates to ecosystems from field assessments. Updates are on-going
	Taan Inventory updates	2020	Data is updated as new TEM project data becomes available.
Terrain Stability	Joint Technical Working Group	2010 (data from 1974-2004)	Haida Gwaii - amalgamated inventory from several data sources (industry and government), mapping scales and years
Terrain Stability	Under Development	2018	Updating and refining terrestrial polygons with LiDAR information and field terrain reports.
Recreation Resource & Features	Data BC CHN		Haida Gwaii – Recreation Sites CHN – Areas of Recreation Interest

Visual Landscape Inventory	Data BC Taan Forest – Landscape Visual Inventory	2005 2016	Haida Gwaii – Visual Landscape Inventory Taan Forest – Estimated Amalgamated Landform Visual Inventory
Land Use Order (various layers and files)	Joint Technical Working Group	2011	Haida Gwaii - Mamu habitat, Type I and II fish streams, cedar stewardship areas, forest reserves, alluvial fans, forested swamps, red and blue listed ecosystems, northern goshawk nest areas, potential nest areas blue heron and northern goshawk etc
Wildlife Habitat Areas (WHA)	Ministry of Environment	Updated as they are established	Legally established areas with 'General Wildlife Measures' associated with the areas to specify harvesting restrictions and prohibitions to protect specific species at risk.
Archaeological Overview Assessment	BC Archeological Branch	2002	Overview assessment to rate the potential for archeological sites to guide completion of Archeological Impact Assessments.
Heritage and Cultural Sites	Council of Haida Nation Heritage Branch	2015	Known areas of Cultural and Heritage significance – Spatial Inventory
LUOO Protected Heritage & Forest Features Monumental Inventory Yew inventory	Taan Forest	2020	Spatial inventory of 10 years data collection of LUOO features including reserves and management zones
Active Fluvial Units and 100 year Flod Planes	Gynnis Horel	2017/ 18	Mapping and inventory updates
Forest Health (biotic and abiotic)	MFLNRO Forest Health Program Aerial Overview Survey	2006-2010	Overview assessment to evaluate impacts to the landbase over time from black headed budworm, green spruce aphid, yellow cedar decline, windthrow and landslides.
Non-Timber Forest Products – Mushroom Management Areas	BC Journal of Ecosystem Management Article	2009 - 2018	*Ecological descriptions of Pacific golden chanterelle (Cantharellus formosus) habitat and estimates of its extent in Haida Gwaii' (Kranabetter, J.M., H. Williams, and J. Morin. 2009.).* The report provides key information on the history of botanical use on Haida Gwaii and includes identification of several key Mushroom Management Areas. Spatial analysis and inventory of high value mushroom habitat and longevity

All data is updated on continuous basis as better more accurate information becomes available.

3.0 Other Management Plan Content Requirements

Legal & Other Requirements

The FNWL MP N1G is designed to be consistent with the following requirements:

- The Haida Forest Tenure Opportunity Agreement;
- The First Nations Woodland Licence N1G
- Applicable forestry legislation such as the *Forest Act* and the *Forest and Range Practices Act*; *Wildfire Act*, etc.;
- Higher Level Plans under the *Forest and Range Practice Act*; such as the Haida Gwaii *Land Use Objectives Order*
- Operations Plans, Taan's Forest Stewardship Plan
- Any commitments made in the FLTC A87661 under section 43.54(4)(b) of the Forest Act, or as agreed to by both parties to the licence agreement, where applicable

<u>Haida Forest Tenure Opportunity Agreement</u>

The FTOA Agreement describes the Forest Tenure under section 3 and the preliminary AAC for the licence

Harvest Rights to be shared under section 4. See AAC for FNWL N1G "Surplus Area"

<u>The First Nations Woodland Licence N1G</u>

The First Nations Woodland Licence provides tenure commitments of the licence holder during the term of the licence.

<u>Applicable Forestry Legislation</u>

The Management Plan and related forest management activities by Taan Forest on the licence area must be consistent with all applicable forestry legislation, such as:

- *Forest Act* and associated regulations
- *Forest and Range Practices Act* and associated Regulations
- *Wildfire Act* and regulation

This Management Plan does not grant harvesting authority. Approvals for harvesting timber are issued by the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD) in the form of Cutting Permits and Road Permits and related operational plans that must be consistent with the Higher-Level Plans and the Forest Stewardship Plan.

<u>Haida Gwaii Land Use Objectives Order (LUO)</u>

The Management Plan and related Operational Plans (see below) are consistent with the Haida Gwaii Land Use Objectives Order, enacted in December 2010, amended in April 2014 and September 2017.

The Order establishes legal objectives for cultural and forest-based values to support implementation of Ecosystem Based Management and sets objectives for some of the following key values:

- Cultural features [traditional heritage features, traditional forest features, cedar & yew & CMT/monumental Cw retention] (identification, certification of surveyors, reserve zones
- Aquatic Habitats [Type I & II fish habitat, active fluvial units, upland streams, sensitive watersheds] (protection & reserve zones)
- Biodiversity [forested swamps, site series representation/old forest, red/blue listed spp.] (retention targets & strategies)
- Wildlife [black bear dens, MaMu nest habitat, QC Goshawk habitat, Blue Heron nest habitat, North. Saw-whet Owl nest habitat] (% protection, reserve & buffer zones etc.)

There are no other Higher-Level Plans established for X̲aayda Gwaay.yaay *Haida Gwaii*.

Operational Plans

The licence area will be managed under the requirements of the Taan's Forest Stewardship Plan (FSP), approved May 2018, and as amended from time to time.

The 'X̲aayda *Haida* Tenure' area is included within the approved FSP (under FLTC A87661). An amendment will be required to add the Tenure FNWL N1G.

The FSP specifies management objectives for soils under FPPR s 12.1(1) and s 35 and 36.

FLTC A87661 Commitments

There are no applicable commitments made in the FLTC A87661 licence under the Forest Act section 43.54(4)(b) that are carried forward to FNWL N1G. Commitments that were agreed to by Taan Forest and the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD) include:

- All active Road Permits, Cutting Permits, and Special Use Permits will be transferred over to FNWL N1G
- All silviculture obligations associated with FLTC A87661 will be transferred to FNWL N1G

4.0 "Kayd k'aws" (Forest) Management Objectives

Corporate Objectives

Taan Forest is committed to create a successful forest economy on Xaayda Gwaay *Haida Gwaii* based on the management principles of the Haida Gwaii Strategic Land Use Agreement with the goal of maximizing the benefits from the forest resource for the Xaayda *Haida* and balance the interests of all communities.

Specifically, the primary objectives are to manage for long term sustainability, increase the number of local logging and manufacturing jobs on Xaayda Gwaay.yaay *Haida Gwaii*, extract the best value possible from the areas harvested, and manage the business prudently and effectively.

Taan Forest will manage for logs and lumber products through the custom cut program as well as minor forest products such as post-harvest salvage (shakes, shingles, logs, cants, firewood, etc.). Taan Forest also operates a damaged timer salvage harvesting program.

Sustainable Forest Management Certification

The licence area is managed under the Taan Forest Corporate Management System (CMS) and is certified to the Forest Stewardship Council® (FSC®)[1] sustainable forest management standard for British Columbia.

In addition to the CMS, Taan Forest maintains an FSC® Management Plan that is designed to meet the certification requirements and establish clear linkages between existing plans, procedures and processes that all support the FSC® requirements (such as the Haida Gwaii Land Use Order and Forest Stewardship Plan). This plan is available on the Taan Forest website: www.taanforest.com.

Existing Management Objectives

The corporate objectives will be implemented through management strategies that are consistent with the Haida Gwaii *Land Use Objectives Order* (based on principles of ecosystem based management), the *Forest and Range Practices Act* and related Forest Stewardship Plan, practice requirements, and site level plans and permits, the FSC® Management Plan and the Corporate Management System.

The following existing management plans, agreements and objectives that are currently in place and provide direct and indirect support to the FNWL Management Plan:

Table 2: Existing Management Objectives, Plans & Agreements

Document	Summary
Haida Gwaii Land Use Objectives Order & Associated Amendments to the order (December 2010)	The Land Use Objectives Order establishes legal objectives for forest-based values to support implementation of ecosystem-based management. These objectives protect important Xaayda *Haida* cultural values, support ecosystem integrity and provide environmental benefits by maintaining the diversity and abundance of organisms on Xaayda Gwaay.yaay *Haida Gwaii*.

[1] Trademark licence FSC®-C104355 and FSC®-C108282.

Document	Summary
Licence Agreements – TFL, FLTC, FNWL	Sets out the legal requirements and commitments related to the tenure, defines rights and obligations.
Taan Forest Stewardship Plan May 2018)	Establishes results and strategies designed to implement the *Land Use Objectives Order* and the requirements under the *Forest and Range Practices Act*. It is an operational plan defined under the legislation and must be approved by the Ministry of Forests, Lands and Natural Resource Operations and Rural Development. The FSP covers all harvest land base of X̲aayda Gwaay.yaay *Haida Gwaii* but specifically designed for the managment of the FNWL as shown on attached maps.
Haida Gwaii Management Council - Timber Supply Review -Public Discussion Paper (November 2019) -Draft Data Package (November 2019)	Under the authority of the Kunst'aa Guu – Kunst'aayah Reconciliation Protocol (2009 Protocol), Haida Gwaii Reconciliation Act, and in the X̲aayda Stewardship Law, the Haida Gwaii Management Council (HGMC) was formed. The HGMC includes representatives of the X̲aayda *Haida* and the provincial government. One of the responsibilities and authorities of the HGMC is to determine the AAC for X̲aayda Gwaay.yaay *Haida Gwaii* (as a whole unit). The Chief Forester for B.C. then has the responsibility and authority to allocate the AAC to the different licences in X̲aayda Gwaay.yaay *Haida Gwaii.*
Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) – Chief Forester AAC Announcement.	The Chief Forester AAC Determination for TFL 58, TFL 60 and Timber Supply Area 25 (based on the HGMC Timber Supply Review).
Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) –DM Policy on Visual Management on X̲aaydaa Gwaay	The DM's Guidance for Visual Management on X̲aayda Gwaay.yaay *Haida Gwaii*.
Council of the Haida Nation – Dec 16, 2014 direction of Visual Impacts along Highway 16	Until such time that new VQO's are developed for the highway corridor, development areas should be difficult to see and in small scale while travelling along the corridor (no focal point).
Taan Forest FSC® Management Plan & Annual Monitoring Report	Management objectives and strategies that supplement existing legally required results and strategies under the Forest Stewardship Plan (consistent with the Land Use Order) and are required to meet third party sustainable forest management certification standards.
Taan Forest Corporate Sustainability Statement	Corporate policy outlining the commitments to health, safety, environment and sustainable forest management.
Corporate Management System	Corporate Policies, MS Manual (training, applicable legal requirements and international protocols/ agreements, standard operating procedures, petroleum and hazardous materials, etc.)
Site Level Plans & Assessments	Site level plans and assessments are completed for every development area (as applicable) and must be consistent with legal requirements, the LUO and the Forest Stewardship Plan. Site Level plans include Harvest & Road Plans/ Maps, Site Plans, Silvivulture Treatment Regimes & associated assessments (e.g., cultural, riparian, windthrow, etc.).

Specific Management within the FNWL Area

Through consultation efforts during Taan Forest's FSC® management plan, Taan's Forest Stewardship Plan, Taan's Advisory Group and public meetings four specific management concerns within the FNWL area were highlighted by the public, interest groups and stakeholders. While management of the FNWL is not limited to just these four areas they include:

- Ts'uu *cedar* harvest and regeneration
- botanical forest products (specifically kaagan daajing *mushrooms*)
- visuals
- recreation

Management of Ts'uu

Taan Forest recognizes the importance of Ts'uu *cedar* to Xaaydas *Haidas* and is committed to the reestablishment and survival of these trees on Xaayda Gwaay.yaay *Haida Gwaii* for present and future generations of Xaayda Laas *Haida People*.

Harvest rate of Ts'uu

To minimize the overharvesting of Ts'uu *cedar,* the Chief Forester has issued a Ts'uu *cedar* apportionment for the TSA on Xaayda Gwaay.yaay *Haida Gwaii.*

- TSA not to exceed 38.09% of the AAC

The Partition is not applicable to a First Nation Woodlands Licence however total Ts'uu *cedar* harvest within the FNWL N1G will not exceed the intended apportionment of 38.09% of the proposed AAC.

Protection of Ts'uu

Through current legislation, Taan Forest will continue to reserve and protect cedar (Ts'uu *red* and SGaahlan *yellow*) on the landscape.

Research is supported by Taan Forest with partnership with UBC towards understanding the impacts of SGaahlan *yellow cedar* die-back, climate change, K'aad *deer*, and reforestation challenges.

Further analysis and stand level efforts are being reviewed for long term sustainability of Ts'uu *red* and SGaahlan *yellow cedar* in reserves and protected areas across the FNWL area as decadent stands, such as those in protected area(s) are not regenerating Ts'uu *cedar*(s) naturally.

Reforestation of Ts'uu

Taan Forest is committed to exceed legislated requirements for Ts'uu *cedar* reforestation. Unless ecologically unsuitable, or research indicates otherwise, Taan Forest will reforest Ts'uu *cedar* on all harvest stands that had a percentage of Ts'uu *cedar* in it.

Where Ts'uu *cedar* was a large percentage of the volume from the harvest stand (>50%) Taan Forest will ensure that >50% of the stocking requirement for that stand is planted in Ts'uu *cedar*.

All Ts'uu *cedar* will be protected from K'aad *deer* browse where deemed necessary by a Professional Forester or a person under direction of a Professional Forester. Browse protectors will be monitored throughout the early development of the re-growing Ts'uu *cedar*. Typically, at

3 years post installation maintenance is required to “correct” the protector after being knocked over by wind or ungulates. Generally, at year 6 once the young Ts’uu *cedar* is above the protector height, browse protectors are removed. Used browse protectors, where still in good shape, will be re-utilized. Generally, browse protectors are re-used 3 times, or for a total of 18 years. Where browse protectors are left on the tree because of inaccessible blocks, or only a small number of treated trees, the browse protectors will be checked prior to Free Growing to ensure the Ts’uu *cedar* has “released” from the protector. If necessary, slicing the protector will be employed to “release” the tree.

All Ts’uu *cedar* stock, unless issues arise with the stock or climate change requires a need for seed transfer guidelines to change, seeds will be from Xaayda Gwaay.yaay *Haida Gwaii* origin as long as seed stock is available.

SGaahlan *yellow cedar* seed has poor viability and is difficult to find. With SGaahlan *yellow cedar* dieback issues, improved SGaahlan *yellow cedar* stock, from Xaayda Gwaay.yaay *Haida Gwaii* or not, will be used for the survival of SGaahlan *yellow cedar* provided seed transfer guidelines are adhered to.

Enhancement of Ts’uu

Where deemed ecologically suitable, will enhance the growth of Ts’uu *cedar*, and economically possible, Ts’uu *cedars* will be assessed for enhanced silviculture activities. If appropriate the following enhanced work may be employed:

- Fertilization (Pre-Free Growing and/ or post Free Growing
- Spacing (Post Free Growing)
- Stand cleaning (Pre-Free Growing)

Cedar Stewardship Areas

There are specific objectives of Cedar Stewardship Areas (CSA) within the Taan Forest Stewardship Plan.

The Council of the Haida Nation have a Cedar Stewardship Area Management Plan. Where the Cedar Stewardship Areas are within the FNWL area, Taan Forest will follow from the Cedar Stewardship Area Management Plan.

Under section 3.3.2 of the Council of the Haida Nation’s CSA Management Plan, Taan Forest is managing all silviculture obligations within CSA areas on the FNWL. This includes ensuring stands are Free Growing and removing growth impediments such as browse protectors. All silviculture activity information in CSAs is shared with the Council of the Haida Nation, our ownership.

Ts’uu *cedar* research information mentioned above is shared with our ownership the Council of the Haida Nation, who can apply the information to CSA areas as necessary.

Ts’uu Kaldala Cedar

There are specific objectives of Ts’uu Kaldala *monumental cedar* within the Taan Forest Stewardship Plan.

Ts’uu Kaldala *monumental cedar* are identified and inventoried by certified Cultural Feature Identification Personnel. Inventory information is provided to our ownership, the Council of the Haida Nation, and the Xaayda Gwaay.yaay *Haida Gwaii* Cultural Wood Access Program. If Ts’uu Kaldala *monumental cedar* are harvested, they are harvested under legislated authority and provided to the Xaayda Gwaay.yaay *Haida Gwaii* Cultural Wood Access Program.

Management of Botanical Forest Products

Currently, there is no intent to harvest, manage or charge fees for botanical products. If, in the future, this changes, prior to any harvest of botanical products taking place, this management plan will be amended to include inventories, management objectives and a prescribed rate of harvest for botanical products.

An analysis of the socio-economic base case was completed by an economist as part of the Haida Gwaii Land Use Plan (March 2004). The following is an excerpt from the report:

> *There are a number of botanical or non-timber forest products such as wild mushrooms, berries and other wild foods, plants used in wildcraft and medicinal plants that are harvested on the Islands. Some of these non-timber forest products have a long history of use by the X̱aaydaa. Mushrooms are the most significant botanical from a commercial perspective, and currently they provide an important income supplement to the Haida and other Islands residents. In an average year (production can easily vary by 40%), it is estimated that up to 300 pickers (one -third locals) can earn several thousand dollars per year, harvesting 250,000 pounds of mushrooms (90% chanterelles) on the Islands.*
>
> *Mushroom picking centres on the Islands include the Skidegate Lake area in the northern half of Moresby Island, Masset Inlet and the Yakoun River Valley.*
>
> *Currently, commercial harvesting of other plants, such as floral greenery and medicinals, occurs at only a very small scale.*

The high cost of transportation from X̱aayda Gwaay.yaay *Haida Gwaii* presents challenges for large scale market development of all non-timber forest products (other than local markets/ use). The X̱aayda *Haida* have also expressed concerns with increased commercialization of non-timber forest products and the harvesting of culturally important trees and plants (Pierce Lefebvre Consulting. 2006. Socio-Economic Assessment of the Haida Gwaii Land Use Viewpoints).

Currently, the harvest rates of botanical forest products will not be managed under the FNWL and there are no listed products included in the Licence Agreement Schedule C.

Kaagan daajing Management

Taan Forest recognizes that kaagan daajing *mushroom* picking, particularly the Pacific Golden Chanterelle, is a source of income and food source for many people of X̱aaydaa Gwaay yaay *Haida Gwaii*.

There is one identified kaagan daajing *mushroom* habitat area with FNWL N1G. Currently, the management in these zones focuses on the longevity of resource extraction versus short term gain. Ideal stand age in kaagan daajing *mushroom* producing stands is between 30 and 50 years. Kaagan daajing *mushrooms* continue to develop in stands 70 to 80 years, but production dwindles as the stand ages and begins to show attributes of an Old Growth, mature stand. (JEM report, 2008)

The large kaagan daajing *mushroom* producing area on T'aaxwii X̱aaydaga Gwaay.yaay Linagwaay *Moresby Island* around Kaasda Siiwaay *Skidegate* and Gawu Kuns Siiwaay *Mosquito Lakes*, located within FNWL N1G originated from large harvesting operations in the 1950's to 1970's. Kaagan daajing *mushroom* production in these areas is expected to significantly decrease by 2038 and continue to decrease until 2098 when there will be little to no kaagan daajing *mushroom* production unless there is a source of disturbance to produce new tree growth and younger stands.

The focus in the kaagan daajing *mushroom* producing areas of FNWL N1G is to break up the age class distribution of kaagan daajing *mushroom* producing stands and create a long term indefinite supply of productive kaagan daajing *mushroom* habitat. By default or design, the *Haida Gwaii* Land Use Objectives Order watershed restrictions only allow for small amounts of area to be opened (harvested) in a 5 to 10 year period. By harvesting in these kaagan daajing *mushroom* producing areas now the decline expected in 20 years is minimized and recovery of kaagan daajing *mushroom* production occurs beyond 2038, versus a steady decrease to no production if no harvesting were to occur.

Some areas of current kaagan daajing *mushroom* growth will be harvested over the next 20 years. This will marginally reduce the amount of kaagan daajing *mushrooms* being harvested on Xaaydaa Gwaay. Yaay *Haida Gwaii*. It is in the interest of future generations and prolonged access to kaagan daajing *mushroom* production that harvesting be completed now to regenerate stands and produce new kaagan daajing *mushroom* habitat versus having a sharp decline and no mushrooms to harvest in the future.

Management of Visuals

Refined visuals are required for Xaayda Gwaay.yaay *Haida Gwaii*. At the time of this plan new defined visual polygons and objectives had not been released. Taan Forest has taken the initiative to re-define visuals with the FNWL area. Utilizing the Council of the Haida Nation's (Highway 16 Visual Corridor) and Ministry' s directive for visuals (A Guide to Visual Quality Objectives & District of Haida Gwaii Visual Quality Policy) and the visual areas of concern as addressed by members of the public, Taan Forest has the following visuals to manage for:

a) Travel corridors
    a. Hwy 16 – Highway buffer to harvest areas reducing visual sensitivity of new harvest areas. Goal is to have minimum viewing time of new harvest areas when passengers in vehicle are travelling at speed limit. Development areas planned along the highway are to meet the following criteria
        i. Difficult to see and/ or small in size
        ii. Roads leading to the development from the highway to be angled to minimize a direct view of any opening while still meeting Highway road junction design specifications (i.e. first 15m of side road must be at right angles to the highway)
        iii. No gravel pits, landings etc visible from the travel corridor
        iv. Exposed soils visible along the corridor to be revegetated within a reasonable time frame (by next growing season after disturbance)
    b. Ferry Routes – Retention to partial retention systems exposing no more than 1% - 3% of non-visually greened up harvest areas across the visual landscape between 1 and 8km from the route
    c. Logging Mainlines – Visuals will be managed in accordance with the District's Manager guide to Visual Quality Objectives and new direction and objectives set for Visual Quality on Xaayda Gwaay.yaay *Haida Gwaii*
b) Recreation Areas
    a. Hlkinul Kaahlii *Cumshewa Inlet*
    b. Kaasda Siiwaay *Skidegate* and Gawu Kuns Siiwaay *Mosquito Lakes*

- Defining specific areas of visual sensitivity (i.e., North Side Kaasda Siiwaay *Skidegate Lake* versus South Side) and managing visuals according to public use and in some areas by landform versus landscape. In general, minimize visual impact 1 to 8 km away from landscape area. Maintain a visual buffer along high tide marks and utilize a variety of Silviculture systems including partial cut systems

c) Static Sites
   a. Gaats'iiGundaay *Alliford Bay* Area as viewed from Villages of HGaagilda *Skidegate* and Daajing.giids *Queen Charlotte* – Manage the visual landscape area within the FNWL as retention exposing no more than 1.5% of non-visually greened up harvest areas across the visual landscape. Partial Cut System will likely be the choice Silviculture systems to meet this objective.

Management of Recreation

Currently, Taan Forest does not have any recreation sites that they maintain however several sites and access to sites are within the FNWL area.

Public Safety – The public is encouraged to visit the Taan Forest Office or the Taan Forest website to receive a copy of Taan Forest's Road and Radio Use Procedures. Visiting the office, the public can be made directly aware of harvesting activity locations and timing of those activities. Active operation signs, no hunting signs, and in some areas, gating is placed for public and worker safety. All Dry-land Sorts and shops have a 3km radius no shooting buffer.

Road use/ Access – Roads within the FNWL are maintained as much as possible for industrial use and public safety. All heavily used road permit roads, such as mainlines, and bridges are inspected annually. When roads are inactive by industrial users they do become overgrown quickly. These roads are still checked to ensure there is safe public access and there is nothing that could stop public access, however when roads are overgrown extra caution does have to be used by road users.

Road signage – Roads no longer under road permit are generally deactivated and do not provide safe passage for the public. These roads are posted as deactivated and are not to be used. Kilometer signage and road name signage is on-going for maintenance and updating. Directional signage and updating is on-going. All new signage within the FNWL is to be bi-lingual signage, Xaayda kil *Haida language* and English.

Deactivation of Roads – It is the interest of our ownership to provide access and leave roads open in all areas of the FNWL. Roads that are permanently deactivated are evaluated for safety and environmental risk prior to deactivation. Where roads are safe to leave open and posse no risk to the environment, fish passage or unnecessary access to wildlife habitat (near HlGuu *heron* nests, Stad's Kun *goshawk* nests, Elk Areas) they will be maintained. Small in-block spur roads that provide no additional access to the blocks except for operational purposes will generally be deactivated. Roads that are not expected to have high use are generally seasonally deactivated allowing for 4X4 access only.

Operational timing – Industrial activities on busy recreation access routes (Rennell Main) are timed as much as possible to be outside the tourist window. Where timing does not work out signage and flaggers will be utilized to ensure safe passage for the public.

Visuals – As above, harvest areas that can be viewed from recreation areas are designed to minimize the visual impact a cut block can have on the visual landscape. Harvest areas may still be visible, but impact minimized and in accordance with VQO's set for the visual polygon.

5.0 Consultation and Information Sharing

Existing Processes

Solutions Table

- Under the Xaayda *Haida* Stewardship Law and the Haida Gwaii Reconciliation Agreement between the Xaayda *Haida* and the Government of BC, provisions are included to establish shared decision making called the Solutions Table to oversee technical and operational aspects of forest management. The Solutions Table consists of two Xaayda *Haida* and two provincial representatives. They have full access to a broader set of experts who can be brought in for advice as needed. The Solutions Table reviews applications and makes a recommendation to decision makers. The application and recommendation are then passed to both the Xaayda *Haida* and the Provincial decision maker for a decision. The process is under shared decision-making under the 2009 Protocol and both parties strive for consensus, but if one is not achieved, the province can authorize activities. A summary of the process is as follows:
- All applications received by the province are referred to Front Counter Haida Gwaii.
- Applications are reviewed by a sorting representative at both Xaayda *Haida* and Provincial governments to determine whether the applications are Scenario 1 or Scenario 2.
- Scenario 1 applications go onto the Solutions Table Co-Chairs for review and recommendation before going to the Decision Makers for approval. Scenario 1 applications meet the Haida Gwaii Land Use Objectives Order, other legislation and have no controversial components. The goal is that a Scenario 1 application will be signed within 14 days of submission.
- Scenario 2 are sent to Solutions Table, require a more in-depth technical review and additional information for the applicant. In several cases, a Scenario 2 application will be passed on to the Integrated Stewardship Team, a technical team comprised of technicians/ experts and/or professionals from both the Council of the Haida Nation and Provincial Governments. A Scenario 2 application once reviewed may receive “consensus” from the Table and submitted to Decision makers for approval or “Non-Consensus” and sent to the Decision Makers for further evaluation. A Scenario 2 consensus application may take up to 60 days for approval, a non-consensus application may take up to 90 days before a decision is made.

Taan Forest and BC Timber Sales Joint Planning Processes

- Taan Forest led joint planning processes of the FNWL area are planned on a semi-annual basis between Taan Forest and BCTS. The intent of the joint planning processes is to review potential blocks to meet the Surplus area volume for BCTS to advertises as Timber Sales. The process will ensure the harvest profile and access to harvest areas is equally balanced between both parties.

Forest Stewardship Plan

In addition to the Solutions Table, the Forest Stewardship Plan (FSP) process includes a legislated review and comment period for members of the Xaayda *Haida*, stakeholders and the public, in addition to site specific referrals/ consultation of proposed forest management activities with the X̱aayda *Haida* (information sharing) and the "Intergovernmental process" under the Land Use Order.

A summary of the Information Sharing requirements in the FSP are as follows:

- Land Use Order Intergovernmental Process, specific to the relevant Results and Strategies in the Forest Stewardship Plan, as required.
- Annual information sharing process (including overview of planned forest management activities/ locations)
- Cutblock and road referral process (maps) of proposed developments areas for a 30 day period. Over the last 6 months this has included sitting down with the Council of the Haida Nation's technical staff to review up and coming cut blocks (all 2020 blocks) and to closely examine submitted blocks to Front Counter Haida Gwaii for approval.

Periodic referrals of specific cutblocks and roads may also take place to review reconnaissance locations, "pro-forma" calculations and potential issues/ concern.

Taan Forest is also responsible to maintain records of consultation related to our specific forest management activities (e.g., FSP, Cutting Permit/ Road Permit, etc.).

Where feasible, the FSC Management Plan and High Conservation Value Forest Assessment (HCVF) Assessment will be included in discussions or presentations relating to consultation/ referral of the Forest Stewardship Plan.

<u>FSC Consultation</u>

In addition to the public consultation process under the FSP, the FSC Standard requires public consultation related to the FSC Management Plan, the Assessment of High Conservation Value Forests (HCVF) as well as the planning and annual results of the Monitoring Plan.

One of the objectives of the FSC Management Plan Public Consultation Process is to obtain *free and informed consent* from the X̱aayda *Haida* and the *local rights holders* to any portion of the management plan that affects their rights and resources as well as to provide on-going public participation that accommodates the needs and preferences of *directly affected persons*.

For the purposes of this section, the following terms are defined by FSC:

- **Local rights holders** – A person who resides within or adjacent to the management unit and holds legal or customary tenure or use rights in the management unit.
- **Free and informed consent** – free and informed consent is considered given by local rights holder(s) where: a) local rights holders have participated in a public participation process under Criterion 4.4 that accommodates their needs/preferences with regard to scope and design (as demonstrated by lack of disputes regarding the process from local rights holders); and, b) having been informed of the opportunity to do so, no local rights holder has given written notice to the manager that they dispute that proposed management will protect their rights or resources.
- **Directly affected persons -** Groups or people (both women and men) who consider themselves directly affected by the proposed and current operations; reside in communities within or adjacent to the management unit; or have legal or customary rights in the management unit.

The FSC Management Plan, HCVF Assessment and annual monitoring results (excluding any proprietary information) are posted on the Taan Forest website along with contact information regarding comments or concerns. Updates are posted as they occur.

Consultation of the FSC Management Plan, HCVF Assessment and monitoring results with the public/ stakeholders will occur on an-on-going basis at the following minimum key stages:

- Initial consultation of the FSC Management Plan and HCVF Assessment will include written notification to stakeholders (per the Stakeholder Contacts) and a link to the Taan Forest website. Hard copies will also be made available at the Taan Forest office on Xaayda Gwaay.yaay *Haida Gwaii*. Comments may be received at any time following the initial consultation; however, to ensure feedback is incorporated into the first version of the plan, the review and comment period will be set at 2 weeks.
- All FSC Management Plan and HCVF Assessments, and written notices are sent directly to our ownership, the Council of the Haida Nation.
- All Notices are given directly to the Xaayda Laas *Haida People* by sending the information to them directly into the HlGaagilda *Skidegate* mailboxes and in Gaw Tlagee Old Massett, it is hand delivered house to house on reserve.
- All notifications and information is posted in various areas and businesses in HlGaagilda *Skidegate* and in Gaw Tlagee Old Massett. Additionally, the information is shared on HaiCo's social media, the Council of the Haida Nation's social media and distributed via their email list serve.
- Additional meetings may be held with key parties to review and discuss the key documents, at the discretion of Taan Forest (records maintained on file).
- Updates to the FSC Management Plan, HCVF Assessment or annual monitoring summary will be posted to the internet as they occur. At a minimum, the monitoring results are posted annually. Significant updates or changes may also include notification to stakeholders and/ or be reviewed at meetings with key parties, as determined by Taan Forest.
- Additional forums may be considered (e.g., workshops, open houses, focus meetings) by Taan Forest.
- Comments and input that is received during the Public Consultation Process (include members of the Xaayda *Haida*, members of the public, local businesses, stakeholders, and directly affected persons) are reviewed and considered by Taan Management and where applicable, interests and concerns are forwarded to the Taan CMS Administrator for consideration.
- Records of all input/ comments received in addition to any responses or changes to the FSC Management Plan to address the input is documented and maintained on file by Taan Forest.
- Taan Forest provides access to the Dispute Resolution Process on the website.

Taan Advisory Group (TAG)

Taan Forest has formed an advisory group to relay information and receive information to and from Xaayda *Haida* communities and Xaayda *Haida* representatives. Information exchanged regards resource planning, operations, new policy, legislation and concerns from the communities. The group attempts to meet quarterly and consists of representatives from:

- Council of the Haida Nation Executive
- Stewardship Director
- Heritage and Natural Resource Committee Chair or representative
- Heritage and Natural Resource Department Manager or representative
- Council of the Haida Nation Solutions Table Co-Chair
- Old Massett Village Council Chief Councillor or representative
- Skidegate Band Council Chief Councillor or representative

Forestry Forums

Taan Forest participates in several Forestry Forums initiated by Taan Forest or through the Council of the Haida Nation or Provincial Governments for community presentations and discussions regarding forest policy, operational planning and activities, and information exchange

Website

Taan Forest's website www.taanforest.com provides news and updates regarding contract and employment opportunities, Taan Forest's certification, Operational Planning updates, Taan Forest's FSP and FSC® Management Plan and links to other resources.

Measures to Consult with Non-Timber Production Resource Agreement Users

Under Taan Forest's certification commitments, regular public consultation is completed with the FSC® Management Plan, Annual Monitoring Report and High Conservation Value Forest Assessment with the X̱aayda *Haida* and all stakeholders (e.g., industry, non-governmental groups, local government, trappers, mineral claim tenure holders, water license holders, etc.)The public review strategy regarding the FNWL Management Plan #1 is as follows.

The FNWL MP will be made available for review by non-timber production resource agreement holders through the following avenues:

- Notification emails and/ or letters to the X̱aayda *Haida* as referenced above and all relevant stakeholders (per Taan's Stakeholder Contact list as well as the Haida Laas distribution email list) regarding review and comment and provision of access to a copy of the Management Plan;
- Placing of advertisements in the Haida Gwaii Observer;
- Posting of the Management Plan to the company website with contact information; and
- A copy of plan will also be available for review and comment at the Taan Forest office in HlG̱aagilda *Skidegate*

The advertisement will contain a brief introduction to Taan Forest and the tenure, the proposed AAC and reference to HGMC's draft Timber Supply Review Data packages, Report and Public discussion papers. (refer to Appendix 5 for a copy of the ad).

Summary of Comments Received

Date	Respondent	Description of Comments Received
February 20, 2020	Jim Richardson	Phone call to Planning Manager: With additional volume in the Haida Tenure he hopes there will be opportunity to have more smaller logging contractors

March 18, 2020	Gloria O'Brien	**From:** Gloria O'Brien <gloria@obrienlogging.com> **Sent:** March 18, 2020 10:35 AM **To:** Jeff Mosher <jeff@taanforest.com> **Subject:** RE: FNWL Looking at the map on the notice it is apparent that this is a huge hit for the small business operators here on the island. Is it the intention to see us out of work completely? If so it would it not be the kind thing to do to let us know in order for us to make an exit plan for our employees. **From:** Jeff Mosher [mailto:jeff@taanforest.com] **Sent:** March-18-20 2:32 PM **To:** Gloria O'Brien **Cc:** Richard Jones **Subject:** RE: FNWL Hi Gloria, Thanks again for your e-mail and concern. The area, boundary or location of the Haida Tenure has not changed since it was first negotiated by the Council of The Haida Nation and the Province at the signing of the Kunst'aa Guu – Kunst'aayah Reconciliation Protocol in 2009. When the Haida Tenure was created the Province had not finalized the legal framework for a First Nation Woodland Licence. The Province issued to Taan Forest for The Haida Nation a 10 year temporary Forest Licence to Cut A87661. Within this initial licence and part of the K&K Protocol 120,000m3 annually is for the Haida Nation. Based on the last Timber Supply Review and AAC determination the area of the Haida Tenure sustained 134,960m3 annually. As part of the Tenure agreement signed by the Council of The Haida Nation, 14,960m3 annually would be managed for/ by the BCTS program. Some of the BCTS volume harvested within the Haida Tenure was by your company, such as the volume removed from JUN003. The majority of the volume was removed by other BCTS operators such as Riverside, near Mosquito Lake. Now that ten years has nearly passed we are changing the FLTC A87661 licence to the initial licence intent of the Haida Tenure, a First Nation Woodland Licence. Within the Woodland Licence Management Plan it is a requirement to propose an Allowable Annual Cut for the Licence area. Based on the current Timber Supply Review Process underway (See November 2019 Public Review and Comment Period from the Haida Gwaii Management Council) the new predicted AAC for the Haida Tenure area is 153,524m3, 18,564m3 more than the last Timber Supply Review. The increase in AAC is due mainly from better inventory information collected over the last 10 years in the tenure area. The Tenure agreement has calculations to determine how an increase, or decrease in the AAC will be split by Taan (Haida Nation) and BCTS. Taan will have an increase from 120,000m3 to 137, 269m3 and BCTS will have an increase from 14,960m3 to 16,255m3.

		An increase in BCTS volume provides more opportunity for small business operators. We will also highlight the majority of the Haida Tenure Volume, now 153,524m3 annually, is sent out for bid as harvest opportunities for small business operators. The increase in volume will again provide more opportunity. While Taan/ Haida Nation retain full ownership of the fibre, unlike BCTS, these harvest opportunities have built capacity and provide employment to many small businesses on Haida Gwaii. We have not seen any recent bids on these opportunities from O'Brien & Fuerst in several years. In fact I believe that last time we worked together was on the KUM002 block out NEY1000 when Taan first started. We encourage your company to watch for these harvest opportunities and bid on them. Sincerely, Jeff Mosher **From:** Gloria O'Brien <gloria@obrienlogging.com> **Sent:** March 18, 2020 2:37 PM **To:** Jeff Mosher <jeff@taanforest.com> **Subject:** RE: FNWL We would be very interested in bidding on any blocks advertised and sold by Taan.
No additional comments recieved		

Appendices

The following pages include all of the related supporting information to the Management Plan.

Appendix 1:
Haida Gwaii Management Council - Timber Supply Review Public Discussion Paper (November 2019)

Haida Gwaii

BRITISH COLUMBIA
The Best Place on Earth

Public Review Period *for* *an* Annual Allowable Cut Determination

By the

Haida Gwaii Management Council

November 2019

1. Executive Summary

Haida Gwaii consists of more than 150 islands located roughly 80 kilometres off the northern mainland coast of British Columbia (BC). In 2009, the Council of the Haida Nation and the Province of British Columbia ('the Province'), while acknowledging dispute of title over Haida Gwaii, signed the historic *Kunst'aa Guu – Kunst'aayah Reconciliation Protocol* (Reconciliation Protocol).

Through the Reconciliation Protocol, both Governments choose a more respectful approach to co-existence by way of land and natural resource management through shared and joint decision-making. One aspect of the 2009 Reconciliation Protocol was a commitment to establish the Haida Gwaii Management Council (HGMC). This commitment was enabled by the Council of the Haida Nation's 2010 KaayGuu Ga ga Kyah ts'as – Gin 'inaas 'laas 'waadluwaan gud tl'a gud giidaa (*Haida Stewardship Law),* and BC's *Haida Gwaii Reconciliation Act*. With this commitment and legal authorities in place , the HGMC was formed in 2011.

The HGMC consists of two members appointed by the Haida Nation, two members appointed by the Province, and a chairperson jointly appointed by both Governments. The HGMC has the authority to make joint decisions related to a specified set of strategic land and resource decisions

Prominent among the official responsibilities of the HGMC, is the determination of an allowable annual cut (AAC), to define how much timber may be commercially harvested each year from the Haida Gwaii Management Area ('Haida Gwaii') – which encompasses all of Haida Gwaii except for private land, and areas within Indian Reserves and municipalities. The HGMC sets an AAC for Haida Gwaii, and the *Haida Gwaii Reconciliation Act* requires that the determination of AACs for specific management units (Tree Farm Licences, Timber Supply Area, Woodlots, Community Forest Agreements, and First Nations Woodland Licences) not exceed the overall level determined by the HGMC. Further information on the HGMC can be found at: http://www.haidagwaiimanagementcouncil.ca/

A key purpose of the Haida Gwaii timber supply review is to ensure that the AAC reflects the protected areas and ecosystem-based management (EBM) regime stemming from the 2007 Strategic Land Use Agreement and the *Haida Gwaii Land Use Objectives Order*; and reflects any new land use decisions and inventory updates affecting the forest management land base.

The HGMC mandated the Joint Technical Working Group, made up of technical representation from the Council of the Haida Nation and the Province, to oversee the technical process associated with the timber supply review. The Joint Technical Working Group prepared the 2019 Haida Gwaii timber supply review *Data Package* and *Timber Supply Analysis Report* for the HGMC. The *Data Package* describes the inputs and approaches that were used in the timber supply modelling, while the *Timber Supply Analysis Report* describes the findings from the modelling; both documents are key to informing the AAC determination for Haida Gwaii.

As part of the technical process, a computer-generated spatially explicit projection of timber supply available under assumed land use and forest management conditions was prepared to provide a 'base case' harvest projection. Analytical findings are described briefly in this discussion paper and include the 'base case' projection showing that for all of Haida Gwaii an even flow annual harvest level of 842,781 cubic metres can be maintained.

This base case projection is not a recommended AAC for Haida Gwaii. The base case is just one of several projections and sources of information the HGMC will consider in its AAC determination. Other sources include the ideas, opinions, and personal experiences of people who live on Haida Gwaii and/or who consider their interests to be affected by the determination. As part of the AAC determination process the HGMC will consider the technical data as well as social, economic and cultural considerations, including those brought forward through the engagement processes.

To engage Haida citizens, other residents of Haida Gwaii and in BC, the HGMC is circulating this *Public Discussion Paper* as an integral part of its decision-making process. This *Public Discussion Paper* provides information on the timber supply analysis, forest management issues, and socio-economic factors that HGMC will consider in making its determination, as well as on the AAC determination process itself. The HGMC hopes this will enable individuals, communities, licensees, and other interested parties to provide informed responses on any matter that they believe should be considered in the AAC determination, whether consistent with, or critical of, any data, information or approaches used in the *Data Package*. The HGMC now therefore invites and welcomes your feedback on any aspect of this *Public Discussion Paper*, and/or on any other issue or concern that you feel needs to be considered in assessing the timber supply on Haida Gwaii.

To that end, please see Section 13 **'Your Feedback is Needed'** at the end of this document. To help the determination process to remain on schedule, we would appreciate receiving your comments during the **Public Review and Comment period. In consideration of the upcoming holiday season, the HGMC is extending this period from November 15, 2019 to January 14, 2020.**

Following the HGMC's AAC determination for Haida Gwaii, the Province's Chief Forester, using the same technical information and public feedback from this *Public Discussion Paper*, will then make separate AAC determinations for the Timber Supply Area (TSA) and the two Tree Farm Licences (TFLs) on Haida Gwaii that must not in total, when combined with Woodlot Licence AACs, exceed the HGMC AAC determination. After the Chief Forester's determinations are made, the Minister of Forests, Lands, Natural Resource Operations and Rural Development ('the Minister') will apportion the TSA AAC to different forest tenure types.

2. Introduction

Major Government-to-Government agreements, protocols, processes and land use objectives that have shaped the timber supply review for Haida Gwaii are highlighted in this section.

Timber Supply Review

A timber supply review assesses the amount of timber available for harvesting over time. An allowable annual cut (AAC) is the maximum average level of timber harvest permitted for a forest management area, usually expressed as cubic metres of wood. The AAC represents a harvest level that aims to balance environmental, economic, social and cultural considerations.

When undertaking a timber supply review in support of an AAC determination, basic elements of timber supply need to be described:

- The location and types of forest including timber volumes and values (forest inventory)
- How fast forests grow over time (growth and yield)
- Where timber harvesting can occur (timber harvesting land base)
- Forest management practices based on legal requirements and other factors such as economics
- Rate or level of harvesting over time (such as even-flow annual harvest levels).

The unique AAC circumstance of Haida Gwaii

The authority for determining the AAC on Haida Gwaii rests with the HGMC, a specially mandated body established under the *'Kunst'aa Guu – Kunst'aayah' Reconciliation Protocol*; as well as in the *Haida Gwaii Reconciliation Act*, and in the *Haida Stewardship Law*. This unique arrangement has developed from these and other significant agreements reached between the Council of the Haida Nation and the Province as described below.

2007 Strategic Land Use Agreement

The 2007 Strategic Land Use Agreement between the Council of the Haida Nation and the Province identified land use zones (including new protected areas, special value areas, and operating areas), and provided EBM objectives for cultural, aquatic, biodiversity and wildlife values.

2009 Kunst'aa Guu – Kunst'aayah Reconciliation Protocol

The 2007 Strategic Land Use Agreement was followed by the co-signing of the historic 2009 *Kunst'aa Guu – Kunst'aayah Reconciliation Protocol* ('Reconciliation Protocol') by the Council of the Haida Nation and the Province.

The 2009 Reconciliation Protocol, whose title means 'in the beginning', is a commitment by both Governments to continue working together toward comprehensive reconciliation, focussing on joint and shared strategic-level decision making respecting lands and natural resources on Haida Gwaii, and other collaborative arrangements. The Reconciliation Protocol includes agreements to address:

- Shared and joint decision making
- Carbon offset and resource revenue sharing
- Forest tenures and other economic opportunities
- Enhancement of Haida socio-economic well-being.

Haida Gwaii Management Council (HGMC)

The 2009 Reconciliation Protocol committed both Governments to a process for shared decision-making regarding resource use on Haida Gwaii, notably by requiring the creation of the HGMC, which was established in 2011. The 2009 Reconciliation Protocol required both Governments, in consultation with the other, to appoint two members, and to then jointly appoint a chairperson. The HGMC's documented responsibilities include making key strategic decisions through a joint decision-making process that aims to achieve consensus. If consensus is not reached, a vote will be taken, excluding the chairperson, and in the event of a tied vote, the chairperson will cast a deciding vote.

Joint decisions made by the HGMC focus on:

- Implementation and amendment of the 2007 Haida Gwaii Strategic Land Use Agreement
- Establishment, implementation and amendment of land use objectives for EBM forest practices
- **Determination of the AAC for Haida Gwaii**
- Approval of management plans for protected areas
- Development of policies and standards for the identification and conservation of heritage sites.

Significant in the above list is the third point, the requirement for the HGMC to determine an AAC for Haida Gwaii; it is in support of this requirement that this *Public Discussion Paper* was prepared.

Land Use Objectives

To further implement the 2007 Strategic Land Use Agreement and consistent with the 2009 Reconciliation Protocol, both Governments collaboratively developed land use objectives.

The land use objectives for forest-based values were formally agreed upon by both Governments and were established through the 2010 *Land Use Objectives Order* as legal requirements to further the implementation of EBM. The 2010 Order was amended by the HGMC in 2014 and 2017 to support improved implementation of EBM. Forest plans and practices on Haida Gwaii must be consistent with the land use objectives that include:

- Cultural objectives
- Aquatic objectives
- Wildlife objectives
- Biodiversity objectives.

The timber supply review therefore has accounted for these land use objectives in support of the HGMC's AAC determinations.

3. Haida Gwaii Timber Supply Review

This Timber Supply Review (TSR) was prompted by two considerations. In 2014 an updated inventory on the forests of Haida Gwaii (Vegetation Resource Inventory, or VRI) was completed, and between 2015-2017 the inventory was independently audited. Between 2012-2015 both Governments monitored the rate of cedar harvests on Haida Gwaii relative to the maximum ceiling set by the Chief Forester's AAC determination in 2012. The HGMC initiated an early TSR with an interest in applying the new forest inventory to an updated AAC determination, as well as informing the timber supply for cedar. The HGMC's AAC determination process began with the appointment of a Joint Technical Working Group co-led by both Parties to provide two timber supply review reports: (i) a *Data Package* that describes current forest management as a basis from which to assess the timber supply on Haida Gwaii; and (ii) a *Timber Supply Analysis Report* that documents results of a spatially explicit analysis, including projections of feasible future harvest levels based on inputs about the forest and how it grows, and the objectives and practices used to protect and conserve important values. In addition, the HGMC commissioned a socio-economic analysis report for Haida Gwaii. The three reports are available at: www.haidagwaiimanagementcouncil.ca.

The projections in the *Timber Supply Analysis Report* include a 'base case' projection that reflects current land use and forest management conditions. However, the base case projection is not a recommended AAC for Haida Gwaii; rather, it provides one of the several sources of information the HGMC will consider in making its AAC determination. Other information sources include: sensitivity analyses (prepared as part of the timber supply analysis - see Section 11) that examine different assumptions in forest management, and compares that with the base case; the socio-economic analysis report; and—very importantly and the reason for this paper—the ideas, opinions, and personal experiences of people who live on Haida Gwaii, and/or who consider their interests to be affected by the determination.

The HGMC hopes that the information in this *Public Discussion Paper* will engage local communities across Haida Gwaii, as well as other individuals, licensees, and interested parties to provide informed responses on any matter that they believe should be considered in the AAC determination. All of information received during the comment period will be taken into account by the HGMC before making their AAC determination.

To provide your ideas and suggestions, please see Section 13 **'Your Feedback is Needed'** at the end of this document – which, for example, states where you can submit your feedback. To help the determination process remain on schedule, we would appreciate receiving your written comments by January 14, 2020 which is the end of the 60-day Public Review and Comment period.

The 2009 Protocol requires all decisions by the HGMC, which include AAC determinations, be made by consensus or vote as described earlier in Section 2 under 'Haida Gwaii Management Council'. These requirements are mirrored in the *Haida Gwaii Reconciliation Act*, which also requires HGMC decisions to be published in the *BC Gazette*. The decision will also be published in the Haida Laas newsletter, the Haida Gwaii Observer, and the Haida Gwaii Trader. The HGMC's rationale document for its AAC determination will be posted on its website www.haidagwaiimanagementcouncil.ca and in the *BC Gazette*.

Stages in the AAC determination process

- Joint Technical Working Group began assembling data for data package
- The Province's Chief Forester provided information needed to analyze timber supply to HGMC
- Data package, timber supply analysis, and socio-economic analysis completed [November 2019]
- **Public discussion paper released [November 2019]**
- **60-day Period for Review and Comment by public and licensees** [November 15 to January 14, 2020]
- AAC determination for Haida Gwaii by HGMC completed and conveyed to Chief Forester
- HGMC rationale released

- BC's Chief Forester determines AACs for specific management units within limits of HGMC determination (see 'Chief Forester's role' below)
- Chief Forester's determination and rationale released (anticipated in early 2020).

Chief Forester's role

The Province's Chief Forester will make separate AAC determinations for the TSA and two TFLs that must not in total, when combined with Woodlot Licence AACs, exceed the overall AAC determined by the HGMC for Haida Gwaii. It is anticipated that the Chief Forester will make these determinations as soon as possible after the HGMC determines the new AAC for Haida Gwaii. The determinations by the Chief Forester are required by Section 8 of the Province's *Forest Act*, under which the Chief Forester must regularly determine a new AAC for all TFLs and TSAs in BC.

What the AAC determination does and does not do

The new AAC set by the HGMC will regulate how much timber may be harvested on Haida Gwaii, and the decisions by the Chief Forester will determine how much of the AAC may be harvested from each TFL and the TSA. A key purpose of the AAC determinations is to establish allowable harvest levels that are sustainable and consistent with the land use objectives that support the EBM regime for Haida Gwaii.

The AAC determination does not allocate harvesting rights or direct forest practices. These decisions are made through other processes - for example, the Minister will apportion the AAC that is determined for the TSA among various types of forest tenures, and the HGMC can amend the land use objectives that support EBM implementation. The AAC determination process does not make land use decisions, such as adding new protected areas. The sensitivity analyses conducted through this process can help inform future land use or resource management decisions.

4. Description of Haida Gwaii

Xaadaa Gwaay, Xaaydaġa Gway.yaay, or Haida Gwaii ("Islands of the people") is an archipelago of more than 150 islands off the north coast of BC. The mainland north coast of BC lies 80 kilometres to the east across Hecate Strait, and the state of Alaska lies to the north across Dixon Entrance. Haida Gwaii's total landmass of just over a million hectares is situated mostly on two main islands: the larger, *Kiis Gwaay* (Graham Island), being to the north; and *Gwaay Haanas* (Moresby Island) to the south.

The geography of the Islands is similar to the mainland coast of BC and the southern regions of Alaska, including mountainous terrain, deep fjords, temperate rainforests, sub-alpine forests and alpine tundra.

The rugged mountains that dominate the west side of the Islands descend abruptly into the ocean to form a steep, rocky coastline. The weather is cool and wet, with deep snow at higher elevations. Steep headwater streams and gullies drain the mountainsides, carrying water, sediment and organic materials to the alluvial fans and floodplains that line the valley bottoms.

The Skidegate Plateau occurs east of the west coast mountains and includes the most productive forest lands on the Islands. Many of the largest trees found on Haida Gwaii are located within the Skidegate Plateau. The Plateau has high levels of biodiversity with some of the best habitat for wildlife found anywhere on the Islands.

Relatively flat, lowlands are found to the northeast of the Skidegate Plateau. This area is dominated by extensive blanket bogs, shallow lakes and scrub forest, with patches of productive forest in well-drained areas.

The diverse geography and landscapes of the Islands is reflected in its biological diversity. There are many plant and animal species and sub-species that are only found on the Haida Gwaii archipelago. This is one reason why the Islands are often referred to as "the Galapagos of the North."

Coastal temperate rainforests represent only 2% of the world's forests but provide critical habitat for many unique species. BC has a sizeable percentage of the world's coastal temperate rainforests in areas like Haida Gwaii and the Great Bear Rainforest. Haida Gwaii's coastal temperate rainforests occur at lower elevations with western hemlock, western redcedar and Sitka spruce being the most dominant tree species along with lodgepole pine, western yew, and red alder. High elevation tree species include mountain hemlock and yellow-cedar. At yet higher altitudes, closed forests give way to open parkland forests and alpine meadows. About 80% of Haida Gwaii is forested.

Haida Gwaii supports a wide range of wildlife including species for which land use objectives have been established. These are black bear, northern goshawk, northern saw-whet owl, marbled murrelet, and great blue heron.

As shown in Figure 1 and later in Table 3, about half of Haida Gwaii is in protected areas. Figure 1 also shows the location of the three main forest management units on the Islands: the Timber Supply Area (TSA) and two Tree Farm Licences (TFLs).

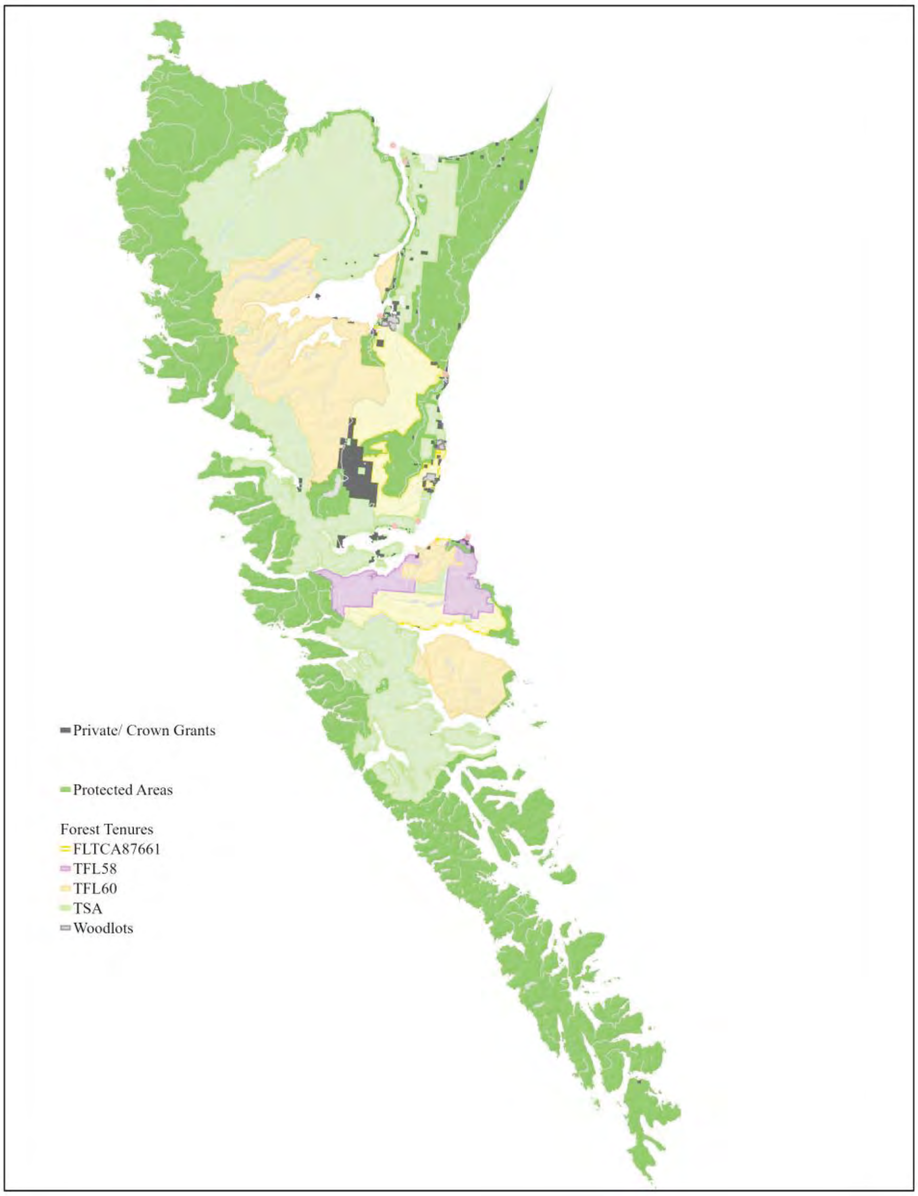

Figure 1: Protected Areas and Forest Management Units on Haida Gwaii

5. Socio-economic Conditions

This section highlights key findings from the *Socio-Economic Analysis in support of the Haida Gwaii Timber Supply Review* report that was commissioned by the HGMC. The socio-economic report provides sources of data for the information presented in this section of the *Public Discussion Paper*, and is available at: www.haidagwaiimanagementcouncil.ca.

Population

The 2016 population of Haida Gwaii was 4,198, a 12.8% decrease from the 2006 population of 4,812, and a 28.0% decrease from the 1996 population level. By comparison, the overall population of BC rose by 12.2% over the 2006-2016 period. In 2016, an estimated 47.5% of the Haida Gwaii population identified as an Aboriginal/Indigenous person. The Haida population of Haida Gwaii was an estimated 1,915 in 2016, a 1.6 % increase over the 2006 population of 1,885. Although demonstrating a positive trend, the Haida population increase of 1.6% trailed, by a large margin, the 38% increase in the overall BC Aboriginal/Indigenous population during the 2006-2016 period.

The five main communities by population in 2016 are Queen Charlotte (852), Skidegate (*Higa̱agilda)* (837), Masset (793), Old Massett (*G̱aw)* (555), and Port Clements (282); these communities account for about 80% of the overall population on Haida Gwaii. The remaining 20% of the population inhabits other areas of Haida Gwaii including the unincorporated communities of Tlell, rural Graham Island, and Sandspit. Skidegate was the only Haida Gwaii community or area that registered a population gain for the 2006-2016 period. The median age of the Haida Gwaii population increased from 39.7 years to 45.1 years over the 2006-2016 period, By comparison, the estimated 2006 median age on the islands was similar to that of the province (40.8 years) whereas by 2016, the estimated Haida Gwaii median age (45.0) was higher than the BC median of 43.0 years.

Labour Force

Table 1 shows the estimated total number of labour force workers[1] resident on Haida Gwaii and estimates for the three main sectors (public services, tourism and forestry) in 2016 and 2006. The resident labour force in 2016 totaled 2,290 workers, a 19.1% decline from the 2006 total of 2,830. Worker numbers in two of the main sectors, tourism and forestry, declined over the 2006-2016 period, 9.4% and 10.8%, respectively, but by a lesser amount than in the public services sector and other sectors (as a group).

Sector	2016 #	2016 %	2006 #	2006 %	% change 2016 vs 2006
Tourism	387	16.9	427	15.1	-9.4%
Forestry	290	12.7	325	11.5	-10.8%
Public Services	640	27.9	795	28.1	-19.5%
Other Sectors	**973**	**42.5**	**1,283**	**45.3**	**-24.2%**
Total	**2,290**	**100**	**2,830**	**100**	**-19.1%**

Table 1: Haida Gwaii Labour Force, 2016 and 2006

The preceding table focused on the resident labour force. Both the forestry and tourism sectors on Haida Gwaii have historically utilized non-resident workers who either reside seasonally or long-distance commute for periods of one or more weeks to Haida Gwaii. Generally, less data and information are available on this group of workers but a survey conducted for this timber supply review indicates that the on islands resident share of Haida Gwaii forestry employment has risen in recent years. This shift appears

1 Includes persons working part-time and full-time

to be largely due to the efforts of Haida Gwaii headquartered Taan Forest Products Ltd. to utilize Haida Gwaii resident workers and contractors. Fishing resort lodges (an estimated 16 in 2018) have collectively been an important factor in the Haida Gwaii tourism sector since the 1990s but they have relied as a group on a significant number of off islands seasonal and full-time workers. A new study (expected to report in 2019) may show a greater reliance on local workers at these lodges, in part due to Haida Gwaii-headquartered HaiCo's entrance into the fishing lodge sector and its efforts to hire Haida Gwaii resident workers for its lodges.

AACs and Haida Gwaii Timber Harvest

Table 2 shows recent AACs for Haida Gwaii management units TSA 25, TFL 58, and TFL 60. The sum of the management unit AACs determined in 2012 for Haida Gwaii was 931,000 cubic metres, a decline of 47.5% from the previous total AAC of 1,772,616. The four woodlot licences contribute an additional 9,293 cubic metres of AAC.

Management Unit	**AAC determined in 2012** (cubic metres)	**Prior AAC** (cubic metres)	**% change in AAC**
TSA 25	512,000	869,748	-41.1%
TFL 58	79,000	100,000	-21.0%
TFL 60	340,000	802,868	-57.7%
All Units	**931,000**	**1,772,616**	**-47.5%**

Table 2: Recent AACs for Haida Gwaii Management Units (cubic metres)

The 5-year average annual harvest on HGMA lands was 831,172 cubic meters between 2013 and 2017 which is about 10% less than the sum of the current AACs.

Although the available timber supply for annual harvesting was in the 1.2–1.8 million m^3 range over the 2000–2012 period, the amount of timber harvested by commercial operators and supplied into domestic and international markets fell well short of these levels due to target market demand conditions, cost constraints, and administrative and policy parameters on the Haida Gwaii timber supply side. During the 10-year 2003-2012 period prior to the initial AAC determination of the HGMC, the Haida Gwaii annual timber harvest averaged approximately 780,000 m^3, well below the cumulative total of the then current Haida Gwaii AACs and below the average annual harvest for the 5-year 2013-2017 period.

Over the 2008-2017 decade, red and yellow cedar accounted for an annual average share of almost half (48.4%) of the total Haida Gwaii Management Area (HGMA) harvest. Historically, stands with substantial percentages shares of old growth western redcedar volumes have formed a large portion of the operable timber harvesting landbase of Haida Gwaii. This accessible local cedar supply in combination with the strong and large scale external demand for cedar logs and wood products in Canada, the U.S. and abroad over the past couple of decades, have resulted in both attractive prices for cedar logs and wood products and substantial cedar timber harvests on both HGMA lands and private lands.

As throughout coastal BC, log export volume from Haida Gwaii has increased markedly over the past decade. The volume and share of the timber harvest on HGMA lands that was exported under provincial log export rules climbed from 61,552 m^3 and a 9.1% share of the HGMA lands harvest in 2010 to 267,873 m^3 and a 41.5% share in 2017. Lower value whitewood species accounted for the vast majority of coastal BC export logs because the Government of BC limits the issuance of export permits for cedar logs to ceremonial or religious uses (incorporation into construction of a religious temple for example). No red or yellow cedar logs harvested on HGMA lands over the 2010-2017 period were exported outside of BC; the HGMA lands harvest that was exported outside of BC was comprised of whitewood logs.

Forest Sector Employment Trends

Both timber harvesting and wood processing employment of Haida Gwaii residents fell since the mid-2000s. The main factors contributing to declines in harvesting-related employment were:

- Lower AACs in response to new protected areas and land use objectives (see Table 2)
- Actual harvest levels over the 2013-2017 period were about 10% lower than the AAC level set forth in the 2012 determination for the HGMA
- 2008 financial crisis that lowered demand for wood products in key markets (U.S. housing for example) resulting in less timber harvesting and associated forestry employment on Haida Gwaii that recovered but not to the pre-financial crisis levels
- Increased use of mechanized (less labour intensive) harvesting methods
- Timber harvest permitting challenges
- Forestry labour supply sourcing challenges

Timber processing activity and associated employment has historically been relatively low on Haida Gwaii and dropped in recent years. The total amount of Haida Gwaii timber processed on the islands was small (5%) in 2002-2004 by comparison to the Haida Gwaii volume processed elsewhere, which is also the current situation. In the 2015-2017 period, the portion of the Haida Gwaii harvest annually processed on the islands was an estimated 0.6%. The main factor in the reduction of wood processing employment on Haida Gwaii is the combination of adverse operational and financial challenges faced by Haida Gwaii Forest Products (formerly Abfam), which has a small sawmill in Port Clements. This facility was shuttered in 2017 but discussions have taken place between the owners and potential investors about renovating and re-opening this Port Clements mill. The portion of the Haida Gwaii harvest processed in BC and controlled by Haida Gwaii focused operations did increase significantly, however, due mainly to TaanForest Product Ltd.'s establishment of a custom cut program, which was an addition to the well-established custom cut programs of O'Brien & Fuerst and Husby Forest Products Ltd.[2] The custom cut programs of these Haida Gwaii focused harvesting operators accounted for the majority of the Haida Gwaii logs that stayed in BC for processing (and supported associated mill employment).

During the 2015-2017 period, the estimated annual average direct employment on Haida Gwaii based on harvesting and processing HGMA timber was 285 person years (PYs), and the majority of this direct employment, 270 PYs (95%), was in harvesting activities including log transport.[3] In terms of total employment on Haida Gwaii, which also includes an estimate of the employment supported by forestry firms purchasing goods and services and the employment supported by forest sector connected households locally buying goods and services, the average annual effect of the local forest sector activity on Haida Gwaii was an estimated 414 PYs during the 2015-2017 period.

On a province-wide basis, the employment effects connected to harvesting and processing Haida Gwaii timber more than double. During the 2015-2017 period, the estimated annual average direct employment in the province based on harvesting and processing HGMA timber was 622 PYs and the total employment effect was an estimated annual average of 1,244 PYs. Although Haida Gwaii resident workers accounted for the largest share of harvesting direct employment (82%), on islands workers held less than half of the total (harvesting and processing) direct employment (43%) because of the small amount of wood processing activity on Haida Gwaii.

2 Custom cutting programs on coastal BC are based on a market logging or log trading operations renting capacity and services at southwest BC sawmills in order to process their harvested logs (mainly cedar logs) and to sell the resulting lumber products to wholesalers and retailers in Canada, the U.S. and internationally. Custom cut programs are an alternative to owning and operating wood processing facilities.

3 Employment is stated in person-years (PYs), which is defined as one person working the equivalent of one full year, which is defined as 180 days of work. A person working for 90 days accounts for 0.5 PYs. Full-time equivalents (FTEs) is a term that is used inter-changeably with PYs.

6. Timber Supply Analysis and the Land base

Haida Gwaii Timber Supply Review Considerations

The AAC determination for Haida Gwaii will be the second undertaken by the HGMC that involves a comprehensive review of the timber supply for all of the forest management units on Haida Gwaii into one determination.

The Haida Gwaii land use objectives were used by the Joint Technical Working Group to support the Haida Gwaii timber supply review. The land use objectives support an EBM regime on Haida Gwaii that in many cases supersedes or augments objectives under the Province's *Forest and Range Practices Act.* However, where the land use objectives requirements do not apply, forest practices must still be consistent with the *Forest and Range Practices Act*. The Haida Gwaii timber supply review accounts for all protected areas including heritage sites, conservancies, ecological reserves, parks and protected areas as these areas do not contribute to timber supply.

Timber Supply Analysis – improved information and analysis since the last time

Since the last timber supply review that supported the HGMC's 2012 AAC determination, a number of changes have occurred to improve the Haida Gwaii timber supply analysis including use of:

- New forest inventory
- Improved site productivity estimates based on a higher number of Haida Gwaii field samples
- Improved information on growth and yield with model estimates compared against field plots
- Improved operational data to estimate the timber harvesting land base and reflect forest practices based on implementation of the land use objective order
- Better data in general (e.g. use of LiDAR for new terrain and fluvial mapping)
- Refined estimates of natural disturbances
- Detailed operability modelling
- More sophisticated spatial model
- Large number (over 60) of sensitivity analyses.

Protected Areas

Protected areas, where timber harvesting is excluded, are valuable areas that help ensure continuance of the natural values that support activities integral to the traditional way of life of the Haida, and also ensure protection of the environmental values that attract visitors from all over the world. This visitor activity is also an important contributor to the economy of Haida Gwaii. The Council of the Haida Nation and the Province collaboratively manage provincial protected areas. The Council of the Haida Nation and the federal government collaboratively manage Gwaii Haanas. In the timber supply review, all protected areas on Haida Gwaii (listed in Table 3) were excluded from the timber harvesting land base.

Protected Area	Area (hectares)
Gwaii Haanas National Park & Heritage Site	145,753
Daawuuxusda	70,295
Damaxyaa	822
Drizzle Lake	814
Duu Guusd	144,762
Duu Guusd Ecological Reserve	8,684
K'uuna Gwaay	2,105
Kamdis	1,894
Kunuxalas	3,344

Protected Area	Area (hectares)
Naikoon Provincial Park	67,268
Nang Xaldangaas	6,897
Pure Lake Provincial Park	142
SGaay Taaw Siiwaay K'adjuu	597
Tlall	16,208
Tow Hill Ecological Reserve	451
Yaaguun Gandlaay	2,450
Yaaguun Suu	7,970
Total	**480,456**

Table 3: Protected Areas on Haida Gwaii

Forest Tenures

The majority of the area on which timber harvesting is permitted is contained within two Tree Farm Licenses (TFLs), TFL 58 and TFL 60, and the Timber Supply Area (TSA) as shown in Figure 1.

TFL 60 is a replaceable area-based tenure that was purchased in 2012 by Taan Forest – a 100% Haida-owned forest company, and a wholly owned subsidiary of the Haida Enterprise Corporation, the economic development entity of the Haida Nation whose shareholders are Xaayda *Haida* citizens. TFL 60 is the largest area-based tenure on Haida Gwaii with a total area of 134,526 hectares (including non-forested areas). Most of TFL 60 is on Graham Island with a smaller portion on northern Moresby Island and Louise Island. TFL 60 is certified under the Forest Stewardship Council's sustainable forest management standard for BC.

TFL 58 is replaceable area-based tenure that was purchased in 2016 by A&A Trading (Haida Gwaii) Ltd. The total area of the TFL is 23,933 hectares (including non-forested areas) occurring entirely on northern Moresby Island.

Forest Licence to Cut (FLTC) A87661 is a short term non-replaceable tenure with a maximum volume that was provided to Taan Forest in 2012 as part of the fulfillment of the 2007 Strategic Land Use Agreement and the 2009 Reconciliation Protocol for the management of 120,000 cubic meters/year area based tenure. A Haida Forest Tenure Agreement was signed between the Province and the CHN in 2014, and the CHN were invited to apply for a First Nations Woodland Licence over a specified area. The 58,606 hectare area is currently managed under the FLTC pending the creation of the First Nations Woodland Licence. The tenure area, as shown in Figure 1, is primarily located on the central coast of Graham Island, along with a supply area on north Moresby Island.

Table 4 shows the current apportionment and commitments of the AAC for the rest of the TSA. Also shown are the AACs for the four area-based Woodlot Licences on Haida Gwaii, with a combined total area of 1,842 hectares and a combined AAC of 9,293 cubic metres. The current AAC established in 2012 for the TSA and two TFLs (without the Woodlots) is 931,000 cubic metres.

Tenure	Holder	Total Area (hectares) includes non-forest area	Current AAC (cubic metres/year)
TFL 60	Taan Forest	134,526	340,000
TFL 58	A&A Trading (Haida Gwaii) Ltd	23,953	79,000
TSA 25: FLTC A87661	Taan Forest	58,606	120,000
TSA 25*:* Other tenures - FL A16869 - FL A16870	 -Husby Forest Products Ltd	337,700 - -	392,000 (192,044) (13,632)

Tenure	Holder	**Total Area** (hectares) includes non-forest area	**Current AAC** (cubic metres/year)
- FL A75084 - Licence/licence to cut - Non-replaceable licence - Community Forest Agreement - Forest Service Reserve	-A&A Trading (Haida Gwaii) Ltd -Dawson Harbour Logging Co -BC Timber Sales - -proposed -	- - - - -	(7,956) (81,658) (14,210) (80,000) (2,500)
Woodlots:			
- W1841	- Old Massett Village Council	478	2,120
- W1840	- Skidegate Band Council	422	2,000
- W0161	- Dave Younger	477	2,728
- W0162	- Gerald Lavoie	465	2,445
Totals		**556,627**	**940,293**[4]

Table 4: AAC Forest Tenure Apportionment and Commitments on Haida Gwaii

7. Forest Management

The Haida Gwaii timber supply review accounted for the Haida Gwaii land use objectives, and for several other important factors and values as described below.

Ecosystem-Based Management (EBM)

The 2007 Strategic Land Use Agreement defined EBM for Haida Gwaii as:

> "an adaptive, systematic approach to managing human activities, that seeks to ensure the co-existence of healthy, fully functioning ecosystems and human communities."

The Strategic Land Use Agreement also notes that:

> "[t]he Haida will establish the EBM Objectives in accordance with their laws, policies, customs, traditions and decision-making processes."

The Haida Gwaii Land Use Objectives Order states:

> "This Land Use Objectives Order establishes legal objectives for forest-based values to support implementation of ecosystem-based management. These objectives protect important Haida cultural values, support ecosystem integrity and provide environmental benefits by maintaining the diversity and abundance of organisms on Haida Gwaii. Human well-being is maintained through policies and initiatives designed to achieve socio-economic benefits, including carbon values, and timber harvest levels that will support a viable forest industry."

The aim of Haida Stewardship Law is: '...bringing land and resource use balance to Haida Gwaii to ensure the continuity of Haida culture and a sustainable islands economy'.

The Haida Land Use Vision places emphasis on 'the well-being of the land', 'the condition of the land', and 'the natural ability of the land to function and provide'. The Haida Land Use Vision also refers to:

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[4] Includes 9500 cubic metres for municipal areas in the TSA and TFL 60, and private land portions of woodlots - that are not part of the aggregate area determined by HGMC in 2012

"Yah'guudang—our respect for all living things—[which] celebrates the ways our lives and spirits are intertwined and honours the responsibility we hold to future generations."

Incorporating Haida Gwaii Land Use Objectives in the Timber Supply Review

Haida Gwaii land use objectives support EBM implementation on Haida Gwaii. The establishment of these legal objectives through the *Land Use Objectives Order* helps ensure that forest plans and practices on Haida Gwaii are consistent with the objectives. The land use objectives are accounted for in the timber supply review as required current practice. The legally established land use objectives include:

Cultural objectives for:

- Cedar Stewardship Areas
- Cultural Feature Identification
- Haida Traditional Heritage Features
- Haida Traditional Forest Features
- Western redcedar and yellow-cedar retention
- Western yew retention
- Culturally modified trees and monumental cedar.

Aquatic habitat objectives for:

- Type I fish habitat [as defined in the Order]
- Type II fish habitat [as defined in the Order]
- Active fluvial units
- Upland stream areas
- Sensitive watersheds.

Biodiversity objectives for:

- Forested swamps
- Ecological representation
- Red-listed and blue-listed ecological communities.

Wildlife objectives for:

- Black bear dens
- Marbled murrelet nesting habitat
- Northern goshawk habitat
- Great blue heron nesting habitat
- Northern saw-whet owl nesting habitat.

Forest reserve objectives for:

- Areas reserved to meet landscape level objectives.

Examples of how these objectives are incorporated into the analysis are described briefly below. Please refer to the *Data Package* for a full description of how each objective was accounted for in the timber supply review, either by excluding areas from the timber harvesting land base or by applying forest cover requirements. One example objective requires that all Class 1 Haida Traditional Heritage Features (as defined in the Order) be protected in a reserve zone with a minimum width of 500 metres, measured from the edge of the feature. (The reserve zone may be reduced if it is decided through an intergovernmental process that it is necessary and unavoidable.)

To account for these reserves in the timber supply analysis, an appropriate, corresponding area was excluded from the timber harvesting land base and was assumed to not contribute to the timber supply at any time. The reserves provide forest cover and therefore contribute to achieving biodiversity objectives.

Another example objective requires that all forest within Type I fish habitat (as defined in the Order), and all forest within two tree lengths adjacent to such habitat (plus or minus half a tree length), be protected in a reserve zone. Accordingly, for the analysis, the area of riparian reserves within each forest stand was determined, and that area excluded from contributing to the timber harvesting land base.

For some objectives, instead of excluding area from the timber harvesting land base, a forest cover requirement was applied such that no more than a given percentage of the forest cover may be harvested at any time. For example, sensitive watersheds equal to or greater than 500 hectares require that no more than five percent of the watershed area be harvested in a five-year period; while sensitive watersheds smaller than 500 hectares require that no more than 10 percent of the watershed area be harvested in a 10-year period.

If too much timber has already been harvested in a sensitive watershed (representing an equivalent clearcut area of 20 percent or more), then no harvesting may occur until the area is adequately ‘greened-up’.

In these ways, the land use objectives that help implement EBM were modelled in the spatially explicit timber supply analysis for the Haida Gwaii.

Of particular note is management and protection of monumental cedar. A new version of the Cultural Feature Identification Standards Manual was released in late October 2019. The standards were designed to implement the LUOO requirements as currently written, not to revise the LUOO. A preliminary estimate of the frequency of monumental cedar was applied in the base case. However, some uncertainties remain, including: how many cedar trees with diameters over 100-cm meet monumental cedar criteria; and how monumental cedar will be managed and harvested. In response to these uncertainties, the HGMC through the Technical Working Group will be compiling additional information and undertaking analysis to explore: (1) the likelihood that a broader range of log grades than estimated for the base case will contribute monumentals; (2) indications that younger ages classes than assumed for the base case will contain monumental cedar; (3) timber supply implications of various levels of retention of monumental trees from harvesting. Given the recent release of the new standards, these analyses are ongoing. The results will be available for the HGMC for its determination of the Haida Gwaii AAC. This issue is an example of the dynamic nature of forest management that means the base case timber supply projection described in section 10 is just one source of information for the HGMC and must be interpreted together with other relevant information, such as the sensitivity analyses discussed later in this document, and that will be completed on monumental cedar.

Other Factors Considered

In addition to land use objectives, other factors considered in the timber supply review either reduced the timber harvesting land base or were addressed through forest cover requirements such as:

- Natural disturbance reductions
- Visual quality objectives
- Community watersheds
- Terrain stability
- Wildlife habitat areas
- Hydrologic recovery
- Economic operability (see Section 11 on ‘Sensitivity Analysis’)
- Karst management
- Wildlife tree retention areas
- Permanent sample plots
- Recreation sites and trails
- Minimal harvestable age requirement for timber.

The first five factors listed above are described briefly below. Please refer to the *Data Package* for a full description of how each factor was excluded from the timber harvesting land base or otherwise addressed in the timber supply review.

Trees that are killed by natural disturbances and are not harvested result in non-recoverable losses in timber supply analyses. The timber supply review used forest health aerial overview survey data collected between 2006 and 2017 to estimate current and future losses from forest pests. Satellite imagery was used to assess forest impacts from winds and landslides in 2011 and 2017 to account for current and future losses from these events.

Visual quality objectives set a threshold for how much a forest can be visually altered within scenic areas (e.g. designated areas that can be seen from significant public viewpoints). The amount of alteration permitted varies by visual quality objective class ranging from preservation (no visible activities) to maximum modification (where activities are dominant). 'Visually effective green-up' is a term used to describe when forest regeneration is no longer considered visibly altered. The timber supply analysis accounted for existing visual quality objectives and estimates of when visually effective green-up can be reached thereby restraining how much forest harvesting can occur in scenic areas.

Community watersheds that have been legally designated on Haida Gwaii are those that feed domestic water use for Skidegate and Queen Charlotte which include the Honna, Jervis, Slarkedus and Tarundl watersheds. Forest activities in these watersheds must ensure that the cumulative hydrological effects do not materially adversely impact the quantity of water, timing of water flow, or human health. In the timber supply analysis, a forest cover requirement was applied where at least 80% of the entire area of community watersheds needs to be hydrologically recovered consistent with professional hydrologic assessments.

Terrain areas with a moderate or high likelihood of landslide initiation following timber harvesting or road construction have been mapped, or existing mapping was improved, using recently acquired Light Detection and Ranging (LiDAR) coverage for Haida Gwaii. The timber supply review assessed the contribution of these terrain areas to the timber harvesting land base. The timber supply review also assessed the areas of slides relative to the total area logged in these terrain areas and found the area to be small (less than one percent).

Two Wildlife Habitat Areas (WHAs) for northern goshawk with a total area of 4,905 hectares were established in 2001 and 2003 under the *Forest and Range Practices Act.* The WHAs include Post-Fledging Areas (PFAs) and Foraging Areas. The PFAs are smaller reserves within the broader WHAs generally centered on known nest sites and do not allow any forest harvesting. Consequently, the PFAs were deducted from the timber harvesting land base. The WHA Foraging Areas have forest age class requirements (e.g., at least 384 hectares must be in old forest age class of >250 years in WHA #6-001) that were modelled in the base case.

8. Timber Harvesting Land Base

Protected areas, areas set aside to support EBM and land use objectives, and others areas that do not contribute to timber supply were removed from the timber harvesting land base for Haida Gwaii as shown in Table 5. Following these deductions, some of which overlap, the total of the combined areas in the TFLs and the TSA which contribute directly to the current timber harvesting land base is 147,746 hectares about 15% percent of the total area of Haida Gwaii. This is about 18% less than the 190,907-hectare timber harvesting land base that was derived in the last timber supply review.

Table 5: Areas removed from the timber harvesting land base for Haida Gwaii *(including overlaps)*

Protected Areas, EBM-related Areas and Other Areas removed from the timber harvesting land base	**Total area removed** (hectares)
Protected areas	
• Protected areas (CHN/Federal)	145,735
• Protected areas (CHN/Provincial)	332,273

Protected Areas, EBM-related Areas and Other Areas removed from the timber harvesting land base	Total area removed (hectares)
Cultural	
• Heritage (e.g. Haida Traditional Heritage Features, Culturally Modified Trees, Archaeological Sites)	27,946
• Cedar Stewardship Areas	25,303
• Monumental cedar (current retention)	442
• Monumental cedar (future retention)	77,615
• Haida Traditional Forest Features (current retention)	281
• Western Yew retention (current retention)	212
• Cultural and recreation trails	1,693
Aquatic habitat	
• Active fluvial units	36,353
• Type 1 fish habitat	93,149
• Type 2 fish habitat	58,108
• Other riparian reserve zone and riparian management zone	24,143
• Forested swamps	15,331
Biodiversity	
• Red-listed ecosystems	13,567
• Blue-listed ecosystems	62,444
• Karst ecosystems	7,179
• Rare ecosystems	12,019
• Small islands	3,123
Wildlife	
• Marbled Murrelet reserves (current retention)	116
• Northern Goshawk nesting	3,661
• Saw-whet Owl nesting	730
• Black Bear denning (current retention)	62
• Wildlife habitat areas	623
• Stand level (in block) retention (also for cultural values)	85,353
Forest reserves (landscape level objectives)	
• Forest reserves (Marbled Murrelet, Rare Ecosystems)	31,201
Terrain stability and economic	
• Landslides	1,209
• Class IV Terrain	16,816
• Class V Terrain	30,987
• Low productive forest	79,652
Other	
• Surface water	64,685
• Non-forest	86,940

Protected Areas, EBM-related Areas and Other Areas removed from the timber harvesting land base	Total area removed (hectares)
• Existing roads	9,100
• Federal reserves	1,541
• Other federal (e.g. military)	1,026
• Provincial reserves/non-timber tenures	6,259
• Private (crown grants)	17,300
• Municipal	3,092
• Permanent Sample Plots	1,010

9. Forest Inventory

The forest inventory used for this timber supply review consisted of the most up to date:

- Vegetation Resource Inventory completed for all of Haida Gwaii between 2011 and 2013 for natural stands for attributes such as species, age and site index (updated to 2018)
- LiDAR Enhanced Forest Inventory for natural stands for attributes such as basal area and heights
- Silviculture records for existing managed stands.

Two types of field audits were used to assess the accuracy of the inventory:

- Mature stand audit
- Young stand monitoring.

The mature stand audit results indicated that the photo-interpreted ages matched ground samples very well; that ground-measured heights were slightly lower than the photo-interpreted inventory; and that ground-measured basal area and number of trees per hectare were substantially greater than the photo-interpreted inventory. However, due to large sampling errors, the results of the mature stand audit were not applied to the inventory or in other aspects of the analysis.

Forty-three (43) young stand monitoring plots, established in 2016, targeted stands between 15 and 50 years of age to compare, among other things, observed stand yields with those estimated from managed stand yield models. Based on the plots sampled, there was no statistically significant difference between observed and modeled manage stand yields.

The growth of young forests following timber harvesting ranges from about 5 to 10 cubic metres per hectare per year depending on ecological conditions while averaging around 8 cubic metres per hectare per year overall for Haida Gwaii.

LiDAR coverage was acquired for a significant portion of Haida Gwaii between 2015 and 2017 through various partners and projects. LiDAR was used to provide enhanced terrain stability and active fluvial unit mapping; and was also used to enhance the photo-interpreted forest inventory for attributes such as volume, basal area and height.

Based on the forest inventory, Figure 2 shows the tree species and age class distribution by volume for all forests on Haida Gwaii and for the timber harvesting land base where Y = yellow -cedar; C = western redcedar; S = spruce; H = hemlock; P = pine; and D = red alder. Most forests are in the older age classes with western redcedar and hemlock being the main species. Younger age classes are mainly comprised of hemlock and spruce with minor amounts of western redcedar.

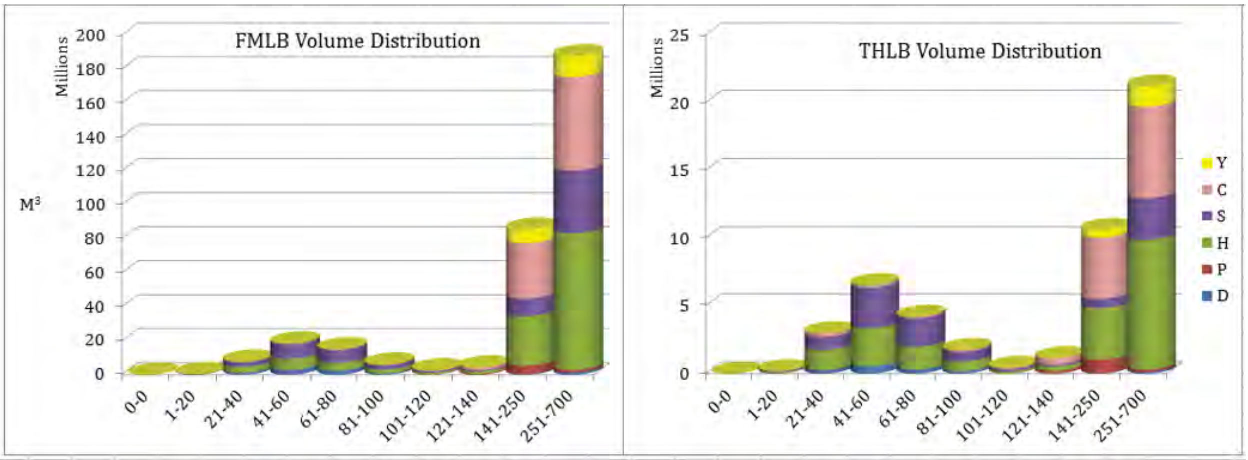


Figure 2: Haida Gwaii Forest Managed Land Base (all forests) and Timber harvesting land base (THLB) age class volume distribution by species

10. Timber Supply Analysis Results

The information the HGMC will review in making its AAC determination for Haida Gwaii includes the timber supply analysis, prepared by the Joint Technical Working Group, which models the development of the forest on the Islands through time and its response to harvesting while respecting land use objectives and other forest management requirements. This section highlights some of the important findings from the timber supply analysis. The HGMC will also be reviewing your comments on this *Public Discussion Paper* as another important consideration before making their AAC determination (see Section 13, **'Your Feedback is Needed'**).

The base case

The Haida Gwaii timber supply analysis uses the timber harvesting land base and forest management information such as EBM implementation through the land use objectives. The analysis includes a timber supply projection, aggregated from the projections prepared for the TFLs and the TSA, using the most up-to-date and best available information. Based on analysis principles such as having an even flow (or non-declining) harvest projection, a timber supply projection is provided that is called the 'base case'. The base case is not an AAC recommendation, but rather one of many potential harvest projections and other sources of information the HGMC will consider when determining the AAC, which may be greater or lesser than the harvest levels projected in the base case. Other assumptions or sources of uncertainty are examined in the timber supply analysis as described in Section 11, 'Sensitivity Analysis'.

The base case harvest projection in Figure 3 shows an even flow annual harvest level of 842,781 cubic metres for Haida Gwaii. Figure 3 also shows harvest projections for TSA and the two TFLs. These results are relevant for the Chief Forester's determinations for the TSA and TFLs. The even flow annual harvest level projection for the TSA is 425,287 cubic metres; for TFL 58 is 91,169 cubic metres; and for TFL 60 is 298,325 cubic metres.

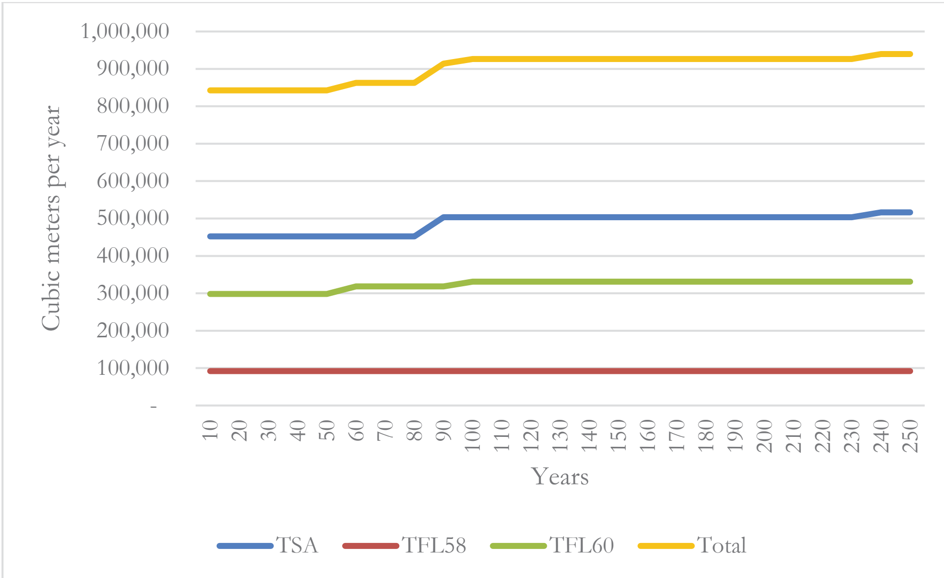


Figure 3: TSR base case harvest projection

11. Sensitivity Analysis

Over 60 sensitivity analyses were undertaken as described in the *Data Package* and *Timber Supply Analysis* reports. Types of sensitivity analysis undertaken responded to:

- Anticipated policy changes
- Reasonably foreseeable changes to markets or economic operability
- Potential changes in forest growth over time
- Potential changes in forest management strategies (e.g. rotation lengths)
- Alternative technical approaches to represent management practices and objectives.

Below is a description of some of sensitivity analysis undertaken and key findings.

Cedar sustainability

The long-term sustainability of cedar was a principle reason why the HGMC initiated this timber supply review. Aside from the high cultural value of cedar, the sustainability of western redcedar and yellow-cedar in the timber harvesting land base is a concern as the presence of cedar generally improves the economic viability of timber harvesting. Consequently, stands with higher volumes of cedar are typically targeted first for harvesting. The base case shows that timber supply from cedar stands within the timber harvesting land base will decline in all management units within Haida Gwaii from about 277,000 cubic metres per year in Year 10 to about 122,000 cubic metres in Year 40 before increasing to approximately 176,000 cubic metres annually in Year 80 (see Figure 4). The current AAC includes a maximum limit of 360,000 cubic metres per year for cedar (although at this time the only formally established partition is for the TSA - 195,000 cubic meters – since the maximum limits were being followed voluntarily in the TFLs).

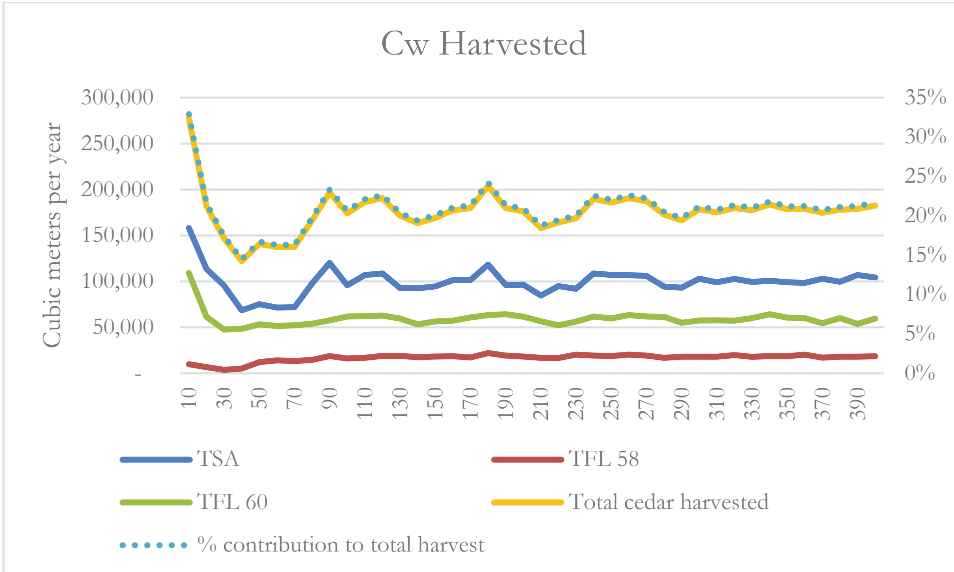


Figure 4: Base case projection of cedar volumes in the timber harvesting land base

If cedar were harvested in a manner that achieved a more or less even flow, the average amount of cedar that could be harvested annually over the entire analysis horizon would be about 146,371 cubic metres. This would allow mature/old cedar in the timber harvesting land base to last until a greater amount of second growth cedar can contribute to harvest levels. Managing cedar in this manner would result in a base case harvest levels for all species of 762,731 cubic meters per year.

Northern goshawk foraging habitat

Stads k'un *northern goshawk* was named by the Council of the Haida Nation as Haida Gwaii's national bird. Northern goshawk is a red-listed subspecies that is considered threatened by the Committee on the Status of Endangered Wildlife in Canada. A peer reviewed, published article cites the Haida Gwaii goshawk as genetically distinct from other northern goshawks. Northern goshawk nesting habitat is protected by the land use objectives with approximately 200-hectare reserves over 22 known goshawk territories. In total 3,661 hectares of known nesting habitats were excluded from the timber harvesting land base (see Table 5).

A predictive goshawk nesting territory model was used to account for 200-hectare reserves from expected goshawk territories that are not currently known. A series of sensitivity analyses explored retaining nesting reserves for predicted territories. Outside the protected areas, and the two wildlife habitat areas (noted in Section 7), northern goshawk foraging habitat is not protected. A 2015 publication concluded that territories with at least 60% suitable foraging habitat have the lowest risk of territorial abandonment based on data from Haida Gwaii and Vancouver Island. The 2018 proposed Federal *Recovery Strategy for the Northern Goshawk* also cites the importance of maintaining 65% of suitable foraging habitat per territory. A series of sensitivity analyses were undertaken to examine the timber supply implications of maintaining 65% of suitable foraging habitat for each known or predicted goshawk territory (see Table 6). This was initially applied using the Federal Recovery Plan target of 38 territories. The same analysis was applied using the 2018 Provincial Implementation Plan for northern goshawk recovery, which targets 25 territories. Lastly, a 'full occupancy' scenario assumed 67 territories as managed for nesting and foraging habitat.

	22 territories	25 territories	38 territories	67 territories
Foraging target of 65% suitable habitat and projected annual harvest level impacts relative to the base case	838,244 m^3 (0.5% reduction)	832,857 m^3 (1.2% reduction)	802,043 m^3 (4.8% reduction)	689,656 m^3 (18.2% reduction)

Table 6: Results from goshawk foraging habitat scenario

Mosquito Lake and Slatechuck watersheds

A 2015 Haida House of Assembly resolution designated Mosquito Lake watershed as an area of importance to be placed under the protection of the Council of the Haida Nation. The watershed is currently within the TSA on northern Moresby Island. A sensitivity analysis was undertaken to examine the removal of the watershed from the timber harvesting land base.

Slatechuck or *Tllgaduu* is a watershed and mountain east of the Village of Queen Charlotte whose creek, *Tllgaduu Gandlaay*, empties into Skidegate Inlet, to the ancient village of *Tllgadaaw Llnagaay*. The argillite deposits found in the watershed are the focus of a sacred quarry that the Haida Nation has traditionally used to access high quality argillite for carving. The quarry is protected by an 18-hectare federal reserve. Recent proposals for timber harvesting within the watershed outside the quarry reserve have been met with opposition by the Council of the Haida Nation. A sensitivity analysis was therefore undertaken to assess the implications of removing the watershed from the timber harvesting land base.

For Mosquito Lake there was a 19,800 m^3 or 2.3% decrease from the base case that results from a 1,845 hectare reduction from the THLB. For Slatechuck there was an 5,450 m^3 or 0.6% decrease from the base case that results from a 203 ha reduction of the THLB.

Economic operability

The ‘operable area’ in which licensees are able to harvest economically is subject to uncertainty. In some cases, harvesting has taken place in areas previously assumed to be inoperable, and some areas assumed operable have proved to be too expensive to harvest. If the assumed economically operable area is over-estimated, then the modelled timber supply would not be sustainable. For the base case, the timber supply review incorporated an economic operability assessment through a relative cost and marginal value model. The model incorporates costing surrogates (roads) and value surrogates (dynamic stand values) that approximate operational limitations. The relative stand values were derived from: (a) harvested stands in Haida Gwaii; and (b) log market prices. The base case assumed average log market prices when defining economic operability. Sensitivity analyses explored using high (strong) and low (weak) markets between 2008 to 2017, to assess impacts on operability and timber supply. These resulted in an approximate +/- 3.4% change in timber supply.

Another sensitivity analysis treated isolated areas, namely Sewell Inlet, Peel Inlet and Louise Island, as distinct timber supply units to assess the implications if any of these areas were partitioned in an AAC determination. Collectively these areas contribute 118,937 m^3 annually to the harvest projections. Approximately 77,624 m^3, representing 17% of the volume of the TSA and 40,550 m^3 or 14% of the volume of TFL 60.

Minimum harvestable age

For timber supply analysis, estimates are made when trees will reach a harvestable condition. Mean annual increment (MAI) is a measure of the volume grown annually. Culmination mean annual increment (CMAI) is the age at which the average productivity of a stand is at the maximum. Viewed over many stands, harvesting at or near the age of CMAI would produce the maximum long-term timber supply. Due to harvest flow requirements, setting a timber supply model to CMAI tends to force the model to harvest a stand after CMAI. Therefore, for this factor, the minimum harvest age was set in the base case to when 95% of CMAI is achieved. Minimum harvest volumes is another factor addressed in the timber supply analysis where a minimum volume of 250 cubic metres per year was assumed in the base case; this factor can increase the minimum age before a stand is harvested beyond 95% of CMAI.

There is some uncertainty regarding what the minimum harvestable ages in reality should be. There were several sensitivity analyses that examined uncertainty in this factor. For example, one sensitivity analysis set the economic harvest rotation based on a 30 cm minimum stand diameter where the minimum age was lowered for those analysis units that met the minimum diameter before CMAI, otherwise the minimum harvest age was kept at 95% of CMAI (as per base case). This resulted a 3.5% (29,837 m^3) decrease in timber supply.

Another sensitivity analysis examined extending the rotation age to better represent natural forest age distributions on Haida Gwaii, and to increase log quality, increase carbon sequestration, and improve habitat conditions for late seral dependent wildlife. In this scenario, all existing and future managed stands had a minimum harvest age set to 150 years or maintained CMAI age if it was over 150 years. A reason for exploring this scenario is that most stands 150 years of age or older have log grade characteristics similar to old forests. This resulted in a 79% (667,837 m^3) decrease in timber supply.

Community Forest

The Province has been in negotiations with the Communities of Haida Gwaii towards the establishment of a Community Forest Agreement (CFA) from portions of the TSA. The Minister has apportioned 80,000 cubic metres of the TSA's AAC for the proposed Community Forest. The Council of the Haida Nation continues to support the establishment of an area-based Community Forest. In 2017, the Province made a formal offer of a Community Forest tenure that included a reduced volume condition and legal partnership with BC Timber Sales. While the offer has not been accepted, a sensitivity analysis was undertaken to assess the timber supply implications if that 2017 offer proceeded and the area was deleted from the TSA.

The proposed CFA area would sustain a harvest of 48,325 m^3 per year and result in a 1.6% decrease in overall timber supply on Haida Gwaii. Overall this would amount to a 13% reduction to the volume of the TSA (as the volume would be shifted into the CFA).

First Nations Woodland Licence

In 2011, the Council of the Haida Nation became the forest manager of TFL 60 and also have a commitment for an area based First Nations Woodland Licence (FNWL) tenure over the area currently within the TSA managed under Forest Licence to Cut (A87661). The Province, Council of the Haida Nation, and Taan Forest Products have been negotiating the creation of an expanded First Nations Woodland Licence that would effectively merge TFL 60 and the original area of the First Nation woodland licence invitation, currently managed under the Forest Licence to Cut. Taan Forest Products manages both tenures as if they were one already (e.g. in the submission of one Forest Stewardship Plan). A sensitivity analysis was therefore undertaken to assess the timber supply implications of merging TFL 60 and the area identified for the first nations woodland licence into one management unit. The timber supply implications potentially affect both the proposed expanded First Nations Woodland Licence and the reduced TSA, and therefore the Haida Gwaii AAC overall in terms of meeting even flow annual harvest levels for each management unit.

The proposed FNWL area would sustain a harvest of 489,025 m^3 per year and a 1.4% increase in overall timber supply on Haida Gwaii. Overall this would amount to 39% reduction to the volume of the TSA (as the volume would be shifted into the FNWL).

12. Next steps

After the public review and comment period is complete, the HGMC will review feedback and, based on the feedback, will determine if further timber supply analysis is required ahead of a determination. A determination, which considers the timber supply methods and inputs, analysis results, socio-economic assessments as well as industry and public feedback will follow.
This AAC determination, and the rationale to support it, will then be published and provided to the Chief Forester to support the Chief Forester's subsequent determination for the three management units on Haida Gwaii (TSA, TFL 58, TFL 60).

13. Your Feedback is Needed

Information provided by local and interested people is of major importance in the considerations that support AAC determinations. Your personal experience and knowledge of a particular area may be essential to a well-informed determination, particularly if something significant has been overlooked in the information under consideration. Your feedback is welcomed on any aspect of this discussion paper, on any other issue related to the timber supply, or on any other matter you feel the HGMC and the provincial Chief Forester should account for in making their AAC determinations.

If interested, you can view the timber supply data package report, timber supply analysis report, and the socio-economic analysis report at the HGMC website at www.haidagwaiimanagementcouncil.ca.

This is your opportunity to provide input on the HGMC's Haida Gwaii AAC determination as well as the Chief Forester's AAC determinations for the TSA and TFLs. There will not be a separate public consultation process for the Chief Forester's determinations.

The HGMC will be pleased to hear from you and to answer questions to help you prepare your response.

**Please send your written comments via e-mail to: admin@haidagwaiimanagementcouncil.ca
or to PO Box 589 Masset, Haida Gwaii, BC V0T 1M0.**

In the interest of keeping the AAC determination on schedule, it would be appreciated if we can receive your comments by the **end of the Public Review and Comment Period, on January 14, 2020.**

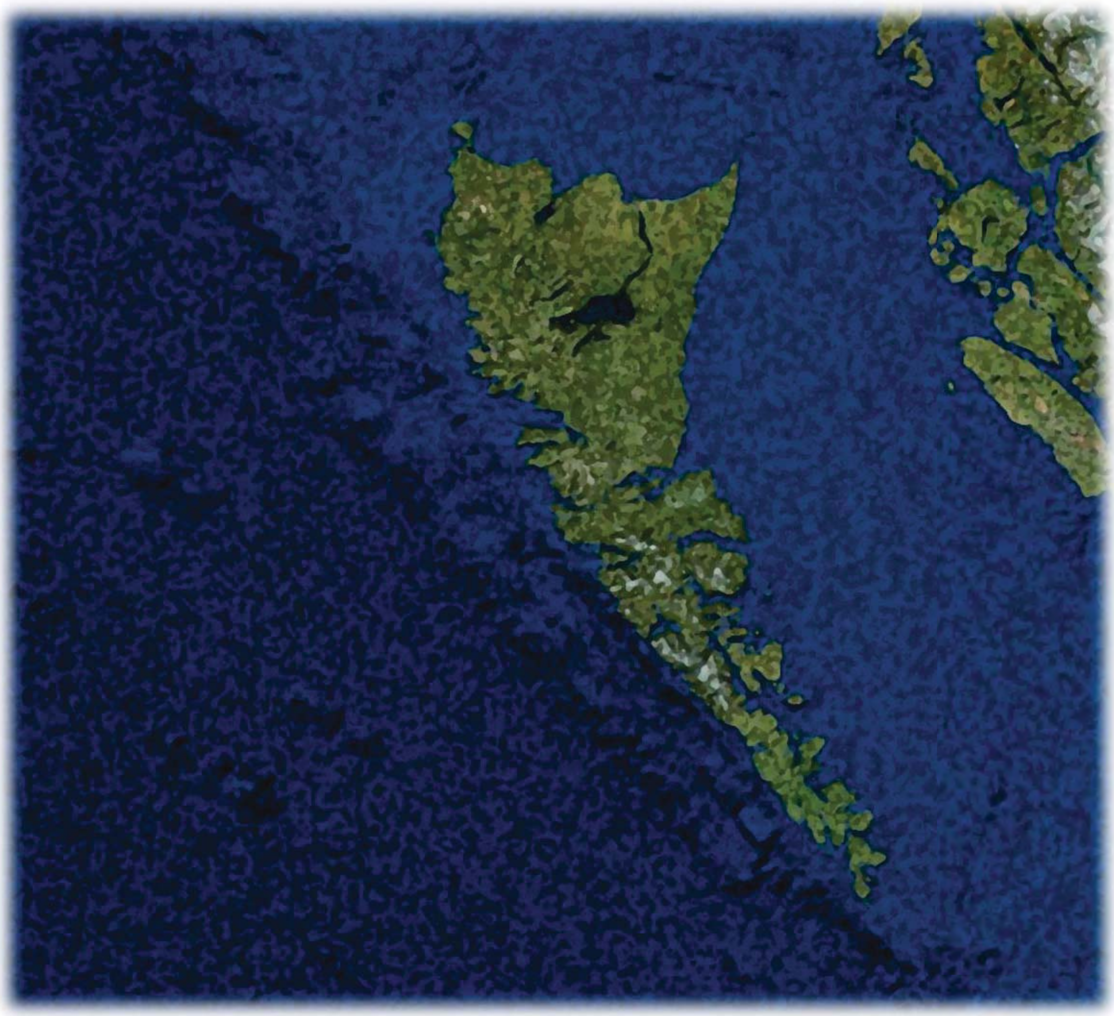
You may identify yourself in your response if you wish; please note that all responses may be made public under the *Freedom of Information and Protection of Privacy Act*, but if the responses are made public, personal identifiers will be removed before the responses are released.

For more information, please contact the Haida Gwaii Management Council at:
admin@haidagwaiimanagementcouncil.ca
Or, write to: **PO Box 589 Masset, Haida Gwaii, BC V0T 1M0**

Appendix 2:
Haida Gwaii Management Council -
Timber Supply Review Draft Data Package
(November 2019)

Haida Gwaii Timber Supply Review

DRAFT Data Package



Timber Supply Review Technical Working Group report for the Haida Gwaii Management Council

2019

Date
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The Technical Working Group (TWG) was co-chaired by Nick Reynolds, RPF (CHN) and Christine Fletcher, RPF (Forest Analysis and Inventory Branch), and included members David Stuart, RPF (Forest Analysis and Inventory Branch) and Sean Muise, RPF (Haida Gwaii Natural Resource District) and Ted McRae (Forest Analysis and Inventory Branch). The TWG received substantial and invaluable support from Dr. Andrew Fall (Gowlland Technologies).

Contents

Glossary

Base case :	
CHN	Council of the Haida Nation
CMAI:	Culmination Mean Annual Increment
ECA	Equivalent Clearcut Area
EMS:	Existing Managed Stands
FAIB:	Forest Analysis and Inventory Branch
FGS:	Free growing stems
FMS:	Future Managed Stands
FPPR:	Forest Planning and Practices Act
FRPA:	Forest and Range Practices Act
HGLUOO:	Haida Gwaii Land Use Objectives Order
HGMC:	Haida Gwaii Management Council
LEFI	LiDar Enhanced Forest Inventory
LIDAR	Light Detection and Ranging
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
MHA:	Minimum harvest age
MHV:	Minimum harvest volume
NSYT	Natural Stand Yield Table
RESULTS:	The Reporting Silviculture Updates and Land Status Tracking System
SPH:	Stems Per Hectare
TASS:	Tree and Stand Simulator
THLB	Timber Harvesting Land Base
TIPSY:	Table Interpolation Program for Stand Yields
TWG	Technical Working Group
VDYP	Variable Density Yield Projection
VLI:	Visual Landscape Inventory
VQO:	Visual Quality Objectives
VRI	Vegetation Resource Inventory

Chapter 1 Introduction

1.1 Authority of a Timber Supply Review

This timber supply review (TSR) has been directed under the authority of the Haida Gwaii Management Council (HGMC), which in turn was established as a result of the Kunst'aa guu- Kunst'aayah or Haida Gwaii Reconciliation Protocol (2009), which set out terms for joint and shared decision making for resource management on Haida Gwaii. The HGMC was delegated legal authority for setting the Allowable Annual Cut (AAC) on Haida Gwaii under the Haida Nation's *KaayGuu Ga ga Kyah ts'as - Gin 'inaas 'laas 'waadluwaan gud tl'a gud giidaa* (Haida Stewardship Law) and the Province of BC's *Haida Gwaii Reconciliation Act*. The authority to set an AAC is meant to include all forestry-tenures on Haida Gwaii (not including private lands). While the HGMC sets an AAC for all of Haida Gwaii, the *Haida Gwaii Reconciliation Act* requires that the determination for specific management units (Tree Farm Licences, Timber Supply Area, woodlots) not exceed the overall level determined by the HGMC. Information on the Haida Gwaii Management Council can be found at www.haidagwaiimanagementcouncil.ca. More information on BC's TSR process can be found at here[1].

This data package and appendices represent the inputs and approaches that were used in the timber supply modelling and that are key to informing the AAC determinations on Haida Gwaii. While the authority for establishing the overall AAC (HGMC) and the AAC by management units (Chief Forester for the Timber Supply Area and Tree Farm Licences and Minister or delegate for First Nation Woodland Licence, Community Forest Agreement, and Woodlots) and further determinations at a TSA licence level (Minister), this data package is meant to act as a reference at all levels of decision making.

The Haida Gwaii Management Council mandated a Technical Working Group (TWG), made up of technical representation from the Council of the Haida Nation and the Province of BC to oversee the technical processes associated with this TSR[2]. This involved enlisting support (both inside and outside of the governments) to complete the analyses for informing an AAC determination.

1.2 Overview of concepts and process

TSRs include the technical analyses and reporting, consultations (public, stakeholders, licensees) as well as the determination process. **This data package is only that part of the TSR that involves the explanation of the technical analysis.**

Other key documents that support the TSR process include:

(i) The Analysis Report: summaries and interpretation of findings that result from the timber supply modelling described in this data package;
(ii) A Public Discussion Paper: An amalgamation of key timber supply inputs, approaches and findings, as well as a description of the TSR process and timelines;
(iii) A Socio-Economic Analysis Report: a detailed socio-economic evaluation of the forest industry on Haida Gwaii;
(iv) The AAC rationales: The final determination document by decision makers that sets the AAC.

Timber supply analysis involves collating and analysing information to characterize:

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[1] https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut

[2] The Technical Working Group (TWG) includes Nick Reynolds, RPF (CHN), Christine Fletcher, RPF (Forest Analysis and Inventory Branch), David Stuart, RPF (Forest Analysis and Inventory Branch) and Sean Muise, RPF (Haida Gwaii Natural Resource District) and Ted McRae (Forest Analysis and Inventory Branch). The TWG had critical support from Dr. Andrew Fall (Gowlland Technologies).

- Where there are forests and the attributes of those forests (species, age, stand heights etc.) (inventory);
- How the forests grow over time (growth and yield);
- What forests are available for commercial logging (defining the Timber Harvesting Land Base);
- Applying current resource management practices (e.g., Land Use Objectives Orders; regulations under the Forest and Range Practices Act, etc.).

The data and assumptions for each of these factors are detailed in this data package.

This particular TSR applies important principles for estimating a sustainable rate of cut:

- Use the best available data;
- Where possible, utilize local empirical data;
- Utilize a spatially explicit timber supply model;
- Report on timber supply as an evenflow or non-declining flow over a 400-year time horizon.

Appendix 8 of this data package provides a summary of the technical inputs that have informed this TSR.

1.3 Spatial Timber Supply Modelling

This section describes the software platform used to conduct the timber supply modelling. The following is sourced from (Fall & D., 2006).

1.3.1 SELES Spatial Modelling Tool

A number of tools are available for performing spatio-temporal analysis at broad scales. The Spatial Timber Supply Model built using the SELES (Spatially Explicit Landscape Event Simulator, Fall and Fall 2001) modeling language was the tool chosen for making spatial analyses to support this TSR[3].

SELES is suited to support the TSR because it can operate at the different scales required (management units, landscape units, watersheds, broad ecological scales) and can easily transfer information between scales. SELES is a raster (grid) based tool, and so one important aspect is that all spatial data must be represented in raster format. It is fairly straightforward to export spatial information from a GIS (e.g. ArcGIS) in a raster form usable by SELES, and conversely to import spatial raster outputs from SELES back into a GIS as needed.

1.3.2 SELES Spatial Timber Supply Model

The SELES Spatial Timber Supply Model (STSM) is the underlying timber supply model used in many projects (e.g. the decision support tools developed for the North Coast LRMP and Haida Gwaii LUP). For more details of STSM, see Fall (2002).

The STSM consists of a linked set of sub-models of landscape change that include forest growth, forest harvesting and roading. The inputs consist of digital raster maps describing the land base and parameter files that control model behaviour. The outputs include text files that record various aspects of the land base (e.g. growing stock, age class distribution) and time series raster maps of landscape conditions (e.g. stand age) during the simulation. Output is used both to verify correct model behaviour and to provide indicators for values of interest. Via the user interface of SELES, the model landscape can also be viewed during model runs. The "process" portion applies to the sub-models that simulate ecological and management-induced change (e.g. stand aging, harvesting). The model projects initial landscape conditions (described by input

[3] SELES is provided freely at www.gowlland.ca..

maps) forward through time, using processes represented in the sub-models (and controlled partially by input parameters) to create a model of landscape dynamics and to estimate future landscape conditions (summarised in output files and spatial maps). Users create new scenarios primarily by modifying maps of management zones and parameters affecting management and natural processes.

The STSM has some stochastic elements regarding the location and shape of cutblocks, controlled by parameters. Although each model run may produce different results, the variation between runs is usually low when harvesting is specified as a deterministic preference (e.g. stand age relative to culmination age). The overall model design is shown in Figure 1.3.2.1. All data layers are derived from inventory information provided. Management zones include landscape units, visual quality zones and resource management zones (protected areas, private land, forest tenures, etc.). Species are represented using forest stand type groups, based on leading species, and forest productivity groups.

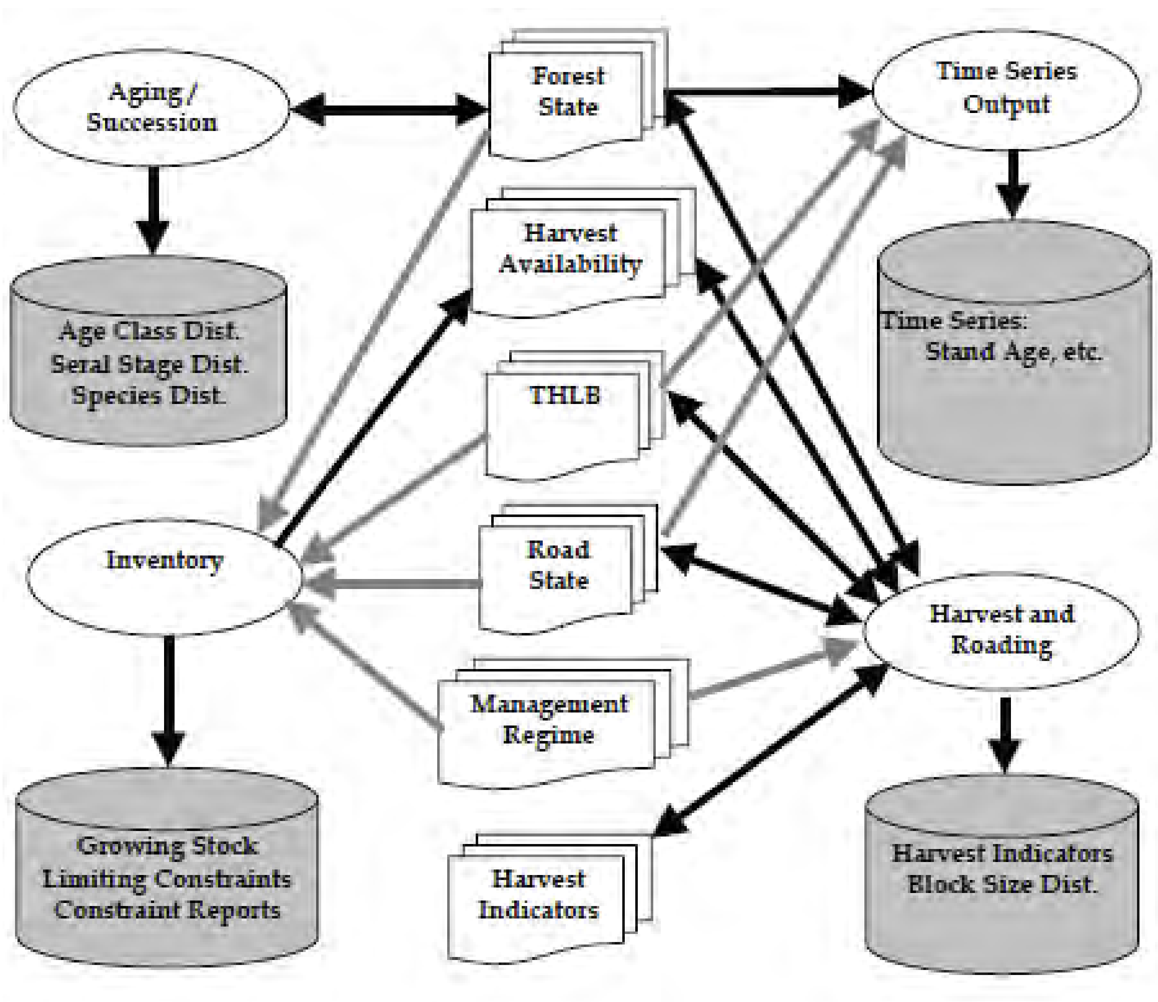

Figure 1.3.2.1 Elements of the Spatial Timber Supply Model

Each main modeled process is shown as an oval, while the main parts of the landscape state (represented as spatial data layers and tables) are shown in the centre, and output files are shown as grey drums. Arcs indicate that a process depends on and/or modifies the connected landscape state.

The forest is represented using species and age. Harvest availability indicates which cells are available for harvesting according to harvest policy and rules as specified for the base case analysis. The timber harvesting land base (THLB) is modeled spatially as a portion of each cell (e.g. road reductions are captured as partial netdowns of non-forest within cells). Growth and yield information was generated as described in Chapter 5. The road state tracks current and developed roads.

In addition to the spatial information above, a variety of non-spatial parameters are included, such as the harvest level, minimum harvest age, management objectives, and forest cover constraints.

Chapter 2 Forest Management Overview (practice, policy and regulation)

2.1. Current forest policies

Forest management on Haida Gwaii has changed dramatically over the last several decades. The underpinnings of how much forest can be logged, where it can be logged and how it can be logged can be traced back to various forest and land use policies. The TSR is meant to represent current forest and land use policies as opposed to create policy. In other words, TSR timber supply analyses are meant to reflect current policy and practice as opposed to dictating what they should or will be. An exception to this rule is where decision makers (Haida Gwaii Management Council, Chief Forester, Minister) determine that a partition is required to best sustainably manage the forests, which in turn may affect current practices.

The Province of BC has numerous Acts and Regulations that inform timber supply, however there are also important laws and policies under the Haida Nation that have equal effect on timber supply on Haida Gwaii. The most notable policy regarding the effect on timber supply on Haida Gwaii is the Haida Gwaii Strategic Land Use Agreement (2007) signed by both governments, proposed to bring the level of protection up to approximately 50% of Haida Gwaii in some form of protection, and stipulated that the rest of the Forest Management Land Base be managed under an Ecosystem Based Management (EBM) framework.

The following laws and policies inform this TSR:

- Kunst'aa Guu-Kunst'aayah Reconciliation Protocol
- The *Haida Gwaii Reconciliation Act*
- The *Forest Act* and its regulations, principally
    - *Section 8, Allowable Annual Cut*
- *The Forest and Range Practices Act* and its regulations, principally
    - *Part 2, Forest Stewardship Plans*
    - *Forest Planning and Practices Regulation;*
- The *Land Act* and its regulations, principally:
    - *The Haida Gwaii Land Use Objectives Order*
- *The Wildlife Act*
- *Parks Act* (for defining the THLB);
- *Ecological Reserve Act* (for defining the THLB);
- *Conservancy Act* (for defining the THLB);
- *Indian Act* (under Aboriginal Affairs and Northern Development Canada, for defining the THLB),
- *Public Lands Grants Act* (under the federal Department of Defence, for defining the THLB);
- *KaayGuu Ga ga Kyah ts'as - Gin 'inaas 'laas 'waadluwaan gud tl'a gud giidaa* or Stewardship Law (Haida Nation)
- The *Haida Nation Constitution*, principally section *A.8.S6* (Haida Nation)
- The *Cedar Stewardship Area Management Plans* (Haida Nation)
- Haida Nation *House of Assembly Resolutions*
- *The Cultural Feature Identification Standards Manual* (Haida Nation).

Chapter 3 Timber Harvesting Land Base

3.1 Spatial data- overview

The Haida Gwaii TSR is based on spatially-explicit inputs for defining: (1) where forests can be logged; (2) what types of trees are where; (3) how fast trees are predicted to grow, and; (4) how forests are managed and harvested.

A series of spatial files incorporates these key elements into timber supply modelling. They include administrative boundaries (ex. resource tenures, protected areas), biophysical boundaries (ex. forest inventory, lakes, wetlands, rivers), and boundaries that represent management strategies for objectives set by the Council of the Haida Nation (CHN) and/or BC (e.g., buffers on streams, Wildlife Habitat Areas, etc.).

Some of these inputs are informative – for example an inventory layer maps a stand of trees – while some inputs have prescriptive management implications – their occurrence inherently influences timber supply (e.g., a protected area boundary). Those inputs that have prescriptive management implications go on to form the basis of the Timber Harvesting Land Base.

3.1.1 Spatial inputs towards defining a Timber Harvesting Land Base (THLB)

This section provides a description of the inputs, including the sources of the information, and a summary of each inputs' effect on timber supply. For the purpose of this data package, inputs are divided into the following categories:

1. *Administrative areas* that do not contribute to forestry (see 3.1.2 below);
2. *Inventory data*, which include Vegetation Resource Inventory (VRI), Ecosystem Mapping and LiDAR enhanced forest inventory (LEFI) (see chapter 4);
3. *Resource management data*, which includes spatially explicit delineation of all resource management factors (see chapter 6).

Together, these spatial data help define the Forest Management Land Base.

3.1.2 Forest Management Land Base (FMLB)

The Forest management Land Base represents the area that contributes in some way to forest management, whether it is for timber or other types of forest values. The inventory designation describes whether an area (polygon) is forested or has been forested and is capable of producing a stand of trees.

Data used to define forested areas included:

Hydrologic features

Terrestrial Resource Information Management *(TRIM)* data was used to identify wetlands (e.g., swamps, marshes, bogs, fens), lakes, and double-line rivers (e.g., wide rivers). This data was mapped using 1:20,000 aerial photo interpretation on Haida Gwaii in 1985-86 with updates to the coastline in 2005-2006[4]. This mapping followed specifications developed by the BC Ministry of Environment, Lands and Parks (BC MELP, 1997).

Non-forest areas

Non-forested areas are defined through the BC Land Cover Classification Scheme (RIC, 2002) as attributed within the VRI standards and product. These include non-treed (any wetland, upland or alpine area with less than 10% crown closure) and non-vegetated units (<5% vegetation cover). Note that these do not include

[4] GeoBC *TRIM updates by year* retrieved Dec.12, 2018
https://www2.gov.bc.ca/assets/gov/data/geographic/topography/trim/trim_updates_by_year.pdf

low-productivity forested stands (these exclusions, including minimum harvest volume limitations, are defined in section 7.1).

An additional filter applied to define non-forested areas was where the inventory site index from the VRI had a value less than or equal to 5.

Roads

Roads were grouped into three main categories: Permanent (paved), mainlines, and branches. Existing roads were mapped using a variety of sources, including TRIM, historic licensee road data (TFL 39), road segments from the RESULTS dataset[5], as well as roads from a mapping gap analysis conducted by the CHN's Heritage and Natural Resource Department using high resolution imagery. Buffers of 10m and 20m (total) were put along branch roads and permanent/mainline roads respectively and excluded from the Forest Management Land Base. See section 6.9 for a more detailed description of roads, trails and landings.

3.1.3 Timber Harvesting Land Base (THLB)

The Timber Harvesting Land Base (THLB) represents areas that are estimated to be available for logging. It excludes areas that have been administratively removed from eligibility for logging, such as areas protected under the Haida House of Assembly which coincide with protection under BC's legislation such as under the *Parks Act*, *Ecological Reserve Act*, or *Conservancy Act*. The THLB excludes other administrative classes such as 'crown grants', which include private or 'fee simple' lands, and federal crown grants. The THLB also accounts for a host of other spatially explicit laws and policies, such as areas under the Haida Gwaii Land Use Objectives Order or Wildlife Habitat Areas that may limit logging. Beyond legal, other policy or administrative removals, the THLB also accounts for operational factors, such as unstable terrain, that renders areas inaccessible or somehow restricts logging.

Being a 'spatially explicit' dataset, each component is mapped, and the inputs, which together define the THLB, form some of the most influential elements affecting timber supply.

A thumbnail map of the THLB can be seen in figure 3.1.3.1, and THLB inputs are available in map form (appendix 11), or part of a GIS geo-database available through the HGMC[6].

3.1.3.1 Inclusion factors

Inputs into the THLB include a broad range of factors, some that restrict industrial logging absolutely, others that may partially restrict logging. An 'inclusion factor' is a common approach to assigning the proportion of an area that contributes to timber supply. For example, Protected Areas do not contribute at all to timber supply, so have an inclusion factor of '0'. 'Crown grants' that are classed as 'private land' also do not contribute to timber supply, therefore have an inclusion factor of '0'. If raster only partially overlaps an area that is not available for harvest, the inclusion factor would be between 0 and 1, depending on the extent of overlap.

Figure 3.1.3. Illustrative example of THLB inclusion factors and scaling data up to 1 hectare spatial units

[5] WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW

[6] Some inputs have restrictions due to sensitivity (ex. archaeological sites, wildlife denning or nesting etc.) and may be restricted to data sharing/ confidentiality agreements.

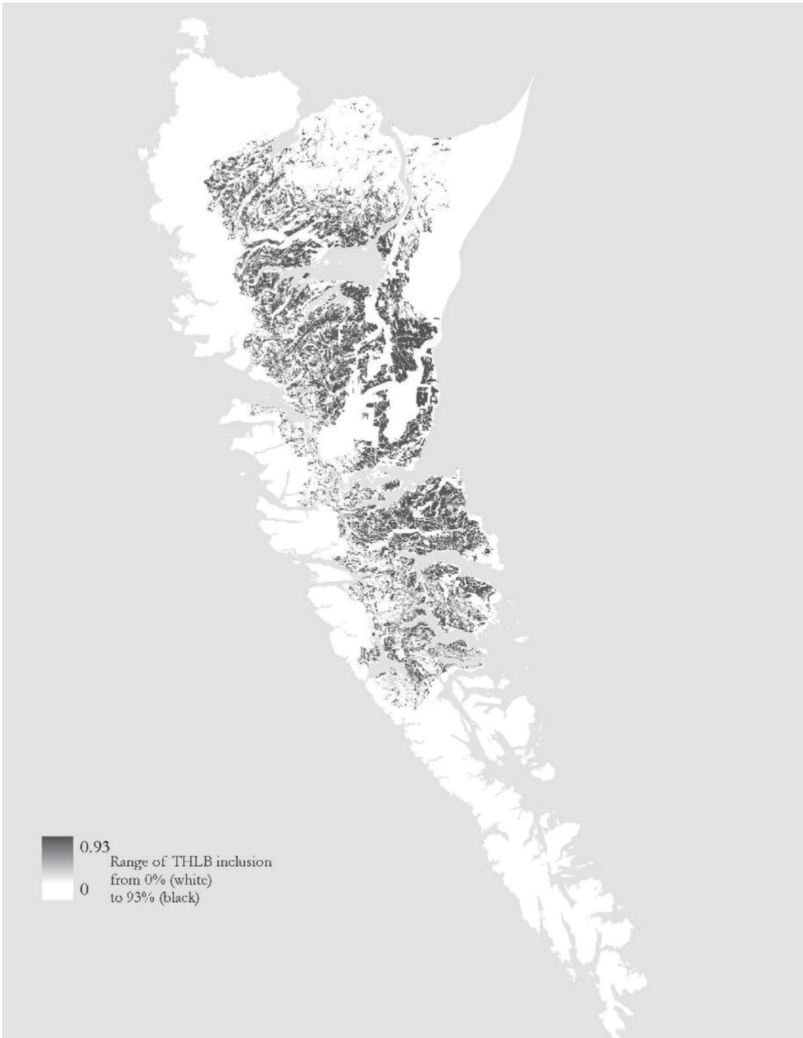

Figure 3.1.3.1. Map of the Timber Harvesting Land Base used for the base case reference scenario.

Where there are overlapping elements within each hectare (ex. wetland and road) there is assumed to be no overlap between the elements, but each element's contribution to the hectare is area-weighted and summed. To illustrate this, in the 1 hectare example in figure 3.1.3, 15% of the area is wetland (0% THLB), 15% of the area is a mainline road (0% THLB) and the remaining 70% of the area is forest (100% THLB), therefore the THLB for this 1 hectare unit would be
$(0.15x\ 0 + .15x0 + .7x1)$ and amounts to a THLB inclusion factor for the entire hectare of 70%. Where multiple elements overlap the same area (e.g., monumental AND riparian area), then that element with the lowest THLB inclusion is used.

3.1.3.2 Overlaps

Inputs into the THLB often geographically overlap each other. For example, there may be a reserve zone for a Culturally Modified Tree within the area of a Saw Whet Owl nesting reserve, or a boundary to protect a research permanent sample plot within a riparian reserve. The total effect of each input on the THLB is recorded as the gross area, and its overlap with other inputs is accounted for in defining net effect on the THLB (net area). The THLB tables below summarize each input or factor. The factors are reported ranging from most restrictive to logging (absolute exclusion) to least restrictive to logging (partial exclusion).

3.1.4 Administrative areas that do not contribute to forestry

3.1.4.1 Municipal boundaries

Three communities have formal municipal boundaries under section 12 of the *Municipal Act*: Queen Charlotte, Port Clements and Masset.

The Kunst'aa Guu- Kunst'aayah Reconciliation Protocol (CHN; Province of BC, 2009) excludes municipalities from the Haida Gwaii Management Council's Allowable Annual Cut determination.
This exclusion is further defined (as *management areas*) within the 2010 *Haida Gwaii Reconciliation Act* (HGRA). However, section 8 of the *Forest Act* mandates the Chief Forester to determine an Allowable Annual Cut for the Timber Supply Area on Haida Gwaii, which includes some areas within municipal boundaries, while

meeting the constraint that all individual AACs on Haida Gwaii must sum to at most the AAC set by the HGMC, as defined by the HGRA.

The HGMC tasked the Technical Working Group (TWG) to develop a timber supply analysis that could facilitate a simple transition between the HGMC's AAC and the subsequent AACs determined by the Chief Forester (HGMC, 2016). As such, the TWG accounted for and tracked the amount of THLB that contributes to the overall AAC within municipalities for respective decision makers to consider.

The three municipalities all have Official Community Plans (OCP) under section 875 of the *Local Government Act* and all three include mapped restrictions to industrial forestry operations in specific zones. The Village of Port Clements OCP designates *Resource Management Land Use* as areas open to forestry activities (Village of Port Clements, 2012) amounting to 307 hectares out of a municipal boundary of 575 hectares.

The Village of Queen Charlotte established an OCP under Bylaw 50-2011 in 2011 which, under sec. 10.3 designates areas within the municipal boundaries for *Industrial Land Use* which includes primary forestry activities, amounting to 2849 hectares out of a municipal boundary of 3595 hectares (Village of Queen Charlotte, 2011).

The Village of Masset adopted the *Village of Masset Integrated Official Community Plan* under Bylaw 628 in 2017 (Village of Masset, 2017), and while there are designations for light and heavy industrial areas, these are targeted towards manufacturing sites as opposed to primary forestry activities. Forested areas are otherwise designated under *Parks and Green Space* zonation for passive and active recreation and leisure. Masset's municipal boundary encompasses 2149 hectares.

3.1.4.2 Crown grants/private land

Crown grants, or 'fee simple lands' are lands that have been granted by the Province of BC and are considered private land. All private lands are excluded from this Timber Supply Review (i.e., do not contribute to the FMLB or THLB). Data sources for private land were based upon the *Integrated Cadastral Information Society* (ParcelMap BC), sourcing data through a partnership with the Land Title and Survey Authority of British Columbia (LTSA), in turn minimizing data discrepancies between multiple information sources through a dynamic database. Further review was conducted in conjunction with the HG Natural Resource District and cross-referenced with *BC Assessment* and updated LTSA data. A total of 17,300 hectares are included within this administrative category.

Figure3.1.4.2. Private lands (black)

3.1.4.3 Federal Reserves

Federal reserves were excluded from the THLB. These include reserves under *Indian Act* (under Aboriginal Affairs and Northern Development Canada), military reserves under the *Public Lands Grants Act* (under the Department of Defence) and miscellaneous reserves under the *Navigation Protection Act* (e.g., under Transport Canada). These amount to 2,631 hectares. Reserves under the *Indian Act* constitute the largest removal from the THLB for Federal Reserves (outlined in table 3.1.4.3 and listed in appendix 10) and amount to 1,631 hectares.

3.1.4.4 Protected Areas

All Federal and Provincial protected areas on Haida Gwaii were excluded from the THLB:

Protected Area	Area (Hectares)
Gwaii Haanas National Park and Heritage site	145,753
Daawuuxusda	70,295
Damaxyaa	822
Drizzle Lake	814
Duu Guusd	144,762
Duu Guusd - ER	8,684
K'uuna Gwaay	2,105
Kamdis	1,894
Kunxalas	3,344
Naikoon Provincial Park	67,268
Nang Xaldangaas	6,897
Pure Lake Provincial Park	142
SGaay Taw Siiwaay K'adjuu	597
Tlall	16,208
Tow Hill Ecological Reserve	451
Yaaguun Gandlaay	2,450
Yaaguun Suu	7,970

These areas encompass a total of 478,008 hectares, which is 48% of the total area (including surface water) of Haida Gwaii.

3.1.4.5 Tenures

Non-Forestry Tenures

'Tenures' broadly refer to licences, permits, leases, reserves or other authorizations that confer rights, responsibilities, or restrictions to the use of land. A number of tenures on Haida Gwaii negate forestry activities over an extended period and as such were removed from the THLB. These include:

- Section 15 Land Act Reserves (MFLNRO, 2011);
- Section 16 Land Act withdrawals from disposition (MFLNRO, 2011);
- Crown land permits (licences of occupation that preclude long-term commercial forestry, e.g., gravel pits, airports, community institution, etc.);
- Designated recreation sites or recreation reserves (including Shields Bay, Rennell Sound, Riley Creek, Bonanza Creek, Hangover Creek Spirit lake, Onward Point, Marie Lake, Mosquito Lake, Moresby Camp, Tarundl Creek, Stanely Lake, Lawnhill, Ship Island, Maast Island),

Collectively these tenures amount to a gross exclusion of 3,637 hectares.

Forestry Tenures

Forestry tenures include the volume based and area-based licences under the *Forest Act* (excluding Timber Sale Licences which are short-term, generally non-renewable licences sold through BC Timber Sales). While the HGMC's mandate is to set an AAC for the entirety of Haida Gwaii, this TSR includes analysis of individual management units and then aggregates results up to the entire archipelago. The forestry tenures included in this TSR are:

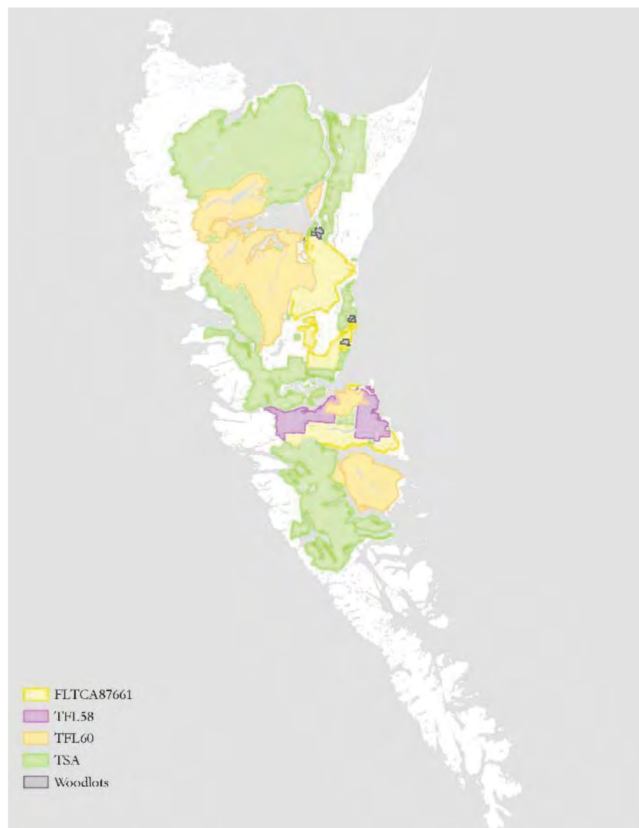

Figure3.1.4.5. Forestry tenures on Haida Gwaii

TFL 60

Tree Farm Licence 60 is a replaceable area-based licence that was purchased by Taan Forest Products in 2012 from Western Forest Products. The original licence was acquired by the Powell River Company in 1961 as part of TFL 39, but in 2010 it was deleted from TFL 39 and became TFL 60 (Brash & West, 2012). The total area of the TFL is 134,507 hectares (including non-forested areas) and includes most of central Graham Island, a small portion of northern Moresby Island, as well as Louise Island and some area in the Chadsey Creek drainage. It is the largest area-based tenure on Haida Gwaii and is currently certified under Forest Stewardship Council sustainable forest management standard for British Columbia.

TFL 58

Tree Farm Licence 58 is a replaceable area-based licence that was purchased by A&A Trading (Haida Gwaii) in 2016 from Teal Cedar Products Ltd. The original licence was the result of an amalgamation of TFL 2 and TFL 12 into TFL 47 in 1985, then owned by Crown Forest Industries Ltd. (Pederson, 1996). This tenure was eventually transferred to TFL Forest Ltd. (a subsidiary of TimberWest). In late 2006, the Moresby Block was deleted from TFL 47 to create TFL 58, which was transferred in 2007 to Teal Cedar Products. The licence includes four parcels of fee simple private lands or "Schedule B" lands that are subject to the terms of the Tree Farm Licence (District Lots 1362, 167, 2143 and 2854). The total area of the TFL is 27,873 hectares and is entirely contained within north Moresby Island.

Forest Licence to Cut (FLTC) A87661
FLTC 87661was awarded as a non-replaceable volume-based licence to Taan Forest Products in 2012 as part of the fulfillment of the Strategic Land Use Agreement and subsequent Kunst'aa guu- Kunst'aayah Reconciliation Protocol (CHN; Province of BC, 2009) for the management of 120,000m^3 per year by the Haida Nation. The area is technically within the Timber Supply Area, however a 'chart' area has been designated for management of the volume. The area is primarily located on the central east coast of Graham Island, along with a supply area on north Moresby Island and covers 58,606 hectares.

Woodlots
There are four woodlots on Haida Gwaii. W1841 is managed by Old Massett Village Council and covers approximately 478 hectares just south of Port Clements. W1840 is managed by Skidegate Band Council and includes 422 hectares near Jungle Creek. W0161 is managed by Dave Younger and covers 477 hectares just east of Port Clements. W0162 is managed by Gerald Lavoie and is 465 hectares within the Lawn Hill area.

Timber licences
Timber licences are the oldest form of forestry tenure in BC, having originated in the 1860s. These grant exclusive right to harvest timber in a specified area. This right however is reverted to a licence holder (if the timber licence is in a TFL) or back to the TSA after the mature or natural stand is cut (e.g., they represent rights to one-time harvests). As such, these licences are not considered as individual long term timber supply units, but rather contribute to the broader unit which they are contained within (e.g., TFL or TSA). It is common practice in provincial TSRs that the initial Timber License harvests are not include in TSA projections until after the initial harvest. However, the majority of Timber Licences on Haida Gwaii are within the TFLs (owned by the TFL holders) and therefore do not constrain or reduce timber supply for those units. As such, Timber Licences were not tracked as supply units within this TSR.

Timber Supply Area
All the area outside of the aforementioned tenures or administrative units (e.g., protected areas) is considered the Timber Supply Area. Within this unit the majority of the volumes currently are allocated to a series of replaceable Forest Licences (Husby's A16869, Dawson Harbour Logging Co.Ltd's A75084, A&A Trading's A16870). In addition the area charted for Taan Forest Product's Forest Licence to Cut of 120,000m^3 also comes out of the Timber Supply Area as well as the area allocated to BC Timber Sales Timber Sale Licences.

3.2 THLB tabular summaries

The THLB is generated using vector-based spatial data (polygons) that get integrated into a raster based one-hectare grid (see appendix 1 meta data).

The resulting THLB for the HGMA is estimated at 147,746 hectares with a long-term THLB (after future roads are built) to be approximately 138,290 hectares. This is not entirely an administrative unit (legally defined area) but rather an amalgamation of legally defined areas and outputs from analyses described in this data package. The sum of all three management units (TSA, TFL 58 and TFL 60) is slightly less than the total reported in section 3.2.1 as that total includes woodlot areas.

3.2.1 THLB for all of Haida Gwaii

Spatial net downs	Gross Removal	Net Removal	After Net Removal	Net % Haida Gwaii
HaidaGwaii			**1,004,982**	
Protected Areas (CHN/Federal)	145,735	145,735	859,247	15%
Protected Areas (CHN/Provincial)	332,273	332,273	526,974	33%
Surface water (TRIM waterbodies)	64,685	37,428	489,546	4%
Non-forest	86,940	19,454	470,092	2%
Current roads	9,100	8,768	461,324	1%
Federal Reserves (IR)	1,541	1,433	459,891	0%
Federal Misc (Military/other)	1,026	865	459,026	0%
Provincial Reserves/non-timber tenures	6,259	3,003	456,023	0%
Private (crown grants-40N)	17,300	15,833	440,190	2%
Municipal	3,092	1,055	439,135	0.1%
AFU	36,353	20,502	418,634	5%
Type 1 Fish Habitat	93,149	32,774	385,860	7%
Type 2 Fish Habitat	58,108	28,140	357,720	6%
Forested Swamps	15,331	1,960	355,760	0.4%
FPPR Riparian	24,143	1,452	354,308	0.3%
Red listed Ecosystems	13,567	823	353,485	0.2%
Blue listed Ecosystems	62,444	15,566	337,920	4%
Karst	7,179	2,572	335,348	1%
Forest Reserves (Marbled Murrelet, Rare Ecosystems)	31,201	20,467	314,881	5%
Marbled Murrelet reserves	116	64	314,817	0.0%
Northern Goshawk nesting	3,661	2,116	312,701	0%
Saw Whet Owl nesting	730	327	312,374	0.1%
Black Bear denning (current in-block)	62	43	312,331	0.0%
Wildlife Habitat Areas	623	178	312,153	0.0%
Heritage (HTHH, CMTs, Arch Sites)	27,946	5,937	306,217	1%
Cedar Stewardship Areas	25,303	15,372	290,845	4%
Monumentals (current in-block)	442	251	290,593	0.1%
Monumentals (future)	77,615	44,584	246,009	4.4%
Haida Traditional Forest Features	281	137	245,872	0.0%
Yew (current in-block)	212	51	245,822	0.0%
Trails (current in-block)	1,693	279	245,542	0.1%
Permanent Sample Plots	1,010	360	245,182	0.1%
Landslides	1,209	686	244,497	0.2%
Class IV Terrain	16,816	10,962	233,535	2%
Class V Terrain	30,987	17,802	215,732	4%
Rare Ecosystems	12,019	4,840	210,892	1%
LUOO in block retention	85,353	23,356	187,536	5%
Low productive forest	79,652	39,541	147,995	4%
Small islands	3,123	249	147,746	0%
Future Roads/Trails/Landings (6.4%)		9,456	138,290	2%

3.2.2 THLB by management unit

TSA 25

Spatial netdowns	Gross Removal	Net Removal	After Net Removal
TSA			**339,063**
Surface water (TRIM waterbodies)	30,776	30,762	308,301
Non-forest	29,311	16,476	291,825
Current roads	4,163	4,148	287,677
Provincial Reserves/non-timber tenures	768	712	286,964
Municipal	1,265	1,009	285,955
AFU	13,838	12,990	272,965
Type 1 Fish Habitat	33,801	24,752	248,213
Type 2 Fish Habitat	21,183	18,580	229,633
Forested Swamps	1,976	1,007	228,625
FPPR Riparian	7,739	1,808	226,817
Red listed Ecosystems	4,379	649	226,168
Blue listed Ecosystems	16,539	9,843	216,325
Karst	1,966	1,277	215,048
Forest Reserves (Marbled Murrelet, Rare Ecosystems)	18,834	12,635	202,413
Marbled Murrelet reserves	116	64	202,349
Northern Goshawk nesting	2,190	1,517	200,832
Saw Whet Owl nesting	141	75	200,756
Black Bear denning (current in-block)	32	24	200,732
Wildlife Habitat Areas	379	141	200,591
Heritage (HTHH, CMTs, Arch Sites)	6,645	3,999	196,591
Cedar Stewardship Areas	11,962	6,744	189,847
Monumentals (current in-block)	340	203	189,644
Monumentals (future)	54,412	32,336	157,308
Haida Traditional Forest Features (current in-block)	191	82	157,225
Yew (current in-block)	189	44	157,182
Trails	1,014	271	156,910
Permanent Sample Plots	306	191	156,719
Landslides	773	449	156,270
Class IV Terrain	11,632	7,508	148,763
Class V Terrain	22,682	13,019	135,744
Rare Ecosystems	6,464	2,276	133,467
In block retention (LUOO and WTRA)	29,224	15,687	117,780
Low productive forest	71,344	34,544	83,237
Small islands	157	17	83,219
Future Roads/Trails/Landings (6.4%)		5,326	77,893

TFL 58

Spatial netdowns	Gross Removal	Net Removal	After Net Removal
TFL58			**23,933**
Surface water (TRIM waterbodies)	189	189	23,744
Non-forest	175	165	23,578
Current roads	762	762	22,816
Provincial Reserves/non-timber tenures	40	36	22,780
Municipal	0	-	22,780
AFU	1,285	1,199	21,581
Type 1 Fish Habitat	2,513	1,657	19,925
Type 2 Fish Habitat	1,932	1,797	18,128
Forested Swamps	73	8	18,120
FPPR Riparian	398	171	17,949
Red listed Ecosystems	226	5	17,945
Blue listed Ecosystems	553	363	17,582
Karst	270	238	17,344
Forest Reserves (Marbled Murrelet, Rare Ecosystems)	1,166	567	16,777
Marbled Murrelet reserves	0	-	16,777
Northern Goshawk nesting	0	-	16,777
Saw Whet Owl nesting	0	-	16,777
Black Bear denning (current in-block)	1	1	16,776
Wildlife Habitat Areas	0	-	16,776
Heritage (HTHH, CMTs, Arch Sites)	636	393	16,383
Cedar Stewardship Areas	309	259	16,124
Monumentals (current in-block)	0	-	16,124
Monumentals (future)	1,827	1,160	14,964
Haida Traditional Forest Features	2	1	14,963
Yew (current in-block)	0	-	14,963
Trails	0	-	14,963
Permanent Sample Plots	16	12	14,952
Landslides	22	17	14,935
Class IV Terrain	537	400	14,535
Class V Terrain	1,264	779	13,756
Rare Ecosystems	1,459	1,094	12,662
In block retention (LUOO and WTRA)	1,828	1,260	11,402
Low productive forest	652	301	11,101
Small islands	1	-	11,101
Future Roads/Trails/Landings (6.4%)		710	10,390

TFL 60

Spatial netdowns	Gross Removal	Net Removal	After Net Removal
TFL60			**134,526**
Surface water (TRIM waterbodies)	4,431	4,431	131,932
Non-forest	2,913	2,594	128,724
Current roads	3,210	3,208	128,580
Provincial Reserves/non-timber tenures	146	144	128,580
Municipal	0	-	122,360
AFU	6,653	6,220	116,118
Type 1 Fish Habitat	9,774	6,242	108,431
Type 2 Fish Habitat	8,582	7,687	108,163
Forested Swamps	470	268	108,025
FPPR Riparian	895	138	107,857
Red listed Ecosystems	1,476	168	102,623
Blue listed Ecosystems	11,205	5,234	101,571
Karst	1,673	1,052	94,317
Forest Reserves (Marbled Murrelet, Rare Ecosystems)	11,015	7,255	94,317
Marbled Murrelet reserves	0	-	93,719
Northern Goshawk nesting	1,096	598	93,477
Saw Whet Owl nesting	571	241	93,460
Black Bear denning (current in-block)	23	18	93,423
Wildlife Habitat Areas	243	37	92,041
Heritage (HTHH, CMTs, Arch Sites)	2,227	1,382	83,737
Cedar Stewardship Areas	12,791	8,305	83,689
Monumentals (current in-block)	100	48	72,607
Monumentals (future)	21,185	11,082	72,553
Haida Traditional Forest Features	86	54	72,546
Yew (current in-block)	23	7	72,546
Trails	0	-	72,394
Permanent Sample Plots	273	153	72,173
Landslides	357	220	69,119
Class IV Terrain	4,646	3,054	65,115
Class V Terrain	7,040	4,004	63,649
Rare Ecosystems	3,248	1,466	62,183
In block retention (LUOO and WTRA)	11,237	6,265	55,918
Low productive forest	7,576	4,642	51,276
Small islands	0	-	51,276
Future Roads/Trails/Landings (6.4%)		3,282	47,994

Chapter 4 Inventory

Forest Inventory

This section describes forest inventory evaluated and used during this TSR. While many iterations are described here, the main forest inventory used in this TSR consisted of: VRI (species, age, site index for natural stands); LiDAR enhanced Forest Inventory (basal area, heights) for natural stands; RESULTS (silviculture records) updates and 2017 depletion (remotely sensed) data for existing managed stands.

4.1 VRI and Inventory Audits

A VRI was completed for all of Haida Gwaii between mid-2011 and 2013 (Sandvoss, 2014). VRIs describe the characteristics of vegetation, primarily trees, and provide information such as tree species, height, age, basal area, stems per hectare and other attributes that support forest management and analysis. The Haida Gwaii VRI had two general stages: (1) Phase 1, estimation of vegetation characteristics based on aerial photographs along with 283 ground and 547 air calibration points; and (2) Phase 2, measurement of field plots located using a statistical design, and use of the resulting ground data to calculate statistics on the accuracy of the photo-interpreted estimates. In many areas and where the audits show statistically significant differences, the Phase 2 statistics can be used to adjust the photo-interpretation (Phase 1) inventory information for use in timber supply analysis.

4.1.1 Photointerpretation VRI (Phase 1)

Work on the photo-interpretation Haida Gwaii VRI commenced on July 28, 2011 and was completed in December, 2013. A comparison of the new Phase 1 inventory with the amalgamation of inventories used in the previous (2011-12) TSR showed that the total volume in the Phase 1 was about 22% lower than the previous TSR on the total forest area, and almost 25% lower on a rough approximation of the THLB. The comparison also showed that the Phase 1 inventory contained substantially less area in very old forest (over 250 years old) and more area in mature forest (141-250 years old), and generally that height estimates were lower than in the inventory used in the previous TSR. These differences reinforced the need to do a Phase 2 ground-based inventory audit.

4.1.2 Mature Audit and Young-Stand Monitoring (Phase 2)

Two types of ground studies were done in Phase 2 of the Haida Gwaii VRI: a mature stand volume audit of stands with an age over 50 years old; and a young stand monitoring (YSM) project, applicable to stands in the 15-50 year old range. This section summarizes the mature stand audit. A subsequent section will cover the YSM study.

The Phase 2 inventory audit results [7]indicated that the Phase 1 photo-interpreted ages matched ground samples very well; that ground-measured heights were slightly lower (about 5%) than in the photo-interpreted inventory; and that ground-measured basal area (BA) and number of trees per hectare were substantially greater than in the Phase 1 inventory, by 21.5% and 63.8% respectively. The differences between the Phase 1 and Phase 2 led to an overall Phase 2 ground volume, based on local loss factors, that was 22.8% higher than estimated from the Phase 1 inventory (Penner, 2018).

About two-thirds of the difference in volumes was due to "attribute bias" – specifically to the larger BA noted in the Phase 2 ground sampling. This bias resulted because photo-interpreters were unable to see some of the larger stems through the forest canopy, which is a common issue with coastal inventories in particular.

[7] Haida Gwaii. Documentation of Vegetation Resources Inventory Analysis – Volume Audit (Mature), March 16, 2018. Prepared for: Forest Analysis and Inventory Branch, FLNRO.

The other third of the difference was due to "model bias" which refers to differences in the manner in which volumes are determined from the inventory data. The Phase 1 estimates were based on the VDYP yield model, which uses a database of stand-level yield data, while for the Phase 2 ground estimates, individual tree-level taper equations were used. The taper equation approach is generally believed to provide more accurate yield estimates than the stand-level model.

The volume difference between the photo-interpreted and ground-plot-based inventory of 22.8% noted above, was the average for all species. However, the differences were 54.4% for redcedar and yellow cedar, and 0.4% for other species (primarily hemlock and spruce). The cedars were placed in a separate category because of their economic importance on Haida Gwaii (cultural and traditional values are generally assumed to be protected through the LUOO and are not part of the THLB), and because the difference was so significant. Species other than cedar were combined because the sample size was small for spruce, and hence the sampling error for that species alone was very large.

4.1.3 Inventory and volume bias ratios

Table 4.1.3.1 shows the ground plot over Phase 1 ratios from the mature inventory audit. The strata ratios are based on Table 8 of "Haida Gwaii Documentation of Vegetation Resource Inventory Analysis-Volume Audit (Mature)", revised March 16, 2018) for the VDYP7 adjustment processes. For reference, the full table of ratios and sample errors is reproduced in Table 4.1.3.2, below.

Table 4.1.3.1 Mature stand audit ratios (sampling errors in parentheses)

	Leading species Strata	
Attributes ratios	**Cw/Yc**	**Hw/Hm & SS+**
Leading Species matched age	1.037 (8.8%)	0.996 (15.9%)
Leading Species matched height	1.057 (9.5%)	0.941 (13.1%)
Basal area	1.282 (12.8%)	1.135 (18.8%)
Trees/ha	1.425 (18.3%)	2.057 (41.3%)
Lorey Height	0.977 (9.7%)	0.887 (13.7%)
Volume net Dwb (Local Loss Factors) (m^3/ha) 17.5 cm+	1.544 (22.9%)	1.004 (23.8%)

Table 4.1.3.1 shows that some of the sampling errors, particularly for net volume, are large. For this reason, the ratios were not used for the base case in the analysis. The ratios were applied to the photo-interpreted attributes for exploratory analysis, as described in section 5.8. However, for most part, LiDAR enhanced inventory information was used where available for the timber supply analysis, including the base case.

Volumes were defined based on close utilization volume net of decay, waste and breakage (DWB). Volumes were calculated using local taper functions developed from destructive sampling of approximately 813 trees on Haida Gwaii in the 1990s (Flewelling, 2001), and subsequent Haida Gwaii specific taper equations developed by Kozak (1997)Utilization standards were 17.5 cm dbh for all species except for pine, for which the minimum dbh was 12.5 cm. See appendix 5 for a description of the Haida Gwaii specific taper equations.

Table 4.1:3.2 Reproduction of Table 8 from "Haida Gwaii Documentation of Vegetation Resource Inventory Analysis-Volume Audit (Mature)", revised March 16, 2018

Attribute	Cw/Yc	Hw/Hm	SS+	Hw/Hm & SS+	THLB	Non THLB	All
Leading Species Age (years)	1.043 (8.8%)	1.051 (19%)	0.827 (14.1%)	0.995 (15.9%)	1.054 (10.9%)	0.985 (10.5%)	1.027 (7.8%)
Leading Species matched Age (years)	1.037 (8.8%)	1.053 (19%)	0.827 (14.1%)	0.996 (15.9%)	1.052 (10.9%)	0.978 (10.7%)	1.023 (7.8%)
Second Species matched Age (years)	0.978 (17%)	1.328 (34.8%)	1.043 (0%)	1.321 (34.1%)	1.066 (17.4%)	1.096 (39.6%)	1.074 (16%)
Leading Species Height (m)	1.054 (9.5%)	1.056 (12.1%)	0.697 (22.8%)	0.935 (12.9%)	0.973 (10.4%)	1.035 (12.8%)	0.996 (7.2%)
Leading Species matched Height (m)	1.057 (9.5%)	1.066 (12.2%)	0.697 (22.8%)	0.941 (13.1%)	0.979 (10.5%)	1.037 (12.8%)	1.001 (7.3%)
Second Species matched Height (m)	1.031 (17.4%)	1.044 (25.2%)	1.018 (0%)	1.041 (22.4%)	0.994 (14.4%)	1.138 (30.9%)	1.036 (13.9%)
Basal area (m2/ha) 7.5 cm+	1.282 (12.8%)	1.189 (23%)	1.011 (30.4%)	1.135 (18.8%)	1.284 (12.6%)	1.104 (19.7%)	1.215 (10.8%)
Trees/ha 7.5 cm+	1.425 (18.3%)	1.821 (56%)	2.957 (27.9%)	2.057 (41.3%)	1.759 (29.9%)	1.465 (22.9%)	1.638 (20.1%)
Lorey Height (m)	0.977 (9.7%)	0.984 (14.7%)	0.676 (22.6%)	0.887 (13.7%)	0.932 (11.2%)	0.932 (12.5%)	0.932 (7.8%)
Volume net Dwb (m^3/ha) 17.5 cm+ **NVAF**	1.635 (22.3%)	1.208 (26.5%)	0.708 (46.2%)	1.03 (24%)	1.385 (20.3%)	1.118 (31.2%)	1.282 (15.9%)
Volume net Dwb (m^3/ha) 17.5 cm+ **LF**	1.544 (22.9%)	1.17 (25.8%)	0.702 (47.8%)	1.004 (23.8%)	1.323 (19.8%)	1.078 (32%)	1.228 (16%)
Leading Species Site index (m) age 10-120	1.121 (19.3%)	1.102 (13.9%)	0.85 (27.8%)	0.998 (14.9%)	1.001 (14.9%)	1.081 (21.3%)	1.029 (11.1%)
Leading Species Site index (m) All ages	1.061 (8.5%)	1.123 (8.6%)	0.833 (22.9%)	1.018 (10.8%)	1.022 (8.5%)	1.063 (12.4%)	1.037 (6.4%)
Leading Species matched Site index (m) age 10-120	1.245 (20.8%)	1.104 (13.7%)	0.923 (29.4%)	1.041 (13.8%)	1.027 (15.4%)	1.234 (14.9%)	1.09 (11.1%)
Second Species matched Site index (m)	1.652 (68.2%)	0.892 (8%)	0.993 (0%)	0.916 (7.5%)	0.918 (8.9%)	1.243 (61.8%)	1.011 (16.6%)
Leading Species matched Site index (m) All ages	1.121 (7.9%)	1.11 (8.7%)	0.855 (31.6%)	1.04 (11%)	1.042 (8.7%)	1.155 (10.7%)	1.078 (6.3%)
Site index (m) PSPL	0.78 (20.2%)	0.962 (18.9%)	0.892 (25.2%)	0.945 (15.7%)	0.899 (16.6%)	0.875 (19.4%)	0.892 (12.7%)

Note: Top number in each cell is the ratio; the value in parentheses is the sampling error at a 95% confidence level.

4.2 Young stand monitoring study

Young stand monitoring (YSM), a FLNR Forest Analysis and Inventory Branch initiative, was designed to provide information useful for evaluating stand development in the young and intermediate age range (15-50 years) (DeJong, 2017b). Given sufficient sampling over time these data can be used to assess if adjustments to inventory attributes, relative to photo-interpreted information, are warranted in stands in this age range.

YSM has five specific objectives:

1. Characterize the young stand population, including composition, structure, mortality, growth, yield, and health.
2. Assess the accuracy of some Phase I Vegetation Resources Inventory (VRI) photo-interpreted polygon attributes (e.g., age, height, density and site index) for young stands.
3. Assess the accuracy of site index estimates in the Provincial Site Productivity Layer (PSPL).
4. Compare observed stand yields (e.g., basal area/ha and trees/ha) to predictions generated from TIPSY.
5. Compare observed growth to forecasts from growth and yield models for the young stand population once remeasurements are available.

Since remeasurements are not yet available for Haida Gwaii, the 2017 YSM study focuses on the first four objectives only.

In Haida Gwaii, the YSM population consists of polygons that are currently 15-50 years old, which cover approximately 100,000 ha. Forty-three ground samples were established in 2016. The YSM population is dominated by hemlock (48% by basal area) followed by spruce (42%) with minor amounts of alder, cedar, yellow cedar and pine. Of the 43 YSM plots 24 were in hemlock-leading stands, 13 were in spruce-leading stands, 3 were in stands dominated by cedar, and 3 were in stands with other leading species.

The photo-interpreted (Phase I) inventory was used as the baseline for comparison of basal area, age, and height. The provincial site productivity layer (PSPL) was the comparison baseline for site index. TIPSY using Phase 1 forest cover estimates was the baseline for volume estimates.

Table 4.2 summarizes the results of the YSM study.

Table 4.2. Summary of comparison of ground plots to the inventory and to the YSM assumptions. A p-value < 0.05 is generally considered to indicate a statistically significant difference (or bias). Volume estimates do not include residual trees. All attributes are at the 7.5 cm utilization level.

Attribute	N	Baseline estimate	Ground mean	Inventory mean	Difference (grnd – inv)	Difference as % of grnd mean[1]	p-value
Basal area (m^2/ha)	43	VRI	31.4	27.0	4.4 ± 2.2	14%	0.053
Species matched age (years)	43	VRI	39.6	32.5	7.1 ± 2.7	18%	0.011[2]
Species matched height (m)	43	VRI	15.4	16.3	-0.9 ± 0.7	-6%	0.208
Site index (m)	41	PSPL[3]	23.3	25.4	-2.2 ± 1	-9%	0.042
Whole stem volume (m^3/ha)	40	TIPSY	219.6	189.9	29.7 ± 29.2	14%	0.314
Volume model bias (m^3/ha)	40	TIPSY	—	—	38.7 ± 13.2	18%	0.006
Volume attribute bias (m^3/ha)	40	TIPSY	—	—	-9 ± 22.1	-4%	0.687

Notes:
(1) The YSM report table 1 shows differences as the percent of the ground mean, but in the text uses the inventory as the reference. For example, the report text says that the ground BA is about 14% higher than the inventory BA, but in fact, the inventory BA is 14% lower than the ground BA.
(2) Shaded values are statistically significant at a p-value of less than 0.05
(3) PSPL is provincial site productivity layer

While the difference in BA shows as not statistically significant in Table 4.2 (i.e., > 0.05), in fact the BA difference in stands in the 15-30 year range is larger and statistically significant, while the difference in the 31-50 year range is smaller and not statistically significant.

The analysis has a number of complications. These are young samples and the trees are small. Small changes in age and height can have relatively large effects on SI. The age, height, site index and basal area biases are smaller in the older age class (31 – 50) than the younger age class (15 – 30).

Since this was the first YSM analysis for Haida Gwaii, the results were not used to adjust attributes and volumes for this TSR. YSM information will have greater utility for future TSRs once remeasurements have been done.

4.3 LiDAR and Enhanced Forest Inventory
Light Detection and Ranging (LiDAR) was completed on Haida Gwaii between 2015-2017 through various partners and projects. LiDAR is an airborne survey method that uses laser pulses from an aircraft to measure distances to an object below (a point density of 8 pulses/m^2 on Haida Gwaii). Its applications in resource management are wide ranging, however the most common products include a digital elevation model, digital terrain model (both to 1m resolution on Haida Gwaii), contours and canopy height models. The ground returns (e.g, point clouds) can be used to model a series of forest attributes (described below). The table summarizes the approximate extent of the projects flown on Haida Gwaii.

Table 4.3.1 LiDAR project proponents and area coverage

MoE (parks/protected areas)	786 km^2
FLNRO (TSA)	1350 km^2
FLNRO (TSA)	1900 km^2
TAAN (operating areas)	1930 km^2
Island Timberlands (operating areas)	104 km^2
GWAII HAANAS	1470 km^2
BCTS (TSA)	500 km^2

These LiDAR data were used extensively for this TSR for derived mapping projects to enhance terrain stability mapping (see section 6.8) and mapping active fluvial units (see section 6.11.4), but most notably for enhancing forest inventory attributes, or LiDAR Enhanced Forest Inventory (LEFI).

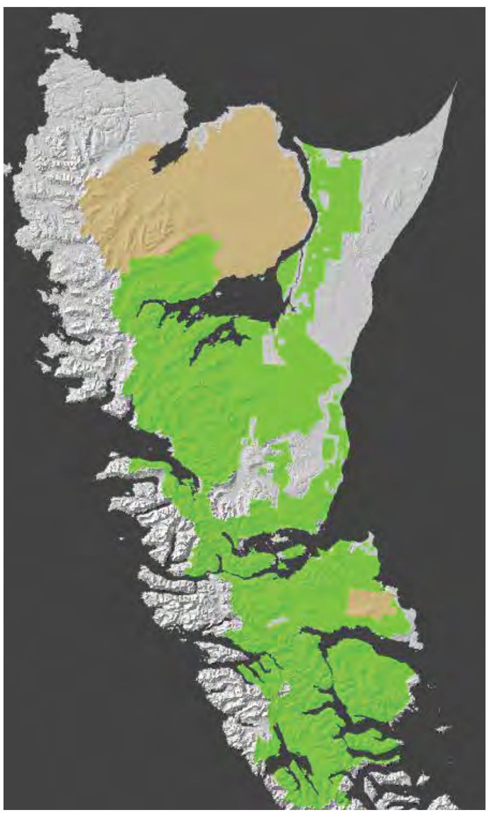

Figure 4.3 LiDAR coverage (light green) and no coverage (brown) within the Haida Gwaii operating areas.

The Forest Analysis and Inventory Branch (FAIB) developed an area-based parametric prediction model that was based upon metrics sourced from the LiDAR canopy point cloud data and ground tree measurements (Yuan & Wang, 2017). A total of 84 ground plot tree measurements were used from the VRI audit inventory plots (35 Young Stand Monitoring, 3 Change Monitoring, 46 VRI audit plots). Final inventory parameters that were produced include top height, Lorey height, diameter, basal area, crown cover and whole stem/net volumes and delivered as a 20m x 20m raster product. Height (actual LiDAR output) and basal area/quadradic mean diameter (derived LiDAR outputs from parametric modelling) were computed through FAIB's ground compiler which utilizes the 2002 'QCI' decay, waste and taper equations to calculate volume (see section 4.1.3 for more information on DWB).

The initial LEFI project was completed in 2017, however the same methodology was later applied to new LiDAR acquisitions of approximately 500km^2 (BCTS). The following table summarizes key statistics from the prediction equations, indicating a reasonable correlation (R-squared values) between the prediction model and ground samples.

Table 4.3.2. Statistics of the LEFI prediction equations (Yuan & Wang, 2017)

Variable (in log)	Adjusted R-squared	Root MSE	p-value
Lorey height	0.8995	3.364	<0.0001
Top height	0.9013	3.202	<0.0001
Basal area	0.8651	0.3208	<0.0001
Quadratic mean diameter	0.7608	0.3320	<0.0001
Whole stem volume	0.9148	0.3896	<0.0001
Net waste/breakage volume	0.9208	0.5010	<0.0001

4.4 Ecosystem Mapping

Ecosystem mapping is made up of tenure specific projects on Haida Gwaii. From 1994-2017, there were 17 ecosystem mapping projects on Haida Gwaii (Madrone Environmental Services Ltd., 2017): Nine projects were collated from TFL 39[8] (now TFL 60) where Terrestrial Ecosystem Mapping (TEM) was undertaken to a survey intensity level (SIL) 4 between 1995-1999. That overall project (approximately 270,500 ha) had quality assurance completed by B.Beese and D.Meidinger (exceeding 65% accuracy threshold). Other Ecosystem Mapping projects include:

a. Five projects completed to a Survey Intensity Level 5 in the Timber Supply Area[9] between 2004-2007, covering approximately 437,200 ha. Quality assurance was completed by Timberline Natural Resource Group in 2008 (dominant entity correct with and without alternate calls was 45%/59% respectively (see discussion below);
b. A pre-TEM (before Resource Inventory Committee published standards) mapping project was completed for TFL 25[10], covering approximately 52,900 ha. Q/A not available;
c. A pre-TEM project for TFL 58 (formerly TFL 2 and 47) was done by T. Lewis. Approximately 27,300 ha. Q/A not available;
d. A TEM project (including quality assurance) was completed for a portion Louise and north Moresby Islands in 2015-6 by Madrone as part of a strategic re-inventory and updating of TEM for Haida Gwaii (Tripp, J.McEwen, H.Williams, & R.Adams, 2017).
e. A TEM project completed for Skidegate Lake Landscape Unit by Blackwell Consulting. This mapping overlapped and replaced the pre-TEM project described in (c) above;
f. Gwaii Haanas biophysical mapping project was completed in 1994 (not using a BEC basis);
g. A Predictive Ecosystem Mapping project was completed in 2002 by EBA Engineering Consultants for the north/central coasts and Haida Gwaii to support Land and Resource Management Planning (EBA Engineering Consultants Ltd., 2002);
h. The Reporting Silviculture Updates and Land Status Tracking System (RESULTS) provides site series mapping at the Standard Unit scale.

For the Timber Supply Review, projects described were collated to provide a complete coverage of Haida Gwaii, as detailed in Figure 4.4 and Table 4.4.

BEC Classification updates

In 2014 the Biogeoclimatic Ecological Classification system for Haida Gwaii was updated from the previous classification published in1994 (Green & Klinka, 1994). The update incorporated results from newer

[8] Mapping in 1994-1998 for MacMillan Bloedel
[9] Mapping in 2005-2006 led by Husby Forest Products
[10] Mapping revised in 2003 to TEM attribute standards by T.Lewis Ph.D, P.Ag, P.Geo

ecological research plots and analysis into the Land Management Handbook 68 (Banner A. P., 2014). The new classification led to a number of changes at the BEC variant level and site series level (e.g., the change from CWHvh2 to CWHvh3, etc.). In addition, new BEC variant mapping was published by the Ministry in 2014 that adjusted boundaries, particularly for the very wet hypermaritime zone (CWHvh2/3).

The application of the new classification is confounded by the fact that the HGLUOO's ecosystem representation targets (HGLUOO Schedule 10) and red/blue ecosystem targets (HGLUOO Schedule 13) and the majority of the ecosystem mapping are based upon the 1994 BEC classification. Currently the HG Natural Resource District and the Council of the Haida Nation are undertaking an initiative to update (re-map or cross-walk) all the ecosystem mapping on Haida Gwaii, in accordance with a Strategic Plan that was developed in 2017 (Tripp & Temmel, 2017).

Therefore, for all elements of the TSR that use ecosystem mapping (e.g., site productivity estimates, spatial net downs, etc.), both classifications were used (where applicable). The cross-walk table (table 4.4.2 below) was applied (Banner, W. MacKenzie, MacKinnon, Saunders, & H.Klassen, 2014).

Table 4.4.1 Area of ecosystem mapping projects used in this TSR.

Project	Hectares
Gwaii Haanas Ecosystem Mapping	147,013
Madrone 2016 (TEM)	17,892
RESULTS Ecosystem Mapping	41,800
SS Predictive Ecosystem Mapping	78,779
TFL 25 (TEM)	40,109
TFL 39 (TEM)	214,393
TSA (TEM)	416,957
Blackwell (2019)	48,700

Table 4.4.2. Relationship between site unit numbers used in Green and Klinka (1994) and those presented in Allen et. al (2014)

Current site unit	Current biogeoclimatic unit (presented in this guide)[a]			
	CWHvh3	CWHwh1	CWHwh2	MHwh
101	vh2/01, vh2/03	wh1/01	wh2/01, wh2/02	wh/01, wh/04[b]
102	vh2/02	wh1/02	N/A[c]	wh/02[b]
103	vh2/14, vh2/16	wh1/13, wh1/15	N/A	N/A
104	vh2/15	wh1/14	N/A	N/A
105	vh2/04	wh1/03, wh1/16	N/A	N/A
106	vh2/05, vh2/17	N/A	N/A	N/A
110	vh2/06	wh1/04	wh2/03	wh/03[b]
111	vh2/08	wh1/05	wh2/05	wh/05, wh/06, wh/07, wh/09[b]
112	vh2/09	wh1/07	wh2/04, wh2/06	N/A
113	vh2/10	wh1/08	N/A	N/A
114	vh2/07	wh1/09	N/A	N/A
115	vh2/11	wh1/10	N/A	N/A
116	vh2/18, vh2/19	wh1/06	N/A	N/A
117	vh2/13	wh1/17, wh1/18	N/A	N/A
118	N/A	wh1/12	N/A	N/A
Wb51	N/A	wh1/11	N/A	N/A
Wb53	vh2/12	N/A	NPE[d]	wh/08[b]
Wb54	NPE	N/A	NPE	wh/08[b]
Wf51	NPE	NPE	N/A	N/A

a See Appendix 4 of MacKenzie and Moran (2004) for crosswalk to other nonforested and wetland units.

b Includes both the MHwh1 and MHwh2, which were lumped as MHwh in Klinka and Green (1994).

c Not applicable — site unit does not occur in the current classification for this biogeoclimatic unit presented in this guide.

d No previous equivalent — site unit did not occur in previous published classification for Haida Gwaii (Green and Klinka 1994).

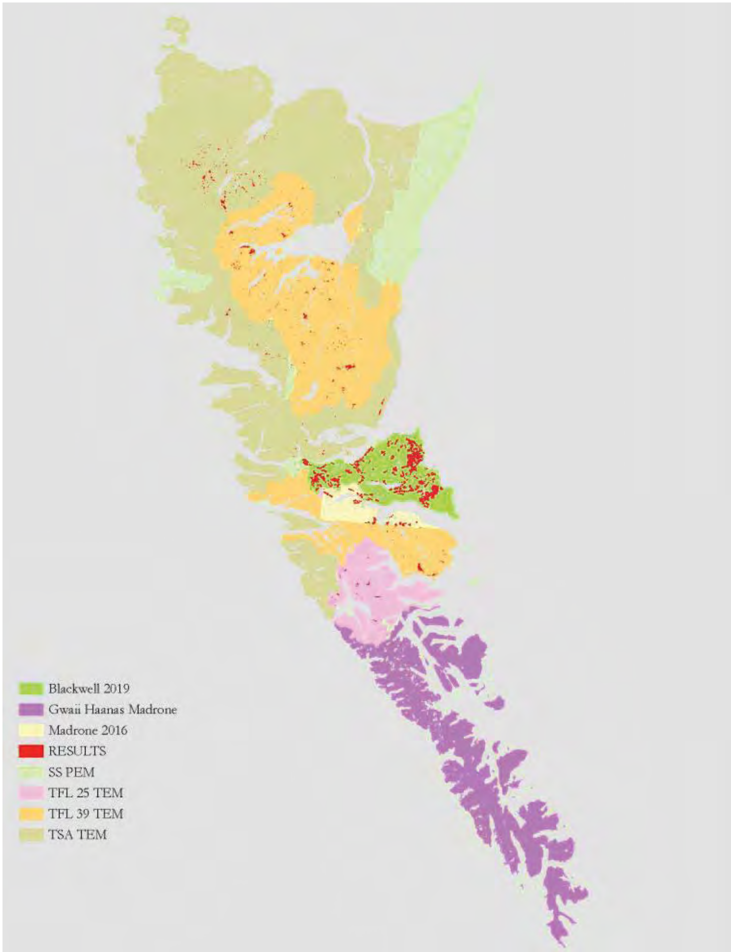

Figure 4.4. Ecosystem mapping sources used within this TSR

Chapter 5 Growth and Yield

5.1 Site Productivity

Site productivity, or the capacity of an area for growing trees, is often measured using site index. Site index (SI) is the average height in metres (m) that the tallest trees in a stand are expected to achieve at age 50 (e.g., a site index of 25 means that a site is expected to grow a stand to a height of 25 metres in 50 years).

SI is an important input for growth and yield models, which are used to project the estimated timber volume of different types of forest stands over time. Site index is a key input into the managed stand growth and yield model (TIPSY) and the natural stand growth and yield model (VDYP), discussed in detail in section 5.6 and 5.9 respectively.

Various methods can be used to estimate site index, including the growth intercept method, site index curve method, or Site Index by Biogeoclimatic Ecological Classification (SIBEC) (Mah & G.Nigh, 2015). Studies on Haida Gwaii[11] and throughout BC have demonstrated that inventory information from old-growth forests tends to under-estimate site productivity. This, in part, is because most trees in old stands, which tend to be uneven-aged and multi-layered, have grown under substantial competition and suppression, and often have broken tops. Therefore, it is important when generating growth and yield estimates for managed stands to use SIs that to the extent possible realistically reflect anticipated growth, rather than rely on inventory information on old forests to estimate site productivity.

For this timber supply analysis, the primary source of SIs was the SIBEC database, which is described in more detail below. Since ecosystem mapping is required to apply SIBEC, where ecosystem mapping is unavailable the SI from the provincial site productivity layer – also described below - was used.

5.1.1 SIBEC

The SIBEC project began in 1994 as scientists and foresters recognized strong correlations between site factors (e.g. temperature, soil moisture and nutrients) and site productivity. As a result, standards were developed in 1997 to develop estimates for site index for each ecosystem 'site series' for each BEC unit across the province, with a second version coming out in 2009 (B.C. Ministry of Forests and Range, 2009). SIBEC plots, which are $100m^2$ in size, are established in homogeneous site series with trees between 20-120 years of age, with site trees (healthy, largest trees in the plot) measured to estimate height at breast height age 50.

SIBEC approximations aim to report on the mean site index and standard error of the mean (if there are at least 7 plots)[12] by site series and tree species. Estimates are updated based upon the availability of new information that meets the SIBEC standards. The last publication for Haida Gwaii was in 2013 (MFLNRO, 2013).

During the TSR, forest mensuration field plots from a variety of sources were collated to increase the SIBEC samples for Haida Gwaii. One dataset was created by the Forest Analysis and Inventory Branch to amalgamate all forest mensuration plots from Haida Gwaii. This dataset, which is supplementary to the SIBEC dataset, consists of 685 field plots ranging from 1945-2016. The following projects were included:

- Growth Natural Permanent Plots (subjectively located)
- Research-based untreated control plots
- VRI Phase II (mature audit) 5-point clusters (PPSWR-based selection)

[11] (Hardy K. , 2005); (Hardy K. , Remeasurement of 2nd growth permanent sample plots on Moresby Island. Project Report SFM15-05., 2006); (Hardy K. , Queen Charlotte Islands stump-site index study, 2007)
[12] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/ecosystems/sibec

- Change Monitoring Inventory
- Silvicultural Treatment Program (discontinued)
- Intensive Forestry Program (discontinued)
- Research Branch Experimental Projects
- Site Index Adjustment Project

The TWG compiled these supplementary data, along with the SIBEC plots and additional Provincial research plot data[13] into one dataset. In this dataset, a total of 1,170 plots contained specific site index information and site series designation allowing for comparison of site index estimates from various sources. See appendix 2 for a detailed description of findings.

See section 5.4 below for the documented use of site index in the base case in this TSR.

5.2 Alternative sources of site index assignments to inventories

Site index can be estimated and spatially assigned using a number of methods. The following summarizes both the approach used for the base case, as well as methods considered but not applied. See appendix 3 for the evaluation of alternative sources of site index assignments.

Ecosystem mapping

Ecosystem mapping provides a direct link between field-based SIBEC estimates of productivity by site series and the spatial representation of those site series across the land base. While not all ecosystem mapping projects have been independently assessed for accuracy, all existing mapping is being used on the premise that it provides superior site productivity information compared to using site index derived from inventory attributes of old growth stands.

TSA TEM calibration study

The TSA TEM project had a final accuracy assessment completed in 2008 (Timberline Natural Resource Group, 2008), the result being that the product did not pass the Provincial standards for inclusion in the TSR. In 2011, through coordination with the FLNRORD Regional Ecologist (Dr. Andy MacKinnon), the accuracy assessment data was used to analyze error trends and make adjustments to the inventory (Ran, 2011). Error trends were calculated based on the site series proportions of the unbiased accuracy assessment plots sampled in the field. The following error trends were found:

a. CWHwh1: The TEM has over-mapped site series 01 and under-mapped site series 04 and 10. The TEM has also over-mapped site series 05 and 06;
b. CWHwh2: The TEM has over-mapped site series 01 and 03 but under-mapped 02 and 05;
c. CWHvh2: The TEM has over-mapped site series 01 and 04, but under-mapped site series 06, 07, and 13.

The resulting analysis was applied through a biophysical model, informed by an expert review[14], to adjust mainly the second and third deciles of the mapped TEM (no linework was adjusted) in order to utilize the mapping for the previous timber supply review. A 2011 review of the adjustment to the inventory specific to the Forest Management Land Base[15] showed a weighted average site index increase of 0.7 metres (TSR Joint Technical Working Group , 2012).

[13] Research plots include SIBEC data stored and managed using VPRO software,from P.Dykstra; and Ecoysystem Recovery Plots data from A.Banner.

[14] Model parameters were reviewed by ecologists Andy MacKinnon, Sari Saunders and Alan Banner.

[15] FMLB are those areas remaining after non-forest areas and areas not administered for forest management are excluded from the land base.

RESULTS
The Reporting Silviculture Updates and Land Status Tracking System (RESULTS) reports site index derived from silviculture surveys in the field. A variety of methods are acceptable under BC's Silviculture Survey Standards (MFLNRORD, 2018), which include growth intercept method, height-age reference curves, SIBEC and others. On Haida Gwaii, the majority (52%) of all site index estimates from RESULTS use the SIBEC method whereby a forester classifies a 'standard unit' (part of a harvest opening) based on BEC, and then refers to the published SIBEC estimates. However, since SIBEC estimates are updated over time with new information, the growth intercept method (using the in situ height and age of trees) is considered the most reliable. Site index in RESULTS was assigned using growth intercept on approximately 6,020 hectares on Haida Gwaii.

Provincial Site Productivity Layer (PSPL)
The Provincial Site Productivity Layer is a well-documented spatially explicit database that consists of site index for commercial tree species. Site indexes were derived primarily in one of two ways. The first is by linking published SIBEC estimates with an ecological map or a biophysical model (Cloverpoint, 2016). Ecological maps, such as TEM or Predictive Ecosystem Mapping (PEM) are used if they meet the Provincial protocols for accuracy assessments of ecosystem maps (D.Meidinger, 2003). The second approach is used if TEM/PEM is not available. In that case, a biophysical model is used to predict site index based on BEC zone, slope, aspect, elevation and climate variables (Nigh G. , 2012). The PSPL dataset has been validated using a variety of independent ground plots, such as Growth Natural Permanent Sample Plots and Vegetation Resources Inventory plots, comparing predicted and observed site index in order to provide a measure of confidence (Nigh & deJong, 2015). The PSPL dataset covers all of Haida Gwaii, using a biophysical model to derive site index in conjunction with the 'TFL 39' TEM data (linking SIBEC estimates to leading ecosystem type in TEM).

Site Index based on inventory attributes
Site Tools is a software platform for making site index calculations that was developed and made available through MFLNRORD[16]. It integrates site index models for 24 species throughout BC. The software benefits from four types of site index models including height-age models, growth intercept models, juvenile height growth models and species conversion models. Site Tools is incorporated into the Forest Analysis and Inventory Branch TASS, TIPSY and VDYP growth and yield programs. As a result, Site Tools calculations form the basis of site index attributes within the Vegetation Resource Inventory.

The problem with using inventory height and age as inputs to Site Tools (or any other SI generating application) is that for older stands in particular, those attributes may not reflect actual site potential given competition and damage to trees.

Paired plot studies
In the late 1990's, regional studies were conducted for a number of major commercial tree species to derive adjustments for old growth site indices. Paired plots were installed in old growth stands adjacent to logged and regenerated (LAR) stands of the same site type/productivity (Nussbaum, 1998). However, none of the adjustment equations are applicable to Haida Gwaii.

Site index adjustment (SIA) studies
A Site Index Adjustment study was completed in Haida Gwaii's TSA in 2010, involving sampling young stands between the age of 9-61 years old (Timberline Natural Resource Group Ltd., 2010). The primary objective of the study was to test a proprietary biophysical model to map site productivity across Haida Gwaii. The resulting site index adjustments were based on site index derived from field samples (young

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16 https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/growth-and-yield-modelling/site-index-tools-sitetools

spruce and hemlock in the TSA) and site index derived from the biophysical model. While the study report provided adjustment equations, expert review indicated that there was not a statistically significant relationship[17]. The results of the SIA were not applied in the Haida Gwaii base case.

Stump site index
The stump site index work was conducted by researchers from the Ministry of Forests and Range in 2005-2007 (Hardy K. , 2007). The work provided statistically valid site index adjustments for western hemlock and Sitka spruce stands on Haida Gwaii. Localized taper equations and existing cruise data were used to estimate tree heights from stumps, which were compared to site indexes measured from a regenerating stand. Statistically significant regression equations were developed by using a growth intercept method to estimate site index for spruce and hemlock in Logged-And-Recovered stands. While the sampling for the stump site index project was specific to what was then TFL 39 (now TFL 60), the findings have been considered applicable to the entire operating area of Haida Gwaii. The stump site index model uses the Vegetation Resource Inventory attributes of leading species and age as model parameters to derive site index. The accuracy of leading species has since been the subject of the Phase II VRI ground audits (Penner, 2018), resulting in relatively low agreement for hemlock and spruce leading stands[18]. In addition, the stump SI adjustments were broad-scale, that is, applied across Haida Gwaii. Therefore, localized SIBEC estimates applicable to site series were used in the timber supply analysis rather than stump site index adjustments.

5.3 Site Index application in the base case for managed stands

SIBEC applied through ecosystem mapping, as well as the Provincial Site Productivity Layer (PSPL) were used in the base case for existing and future managed stands (managed stands). Where ecosystem mapping was available, species composition from RESULTS was paired with SIBEC site indices for managed stands. Where there were gaps in the ecosystem mapping coverage, the Provincial Site Productivity Layer was used, in conjunction with VRI leading species[19]. The following table details the hectares of site index source used across the FMLB for the TSR for managed stands.

[17] Personal communication, Peter Ott, Senior Biometrician at Forests, Lands and Natural Resource Operations and Rural Development.
[18] The accuracy of species composition in VRI increases when the all species are considered (i.e not just leading species). The Phase II result had a 52% and 50% agreement between VRI attributes and field observations for western hemlock and Sitka spruce respectively.
[19] Note that PSPL filled gaps for generally low-productive/inoperable areas where ecosystem polygons were missing.

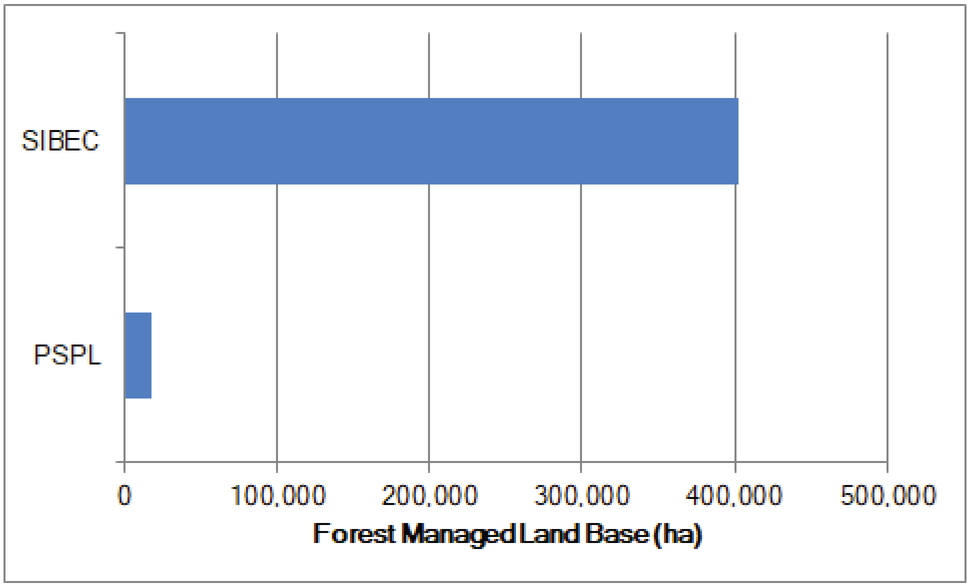


Figure 5.3.1 . Application of SIBEC vs. PSPL in the base case

SIBEC links ecosystem types (site series) to productivity based on field studies on Haida Gwaii. Ecosystem mapping delineates site series by complex polygons, whereby each polygon may represent between one and three different site series (represented as 'deciles'). As tree species grow at varying rates in different site series, assigning site index for each species components in a polygon is considered a reasonable way to estimate site productivity.

Where ecosystem mapping and species combinations produced units not otherwise represented in the SIBEC look up table, site indices were applied based on expert opinion (Dr. Allan Banner, ecologist) that considered site productivity of adjacent edatopic units within the same biogeoclimatic (BGC) variant[20].

The complete SIBEC look up table for this Timber Supply Review is shown in table 5.3.3. The following figures detail the site index by soil moisture regime (SMR) and soil nutrient regime (SNR) for the major commercial tree species and three main biogeoclimatic units within the THLB.

[20] See table 5.3.1, where *no. plots* is null.

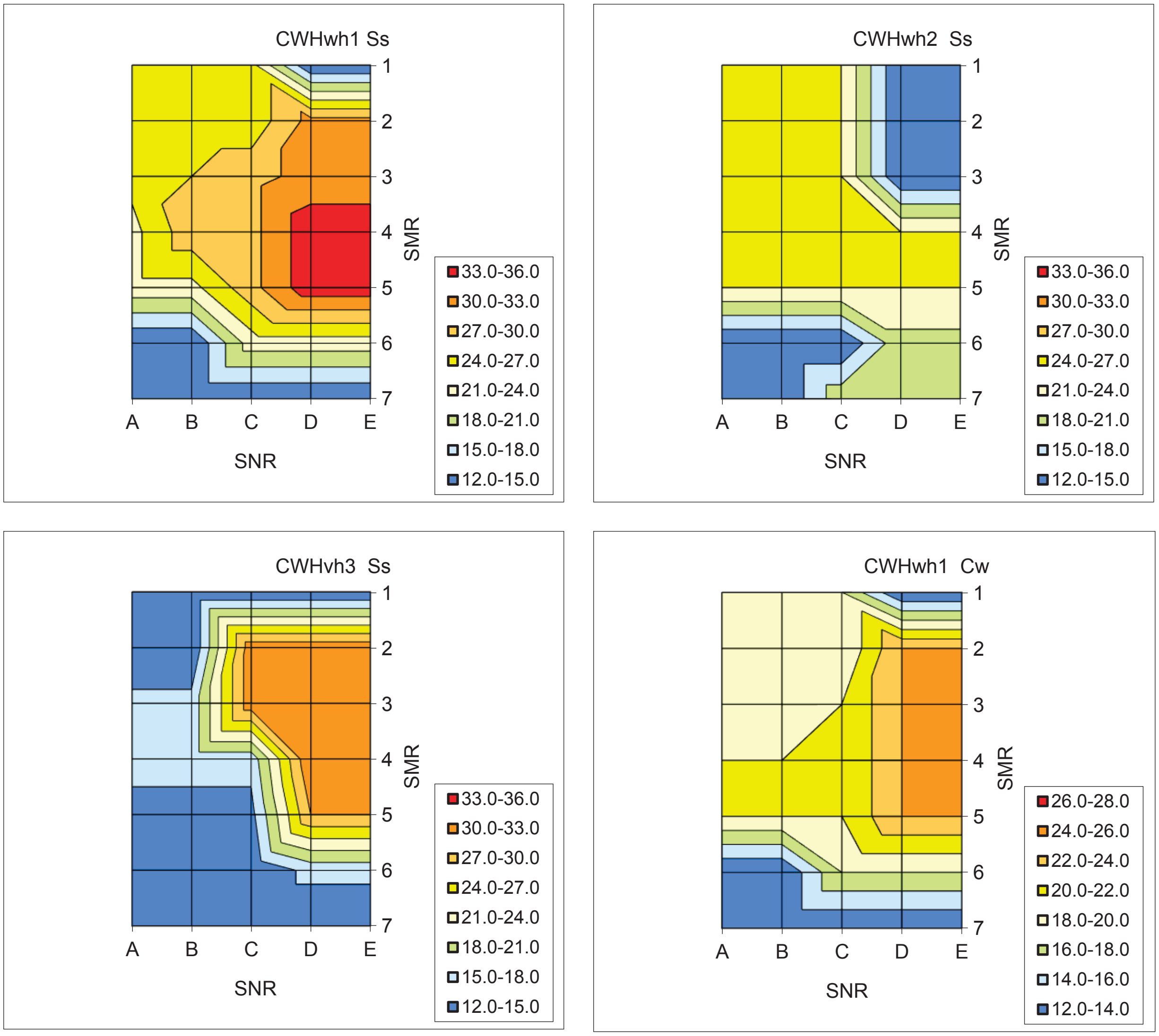


Figure 5.3.2Site index by soil moisture regime (SMR) and soil nutrient regime (SNR) for the major commercial tree species and three main biogeoclimatic units within the THLB

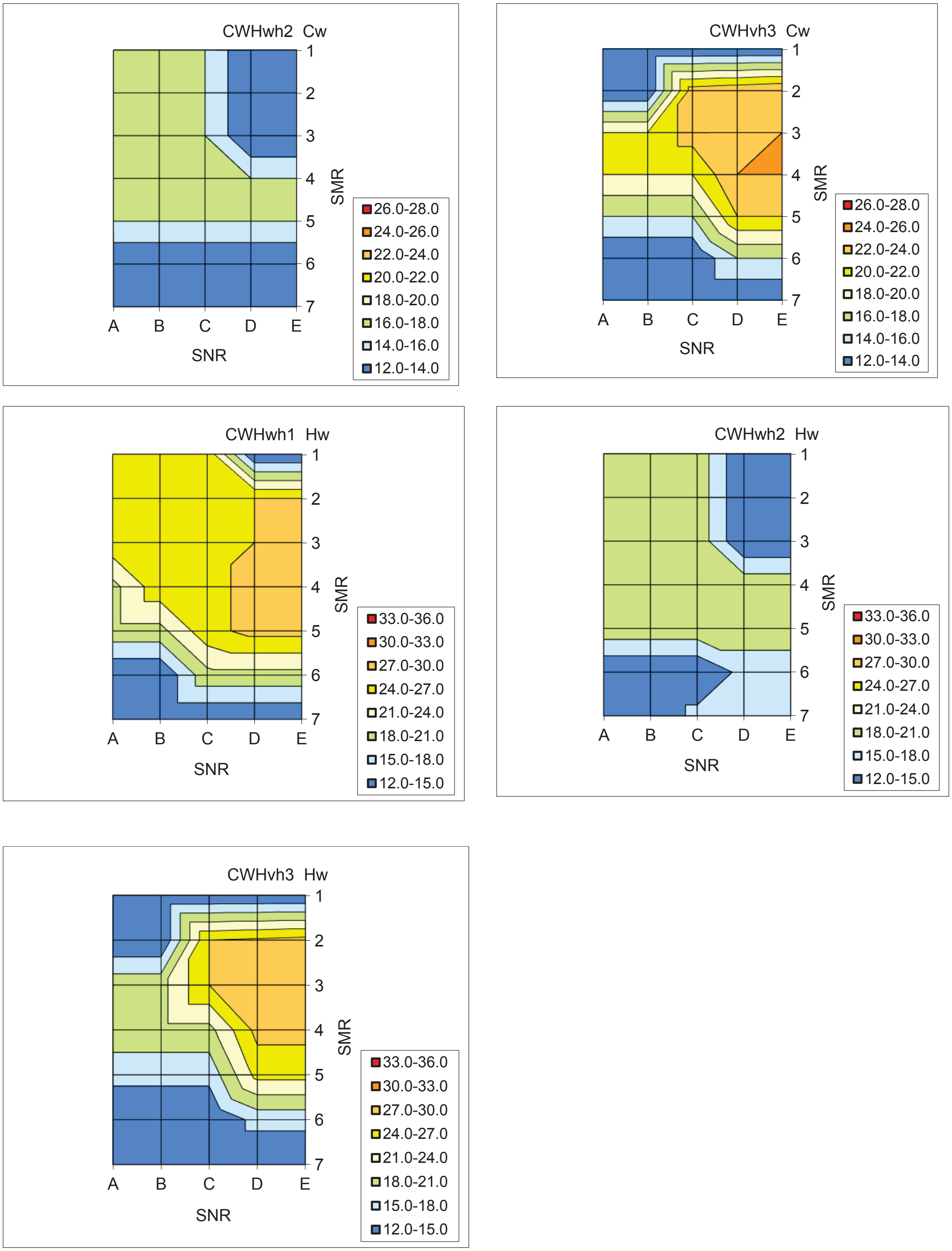


Figure 5.3.2Site index by soil moisture regime (SMR) and soil nutrient regime (SNR) for the major commercial tree species and three main biogeoclimatic units within the THLB (cont.)

Table 5.3.3. Enhanced SIBEC look up table (rounded) for species by site series.

BGC_Unit	*n* plots	Site Series	Cedar	Western Hemlock	Mountain Hemlock	Lodgepole Pine	Sitka spruce	Yellow cedar
CWHvh3		12	8			12		8
CWHvh3	2	11	12	12		16		12
CWHvh3		14	12	12			16	
CWHvh3		16	12	12			16	
CWHvh3	6	13	16	16			16	16
CWHvh3		15	16	16			20	
CWHvh3	2	3	16	16		16		16
CWHvh3	22	1	20	20		20	16	16
CWHvh3	9	8	24	24			32	
CWHvh3	41	7	22	25			30	
CWHvh3	143	4	23	27			32	
CWHvh3		17	24	28			32	
CWHvh3	17	5	24	28			32	
CWHvh3		9	24	28			32	
CWHvh3	70	6	24	28			33	
CWHwh1	4	11	8			12		8
CWHwh1		17	16				20	
CWHwh1	26	10	12	12		16	12	12
CWHwh1	2	13	12	12			16	
CWHwh1		15	12	12			16	
CWHwh1	8	12	16	16			16	
CWHwh1		14	16	16			20	
CWHwh1		4	20	20		20	23	
CWHwh1	21	6	20	24			29	
CWHwh1	132	2	18	26		20	25	
CWHwh1	156	1	20	26			29	
CWHwh1	7	16	24	27			30	
CWHwh1	152	3	24	27			31	
CWHwh1	84	5	24	28			35	
CWHwh1	2	7	24	28			32	
CWHwh1	2	8	24	28			32	
CWHwh2		5	8	8	8			8
CWHwh2		6	12	12	12		16	16
CWHwh2		2	16	16	16		16	16
CWHwh2	2	4	12	16			20	16
CWHwh2	13	1	16	20	16		24	16
CWHwh2	8	3	16	20			24	16
MHwh		2		8	8		8	8
MHwh		5		8	8		8	8

BGC_Unit	*n* plots	Site Series	Cedar	Western Hemlock	Mountain Hemlock	Lodgepole Pine	Sitka spruce	Yellow cedar
MHwh		6		8	8		8	8
MHwh		7		8	8		8	8
MHwh		9		8	8		8	8
MHwh		1		12	12		12	12
MHwh		3		12			12	12
MHwh		3		12	12		12	12
MHwh		4		12	12		12	12

5.4 Site Index application in the base case for natural stands

For natural stands (e.g. unmanaged stands), site index was sourced from the Vegetation Resource Inventory Phase I (adjusted) attributes. VRI does not use photo interpretation to estimate site index for stands greater than 30 years old (MSRM, 2002), but rather derives site index from inventory attributes using SiteTools within the VDYP7 growth and yield program.

Section 5.8.7 provides further a chart on the distribution of site index classes across the THLB.

5.5 Height-Age (site index) curves

Growth curves estimate stand attributes (primarily height over age) and are based on empirical field plots from a variety of growing conditions and species types. These mathematical models predict height from site index and age, based on how the species grows within ranges of nutrient availability.

The following summarizes the sources of site index models that were used for all stand types (unmanaged/natural stands, existing managed stands, future managed stands) based on TIPSY and VDYP7 to derive the growth and yield curves for the timber supply analysis[21]. Figure 5.5 summarizes the proportion of volume, by species and age class across the THLB to illustrate the importance of these various curves to timber supply.

[21] Some descriptions are sourced from *Site Tools 4.1*

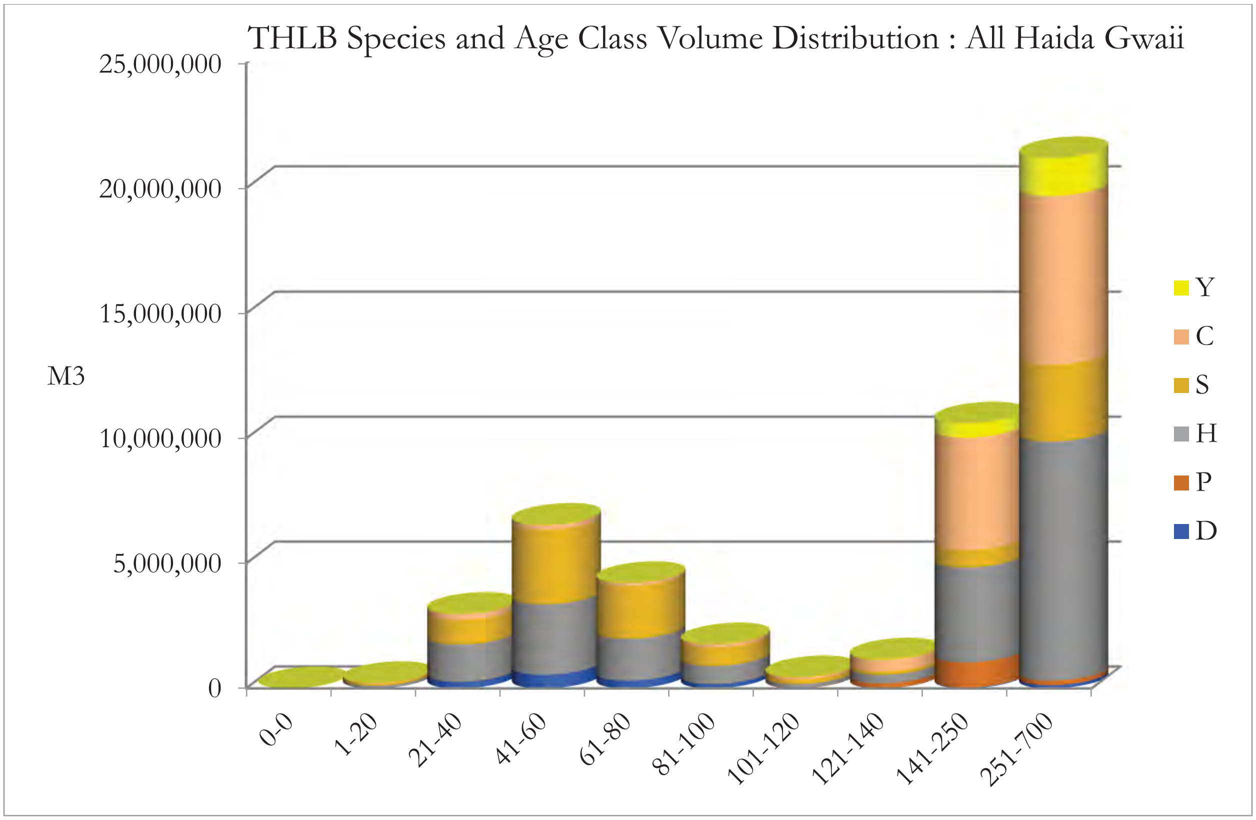
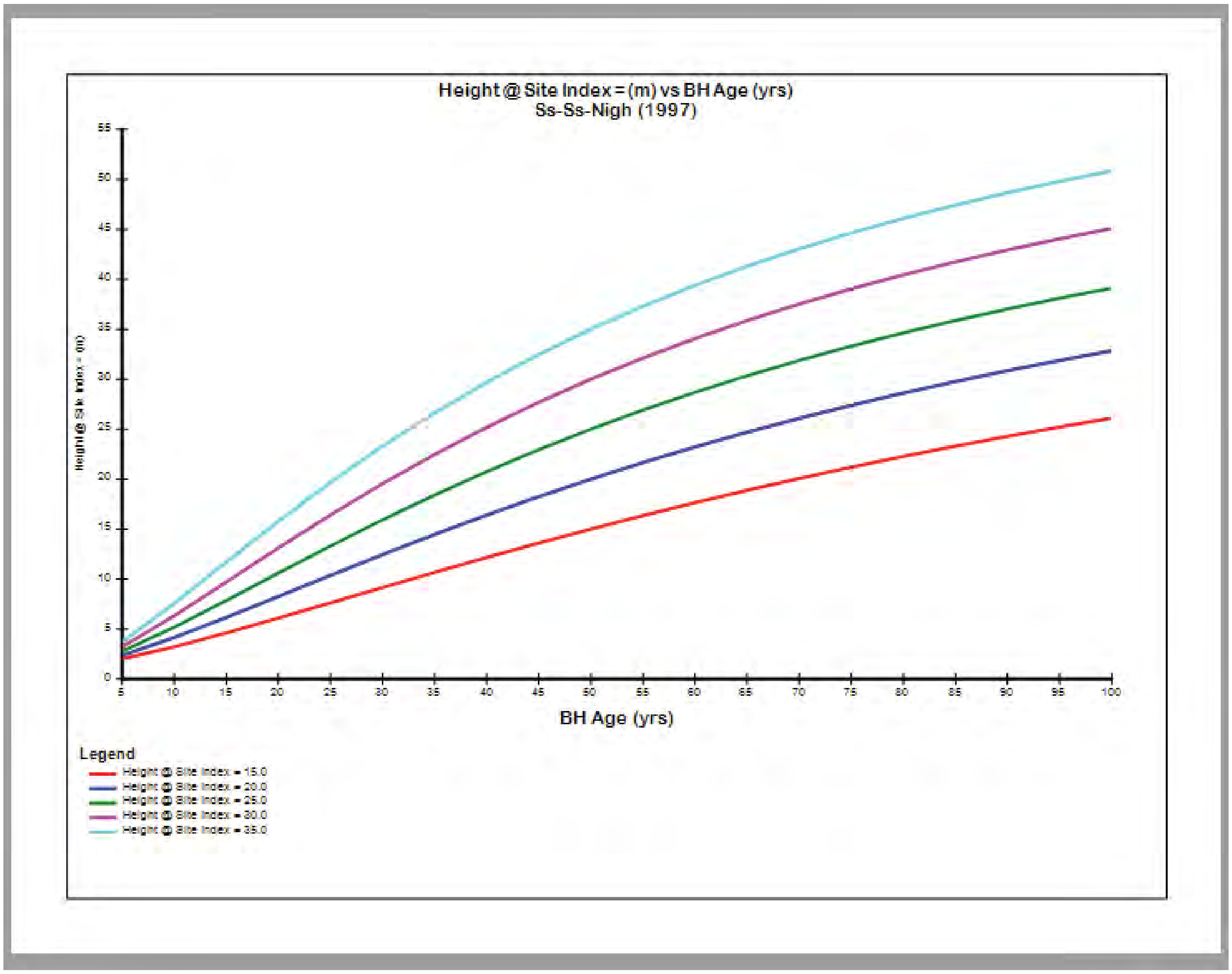


Figure 5.5 Volume distribution by species and age class within the THLB (Y= yellow cedar, C= red cedar, S= Sitka spruce, H= western hemlock, P=lodgepole pine, D= red alder).

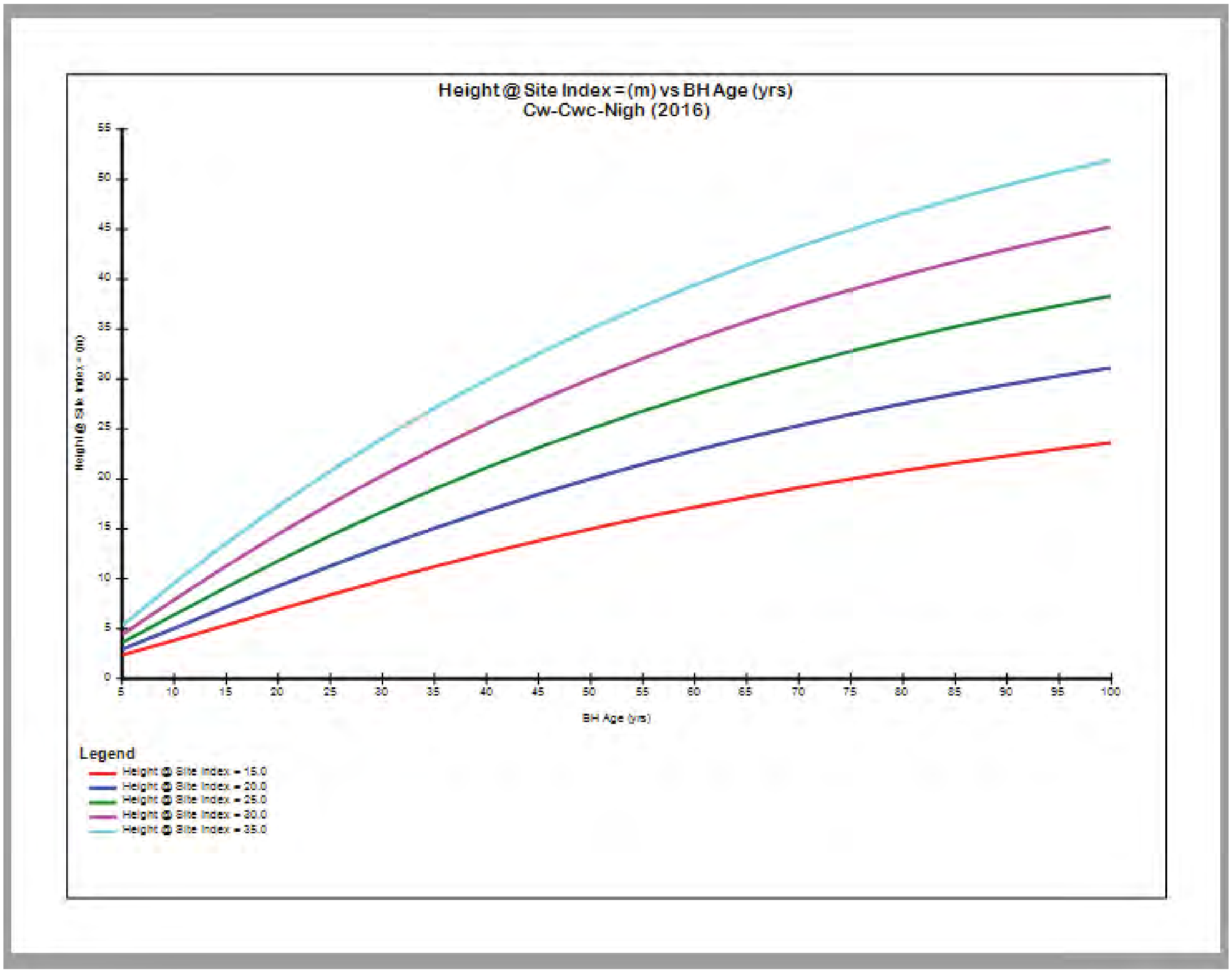
5.5.1 Sitka spruce

The primary purpose of this model is to estimate stand heights over time for immature Sitka spruce stands. The height-age (site index) curves for Sitka spruce were developed from 40 stem analysis plots established in edaphically uniform areas of Sitka spruce stands on Haida Gwaii (Nigh G. , 1997) and include revisions from newer growth intercept modelling techniques (Nigh G. , 1998). All plots were in the sub-montane wet hypermaritime Coastal Western Hemlock (CWHwh1) biogeoclimatic variant (Banner, et al., 2014). Plot ages ranged from 50 to 121 years at breast-height and site index from 13.6 to 40.3 m.



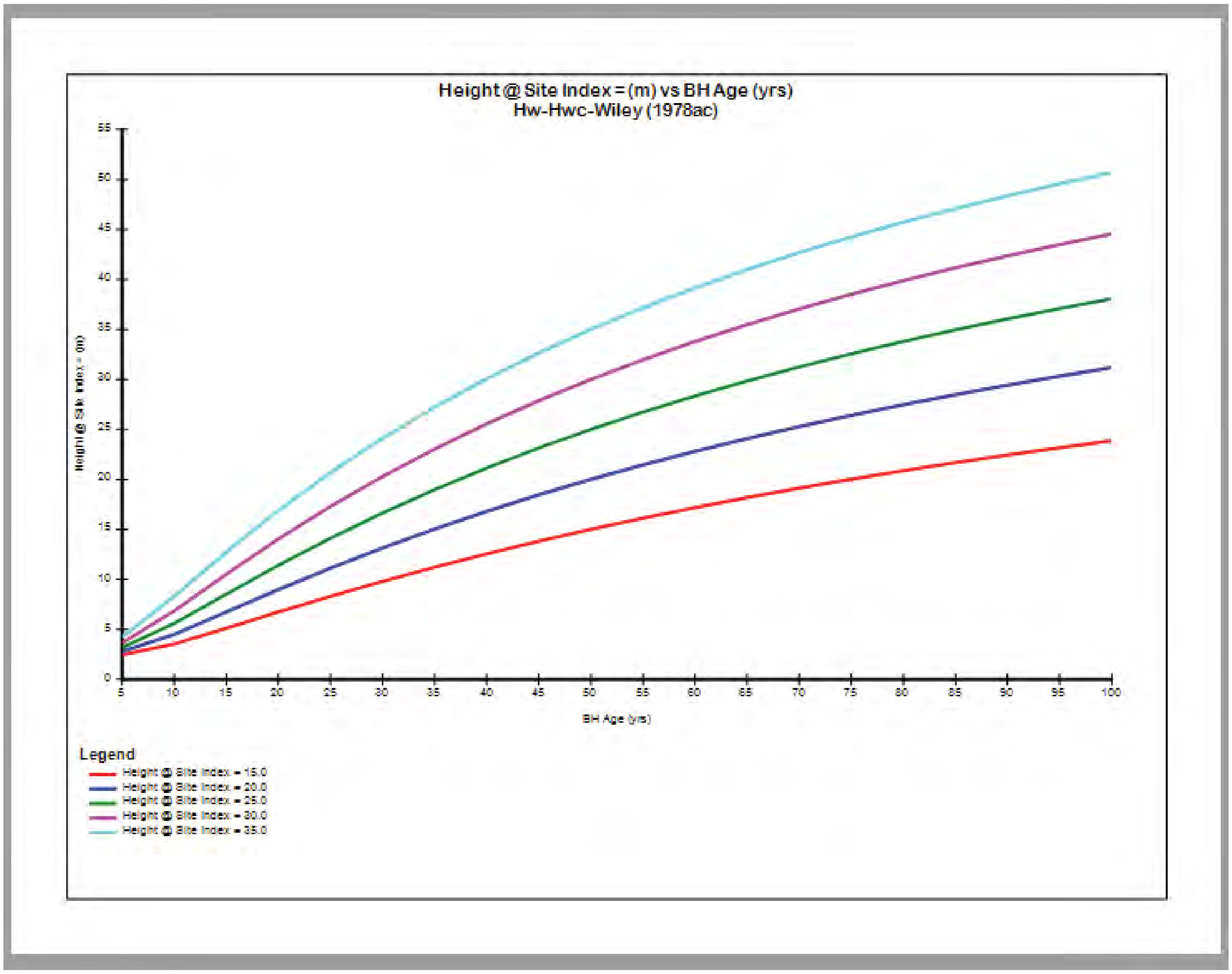
5.5.2 Western redcedar

An original site index model was developed for coastal western redcedar by MacMillan Bloedel Ltd in 1978 (Kurucz, 1978). This model used stem analysis from approximately 50 stands throughout Vancouver Island and the mid-coast and included trees ranging in age from 33-285 with site indices ranging from 10 to 40. In 2016, the Ministry of Forests, Lands and Natural Resource Operations updated the Western redcedar site index model to improve estimates of heights and site index predictions for old trees, and to use newer statistical techniques. In this case a "grounded-generalized algebraic difference approach was applied to a Chapman-Richards function to derive a base-age invariant site index model" (Nigh G. , 2016). The updated model used data from four sources, including the 1978 MacMillan Bloedel samples, as well as wood quality and foliar nutrient analysis samples from other coastal research projects. Note that there currently is not a height-age model for yellow cedar. As such, the Nigh (2016) curves are used for yellow cedar.



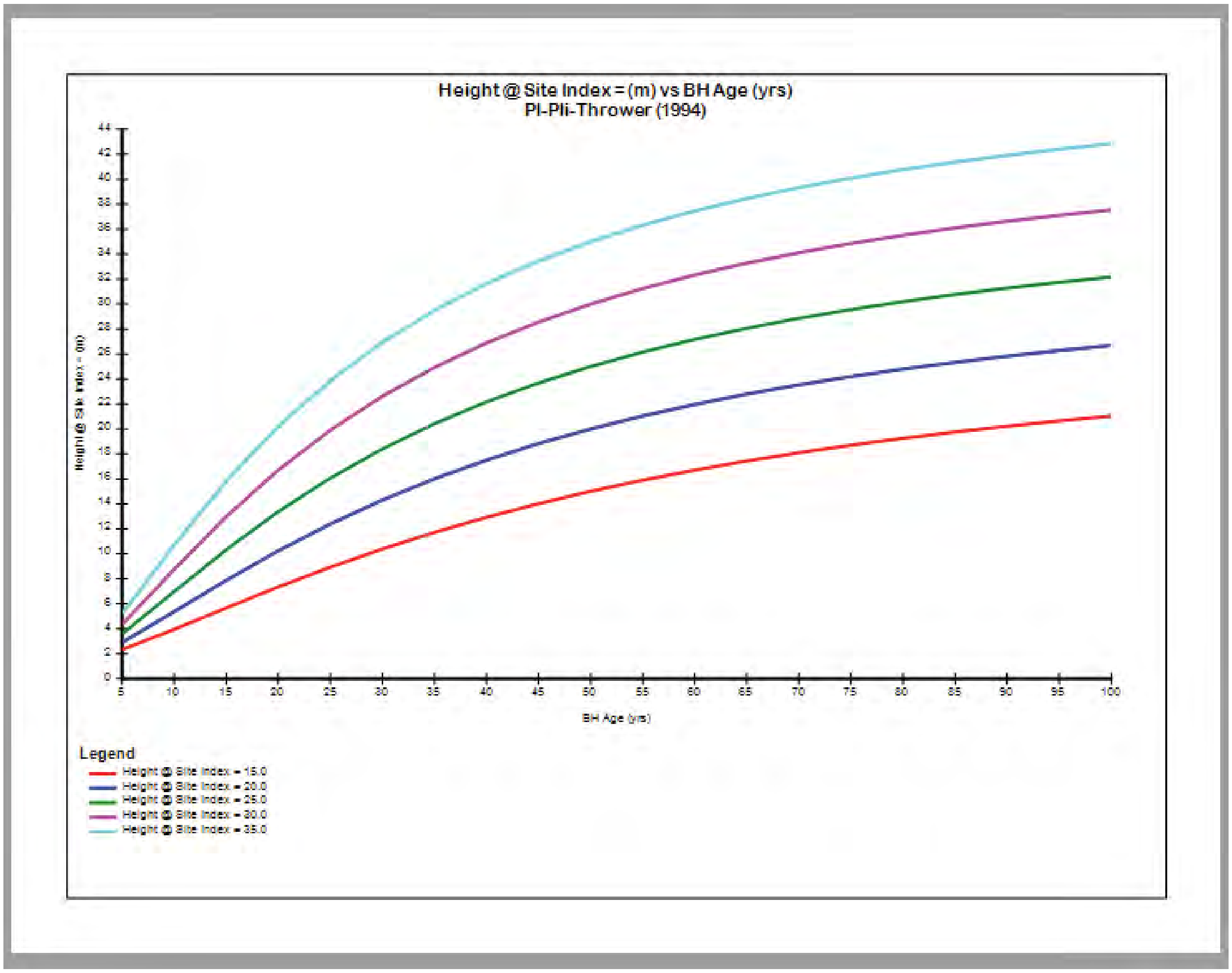
5.5.3 Western hemlock

The site index (height-age) curves were developed from stem analysis data collected from 90 plots in Washington and Oregon (Wiley, 1978). The plots ranged from site index 18 to 40m and from about 60 to 130 years breast-height age. MacMillan Bloedel Ltd. calibrated these curves to better represent the local growing conditions. Growth intercept curves were then developed from 46 stem analysis plots established in ecologically uniform areas throughout the CWH biogeoclimatic zone. Plot ages ranged from 50 to 173 years at breast-height and site index from 7.7 to 38.1m these models were updated to reflect changes in the growth intercept modelling technique (Nigh G. , 1999).



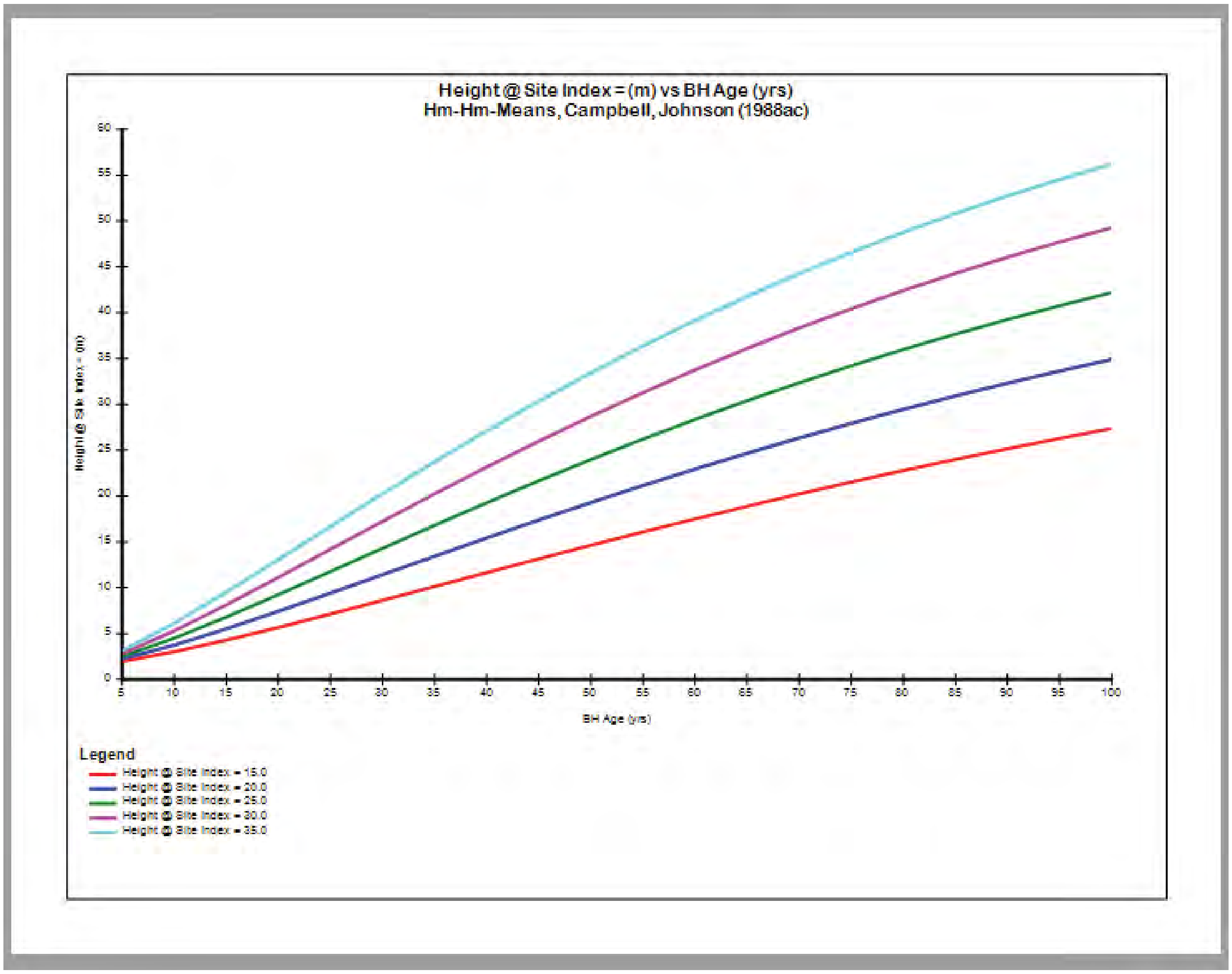
5.5.4 Lodgepole pine

The height-age models were developed from 106 plots established throughout the interior of British Columbia (Thrower, 1994). Ages ranged from 50 to 130 years at breast height. The site indices of the plots ranged from 6 to 27 m at breast height age 50. A years-to-breast-height model was also developed. These curves replace the ones by Goudie (1984) and utilize data collected in British Columbia.



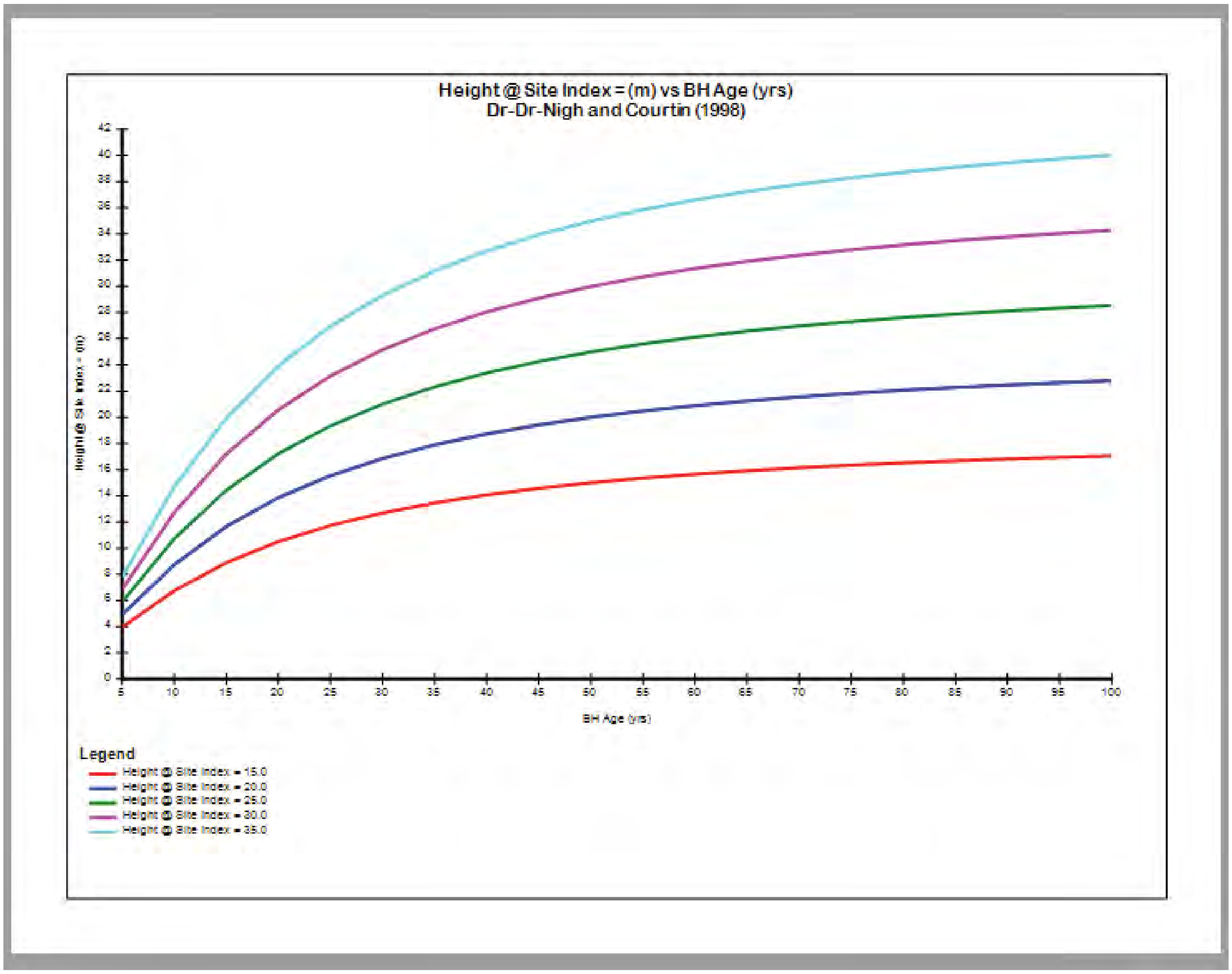
5.5.5 Mountain hemlock

The height-age curves for mountain hemlock were developed from 95 trees sampled in the Cascade Mountains in Washington and Oregon (Means, Campbell, & Johnson, 1988). The stands from which the trees were sampled were unmanaged, and the trees were dominant or co-dominant with no signs of stem breakage or suppression. Most of the sample trees were between 150 and 350 years of age and the site index ranged from 3 to 15m (mean 8m). The years-to-breast-height function for coastal western hemlock is being used for mountain hemlock.



5.5.6 Red alder

The height-age equation was developed from stem analysis of 30-0.04 hectare plots from natural red alder stands in the CWH biogeoclimatic zone in British Columbia (Nigh & Courtin, 1998). Breast height ages ranged up to 54 years and site index ranged from about 15 to 28 m. Conversions from a breast height age 25 site index to a breast height age 50 site index are derived from the height-age model.



5.6 Existing and Future Managed Stand Analysis Units - TIPSY inputs

The following section describes the inputs for modelling growth and yield for existing and future managed stand analysis units. A description of existing unmanaged (natural) stands is provided in section 5.8. Inputs such as species composition, site index and densities of spatially delineated stands are run through the *Table Interpolation Program for Stand Yields* (TIPSY). TIPSY is a growth and yield program that reports managed stand yield tables generated by the *Tree and Stand Simulator* (TASS) program (Di Lucca, 1999), which in turn is based on over 15,000 Permanent Sample Plot measurements throughout BC. Growth projections are based upon pure (single species) even-aged stands. Growth for multiple species stands (e.g., the majority of Haida Gwaii stands) are not biologically modelled in TASS (e.g., interspecies interactions are not accounted for), but growth is prorated based upon species composition and site index. TIPSY reports growth curves, starting at age zero, for each spatial unit used in the timber supply analysis.

For this timber supply analysis two separate sets of growth and yield curves were generated for existing and future managed stands (collectively referred to as *managed stands*). A total of 4,542 curves were generated for existing stand analysis units, and a total of 807 curves were generated for future managed stand analysis units (see descriptions below).

Figure 5.6.1 is a conceptual diagram of key inputs that go into TIPSY for existing and future managed stands.

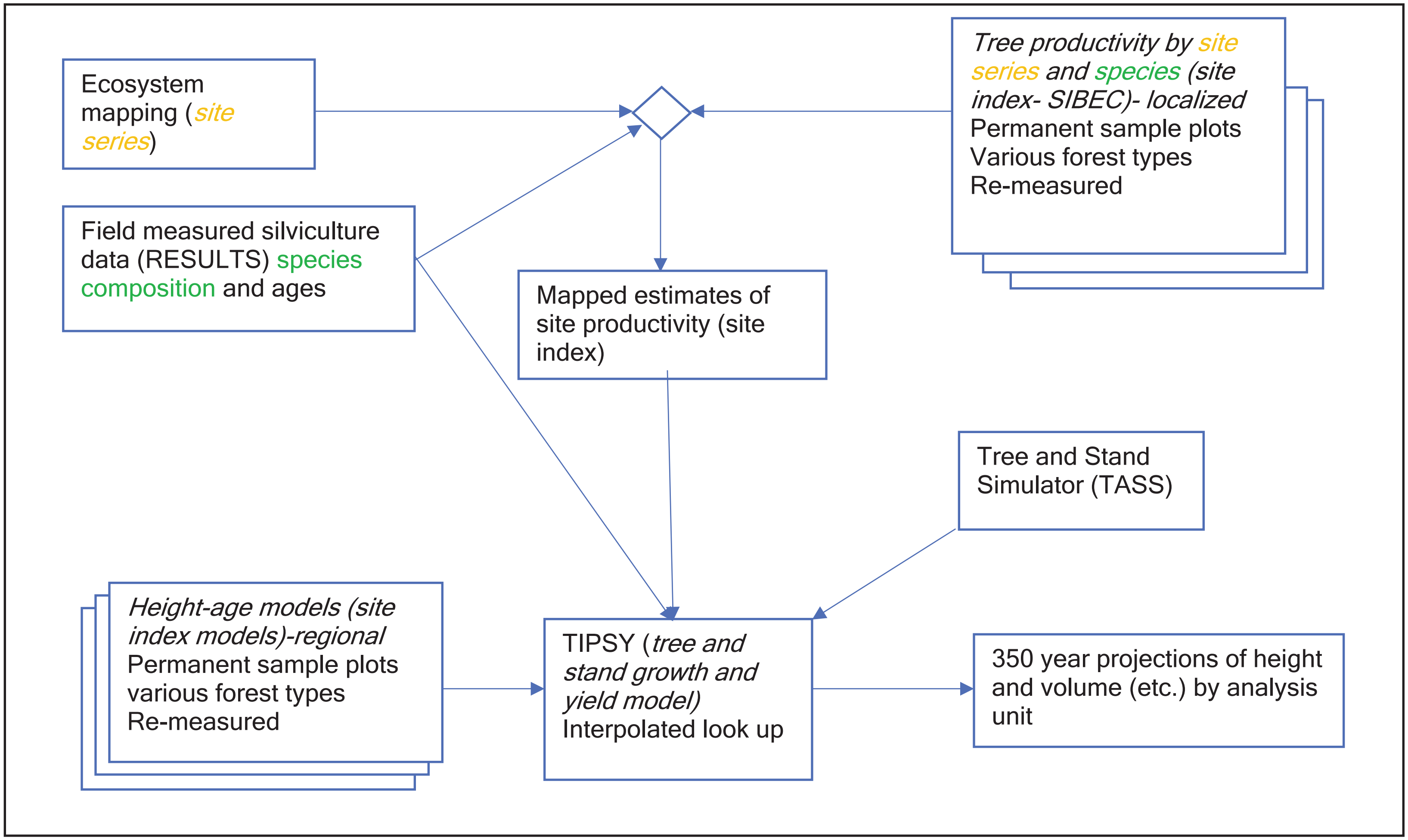


Figure 5.6.1 Conceptual diagram of key inputs and sources into the growth and yield model *TIPSY* for this TSR

The source of both the existing and future managed stand inputs into TIPSY for age, species composition, site series (linked to SIBEC site index) and density is the RESULTS forest cover silviculture layer (WHSE_FOREST_TENURE.RSLT_FCSLV dataset (Resource Practices Branch, 2017)). RESULTS silviculture records can date back to 1987, when the requirement for silviculture prescriptions was legislated[22]. Haida Gwaii digital spatial silviculture records go back to 1991 and include 39,426 hectares (up to 2017) of existing managed stand data. Each individual standard unit (with site specific silviculture classifications and prescriptions for site series and stocking) forms the basis of inputs for existing managed stand analysis units. Future managed stands use the attributes from RESULTS averaged to the site series. Together there are 5,349 managed stand yield curves for this TSR. All stands established after 1986, but without RESULTS silviculture records, are regenerated on TIPSY future managed stand curves. The inputs for existing and future managed stands are the same unless otherwise noted in this section.

5.6.1 Species composition

Existing Managed Stands (EMS)

All species composition data (up to 5 species) are sourced from RESULTS. Units are at the Standard Unit scale, which is the unit delineated during a silviculture prescription. VRI standards also incorporate RESULTS silviculture data, however data are generalized to the block, or Feature ID scale. Using the Standard Unit scale was preferable to using the Feature ID scale (blended block) for the following reasons:

- Blocks have a variety of Standard Units, each may be a separate ecosystem (site series) with different species compositions and productivity.
- In the CHWwh1 Queen Charlotte Lowlands ecosection, Cw-Hw salal-deer fern sites (04 or 110) are often a secondary ecosystem to zonal sites. Generalizing species composition to the zonal site would misrepresent (e.g., underestimate) cedar composition by leaving out the 04 site series. Given the importance of quantifying cedar stocks for this TSR, a higher resolution product was considered the best available data.
- Maintaining the Standard Units provides a closer representation of what is in the field. The use of Batch TIPSY software facilitates an increased number of growth curves enabled by higher resolution data sets.

The existing managed stands were comprised of a total of 4,542 units from RESULTS (e.g., 4,542 separate growth curves).

Future Managed Stands (FMS)

TSR analyses sometimes assume that future managed stands will have the same species composition as current unmanaged forest inventory. For this timber supply analysis, FMS species composition was based on data that are sourced from the WHSE_FOREST_TENURE.RSLT_FCSLV dataset (Resource Practices Branch, 2017) and has been compiled to provide estimates for inputs into TIPSY. An analysis was completed to determine what the species composition was, by site series, in second growth stands, based on the time a stand was declared as free growing. Free growing stems (FGS) are a subset of well-spaced trees that are not constrained by the competition from shrubs or other trees, meet a well-spaced definition, and meet the requirements for free growing height (Resource Practices Branch, 2016). Free growing stems best correlates with ‘crop trees’ (pers. com. Craig Wickland, RPF, section head- Forest Stewardship Branch, MFLNRORD).

A weighted area analysis by species and site series only included records where the reference year (REF_YR) was after the year 2009. This was to acknowledge the change in the HG Forest District cedar policy in 1995 and 1998 where minimum stocking standards were required. Major licensees began planting to the new standards in the spring of 1999 (pers. com. Ken Briggs, RFT), and free growing takes between 8-12 years from the date of planting (therefore the reference year was set to 2009).

[22] *Bill 70- Forest Amendment Act No. 2, 1987*

Based upon expert review (K.Briggs, RFT and Mark Salzl, RPF) it was concluded that the main change in stocking standards after both the 1998 District policy change and the 2011 LUOO was for zonal site series in the CWHwh1. In this case it is anticipated that FGS for western redcedar (Cw) will be between 200-225 SPH, from a total of 700-800 FGS (approximately 25-32% Cw content). To account for this adjustment, the RESULTS species composition was pro-rated (species were proportionately reduced) to account for the increase in Cw, however to remain pre-cautionary about the degree to which cedar will become established, the lower FGS estimate (25%) was used. This assumption is in part underwritten by Haida Gwaii Natural Resource District planting records (RESULTS) that show the proportion of the total planted for redcedar ranged from 25% in both 1988-1995 (pre-district cedar policy), and 1995-2011 (post- district cedar policy), to 28% from 2012-2017 (post-LUOO), see figure 5.6.2. This small increase may be concentrated within the CWHwh1 zonal site series (as suggested by licensee silviculturalists).

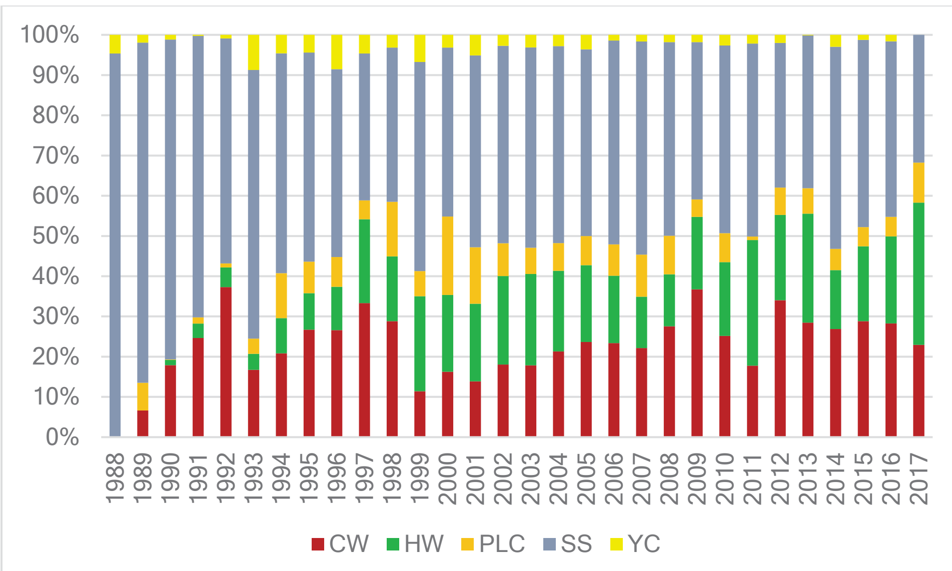


Figure 5.6.2 . Proportion of planted species from 1988-2017 on Haida Gwaii

Shifts in species composition over a rotation period is a legitimate concern. Western redcedar is of specific interest during this TSR and given the higher site index for western hemlock in the most common cedar-leading stands, managers (and modellers) would like to know how much species composition changes between 'initial condition' and harvest. A composition change analysis was conducted with 65 Permanent Sample Plots (PSPs) where re-measurement data existed for leading western redcedar stands. The percent change (±) in composition was calculated between first and last measure (earliest from 1964, latest from 2012). The results were that 90% of the Cw leading species within the plots changed by ±8.46% over the course of the re-measurements (with Cw remaining as a leading species). The average change in leading species (Cw) composition between initial measurement and last re-measurement within the plots was 2.5%. The average time between re-measures for this dataset was 18 years (min 5, max 41 years) which suggests that leading species composition (for pole sapling to understory re-initiation succession) does not change significantly over this period.

Where there were gaps in the ecosystem mapping coverage with RESULTS, the PSPL was used in conjunction with VRI leading species.

Table 5.6.3 Future managed stand species proportion (%) and density (sph) inputs into TIPSY

Site Series	Cw	Hw	Hm	Ss	Yc	Pl	Dr	Free Growing density
CWHwh1 01	25	44		29		1		1315
CWHwh1 02	32	51				17		835
CWHwh1 03	3	44		49			3	1840
CWHwh1 04	33	51		3	1	11		1107
CWHwh1 05	4	34		54		1	7	1251
CWHwh1 06	15	46		34	3	2		817
CWHwh1 10	35	51		2	1	11		1021
CWHwh1 11	33	28				39		375
CWHwh2 01	2	62	2	33	1			1172
CWHwh2 02	9	72	2	11	5			1090
CWHwh2 03	2	50		48	1			1398
CWHwh2 04	4	51	1	41	4			1035
CWHwh2 05	11	57	7	1	13	11		720
CWHwh2 06	11	66		17	4		1	1121
CWHvh2 01	21	59	1	14	5			975
CWHvh2 03	27	66		1	6			907
CWHvh2 04	6	45	48				1	2003
CWHvh2 05	6	53		42				748
CWHvh2 06	7	42		51				802
CWHvh2 07	2	60		38				580
CWHvh2 11	14	55		26	5			856
MHwh 01		34	31	35				907
MHwh 02					100			494
MHwh 03		85	15					1107
MHwh 04		34	31	35				1107
MHwh 05	50		13	25	12			1107
MHwh 06	50		13	25	12			984
MHwh 07	50		13	25	12			1107
MHwh 09	50		13	25	12			984

5.6.2 Site Index

Site index was derived from the enhanced SIBEC table and the Provincial Site Productivity Layer, as described in section 5.3. Site index was assigned to each species component therefore site index conversion equations were not used[23].

5.6.3 Regeneration method

Not all stems that reach free growing are from planted stock, as natural regeneration is a common and important part of silviculture strategies. An analysis of 933 opening ID's using RESULTS planting records[24] compared planted stems (initial establishment) to free growing stems. In Figure 5.6.3 points to the left of the diagonal reference line represent opening IDs in which there are more trees in the free growing surveys than were planted. This difference is a result of natural ingress. TIPSY however does not provide an option to initiate a curve with planted *and* natural stock. While there is some modelling uncertainty introduced, it was considered reasonable for all existing and future managed stands to be treated as *planted* within TIPSY for the base case.

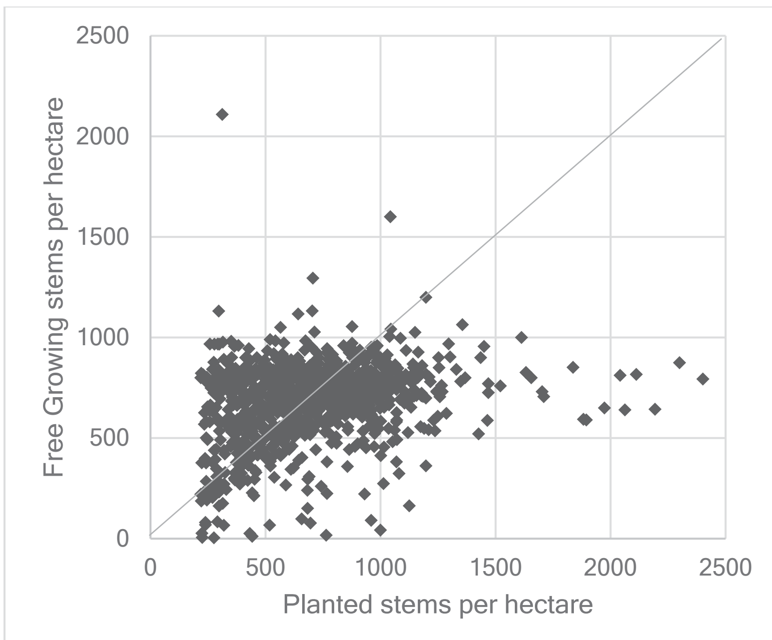


Figure 5.6.3 Planted versus free growing stems per hectare for 933 opening IDs (90th percentile of all openings with planting and free growing records).

5.6.4 Utilization limit

Utilization limit, also known as merchantability limits, defines the minimum diameter at breast height that a tree must achieve to be included in TIPSY stand attributes reports. For this TSR, utilization limits are 12.5 cm, which is the minimum diameter that stumpage is applied to second growth stands in B.C., as outlined in the Coast Merchantability Specification of the Provincial Logging Residue and Waste Procedures Manual (Timber Pricing Branch, 2018).

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[23] Site index conversion equations are often used for stands with multiple-species to predict the site index of an additional (e.g. secondary, etc.) species through statistical regression based on the site index of a reference species with a known site index.

[24] Haida Gwaii Natural Resource District planted trees tracked in RESULTS, sourced from Mei-Ching Tsoi, Oct 30, 2017.

5.6.5 Operational Adjustment Factor 1[25] (OAF1)

OAF1 is designed to capture gaps or non-uniformity of stands as they reach harvest age. OAF1 is a constant multiplier applied uniformly at all ages. The ministry default is 0.85, which was used for this analysis (assumes that 15% of the area of a stand is not occupied by commercial trees). OAF1 is used to reduce yields for various abiotic and biotic factors not accounted for in the data that underlie TIPSY. Small, unmapped non-productive area (NP, e.g., rock and wetland) is normally the dominant abiotic factor, but it can also include weather-related stocking loss (e.g., wind, snow, ice). Biotic factors include competition-related stocking gaps on otherwise productive ground, e.g., growing space occupied by non-commercial species or brush, and other endemic losses, e.g., forest health impacts, etc.

5.6.6 Operational Adjustment Factor 2[26] (OAF2)

OAF2 is a progressive multiplier; the value and impact increases with age. The ministry default is 0.95, which was used for this analysis (5% loss at 100 years). The default is generally assumed to account for merchantable volume losses due to decay, waste, and breakage (DWB). However, OAF2 can also be used for endemic biotic factors (e.g., forest health impacts) with yield effects that increase over time.

An OAF2 value is indexed to age 100, such that its specified value (e.g., 0.95) equals its yield impact at age 100. The impact increases by a constant amount per year ((1-OAF2)/100 yrs) reaching the specified value at age 100 and continues increasing by the same percentage per year thereafter. For example, for an OAF2 of 0.90, yields are multiplied by 0.999 at age 1, 0.95 at age 50, 0.90 at age 100 (the index year), and 0.80 at age 200, etc.

Young Stand Monitoring plot results indicated that tree-level forest health factors affected 7% of live trees (not including windthrow[27] or forks/crooks), including 1% for dwarf mistletoe (western hemlock), 1% broken tops, 2% logging wounds and 3% unknown damage (DeJong, 2017b). Not all of these forest health factors will affect merchantable volume (DWB). Similarly, a review of 10 years (2008-2017) of blocks from the Harvest Billings System second growth blocks (*n*=175) listed avoidable waste as 8.4% of total volume scaled. This is slightly higher than the OAF2 applied, however is reasonable when considered in tandem with both OAFs (e.g., 20% reduction).

See sections 4.1.3 and 5.8.5 for a description of decay, waste and taper inputs for unmanaged/natural stands in this timber supply analysis.

5.6.7 Regeneration Delay

Regen delay is the number of years from disturbance (e.g. harvesting) to the beginning of the stand establishment period. For all planted stands the default used in this timber supply analysis was 1 year, which assumes all stands are planted 1 year after logging. Note that planted stock assumes 1-year old stock, effectively moving the regeneration delay to zero.

5.6.8 Genetic worth

Genetic worth is an indication of the quality of genetically improved seed, as represented by a percentage volume increase expected near harvest age. The MFLNRORD's Forest Genetics Program develops genetically improved seed through selective breeding programs of seed collected from superior natural (wild) trees. The Seed Planting and Registry System (SPAR) tracks seedlot information used within different Natural Resource Districts across the province and includes information on genetic worth (by seed class) and selection age.

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[25] sourced from TIPSY 4.4

[26] (sourced from TIPSY 4.4)

[27] Note that windthrow is treated as a natural disturbance factor as described in section 7.4.

An analysis of the genetic worth of seedlings from the SPAR system for the Haida Gwaii Natural Resource District is provided below. The weighted average of select seed used (from which genetic gain is estimated) over a 15-year period on Haida Gwaii amounts to 71% of all seed. Of that select seed, the majority has a genetic worth of 2% (SPWR003(v2), 2018). When accounting for the weighted average (select seed vs. non-select seed) genetic worth for each species over that 15-year period, Cw has 2.06%, Hw has 1.99% and Ss has 1.4% genetic gain, with a total weighted-average (all species) of 1.8%. Accounting for the proportion of select seed (71%) this lowers the genetic worth to 1.27%. In a similar analysis, the Haida Gwaii Young Stand Monitoring project found that 50% of its randomly established plots (post 1987) were made up of natural stands (DeJong, 2017b). The uncertainty of planted crop trees *versus* natural crop trees at harvest age further dilutes the confidence in increased genetic gain. As such, genetic gain was not included in TIPSY growth curves.

5.6.9 Stock height

Planted tree stock heights used in this timber supply analysis are defaults used within TIPSY, which in turn are sourced from Forest Practices Branch (1998). All stock ages are assumed to be 1-year old.

Table 5.6.9. Planted tree stock heights used in TIPSY. Note bold heights have been weighted by the planting frequency of different stock types (e.g, PSB415B, PSB 410, BSB 313B, PSB/PCT 415B).

Species	Stock heights (cm)
Western hemlock	**22**
Western redcedar	**27**
Sitka spruce	26
Yellow cedar	27
Lodgepole pine	**13**
Mountain hemlock	22

5.6.10 Density

Density is the initial stocking condition in the TIPSY model, in other words the number of established trees within the stand expressed in stems per hectare (SPH). RESULTS silviculture planting data and free growing data from silviculture surveys was summarized by BEC site series. Stands are typically a mix of natural and planted trees, whereby planted stocking targets range between a minimum of 500 stems per hectare to a maximum of 900 stems per hectare (Taan Forest Ltd & Limited Partnership, 2018), but may be as low as 200-400 SPH on very wet sites. Free growing surveys are a measure of well-spaced trees that are anticipated to become crop trees (Resource Practices Branch, 2018). Free growing is a requirement under section 97(7) of the *Forest Planning and Practices Regulation*, including declaration of a regeneration date. Regeneration is qualified by a site-specific strategy (species composition, heights and SPH). Competition pressures from naturals (e.g. western hemlock) are often highest ahead of free growing. Therefore, data from free growing surveys is a more useful indicator of species composition than planting data as trees move into older successional stages (e.g. pole sapling). However free growing surveys tend to occur between 8-12 years after the initial stocking condition.

To account for this, free growing survey SPH was compared to TIPSY SPH (initial condition) at age 10 for zonal sites for the CWHwh1, CWHwh2, CWHvh3 and MHwh. The objective was to determine what TIPSY density input (initial condition) would produce outcomes closest to the RESULTS free growing numbers at age 10 for zonal sites for all BEC zones on Haida Gwaii.

For example, the weighted-area average density for zonal (01 or 101) site series within the CWHwh1 is 1315 SPH at free growing. An adjustment factor of 1.22 in TIPSY (1315 x 1.22) sets an initial condition (age 0) of 1604 SPH in TIPSY, coming closest to the 1315 target at age 10 (due to the reverse J-Curve theory of diminishing stems over time). Table 5.6.10 lists the density adjustment factors applied to the RESULTS-based density figures. Note that table 5.6.1 provides the RESULTS density figures by site series that were inputs into TIPSY.

Table 5.6.10. Density adjustment factors applied to RESULTS free growing stems per hectare data to set initial (stocking) condition in TIPSY

BEC zone	Density adjustment factor
CWHwh1	1.22
CWHwh2	1.19
CWHvh2	1.23
MHwh	1.23

Note that TIPSY does not allow for initial densities to be lower than 494 SPH, therefore a limited number of records were adjusted to meet this criterion.
Where there were gaps in the ecosystem mapping coverage, and PSPL was used, the density was set to TIPSY default of 1600 stems per hectare.

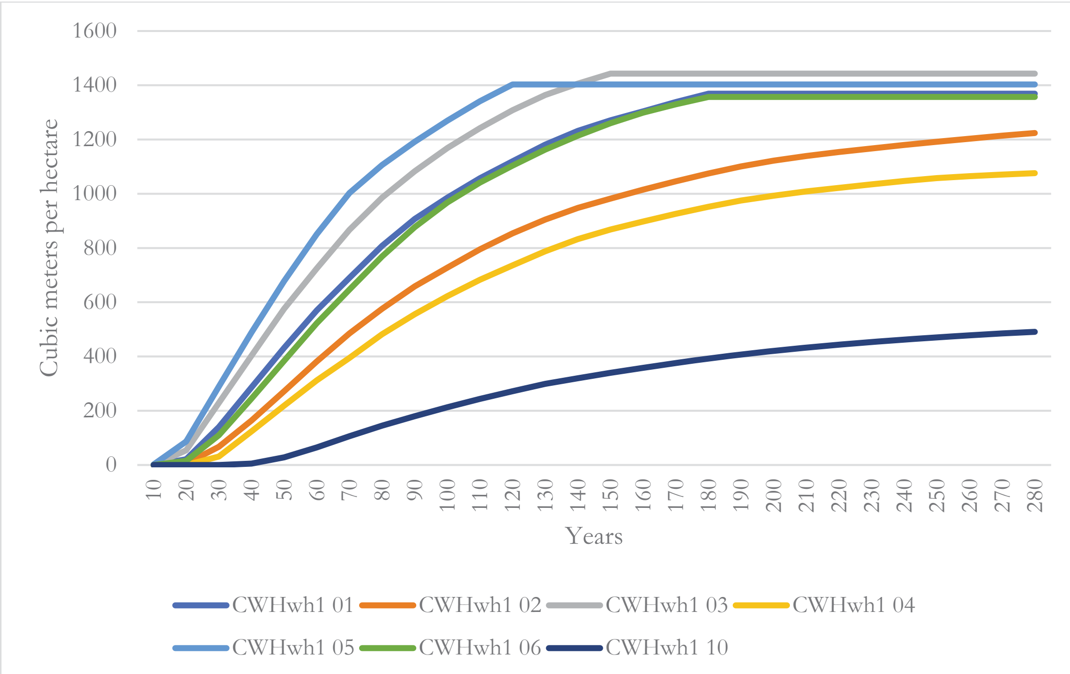
5.7 Growth Curves

The following graphs illustrate the growth curves of the most common analysis units (site series) for future managed stand tables on the THLB. It is impractical to graph the individual curves of the existing managed stand tables as each standard unit/silviculture record has its own curve. Note however that, as the future managed curves are derived as averages from the existing managed stand data (RESULTS), the curves by site series are very similar. Note that units are presented in the Green et al (1994) classification format, as this is the format of most of the ecosystem mapping on Haida Gwaii (including within RESULTS)[28].

Appendix 4 provides a detailed evaluation that compares future and existing managed stand growth and yield curves using Haida Gwaii Permanent Sample Plot (PSP) re-measurement data by BEC site series.
Whereas Analysis Units generally move from a natural stand curve to a future managed stand curve after harvesting in the timber supply model, a small amount of area does not have a corresponding future managed stand curve, as a result of data gaps in ecosystem mapping or the Provincial Site Productivity Layer. In these instances that harvested areas regenerate again on the same natural stand curves.

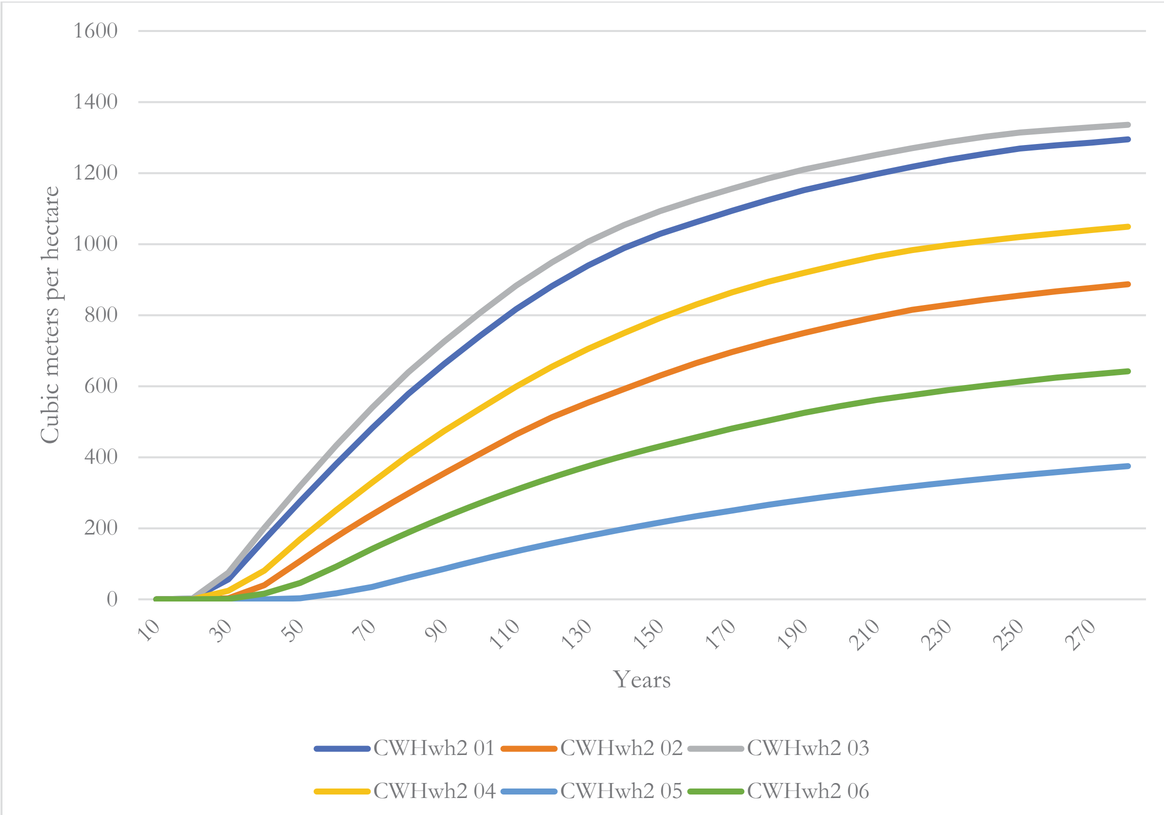
[28] Section 4 provides a crosswalk table between the current BEC format (2014) and the old format (1994).

Table 5.7.1 TIPSY growth curves for key site serieswithin the CWHwh1 (Green, 1994)



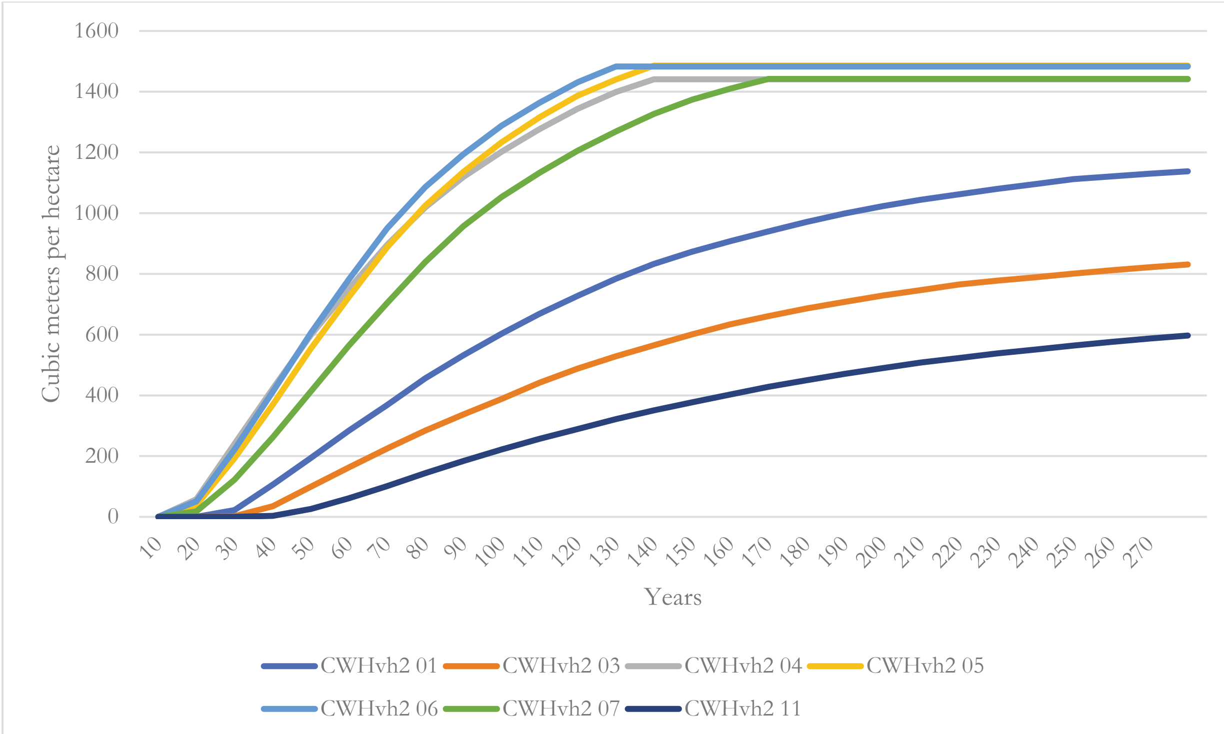
Site Series	Culmination Mean Annual Increment (CMAI)	Age at CMAI (rounded)
CWHwh1 01	10.1	80
CWHwh1 02	7.3	90
CWHwh1 03	12.4	70
CWHwh1 04	6.2	100
CWHwh1 05	14.3	70
CWHwh1 06	9.7	90
CWHwh1 10	2.3	130

Table 5.7.2 TIPSY growth curves for key site series within the CWHwh2 (Green, 1994)



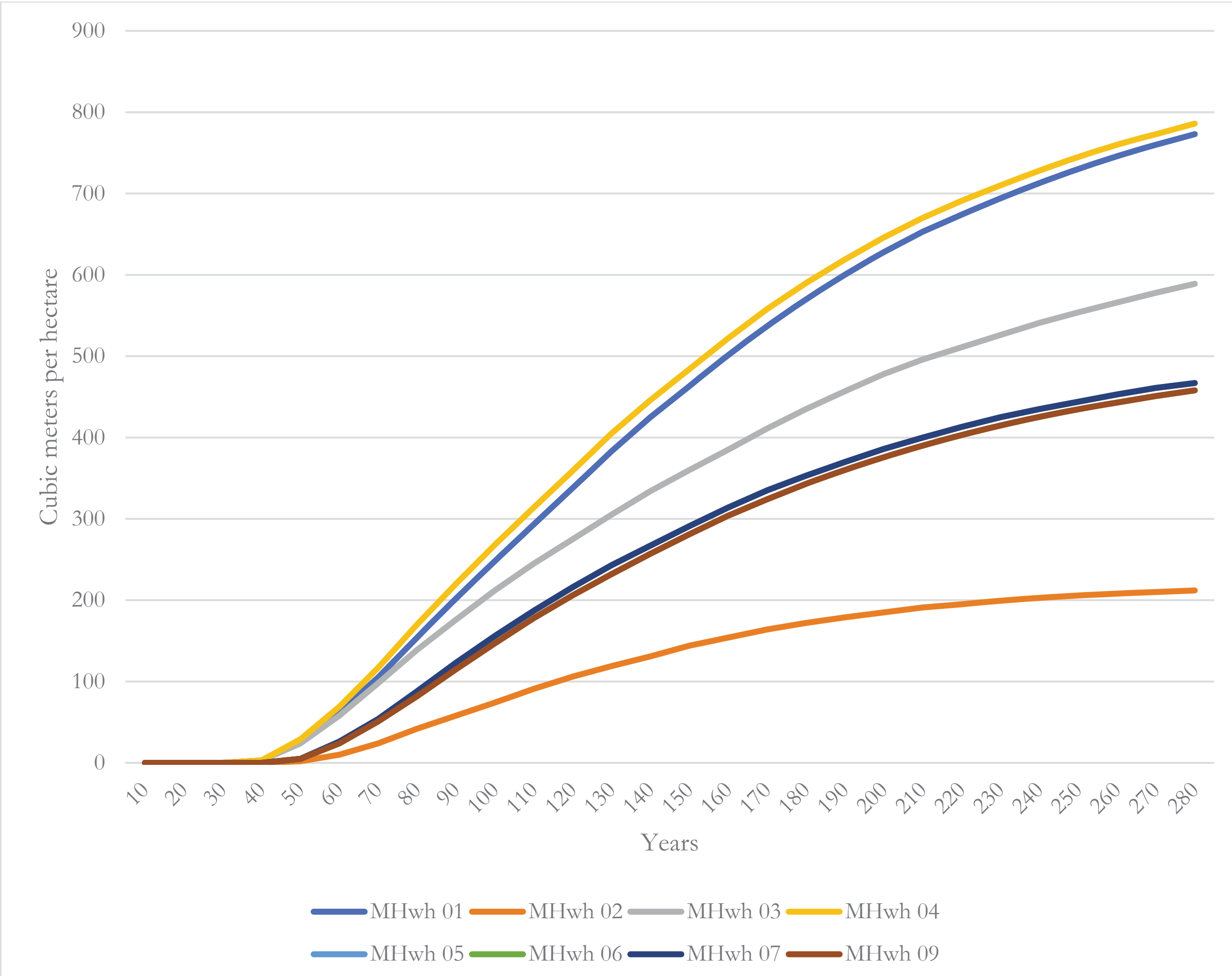
Site Series	Culmination Mean Annual Increment (CMAI)	Age at CMAI (rounded)
CWHwh2 01	7.4	110
CWHwh2 02	4.3	120
CWHwh2 03	8.0	100
CWHwh2 04	5.5	120
CWHwh2 05	1.5	180
CWHwh2 06	2.9	140

Table 5.7.3 TIPSY growth curves for key site series within the CWHvh2 (Green, 1994)



Site Series	Culmination Mean Annual Increment (CMAI)	Age at CMAI (rounded)
CWHvh2 01	6.1	110
CWHvh2 03	4.1	130
CWHvh2 04	12.8	70
CWHvh2 05	12.8	80
CWHvh2 06	13.6	80
CWHvh2 07	10.6	90
CWHvh2 11	2.5	160

Table 5.7.4 TIPSY growth curves for key site series within the MHwh (Green, 1994)



Site Series	Culmination Mean Annual Increment (CMAI)	Age at CMAI (rounded)
MHwh 01	3.2	180
MHwh 02	1.0	170
MHwh 03	2.4	170
MHwh 04	3.3	170
MHwh 05	2.0	170
MHwh 06	1.9	170
MHwh 07	2.0	170
MHwh 09	1.9	170

5.8 Natural Stand Growth and Yield

Variable Density Yield Projection version 7 (VDYP7, hereafter called VDYP) is the provincial empirical growth and yield prediction program specialized for updating and projecting attributes in the otherwise static VRI beyond the initial year of interpretation, through the VRIMS (Vegetation Resources Inventory Management System). Independent of the VRIMS, VDYP is also used to create natural stand yield tables for timber supply analyses. It is based on 52,000 permanent field plots and 9300 temporary sample plots province-wide (FAIB, 2007). VDYP7 projects stand heights, diameters, basal area, stems per hectare and volumes at various utilization levels and stand ages and bases its projections on forest inventory attributes such as age, height, species composition, density of stems, basal area, and site index, and BGC Zone.

In this Haida Gwaii TSR, all the natural stands have height and volume curves generated using VDYP. Natural stands are defined as those stands that have no history of silviculture and established before 1986. Most of these natural stands have not been felled commercially and therefore are old stands, but some have been harvested and were naturally regenerated prior to the time when stocking standards were applied in FRPA and FPPR.

A progression of several sets of VDYP7 curves were developed for this analysis to help assess the implications of the various data sources and models, on the way to deciding which to use in the base case:

1. Phase 1 VDYP curves: from VRI Phase 1 (photo-interpretation) inputs.
2. Phase 2 VDYP curves: Phase 2 (mature ground audit) attribute adjustments made to VDYP inputs.
3. LEFI-based VDYP curves: LiDAR Enhanced Forest Inventory (LEFI) curves from a combination of VRI Phase 1 and LEFI inputs.
4. LEFI-based analysis unit curves: The LEFI-based VDYP curves were aggregated into 66 analysis units (AUs).
5. LEFI volume adjustments made to analysis unit curves: The LEFI-based VDYP curves were adjusted based on LEFI net merchantable volumes. This set of 66 AU curves is used in the base case.

The following sections provide specifics related to each of these sets of volumes curves.

To help illustrate the different outcomes among these types of curves, two charts showing the existing timber volumes are presented below; one for western red cedar leading, and one for hemlock leading stands. These charts plot the average volumes in cubic metres per hectare of stands of the same age based on the various yield estimates listed above. The inventory volumes matching the Phase 1 VDYP are shown in black. Phase 2 adjusted VDYP volumes are shown in red. LEFI-based VDYP volumes are green. LEFI net merchantable volumes are in purple.

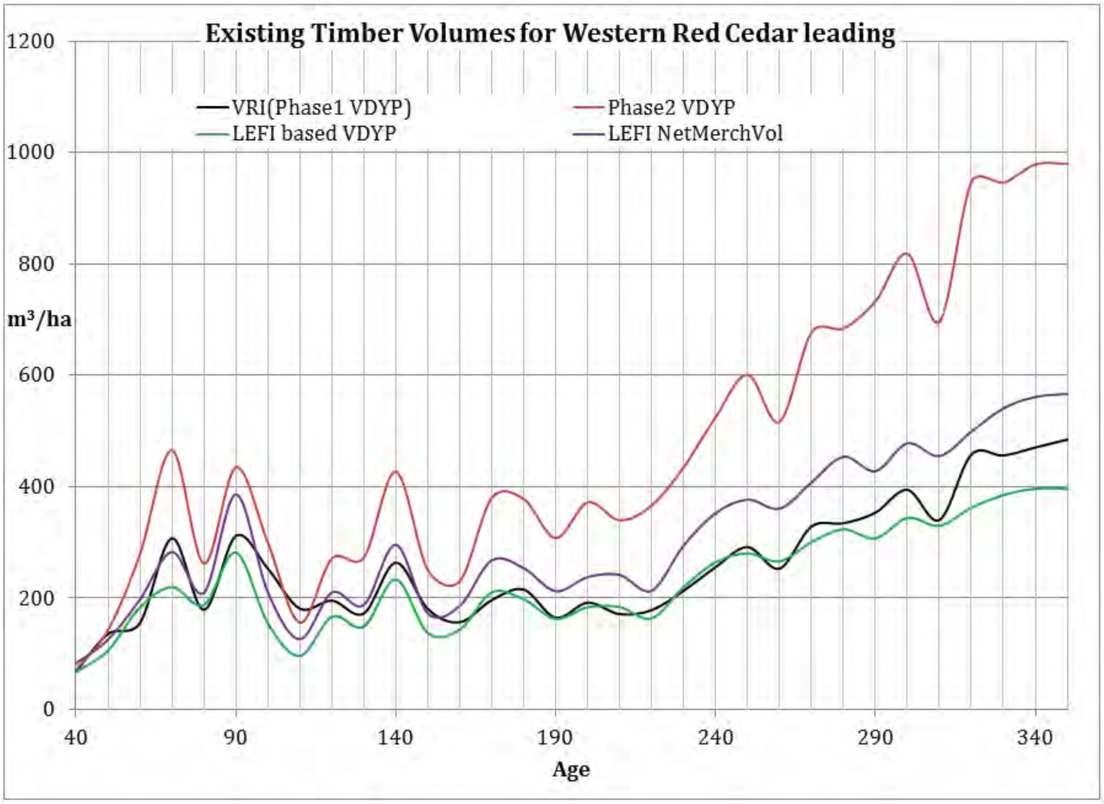


Figure 5.8.1: Existing Timber Volume Comparisons for Western Red Cedar Leading Stands

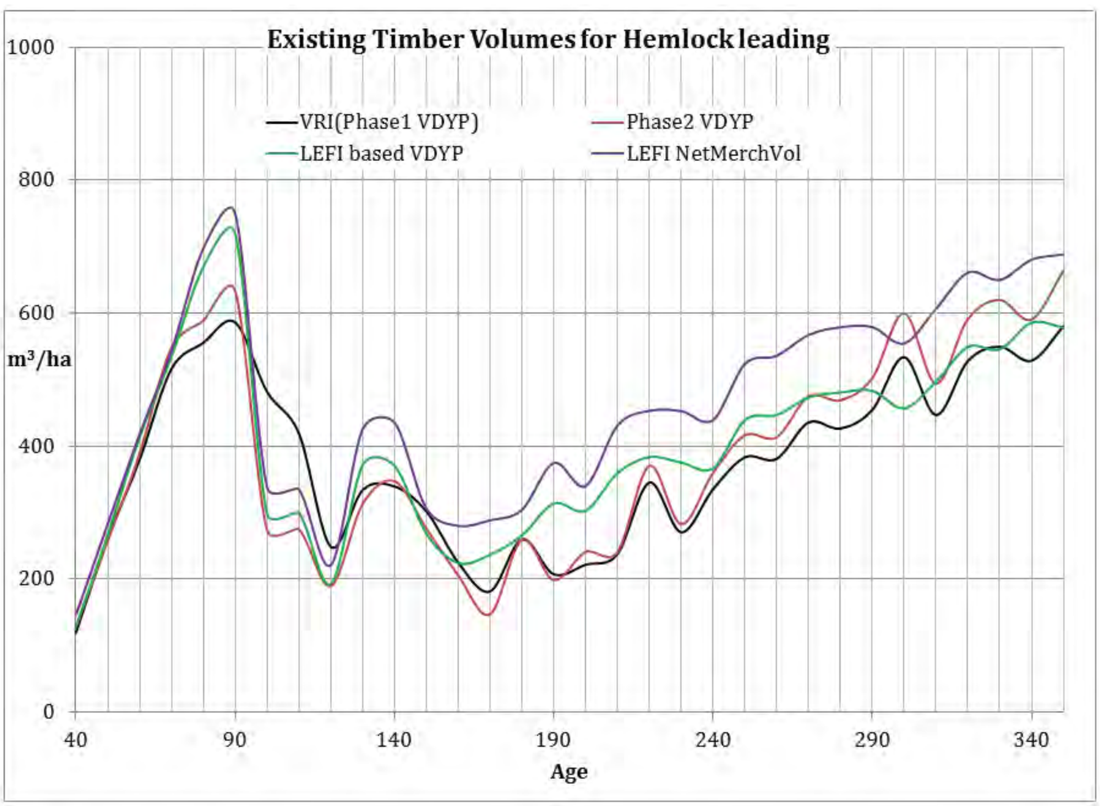


Figure 5.8.2: Existing Timber Volume Comparisons for Hemlock Leading Stands

5.8.1 Phase 1 VDYP Curves

The first set of natural stand yield tables (curves) generated for this TSR from VDYP was the Phase 1 VRI curves. These curves are specific to each VRI polygon and are consistent with the VRIMS which means that the current volume of stands on these curves matches the value found in the VRI. All the required VDYP7 inputs were available in the Phase 1 VRI which is based on air photo interpretation. They were prepared for initial modeling and comparison purposes only, and were not used in the base case.

5.8.2 Phase 2 VDYP Curves

A second set of curves was produced using the results of the Phase 2 assessment of the accuracy of the Haida Gwaii Phase 1 inventory. Such a ground-plot based study is a standard method following a Phase 1 inventory and the findings can be used to verify and enhance the Phase 1 inventory attributes used as VDYP inputs. The details of this Phase 2 VRI program are provided in the Haida Gwaii Vegetation Resources Inventory Analysis – Volume Audit (Mature) report by Penner (2018). The Phase 2 adjustments were made in creating the set of Phase 2 VDYP curves which ended up being an interim step, given concerns about the confidence about the adjustments, as discussed immediately below. These were also VRI polygon specific curves.

The Phase 2 study resulted in very large bias estimates for cedar. However, the sampling error associated with that estimate was also largely due to a limited sample size. Figure 5.8.1 above shows the differences between the curve sets discussed here in the cedar leading stands. The very high volume estimates from the Phase 2 adjustments for red cedar is obvious. Figure 5.8.2 shows the effect on the growth and yield of hemlock leading stands.

The Phase 2 study suggests that there were biases associated with the Phase 1 inventory, which needed to be addressed. However given the large sampling errors associated with the Phase 2 adjustments, particularly for cedar, the TWG evaluated the potential of another data source for natural stand growth and yield refinements.

5.8.3 LEFI-based VDYP Curves

Fortunately, a new forest inventory technology product is also available for a large proportion of Haida Gwaii including the majority of the THLB: LiDAR enhanced forest inventory or LEFI. The LEFI model generates 20 metre raster grids of six inventory attributes: basal area, Lorey height, top height, stems per hectare, quadratic mean diameter, and net merchantable volume. The LEFI combines information from ground plots and from LiDAR to derive forest attributes that can be used with a high degree of confidence.First, correlations between the compiled field plot data and the LiDAR are created for all the available field plots. Those correlations are then extrapolated to the rest of the LiDAR extent on a 20m raster grid using least difference parametric equations. The LiDAR Enhanced Forest Inventory (LEFI) Haida Gwaii Summary Report 2016/2017 by Yuan and Wang (2017) contains further information.

Having LiDAR and LEFI available meant having a viable option for Natural Stand Yield Table (NSYT) inputs and led to a recommendation from FAIB inventory specialists to use LEFI-based NSYTs in the base case as the best available information, instead of the Phase 2 adjustment-based curves. All of the LEFI attributes were used as VDYP inputs except for LEFI net merchantable volumesince VDYP does not use volume estimates from other sources as input. However, the LEFI volumes were used later for ratio adjusting the VDYP curves (see 5.8.4 below).

It was necessary to combine LEFI and VRI attributes for a complete set of VDYP inputs because LEFI does not provide all of the input required for VDYP. VDYP also requires species composition, stand age and site productivity inputs which are available for each polygon from the VRI Phase 1. This need to combine LEFI and VRI attributes led to the decision to produce LEFI attribute averages for each VRI polygon.

So, the inputs for this third set of VDYP curves are:

- VRI polygon averages for the following LEFI values
    - basal area,

- Lorey height,
    - top height,
    - stems per hectare,
    - quadratic mean diameter
- VRI polygon values from Phase 1
    - age,
    - species composition, and
    - site index (from Site Tools).

This third set of curves was created for all VRI polygons with LiDAR data coverage since that is also the LEFI extent. For the area that was lacking LiDAR and LEFI, aggregated analysis unit curves were used, as described in the next step (Section 5.8.4).

5.8.4 Analysis Units for LEFI-based VDYP Curves

Creating the fourth curve set involved aggregating the VRI polygon-specific LEFI-based curves in the third set together into much larger analysis units. Advantages of creating aggregated analysis units include:

i. It is easier to report, display and discuss a few dozen curves than 84,000, which is the approximate number of VRI polygons.
ii. Aggregating has the effect of cleaning up a minority of odd shaped curves and other anomalies that resulted with the mix of the algorithm-based inputs from LEFI and the attributes based on photo-interpretation, which came from VRI.
iii. The forest cover information at the polygon level, at least for the Phase 1 inventory, is subject to uncertainty. Averaging over many similar polygons combines information for the class which evens out the polygon-level uncertainty.
iv. LEFI (same extent as LiDAR) is not available for all of Haida Gwaii. With the area weighted aggregation of curves, it became straightforward to extend the LEFI-based curves to the non-LEFI extent of Haida Gwaii.

The VRI polygon-specific LEFI curves were aggregated into 66 analysis unit curves. These were created by area-weighting polygon curves according to:

1. Biogeoclimatic Zone
2. leading species (single letter species codes C, D, H, P, S, Y)
3. site index classes: 00, 01 to 05, 06 to 10, 16 to 20, 21 to 25, 26 to 30, 31 to 45.

The 66 AU curves were distributed to the non-LEFI extent of the forest management land base. This was also done according to BGC Zone, leading species and site index class. Once these analysis units were identified across the entire FMLB, even where there is no LiDAR, the yield tables based on Phase 1 VRI and LiDAR/LEFI information were available for the entire land base. No information from the VRI Phase 2 was used in these VDYP curves or other analysis inputs.

5.8.5 LEFI net volume adjustments of LEFI-based VDPY curves

LEFI net merchantable volumes, like the other LEFI attributes, were generated using information from ground plots and from LiDAR and can be used with a high degree of confidence. The TWG considers the LEFI volumes (which are net of decay waste and breakage at a utilization level of 12.5 cm) the best available information on the current volume of stands. These LEFI net volumes averaged to the VRI polygon are not yield curves. Instead, they represent current volumes. They are useful for adjusting the magnitude of the LEFI-based VDYP curves for two reasons.

Firstly, the ground plot volume calculations on which the LEFI volumes are based are compiled using Haida Gwaii specific taper factors and Haida Gwaii specific loss factors for decay, waste and breakage. In contrast, the VDYP7 model uses taper factors and loss factors that are generalized to the entire area of the provincial BGC zones. The forests outside Haida Gwaii are not exactly the same even if in the same BGC zone and so the factors do not match. In this sense the LEFI net volumes are more specific to Haida Gwaii than the LEFI-based VDYP curves.

Secondly, in attaining the LEFI net volumes, the LEFI model uses parametric equations to extrapolate from these ground measurements and locally specific compilations. This is a high-resolution extension of the ground data that does not involve combining LEFI information with VRI information. In contrast, the LEFI-based VDYP curves (described in section 5.8.3) are produced using VDYP inputs from two very different sources: air photo interpretation and ground plot measurements distributed by the LEFI model. Using the two different sources of information is a creative and carefully considered approach intended to make the best use of the available information, and an improvement over Phase 2 adjustment (section 5.8.2). Using the detailed LEFI information provides a way of verifying and calibrating the yield estimates based on LEFI and VRI inputs and the VDYP model.

5.8.6 LEFI net volume adjustments of LEFI-based VDPY7 curves: Magnitude and Method

With the above justification for making adjustments, the methods and magnitude of the adjustments are described next. The current volumes of stands on the LEFI-based VDYP curves were compared to the LEFI net volumes in scatter plots created for each leading species (C, P, S, and Y, and for H younger than 250 years, and H at least 250 years). For each case, a line of best fit through the origin and a co-efficient of determination (R^2) were generated using MSExcel. There is a distinct pattern in each case. The cedar leading example is shown below (see figure 5.8.6); the remainder are in appendix 9

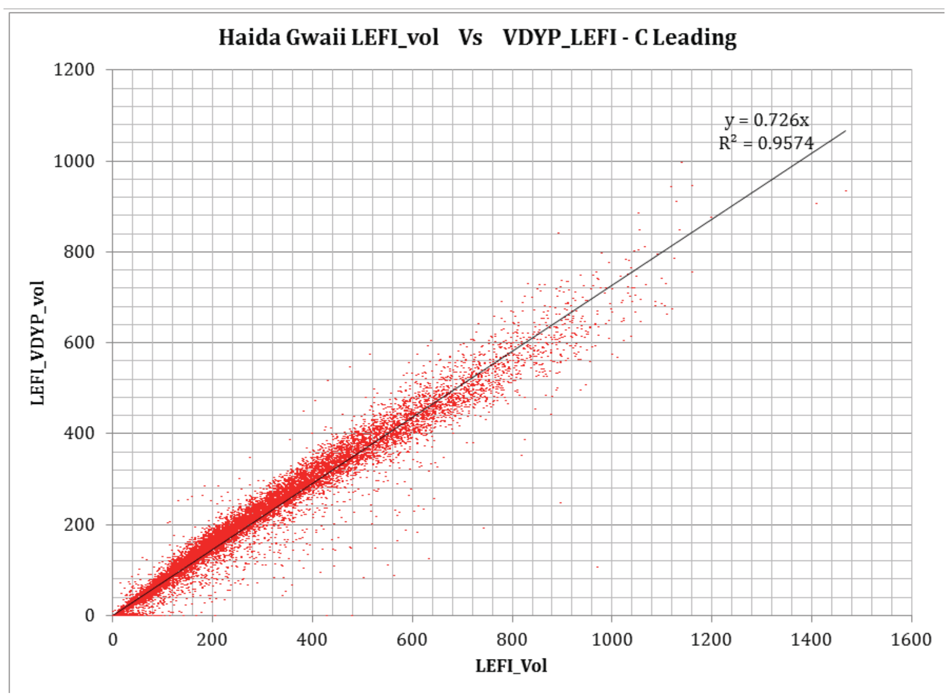


Figure 5.8.6Comparison between LEFI-based VDYP curve volumes and LEFI net volumes for cedar.

These equations of best fit have very high coefficient of determination or R^2 values. This statistic indicates the percentage of the variance in the dependent variable that the independent variable explains. In these cases, depending on the leading species, between 89 and 98 percent of the relationship between the points is described by the line of best fit through the origin (shown in the table below).

Table 5.8.6 Line of best fit ratio- LEFI-based VDYP / LEFI net volume

Line of best fit ratio - LEFI based VDYP / LEFI net vol

Sp1_1	U_O_250	Ratio (current volume LEFI based VDYP / LEFI net vol)	R^2	reciprocal (1/Ratio)
C		0.726	0.957	1.377
H	250 years and over	0.831	0.954	1.203
H	under 250	0.905	0.895	1.105
S		0.875	0.891	1.143
P		0.808	0.951	1.238
Y		0.751	0.980	1.332

Two sources for the difference are proposed. First, VDYP7 does not include the Haida Gwaii specific taper factors and decay and waste factors. Second, the LEFI-based VDYP curves have input from VRI as well as LEFI, and this has an effect of unknown direction and magnitude.

The slopes of those lines of best fit were used to adjust the magnitudes of existing unmanaged stand yield curves; specifically the LEFI-based VDYP curves that are aggregated into 66 analysis units. The reciprocal of these ratios was used as a multiplier.

At this stage, the 66 LEFI-based VDYP curves that were based on LEFI inputs and Phase 1 species, age and SI, as discussed in section 5.8.4, are adjusted using current net merchantable LEFI volume.

5.8.7 Utilization Adjustment

The LEFI net volumes are based on a 12.5 cm diameter utilization limit, whereas the VDYP curves discussed are based on 17.5 cm diameter utilization limit for all species except pine and alder at 12.5 cm. Therefore, a final adjustment was necessary to correct for the difference between 17.5 cm and 12.5 cm utilization. The ratio of the difference between the two utilization limits was found along the analysis unit volume curve using the LEFI-based VDYP curves, then it was applied to the LEFI-based VDYP curves with the LEFI net volume adjustment. The equation used is shown here, followed by a chart (5.8.7) highlighting an example analysis unit; CWH_C_10to15.

A = Volume at 17.5 cm utilization.

B = Volume at 12.5 cm utilization

LV = LEFI-based VDYP volume curves

LVL = LEFI-based VDYP volume curves adjusted using LEFI net volume (12.5 cm utilization)

$$A_{LVL} = A_{LV} * B_{LVL}/B_{LV}$$

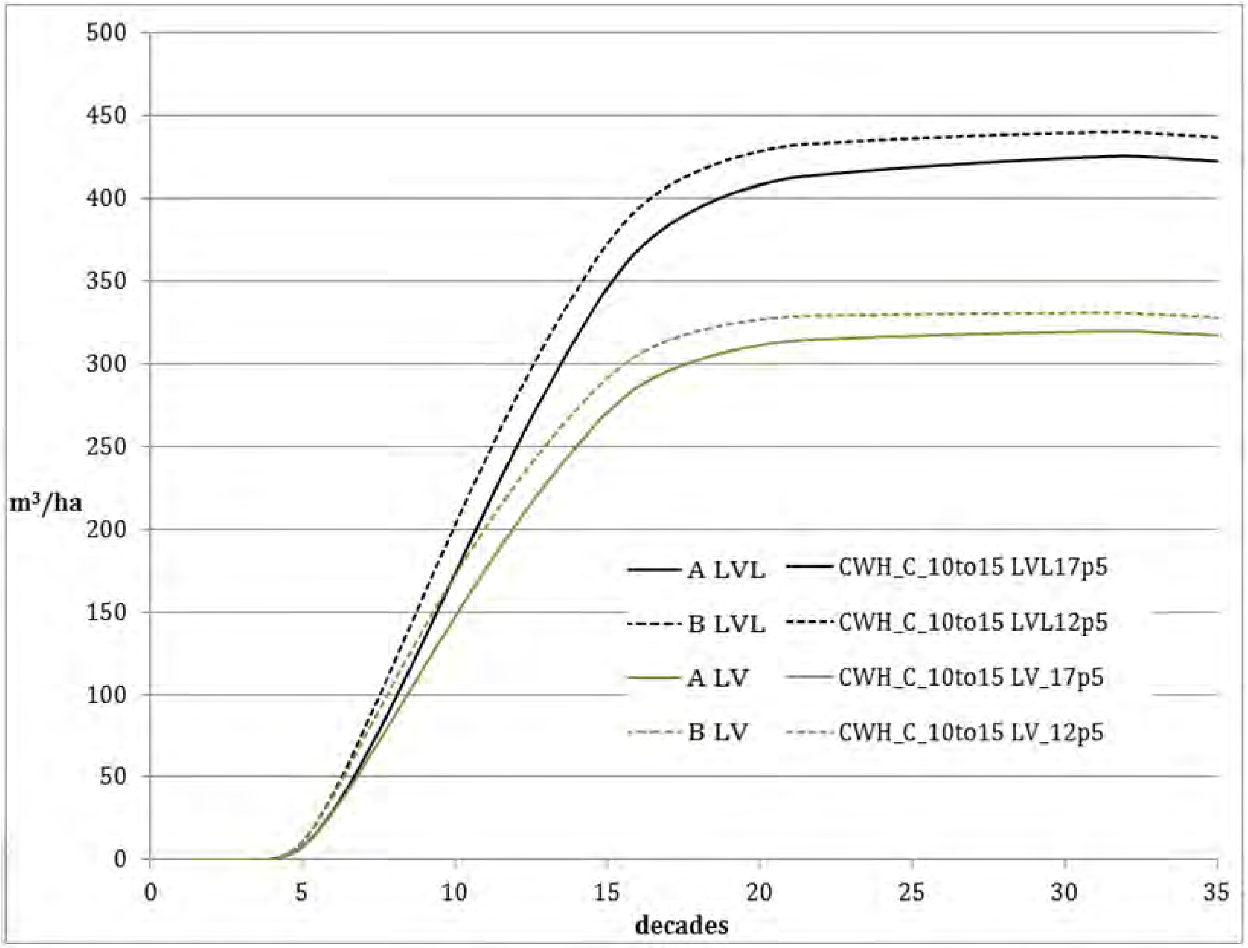


Figure 5.8.7 Differences between 12.5cm and 17.5cm utilization using LEFI-adjusted VDYP curves

The following table summarizes the utilization differences for CWH analysis units covering the majority of the THLB. To reduce the size of the table, it does not include:

- Red Alder AUs,
- AUs not expected to reach 250 m^3/ha,
- AUs with less than 20 ha THLB, or
- Any of the MH AUs – most of them have very little THLB, and the trend is like CWH AUs.

Some trends are apparent in the table:

1. High SI stands are not affected by the utilization change.
2. The difference is greater at younger ages, which is moderated by the time stands achieve the minimum harvest volume (MHV) of 250 m^3/ha. Values that are below minimum harvest volume (MHV) of 250 m^3/ha are struck through to emphasize that the larger differences found at younger ages are not realized in the harvest.
3. Spruce leading AUs are affected the least. Cedar leading and Pine leading are affected more.

Table 5.8.7 Impact of utilization-level change (12.5 cm dbh to 17.5 cm dbh)

					Volume at Util 17.5 cm dbh					Volume at Util 12.5 cm dbh					Util Dif					Util Dif %				
Ha	THLB	CurveSet / Age			50	100	200	300	350	50	100	200	300	350	50	100	200	300	350	50	100	200	300	350
3,534	1,368	CWH	Y	11 to 15	~~28~~	~~178~~	338	352	351	~~35~~	~~204~~	354	363	362	~~7~~	~~26~~	16	11	11	~~21.3%~~	~~12.7%~~	4.5%	3.2%	3.0%
72,759	26,665	CWH	C	11 to 15	~~29~~	~~176~~	314	319	316	~~39~~	~~201~~	329	331	327	~~10~~	~~25~~	15	11	11	~~25.0%~~	~~12.5%~~	4.5%	3.4%	3.3%
17,012	4,762	CWH	C	16 to 20	~~61~~	291	476	475	470	~~79~~	318	486	482	476	~~18~~	27	11	7	7	~~23.1%~~	8.6%	2.2%	1.5%	1.4%
1,841	986	CWH	C	20 to 25	~~241~~	676	877	835	814	~~271~~	681	877	835	814	~~30~~	~~5~~	0	0	0	~~11.0%~~	0.7%	0.1%	0.0%	0.0%
327	177	CWH	C	25 to 30	356	891	1,154	1,099	1,075	388	892	1,154	1,099	1,075	32	2	0	0	0	8.2%	0.2%	0.0%	0.0%	0.0%
24,245	9,288	CWH	H	06 to 10	~~19~~	~~168~~	367	359	353	~~25~~	~~194~~	381	369	362	~~7~~	~~26~~	15	10	10	~~26.5%~~	~~13.4%~~	3.9%	2.8%	2.7%
59,502	16,889	CWH	H	11 to 15	~~40~~	292	571	547	534	~~53~~	326	582	553	541	~~14~~	33	11	7	6	~~25.9%~~	10.2%	1.9%	1.2%	1.1%
25,454	11,438	CWH	H	16 to 20	~~157~~	549	809	749	731	~~184~~	564	811	750	732	~~27~~	15	3	2	1	~~14.8%~~	2.6%	0.3%	0.2%	0.2%
35,251	17,758	CWH	H	20 to 25	292	785	1,036	947	923	320	789	1,037	947	923	28	5	0	0	0	8.8%	0.6%	0.0%	0.0%	0.0%
17,204	8,036	CWH	H	25 to 30	418	990	1,255	1,153	1,125	441	992	1,255	1,153	1,125	23	2	0	0	0	5.3%	0.2%	0.0%	0.0%	0.0%
5,184	2,258	CWH	H	06 to 10	509	1,106	1,381	1,267	1,237	525	1,108	1,381	1,267	1,237	16	2	0	0	0	3.1%	0.2%	0.0%	0.0%	0.0%
3,061	1,184	CWH	P	11 to 15	~~56~~	~~191~~	265	254	248	~~61~~	~~200~~	273	262	256	~~5~~	~~10~~	8	7	7	~~8.7%~~	~~4.8%~~	3.0%	2.8%	2.8%
913	330	CWH	P	20 to 25	~~97~~	259	334	319	311	~~105~~	269	341	325	317	~~8~~	10	7	6	6	~~7.5%~~	3.8%	2.1%	1.9%	2.0%
101	64	CWH	P	25 to 30	~~85~~	~~196~~	245	234	229	~~93~~	~~202~~	250	239	233	~~8~~	~~6~~	4	4	4	~~8.2%~~	~~3.1%~~	1.7%	1.7%	1.8%
1,950	471	CWH	S	06 to 10	~~13~~	241	609	577	571	~~17~~	264	617	584	577	4	23	8	6	6	~~24.7%~~	8.7%	1.3%	1.1%	1.0%
5,480	1,016	CWH	S	11 to 15	~~18~~	302	700	661	652	~~24~~	326	706	666	656	~~6~~	24	6	5	4	~~23.5%~~	7.4%	0.8%	0.7%	0.6%
5,870	1,457	CWH	S	16 to 20	~~105~~	511	877	818	805	~~120~~	529	881	821	808	~~16~~	18	4	3	3	~~12.9%~~	3.5%	0.4%	0.4%	0.3%
9,067	3,744	CWH	S	20 to 25	332	914	1,192	1,092	1,075	358	920	1,193	1,093	1,075	26	6	1	1	1	7.2%	0.7%	0.1%	0.1%	0.1%
13,269	5,032	CWH	S	25 to 30	462	1,078	1,317	1,194	1,176	479	1,080	1,318	1,194	1,176	17	2	0	0	0	3.6%	0.2%	0.0%	0.0%	0.0%
15,550	5,260	CWH	S	30 to 45	553	1,187	1,413	1,274	1,256	563	1,187	1,413	1,275	1,256	11	1	0	0	0	1.9%	0.1%	0.0%	0.0%	0.0%

This final set of curves is the set of analysis unit curves used in the base case. These 66 analysis units have LEFI-based VDYP curves adjusted based on the LEFI net volumes, and also the impact of moving from 12.5 to 17.5 cm utilization. These adjustments are applied across the LEFI and the non-LEFI extent of Haida Gwaii.

5.8.8 Example Analysis Unit Charts

The following three charts each show three volume curves; 1) Phase 2 VDYP curves, 2) LEFI-based VDYP curves, and 3) LEFI volume adjusted LEFI-based VDYP curves. All three charts, representing a large portion of the THLB, are focused on an analysis unit within the CWH zone where the SI is between 10 and 15 and each looks at a different leading species: C, H, and S.

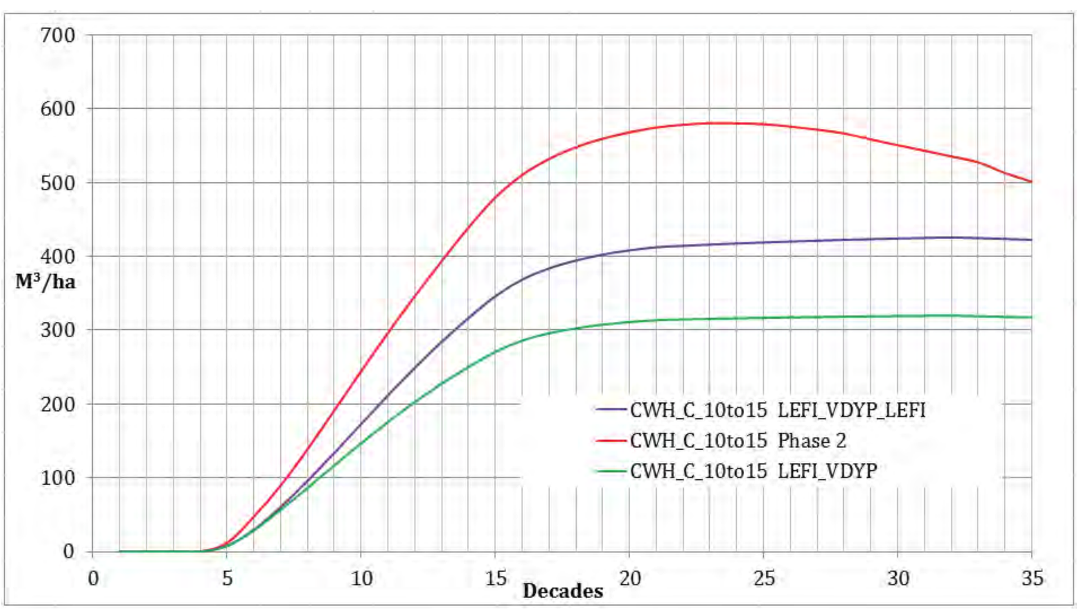


Figure 5.8.8.1: CWH Cedar Leading with SI between 10 and 15.

Figure 5.8.8.1 shows volume curves for the analysis unit containing cedar-leading stands in the CWH zone, with site index 10-15. The Phase 2 curve in red is much higher than the LEFI-based VDYP curve in green, and the curve resulting from the LEFI volume adjustment, in purple, is intermediate between the others. The adjusted curve is used in the base case.

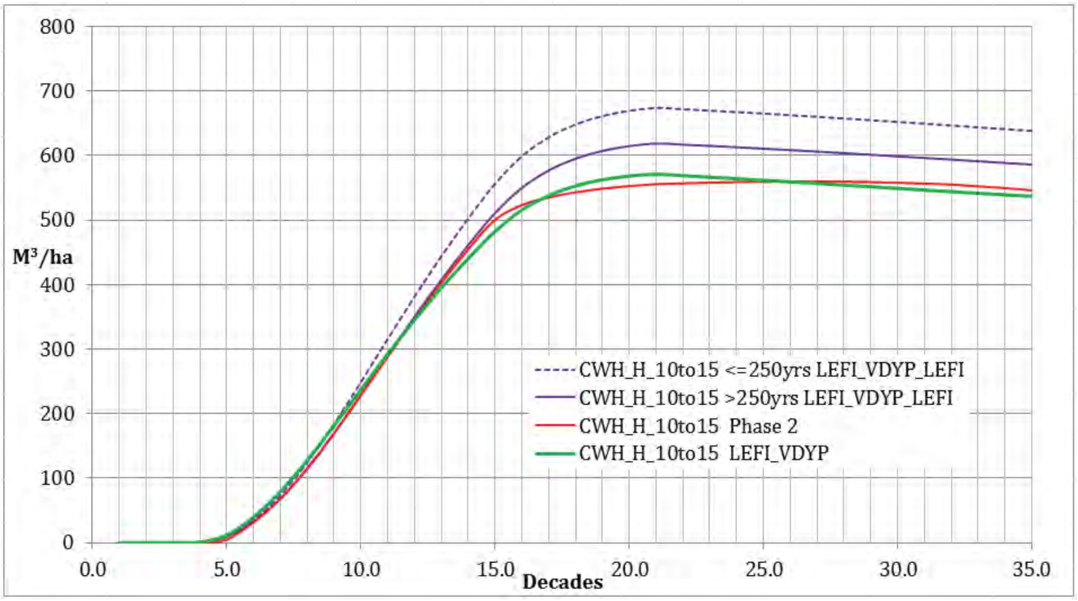


Figure 5.8.8.2: CWH Hemlock Leading with SI between 10 and 15.

Figure 5.8.8.2 compares curves for the hemlock leading CWH, site index 10 to 15 analysis unit. The Phase 2 curve in red is has very similar magnitude as the LEFI base VDYP curve in green. The LEFI volume adjustment depends on the age bracket of the stands. For stands 250 years and older, the green curve is adjusted creating the dashed purple curve. For stands younger than 250, the result is the solid purple line. These higher purple lines mean that the base case curves for hemlock-leading stands (with LEFI volume adjustment) are higher than the Phase 2 curve or the unadjusted LEFI-based VDYP curve.

Figure 5.8.8.3 below compares the spruce leading CWH, site index 10 to 15 analysis unit. The Phase 2 curve is shown in red. Its magnitude for stands older than 300 years is nearly identical to that of the purple LEFI Volume adjusted curve. The LEFI-based VDYP curve in green has less volume at all ages than the Phase2 VDYP curve. The LEFI volume adjustment of the green curve creates the purple curve which is used in the base case.

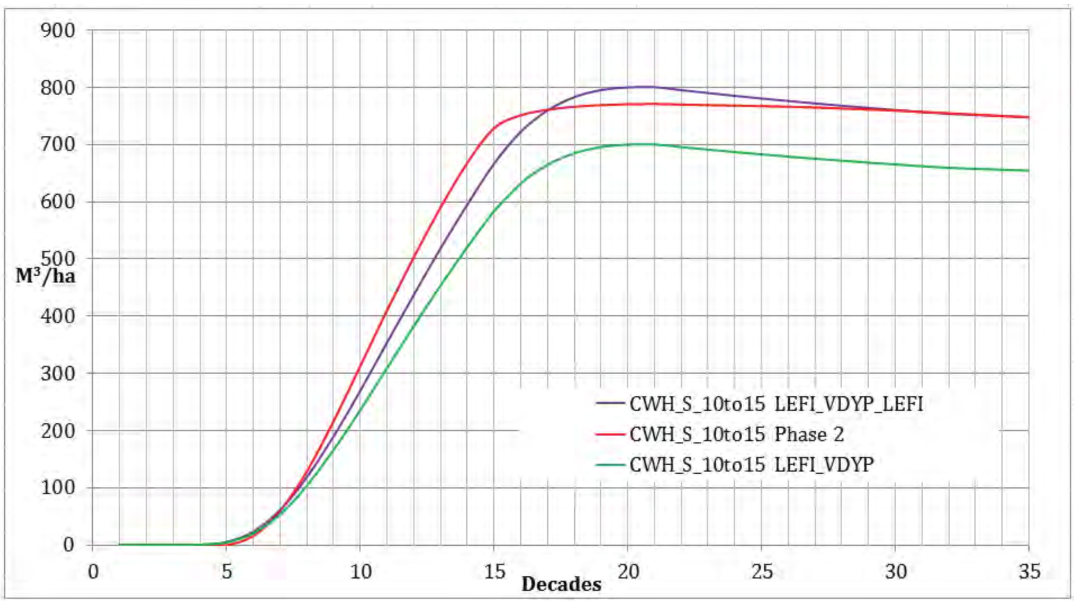


Figure 5.8.8.3.CWH Spruce Leading with SI between 10 and 15.

The following charts show base case volume curves (LEFI volume adjusted) for the most common analysis units. Note the very high site index curves are somewhat anomalous given the small areas they represent (see figure 5.8.8.10 below for the distribution of site index classes in the THLB).

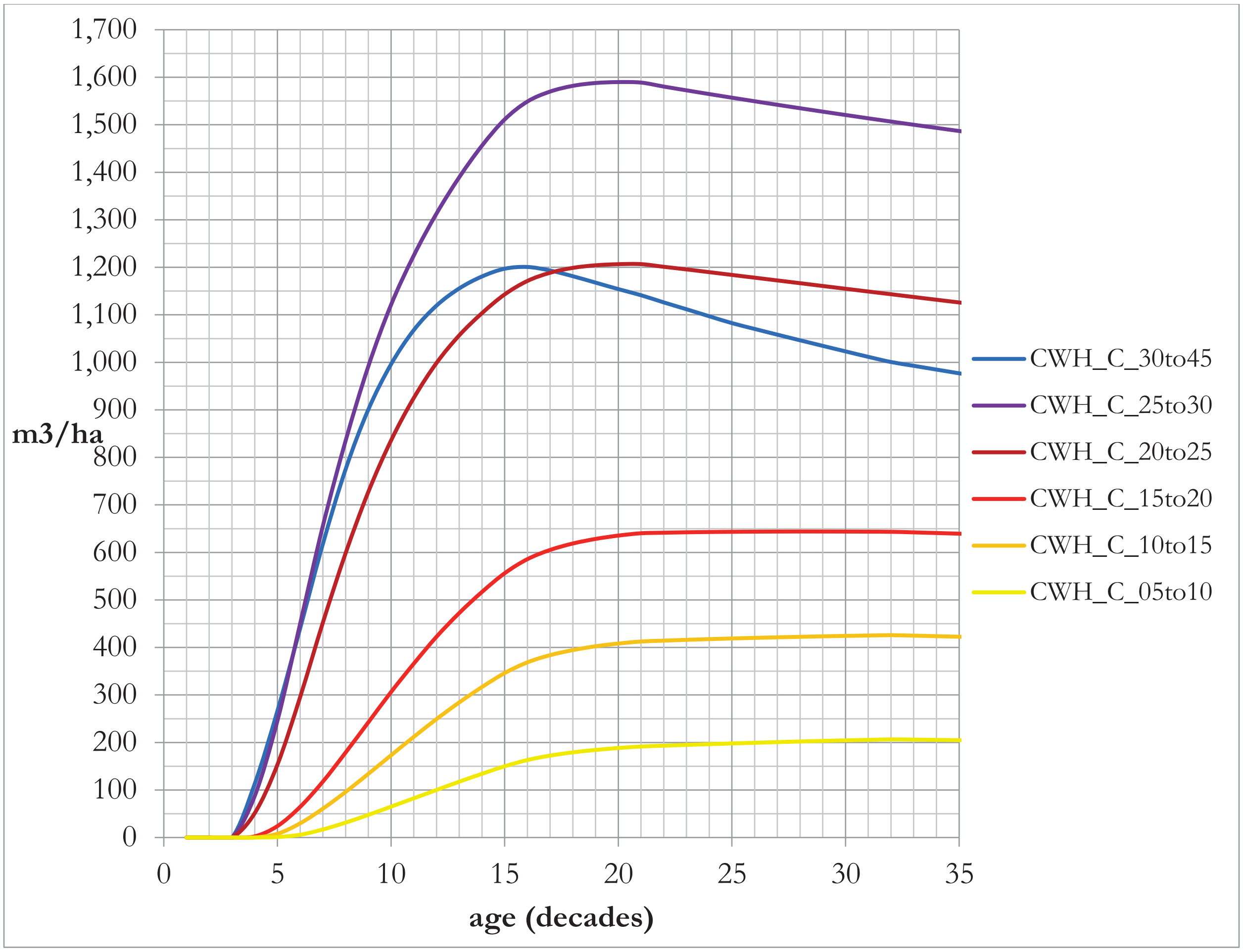


Figure 5.8.8.4. Red cedar leading natural stand analysis units by BEC zone and site index class

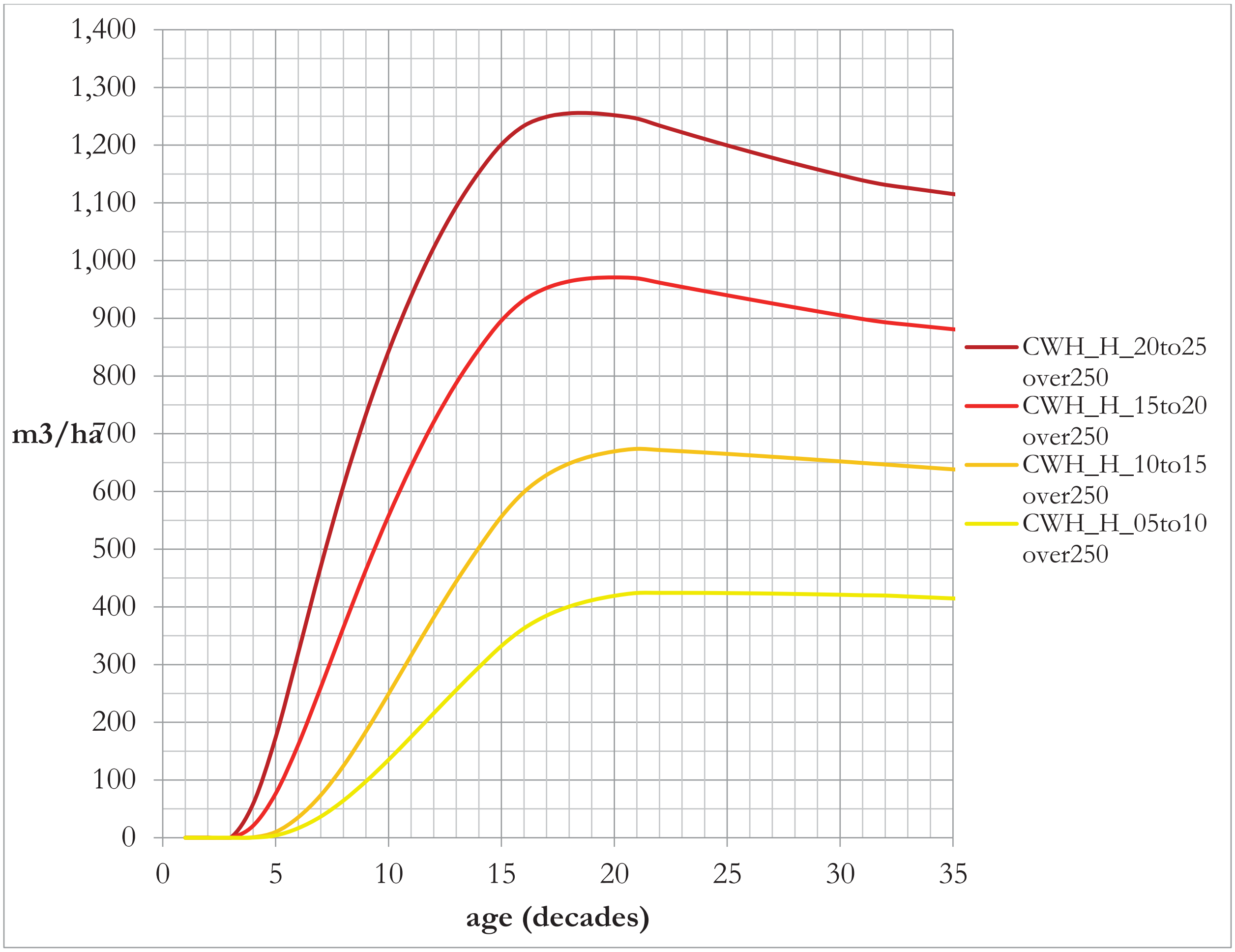


Figure 5.8.8.5 Western hemlock leading natural stand analysis units by BEC zone and site index class (natural stands over 250 years).

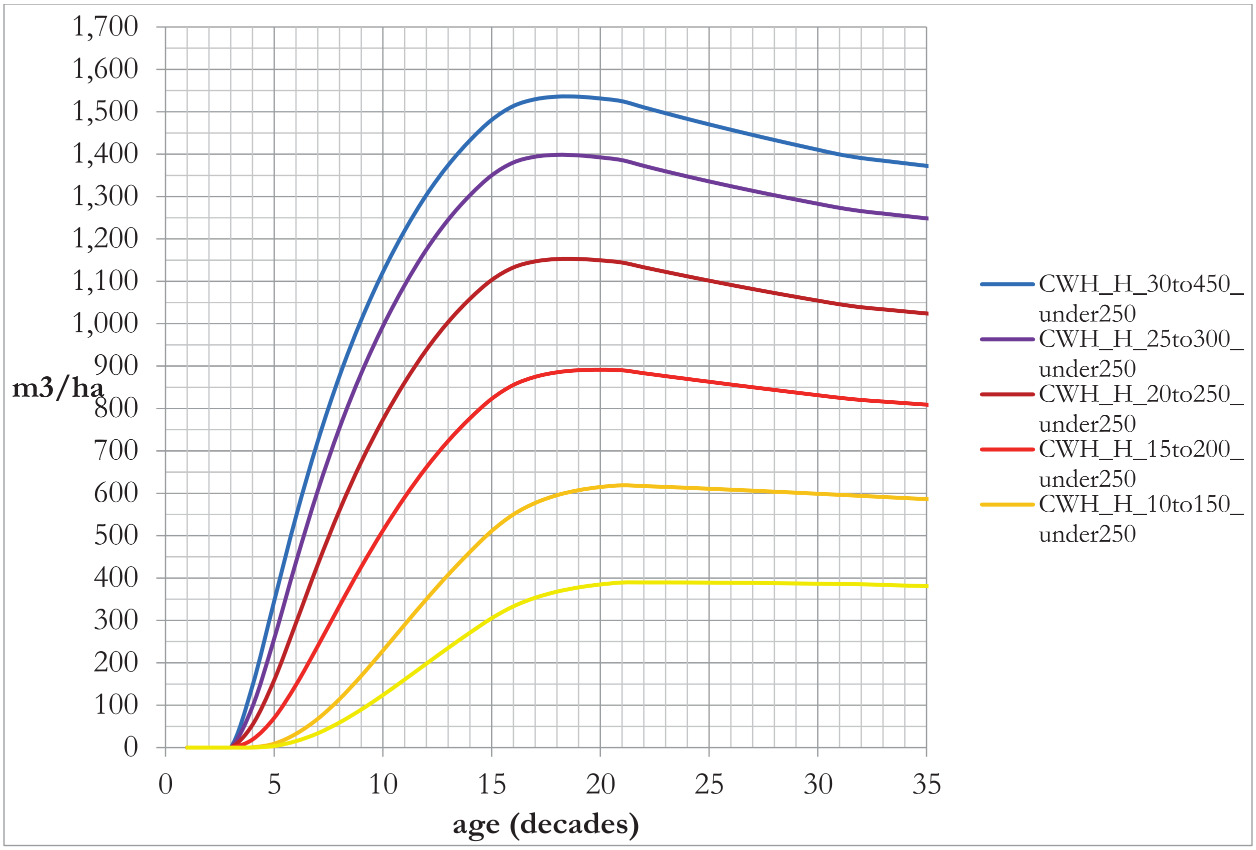


Figure 5.8.8.6 Western hemlock leading natural stand analysis units by BEC zone and site index class (natural stands under 250 years).

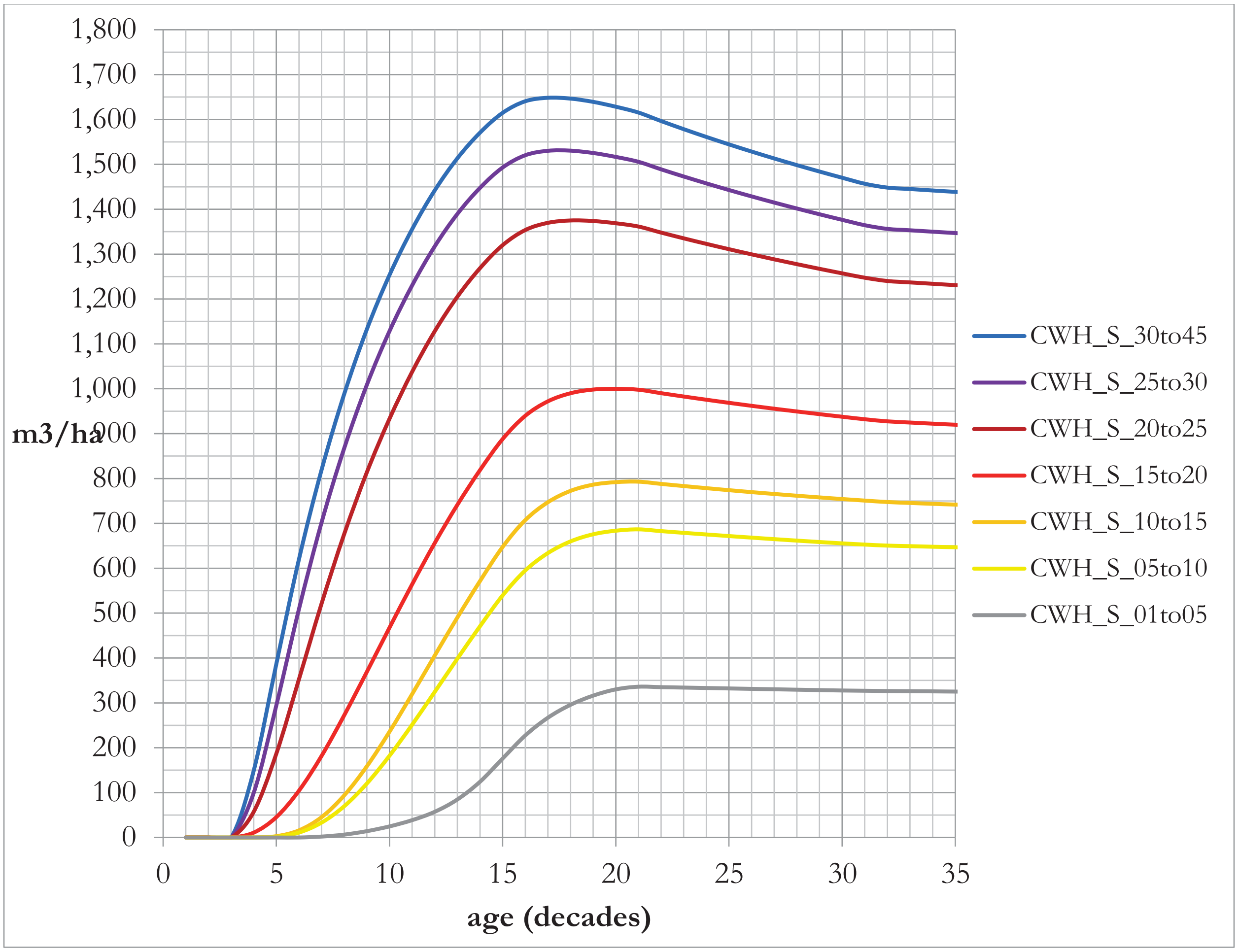


Figure 5.8.8.7 Sitka spruce leading natural stand analysis units by BEC zone and site index class.

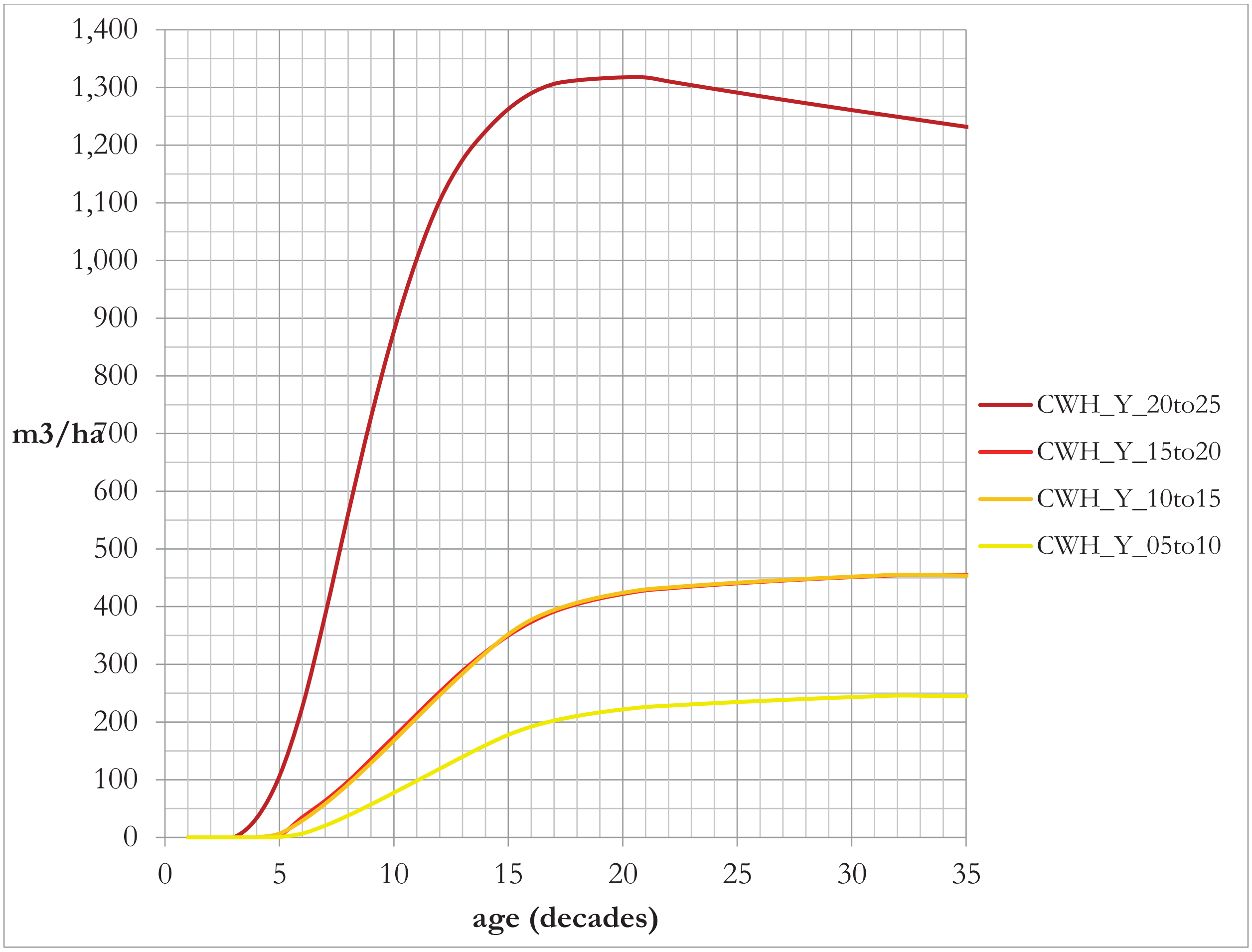


Figure 5.8.8.8 Yellow cedar leading natural stand analysis units by BEC zone and site index class.

Note that while the growth and yield estimates for the high site index yellow cedar sites (SI 20-25) are significantly higher than other sites, these sites do not occur within the THLB (see figure 5.8.7.7).

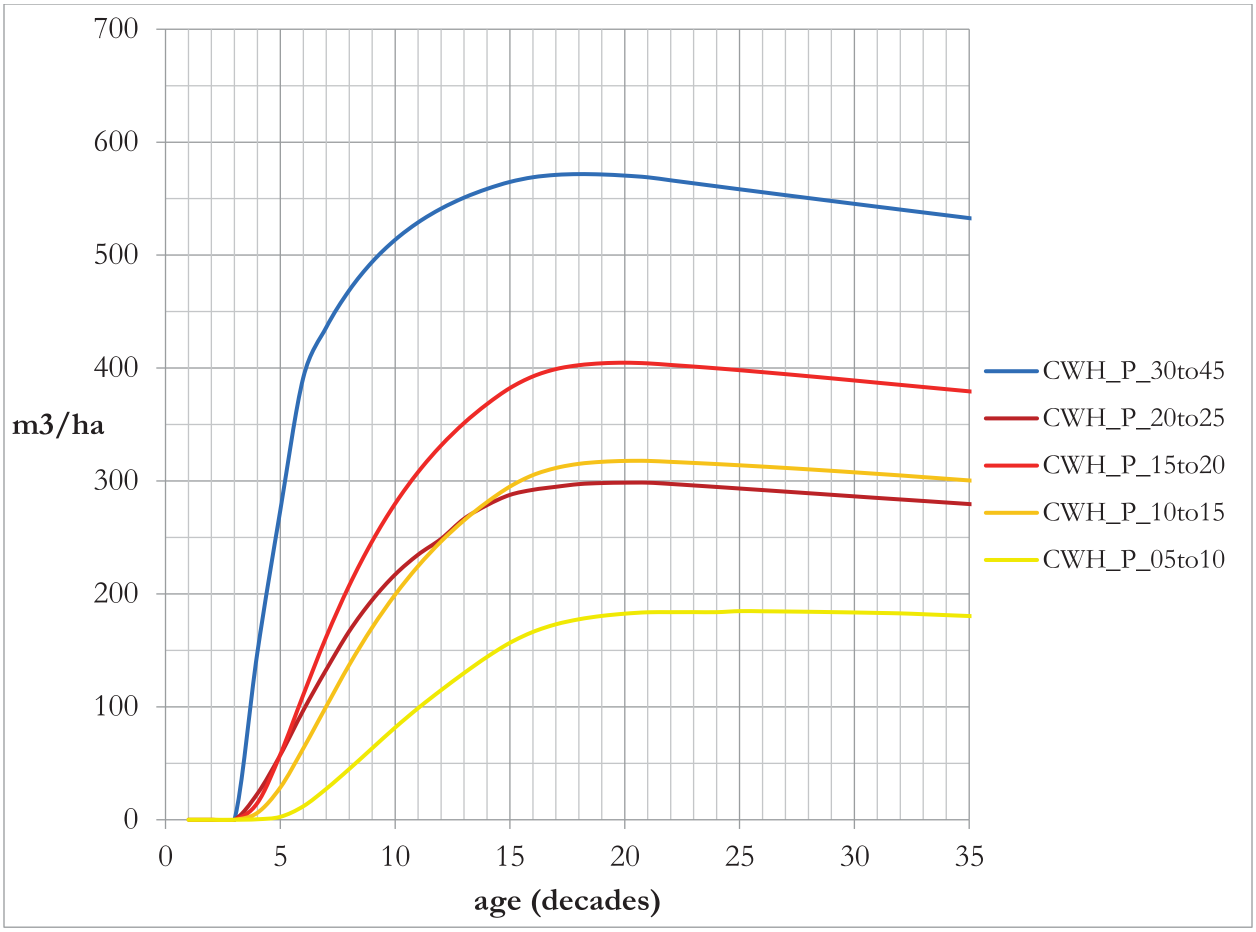


Figure 5.8.8.9 Lodgepole pine leading natural stand analysis units by BEC zone and site index class.

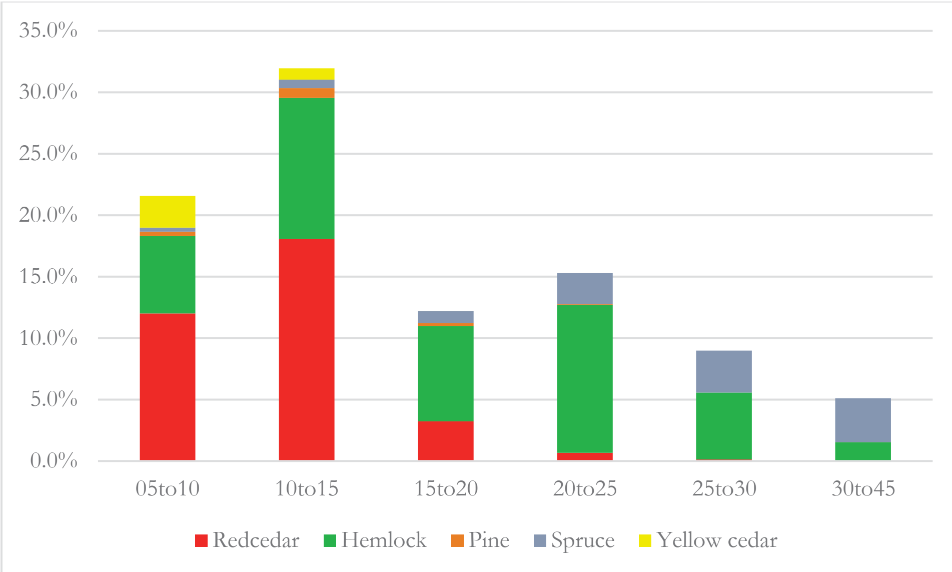


Figure 5.8.8.10. Distribution of species by site index classes for natural stands as a percent of the THLB[29].

[29] Note this graph only includes species and site index groupings within the CWH BEC zone. These units represent 95% of THLB.

Chapter 6- Resource Management

6.1 Visual Quality Management

Managing for visual quality is an important value on Haida Gwaii and is guided by several Provincial policies. Achieving Visual Quality Objectives (VQOs) in British Columbia involves setting thresholds for visually altered forests on landforms that are between 1 to 8 kilometres from a significant public viewpoint (e.g., how much logging is visible from significant public viewpoints). The *Forest and Range Practices Act* explicitly identifies the need to manage for scenic values. Section 1.1 of the *Forest Planning and Practices Regulation* sets out categories for visually altered forest landscapes. On Haida Gwaii, a Visual Landscape Inventory (VLI) was completed in the early 2000s identifying viewscapes based on known public vantage points, creating 1,014 polygons, each with its own VQO. The VLI includes spatial/mapped information on important viewscapes for communities, travel corridors and public recreation sites.

In 2005, the VLI was brought into force through the *Visual Quality Objective Order*, made under Section 7(2) of the Government Actions Regulations (*B.C. Reg. 582/2004*) (Munt, 2005). After the 2005 GAR Order, all forest companies needed to manage VQOs on a VLI polygon basis. The Visual Impact Assessment Guidebook (MoF, 2001) provided numerical ranges for measuring altered forest landscapes by Visual Quality Classes, and in 2013 the Haida Gwaii Natural Resource District established a new policy that set expectations around those numerical ranges (Munt, 2013), as outlined in table 6.1.

Table 6.1. Haida Gwaii Natural Resource District's Stewardship Policy for Managing Visual Resources on Haida Gwaii (2013)

VQO Class	**Scale** (MoF, 1998)	**Percent Alteration**	**Midpoint**
Preservation	No visible activities	0%	0
Retention	Activities are not visually evident	0% - 1.5%	0.75%
Partial Retention	Activities are visible, but remain subordinate	1.6% - 7%	4.3%
Modification	Activities are visually dominant but appear natural	7.1% - 18%	12.6%
Maximum Modification	Activities are dominant and out of scale	18.1% – 30%	24%

Percent alterations are implemented by ensuring that recent disturbance does not exceed the listed percentages for a given landform (VLI polygons), averaged across several established viewpoints. Many factors may contribute to meeting VQOs, such as block shape, distance from a known viewpoint, the shape or absorption capacity of a landform, or the size of an opening.

6.1.1 VQO's in Timber Supply

Applying VQOs to timber supply analyses requires constraining the amount of recently disturbed (not visually greened-up area) in VLI polygons to ensure that percent alterations are not exceeded. Three variables are commonly used to help calibrate VQO requirements within a spatial modelling environment: 'Visually Effective Green-up' (VEG); Visual Absorption Capacity (VAC); and Plan to Perspective ratio (P2P).

Visually Effective Green-up (VEG) is a term commonly used to describe forest regeneration that has reached a state that is no longer considered 'altered' or visibly disturbed. A greened-up state will vary based on biophysical conditions but is typically considered to be achieved if an area is well-stocked and trees are between 3 to 8 metres in height. Generally, a steeper slope requires taller trees to mask visibly disturbed ground.

Visual absorption capacity (VAC) refers to a landform's visual sensitivity to harvest openings; for example, a clearcut may be more visible on a steep straight slope as opposed to on an undulating slope or flat ground. Slope (%) is used as a surrogate for VAC in spatial modelling.

Estimates of tree heights required to meet VEG relative to hillslope gradients were published by the Province in 1998 (MoF) and have been considered standard practice to guide spatial modelling for timber supply analyses (table 6.1.1).

Table 6.1.1 Tree height required to meet Visually Effective Green-up relative to slope (MOF 1998)

	Slope range (%)											
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-45	46-50	51-55	56-60	60+
Height (m)	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5

Each VLI polygon was assigned a slope class (derived from 20-m Digital Elevation Model and gradient functions in ArcGIS) and then an area-weighted average tree height (VEG) was calculated for each VLI polygon. The mean VEG height for a polygon is therefore calculated by: $\frac{(x_1 * y_1)+(x_2 * y_2)+\cdots}{Total\ Area}$ whereas *x*= area and *y*= VEG tree height.

For example, a 100-hectare VLI polygon with 5 different slope classes (each 20 hectares in size) with 5 separate VEG height requirements of 4m, 5m, 6m, 7m, 8m, and would have a mean VEG height of 6m.

The perspective view is the point of view of someone on the ground looking horizontally across to a landform. VLI polygons and their subsequent VQOs were all developed in a perspective view, and operational approvals also vet alteration amounts based on the perspective view. Spatial timber supply models use the VLI spatial linework, but apply it from a plan view (e.g., as one looks at a map- from above). A plan to perspective (P2P) ratio converts the perspective percent alteration for each VQO using slope-specific ratios, thereby more accurately representing reality in a modelling environment. Slope-specific ratios have been developed from research undertaken within the MFLNRORD (MoF, 2003), and are presented in table 6.1.2.

Multiplying the P2P ratio with the alteration limit provides the plan-view alteration limit.

For example, if a VLI polygon has a *Partial Retention* VQO class (alteration limit of 1.6-7%, or mid-point of 4.3%), and a slope of 35%, then we would multiply the alteration mid-point of 4.3% by the P2P ratio of 2.45, which amounts to a planimetric view alteration limit of 10.5%. The P2P ratio suggests that the steeper the slope, the closer the alteration limit is to a perspective view.

Table 6.1.2 Plan to perspective ratios by slope class.

Slope range (%)	0-10	11-20	21-30	31-40	41-50	51-60	60-70	70+
P2P	4.68	3.77	3.04	2.45	1.98	1.60	1.29	1.04

For this timber supply analysis, each polygon within the Haida Gwaii VLI was assigned the plan-view alteration limit for its VQO class. The plan-view alteration limit is also an area-weighted calculation (e.g., a P2P ratio is proportionally determined by the area of slope classes within each VLI polygon).

All of Haida Gwaii's 1,014 VLI polygons were assigned mean VEG heights in addition to the alteration limits before being converted to a 1-hectare raster or *cell* for the spatial timber supply model (STSM).

A forest cover constraint was applied to each VLI cell within the STSM model based on the alteration limit and mean VEG height. While for timber supply analysis a minimum green-up height is assigned for each VLI polygon, table 6.1.3 provides the average minimum heights by VQO class.

Table6.1.3. Distribution of Visual Quality Objectives and average minimum VEG heights

VQO	Area (ha)	Area-weighted average minimum height (m)
Modification	53,244	5.4
Partial retention	148,532	6.4
Retention	52,297	5.6

6.2 Wildlife Habitat Areas

Wildlife Habitat Areas (WHA) are reserves designed to protect the habitat of Species at Risk or regionally important wildlife. The *Wildlife Act* mandates the Province to protect these two categories of identified wildlife, which subsequently provides formal management directions under the *Identified Wildlife Management Strategy (IWMS).* WHAs are one management strategy to protect or restore habitat for species' current or historic ranges. Originally WHAs were established under the *Operational Planning Regulation* through the *Forest Practices Code.* Currently, the authority to establish WHAs is enabled through sections 9 and 10 of the *Government Actions Regulation*.

WHAs on Haida Gwaii came into effect long before the Haida Gwaii Land Use Objectives Order (2010), which also provides measures to protect focal wildlife species. Currently four WHAs remain on Haida Gwaii, two areas for Northern Goshawk (*Accipiter gentilis laingi)* established in 2001 and 2003 amounting to a total of 4,905 hectares within the Datlamen and Bonanza Creek watersheds (orders 6-001 and 6-002). In addition, two areas for Marbled Murrelets (*Brachyramphus marmoratus*) were established in 2003 (orders 6-041, 6-046), amounting to a total of 380 hectares, within the Naden and Davidson watersheds.

Both Northern Goshawk WHAs are divided into *Post-Fledging Areas* (PFA) and *Foraging* areas. Post-fledging areas are smaller reserves nested within the broader WHA generally centered around known nest sites and do not allow any forest harvesting (Thompson & Pederson, 2001) (Macatee, 2003a). In other words, for timber supply analyses, the PFAs are 100% net-downs from the THLB. The two Marbled Murrelet orders also do not allow any forest harvesting (Macatee, 2003b) (Macatee, 2003c).

For the two Northern Goshawk WHAs, foraging areas have activity restrictions to maintain forest ages or succession classes (e.g., old, mature, young forest) as specified within each WHA (see table 6.2). For example, the WHA 6-001 must always be comprised of 384 hectares of old forest. In addition, the WHA requirements specify timing windows and other harvest/planning considerations.

Table 6.2. Foraging habitat forest succession class requirements for Northern Goshawk WHAs.

WHA_No	Old	Mature	Young	Very young
	>250 yrs	81-250 yrs	40-80 yrs	<40 yrs
6-001	384 ha	864 ha	432 ha	480 ha
6-002	240 ha	960 ha	960 ha	480 ha

Table 6.2 lists forest succession class requirements for each of the two Northern Goshawk WHAs. Ages have been referenced from the 1995 Biodiversity Guidebook (MoF)[30].

The timber supply analysis accounted for the WHAs by 100% netdowns or exclusion from the THLB for the two Marbled Murrelet WHAs and the two post fledgling areas of the two Northern Goshawk WHAs. Forest cover constraints were modelled based on the forest succession class restrictions (table 6.2) within the forage areas of the two Northern Goshawk WHAs.

6.3 Karst Management

Karst is a soluble carbonate bedrock (limestone) associated with subterranean cave systems and unique ecosystems. Karst is a resource feature often related to paleontological or archaeological resources as well, given the high potential habitation qualities of karst caves. Karst landforms are characterized by grooved rock surfaces, sinkholes, canyons,natural arches and caves and are divided into surface (epikarst) and subsurface (endokarst) features.

Geological mapping of karst began in the 1960s on Haida Gwaii (Brown, 1968), with most of the karst on Haida Gwaii occurring on the Sadler geological formation (Griffiths & Ramsey, 2009), which originated in the Triassic geologic period (227-208.5 million years ago). This relatively pure formation underlies approximately 60km^2 of the Islands, with about 1/3rd of the formation within Gwaii Haanas National Park Reserve and Haida Heritage Site. The Sadler limestone formation and other karst formations were mapped by Sutherland Brown in 1968, and again in the 1980s by the Geologic Survey of Canada (Desrochers & Orchard, 1991) (Woodsworth, 1991).

In 2006, the Haida Gwaii Natural Resource District established a Section 5 *GAR Order* under the *Forest and Range Practices Act* (FRPA) that identifies surface or subsurface elements of a karst system as a resource feature (Munt, 2006). These include significant surface karst features, high or very highly vulnerable karst terrain, and karst caves. Special management may include full protection from primary forest activities.

Schedule 2 of the HGLUOO (2010)lists karst as a Class 2 Haida Traditional Heritage Feature. Karst is protectedunder section 5(4) of that Order, when associated with high potential habitation sites, utilized on a temporary or permanent basis for shelter or other significant cultural or ceremonial activity.

The Sadler formation has the highest correlation with being karstic (pers. com. Paul Griffiths, 2019); with up to 50% being karst. Conversely, other formations such as the Peril formation may only include carbonates as a component, but karst still does occur in other geological formations; however there is incomplete inventory on the exact locations.

While there are uncertainties around the prescriptions for protecting karst (e.g. low samples of karst affecting forest management, therefore no clear patterns of buffering etc.), this uncertainty is more of a stand-level management uncertainty rather than a timber supply uncertainty.

For this timber supply analysis, 100% of the Sadler Formation was excluded from the THLB, which amounted to 12,356 hectares (gross) and 2,485 hectares (net after accounting for overlaps with other features). While this may over-represent karst in this specific geological formation, this is balanced by under-representing karst in the other limestone-based geologic formations.

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https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/BIODIV/tab2.htm

6.4 Community Watersheds

Community watersheds are legally designated watersheds under the *Forest Planning and Practices Regulation* (Sec. 8.2). Currently only those watersheds that feed domestic water use for Skidegate and Queen Charlotte are formally listed under the regulation. These watersheds include the Honna, Jervis, Slarkedus and Tarundl watersheds. The regulation sets out objectives to ensure that the cumulative hydrological effects from primary forest activities do not materially adversely impact the quantity of water, timing of water flow or human health. Hydrological recovery of community watersheds is often gauged by calculating an Equivalent Clearcut Area (ECA).

A recent hydrologic assessment completed for the most developed of these watersheds (Honna) estimated the ECA in 2018 to be between 10-11.6% of the watershed area. This along with relatively low densities of road (0.89km/km^2) has led to low levels of hydrologic hazards for the area (Brayshaw, 2016). The current prescribed rate of development to maintain these low levels of hydrologic hazards is 1% of the watershed per year, which given the time taken to reach hydrological green-up, amounts approximately to a 20% ECA (Church & Eaton, 2001).

Hydrologic recovery is defined in the HGLUOO as *the point at which regenerated forest stands have hydrologic properties similar to the pre-harvest hydrologic properties of the stands, with hydrologic responses within the range of natural variability*. For timber supply analyses and modelling purposes, hydrologic recovery was calculated using a logarithmic recovery curve developed by Floyd (2012), whereby each polygon's forest height over time contributes as an area-weighted average towards the hydrologic recovery of a watershed. For the base case, a forest cover constraint was applied, whereby 80% of the entire area of the watershed (forested and non-forested) needed to be hydrologically recovered. See section 6.11.6 for a more detailed description of hydrologic recovery in timber supply analysis.

6.5 Wildlife Tree Retention Areas

Section 66 of the *Forest Planning and Practices Regulation* requires that areas with wildlife trees must be retained to provide wildlife habitat and assist in the conservation of stand-level biodiversity. The regulation stipulates that an annual average of 7% across all cutblock areas in a 12 month period must be retained as Wildlife Tree Retention Areas (WTRAs).

Data on WTRAs for the years 2012-2016 were collated from all licensees to determine the net downs on the THLB.

Data were submitted by licensees in standardized geo-database formats either at the end of the calendar year, or on an application-by-application basis (for Road Permit, Cut Permit or Timber Sale Licence information sharing) to the Solutions Table.

The TWG undertook a spatial analysis to determine the gross and net effect of WTRAs on the THLB by licencee and by Management Unit. Determining the net effect meant examining the extent of overlap between WTRAs and other retention designated under the LUOO. In addition, Ministry guidance is for licensees to locate WTRAs optimally to incorporate multiple values or purposes (Forest Practices Branch, 2006). In total, licensees retained 2,980 hectares, or almost 21%, within Development Areas to meet LUOO and WTRA objectives. Of this amount, 1,835 hectares were retained to meet LUOO objectives and as WTRAs. The area retained solely for WTRAs was 1,145 hectares. A total of 2,345 hectares, or nearly 17% of Development Areas, were labelled WTRA, meaning that 1,200 hectares (2,345 – 1,145) were subject to co-location of WTRAs and retention for LUOO values (see table 6.5.1).

Table 6.5.1. Total area, average size per development area and distribution of exclusive WTRA polygons by licensee. (includes walkaway areas.)

	Total Development Area (ha)	Total– LUOO retention[1] (ha)	Total LUOO retention	WTRA – net of LUOO retention (ha)	WTRA-net of LUOO	Average size of WTRA per Development Area (ha)
BCTS	3896	201	5.2%	257	6.6%	3.2
Husby	4648	962	20.7%	353	7.6%	3.5
TSA 25 (BCTS & Husby[2]	8544	1162	13.6%	611	7.1%	3.4
TFL 60 (Taan)	4422	623	14.1%	502	11.3%	6.3
TFL 58 (Teal Jones)	1286	49	3.8%	33	2.6%	0.9
Total	14252	1835	12.9%	1145	8.0%	3.5

Notes:
(1) LUOO&WTRA denotes areas labelled as being retained for both LUOO objectives and as WTRAs; that is, LUOO retention excludes area retained solely for the purpose of WTRAs
(2) TSA 25 areas are an area-weighted average based on submissions from BCTS and Husby

For the base case it was assumed that WTRAs will overlap with LUOO retention objectives. LUOO in-block retention netdowns were stratified by old forest (≥250 years) and young forest (<250) to reflect the observed distribution of LUOO features (see section 6.11.16-6.11.21 or appendix 6). These LUOO retention netdowns amounted to 10.94% and 5.89% in old forest and younger forest respectively, in the Development Areas.

Given the expectation that WTRAs will be located within areas that are already being retained for other reasons, the retention for the LUOO already exceeds the needs for WTRAs for old forest, but falls short of the 7% FPPR minimum for younger forests. Therefore, for the base case there is no specific THLB exclusion for WTRAs in old forest, and a total 7% (or 1.11% above and beyond LUOO retention) exclusion in younger forest.

See section 8.2.8.2 for details on a sensitivity analysis that explores current practice WTRA retention levels.

6.6 Permanent Sample Plots

Permanent sample plots (PSP) are field measurement plots used to collect and maintain long-term re-measurement data on forests. Data are important components of developing and testing growth-and-yield models used to project future stand conditions in the province. Throughout BC approximately 7,800 plots have been established (FAIB, 2018). On Haida Gwaii, there are a total of 419 active PSPs, with some re-measured as many as four times dating back to their establishment in the 1960s.

While PSPs are not afforded formal legislated protection from forest harvesting, the Chief Forester formally requests licensees and natural resource decision makers to protect these assets from harvesting by maintaining a windfirm buffer in addition to the plot radius itself (Nicholls, 2018). A 100-m buffer is requested of licensees on Haida Gwaii, in addition to the plot size, which is typically 400m^2 (pers. communication, A.Reid, Inventory Forester, FAIB).

For the timber supply analysis, 100-m buffers were placed on all active PSPs on Haida Gwaii, with a 100% exclusion from the THLB. This is not a legal requirement and protection measures are not always applied and therefore the netdown may overstate the actual impact on the THLB.

6.7 Recreation Sites and Trails

Recreation sites

Recreation sites are found throughout Haida Gwaii, with some sites receiving formal designations as a recreation site or interpretive forest for protection under section 56 of the *Forest and Range Practices Act,* and others formally designated as *Land Act* reserves, typically for an 'environment, conservation and recreation' purpose and what used to be known as Use, Recreation and Enjoyment of the Public (UREP) sites. The majority of recreation sites on file overlap with and are protected by protected areas under the *Protected Areas of British Columbia Act*. The following is a list of recreation sites that do not overlap with established protected areas. Bolded sites are those that have legal designation and were excluded from the THLB. The others are not be legally designated but have recreational use and may be considered/managed at an operational level:

Mosquito Lake	Lawn Hill
Moresby	Marie Lake
Clapp basin	Ship Kleta Island
Rennell Sound	Hangover Creek
Small Lake	Stanley Lake
Spirit Lake	Copper Bay
Kagan Bay	Shields Island
Tarundl Creek	Roderick Island

Trails

A number of known recreation trails also overlap with protected areas. The CHN's Heritage and Natural Resource Department completed a trails inventory using high resolution differential GPS for trails that are widely used, as well as existing inventories of trails maintained by community organizations (e.g., Anvil trail). The Haida Gwaii Strategic Land Use Agreement identified protection of UREP sites, as well as protection of 40 trails listed as important for the future development of a tourism strategy (PMT, 2006) as key objectives While some ended up in protected areas/conservancies, many of these were not legally designated or protected. As a result, there is uncertainty around how these trails may be managed during forestry operations. A total of 23 trails were excluded from the THLB. Bolded names indicate *section* 57 designations under FRPA:

3-mile	Old Massett trails
Anvil Trail (in Tlall protected area)	**Onward Point**
Crabapple Creek	Pallant Falls
Drizzle Lake	Gore Brook
Evan's Farm	Riley Creek (in Duu Guusd protected area)
Gore Brook	Sandy Bottom Lake
Jags Lookout	Skonun Lake
Kumdis	**Slatechuck Mountain**
Kumdis Bay	**Sleeping Beauty**
Moresby Mountain	Spirit Lake
Mosquito Mountain	Tarundl Loop
Old Growth Alley	**5 Mile Beach**

For the purposes of timber supply analyses, the recreation sites listed above were 100% excluded from the THLB andwere given 100-mbuffers.. Despite the uncertainty regarding how these trails will affect forestry operations over the effective period of the upcoming AAC determinations, the effect of netting them out of the THLB is <0.1% of the FMLB.

6.8 Terrain Stability

Unstable terrain, subject to mass wasting disturbances such as landslides or debris torrents are typically not suitable for timber harvesting. Section 35 of the *Forest Planning and Practices Regulation* sets soil disturbance limits, which requires mapping of sensitive soils. Unstable terrain is divided into two main types: Class IV and, Class V terrain as defined by Chatwin (Chatwin, Howes, Schwab, & Swanston, 1994) and the Forest Practices Code Guidebook (MoF, 1999). Class4 and Class 5 terrain contains areas with a moderate likelihood and high likelihood (respectively) of landslide initiation following timber harvesting or road construction. Section 7.4 of this data package.4 details netdowns for natural disturbance resulting from past landslides and the projected occurrence for future landslides.

A variety of terrain mapping projects have been compiled into a consistent dataset to map Class 4 and Class 5 terrain on Haida Gwaii[31]. One project commissioned by the HGMC was to complete Terrain Stability Mapping for the Bonanza watershed using LiDAR digital terrain models and high resolution digital aerial photogrammetry (1:10,000 scale softcopy mapping) (Weiland, 2018).

For the timber supply analysis, an empirical approach was used in defining the amount of unstable terrain that is unlikely to contribute to the THLB. The proportion of timber harvests within the unstable terrain was calculated based on current practice: cutblock openings from the last 10-year market cycle (18,723 hectares), with data sourced from RESULTS and the HGLUOO annual digital spatial submissions. The objective was to determine the preference to avoid unstable terrain.

If the proportional contribution of a terrain class to the total harvest equals or exceeds its contribution to the THLB, then no netdown is warranted; in other words, if a class of unstable terrain contributes to harvesting in proportion to its contribution to the THLB (prior to exclusion of any unstable terrain), this would suggest that there is no tendency to avoid such areas. A preference ratio was calculated using the percent contribution of harvest within each terrain class and the percent contribution of the terrain class to a preliminary THLB. Therefore, the percent of terrain stability exclusion can be calculated as:

$$1 - \frac{\sum B \div \sum D}{\sum A \div \sum C}$$

Wherein *A* represents all the hectares in Class 4 or 5 terrain, *B* represents the hectares logged within Class 4 or 5 terrain over the last 10 years, *C* amounts to the hectares of preliminary THLB (prior to unstable terrain being removed), and *D* represents all hectares logged over the last 10 years.

Given that the amount of unstable terrain varies considerably among the three management units, and that licencees log these areas at different rates, it was considered important to calculate this ratio by management unit (TFL 60, TSA, TFL 58).

Table 6.8.1. Inputs into the terrain stability exclusion calculation or preference ratio for TFL 60

	Total area (ha)	Proportion of THLB	Area logged in previous10 years (ha)	% that was logged	THLB inclusion factor
Class 4 terrain	6,003	9%	170	4%	0.48
Class 5 terrain	6,363	10%	124	3%	0.33
THLB (preliminary[32])	65,648		3,879		

[31] Terrain stability mapping projects included *MoE 1978 (Digital Terrain Map Library); Western Forest Products, TSM Level D (D.Maynard); Queen Charlotte TSA, TSM Level E; Rennel Sound 1996 (J.R. Fulton, Geologic Survey of Canada); Gwaii Haanas TSM Level D (D.Maynard); Bonanza TSM, 2018 (Irena Weiland).*

[32] Preliminary THLB is an initial estimate of THLB that includes unstable terrain. Based upon a provisional THLB.

Table 6.8.2. Inputs into the terrain stability exclusion calculation or preference ratio for TSA

	Total area (ha)	Proportion of THLB	Area logged in previous10 years (ha)	% that was logged	THLB inclusion factor
Class 4 terrain	13,711	11%	657	5%	0.46
Class 5 terrain	15,867	13%	200	2%	0.12
THLB (preliminary[33])	123,258		12,965		

Table 6.8.3. Inputs into the terrain stability exclusion calculation or preference ratio for TFL 58

	Total area (ha)	Proportion of THLB	Area logged in previous10 years (ha)	% that was logged	THLB inclusion factor
Class 4 terrain	1,631	11%	152	9%	0.77
Class 5 terrain	1,297	9%	66	4%	0.42
THLB (preliminary[34])	14,251		1,735		

The THLB inclusion factor is the inverse of the exclusion calculation above. For example, for TFL 60, the preference ratio (exclusion factor) for Class 4 terrain is 52%, therefore 48% of this terrain class is included in the THLB.

Using the numbers in table 6.8.1 to 6.8.3 amounts to a total gross netdown of 16,816 hectares from Class 4 terrain and 30,987 hectares from Class 5 terrain from the THLB. Areas harvested since 1996 within Class 4 and Class 5 terrain were kept in the THLB (no netdown inclusion factor applied).

Logging in class 4 or 5 terrain may increase the risk of mass wasting and therefore may not be good stewardship. Given that the preference ratio is dependent on the number of hectares logged in Class 4 or 5 terrain, an analysis was completed to determine the number of landslides within areas logged in Class 4 or 5 terrain over the last 10 years. Landslide mapping (including initiation points) were overlapped with cutblocks within Class 4 and 5 terrain. The total slide area overlapping cutblocks was 11 hectares, and the total slide area with the slide initiation inside the blocks is 6.4 hectares. Therefore, the area of slides relative to the total area logged within Class 4 and 5 terrain is small (<1%), suggesting that no further reduction beyond the preference-related exclusions discussed above are warranted.

See section 8.2.14 for details on a sensitivity analysis whereby a broader range of cutblocks were sampled (extending back to 1996).

6.9 Roads, Trails and Landings

Roads, trails and landings represent a loss of productive forest area. Existing roads were mapped using a variety of sources, including TRIM, historic licensee road data (TFL 39), road segments from the RESULTS dataset[35], as well as roads from a mapping gap analysis conducted by the CHN's Heritage and Natural

[33] Preliminary THLB is an initial estimate of THLB that includes unstable terrain. Based upon a provisional THLB.
[34] Preliminary THLB is an initial estimate of THLB that includes unstable terrain. Based upon a provisional THLB.
[35] WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW

Resource Department using high resolution imagery. Existing roads were classified as 'permanent', 'mainlines' and 'branches'. The following summarizes the lengths of road used within the timber supply analyses.

Road type	Length (km)
Permanent	322
Mainline	1,412
Branch	5,754
Total	7,488

An analysis of average non-vegetated road widths was completed to determine a net down to existing productive forests, leading to a 10m and 20m (total) buffer width on branches and permanent/mainlines respectively. 100% of these areas were excluded from the THLB.

A review of primary forest activities in second growth stands was conducted to determine what proportion of old road prisms and ditchlines were contributing to harvested volumes. Cruise and scale from a number of blocks within the Datlaman/Juskatla Inlet and Cumshewa (Aero camp) areas (Taan Forest Products) were reviewed and confirmed that right of way volumes from old branches/mainlines have not contributed to merchantable volumes. As more second growth is developed over the next timber supply period (10 years), further data can be gathered on historic right-of-way contributions to timber supply.

Exclusion of future roads from currently undeveloped areas of the THLB was calculated by determining the proportion of roaded to un-roaded area relative to 725 cutblock openings over the last 10 years (referred to as *market cycle blocks*). Using the road classifications and buffer widths above, 6.4% of openings were made up of roads.

Forest industry licensees commented that many roads become re-forested and therefore, excluding the full 6.4% figure from the future THLB would overstate the impact of roads. The TWG consulted with researchers with experience on the topic of road rehabilitation. Those experts indicated that while systematic research has not been done on Haida Gwaii, anecdotal observations are that where old road beds become re-forested, alder makes up on average approximately over 80% of the volume, and that the productivity on old roads is lower than the surrounding area. Alder is a minor commercial species on Haida Gwaii, contributing about 0.3% of the volume billed on Haida Gwaii in the 2013-27 period.

Therefore, for the base case, the assumption was that the full 6.4% would not contribute to future timber supply after the first harvest. However, since a concern was expressed, a sensitivity analysis was performed in which allowed for the regeneration of future roads to provide an indication of the potential impact of re-forested roads. See section 8.2.12 for more details on this sensitivity analysis.

6.10 Haida Gwaii Land Use Objectives Order

6.10.1 Data source overview

The Haida Gwaii Land Use Objectives Order (HGLUOO) came into effect in June of 2011 as a major milestone in the implementation of the Haida Gwaii Strategic Land Use Agreement (2007). The HGLUOO sets a total of 23 objectives under the *Land Use Objectives Regulation* of the *Land Act* for the management of cultural, aquatic, biodiversity and wildlife values.

A requirement repeated throughout the HGLUOO is for licensees to submit annual reporting data to the CHN and the Province of BC. This spatial data was used both to identify known reserve zones, management zones, retention areas and features (e.g., streams, monumental cedar, etc.), as well as to help predict the occurrence of currently unknown features.

Appendix 6 includes further descriptions of the HGLUOO annual submission spatial dataset.

6.10.2 Known and predicted exclusions from the THLB

Some objectives have landscape-level spatial inventories associated with them, and others do not. For example, Type I and Type II fish habitat can be mapped and modelled to represent all the estimated fish habitat across the Islands (e.g., HGLUOO Schedule 4) and therefore excluded from the THLB across the entire analysis horizon (400 years). However, most stand-level values (e.g., CMTs or monumental cedar) do not have l spatial inventories that cover all of Haida Gwaii, but their current known spatial occurrences are both excluded from the THLB and are used to predict the frequency of their distribution across the entire landscape. This frequency of distribution, expressed as a percent per hectare, is used to exclude predicted occurrences from the THLB.

Determining the amount of exclusion from the THLB by given objective is broadly defined by three applications:

- **Spatial net downs:** where the value has been mapped, either fully (all occurrences are known across the landscape), or in part (only some occurrences are known)
- **Predicted exclusions:** Where there is an incomplete inventory of a value then a frequency distribution analysis using known occurrences is used to predict unknown occurrences. For example, not all Haida Traditional Forest Features are inventoried across the landscape, however we have a robust dataset to predict their distribution. In certain cases, statistical analysis was used to assess whether values were most closely associated with specific site conditions (e.g., tree ages and/or species).[36].
- **Forest cover constraints:** Where targets have been set to conserve a value (e.g., a specified percentage of an ecosystem type must be covered by mature forest), static retention areas are not established. This allows for a dynamic constraint, whereby strata retention targets are met, but areas retained can move over the timber supply analysis horizon.

The following table classifies how HGLUOO objectives were applied in the TSR, with further details provided throughout this section:

[36] Statistical tests included classification and regression trees and chi-squared goodness-of-fit tests (where expected frequencies are tested against observed frequencies).

Table 6.10.2 HGLUOO data sources and their application to the TSR.

HGLUOO type	Data source[37]	Scale of application	Timber supply model application
Cedar Stewardship Area	HGLUOO Schedule 3	Landscape	Spatial netdown
Forest Reserves	HGLUOO Schedule 8	Landscape	Spatial netdown
Northern Goshawk Nesting Reserves	HGLUOO Schedule 12 and predictive territory model	Landscape	Spatial netdown and predicted exclusion
Marbled Murrelet Nesting Habitat	HGLUOO Schedule 11	Landscape	Forest cover constraint
Saw Whet Owl Nesting Reserves	HGLUOO Schedule 12	Landscape	Spatial netdown
Type I Fish Habitat	HGLUOO Schedule 4 and predictive habitat model	Landscape	Spatial netdown and predicted exclusion
Type II Fish Habitat	HGLUOO Schedule 4 and predictive habitat model	Landscape	Spatial netdown and predicted exclusion
Active Fluvial Units	Various terrain mapping products	Landscape	Spatial netdown
Forested Swamps	Various ecosystem mapping products	Landscape	Spatial netdown
Ecological Representation	Various ecosystem mapping products	Landscape	Spatial netdown
Red/Blue Listed Communities	Various ecosystem mapping products	Landscape	Spatial netdown
Sensitive Watershds	HGLUOO Schedule 7	Landscape	Forest cover constraint
Upland Stream Areas	HGLUOO Schedule 6	Landscape	Forest cover constraint
Northern Goshawk Nesting	HGLUOO Schedule 12	Landscape	Spatial netdown
Saw Whet Owl Nesting	HGLUOO Schedule 12	Landscape	Spatial netdown
Haida Traditional Heritage Features	Registered Archaeological Sites; CHN Heritage Feature database	Landscape & stand level	Spatial netdown
CMTs	Registered Archaeological Sites; CHN Heritage Feature database; HGLUOO licensee spatial submission	Stand level	Spatial netdown Frequency distribution analysis for predicted occurrence
Monumental cedar	HGLUOO licensee spatial submission	Stand level	Spatial netdown Frequency distribution analysis for predicted occurrence
Haida Traditional Forest Features	HGLUOO licensee spatial submission	Stand level	Spatial netdown Frequency distribution analysis for predicted occurrence
Cedar Retention	HGLUOO licensee spatial submission	Stand level	Spatial netdown
Western Yew Retention	HGLUOO licensee spatial submission	Stand level	Spatial netdown Frequency distribution analysis for predicted occurrence
Black Bear Dens	HGLUOO licensee spatial submission	Stand level	Spatial netdown Frequency distribution analysis for predicted occurrence

Final netdown values for HGLUOO objectives with explicit 'spatial netdowns' are listed in THLB netdown tables (section 3.2.1 of this data package). The netdown for those objectives with a frequency distribution analysis are summarized as LUOO in-block retention in section 3.2.1.The results of a frequency distribution analysis are expressed as a percentage of each hectare of THLB both in old forest and younger forest strata (see sections below for more details on analysis approaches).

[37] Details listed in subsequent sections.

6.10.3 Tree lengths

Many objectives within the HGLUOO require a buffer determined by an in-situ tree length, or a tree length based on Schedule 5 of the HGLUOO. Several HGLUOO objectives have landscape-level spatial inventories associated with them that could be used for TSR. Of those, Type I and II Fish Habitat, Active Fluvial Units, and Forested Swamps required tree length buffers to be modelled. Where management/reserve zones for Monumental cedar and CMTs aren't already spatially delineated, those values also require tree length buffers to be modelled. Management buffers were modelled by assigning a Schedule 5 tree length based on the site series that intersects the feature and multiplying that tree length by the HGLUOO requirements (e.g., 1.5 tree lengths).

Site series were determined using the primary decile of the ecosystem mapping layer. Schedule 5 assigns different heights for old and mature stands. For this TSR, old stands were existing unmanaged stands >250 years, and all other stands were assigned heights for mature stands.

Schedule 5 of the HGLUOO lists tree heights used to calculate buffers can be found at http://www.haidagwaiimanagementcouncil.ca/wp-content/uploads/2017/11/HGLUOOSched05_TreeHgt_20170713.pdf

Note that for analytical simplicity spatial boundaries between reserves and management zones were blended using a weighted-area average THLB inclusion factor.

Landscape level Objectives

6.10.4 Active Fluvial Units

Active Fluvial Units (AFU) are active floodplains including low and medium benches and zones of active fans and are reserved from harvest as per section 12 of the HGLUOO. AFUs vary significantly in size. The objective is to protect AFUs where harvesting could cause increased channel erosion and the consequent impacts to fish habitat.

Data source

A variety of data sources were used for delineating these features. Best available datasets were included in the following order of priority:

- LiDAR derived strategic floodplains and fans. This includes mapping from two projects by Horel (Horel, 2017): one for Taan Forest Products Ltd., and one for the Haida Gwaii Management Council covering areas where LiDAR was available. Both projects delineated floodplains and active fans using LiDAR-based digital elevation model, 1-m contours and high resolution (25cm) colour ortho-photography. Operational scale mapping for the Bonanza Creek watershed was included in this dataset.
- Watershed assessment mapping (operational scale) of active floodplains and fans for the Awun (Milne M. , 2002), Datlaman (Milne M. , 2004), Haans Creek (Milne M. , 2003), upper Deena (Milne, M.J., 2007) and Lower Yakoun watersheds.
- Terrain classification mapping (survey intensity level c) was completed by Terry Lewis for Skidegate lake and Mosquito lake for the delineation of floodplains and fans in 2009.
- Riparian Fish Forest floodplain mapping (Broadhead, 2008). For this layer, site series and other Terrestrial Ecosystem Mapping attributes were used to theme major riparian floodplain features.

Some overlaps between these projects exist, mostly between Lewis and Horel and Riparian Fish Forest mapping projects on North Moresby and RFF and Horel in TFL 60. All overlaps were removed, and the AFU layer for the analysis created according to survey or mapping intensity, with the following priority from highest to lowest: Horel, Lewis, CWAP, RFF model.

Net down assumptions
The HGLUOO stipulates a 1.5 tree length management zone from the edge of the active fluvial unit, along with a 10% allowable variance. Tree lengths from LUOO Schedule 5 were used, based on ecosystem mapping updated to mid-2019. As such 100% of the AFUs were excluded from the THLB, and 90% of the buffered management zones were excluded from the THLB.

6.10.5 Type I and Type II Fish Habitat.
The HGLUOO classifies retention for low gradient (<5%) S1, S2 and S3 streams (along with adjacent lakes, wetlands and marine interface zones) as Type 1 fish habitat and higher gradient (>5%) streams (including S4 streams) as Type 2 fish habitat. For the purposes of modelling timber supply, the provisions for riparian management for Type 1 fish habitat, described in section 10 of the HGLUOO, have greater retention objectives and therefore supersede the provisions under the *Forest and Range Practices Acts Forest Planning and Practices Regulation.*

Data source
HGLUOO Schedule 4 (Type I and II Fish Habitat)
2012-2016 HGLUOO annual submission data
Modelled Type I and II Fish Habitat

Net down assumptions
Type I and II fish habitat was spatially represented through a modified Schedule 4 fish habitat model, TRIM lakes and wetlands, and marine interface zone mapping, as described below. For Type 1 habitat, reserve buffers 2-tree lengths wide were created, with 95% of the buffers excluded from the THLB. Buffer width for Type 2 habitat was 1.5 tree lengths, and the exclusion was 80%.

Creating a Modified Schedule 4 Fish Habitat Model
Schedule 4 fish habitat mapping represents a strategic-level product that combines empirical fish absence/presence data (Broadhead, 2008), TRIM streams and modelled gradient breaks (JTT, 2011).
The spatial linework of the Schedule 4 fish habitat mapping is TRIM streams, and as such is known to underestimate the number of smaller order streams and potentially overestimate the number of higher order streams. Underestimating smaller order streams could lead to an underestimation of netdowns from LUOO buffers, and as such overestimate available timber supply. Therefore a key objective was to:

- quantify the discrepancy between Schedule 4 fish habitat mapping and actual classified streams in the field, and then;
- spatially model what is believed to be a more accurate representation of fish habitat distribution on Haida Gwaii.

The following summarizes and borrows the results of that analysis and describes the subsequent landscape modelling conducted by Fall (2017). For more details see the Fall (2017) report.

Quantifying discrepancies between Schedule 4 fish habitat and field-classified fish habitat
Field mapped stream data were collected and analysed for 14,092 hectares of development areas between 2012 and 2016.

While field mapped stream data is not representative of the distribution of these streams over all of Haida Gwaii, the data is useful to characterize the distribution of fish habitat, as seen in table 6.10.5.1. Ecosections are physiographic groupings with distinct topographies that can be used to stratify the land base (Holland, 1976), helping refine our understanding of what habitat types we expect to find in different regions. For example, the QC Lowlands are made of low gradient landforms where we may expect a higher proportion of larger low gradient streams as compared to the QC Ranges ecosection (west coast) where we may expect more smaller high gradient streams. Table 6.10.5.1 summarizes the field mapped streams by ecosection and fish habitat class.

Table 6.10.5.1 Field map streams by ecosection and fish habitat class (sourced from table 2 Fall (2017)

Ecosection	Type I		Type II		Ratio of Type I to II	Type I + II metres per ha
	length (km)	metres per ha	length (km)	metres per ha		
QC Lowlands	114.6	12.7	78.2	8.6	1.47	21.3
Skidegate Plateau	55.3	11.8	55.6	11.8	1.00	23.6
QC Ranges	10.7	10.2	12.0	11.5	0.89	21.7
Total	180.5	12.2	145.7	9.9	1.24	22.1

The adequacy of using Schedule 4 fish habitat mapping for timber supply was evaluated by calculating whether the frequency and distribution of Schedule 4 fish habitat was similar to what was found in the field (see table 6.10.5.2). This confirmed the expectation that Schedule 4 fish habitat mapping overestimates higher order streams (large low gradient type I streams) and underestimates lower order streams (smaller higher gradient type II streams).

Table 6.10.5.2 Comparison between Schedule 4 fish habitat and fish habitat found in the field (sourced from table 3, Fall (2017))

Ecosection	Type I			Type II			Type I + II relative to field
	length (km)	metres per ha	Relative to field	length (km)	metres per ha	Relative to field	
QC Lowlands	158.6	17.5	**138%**	8.9	1.0	**11%**	**87%**
Skidegate Plateau	61.3	13.0	**111%**	39.8	8.4	**72%**	**91%**
QC Ranges	13.0	12.5	**122%**	12.1	11.6	**101%**	**111%**
Total	232.9	15.7	129%	60.8	4.1	42%	**90%**

A Chi-square test for equality of proportions was completed and demonstrated that the frequency/ distribution of fish habitat *versus* non-fish habitat was statistically significantly different between these two data sets. These findings supported the development of a landscape-scale model to more accurately represent the distribution and types of fish habitat across Haida Gwaii.

Landscape level habitat modelling to improve estimations of fish habitat distribution

The proportions and amount of fish habitat found in the field needed to be scaled up to the entire land base while avoiding two types of error: (i) under or over-representing fish habitat in general; and (ii) misclassifying Type I habitat as Type II, or the converse. A scaling analysis compared Schedule 4 fish habitat to the expected proportion and amount of habitat found in the field. The results of a scaling analysis found that overall fish habitat is underrepresented in Schedule 4 across the land base by 7%, as seen in table 6.10.5.3.

Table 6.10.5.3. Schedule 4 fish habitat scaled based on field data. The % of S4 column is the relative percent of the scale values to the Schedule 4 values (sourced from table 5, Fall(2017)).

	Schedule 4			Scaled (expected)					
	Type I	Type II	Type I + II	Type I		Type II		Type I + II	
Ecosection	length (km)	length (km)	Scale factor	length (km)	% of S4	length (km)	% of S4	length (km)	% of S4
QC Lowlands	4,806	534	**115%**	2,615	54%	3,530	661%	6,145	**115%**
Skidegate Plateau	1,692	2,097	**110%**	1,423	84%	2,730	130%	4,153	**110%**
QC Ranges	1,500	2,055	**90%**	1,206	80%	2,005	98%	3,211	**90%**
Total	7,998	4,685	111%	5,245	66%	8,265	176%	13,509	107%

This scaling analysis provided targets for modifying the Schedule 4 fish habitat data in order to reflect stream lengths and distribution of habitat classes found in the field.

A stream model was built using SELES. The scaled Schedule 4 targets were used to re-classify Type I and II fish habitat and to extend or retract streams to match the scaled targets. Extensions of streams were initiated in the lowest gradient stream 'cells' and diffused upslope with preferences for low class streams (high contributing areas) and with a diffusion rate also linked to slope (faster diffusion in lower gradient streams). Final models were cross-validated using the field-based stream data using a Jaccard coefficient statistical test confirming aspatial correlation between the modified Schedule 4 and field data[38]..

Another Chi-squared analysis was done with the scaled or modified Schedule 4 data and resulted in the probability that the two datasets (field based vs. *modified* Schedule 4) were similar (not statistically different).

For timber supply analysis, the raster-based modified Schedule 4 model was converted to polylines and buffered.

Marine interface zones

Marine interface zones into which Type I or II fish habitat streams flow are protected under the HGLUOO. They are high-value marine habitats made up of kelp beds, herring spawn areas, shallow intertidal areas, nearshore habitats used by marine invertebrates for reproduction and rearing) (CIT, 2004) (JTT, 2011). Estuaries, herring spawn areas, eelgrass/kelp bed mapping and clam beds were used to intersect the modified Type I fish habitat. Estuary data was sourced from the Pacific Estuary Conservation Program (Remington, 1993) that mapped significant estuaries across the north coast. Shoreline herring spawn data is sourced from the Ecologically and Biologically Significant Areas (EBSA) project for the Pacific North Coast Integrated Management Area (PNCIMA) (Clark & Jamieson, 2006). Eelgrass, kelp and clam bed mapping from BC's *Coastal Resource Information Management System* (CRIMS) was also used. Data were cross-referenced with data from the *Haida Marine Traditional Knowledge Study* (Windbourne, 2011).

For the timber supply analysis, marine interface zones were assigned the Schedule 5 tree heights of the adjacent site series (buffered intersection)

[38] See table 8 in Fall (2017).

6.10.6 Upland Stream Areas and Sensitive Watersheds

Schedule 7 of the HGLUOO includes all the sensitive watersheds that must be managed under section 14 of the HGLUOO. These watersheds are listed as sensitive due to historic logging, fisheries or water quality importance, higher risk due to topography or stream morphologies or a combination of the above (JTT, 2009). Section 14 of the HGLUOO stipulates that 80% of each watershed must be hydrologically recovered. Hydrologically recovered is defined as *"the point at which regenerated forest stands have hydrologic properties similar to the pre-harvest hydrologic properties of the stands, with hydrologic responses within the range of natural variability"* (HGLUOO 2017).

Upland stream areas are those portions of the watershed sub-units identified in Schedule 6 of the HGLUOO (outside of the reserve and management zones of Type I and Type II fish habitat) wherein 70% of the forests must be hydrologically recovered. This objective is meant to maintain the integrity of non-fish bearing streams, typical of headwaters.

See appendix 7 for a discussion on concepts of hydrologic recovery relative to timber supply and recovery curves.

Data sources

- Schedule 7 of the HGLUOO (sensitive watershed boundaries)
- Schedule 6 of the HGLUOO (upland stream area watershed sub-units)
- Hydrologic recovery curves for rain on snow precipitation regimes[39]:

Modelling assumptions

The following recovery curve equation was used:

$$HR = 100(1-e^{-0.205(H-4.5)})^{1.05}$$

Where HR = hydrological recovery and H = average height of the stand. It is assumed stands have 75 to 90% plus crown closure. HR was cut off at 97.5% in the analysis (see table 7.11.16). See also appendix 7 (recovery curve tables).

[39] Sourced from W.Floyd, regional hydrologist, Ministry of Forests, Lands, Natural Resource Operations and Rural Development

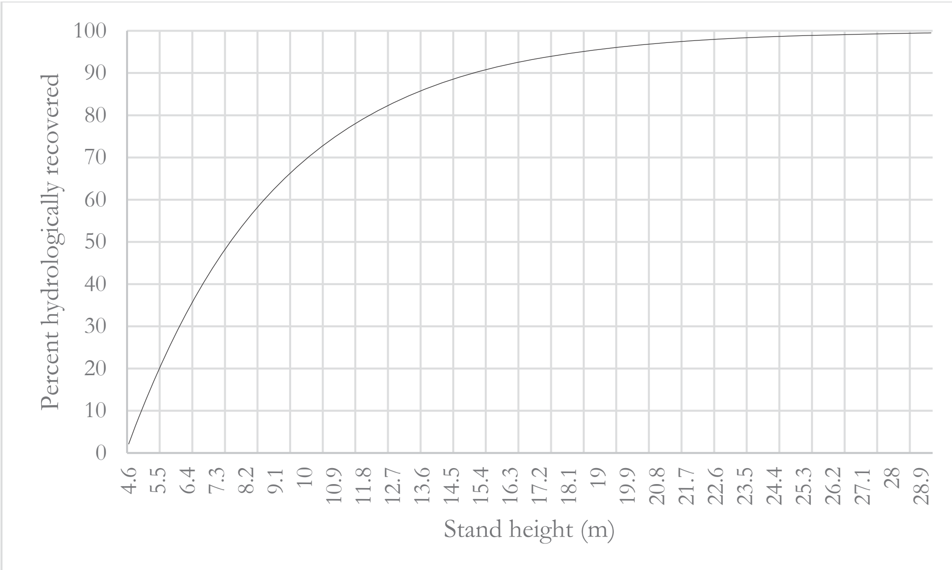

Figure 6.10.6.1 Hydrologic recovery curve used to inform a forest cover constraint for timber supply

For this timber supply analysis, hydrologic recovery curves were used to apply a *forest cover constraint* within the STSM model. Rate of recovery is linked to stand height, and an area-weighted calculation aggregated all the stands within a watershed or watershed sub-unit.

For sensitive watersheds, the entire watershed (forested and non-forested) was used as the denominator since the entire drainage basin forms the hydrological response to water inputs (Church & Eaton, 2001). The model then constrains forest harvesting to ensure that each watershed unit's summed hydrologic recovery does not go below the 80% target for sensitive watersheds.

For upland stream areas, the entire watershed (including non-forest) minus the reserve and management areas for type I and II fish habitat were used as the denominator. This matches the HGLUOO definition of upland stream areas, which are areas that exclude fish habitat (e.g. an objective to manage non-fish bearing streams). The model constrains forest harvesting to ensure each upland stream area's summed hydrologic recovery does not go below 70% target for upland streams areas.

For both sensitive watershed and upland stream areas wetland bogs are considered to be hydrologically recovered. See appendix 7 for more details on hydrologic recovery curves or section 8 that describes a sensitivity analysis that excludes bog wetlands from being considered hydrologically recovered.

6.10.7 Forested Swamps

Relatively rare ecological units classified as Cedar-Spruce-Skunk Cabbage (site series CWHwh1 12, CWHvh2 13[40]), are protected under section 15 of the HGLUOO.

Data source

Ecosystem maps for Haida Gwaii. Spatial layers described in Tripp and Temmel (2017) and section 4.4 of this data package. Primary site series were used to identify forested swamp site series outlined in Schedule 10 of the Haida Gwaii Land Use Objectives Order.

[40] Site series listed above correspond to the HGLUOO listings, however the biogeoclimatic classification system updated in 2014 lists them as site series CWHwh1 118 and CWHvh3 117 (Banner, W. MacKenzie, MacKinnon, Saunders, & H.Klassen, 2014).

Net down assumptions
The HGLUOO stipulates a 1.5 tree length management zone from the forested swamp, along with a 30% allowable variance. Therefore, 100% of the forested swamp units were excluded from the THLB, and 70% of the 1.5 tree length management zone was excluded from the THLB.

6.10.8 Blue/Red listed ecosystems
Site series listed in Schedule 13 are excluded from the THLB to reflect protection measures outlined in section 17 of the HGLUOO (see table 6.11.8.1). Note that all red listed forested ecosystems on Haida Gwaii are floodplain forest sites and therefore tend to overlap with fish habitat or active fluvial unit features.

Data source
Ecosystem maps for Haida Gwaii. Spatial layers described in Tripp and Temmel (2017) and section 4.4 of this data package. Primary site series were used to identify polygons with either red or blue listed ecosystems.

Net down assumptions
While the LUOO requires that red-listed ecosystems be excluded from logging, since they overlap entirely with Type I and II fish habitat and/or Active Fluvial Units, their exclusion has no additional effect on the THLB beyond the impact of those other values.

All blue-listed ecosystems were also 100% excluded from the THLB as this represents the 'default' (low risk) requirements of the HGLUOO.

The table 6.11.8 lists red/blue-listed units.

Table 6.10.8 Applicable excerpts from the HGLUOO Schedule 10.

BEC	Site Series	Name	Status
CWHvh2	5	CwSs - Sword fern	BLUE
CWHvh2	7	CwSs - Devil's club	BLUE
CWHvh2	10	Dr - Lily-of-the-valley	BLUE
CWHvh2	16	Ss - Reedgrass	BLUE
CWHwh1	3	CwSs - Sword fern	BLUE
CWHwh1	6	CwSs - Conocephalum	BLUE
CWHwh1	14	Ss - Kindbergia	BLUE
CWHwh1	15	Ss - Reedgrass	BLUE
CWHwh2	4	CwSs - Conocephalum	BLUE
MHwh	3	SsHm - Reedgrass	BLUE
MHwh	5	YcHm - Twistedstalk	BLUE
CWHvh2	8	Ss - Lily-of-the-valley	RED
CWHvh2	9	Ss - Trisetum	RED
CWHwh1	7	Ss - Lily-of-the-valley	RED
CWHwh1	8	Ss - Trisetum	RED

Blue listed ecosystems make up 62,444 hectares of the forests of Haida Gwaii, however when overlapped with other areas excluded from the THLB only account for an additional 15,566 hectares of netdown from the THLB.

Section 17(3) and (4) of the HGLUOO allow for 30% of blue-listed ecosystems to be altered or harvested altered or harvested if required for road access or to address a safety concern, or for other reasons agreed to through an Intergovernmental Process (IGP). In theory this may represent an additional 4,606 hectares that could be considered THLB, however this allowance has not been put into practice and therefore it was not assessed in the base case, but it's timber supply implications are assessed in a sensitivity analysis detailed in section 8.

6.10.9 Landscape-Level Representation of Common and Rare ecosystems

Common and rare site series and their conservation targets listed in Schedule 10 of the HGLUOO are removed from the THLB to reflect measures outlined in section 16 of the HGLUOO.

Data source

Ecosystem mapping for Haida Gwaii. Spatial layers described in Tripp and Temmel (2017) and section 4.4 of this Data Package. Primary site series were used to identify site series outlined in Schedule 10 of the Haida Gwaii Land Use Objectives Order.

Schedule 10 can be downloaded at http://www.haidagwaiimanagementcouncil.ca/wp-content/uploads/2017/11/HGLUOOSched10_SSTargets_20170713.pdf

Net down assumptions

Landscape unit targets by site series are listed in Schedule 10. An analysis of each site series overlap with existing protection or exclusion from the THLB was completed to determine a landscape unit by site series deficit (area needed to be reserved to meet the Schedule 10 targets). A netdown to the THLB was used as opposed to forest cover constraints due to the complexity of modelling this objective.

In summary, landscape unit deficits were determined for each site series. Where there were deficits (e.g. the conservation targets weren't met in existing protected areas or outside of the THLB) then old forest was the preference to meet the targets, and if there wasn't enough old forest, then second growth/younger forest was identified to meet the targets.

The analysis stratified old forest (>=250 years) from younger forest (<250 years), as the HGLUOO mandates a preference for old forest retention.

Out of the 154 site series/landscape unit combinations, 105 had all Schedule 10 targets met outside of the THLB, therefore did not require any further exclusions. For the remaining 47 units, a deficit was calculated and used to exclude areas of those units from the THLB proportional to their landscape unit occurrence and conservation targets.

For example, to calculate the THLB exclusion for the CWHwh2 05 sites series in Honna Landscape Unit, the Schedule 10 target is to retain 586 hectares as old forest. Currently, approximately 316 hectares have a pre-existing exclusion from the THLB. Therefore, the Landscape Unit deficit is 270 hectares (586-316). The entire area of CWHwh2 05 in this Landscape Unit is 761 hectares, of which 324 hectares is old forest in the THLB. Therefore, a total 83% of this unit (270÷324) must be excluded from the THLB to meet the Schedule 10 target.

This target was subsequently applied to old forest, however, if there were not enough hectares of old forest, then the remaining proportional deficit was applied to younger forest in the THLB.

Note that for Skidegate Lake, Louise Island and Sewell, the TSR ecosystem mapping dataset has site units using both the old BEC classification and the new BEC classification. In these cases, the new BEC was cross-walked and the target/deficit/constraint calculations were aggregated/shared across the units to avoid double counting a constraint.

Table 6.10.9 lists the final retention targets to be excluded from the THLB by site series. Bold units represent hectares excluded from the THLB in order to meet targets, with the percentage in green to represent old forest exclusion, and orange to represent young forest exclusion[41] necessary to meet the targets. Units with a dash (-) represent areas where targets were met outside of the THLB. The following is a descriptive example of table 6.10.9.1

BEC Variant	Site Series	Exclusions for Honna LU	
CWHwh1	02	**15 ha**	area of this site series excluded from the THLB to meet Schedule 10 targets
		100%	excluded % of each old-growth polygon in this site series
		72%	excluded% of each second-growth polygon in this site series
CWHwh1	10	**218 ha**	
		100%	excluded% of each old-growth polygon in this site series was excluded
		100%	excluded% of each second-growth polygon in this site series
CWHwh2	05	**586 ha**	
		83%	excluded % of each old-growth polygon in this site series
		0%	excluded% of each second-growth polygon in this site series

[41] Site series/Landscape Units not listed means that targets have been met in protected areas, or the LU's do not overlap with the forest management land base.

Table 6.10.9 Ecosystem targets by landscape unit. Bold units represent hectares where area was excluded from the THLB in order to meet targets, with the percentage in green to represent old forest exclusion, and orange to represent young forest exclusion to meet those targets. All dashed (-) units mean that targets were met outside the THLB.

BEC Variant	Site Series	Eden Lake	Honna	Ian	Louise Island	Lower Yakoun	Masset Inlet	Naikoon	Otun	Rennell	Sewell	Skidegate Lake	Tasu	Tlell	Yakoun Lake
CWHvh2	2						-								
CWHvh2	6									-	-		-		
CWHvh2	14												-		
CWHwh1	1	-	-	-	-	-	-	-	-	-	-	3147 100% 68%		-	-
CWHwh1	2	-	**15** 100% 72%	**627** 100% 100%	**1030** 100% 100%	-%	**2181** 100% 100%		-		-	-		-	**382** 100% 97%
CWHwh1	4	-	-	-	-	-	-	-	-	-	-	-		-	-
CWHwh1	5	-	-	-	-	-	-	-	-		-	-		-	-
CWHwh1	9				-	-					-				-
CWHwh1	10	-	**218** 100% 100%	-	-	-	**272** 100% 1%	-	-		-	-		-	-
CWHwh1	11	**938** 100% 100%	-	**478** y 100%	**41** 100% 100%	-	**65** 100% **1%**	-	**5690** 100% 100%	-	**49** 0% 100%	-		-	**95** 100% 10%
CWHwh1	13										-	-			-
CWHwh1	16		-									-		-	
CWHwh2	1	-	-	-	-	-	-			-	-	-		-	-
CWHwh2	2	-	-	-	165 100% 5%	-	**1868** 13%			-	**81** 62%			-	-
CWHwh2	3	**2042** 100% 5%	-	**20** 100% 87%	**36** 100% 100%	-	**76** 100% 84%			-	-	**259** 50%			**148** 100% 100%
CWHwh2	5	**656** 27%	**586** 83%	**178** 100% 100%	62 100% 100%	**41** 100% 100%	**173** 100% 100%			**6** 62%	**315** 100% 100%	**76** 100% 100%		**210** 100% 100%	-
MHwh	1	-		**309** 100% 100%	-	-	**779** 100% 100%				**438** 0% 100%	**219** 100% 100%	-		**275** 100% 100%
MHwh	2		-	-	-	-	-			-		**184** 100% 100%	-		
MHwh	4	-	**158** 7%								-		**77** 100% 100%		
MHwh	6									-			-		
MHwh	8	-	-							**63** 100%			-		
MHwh	9									-					

6.10.10 Forest Reserves

These are areas reserved from harvesting as per section 23 of the HGLUOO to meet Marbled Murrelet and Ecosystem Representation targets. Section 23(2) allows for a 5% reduction of an individual forest reserve polygon (operational variance does not require an intergovernmental process).

Data source
HGLUOO Schedule 8.

Net down assumptions
95% exclusion from the THLB of each forest reserve polygon.

6.10.11 Marble Murrelet habitat

Areas retained to meet Marbled Murrelet nest habitat by landscape unit, as outlined in Objective 19, Schedule 9 (landscape unit targets) and Schedule 11 (mapped habitat) of the HGLUOO.

Data source
HGLUOO Schedule 9 (Landscape Unit targets), Schedule 11 (Marbled Murrelet habitat map), and Schedule 1 (Landscape Units).

Net down assumptions
An analysis was completed that calculated the amount of Schedule 11 Marbled Murrelet habitat outside of the THLB by landscape unit relative to Schedule 9 targets. The analysis found that all the targets (detailed in table 6.10.11) were met outside of the THLB and therefore no further forest cover constraints or netdowns were necessary.

Table 6.10.11 Applicable excerpt from HGLUOO Schedule 9- Marbled Murrelet conservation targets

Landscape Unit	TSR target for retention (ha)
Bigsby	397
Eden Lake	7687
Honna	3854
Ian	1253
Louise Island	4674
Lower Yakoun	1134
Masset Inlet	4881
Naikoon	1610
Otun	2243
Rennell	5280
Sewell	3488
Skidegate Lake	2210
Tasu	3941
Tlell	3315
Yakoun Lake	2340

6.10.12 Northern Goshawk

Northern Goshawk is a red-listed sub-species and the national bird of Haida Gwaii that is considered threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Its nesting areas are protected under the HGLUOO section 20 with approximately 200-hectare reserves of suitable habitat. As of September 2019, a total of 23 territories have been identified on Haida Gwaii.

Data source
HGLUOO Schedule 12
Predictive goshawk nesting territory model

Net down assumptions
All Schedule 12 Northern Goshawk nesting reserves, as well as additional nests discovered up to 2019 were excluded from the THLB. One breeding areas (Canoe creek) had a draft reserve design that was used for the THLB netdown, and another breeding area (Ian lake east) had a 800m buffer included around the nest area given that a reserve has yet to be designed.

Section 20 of the HGLUOO requires that when a new Northern Goshawk nest is discovered and is not within a Schedule 12 reserve, a restricted activity zone of at least 800-m radius and a 200-hectare reserve around the nest site be established. For the base case, discovery of new nests was not reflected. However, sensitivity analyses were performed to explore the implications of establishment of more nesting reserves in line with both provincial government implementation plans and the federal recovery plan. These are discussed in section 8.

6.10.13 Saw-whet Owl
Saw-whet Owls are a focal species listed within the HGLUOO that nest in mature/old forest snags. Nesting reserves are displayed in HGLUOO Schedule 12. Similarly, there is a requirement to retain *or recruit* 10 hectares of mature/old forest under 300m elevation in a grid approximately every 1400m as 'core nesting habitat'.

Data source
HGLUOO Schedule 12

Net down assumptions
All Schedule 12 Saw-whet Owl nesting reserves were 100% excluded from the THLB.

An analysis was conducted whereby hexagonal spatial units were placed on 1400m centres and a nearest-neighbour spatial function determined whether 10 hectares of contiguous old/mature forest was retained, or younger forest retained in the absence or deficit of old/mature forest within the hexagon. The results found that while some landscape units (notably Skidegate Lake and Lower Yakoun) have deficits of old/mature forest, all areas had contiguous forest retained to meet the core nesting habitat requirements. These findings coincide with recent findings from a Forest Practices Report that similarly evaluated Saw-whet Owl core nesting habitat requirements in the Skidegate Lake Landscape Unit (Forest Practices Board, 2019).

As a result of this analysis, no further netdowns were applied for core nesting habitat.

6.10.14 Blue Heron
Blue Herons are a focal species listed within the HGLUOO that nest in mature/old forests. The HGLUOO provides 45-hectare temporary (3-year) protection to active blue heron nests. Two Blue Heron nesting areas have been discovered between 2011-2018, amounting to approximately 90 hectares that are reserved from harvesting. Given the very small area affected, no area was excluded from the THLB for the analysis.

6.10.15 Cedar Stewardship Areas
CSAs are areas retained for long term access for Haida cultural use as per section 3 of the HGLUOO. The risk-managed provisions to harvest a total of 10% of the area for commercial purposes is covered in section 8 of the data package (sensitivity analyses). This risk-managed area (approximately 2500 hectares over 10 years)

amounts to approximately 1.6% of additional THLB that could be accessed through an Intergovernmental process. Note that <10 hectares have been accessed since the HGLUOO came into effect in 2011.
Data source
HGLUOO Schedule 3
Net down assumptions
Consistent with Schedule 3 of the LUOO, 100% of CSAs were excluded from the THLB.

6.10.16 Haida Traditional Heritage Features
Haida Traditional Heritage Features include those listed in Schedule 2 of the HGLUOO, with 500 metre buffers applied around class 1 features, and 100m buffers applied to class 2 features.

Table 6.10.16. Class 1 and 2 Haida Traditional Heritage Features (Schedule 2, HGLUOO).

Class 1:
Village/Seasonal Village
Inland Camp/Camp
Burial Site
Identified Oral History site
Identified Spiritual site

Class 2:	
Midden	Lookout site
Bear Trap	Fort
Fish Weir	Cache
Cave	Canoe run
Petroglyph	Shoreline habitation site
Lithic production site	Rock Shelter
Trail	Karst Feature

Data sourced from
These are the most sensitive but also most widely studied types of heritage features that also have protection under the *Heritage Conservation Act*. As a result, most timber harvesting avoids these sites, and identifies them as a result of Archaeological Impact Assessments and/or Cultural Feature Identification surveys (CHN, 2016). Data were sourced from the 2012-2016 HGLUOO annual submissions data from licensees, however this source was limited to only four records. Data were also sourced from the 2002 *Archaeological Overview Assessment Haida Gwaii, North of Gwaii Haanas* (Christensen & Stafford, 2002). Additional heritage data was sourced from the Council of the Haida Nation's *Placenames* database (village sites). Sites identified within the Remote Access to Archaeological Data (or *RAAD*) current to May, 2019, from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development were also excluded from the THLB.

Netdown assumptions
One hundred percent of the areas contained within the associated buffers were excluded from the THLB. 100m buffers were applied to class 2 features, 500m buffers applied to class 1 features.

6.10.17 Stand Level Objectives
A number of LUOO objectives are for features that don't have full inventories or are yet-to-be identified in the field. As discussed in section 6.10.2 and appendix 6, a sample of operational data was used to do a frequency distribution analysis to help predict these occurrences and then net them out of the THLB. The following table summarizes these net downs, with greater descriptions provided in the corresponding sections.

Table 6.10.17. Summary of netdowns for stand-level LUOO objectives.

Type	Total Netdown	Young forest	Old forest	Comment
Bear	0.1%	**0.1%**	**0.1%**	features found in young and old forest
HTHF	0.1%	**0.1%**	**0.1%**	features found in young and old forest
HTFF 2	2.5%	**0.15%**	**2.3%**	94% of the 2.5% netdown is found in old forest
HTFF 1	0.9%	**0.14%**	**0.74%**	84% of the 0.9% netdown is found in old forest
CMT	1.8%	**1.8%**	**1.8%**	features found in young and old forest
Yew	2.3%		**2.3%**	Features only found in old forest
Unspecified	3.6%	**3.6%**	**3.6%**	THLB retained with unspecified objectives
Total		**5.89%**	**10.94%**	

6.10.18 Culturally Modified Trees

Culturally Modified Trees (CMTs) are identified for protection under section 9 of the HGLUOO and include trees modified by Haida people for cultural use prior to 1920.

Data sourced from

The Council of the Haida Nation and the Province of BC have been systematically cataloguing Culturally Modified Tree data since the 1980s. A number of separate inventory initiatives have occurred over the decades, and for the purpose of timber supply analysis, these datasets have been collated in order to determine the current known extent of CMTs and the associated reserve network. Data sources include:

- The 2002 Archeological Overview Assessment (Christensen & Stafford, 2002), which is a collation of data from over 97 Archaeological Overview Assessment (AOA) reports; Archaeological Inventory Studies (AIS); excavation and Archaeological Impact Assessments (AIA). It also included data from over 300 reports produced by the CHN's CMT Inventory program;
- 2017 BC Heritage Branch's Registered Archaeological Sites - all CMT features from Haida Gwaii were parsed from the overall *Remote Access to Archaeological Data* (RAAD) data set, provided by Diana Cooper (Archaeological Site Information and Data Administrator - Ministry of Forests, Lands and Natural Resource Operations, and Rural Development).
- Archaeological inventory studies - a variety of data collated from licensee commissioned Archaeological studies (AOAs, AIAs etc.);
- Cultural Feature Identification survey data - CMT data sourced from the LUOO digital submission dataset from 2012-2016.
- Areas where some level of forest planning occurred but was not completed due to the number of values requiring retention making the area not viable for development. These areas were sourced from licensees. For CMTs these included blocks FLO004, CHI001 and DRL107.

Net down assumptions

The HGLUOO stipulates a 0.5 tree length reserve zone and a one tree length management zone around known CMTs, both of which are to be maintained (i.e., reserved from harvest). The data were used for two separate applications: (i) to exclude retention areas around known CMTs, and; (ii) to undertake an aspatial frequency distribution analysis for estimating an exclusion factor to account for yet to be identified CMTs.

For known CMTs, existing HGLUOO retention buffers were excluded from the THLB. For known CMTs without a designated retention area (e.g., CMTs not registered as an *Archaeological site* under the *Heritage Act*, or not included in Development Areas of the HGLUOO) 1.5 tree length buffers were assigned and excluded from the THLB, as described in section 6.10.3 of this data package.

For not yet identified CMTs, netdowns were predicted across the land base using operational adjustment factors outlined in appendix 6 using the 2012-2016 HGLUOO annual submission data. Similar to Haida Traditional Heritage Features, licensees tend to avoid areas with high numbers or high potential numbers of CMTs. Therefore, using the 5-year operating dataset (2012-2016) reflects a smaller netdown factor then when compared with past TSRs. For example, the netdown or exclusion factor for this base case is 1.8% of every hectare, compared to a 7.7% reduction (to old forest only) in 2011 (JTWG, 2012). The current base case exclusion factor applies to forests of all ages, as CMTs are found in all age classes. The exclusion factor was calculated based on information from the portion of the land base where harvesting has occurred, but also accounts for an additional 115 hectares where harvest planning was done, but was ultimately not harvested as a result of high densities of CMTs.

6.10.19 Monumental cedar

Monumental cedar are defined both within the Haida Gwaii Strategic Land Use Agreement (CHN & BC, 2007) and the HGLUOO as a "*visibly sound western redcedar or yellow-cedar tree that is greater than 100 centimeters in diameter at breast height and has a log length of 7 meters or longer above the flare with at least one face that is suitable for cultural use"*. Protection measures for monumental cedar detailed in section 9 of the HGLUOO provide long-term cultural access for the Haida Nation. Monumental cedar greater than 120cm diameter at breast height, or that occur within a 'cultural cedar stand' are, by default, protected from harvesting. Ten percent of smaller monumental cedar that are not within a 'cultural cedar stand' must be protected from harvesting.

Data sourced from
HGLUOO 2012-2016 annual submission data. This data included 1,085 monumental trees of which 763 or 70% of were protected and 30% were logged. Data to support the analysis was also sourced from the Harvest Billings System scaling data (2003-2010) and forest inventory (see descriptions below).

Timber Supply Considerations
For known occurrences of monumental cedar, the reserve and management zones within the HGLUOO annual submission data were entirely (100%) excluded from the THLB.
The following describes methods used to estimate netdowns to the THLB resulting from the current *Cultural Feature Identification Standards* (October, 2019, v.5).

This involved numerous steps using the following logical sequence:

1. What quality of cedar trees are included in monumental classifications? An analysis determined an equivalency to the Provincial scaling system.
2. How many of these trees are there? The frequency of occurrence of those log grades was based on an analysis of 7-years of log-scale data from Haida Gwaii. General volumes were converted to (average) individual tree volumes.
3. Where are these trees and how are they distributed? Assuming these trees are only found in old forest and not uniformly distributed, the forest inventory was used and higher cedar content meant a higher probability of a tree being there. Trees were randomly assigned across the old forest within management units..
4. How much area is in retention for these trees? A spatial model was used to identify buffers at 1m resolution to account for fine-scale overlap based on the spatial distribution of trees. This step produced an expected netdown for the randomly located trees that was used as an additional THLB netdown factor.

Determining tree quality

Correlating the approximate provincial log grades with the proposed monumental *Cultural Feature Identification* (CFI) standards changes allows for estimates in the frequency of occurrence of these log grades. A few key attributes were used for comparison.

Table 6.10.19.1 Log attributes comparison for 100-120cm monumentals and the BC Scaling Manual (MFLNRORD, 2011)

Attributes	Proposed CFI monumental allowances	BC Scaling manual maximum allowances		
		D	H	I
Knots	4 knots >8cm	Occasional knots in upper 1/3rd	Occasional up to 8cm on upper 50% of log,	Occasional up to10cm (log radius over 38cm)
Rot	<50%	<33% (50% merchantability of 66% gross scale)	<49% (65% merchantability of 75% gross scale)	<38% (50% merchantability of 75% gross scale)
Max twist	25%	6cm over 30cm= 20%	8cm over 30cm= 27%	30%

This comparison shows that the grade 'H' and better are the closest alignment between the new CFI monumental cedar identification and BC log grades. While the standard does allow for knots greater than 8cm diameter, and 'I' grade allows for knots up to 10cm, the maximum twist for 'I' grade exceeds the twist allowance for monumental identification.

Harvest Billings System and District scale data were used to quantify the frequency of occurrence of cedar log grades greater or equal to grade 'H', as well as the frequency of these logs being greater than or equal to 100cm[42] diameter (see table 6.10.19.2 and 6.10.19.3)

[42] Note that log length was not considered a variable as logs may have been cut to spec, but originally may have met the 7m minimum length criteria.

Table 6.10.19.2 Parameters used to determine the random distribution model.

Variables	Source	Value
Percent of Cw/Cy that are D, F and H grade over 100 cm diameter log(**b**illed data)	HG District scaling data (Scaled January 1, 2003 to March 30, 2010)	5%
Approximate m^3 per average monumental cedar based on average diameter (123cm) and average height monumental cedar (36.7m)	HGLUOO annual submission data; diameters used *n=722*; height used *n=645* samples. Volume based on QC2002 taper equations (net volume)	11.5m^3

Table 6.10.19.3. Log grade distributions for cedar based on scale-data from 381,980 logs, sourced from the Haida Gwaii Natural Resource District from 2003-2010.

		Cedar over 100 cm diameter	
Cedar grades	% of grade contributed to total cedar logged	% of grade made up of cedar ≥100cm diameter	% that grade (and diameter ≥ 100cm and 7m length) contributes of total cedar volume
D	1%	70%	0.3%
F	1%	62%	0.4%
H	25%	16%	3.3%
I	15%	10%	1.3%
J	26%	0%	0%
K	2%	62%	0.6%
L	6%	31%	1.4%
M	5%	11%	0.5%
U	14%	1%	0.1%
X	3%	3%	0.1%
Y	1%	4%	0%
Z	0%	33%	0%

Determining the number of trees

The next step was to estimate the number of these high quality trees per hectare.

High quality cedar is not uniformly distributed across the THLB, therefore two distribution parameters were used: a weighted correlation with cedar volume in the inventory, and; a random distribution. Sensitivity analyses (described in section 8.2.3.6) outline interpretations of the CFI standards that may include a broader range of grades, age classes and levels of retention.

Higher quality cedar is generally found in stands with higher volumes of cedar. Monumental cedar are also generally found in old forest (>250 years). This volume relationship was tested against several thousand monumental cedar data points from the CHN relative to cedar volume distribution in the inventory. The analysis, which compared the normalized weighted area of cedar sites to the number of high quality cedar in those sites confirmed this correlation (as seen in figure 6.10.19.2).

Determining the number of high quality trees (H grade and better) per hectare was calculated by:

1. Defining the applied landbase: forest within the management units (i.e. land in forestry tenures, as shown in Figure 3.1.4.5 above): about 492,000 ha;

2. Estimate old cedar volume (age >= 250 years) : %Cedar * initial Volume/ha in cells with initial age >= 250, summed across applied landbase: about 34,828,000 m3;

3. Multiply old cedar volume on applied landbase by % monumental (assumed to be 5% in base case, as per table 6.10.19.2 above): about 1,741,000 m3 of monumental cedar volume;

4. Divide estimated monumental cedar volume on applied landbase by average m^3 per monumental cedar (assumed to be 11.5 m3 in the base case, as per table 6.10.19.2 above): about 151,000 monumental trees;

The next step was to determine the proportion of these trees that might be logged (and made available to the Haida Nation), as per the HGLUOO. The HGLUOO allows for trees to be logged and made available to the Haida Nation if they are not in a cultural cedar stand, and if they are under 120 cm diameter (conditional to the greater of 10% of monumentals or 1 monumental being retained within the development area). However it is difficult to predict the distribution of tree sizes (over or under 120cm) and their spatial relationship (three or more trees within 50m of each other to be classified as a cultural cedar stand). The 2012-2016 HGLUOO annual submission data from licencees indicated that approximately 70% of all monumental cedar (regardless of size and spatial arrangement) were retained and 30% logged. Starting with the spatial distribution of monumentals (about 151,000), this was reduced by 30% by removing approximately 45,000 trees from the buffering step. About 43,000 are in cells with 3 or more (representing trees in cultural cedar stands). Of the approx. 106,000 in cells with 1 or 2, 45,000 were randomly removed.

Spatial distribution and netdown

The next step was to distribute the number of monumental cedar trees per hectare across the old forest within the management units based on this reference number (106,000 trees). Given lack of information regarding how monumental cedar trees are distributed in relation to each other (and to avoid making the assumption of a spatially uniform distribution), it was assumed that monumental cedar trees are distributed independently of each other. Each tree was located in an old forest grid cell with a relative probability based on its volume of cedar (i.e. spatially randomized but weighted by cedar volume).

Analytical steps included:

1. For a given number of monumental cedar trees, locate them in old stands that have at least 1% cedar, in the applied landbase, randomly but weighted by the amount old cedar volume (number of trees per 1 ha grid cell varied from 0 to 9 in the base case).

2. Create a layer that represents the % of each grid cell covered by a monumental cedar buffer.

   (a) Locate each monumental tree to a 1m x 1m site within each 1-ha grid cell.
   (b) Process each grid cell (focal cell) that includes or is adjacent to a cell with at least one monumental.
   (c) Place all the monumental cedar trees in the focal cell and adjacent cells on a 1m resolution buffer (300 cells by 300 cells).
   (d) Iteratively (10,000 times) compute 60m buffers on each tree to identify the average net buffer area within the focal cell (ranging from 0% to 100%).
   (e) Rescale buffers for each cell to the 1-ha resolution data set to produce a layer that represent the % of each cell the buffer of 1 or more monumental cedar trees (accounting for for buffer overlaps).

3. Use the % buffer grid as an incremental netdown on the base THLB (see Figure 6.10.19.1).

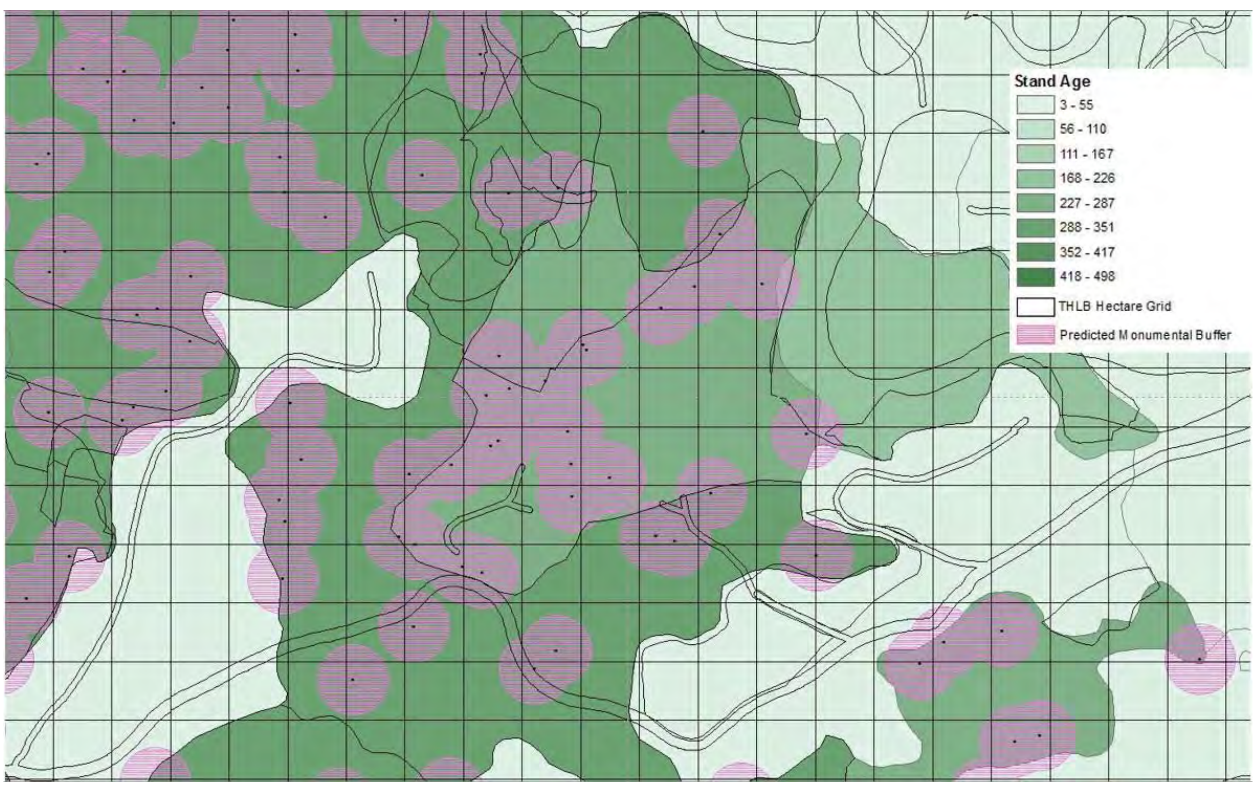

Figure 6.10.19.1 . Example of random spatial distribution of monumental cedar, correlated with stand volume, and their buffers relative to the THLB. This means that some cells will have more monumental cedar trees than others (even if they have the same cedar volume), but overall the reference (106,000 trees) number is

allocated across the land base. The range of the number of trees randomly allocated to a one-hectare cell was between 0 and 9 trees, with 60% of cells having 1 tree, 27% having 2 trees, 9% having 3 trees, 3% having 4 trees, and 1% having between 5-9 trees.

The final step was to assign buffers to the trees.

As there are many cases where buffers may extend beyond a one-hectare grid cell, a sub-model was designed to determine the expected spatial netdown from buffering trees. The sub-model randomly placed trees at 1m x 1m locations within each hectare in which they were located in the previous step. Each hectare and its immediately adjacent hectares were then iteratively processed (using a 1m resolution 300m x 300m grid). For each iteration, a 60m buffer was applied on each tree within the focal hectare and the adjacent hectares to determine the net buffer for the focal hectare, accounting for the buffers and overlaps of all trees that affect the focal hectare. For example, the average buffer on one-hectare (100m x 100x) areas with 3 trees was 94% (counting effects of trees in adjacent areas on the focal hectare, but not counting the area of buffer from the focal hectare that extended into adjacent hectares)

The buffers for each hectare were then rescaled to the one-hectare resolution of the main model to produce a gross netdown factor for monumental cedar and intersected with the THLB. The overall gross buffer netdown was significantly higher than the net effect due to prior THLB netdowns.

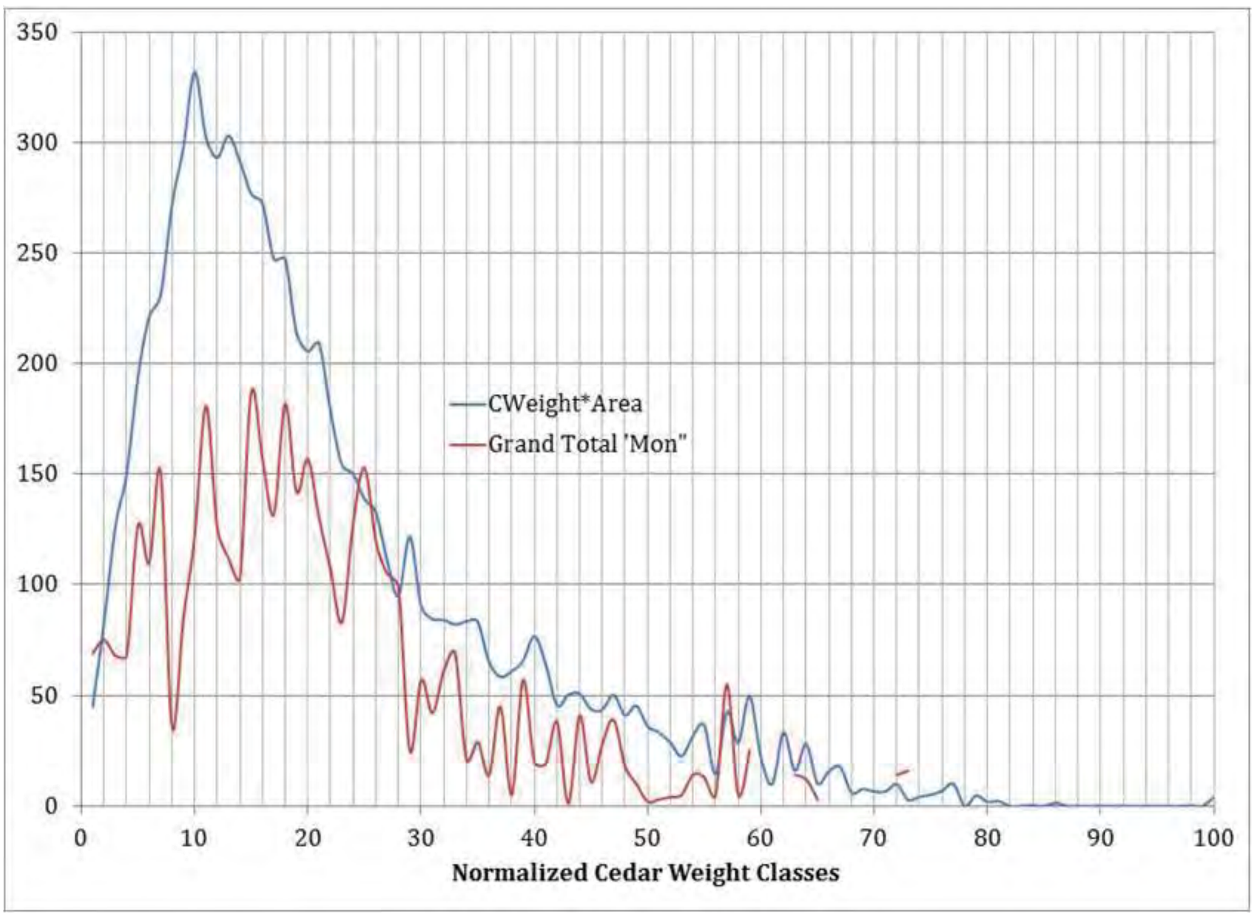

Figure 6.10.19.2 Relationship between cedar in the inventory and the occurrence of high quality cedar 'Mon'.

This resulted in a gross netdown of 77,737 hectares of forest and, after considering overlaps with other objectives, a net reduction of 44,584 hectares from the THLB.

6.10.20 Haida Traditional Forest Features
Haida Traditional Forest Features consist of 11 types of class 1 features and 10 class 2 features as per Schedule 2 of the HGLUOO. Class 1 features require a two tree-length buffer (sec 6 (2) and 6 (3)) whereas class 2 features require stand level retention to protect the integrity of the features (sec 6 (7)).

Data sourced from

- HGLUOO 2012-2016 annual submission data.
- 'Walk away' areas where some level of forest planning occurred but was not completed due to the number of values requiring retention, making the area not viable for development. 'Walk away' areas were sourced from licensees. For HTFFs these included blocks MOS500, NEC504, NEC503, NEC523, NEC524, NEC525, NEC505, NEC506, NEC508, NEC526, NEC527, NEC528.

Net down assumptions
A total of 8,626 features and their retention areas were excluded from the THLB and were used for a frequency distribution analysis for predicting netdowns from yet to be identified HTFF2s. 'Walk away' areas described above amounted to a total of 37 hectares (used for the frequency distribution analysis).

Existing HGLUOO retention areas were entirely (100%) excluded from the THLB. Note that class 1 buffers and the retention areas for class 2 features are built into the HGLUOO annual submission data. The HGLUOO class 2 HTFF retention areas do not always assign the specific HGLUOO value associated with the retention. See appendix 6 for a description on how HTFF values were assigned to retention areas to quantify and attribute specific HTFF netdowns.

For determining an exclusion factor for not-yet-identified HTFF2s, predictive indicators were analyzed to assess whether features were most closely associated with specific site conditions. The purpose is to apply an exclusion factor to sites with the highest likelihood of occurrence, and thereby more closely represent operational realities. Predictive indicators were reviewed using classification and regression tree statistical analysis and Chi-squared goodness of fit for BGC variants and stand age.

For Class 1 forest features, Devil's club constitutes 94% of all class 1 occurrences and for Class 2 forest features, Hellebore and Pacific crabapple constitute over 99% of all features.

BGC variants are a statistically significant predictor of presence, as per chi-squared goodness of fit tests. For example, Devil's club occur disproportionately in the CWHvh3 variant, hellebore occurs disproportionately in the CWHvh3 and CWHwh2 variants, and pacific crabapple only occurs in the CWHwh1 variant (within current samples). However, using BGC variants and HTFF species amounts to 27 different model assumptions for this one HGLUOO value.

Stand age was a simpler predictive variable for consistent application as 94% of all HTFF occurrences are in old forest. A chi-square goodness of fit[43] supported that HTFF presence was dependent on age (chi square 1481, critical value 3.81, $p<0.001$). As such, an exclusion factor proportional to HTFF occurrence by stand age of old forest >=250 years or younger forest <250 years was applied.
For HTFF class 2 features this amounted to a per hectare net exclusion factor of 2.3% and 0.1% for old and young forest respectively. For HTFF class 1 features this amounted to a 0.7% and 0.1% per hectare net exclusion factor for old and young forest respectively.

6.10.21 Yew trees

[43] Note that goodness-of-fit tests used the proportion of old forest vs. second growth forest logged to calculated expected frequencies.

The HGLUOO (sec 8(1)) provides stand-level protection to all yew tree patches. Similarly, individual yew trees are protected at the stand level where practicable (sec 8 (3)).

Data sourced from

- HGLUOO 2012-2016 annual submission data
- 'Walk away' areas are areas where some level of forest planning occurred but was not completed due to the number of values requiring retention making the area not viable for development. 'Walk away' areas were sourced from licensees. For Yew trees these included blocks NEC545 and NEC507.

Net down assumptions

A total of 16,226 features were used to exclude retention areas associated with known yew features, and to undertake a frequency distribution analysis for predicting netdowns from yet to be identified yew features. 'Walk away' areas described above amounted to a total of 9 hectares (used for the frequency distribution analysis).

For determining an exclusion factor for yet to be identified yews, predictive indicators were analyzed to assess whether features were most closely associated with specific site conditions. The purpose was to apply an exclusion factor to certain sites, and thereby more closely represent operational realities. Two predictive indicators were reviewed using classification and regression tree statistical analysis and chi-squared goodness-of-fit tests: BGC variants and stand age.

Of all yew features, 92% occurred within the CWHwh1 variant, as opposed to approximately 8% within the CWHvh3 and under 1% in the CWHwh2 variants. Stand age however was a stronger predictive variable, as a yew is a late-seral dependent species: 99% of occurrences were found in old forest (>=250 years)[44]. As such, age was used as a stratum to apply an exclusion factor to the THLB, which based on the HGLUOO annual submissions data, amounts to a net of 2.3% of old forest at the stand level.

6.10.22 Black Bear dens

Black bear dens are protected under section 18 of the HGLUOO. A total 20m wide reserve zone and 1 tree length wide management zone are established around each identified den.

Data sourced from

HGLUOO 2012-2016 annual submission data.

Net down assumptions

A total of 26 bear dens and their reserve and management zones were excluded from the THLB, and were used in an aspatial frequency distribution analysis for predicting netdowns for yet to be identified bear dens.

100% of the reserve and management zones within the HGLUOO annual submission data were excluded from the THLB. While bear dens are by definition found in old trees, there was no strong correlation between forest age and den occurrence based on the sample size. Therefore, based on a frequency distribution analysis, an exclusion factor of 0.1% of all forest was applied.

Note that CHN's protected area surveys proportionately found three times as many bear dens per hectares than in licensee HGLUOO annual submissions. As such, there is an uncertainty about the frequency of these features across the land base, which may amount to higher proportions of dens located in the future and a larger effect on the THLB.

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[44] Chi-squared value 4434, critical value 3.84, p=0.001

6.11 Archaeological Resources

The *Heritage Conservation Act* (HCA) provides protection to heritage sites within BC. A registry of heritage sites is maintained by the Ministry of Forests, Lands and Natural Resource Operations and Rural Development wherein spatial and reporting information on sites are catalogued and confidentially safeguarded. Heritage sites are protected under section 13 of the HCA. See sections 6.10.16-6.10.17 above.

Data sources

- 2017 BC Heritage Branch's Registered Archaeological Sites - all CMT features from Haida Gwaii were parsed from the overall *Remote Access to Archaeological Data* (RAAD) data set provided by Diana Cooper (Archaeological Site Information and Data Administrator- Ministry of Forests, Lands and Natural Resource Operations).

Netdown assumptions

A total of 2,132 archaeological sites were 100% excluded from the THLB. These sites are represented as polygonal features, and in many cases overlap with features protected under the HGLUOO. See section 6.10.17 for a description of how heritage sites and CMTs (under the HGLUOO) were netted down.

6.12 FPPR Requirements for Streams

The *Forest Planning and Practices Regulation* Division 3 sections 50, 51 and 52 outline restrictions on primary forest activities within riparian management areas. All fish-bearing stream classes and associated retention levels (S1-S4 classes) are in effect superseded by the HGLUOO sections 10 and 11, as FPPR requirements are less constraining. As such only S5 and S6 streams (non-fish bearing >3m and <3 m width respectively) were considered subject to the FPPR. Currently the FPPR only requires ≥10% of the basal area of trees within a 30m management zone of S5's to be retained if it is a minor tenure holder (generally <2,000m^3), or 'enough trees adjacent to the stream to maintain the stream bank or channel stability' if it is a direct tributary to a larger fish-bearing stream or a marine interface zone.

A variety of techniques have been used in previous TSRs to estimate the effect that non-fish bearings streams have on forest management:

- No buffers applied to S5 streams for TFL 47 Moresby Block (now TFL 58) (Angus, 2001);
- A 15% partial netdown of a 30m buffer (equivalent to 4.5m) was applied to modelled S5 streams for TFL 39, block 6 (now TFL 60) (Kofoed, 1999);
- No riparian area reductions for S5 streams for TFL 25 (now part of the Timber Supply Area) (Byng, 2003);
- Within the TSA, past timber supply analyses have modelled streams, assuming S5 streams were streams with >=20% gradient (Cortex Consultants and Gowland Technologies, 2004);

The approach used in this timber supply analysis follows that used in the 2012 TSR (JTWG, 2012). A previous analysis of detailed engineering stream class inventory from TFL 39 block 6 (now TFL 60) indicated that 9% of the total length of non-fish bearing streams were S5 streams. Assuming this frequency and applying FPPR sec 52 management areas would amount to an approximate 90-hectare reduction to the THLB. This is a relatively minor area and when considering the small retention requirements, therefore it was not modelled in this TSR.

Lakes and wetlands also require a riparian management zone. The following table describes specifications for these zones (RMZ retention under FPPR sec 52).

Table 6.12. FPPR derived buffers on non-fish bearing riparian management zones.

Riparian Class	Riparian Management Area (metres)	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)	RMZ Retention (*sec 52)* ratio	***RMZ Buffer (m)***	***Total Buffer (m)***
W1	50	10	40	0.2	***8***	***18***
W2	30	10	20	0.2	***4***	***14***
W3	30	0	30	0.2	***6***	***6***
W4	30	0	30	0.1	***3***	***3***
W5	50	10	40	0.1	***4***	***14***
L1-B	10	10	0	0.2	***0***	***10***
L2	30	10	20	0.2	***4***	***14***
L3	30	0	30	0.2	***6***	***6***
L4	30	0	30	0.1	***3***	***3***

The total buffer widths outlined in table 6.12 were applied to lakes and wetlands mapped in the *Terrain Resource Information Management* (TRIM) dataset (GeoBC).

6.13 Cedar Partition

The HGMC's 2012 AAC determination recognized that there was a mid-term fall down of commercial cedar on Haida Gwaii, and that a strategy was needed to mitigate its economic effects. The HGMC recommended to the Chief Forester the use of partitions for a "*sustainable harvest of cedar-leading stands, in proportion to their contribution to the inventory, to ensure their continuing contribution to the harvest through the transition period to dependence on second growth"* (HGMC, Rationale for Allowable Annual Cut (AAC) Determination fo Haida Gwaii, 2012).

As a result of this, and further timber supply analyses, the Chief Forester established non-legally binding expectations that the harvest of cedar not exceed specific limits for TSA25, TFL58 and TFL60 (Sutherland, 2012). These limits have been referred to as 'soft-partitions'. Furthermore, in 2017, the Chief Forester added a partition under section 8(5) of the *Forest Act* to the TSA AAC since cedar harvest in the TSA had exceeded the direction in the 2012 determination. In 2018 the Minister signed an Order that brought that partition into effect for replaceable licences on the TSA (Order 75.02 (2)- 01/TSA25). For the purposes of this analysis, both the 'soft' partitions and the Order are referred to as the partition.

The following table describes these limits and have been applied in the timber supply model's base case or reference scenario.

Management unit	Partition class	Annual cedar (combined red and yellow) limit
TFL 60	'Soft-partition'	133,000m^3
TFL 58	'Soft-partition'	32,000m^3
TSA	Legal partition for licences A16869 and A16870; 'soft-partition' for other licences[45] within the TSA.	195,000m^3

[45] A16869 and A16870 have annual limits, cumulative over a 5 year period, of 73,142m^3 and 5,192m^3 which represents these licences proportions to the 195,000m^3 soft partition.

Within the Spatial Timber Supply Model, the proportional contribution of cedar to harvest for all stands was tracked (i.e.., all species composition deciles contributed or were aggregated and counted towards the harvest. A harvest constraint was applied such that when the management unit maximum was met no further harvest was permitted in stands with >10% cedar for the remainder of the 10-year period. Note that approximately 96.5% of the cedar within the THLB exists in stands with 10% or greater cedar composition. Therefore, this formulation for the harvest constraint provides some level of model flexibility to continue harvesting in stands with minor amounts of cedar, while ensuring substantial adherence to the partitions. There is some minor degree of flexibility through cut control allowances to exceed the partition, therefore restricting the model to reserve stands with >0% cedar would create undue restrictions. It is also important to note that running the base case at a 10% versus 0% threshold made no difference to timber supply.

Chapter 7 Timber Harvesting Model Parameters

7.1 Minimum harvestable criteria

Minimum harvestable criteria are parameters set within the timber supply model to limit when the model can harvest timber. These parameters are set to reflect current management or follow principles of sustainable forest management. Two such variables are minimum harvestable age (MHA) and minimum harvestable volume (MHV).

7.1.1 Minimum harvestable age

Minimum harvestable age (MHA) approximates how long it takes for a stand to achieve merchantable condition, or rather, the youngest age a timber supply model is allowed to harvest a stand. MHA has a direct relationship with inventory growing stock, as it defines how long the existing merchantable growing stock must be metred out while waiting for regenerated stands to achieve merchantability.

While there is uncertainty regarding when stands will actually be harvested in the future, the criteria is typically related to volume (over a certain operational minimum viability) and value (general increase in log grades over time). Three general scenarios have been considered during this timber supply review:
(i) culmination mean annual increment; (ii) economic rotations, and; (iii) extended rotations. Economic rotations and extended rotations are described in detail in section 8.2.8 of this report.

Culmination Mean Annual Increment

Mean annual increment is a measure of the volume grown annually on a hectare, expressed either at the tree or stand level (yield divided by age). Culmination annual increment is the age on a yield curve where the slope is at its maximum, which occurs when the average annual growth reaches its maximum. Even-aged stand yield curves have a sigmoidal shape, and the inflection point on the curve is the maximum or culmination mean annual increment (Watts & Tolland, 2005). This inflection point is a result of canopy gaps in a mature stand achieve a balance between tree mortality and growth. Therefore, while volumes on individual trees may continue to increase the overall stand volume growth will slow.

CMAI is also referred to as the optimal biological age that maximizes the long-term volume production of a stand (FAIB, 2007). For this reason, CMAI was a key factor in determining the MHA for the base case or reference scenario for this timber supply analysis.

Due to harvest flow requirements (e.g, a consistent flow of timber over time), setting a timber supply model MHA to CMAI tends to force a model to harvest a stand after CMAI. **Therefore, for this timber supply analysis, the MHA was set to the age at which 95% of CMAI is achieved.**

For timber supply modelling, each analysis unit was assigned an MHA (see section 5.6 and 5.8 for a description of analysis units). For consistency and for the purpose of reporting, MHAs are summarized here for managed stands. Note that MHAs do not materially influence harvest criteria for existing natural stands as these tend to be much older (past CMAI) and therefore their MHAs are not reported here.

Table 7.1.1 Minimum Harvest Age for Managed Stands by site index class and leading species

Site index class (m@50 yrs)	CW	DR	HM	HW	PLI	SS	YC
0 to 5	145			170			
5 to 10	136		190	147	145	140	142
10 to 15	112	60	144	117	112	126	112
15 to 20	97	42	110	93	81	95	91
20 to 25	96	50		92	70	86	70
25 to 30	74	37		75		79	
>30		30		61		72	

7.1.2 Minimum harvest volume and low-productivity stands

Minimum harvest volume

Section 3 of this data package describes non-forest exclusions from the THLB which include lakes and wetlands. However there are a wide variety of forested ecosystems on Haida Gwaii that are considered transition forests between wetlands (or alpine) and upland forest. Transitions tend to be made up of lower productivity sites, characterized by scrubby and open forests. These are often located on poorly drained alluvial deposits, blanket mire complexes on toe slopes, depressions or bog woodland patches interspaced within topogenous or open blanket bog ecosystems or swamps (Banner, W. MacKenzie, MacKinnon, Saunders, & H.Klassen, 2014). Many of these ecosystems are found throughout all the physiographic regions and biogeoclimatic variants of the lslands.

Given the mandate to establish a long-term sustainable harvest level for Haida Gwaii, only forests that contribute to continued harvesting were included within the THLB. In other words, forests that could only be harvested once, and would not be expected to meet minimum harvesting criteria in a reasonable time frame were removed from the THLB. This is the basis for which TIPSY does not accept species with a site index estimate less than 10[46].

Minimum harvest volume (MHV) defines a volume threshold for including stands in sustained yield projections. This is done by identifying stands that will not meet the minimum volume (either current inventory or at any point on a yield curve).This can be factored into the timber supply analysis in a couple of different ways, either (i) excluding these areas from the THLB, or; (ii) setting a constraint parameter in the model so the stands below the threshold don't contribute to the predicted sustained yields.

This factor is one way to define the merchantability of low volume stands, but more so quantifying low productivity stands. Economic operability has many factors (e.g., access, markets, volumes etc.) and this is more comprehensively accounted for in section 8 (minimum harvest volume sensitivity analyses).

Past AAC determinations on Haida Gwaii have led to analyses and partitions of low volume cedar stands within the TSA (B.C. Ministry of Forests, 2000), acknowledging that low volume stands may contribute to actual harvests, but their merchantability is very sensitive to markets and access and therefore their contribution to timber supply should be carefully qualified. Past TSRs have qualified these low productivity stands to be under 350m^3 per hectare (B.C. Ministry of Forests, 2000).

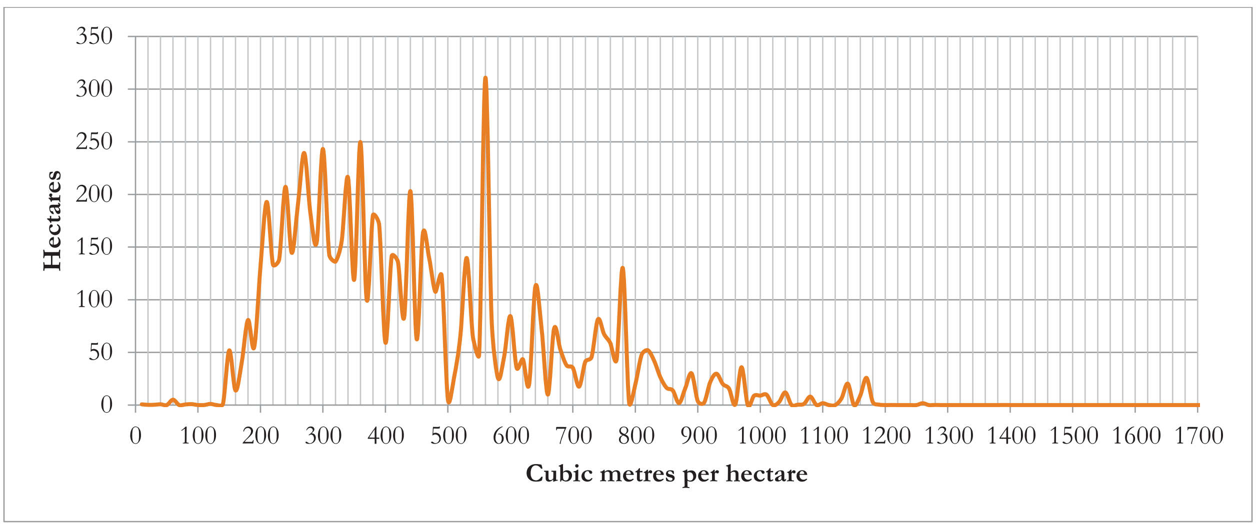
[46] With the exception of Lodgepole Pine (PLC), which excepts an SI as low as 5.

Evaluating MHVs with harvest history
Calibrating these minimum harvest volume thresholds with actual harvesting is considered an important step to validate the exclusion of stands.

Data from 2012-2016 was used to qualify the average cubic meter per hectare logged on Haida Gwaii. Net Area to be Reforested (NAR) data from the 2012-2016 LUOO annual submissions from licensees were used to determine opening size (ha). The timbermarks from these areas were linked to the Harvest Billing System (including avoidable, unavoidable waste). A total 102 timbermarks that had been logged by 2016 were included in the analysis[47]. The results show that 95% of the timbermarks logged had a volume greater than or equal to 257m^3/ha. The weighted area average was 595m^3 per hectare (range 214-2,043m^3/ha).

While this is a useful reference point, actual harvested volume data does not always correspond directly with inventory data. As a result, a second analysis was done that reported on the m^3/ha logged using recent spatial openings and forest inventory data for 7,295 hectares.

Table 7.1.2. Distribution of cubic metres per hectare (forest inventory volumes at 17.5cm utilization) within a sample of 7,295 hectares of recent openings.



The results found that overall approximately 95% of the volume from all openings were in a volume class over 230m^3/ha.
Interestingly, for openings that were second growth stands this threshold increased to 350m^3/ha.

As a result, a MHV was set as a parameter in the base case or reference scenario to 250m^3/ha. All natural and managed stands that are not projected to achieves at least 250 m3/ha within the analysis horizon (350 years) were removed from the THLB.
The following tables detail the site series on Haida Gwaii where the natural stand curves do not reach 250m^3/ha or conversely that have a site index under 10. Both of these categories of productivity contribute to the minimum harvest volume netdown.

[47] Logged by 2016 was qualified through satellite imagery references.

Table7.1.3.1. Site units with SIBEC site index under 10.

CWHvh2 02	MH wh 111 (previous 05, 06, 07, 09)
CWHwh2 111 (previous 05)	MH wh 02
CWHwh2 Wb51	MH wh 08
MH wh Wf	MH wh Wb53 (previous 08)

Table 7.1.3.2. Site units with Future Managed Stand volumes that do not reach 250m³

CWHvh2 12	CWHwh2 11
CWHvh3 102	CWHwh2 09
CWHvh3 113	MHwh 11
CWHwh1 11	MHwh 13
CWHwh1 114	MHwh 102 (previous 02)

These non-productive area exclusions tend to have limited effect on timber supply as a result of the model not accessing these sites anyway due to their low volumes. Three sensitivity analyses were completed (see section 8) to explore outputs without any MHV, outputs with MHVs categorized by different volume classes, and MHV restrictions of 350m³ for second growth stands.

7.1.3 Harvest preference relative to CMAI

While MHA represents a sort of binary criterion for when to log or not log a stand, the model is also able to prioritize stands based upon preference inputs once the model determines a stand is available to be harvested (e.g., meets the minimum harvestable criteria). Two harvest preferences were explored relative to CMAI.

7.1.3.1 Relative highest volume

After a stand meets the minimum harvest criteria outlined in section 7.1.1, a preference was explored to harvest the highest volume stand relative to the minimum harvest age. This was considered to be a less realistic preference since in reality both value and volume are key drivers for prioritizing stands (e.g., between two stands of equal volume, the higher value stand would be preferred). However this model preference was still explored in a sensitivity analysis, as described in section

7.1.3.2 Relative highest value

The relative highest value is a harvest preference that parameterizes the model to harvest the highest value stands relative to culmination age. The derivation of stand value is described in section 7.5. Relative highest value prioritization was used in the base case reference scenario.

7.2 Silvicultural systems

The RESULTS forest cover silviculture spatial database 'RSLT_FOREST_COVER_SILV_SVW) up to 2018 has 2,200 hectares of net logged area under a partial harvest silviculture system, or 4.5% of current areas under silviculture management (approximately 48,600 hectares). These blocks, primarily in the Rennell Sound and Eden Lake landscape units, represent the aerial harvest program that Husby Forest Products undertook in the early to mid 2000s, and given their vintage, these stands were therefore captured/attributed in the 2014 VRI re-inventory. Only ~25 hectares of partial harvest was completed during the last decade or market cycle (2008-2017). Therefore, for purposes of timber supply, only clearcut silviculture was modelled given that partial harvest is currently not practiced.

7.3 Maximum cutblock size and adjacency

Section 64(1) of the Forest Practices and Planning Regulation outlines that cutblocks cannot be larger than 40 hectares in the Coast Forest Region, specifically for clearcut silviculture.

Section 65(3) stipulates that cutblocks cannot be immediately adjacent to one another unless certain minimum green up requirements are met. In summary these requirements are:

- Minimum 75% of the block is re-stocked;
- Re-stocking meets the minimum requirement of 500 stems per hectare;
- Established trees are at least 1.3m in height with 10% of the stems being at least 3m in height.

In addition, section 65(3) does not apply to blocks that are under 40 hectares in size. In other words, the adjacency constraint only applies to blocks greater than 40 hectares in size.

Timber supply considerations
Two criteria needed to be defined for implementing the adjacency requirement: distance between blocks and time required to meet minimum green-up requirements.

With regards to distance between blocks, while the FPPR adjacency rule provides a minimum green up height it does not specify a distance between blocks to be buffered until the minimum green up height is met. The Spatial Timber Supply Model is based upon a 1-hectare grid cell, therefore the minimum between blocks could be set to 100m. However, when the minimum 100m buffer between blocks is applied the model returns to these sites after the adjacency requirement is met and harvests these 100m 'strips'. This in essence creates a harvest pattern where a large amount (e.g. nearly 25%) of all block sizes are under 5 hectares in size. This in turn did not seem to represent reality, where in fact the distribution is based on much larger cutblock sizes, as seen in figure 7.3.1.

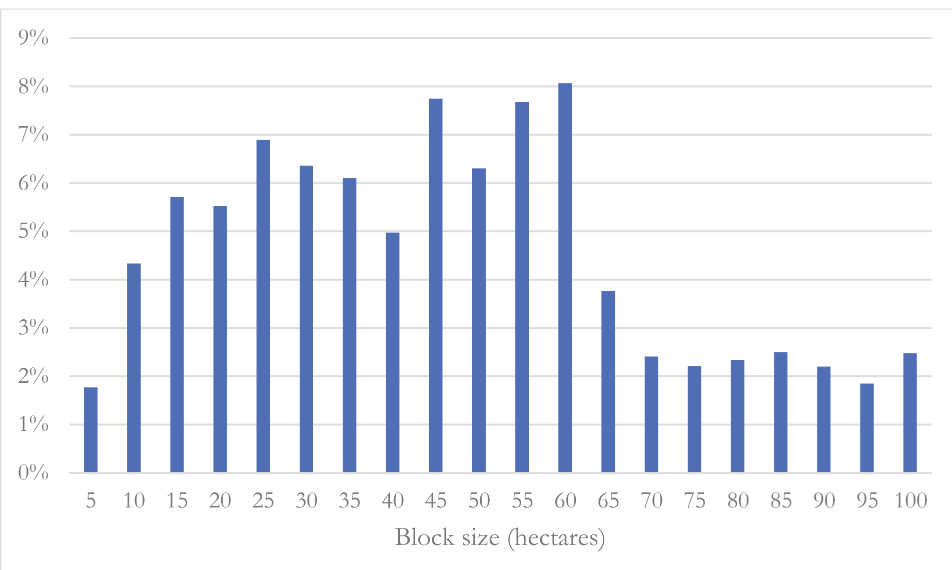


Figure 7.3.1. Block-size distribution from 2008-2017, converted to a 1-hectare raster within the STSM. Note that 'blocks' may be dispersed (not immediately adjacent) or have minor (e.g. 10m) buffer between openings that are lost at the 1 hectare resolution of the spatial timber supply model.

To minimize fragmentation that leads to small remnant patch sizes and subsequent small block sizes, the base case reference scenario applies a 400m buffer. 400m was applied as this reasonably represents the width of a typical block to fill the space between two blocks that had not met the adjacency requirement. This distance is also used by Taan Forest Products Ltd. to guide block placement for meeting adjacency requirements but does not preclude blocks being placed at a distance less than 400m (Taan Forest Ltd & Limited Partnership, 2018). For timber supply modeling, this 400m buffer was not a 'hard' or strict no-harvest buffer, but rather one where the harvest preference was to avoid this 400m area around new blocks.

This approach resulted in a more realistic size and distribution of blocks, as outlined in figure 7.3.2.

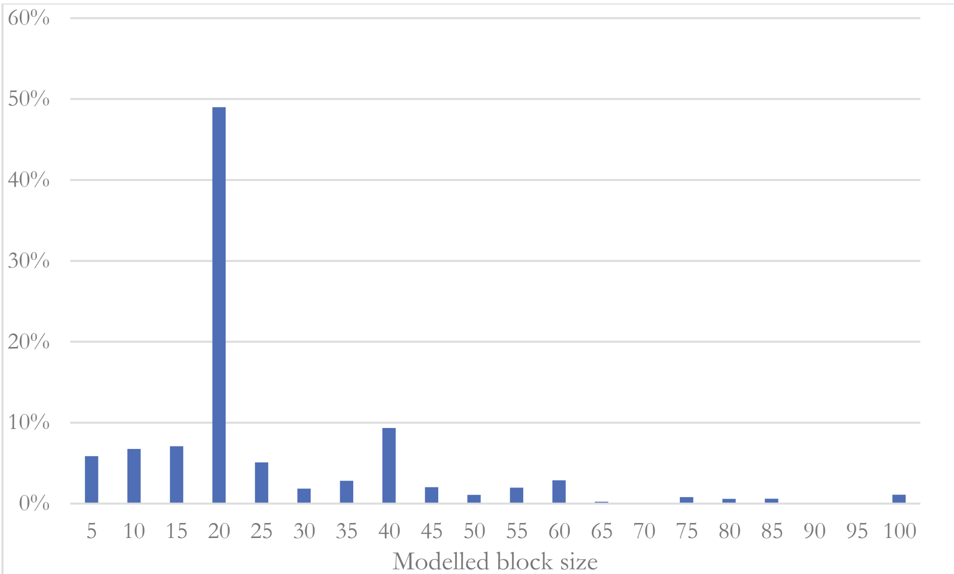


Figure 7.3.2 Modelled block size (first period or decade). The target was 20 hectare openings to reflect average operational openings on Haida Gwaii.

With regards to the time required to meet minimum green up requirements, managed stand yield curves were cross-referenced with the FPPR height requirements (between 1.3m-3m minimums). The weighted area average in the THLB for managed stands at year 10 is 1.03m, and at year 20 is 2.76m. This suggests that, in a modelling environment the green up requirements would be met, on average, between 10-20 years after harvest. The base case adjacency green up height is set to 3m.

7.4 Natural Disturbance

The effects of natural disturbance on timber supply are known as non-recoverable losses (NRL) in timber supply analyses. The intent is to quantify the effect of biotic (insect/disease) and abiotic (wind/slides/fire) stand-replacing events on the forest, and then estimate how much of the loss is likely to be salvaged. In coastal BC, stand replacing natural disturbances are considered rare, although over time the cumulative occurrences of these events can affect long-term forest management planning.

A number of tree-level health issues are not addressed at this scale. The most common influences on tree-level health (pathogens/insects) naturally occur in baseline levels as key parts of functioning ecosystems, particularly gap-phased forest types, where natural disturbance is mostly found at the tree level *versus* stand-replacing level (Lertzman, Sutherland, Inselberg, & Saunders, 1996). Some of these disturbance agents include disease or pathogens that are common in Haida Gwaii's forests, such as fungal root rots (ex. *Armillaria sp.*) and heart rots (ex. *Phellinus sp.*) (which more typically affect older stands), or the ubiquitous western hemlock dwarf mistletoe (*Arceuthobium tsugense)* or Keithia leaf blight (*Didymascella thujina*) which can affect young Western redcedar. These tree-level volume losses are dealt with in the decay reduction equations in the growth and yield models (see section 5).

Two key sources of information were used to evaluate natural disturbances: the Haida Gwaii Aerial Overview Survey data, and a change monitoring satellite image analysis.

The Aerial Overview Survey data (AOS) is a program administered by the MFLNRORD, with data spanning 2006-2017 for Haida Gwaii. Each year an overview flight in a fixed-winged aircraft occurs to map forest health factors across all of Haida Gwaii, following the AOS provincial standards (RISC, 2000)[48] at a 1:100,000 to 1:250,000 scale.

Forest health factors are mapped during the overview flight and each polygon is assigned the following severity classes:

Table 7.4.1. Aerial Overview Survey Forest Health classes

Intensity class	Description	Midpoint
Trace	<1% of the trees recently killed	0.05%
Light	1-10% of the trees recently killed	5%
Moderate	11-29% of the trees recently killed	20%
Severe	30-49% of the trees recently killed	40%
Very severe	50%+ of the trees recently killed	75%

Full annual spatial data for the provincial AOS program can be downloaded here:
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/

For timber supply purposes, data from between 2006-2017 was collated to analyze trends applicable to strategic level timber supply analysis. Total polygon areas were multiplied by the assigned severity ratings (e.g.A total polygon of 10 ha *x* moderate severity of 20% amounts to an affected polygon size of 2 ha).

Two key variables are necessary to apply the findings to timber supply: a) how much forest (and what kind of forest) is affected, and b) over what time period is the effect measured? See figure 7.4.1 for the summary of the area of forest health occurrences over time.

Given the scale of the mapping from the AOS standard, broad scale (landscape, watershed or large stand level) disturbances are most accurate. Individual tree, or small stand replacing events are difficult to capture.

[48] https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/aerial-overview-surveys/methods/standards-for-detailed-surveys

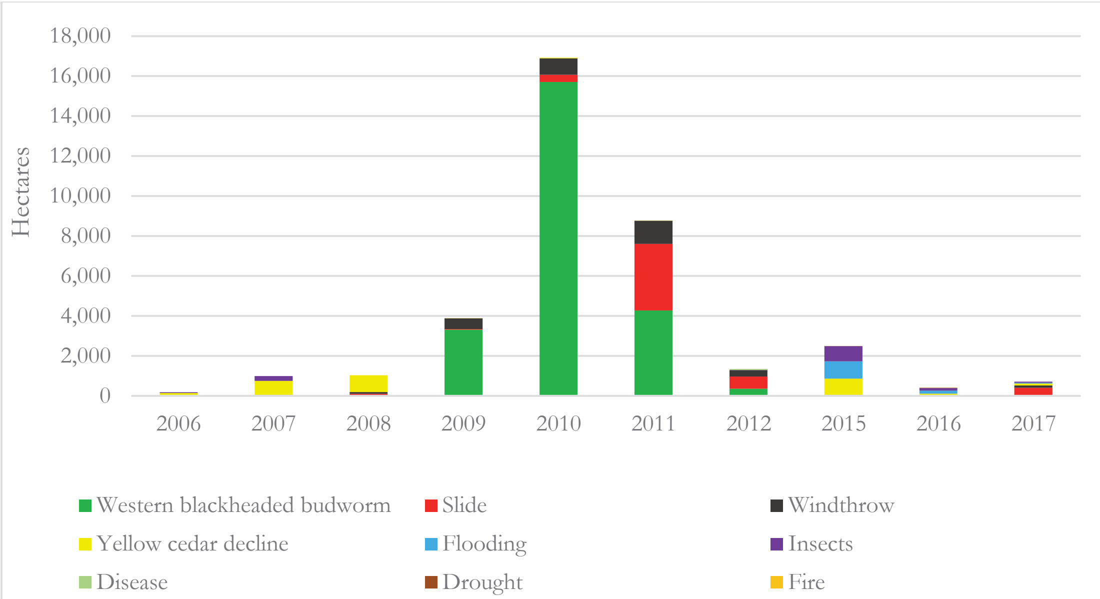


Figure 7.4.1. Haida Gwaii forest health occurrences over time. Source: Aerial Overview Surveys

7.4.1 Change detection analysis

The AOS is well suited for identifying large stand-level replacing events. Two of the most common disturbance events on Haida Gwaii are wind and landslides. Both events can range from very large (200 hectares) to very small (< 1ha) in size. It is the cumulative nature of these smaller events that the AOS data tends to not represent. As a result, a change detection analysis was completed mapping and comparing wind and landslide events from 2011 and from 2017 to determine the rate of change.

Figure 7.4.2. Light green areas represent the extent of satellite imagery cover used in change detection analysis.

Short wave near infrared 2.5m satellite imagery was used in 2011, and 5m near infrared satellite imagery was used in 2017 with a geographic extent that included the forestry operational land base of Haida Gwaii. Manual interpretation and polygon delineation[49] was done to 0.25 hectare resolution. Harvest history data was used to discern natural *versus* anthropogenic disturbance. For wind disturbance, severity rankings were assigned to polygons ranging from 100%, 50% or 25% disturbed. Adjacency to harvest openings was tracked to help distinguish catastrophic from endemic windthrow events. For landslides, point of initiation was tracked as being either within or outside of an existing harvest opening.

7.4.2 Disturbance type, distribution and severity

Not all disturbance types identified on Haida Gwaii are suitable for large scale (geographic and temporal) modelling. The following describes the natural disturbance agents, the source of the data, and their consideration in the timber supply review.

[49] Polygon delineation by Robert Kennedy and Sarah Good. Heritage and Natural Resource Department, Council of the Haida Nation.

Western black-headed budworm

The natural disturbance agent that affects the most hectares of forests on Haida Gwaii at one time is the western black headed budworm (*Acleris gloverana*). The last outbreak ranged from 2009-2011, and before that it occurred between 1996 and 2001. By 2010 the outbreak extended to cover 97,497 hectares on Moresby Island (Maclauchlan & Burleigh, 2011), however the net area affected (accounting for severity ratings using the AOS mapping) amounted a total of 23,716 hectares. The compiled AOS spatial data was used to calculate timber supply impacts.

Figure 7.4.2.1. Young western hemlock affected by blackheaded budworm on Moresby Island. Source (MFML, 2010)

The timing between outbreaks corresponds with the 12-16 year frequency coastal outbreak cycle, with defoliation in one stand lasting for 2 to 3 years (Shepard & Gray, 2001) . These outbreaks primarily affect second growth stands, in many cases affecting 100% of the stands resulting in a loss of growth, with recovery lags of over 5 years after the outbreak (NRCAN, 2005). While this defoliator can affect an entire stand, it only has an estimated mortality rate of 3.6% (Nealis & Turnquist, 2010).

A 20-year study on incremental silviculture (thinning treatments) on Graham Island collected data on the 1996-2001 outbreak. Stem-mapped trees were measured before, during and after the outbreak (5-year measurement cycles) with the conclusion that 2% of affected trees were killed by the infestation (Reynolds & de Montigny, 2015).

Utilizing the conservative mortality estimate of 3.6%, with a recurring cycle of 12 years would translate into an annual mortality rate of 59 ha per year within the THLB.

Windthrow

Windthrow is a natural disturbance that uproots trees (wind strength exceeds anchor strength) or causes stem breakage (wind exceeds stem strength) either in individual trees or at a scale that affects an entire stand (>1 ha). There are two classifications of windthrow in coastal BC: Endemic windthrow is caused by frequent (1-3 year) recurring peak winds affecting localized stand edges or exposed trees; or catastrophic winds which are infrequent (>20 year recurrence) affecting high proportion of trees in a stand as a result of a major wind event (Kielke, Bancroft, Byrne, & Mitchell, 2010). Windthrow, particularly endemic windthrow on Haida Gwaii, is highly correlated with topographic exposure (ex. ridges or shoulders are at higher risk), soil conditions (ex. shallow wet soils are at higher risk) and tree characteristics (ex. tall thin trees are at higher risk) (Rollerson, Peters, & Beese, 2009).

On Haida Gwaii the average winter winds range between 22-27 km/hr, where winds of 43-60 km/hr occur 20% of the time and winds 60-75 km/hr occur 3% of the time during winter (Kielke, Bancroft, Byrne, & Mitchell, 2010). The maximum recorded wind gust speed for Haida Gwaii was 164 km/h at the Sandspit Airport (Banner A. P., 2014).

Haida Gwaii is often divided into three physiographic regions or ecosections that exhibit distinct climactic, geologic, topographical and ecological characteristics (Banner A. P., 2014): Queen Charlotte Lowland (QCL) on the north and east; Skidegate Plateau (SKP- central latitudinal band) and the Queen Charlotte Ranges (QCR). The majority of the windthrow occurrences identified in the change detection mapping occurred in the SKP and QCR ecosections, as outlined in figure 7.4.2.2

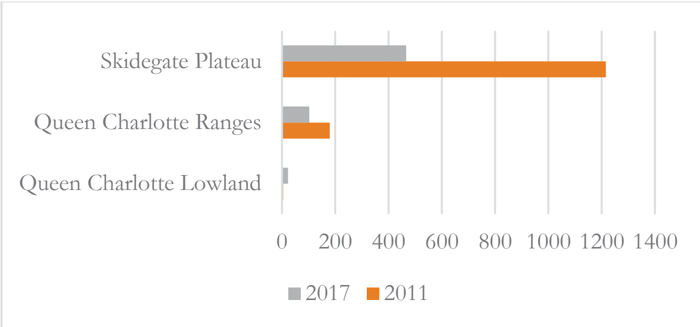


Figure 7.4.2.2 Windthrow occurrences (hectares) between 2011 and 2017 across three physiographic units.

Change detection analysis (described above) mapped all recent windthrow occurrences[50] down to 0.25 hectares in size. The results mapped a total of 1,992 hectares of windthrow, with 1400 hectares mapped from 2011 imagery, and an additional 592 hectares mapped in the 2017 imagery, amounting to an annual rate of change of 114 hectares per year. Applying this to the THLB amounted to an annual disturbance rate of 70 hectares per year.

Landslides

Landslides are a leading abiotic natural disturbance on Haida Gwaii caused by the downslope movement of overlying weathered material and rock initiated by high rainfall intensities, earthquakes or other mechanisms. A landslide is a general term that geologists may further classify into debris slides, debris flows, debris avalanches, rockslides or avalanche tracks. Landslide susceptibility is typically influenced by topography (ex. steeper slopes are higher risk), bedrock geology (ex. sedimentary bedrock is higher risk), surficial geology/soils (ex. folisols are higher risk), and climate (ex. higher precipitation regimes present higher risks) (Howes, 1987). Comprehensive landslide mapping has occurred on Haida Gwaii, with up to 0.84 landslides per km^2 for all of Haida Gwaii (Gimbarzevsky, 1988) which can increase to between 3.82 to 7.23 landslides per km^2 when only accounting for areas with 'active' geomorphology (steeper, unstable terrain) (Jagielko, 2012). Past logging practices, along with natural climate/geomorphology led to significant occurrences of mass wasting on Haida Gwaii through the 1960s-1990s. This led to numerous studies on the causation of landslides on Haida Gwaii (Rood, 1990) and their effects on streams and sedimentation (Hogan & Schwab, 1991), eventually leading to several land management guidance documents for BC on minimizing landslide risks from logging (Hogan, Tschaplinski, & Chatwin, 1998). Likely because of changing forest management practices, an analysis of landslides in the change detection mapping highlighted that only 6 hectares, or 0.5% of the last 10 years of cutblocks (26,483 hectares) overlapped with landslides.

Figure 7.4.2.3. Major landslides in 2012 near Kin.gii Llnagaay (Wells cove) in Gwaii Haanas after the 2012 earthquake.

[50] Areas with little or no vegetation response after an event or low normalized difference vegetation index (NDVI) values. Occurrences tend to by <10 years of age.

Note that analyzing the frequency, scale and distribution of landslides has been done to estimate and project the effect (netdown) on forests available for logging over time. Unstable terrain (not a natural disturbance, but often an operational limitation) has been removed from the THLB (see section 6.8).

Change detection mapping showed that, 787 hectares of landslides were mapped in 2011 and an additional 394 hectares were mapped in 2017 with 99% of the landslides occurring within the QCR and SKP ecosections. The annual natural rate of disturbance was 26 hectares within the THLB.

Yellow cedar decline
The decline of yellow cedar is primarily attributed to environmental stress caused by climate change (P. Hennon, 2016). The mechanism of decline has been extensively researched in southeast Alaska since the 1980s (P. Hennon, 2016). Ecodormancy (winter hibernation that conifers go into) is temperature regulated (versus regulated by photoperiod) and is believed to be triggered at the roots by warming soils. Lower snow pack lessens insulation, warms roots and leads to de-hardening (tree comes out of ecodormancy). The de-hardened trees are then susceptible to late spring freezing events, that lead to freezing injuries (lesions), that in turn lead to phloem necrosis and death. Decline because of freezing injury can be abrupt or last many decades (per tree). By 2014 the decline in southeast Alaska had affected 236,600 hectares (USDA, 2015) and up to 95,000 ha on BC's northcoast (Westfall, 2014).

Figure 7.4.2.4. Yellow cedar decline in Florence creek

Climate model studies suggest the decline will expand for several decades, but ultimately not affect the entire population. There is some evidence that yellow cedar is expanding further north and into higher elevations, but at very slow rates (~5m over ~50 years) (Krapek, Buma, D'amore, & Hennon, 2017).

Aerial overview surveys and field surveys have identified yellow cedar decline across Haida Gwaii regardless of elevational gradients (e.g. ephemeral snow pack and temperate climate) (MFML, 2010) (Reynolds, 2016). Haida Gwaii climate patterns (warming winters, greater winter precipitation) are causing both divergent growth trends where asymptomatic trees show greater growth and symptomatic trees are less sensitive to climatic variation after the onset of decline (L. Daniels, 2016).

Observations on Haida Gwaii are currently restricted to old forests, however there are uncertainties regarding the impact on young forests on Haida Gwaii. In southeast Alaska, the decline seems to affect young stands as well, with about 18% of the yellow cedar in age classes between 40-60 years showing symptoms of decline (Graham, 2017).
Since 2006 approximately 2,720 hectares of yellow cedar decline have been mapped during Aerial Overview Surveys, amounting to an annual disturbance of 40 hectares within the THLB.

7.4.3 Other disturbance agents

The following disturbance agents have not been included in timber supply calculations for a variety of reasons described herein.

Lodgepole pine sawfly (*Neodiprion sp.*) is a defoliator that has affected over 700 hectares west of Burnaby Island in pine dominated forests in Gwaii Haanas. Mortality is uncommon (Burleigh, Ebata, White, Rusch, & Kope, 2014), but has happened concurrently with a localized outbreak of lodgepole pine beetle (*Dendroctonus* *murryanae*). These outbreaks have been documented since 2012 with no sign of occurrences spreading north of Island Bay (Reynolds, 2016).

Minor occurrences (6 ha) of spruce beetle (*Dendroctonis rufipennis)* have been identified throughout mature second growth stands on southern Graham and Moresby Islands. These are considered to be a natural baseline levels common with maturing successional forests and not affecting timber supply.

While nearly 400 hectares have been affected by the green spruce aphid (*Elatobium abietinum*) since 2006, losses attributed to green spruce aphid are assumed to result in a mortality rate of 10% (Koot, 1991). These low mortality numbers spread over a long period result in negligible effects on timber supply.

Over 1,000 hectares of forest have been affected by paludification or natural advancement of wetlands (mapped as flooding) on eastern Graham Island. These areas however have been localized within Naikoon Park (Cape ball area) and do not affect the THLB.

7.4.4 Natural disturbance calculations in timber supply

Natural disturbance happens regardless of administrative boundaries. As described above, the *distribution* of natural disturbance is rather associated with certain physiological/biological characteristics - which can be stratified for the purpose of quantifying their scale and frequency of occurrence. For example:

- Yellow cedar decline affects old yellow cedar stands;
- Black headed budworm primarily affects second growth hemlock leading stands (exists in old forest- but is spotty);
- Windthrow affects older/mature stands as windthrow dynamics are linked, in part, to stand characteristics;
- Landslides almost always occur in the SKP/WQC ecosections, and affect forests of all ages.

Determining the *frequency/distribution* can then be calculated as a disturbance ratio, calculated as

$$\frac{\text{area of disturbance}}{\text{stratified area of interest}}$$

Four factors help quantify this disturbance ratio to determine its impacts on timber supply:
a. **Disturbance strata defined:** What is the forest type affected by the disturbance type (disturbance strata)?
b. **Area of disturbance strata:** How much area does this disturbance strata represent within the area of study? The area of study would be the full geographic extent/area where baseline surveys were conducted (ex. AOS derived data is for all of Haida Gwaii, change detection derived data is for the area identified in figure 7.4.1).
c. **Total disturbance ratio:** What is the ratio of disturbance between the strata affected and the total strata within the area of study?
d. **Area of disturbance strata within the THLB:** total area of the disturbance strata found within the THLB.
e. **THLB annual disturbance:** the annual area of disturbance strata within the THLB.

The following table summarizes the four natural disturbance factors accounted for in this timber supply review:

Table 7.4.4 Annual reductions to timber supply resulting from natural disturbances.

Natural disturbance type	Disturbance strata	Area of disturbance strata (ha)	Annual disturbance (ha)	Disturbance ratio (*rounded*)	Area of disturbance strata in THLB (ha)	THLB annual disturbance (ha)
Wind	>Age class 4 trees in SKP/QCR ecosections	109,000	114	0.1%	66,900	70
Slides	Treed areas in SKP/QCR	323,100	77	0.02%	109,900	26
Black-headed budworm	<Age class 5 Hemlock leading	100,900	142	0.1%	42,100	59
Yellow cedar decline	Old YC leading stands	62,200	389	1.0%	6,400	40
Total annual disturbance on the THLB						195

7.4.5 Application in Spatial Timber Supply Model

The strata and disturbance targets above were applied as an expected rotation (the inverse of the disturbance ratio, or area potentially affected/annual area effected) as the main parameter in the natural disturbance model. The STSM model treats the natural disturbance strata as stochastic analysis units that do not contribute to the overall annual harvest (hence non-salvageable loss). This was because the disturbance targets listed above are typically catastrophic events or events not associated with salvage operations (e.g., slides, catastrophic windthrow or single tree volume losses due to pest or abiotic factors).

7.5 Climate Change

Climate change is widely affecting forests in Canada, ranging from changes in the frequency and intensity of natural disturbances (Abbott & Chapman, 2018), rates of carbon sequestration (R.Hember, K.Werner, & M.Girardin, 2019) shifts in species composition, as well as affecting silviculture such as adapting climate-based seed transfer protocols (Johnston, Webber, O'Neill, T.Williamson, & Hirsch., 2009).

Changes in global climate are expected to increase natural disasters, including drought, flooding, wildfire, rising sea levels and extreme storm events (International Panel on Climate Change, 2014).

On Haida Gwaii, climate trends have demonstrated a moderate increase in temperature (2.5%) and precipitation (2.25%) over the last 70 years. An Environment Canada climate station on Langara Island has continuous daily climatology data since July 1936. Average annual precipitation levels[51] and average daily maximum temperatures indicate a slow increase between 1937-2018[52] (see figure 7.5.1 and 7.5.2). This trend aligns with the CanESM2 model[53], with 2040-2069 precipitation predictions on Haida Gwaii to increase by a maximum of 2.75mm per day (November) and decrease by 1.18mm per day (July) when compared to a 1961-1990 baseline (see table 7.5.7climate data for wet and very wet hypermaritime variants).

Analysis of weather station data from Cape St.James, the southernmost weather station on Haida Gwaii, indicates there hasn't been an increase in average daily windspeeds on Haida Gwaii, and the frequency and intensity of storms (gale force, ≥62km/hr or above) has also remained stable or decreased since a 1980's baseline. This data doesn't suggest an increase in storm intensity and frequency, therefore it was decided to not complete a related sensitivity analysis on wind-related natural disturbance.

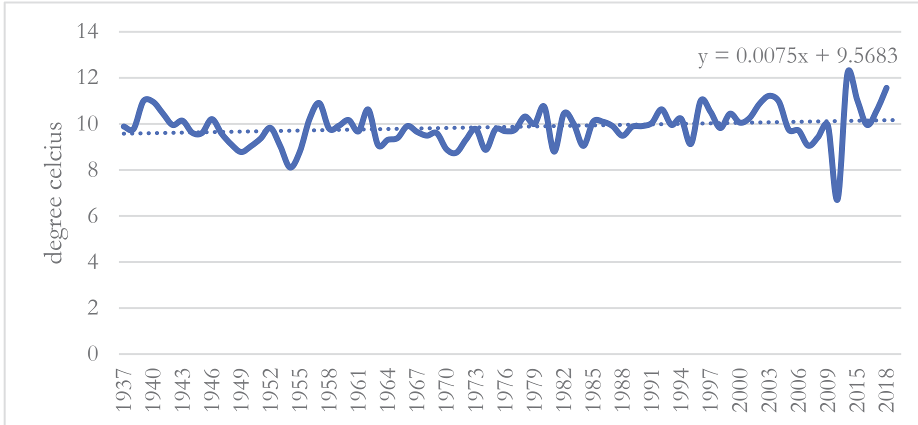


Figure 7.5.1. Average daily maximum temperature and linear trendline- Langara Island (Environment and Climate Change Canada).

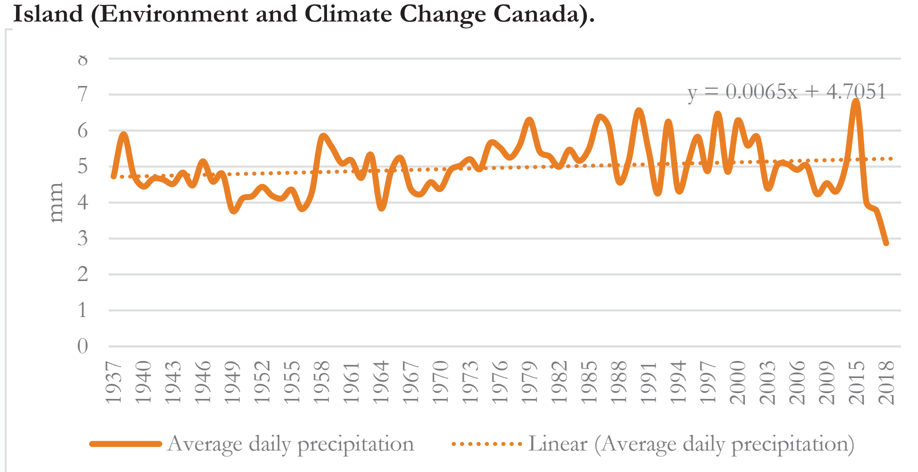


Figure 7.5.2. Average daily precipitation and linear trendline- Langara Island (Environment and Climate Change Canada)

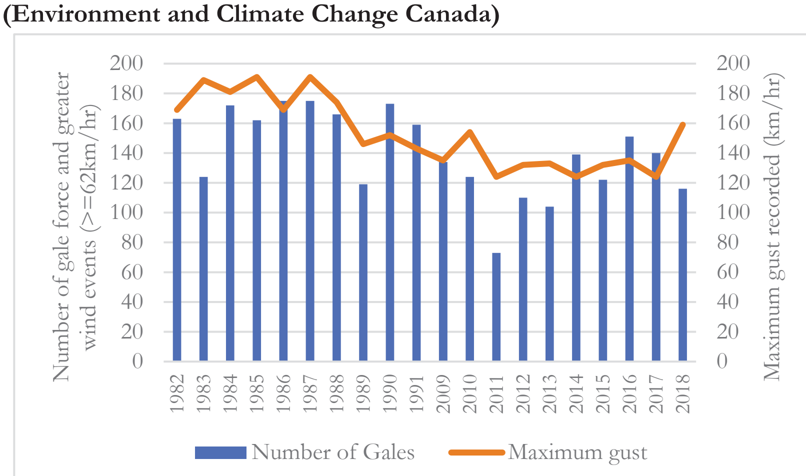


Figure 7.5.3. Decadal trends in gale force storm events and maximum wind gusts at Cape St.James between 1982-1991 and 2009-2018 (Environment and Climate Change Canada)

Effects on forests

Potential changes to natural disturbance types are uncertain, particularly the biotic effects from insects or pathogens. Abiotic natural disturbance factors may include increased peak flows and flooding, increased windthrow, landslides, drought, fire as well as continued or increased decline in yellow cedar forests on Haida Gwaii.

Some of these variables have been monitored and their timber supply impacts quantified in developing estimates of disturbance used in the analysis. Where evidence of natural disturbance is

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51 Average daily precipitation aggregated to month and then to year.

52 Data retrieved through the Pacific Climate Impacts Consortium www.pacificclimate.org

53 Canadian Centre for Climate Modelling and Analysis.

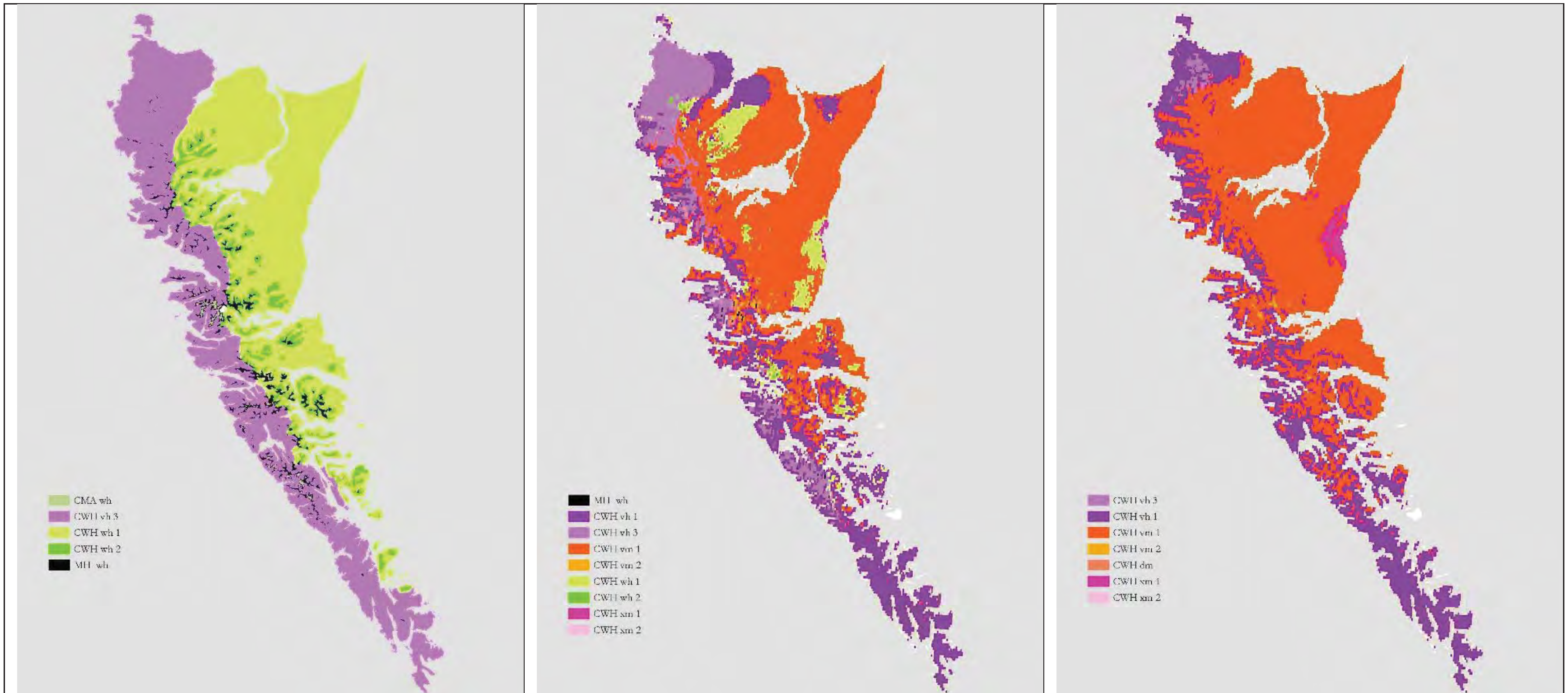
expected to have a material impact on forests, annual-change predictions are built into the timber supply model (see section 7.4). While these predicted effects are stochastically accounted for in the spatial timber supply (e.g natural disturbance targets are randomly applied across the land base) the annual targets do not vary (e.g. they do not increase or decrease in response to climate change).

Some elements of climate change may be significant, such as increased peak flows and flood events, but may have relatively inconsequential effects on timber supply (e.g. hydrogeomorphological features, such as floodplains, have been removed from the THLB).

Changes in temperature and precipitation redraw ecological boundaries and may affect species composition and site potential. ClimateBC project future seasonal and annual climate variables by using both global circulation models (PRISM, (Daly, Gibson, Taylor, Johnson, & Pasteris, 2002.)) and historical weather station data. The program uses historical data (1901-2013) (Mitchell & Jones, 2005) and forecasts future climate scenarios (2020s, 2050s, 2080s) generated by global models from IPCC Assessment Report 5 (International Panel on Climate Change, 2014). The program, described in Wang *et al* (2016), uses a combination of elevation adjustments and bilinear interpolation to deliver 23 annual and 168 monthly climate variables. Regional results for Haida Gwaii are illustrated in figures 7.5.4. While there is a predicted shift in biogeoclimatic (BGC) variants, Haida Gwaii's maritime environment is anticipated to moderate these changes when compared to the changes anticipated in bioclimates in BC's interior.

The long term BGC shift between 2019 and 2080 is expected to be from the CWH wh1 to the CWH vm1 and from CWHvh3 to CWH vh1, which represents a shift from wet to very wet and maritime to hypermaritime climates. The majority of the current THLB would shift to CWHvm1, which is a climate currently more characteristic of the west coast of Vancouver Island (Green & K.Klinka, 1994). Site components, expressing relative moisture and nutrient availability, are a function of physical properties such as soil, terrain, slope position and aspect. While these "enduring features" may not change (the relative edatopic relationships will be the same) the change in bioclimate may result in a change in site potential for tree growth, or productivity. Figure 7.5.5 and 7.5.6 illustrates a comparison of site index by species expressed on edotopic grids between the current and most common BGC unit in the THLB (CWHwh1) and the predicted BGC unit CWHvm1 by 2080. For both western hemlock and western red cedar there is a slight increase in site potential between these two variants.

Despite the minor predicted change in site potential, a sensitivity run with changes to growth and yield were not completed. The growth and yield implications are uncertain due to the interplay of underlying soil productivity with projected climate changes (i.e., moisture is not likely limiting on Haida Gwaii) and of stand productivity with stand-level disturbance agents. As more information become available on climate changes implications for productivity, it can be included in future TSRs.



CMA wh	0.3%	CWH vh 1	29%	CWH vh 1	31%
CWH vh 3	40%	CWH vh 2	13%	CWH vh 2	1%
CWH wh 1	49%	CWH vm 1	49%	CWH vm 1	66%
CWH wh 2	7%	CWH vm 2	1%	CWH vm 2	0.2%
MH wh	4%	CWH wh 1	7%	CWH xm 1	2%
		CWH wh 2	0.3%	CWH xm 2	0.1%
		CWH xm 1	0.2%		
		MH	0.1%		

Figure 7.5.4. Current proportions of BGC variants and predicted ClimateBC shifts in BGC Units for Haida Gwaii, present (left), 2050 (centre), 2080 (right)

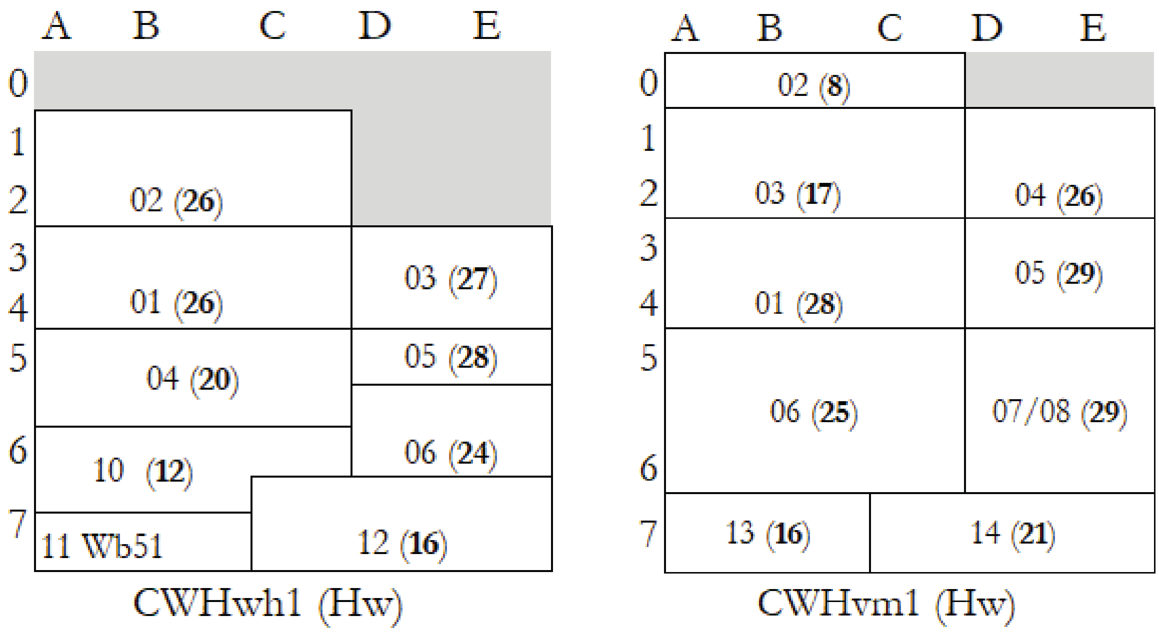


Figure 7.5.5. Ecological edotopic grid (rows increase with relative moisture, columns indicate relative nutrient) comparing SIBEC site index (bold in parentheses) between CWHwh1 (current) and CWHvm1 (predicted future) BGC site series units for western hemlock.

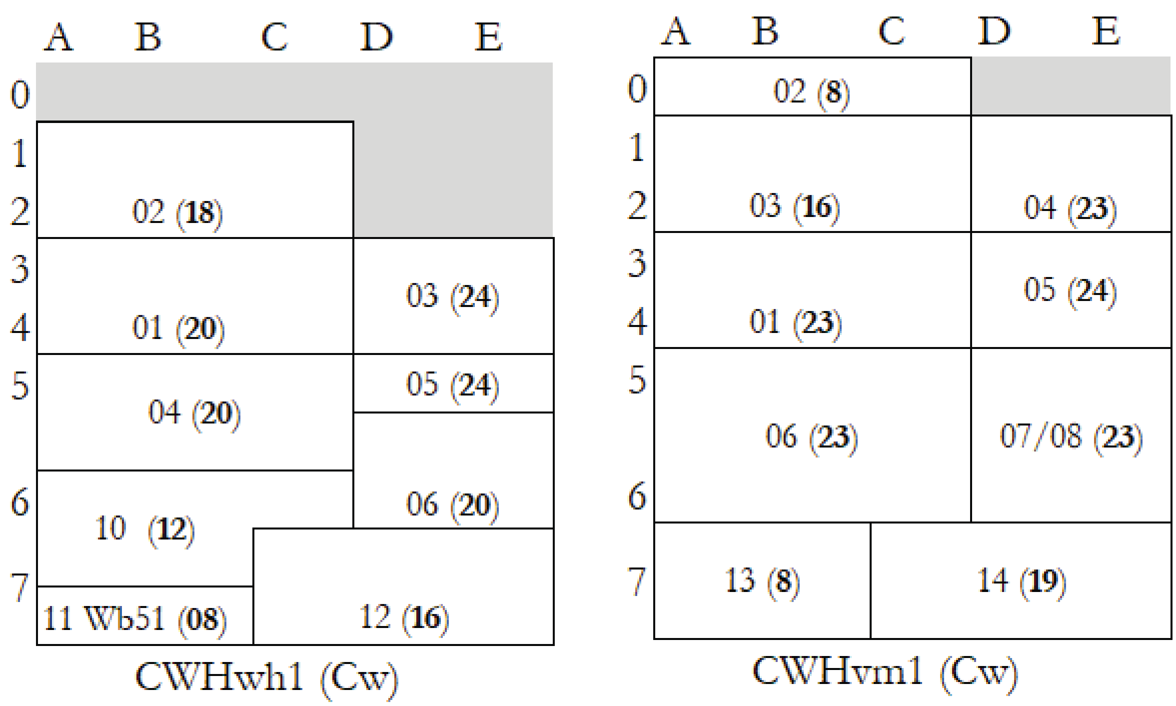


Figure 7.5.6. Ecological edotopic grid (rows increase with relative moisture, columns indicate relative nutrient) comparing SIBEC site index (bold in parentheses) between CWHwh1 (current) and CWHvm1 (predicted future) BGC site series units for western red cedar

Table 7.5.7. Climate data for wet and very wet hypermaritime variants (Green & K.Klinka, 1994).

	CWHwh1[54]	CWHvm1
Mean annual precipication (mm)	1152 to 1535	1555 to 4387
Mean annual temperature	7.1 to 7.9	7.0 to 10.1
Growing degree-days >5 (C)	1206 to 1385	1313 2011

7.6 Economic operability assessment

Realized THLB

The timber supply model typically identifies a long run non-declining flow of timber based upon the THLB (availability), growing stock and key constraints that reflect current forest management strategies or policy. Accessibility, species distribution and markets however play a major part in the economic feasibility of sustainable forest management. Haida Gwaii has areas that significantly vary in age class distribution, access, productivity and species composition, all affecting economic feasibility. Therefore, an AAC that doesn't account for these discrepancies, for example including economically inaccessible areas into a broader cut, may lead to over-harvesting of accessible areas.

To account for this, this TSR incorporated an economic operability assessment through a relative cost and marginal value model. This model incorporates costing surrogates (roads) and value surrogates (dynamic stand values) that approximate operational limitations. The model addresses operability at multiple scales. For example, at the stand level there is often concern that small areas of practically inaccessible low value timber contribute to timber supply, whereas in reality they would not be harvested. At a broader scale this is applicable in woodsheds that may not come 'on-line' (e.g., actually contribute to timber supply) until the growing stock supports a stable harvest over a given time period. Both scenarios can be reflected in a THLB that is never 'realized'.

The following section is sourced directly from Fall (2018) and describes the road costing and stand value model.

The goal of the road cost aspect is to model relative differences in construction and maintenance costs based on geophysical attributes (e.g. slope, land cover). A road cost surface was developed, which was used to develop a full build-out potential road network that can provide access to the entire THLB via a relative lowest-cost layout. The underlying cost of each road segment is retained during timber supply analysis, where segment cost is the relative cost/km multiplied by road segment length.

The goal of the stand value aspect is to model relative differences in stand values per cubic metre of merchantable volume by species. Relative values were derived using log market prices. As these market prices vary by year, scenarios can apply average values, or higher/lower market values. Stand values can be computed dynamically as value/m^3 multiplied by merchantable stand volume, and can be summed at various scales, such as grid cell, block or woodshed.

Limits can be defined for the maximum average unit of road cost per unit of stand value (cost/km to value/m^3 ratio) that can be incurred during a period within each woodshed for road building and maintenance. These limits influence the order in which stands may be harvested (and hence the resulting timber supply). When limits are reached, further harvesting is constrained to the active road network at that point. For remote stands, the effect may be to cause rotations to be extended (e.g. to allow further stand growth that will lower the cost:value ratio to within acceptable limits), and in extreme cases may lead to a stand never being harvested (e.g. stand "isolation" may occur for a small stand of low volume/poor value that would require high road construction costs to access).

[54] Reference weather stations (*n*)=6 for CWHwh1; (*n*)=32

7.6.1 Road costs

The relative road cost layer ranges from 1 to 10, where a value of 1 represents the lowest cost condition (e.g. flat areas through forest). Higher values represent the relative increase in cost (e.g. a value of 10 represents a 10-fold increase in cost, or alternatively, a road segment of length 1 km across an area with cost 10 has the same cost as a segment of length 10 km through an area with cost 1). The same cost factors were applied as in the mainland coast analysis, where cost values were computed as (Fall A. , 2015)maximum cost (10) for glaciers, lakes, rivers, salt water, tide flats, rivers, mud and swamps.
Elsewhere: function of slope in percent: slope/10 (rounded up to next highest integer and bounded to range between 1 and 10).

Figure7.6.1.1 Relative road cost surface in Haida Gwaii: lighter shades indicate higher relative cost.

"Exit points" were identified from log handling site information (which are generally at existing road access points from water). Since log handling sites were polygons, an overlay was done with the existing road network, and a single grid cell was selected as the road network exit point.

To generate a full build-out, a location requiring access is stochastically selected, with probability increasing with distance from network roads. The least cost path across the road cost surface is then found to join the site to the road network. Distance and cost to network information is updated and the process is repeated iteratively until all target areas are within 1 km of a road.

The reason for preferentially selecting sites further from roads is that this creates segments that follow the cost surface and avoid lots of short, angular segments (which look more like spurs than the longer segments, which have a pattern more comparable to mainline roads). Conversely, the reason for not simply selecting the furthest site from the road network is that this creates a road network that is more linear than the actual existing network.

The road network was then decomposed into segments, with segment breaks at forks, where roads change from existing to future, and at woodshed boundaries. The average length of segments in the base case scenario was about 300m.

Information for each road segment is stored in a table that includes the length and relative cost of each road segment, as well as information on connections with other segments in the network.

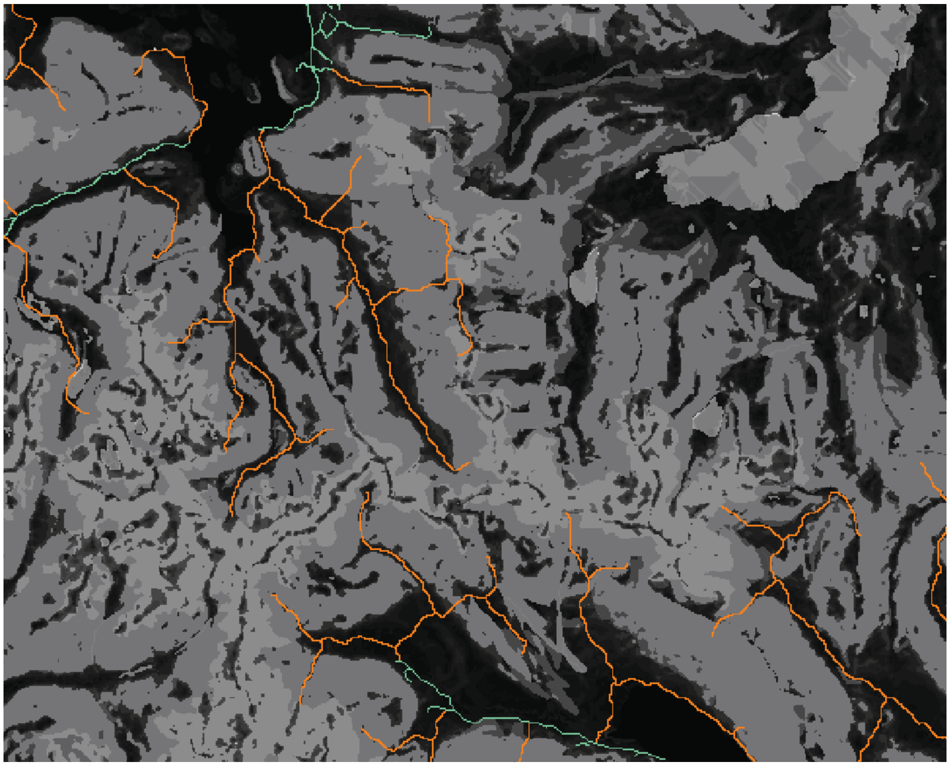


Figure7.6.1.2. Example of full build-out road network. Shades of grey represent relative road costs, where lighter shades represent higher cost. Cyan represents existing roads and orange represents potential future modelled roads.

7.6.2 Relative stand values

The goal was to quantitatively derive value factors per cubic metre for each major species. Two sources of information were explored for deriving relative stand values:
(a) Harvested stands in Haida Gwaii
(b) Log market prices

Information for harvesting in Haida Gwaii was available by timbermark, in which information was available on the percent by species of each harvested unit. Given an overall value for the harvested area, as well as the total volume harvested, factors for the value of each species could be derived via a least-cost-fit (i.e., minimizing the sum of the square of the differences between the actual values of the harvested units and the estimated values using the species factors, prorated by the percent of each species in the harvest unit). Direct information on harvest unit value was not available by timbermark, and so explorations were made on potential surrogates for value (in particular stumpage rate).

Developing stand value parameters based on log market prices
Log market prices provide information for various grades and types of timber based on species, product, etc. These vary by year.

Since log prices for spruce are not published, 2x4 commodity prices for were used for all species. The actual dollar values are not what is important for this application, but rather the relative differences between species and between years. It is, however, important that the prices used for each species are comparable.

An analysis of the rate of export was completed for Haida Gwaii in order to develop a domestic-export value composite for hemlock and spruce. It was important to account for the domestic-export volumes due to the value discrepancy, as seen in figure 7.6.2.1.

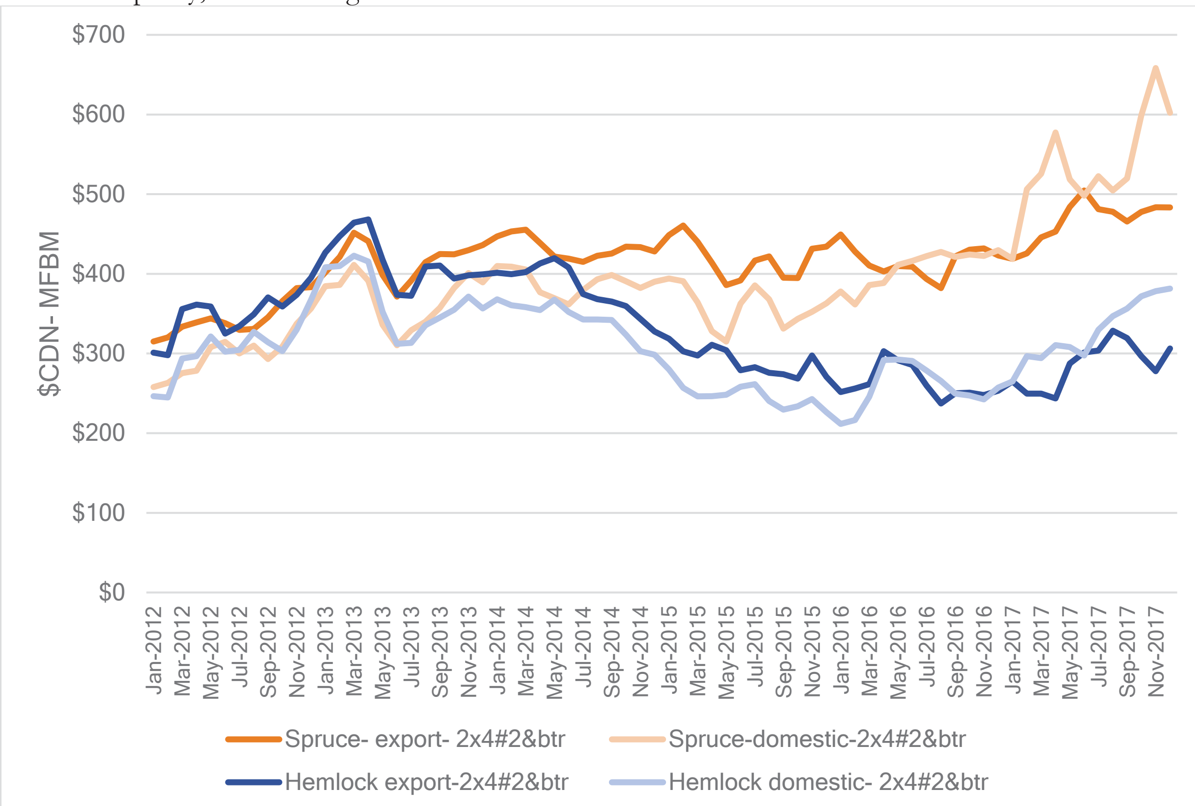


Figure 7.6.2.1. Domestic versus export commodity prices 2012-2017[55]

Export data for 2012-2017 were sourced from the tenure pricing branch[56].

[55] Values were sourced from Madison Lumber Reporting for domestic prices, and from Random Lengths Publications for export values.
[56] https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/log-exports/bi-weekly-advertising-lists

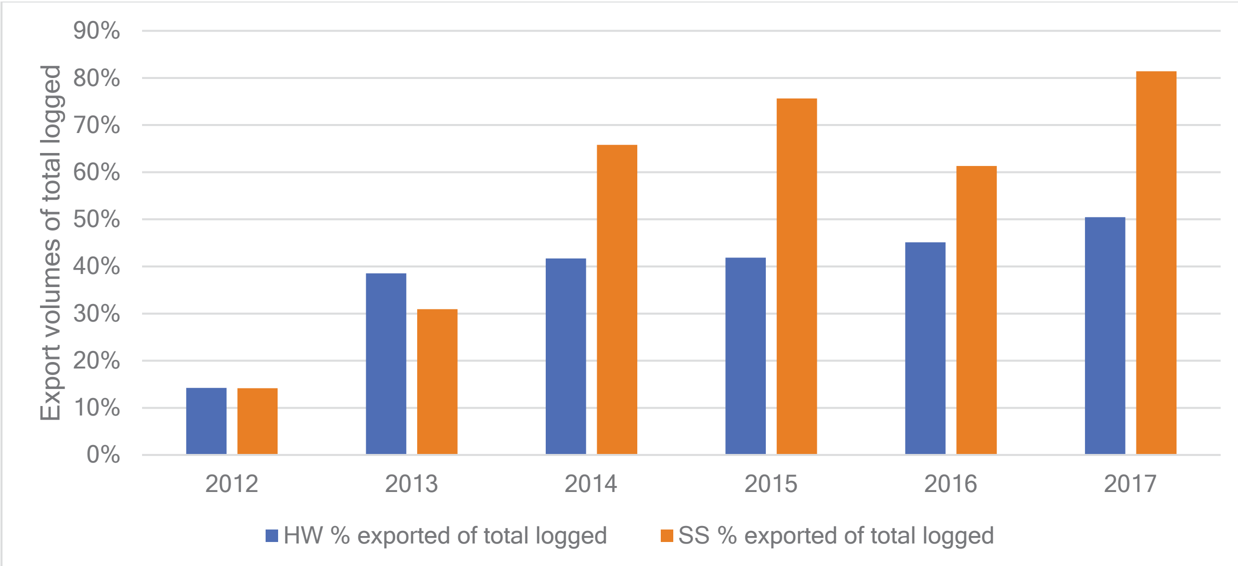


Figure 7.6.2.2. Hemlock and spruce exports from Haida Gwaii, 2012-2017

Hemlock and spruce prices were prorated according to the proportion of export from Haida Gwaii.

Table 7.6.2.2 shows summary information for each species group over the timeframe 2008 to 2017.

Table 7.6.2.2 Summary commodity prices for Cedar, HemBal and Spruce 2008-2017

Species type	Min $/m³	Max $/m³	Mean $/m³
Cedar (WRC 2x4 green)	547	1009	750
Hem/Fir KD Coast Std&Btr	162	385	278
Spruce (WSPF KD #2&Btr 2x4)	206	480	335
Overall	47.73	273.91	

For each species group, monthly prices were averaged across each year (2008-2017) representing a market cycle index.

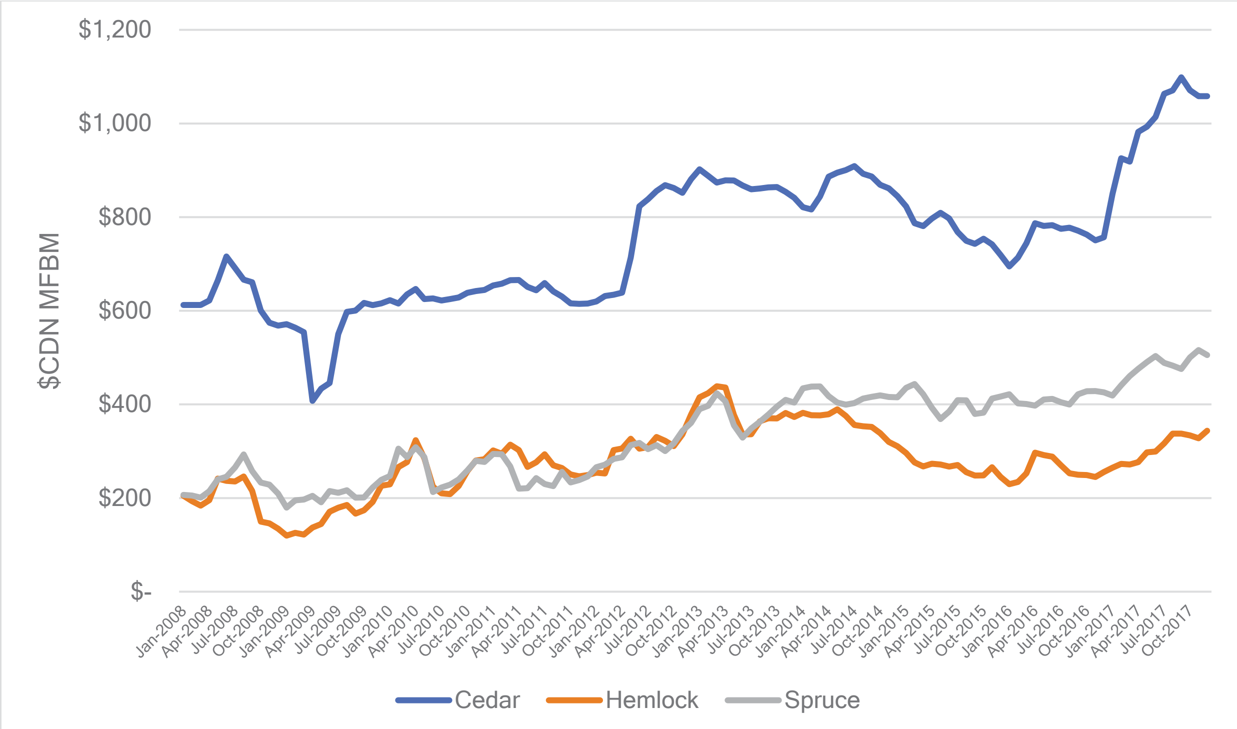


Figure 7.6.2.3. Market cycle index: species commodity values between 2008-2017

Average yearly price values were then divided by the minimum yearly price across all years and species, to put prices on a relative scale. (Table 7.6.2.3).

Table 7.6.2.3. Relative value/m3 by year for Cedar, HemBal and Spruce

Year	Cedar	HemBal	Spruce	All
2008	3.9	1.2	1.4	2.2
2009	3.4	1.0	1.3	1.9
2010	3.9	1.6	1.6	2.4
2011	4.0	1.7	1.5	2.4
2012	4.7	1.9	1.9	2.9
2013	5.4	2.4	2.4	3.4
2014	5.4	2.2	2.6	3.4
2015	4.8	1.6	2.5	3.0
2016	4.7	1.6	2.5	2.9
2017	6.2	1.9	3.0	3.7
Overall average	4.6	1.7	2.1	2.8

The relative values/m^3 by species group can be used to compute total relative stand values by multiplying these relative values by volume proportional to the percent of each species in the stand. The base scenario used the average for each species group across all years.

Sensitivity analyses (section 8 of this data package) explored high/low values by year and/or species. To facilitate this, years were classified into low, mid and high market years by species group and overall based on equal percentiles (table 7.6.2.4), and then the mid-point value/m^3 for each percentile class was calculated.

Table 7.6.2.4 Year value class for Cedar, HemBal and Spruce

Year	Cedar	HemBal	Spruce	All
2008	Low	Low	Low	Low
2009	Low	Low	Low	Low
2010	Low	Low	Mid	Low
2011	Mid	Mid	Low	Mid
2012	Mid	High	Mid	Mid
2013	High	High	Mid	High
2014	High	High	High	High
2015	Mid	Mid	Mid	Mid
2016	Mid	Mid	High	Mid
2017	High	Mid	High	High
Low percentile	**3.95**	**1.59**	**1.59**	**2.39**
Mid percentile	**4.93**	**1.90**	**2.51**	**3.07**

Table 7.6.2.4 Relative value/m3 for each value class for Cedar, HemBal and Spruce

Year	Cedar	HemBal	Spruce	All
Low	3.4	1.0	1.3	1.9
High	6.2	2.4	3.0	3.7
Average	4.6	1.7	2.1	2.8

7.6.3 Projecting stand values

The Spatial Timber Supply Model (STSM) projects stand ages, analysis units, road network and other attributes. A minor modification was made to the STSM to expand the timber analysis unit (AU) input table to include the percent of the three leading species expected in typical stands for the AU. The merchantable volume in a grid cell was then pro-rated by species using these percentages, and the relative value was computed as the sum across all species:

$Total\ Stand\ value = StandVolume * \sum_{i=1,n} SppPercent_i * SppValue_i$

where (i) *StandVolume* is the total merchantable volume in the stand;
(ii) There are *n* species types (in this case Cedar, HemBal and Spruce, so $n=3$);
(iii) Each species type has a relative value/m^3 *SppValue*; and
(iv) Each species has a percentage in the stand *SppPercent* (which sum to 100%).

Developing and applying cost:value ratios

The relative road costs and relative stand values are used to influence stand availability and preference, in combination with other factors in the timber supply model discussed in this data package.

Road construction and maintenance constraints are applied by “roadshed”. Within each roadshed, limits are placed on the maximum cost that can be incurred within a period on road construction and maintenance relative to value harvested (i.e. road cost: stand value ratios).

Roadsheds
A roadshed is defined as a group of one or more adjacent exit points (log handling sites), and all the road segments that are connected to those sites. Analogous to a watershed, wood harvesting in a roadshed flows from further inland to these exit points.

Woodsheds were used as a basis for roadsheds. Fragmented portions of woodsheds were merged with adjacent roadsheds or placed in a separate roadshed, and each roadshed had at least one exit point. This resulted in 14 roadsheds figure 7.6.3.1).

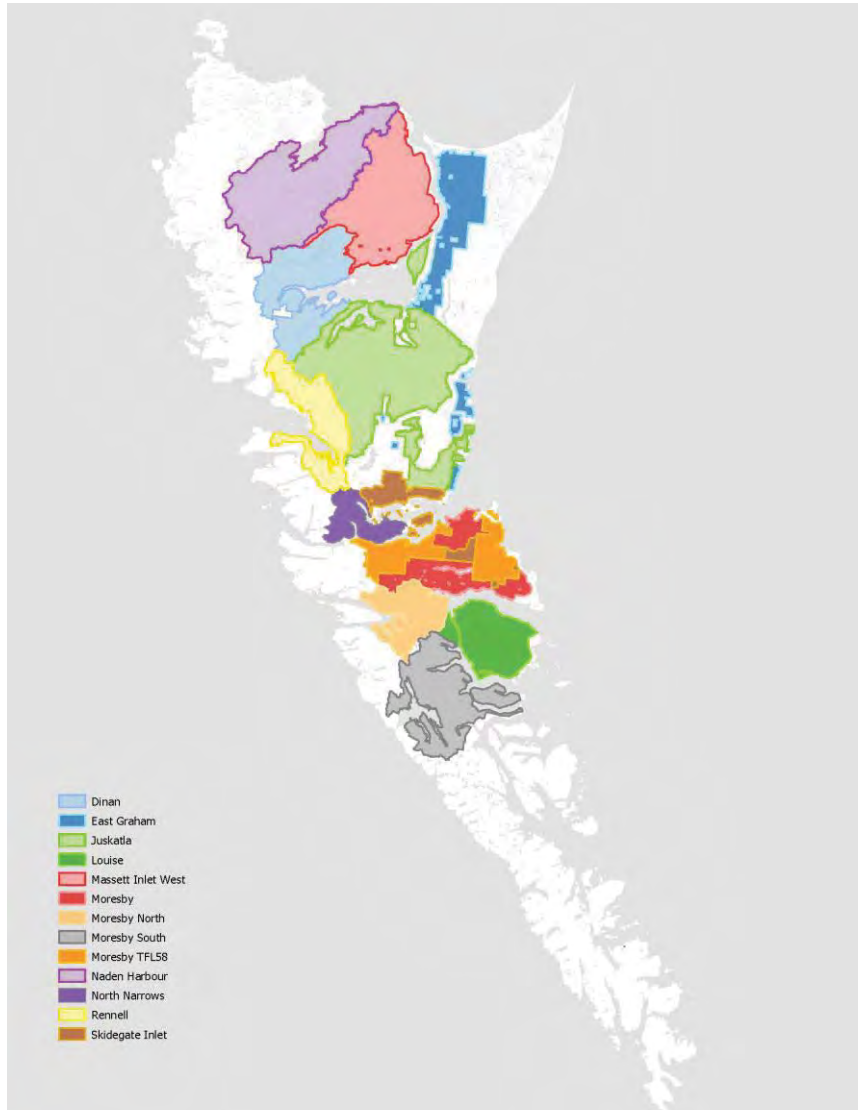


Figure 7.6.3.1. Roadsheds

Roadshed information tracked in timber supply analysis
The SELES Spatial Timber Supply Model tracks information for both individual road segments and entire roadsheds. The net relative cost of each road segment was computed using the road cost surface (represented as the sum of cost values across the length of each segment). During harvest, the volume and relative value of stands harvested, and the length and cost of road segments that are built by the model ("activated" from the road network) is tracked by roadshed. Also, the model tracks the length and cost of previously built segments that are maintained (accessed for the first time in the period). At present, roads are built once, and maintained up to once per period. In addition, hauling effort is tracked as sum of haul distance for each m^3 (volume-weighted haul distance).

Deriving base road cost: stand value ratio parameters
Separate cost:value ratios are derived for road construction and road maintenance. Both road building and road maintenance are relative and independent costs in this model (no scaling between building/maintenance is necessary). Baseline road building and maintenance costs were estimated by running the pre-LUOO scenario with no road cost constraints to produce output by period for each roadshed that included total volume and relative value harvested, and total km and cost of roads built and maintained. This was done using average stand values . Dividing total road building and maintenance costs by the total relative value harvested results in the mean cost per unit value of roads built and maintained.

Road building constraints were derived using the above outputs in each period and adding 10% to provide some within-period flexibility in stand harvest sequencing[57]. In general, road building declines over time (as

[57] The road cost constraints must be met at all times during a period. In some cases, higher cost/lower value stands must be harvested prior to reaching higher value stands. The additional 10% allows modest overrun of the cost:value during a

the road network reaches buildout), and hence maximum mean cost of roads built per unit value of wood harvested also declines (while maintenance costs do not change over time).

Evaluating road cost: stand value parameters
Past harvesting information from the timbermark data was used to assess, and calibrate, the road cost and stand value parameters (Market Cycle Blocks). Given the location, area and volume harvested, modelled relative road costs and stand values for the past harvest units were compared to the overall distribution of modelled road costs and stand values for available stands.

Three modelled harvest scenarios were developed to compare against historical harvesting in order to evaluate model performance:

- Operational Road Cost constraints: the base case TSR scenario (i.e. all constraints, criteria, etc.) with operational road costs.
- No Operational Road Cost constraints: The same as above, but without operational road costs.
- No Operational Road Costs Randomized: The same as the "No Operational Road Costs", but also applying a random harvest preference order for stand harvest selection (rather than based on relative to the age at the culmination of mean annual increment. This scenario was intended to represent as close to "random" as possible, but still respecting constraints, min. harvest criteria, etc.

For each of these scenarios, the Spatial Timber Supply Model (STSM) was run for 10 years, with output of grids for areas harvested and volume/ha prior to harvest.
To make comparisons relevant, the rate of harvest was based on the total volume harvested in the Market Cycle Block data. This is because, in general, road costs/unit value will decline with increasing harvest level (with lots of potential for variability), so it is important to compare scenarios at the same (or nearly the same) harvest level.
For each scenario, a number of metrics were calculated:

- The "value/ha" in harvested cells was calculated using the stand type value weights derived from log market data (by multiplying volume by relative stand value).
- The total road length and total road cost was summed for the road segments accessed for the harvest.
- The average cost/unit value for the roads accessed (separating permanent high-use roads from branch roads) was calculated by dividing total road cost by total value.

Average cost/unit values were then normalized by dividing values for each of the modelled scenarios by the historical harvesting scenario. The final evaluation found:

- Operational Road Costs: 107% for branch roads alone and 98% for all roads
- No Operational Road Costs: 129% for branch roads and 112% for all roads
- No Operational Road Costs Randomize: 161% for branch roads and 147% for all roads

These results show that the modelled operational road costs in the projected 1st decade result in road cost per unit value that are close to (~%7), but slightly higher than the Market Cycle Blocks. This is reasonable, since in the first pass, one would expect that road costs per unit value to increase over time

period. Post-hoc analysis can be done to assess average end-of-period cost:value ratios to ensure that they are not consistently exceeded.

as more remote and isolated stands are accessed, which may require more road or more costly road access, and possibly lower volumes per ha.
The results for scenarios without operational road costs show the magnitude of the improvement, which is reasonably significant given the other factors that constrain and direct harvesting.

Apply road cost constraints
A *road building constraint* is defined, for each roadshed and in each period, as an upper limit on the mean cost of roads built per unit value of wood harvested in the roadshed. A *road maintenance constraint* is defined as an upper limit on the mean cost of roads maintained per unit value of wood harvested in the roadshed during the period.

At the start of each period, information on the current harvest level, roads built and roads maintained by roadshed is cleared. The volume of "potentially available" timber (merchantable timber not reserved to meet a specific constraint) accessed from each road segment is computed (using a grid of nearest road segments).

During the period, "block initiation" cells are queued using the harvest order criteria (e.g., relative oldest-first with preference increasing with stand value, and declining with distance from road to a maximum distance of 1.5km from an existing road for road access and 1.5km from a future road or ocean access) (Ecora, 2015). Before harvest, road constraints are tested as follows.

If the nearest road is not yet built, a test is made as to whether building this segment would exceed the construction constraint limit for the roadshed. Specifically, the test is for whether the net cost (total cost of roads built so far during the period plus the cost for this segment) divided by the net value harvested (the relative value of volume harvested so far during the period plus the relative value of volume available for this road segment) is less than the constraint cost per unit value for road construction.

If the road has been previously built, but has not yet been accessed in this period, a test is made as to whether maintaining this segment would exceed the maintenance constraint limit for the roadshed. Specifically, the test is for whether the net cost (total cost of roads maintained so far during the period plus the cost for this segment) divided by the net value harvested (the relative value of volume harvested so far during the period plus the relative value of volume available for this road segment) is less than the constraint cost per unit value for road maintenance.

As logging progresses, distance to road information is updated. Further, at the end of each period, the total volume harvested with access from each road segment is "flowed" down the road network to the water access point to support computing the total hauling effort.

When applying road constraints, some areas may never be accessed if the cost per length of road is high relative to the available value (which depends on the area of THLB, productivity of stands and relative species value). Some areas will be accessed with delay (compared to not applying road constraints) if available volume must increase to satisfy the road cost requirements. Other areas will be unaffected (e.g. areas with dense, high productivity THLB, with existing road access close to water entry points).

7.6.4 Isolated planning units
Certain operating areas on Haida Gwaii are considered very remote and difficult to operate in as a result of terrain, needs for infrastructure investments and young stands due to past harvest histories. Three of these areas have been identified Sewell inlet (Moresby south) and Peel Inlet (Moresby north), both of which are in the TSA, and Louise Island, which is a part of TFL 60.

The inclusion of areas in the AAC that are practically not operable, or only operable under specific conditions, may lead to over-harvesting other areas in the THLB that are more easily accessible.

Licencees were surveyed to determine what operating criteria would lead to investment and harvesting in these areas (see figure 7.6.3.1 for a map of these areas).

Operational feedback indicates that the Sewell and Peel areas require at least 100,000 m3 for 3 consecutive years, and Louise requires 50,000 m3 for 2 consecutive years.

Scaled to a 10-year model step would mean 333,000 m3 for Tasu/Sewell and Peel, and 250,000 m3 for Louise. This constraint was applied in the base case reference scenario as a minimum harvest volume requirement for these areas.

7.6.5 Small Islands

Haida Gwaii is made up of over 3,670 islands, the majority of which are forested. While most of the islands are in protected areas, a number of islands are available for forest harvesting but are difficult to log. Historically many of these islands were logged using A-frame yarding techniques. Conventional logging has changed dramatically since the A-framing logging era, and islands require log handling, barge/machine loading areas as well as infrastructure such as roads. As a result small islands are typically not operationally feasible. An analysis of the last decade of logging showed that, other than private lands, islands under 150 hectares have not been accessed for commercial logging. As result these islands, amounting to a gross reduction of 3,123 hectares and a net reduction of 249 hectares were removed from the THLB.

Chapter 8 Sensitivity Analyses

8.1 Sensitivity analyses overview

Sensitivity analyses are meant to explore 'what if' scenarios that may have implications to timber supply. These analyses are used as comparisons against what is considered 'base-case' or those assumptions that most reflect current inventory, forest growth and forest management policy. Changing one element or assumption of the base case allows decision makers to explore the interaction of supply over time and place. Types of sensitivity analysis include:

- anticipated policy changes (either from legislation, regulation, resolutions or strategies employed by licensees),
- reasonably foreseen changes to markets or economic operability,
- potential changes in inventory (e.g. the type, frequency and distribution of natural disturbance over time);
- potential changes in forest growth over time, or;
- potential changes in forest management strategies (e.g. rotation lengths);
- alternative technical approaches to represent management assumptions (e.g., different ways of constraining visual quality, etc.).

The following sections describes the context for a sensitivity analysis, the considerations or rationale (e.g., policy driven, information driven, etc.) and the specific technical assumptions employed.

Table 8.1. Summary of sensitivity analysis scenarios.

Category	Description	Data package section
Cedar	Evenflow (long run sustained yield) cedar harvest on TFL 58, TFL 60 and TSA	8.2.1
	Evenflow (long run sustained yield) cedar harvest on TFL 58, FNWL, CFA, TSA	
	Evenflow (long run sustained yield-LRSRY) cedar harvest on TSA woodsheds	
	Evenflow LRSY + 10%(e.g. 110% of LRSY)	
	Evenflow LRSY – 10% (e.g. 90% of LRSY)	
Management Units	Base reference run on TFL 58, FNWL, TSA	8.2.2
	Base reference run on TFL 58, FNWL, CFA, TSA	
House of Assembly/ CHN	Mosquito lake protection	8.2.3
	Slatechuck creek protection- track flow/THLB contribution	
	100% Monumental cedar protection- factor consideration impact on old natural stands	
	Monumental cedar standard identification change (lower grades included) on TFL 58, TFL 60 and TSA- Uniform distribution	

Category	Description	Data package section
	Monumental cedar standard identification change (lower grades included) on TFL 58, TFL 60 and TSA- Random distribution	
Goshawk	Northern goshawk nesting reserves on 25 territories on TFL 58, TFL 60 and TSA	8.2.4
	Northern goshawk nesting reserves on 38 territories on TFL 58, TFL 60 and TSA	
	Northern goshawk nesting reserves on 67 territories on TFL 58, TFL 60 and TSA	
	Northern Goshawk foraging habitat constraint targeting 5,564 ha (65% territories) of suitable/capable habitat for 22 territories on TFL 58, TFL 60 and TSA	
	Northern Goshawk foraging habitat constraint targeting 5,564 ha of suitable/capable habitat for 38 territories on TFL 58, TFL 60 and TSA	
	Northern Goshawk foraging habitat constraint targeting 5,564 ha of suitable/capable habitat (or all suitable/capable habitat if a territory is below this target) for 67 territories on TFL 58, TFL 60 and TSA	
	Northern Goshawk foraging habitat constraint targeting 4,672 ha (55%) of suitable/capable habitat for 67 territories on TFL 58, TFL 60 and TSA	
	Northern Goshawk foraging habitat constraint targeting 3,823ha (45%) of suitable/capable habitat for 67 territories on TFL 58, TFL 60 and TSA	
Economic operability	No road operability constraints TFL 58, TFL 60 and TSA	8.2.5
	Maximum market (High market) scenario TFL 58, TFL 60 and TSA	
	Minimum market (Low market) scenario TFL 58, TFL 60 and TSA	
	No new roads permitted to be built	
	High cost access exclusion	
	Partition or exclude (and long run sustained yield or evenflow) of isolated planning units (Sewell, Peel, Louise Island)	
	No restriction to isolated roadsheds	
Minimum Harvest Criteria	Economic rotation (and MHV) on TFL 58, TFL 60 and TSA	8.2.6

Category	Description	Data package section
	Extended harvest rotation (and MHV) on TFL 58, TFL 60 and TSA	
	No minimum harvest volume constraint on TFL 58, TFL 60 and TSA	
	No minimum harvest age on TFL 58, TFL 60 and TSA	
	Minimum harvest volume constraint raised to 350m3 for managed stands, 250m3 for natural stands on TFL 58, TFL 60 and TSA	
	Maximum harvest age 250 years	
Harvest preference	Relative volume harvest preference (as opposed to relative value)	8.2.7
	Oldest first relative to CMAI TFL 58, TFL 60 and TSA	
	Randomized order of harvest	
Alternate THLB	LUOO risk managed targets	8.2.8
	Assume WTRA retention levels match current practice, is considered exclusive in-block retention ‘above and beyond’ LUOO retention (7.1% increase on the TSA, 11.6% increase in TFL60 and FLTC).	
	Assume increased access to unstable terrain, based on 20 year average of licencee behaviour	
	Assume branchline roads (basecase 10m exclusion) regenerate on Alder AU with site index 21 with natural densities (4444) and a 4 year delay	
Forest cover constraints	Wetlands not considered ‘recovered’ forests on TFL 58, TFL 60 and TSA	8.2.9
	Don’t apply forest cover constraints	
Harvest flow	Short-term uplift (Allow short-term harvest level to increase such that steps to reach mid-term level cannot be more than 10% per decade.)	8.2.10

8.2 Sensitivity analysis scenarios

8.2.1 Ts’uu – Ts’uu sgiid, Sgaahlaan - Sgaahlaang (red cedar and yellow cedar)

Cedar is central to the Haida cultural and an economic mainstay on Haida Gwaii.
This sensitivity deals with the commercial availability of cedar and is one of the principle reasons for an early Timber Supply Review. Historical harvesting and deer browse has led to large age gaps in cedar, threatening a mid-term shortage, or fall down, in cedar supply.

These age gaps are due to the majority of cedar within the THLB being mature or old. The small amounts of mid seral forest creates a reliance in the near and short term for whatever mature and old cedar is left. This, along with cedars high value and historical harvest above the natural profile has in turn has led to considerable administrative and legal conflicts over the last several years.

Cedar, and the variable growing sites of cedar, are not equally distributed among the management units on Haida Gwaii, especially within the operating areas of the TSA. As a result, some operating units with intensive historical logging (such as Sewell, Tasu, north Moresby) have highly productive growing sites with little to no cedar regeneration or mature cedar, while other areas have moderate productivity and high concentrations of mature cedar (Collison point) or low productivity and high concentrations of mature cedar (north east Graham).
A concern was that, without a partition, the AAC contribution of volumes from less operable or marginal areas of the TSA (typically with low cedar content) were being applied to areas with high cedar composition, thereby undermining its long term sustainability.

Policy considerations
In 2012 the HGMC called on the Chief Forester to consider an orderly transition to harvesting in second growth stands to account for the shortening supply of mature cedar. The Chief Forester then set a soft or non-legal partition for cedar in 2012 with recommended annual limits within each management unit generally based on cedars proportionate contribution to the inventory.
In 2017, in response to the over harvesting of cedar relative to the soft partition in the Timber Supply Area (TSA), the Chief Forester set a legal partition within the TSA which was brought into effect with a Ministerial Order in August of 2018. This partition is currently considered to be part of the base case for this TSR (see section 6.13).

The 2018 partition used limits that were originally included as the 2012 'soft' partition on the three management units (TFL60, TFL 58, TSA). These numbers therefore use the previous TSR inventory and assumptions, but also represent harvest limits to cedar that are nested within the HGMC's 2012 AAC determination. In other words, while the current partition approximates the proportionate contribution of cedar to mature forest in the previous inventory, it also represents a limit that theoretically allows for the HGMC's 2012 AAC to be met (e.g., the partition does not constrain the overall AAC). As a result, while the partition mitigates the mid term fall down it does not resolve the mid-term shortage of commercially available cedar. Therefore, the sensitivity analyses described herein explore means to further mitigate this fall down.

For all scenarios, while an evenflow is sustained, there is a decline of natural stand growing stock over time as mature/old growth timber is replaced with second growth stock, as illustrated in figure 8.2.1.

Figure 8.2.1 Base case natural vs. managed growing stock over time

Timber Supply Considerations

Four supply strategies were employed within this TSR:

(i) An analysis was done to assess limits to cedar harvest to accounts for the mature/old cedars contribution to the harvest over time. Contribution to the harvest is based on tracking all species components (leading, secondary, tertiary, etc.). An even or sustained flow of cedar within each management unit (TFL60, TFL58, TSA) was calculated based upon the long-run range average yield (LRAY) of cedar harvest.

This average amounted to approximately 146,371m^3 per year across all management units:

TSA	81,827 m^3
TFL 58	15,245 m^3
TFL 60	49,299 m^3
Total	146,371 m^3

Within the Spatial Timber Supply Model, harvests tracked the proportional contribution of cedar for all stands (e.g., all species composition deciles contributed or were aggregated towards a harvest target). When the target was met a constraint was applied for all stands that had >10% cedar until the end of the period (10 years) (see section 6.13 for a discussion on the 10% model threshold).

(ii) Considering the major discrepancy in the geographic distribution of cedar across the THLB, a second analysis employed the same evenflow as described in (a) but applied to distinct area-based operational units within the THLB (see map 8.2.1). Operational units represent approximate 'woodsheds' or boundaries of supply units with similar timber attributes or operating limitations. These operational units are not formal, or legally designated units or tenures, however, provide a way to measure where cedar contributions are coming from, and evaluate contributions over time.

(iii) The third sensitivity increases the partition constraint by +10% to the long range average yield targets outlined in (a) above.

(iv) The fourth sensitivity decreases the partition constraint by -10% from the long range average yield targets outlined in (b).

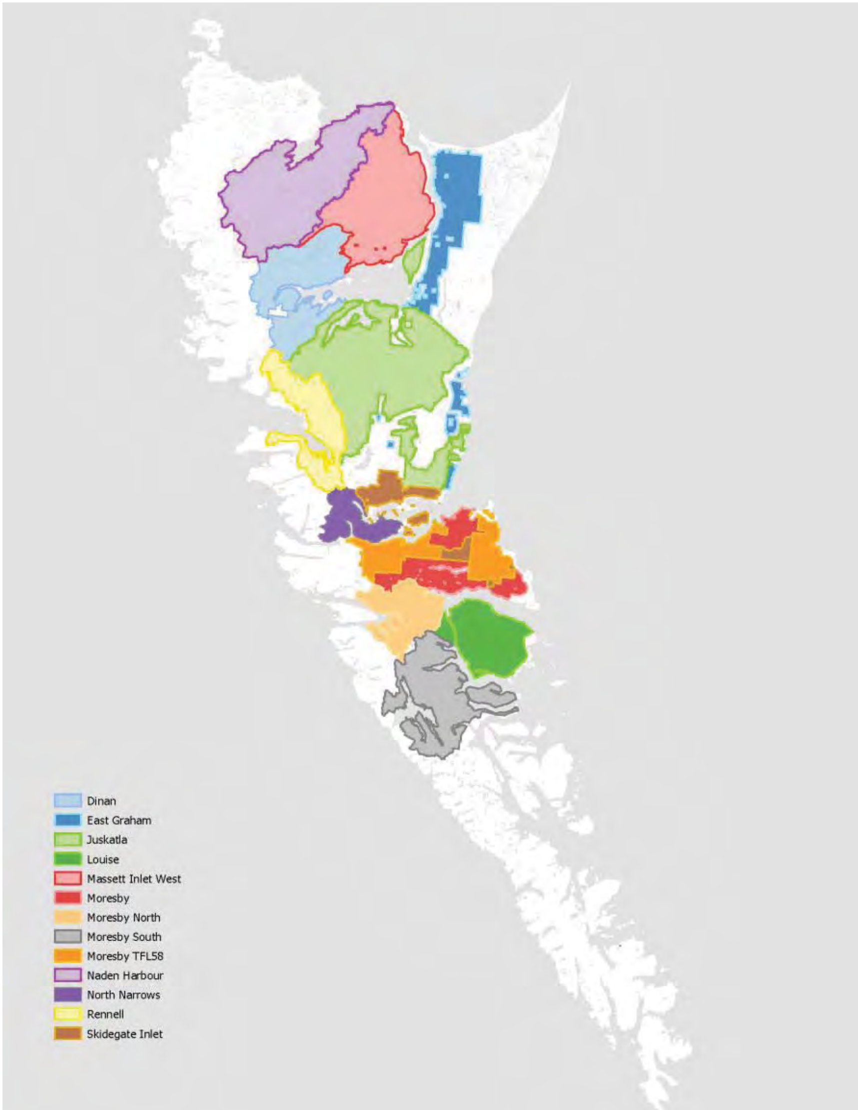


Figure 8.2.1. Timber supply units, or roadsheds within the THLB for purposes of a cedar sensitivity.

8.2.2 Management Units

8.2.2.1 Community Forest

The Province of BC has been working with the Communities of Haida Gwaii (as represented by the Misty Island Economic Development Society, or MIEDS[58]) towards the establishment of a Community Forest Agreement area to come out of the Timber Supply Area. The initial and formal community forest discussions date back to 1996, but in 2010 the Province offered a volume commitment of 80,000m^3 year in partnership with BC Timber Sales. In 2013, with the Ministerial AAC apportionments of volume in the TSA, the 80,000m^3 was tracked as part of the formal apportionment system. While there had been a level of partnership between BCTS and the communities an area had never been formally established or a Community Forest Agreement had not been signed. The Council of the Haida Nation continued to support the establishment of an area-based community forest.

[58] www.mieds.ca

Policy considerations
At the end of 2017 the Province made a formal offer of tenure *K5F* to MIEDS that included a *reduced volume condition* that outlined a formal and legal partnership with BCTS. While the offer has not been accepted, the area proposed within the formal 2017 offer is the area used within this sensitivity analysis, and comes entirely out of the Timber Supply Area, as shown on the following map:

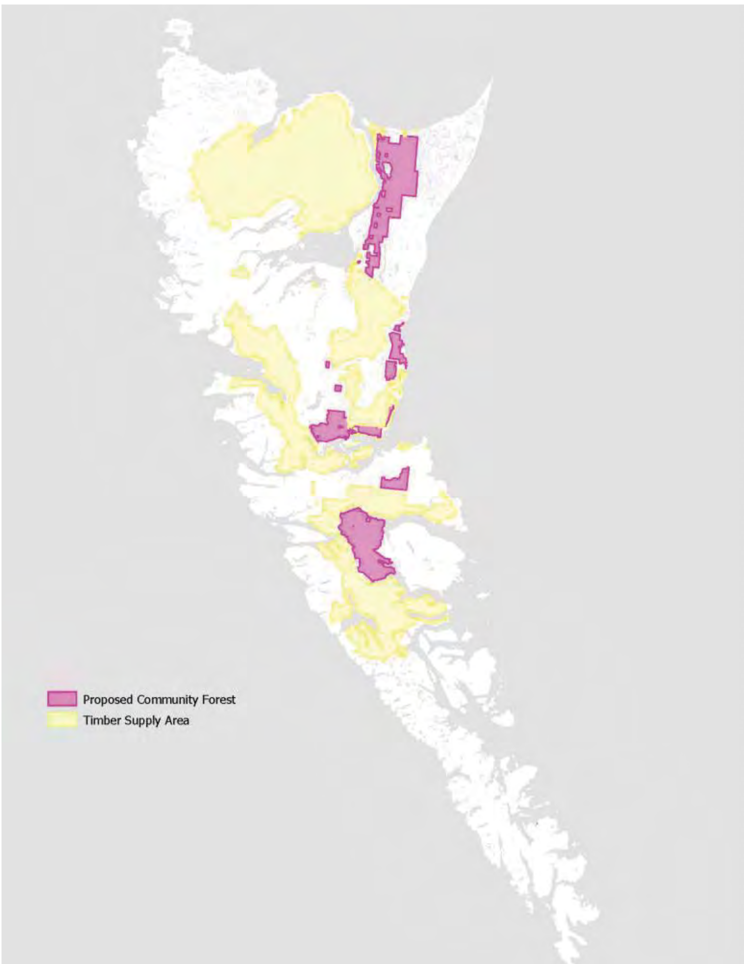


Figure 8.2.2.1 Proposed area of Community Forest Agreement and remaining Timber Supply Area

Timber Supply Considerations
All base case assumptions were applied to the proposed CFA management unit. Given the effect on the TSA (e.g., the CFA is removed from the broader TSA), the refined TSA unit was also modelled using base case assumptions.

8.2.2.2 First Nations Woodland Licence

In 2011, Taan Forest Ltd.became the forest manager of TFL 60, as well as a defined 'chart area' within the Timber Supply Area through an award of a Forest Licence To Cut (A87661). This FLTC was in turn the result of the Strategic Land Use Agreement and subsequent Kunst'aa Guu-Kunst'aayah Reconciliation Protocol which outlined the provision of a tenure to support 120,000m^3 per year for the Haida Nation.

Policy Considerations
The BC Timber Pricing branch (MFLNRORD), the Ministry of Indigenous Relations and Reconciliation (MIRR), the CHN and Taan Forest Products Ltd. have been negotiating the creation of a First Nations Woodland Licence that would effectively merge TFL60 and FLTC A87661 into one management unit. For all intents and purposes, Taan Forest Products Ltd. manages both tenures as though they were one already[59] (e.g., one FSP, integrated management planning and harvest scheduling, etc.).

Timber Supply Considerations
A sensitivity run was completed that merged the management unit boundaries of TFL 60 with FLTCA87661. All the base case assumptions were applied to these unit boundaries. Much like the CFA analysis, this required the complete removal of FLTCA87661 from the TSA, and as a result has implications to the long run sustained yield for the TSA and the proposed FNWL. The following map depicts the management units used in this sensitivity:

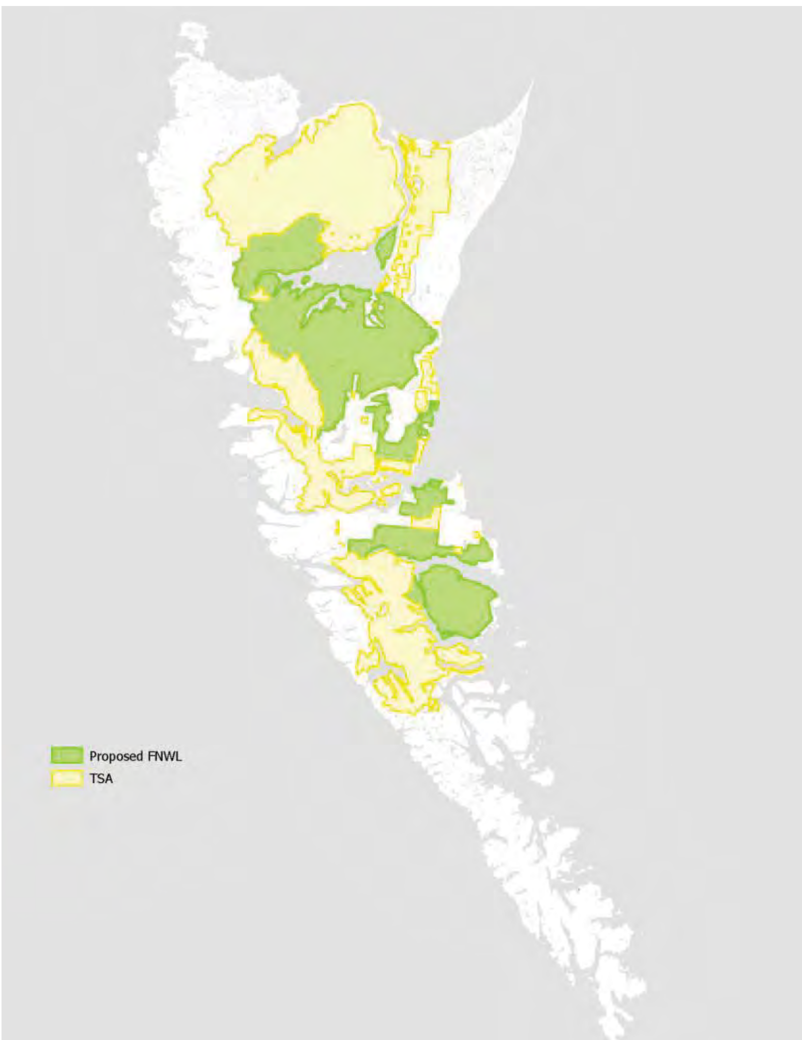


Figure 8.2.2.2. Area of proposed First Nations Woodland License

[59] With the exception of tracking cedar volumes harvested.

8.2.3 Council of the Haida Nation policies

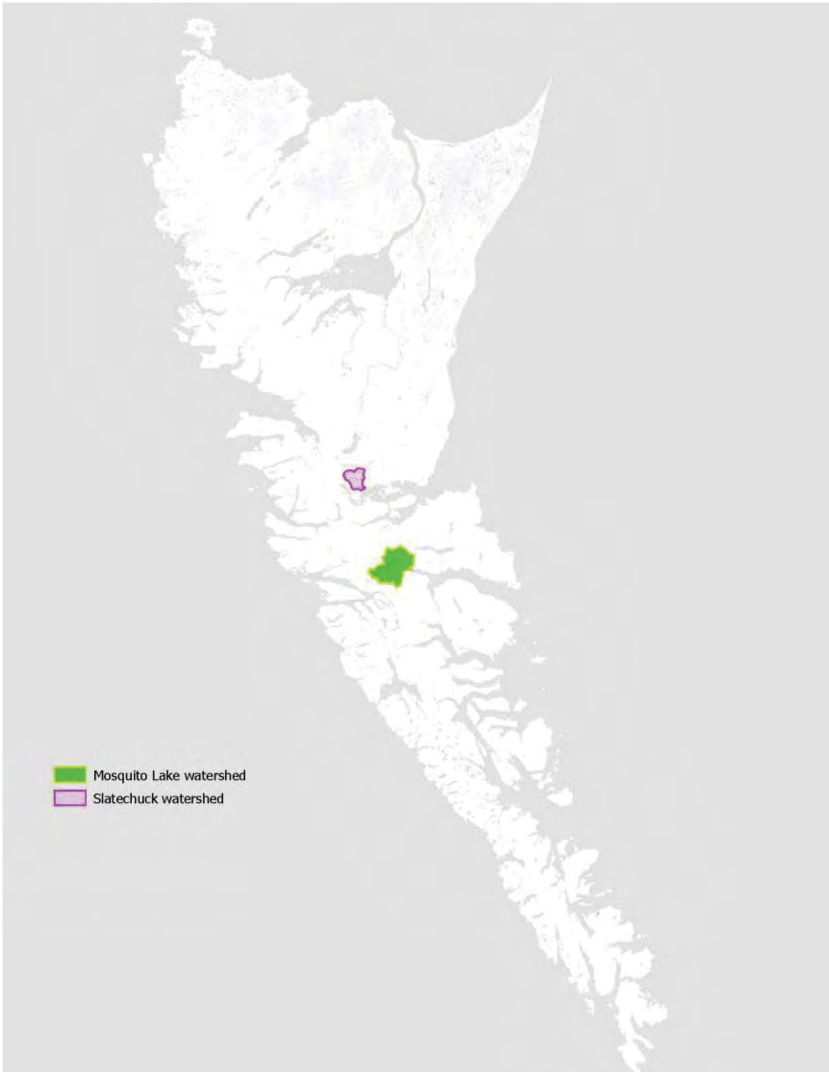
The Haida Nation's House of Assembly is an institution borne from the Haida Nation's constitution. Through resolutions democratically adopted by the citizens of the Haida Nation the Council of the Haida Nation is provided a mandate to implement policy. A number of these mandates include resource management directives. Some resolutions require significant interpretation, process and policy work to implement and/or require a wide variety of actors and legal instruments to bring into effect. Other resolutions are very straight forward and can be immediately incorporated into the doctrine of decision making by the Nation. Several sensitivity analyses were conducted concerning Mosquito lake, Slatechuck watershed, monumental cedar and the Northern Goshawk.

8.2.3.1 Mosquito lake Policy Considerations

In 2015 a House of Assembly resolution was passed (#2015-04) that designated the Mosquito Lake watershed as an area of importance to be placed under the protection of the CHN. Mosquito lake is currently within the Timber Supply Area on north Moresby Island, with the northern half of the watershed within FLTCA87661 (Taan Forest Products Ltd.) and the southern half within the general TSA . The CHN and Taan have confirmed that no harvesting will occur in those areas that drain into Mosquito lake. Planned harvests under Timberwests FLTC A90533 that overlapped the area of interest were rescinded (e.g., block MOSQ013) and currently no planned operations overlap within the watershed.

Timber Supply Considerations

The CHN Executive committee considers the full watershed area to include those hydrologic units that drain into and out of Mosquito lake. A sensitivity run was completed that removed 100% of the Mosquito lake watershed from the THLB (see Map 8.2.3.1).



Map 8.2.3.1 Mosquito lake and Slatechuck Creek watersheds

8.2.3.2 Slatechuck

Slatechuck or *Tllgaduu* is a watershed and mountain east of the Village of Queen Charlotte whose creek, *Tllgaduu Gandlaay*, empties into Skidegate inlet to the ancient village of *Tllgadaaw Llnagaay*. Part of the watershed is composed of the Skidegate Formation, made up of sedimentary deposits of thin bedded sandstone and siltsone (turbidites) along with lesser mudstone and shale. The rocks found here are principally argillite, greywacke and conglomerate turbidites from the cretaceous period (88.5-97 million years old). The argillite deposits are the focus of a sacred quarry that the Haida Nation has traditionally used to access high quality argillite for carving. Historically the Haida used the trail to the quarry and up the watershed for travel between Skidegate inlet and Masset Inlet (Dawson, 1878).

Policy Considerations

The Slatechuck quarry is protected by a small 18-hectare Federal crown reserve (tenure ID 015813495). The quarry is in active use by the Haida Nation, and while there is no formal policy designation for the area, recent proposals to log within the watershed have been met with opposition by the CHN.

Timber Supply Considerations
A sensitivity analysis was conducted to remove 100% of the Slatechuck watershed from the THLB. Watershed boundaries were defined by the aggregation of HGLUOO Schedule 6 upland stream area watersheds (map 8.2.3.1).

8.2.3.3 Monumental cedar
A House of Assembly resolution in 2018 mandated the CHN to conserve all monumental cedar. Currently 100% of large (>120cm DBH) monumental cedar are protected, but only 10% of monumental cedar between 100-120cm are protected, with the remainder being made available to the Haida Nation. Implementing this mandate would require a change by the HGMC of the HG Land Use Objectives Order, which has not occurred. Nonetheless, understanding the timber supply implications is important to informing potential regulatory changes.

Another change in managing for monumental cedar comes from changes in the Haida Nation's *Cultural Feature Identification* manual. Changes in these standards increase the acceptable defects in cedar (e.g., increased knot size and numbers, increased thresholds in rot, fewer indicator to rule out cedars being classified as monumental cedar).

8.2.3.4 Full monumental cedar protection (former monumental classification)
The objective of the monumental cedar sensitivity was to determine *how much area is net down if 100% of monumental cedar are protected.* This analysis used the former classification of monumental cedars (CFI manual version 4), which is congruent with spatial submission data from licencees, and as such is less relevant as it does not represent the current classification of monumental cedar. A spatial analysis of monumental cedar that were part of the 2012-2016 HGLUOO annual submissions data was completed. 1,085 monumental trees and their reserve and management zones formed the basis of the analysis. Where management/reserve zones weren't already spatially delineated (e.g., had been logged under LUOO provisions), tree length buffers were required to be modelled. Buffers were modelled by assigning a Schedule 5 tree length to the site series that intersected the feature and multiplying that tree length by the HGLUOO requirements (e.g., 1.5 tree lengths). A total of 322 or 30% of identified monumental cedar were logged between 2012-2016 and had this buffer applied.

Site series were determined using the primary decile of the ecosystem mapping layer described in section 3 of this data package. Schedule 5 assigns different heights for old and mature stands. For this TSR, old stands were existing unmanaged stands >250 years, and all other stands were assigned heights for mature stands.

Analysis methods included:

- Identifying those trees without reserve and management zones (e.g., within the Net Area to be Reforested), and not within road right of way. Past practice has shown that monumentals within road right-of-ways are in many cases removed and offered to the Haida Nation;
  Buffering those monumentals with the LUOO Schedule 5 (as described above). Buffers within road right of ways were excluded.

8.2.3.5 Netdowns from the former monumental identification standards

In October 2019 the CHN published an update to the CFI standards that included changes to the classification of monumental cedar. The previous classification system had been in place since the HGLUOO had been implemented in 2011, resulting in a significant sample of operational data available to determine how this objective affects timber supply. This scenario applies the learnings from that data to estimate what the predicted netdown would be for as yet to be identified monumentals based on the former CFI standards (v.4).

Net down assumptions
Data from a total of 1,085 monumental trees and their reserve and management zones were used in the analysis to exclude retention areas around known monumental trees and were used in a frequency distribution analysis for estimating an exclusion factor for yet to be identified monumental trees.

The frequency distribution analysis for extrapolating future exclusions from the THLB found that the net exclusion from monumental cedar was 1.9% of all Development Areas (all forest ages) between 2012-2016. Most of these features were found within old forest (92% of occurrences), therefore the exclusions were proportionately weighted by age strata (old forest/younger forest). Note that monumental cedar commonly overlap with other HGLUOO values, as illustrated in appendix 6. This exclusion factor is less than the 2011 prediction of 13.7% exclusion from all old forest (JTWG, 2012). Note however, that the 2011 estimates did not benefit from any operational data that represented the application of the HGLUOO.

Given the importance of Monumental cedar to the Haida Nation, and the policy uncertainties surrounding the future protection of monumentals, sensitivity analyses were undertaken to explore effects on timber supply from potential policy changes (see section 8).

8.2.3.6 Increased estimate of monumental cedar

A new version of the Cultural Feature Identification Standards Manual was released in late October 2019. The standards were designed to implement the LUOO requirements as currently written, not to revise the LUOO. A preliminary estimate of the frequency of monumental cedar was applied in the base case. However, some uncertainties remain, including: how many cedar trees with diameters over 100-cm meet monumental cedar criteria; and how monumental cedar will be managed and harvested. In response to these uncertainties, the HGMC through the Technical Working Group will be compiling additional information and undertaking analysis to explore: (1) the likelihood that a broader range of log grades than estimated for the base case will contribute monumentals; (2) indications that younger ages classes than assumed for the base case will contain monumental cedar; (3) timber supply implications of various levels of retention of monumental trees from harvesting. Given the recent release of the new standards, these analyses are ongoing. The results will be available for the HGMC for its determination of the Haida Gwaii AAC.

8.2.4 Stad's Kun (northern goshawk) foraging habitat

Stad's Kun or the northern goshawk (laingi subspecies) has been designated as the national bird of Haida Gwaii by the Haida Nation.

Stad's Kun or northern goshawk nesting habitat is protected under the HGLUOO (see section 6.10.12) and subsequently accounted for by the removal of areas from the THLB.

The Council of the Haida Nation, the Federal government and the Provincial governments have all adopted policies or the pursuit of policies that support the recovery of this species. The following briefly outlines these policies.

Policy Considerations
A 2017 House of Assembly resolution (2017-08) mandated the Council of the Haida Nation to develop an "Island-based recovery strategy that includes population monitoring, inventories of potential habitat, habitat recruitment and restoration, introduced species mitigation, and proper foraging habitat management."

The Provincial Government published a recovery strategy in 2008 (Ministry of Environment, 2008) with a strategic action goal of identifying critical habitat using habitat and territory models, although was lacking sufficient information at the time to define critical habitat. A Habitat Recovery Implementation Group (RIG) was established as an action of the recovery strategy to help map, model and define critical breeding and foraging habitat.

The Federal Government designated the species as Threatened under the Federal Species at Risk Act in 2013 and in December 2018 published a Recovery Strategy that incorporated the work from the Recovery Implementation Group (Parks Canada Agency, 2018). The federal recovery strategy provides targets for nesting and foraging habitat. Targets use habitat suitability indices for defining critical habitats (discussed in detail below). Critical breeding area list known breeding territories, but also proposes protection of additional breeding areas (e.g., known and currently unidentified territories) in response to the birds genetic isolation (Sonsthagen, et al., 2012), concluding that 38 breeding pairs are necessary to contribute to a minimum viable population to reduce the risk of extinction from the effects of inbreeding depression on demography (Parks Canada Agency, 2018).

In February 2018, the Provincial government published an *Implementation Plan for the Recovery of Northern Goshawk, laingi Subspecies (Accipiter gentilis laingi) in British Columbia* (MFLNRORD, 2018). The implementation plan sets clear targets for the protection of breeding habitat in Coastal British Columbia, including a target of 25 nesting areas protected on Haida Gwaii. While acknowledging the importance of foraging habitat the implementation plan does not provide immediate direction for foraging habitat management, citing the need for continued research.

A recent publication *Science-Based Guidelines for Management Northern Goshawk Breeding Areas* (McClaren, Mahon, F.Doyle, & W.Harrower, 2015) concluded that territories with 60% suitable foraging habitat have the lowest risk of abandonment based on analysis of territory abandonment from data on Haida Gwaii and Vancouver Island. This conclusion was supported by a territory analysis conducted in 2010 that looked at the correlation between active nests and the proportion of suitable habitat by known territories on Haida Gwaii and Vancouver Island (Daust, et al., 2010). Since then a new peer-reviewed article has been published that cites the Haida Gwaii Goshawk as a genetically distinct population apart from the coastal goshawk subspecies (*Accipiter gentilis laingi*) and one of the most endangered organisms on the planet (Geraldes, et al., 2019).

8.2.4.1 Nesting habitat

For the base case reference scenario, known nesting reserves were netdown from the THLB (as of 2019 currently there are 23 territories/breeding areas- but several of them are in protected areas).
To account for the recurring annual netdowns from newly discovered Goshawk nesting territories, predicted nest sites were based upon a predictive territory model. The predictive model started with a mean center statistical analysis to identify the centre of known nesting territories. From known centres, geometric expansion buffers were calculated using 5200m radius territory sizes (10,400m between territory centres, or 8,495 hectares per territory) based on the 2018 Federal Recovery Strategy (Government of Canada, 2017) to identify predicted territories. Predicted territories are all based on future capability (mature/old forest). The 2003 Land Use Plan analysis (Holt R. , 2003) spacings were used to further guide territory placement (see figure 8.2.6.1).

As a sensitivity analysis included nesting reserve netdowns from an additional 2 predicted territories (to match the provincial implementation target of 25), 15 territories (to match the Federal recovery strategy of 38) and a third sensitivity that includes all capable breeding areas/territories (e.g. up to 67 as per Provincial estimates when assuming territory occupancy rates are contingent on ≥40% of a territory made up of suitable foraging habitat). The predicted nesting reserves were based on the updated provincial nest habitat model applied to predicted territories. The centroid of these territory polygons represented a systematic random nest location which was used to identify 200 ha of the most suitable contiguous habitat using the updated Provincial nest habitat model data and a 'roving window' functionality in SELES.

The predicted territories included in the modelling (ex. additional 2 or 15 territories etc.) were chosen from a priority listing of the territories with the most amount suitable habitat first (assuming territories with more suitable habitat have an increased likelihood of occupancy). The updated provincial goshawk foraging (suitability) model (2017) was used to calculate the priority listing of territories with the most to least amounts of suitable habitat.

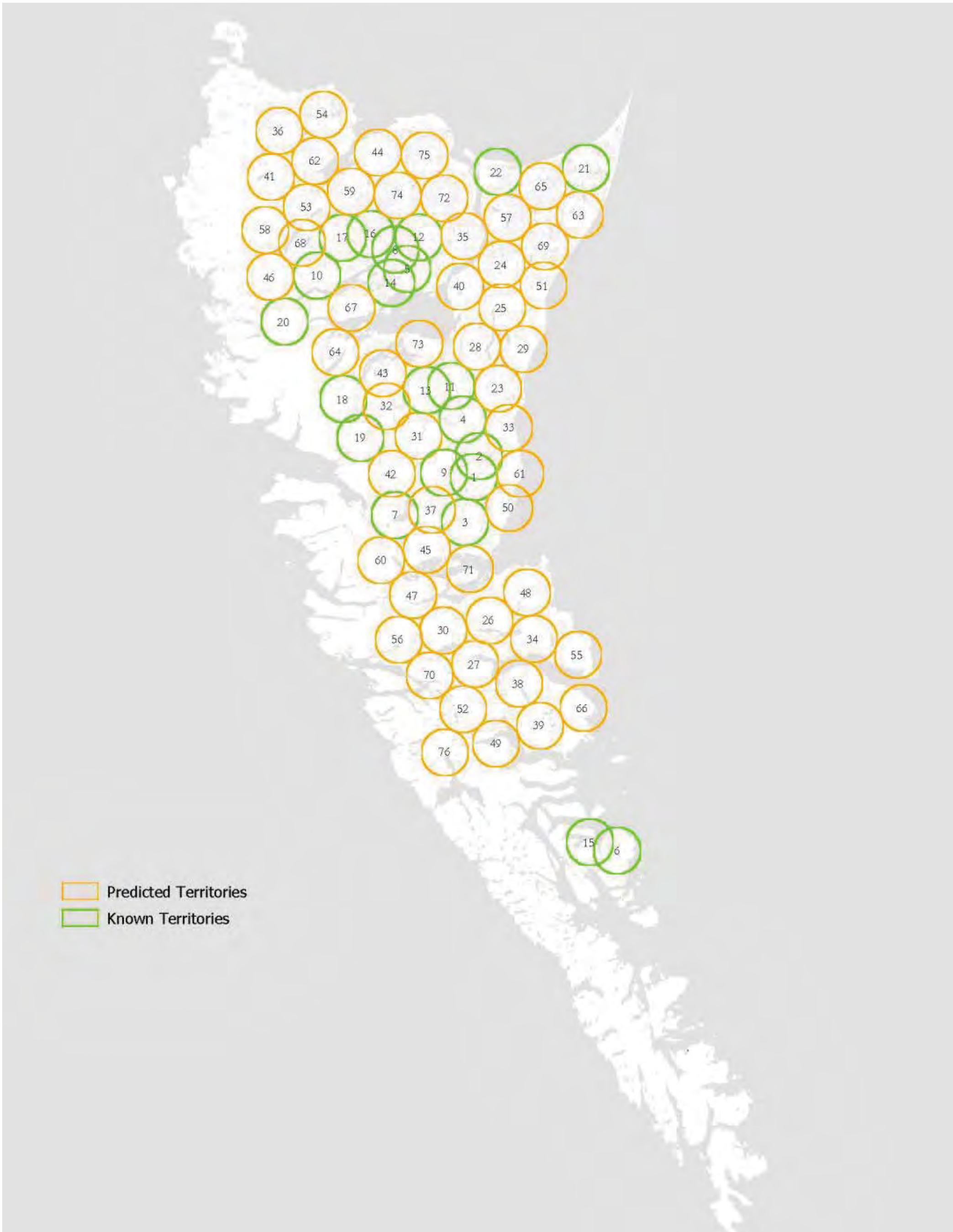


Figure 8.2.4.1 Known and predicted breeding areas/territories for Northern Goshawk, with territories ranked based on amount of suitable habitat in each territory.

8.2.4.2 Foraging habitat

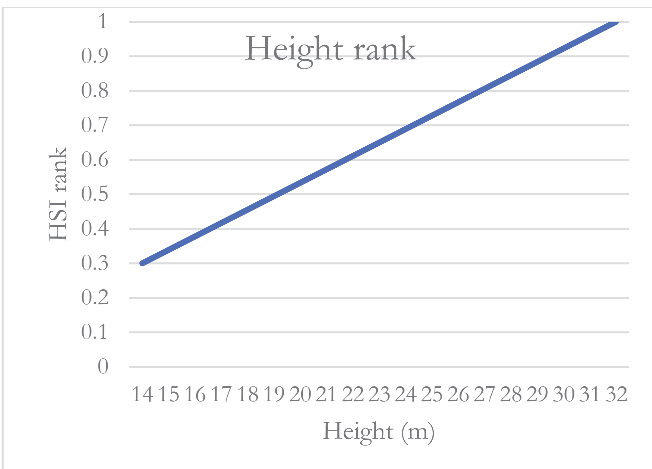
The objective of a goshawk foraging sensitivity analysis was to determine the effects on timber supply using a foraging capability model and current science-based habitat thresholds (McClaren, Mahon, F.Doyle, & W.Harrower, 2015; Daust, et al., 2010; Parks Canada Agency, 2018).

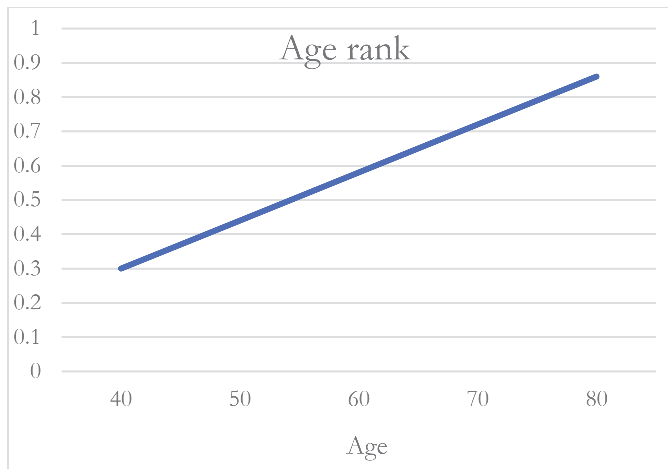
While the initial habitat threshold models used 'backcasting' to determine the territory capability, suitability habitat modelling is applied to a 'current state' to determine habitat availability. Suitability models are less useful for forecasting, as they underestimate future sites that are capable of supporting goshawk foraging (through regeneration etc.). Given the objective of TSR to forecast up to 400 years, a capability model was developed (parameters described below).

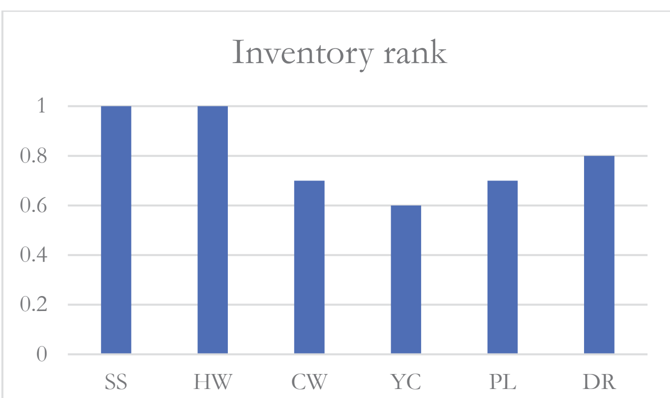
Habitat suitability index (HSI) criteria and rankings were used based upon the *Nesting and Foraging Habitat Suitability Models and Territory Analysis Model* (Mahon, McClaren, & Doyle, 2015). The HSI uses non-compensatory parameters to determine suitability on a polygon level. Each parameter was given a value or rank and the results were binned into a four-class rating scheme of nil, low, moderate and high suitability. Only polygons with an HSI of >=0.5 (moderate to high) were counted towards habitat thresholds (as per (Mahon, McClaren, & Doyle, 2015; Parks Canada Agency, 2018)).

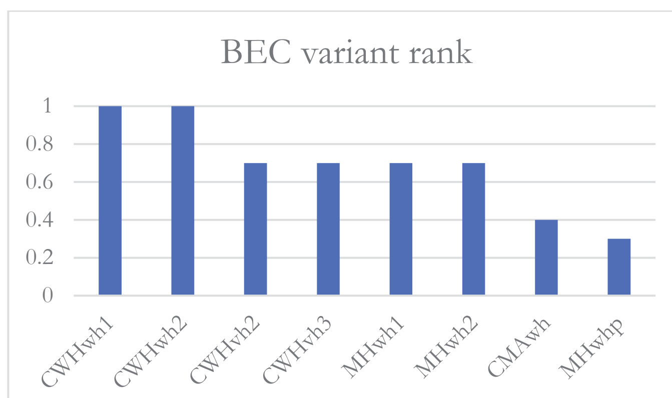
The equation used to calculate suitability ratings was:
HSI_f= mean(Age, Height) * Inventory Type Group * BEC variant **or** non-forest rating (whichever is greater).

The following graphs summarize the parameter rankings for each input:









All roads (20m buffer on mainlines/highway, 10m buffer otherwise) and lakes were given a non-productive value of 0 and wetlands were given a non-productive value of 0.3.

Methods and data inputs:

- Previous territory boundary estimates (primarily from the mid 2000s for Land Use Planning) did not account for updated known territories or minor changes in estimates of nest spacing. Therefore, for capability modelling, the boundaries of territories were determined using a 10.4 km territory radius (Mahon, McClaren, & Doyle, 2015). Radii were applied to all known goshawk territories (22 at the time of analysis[60], see figure 8.2.6.1).
- Inventory inputs (to determine height, age and leading species for the HSI) were based upon the current TSR datasets:
  - VRI for all stands >120 years (mature stands with no history of commercial logging);
  - For stands <120 years, silviculture survey RESULTS-based existing managed stand curves were used to backcast stands values at curve age 350 (e.g., stand height, age and species attributes for existing managed stands were used);
  - For stands <120 years where no silviculture survey is not available, future managed stand curves were used to backcast stands values at curve age 350 (e.g., stand height, age and species attributes for future managed stands were used);

The resulting spatial output represents a pre-industrial condition capability model of moderate to highly suitable habitat by territory. For the purpose reserving habitat, suitable habitat was binarily re-classified (e.g., suitability equals yes or no, as opposed to highly suitable, moderately suitable and not suitable).

The spatial timber supply model was constrained to maintain 65.5%, or 5,564 ha, of each territory as suitable habitat to maintain the lowest risk of territorial abandonment (Mahon, McClaren, & Doyle, 2015) and reflect the current Federal Recovery Strategy.

For territories where there was not enough suitable habitat to meet the 5,564 ha habitat target, the Spatial Timber Supply Model applied the constraints using a recruitment technique. The age at which each analysis unit (natural and managed) met the HSI requirement of >=0.5 was calculated and output as an index layer. This layer represents, for each cell, the youngest age that the cell is suitable (meets the 0.5 HSI requirement). Analysis units were therefore prioritized by units that met the minimum HSI requirements soonest and those were reserved to contribute to meeting the 5,564 ha area targets per territory. This way harvesting could happen in a territory if the appropriate amount of habitat had been reserved by the model and represents meeting a threshold while accounting for spatial variability of sites. Otherwise, if <5,564 ha of habitat was available then the recruitment strategy reserved those areas that meet the minimum HSI requirements soonest (generally oldest first).

Similar to the nesting reserve analysis, the foraging model analysis was completed on existing territories (22), and on 25, 38 and ~67 territories to provide bookend results. The sensitivity analysis that assumes 67 territories assumes territory occupancy rates are contingent on ≥40% of a territory made up of suitable foraging habitat.

8.2.5 Economic operability

Six sensitivity analyses were completed in relation to economic operability:
(i) removing road operability constraints; (ii) assuming a low/weak market values, and; (iii) assuming high market values, (iv) constraining new roads from being built; v) partitioning or excluding isolated planning units; (vi) not restricting isolated planning units.

8.2.5.1 Removing road operability constraints

This scenario does not use the economic operability model, and associated constraints, that were described in section 7.6. Therefore this run is more in line with a biophysical estimate of what the long run sustained yield

[60] Note that one subsequent territory was found after this analysis in 2019 in Gwaii Haanas.

could be based on growing stock, without any limitations on relative costs or relative values in the forest. This scenario was completed to explore how sensitive the model was to the economic operability constraints applied in the base case.

8.2.5.2 Dynamic stand values ('Low' and 'High' market scenarios)

The economic operability sensitivity analyses used the relative net value model described in section 7.6.2. The base case used the average relative value for each species across a 10-year time horizon. The relative values/m^3 by species group were used to compute total relative stand values by multiplying these relative values by volume proportional to the percent of each species in the stand.

The 10-year sample (2008-2017) spanned some of the lowest and highest historical market prices for the industry, therefore helping to justify an assumed average market for the base case. Two sensitivity analyses explored assigning stands with the (i) lowest market value, and (ii) the highest market value. While neither scenario is realistic, it provides insight into how well the model is performing relative to macroeconomic principles (e.g., market demand implications to net marginal values), but also provides bookends for anticipated timber supply implications from weak or strong markets.

The relative values used in the 'low market' and 'high market' scenarios are listed in table 8.2.5, and derived from market commodity indices for all species, accounting for domestic and export values from Haida Gwaii between 2008-2017. Details on how the numbers are derived are described in section 7.5.2.

Table 8.2.5. Relative value/unit for each value class for Cedar, Hemlock and Spruce Year

	Cedar	Hemlock	Spruce	All
Low	3.5	1.2	1.2	2.0
High	6.3	2.1	2.0	3.5
Average (base case)	4.7	1.7	1.6	2.7

8.2.5.3 No new roads permitted to be built

This scenario is primarily devised to test the effects of future road building and the development of previously unlogged areas on timber supply. The model parameters only allow access to harvesting from the current road network.

8.2.5.4 Exclusion of isolated planning unit

Section 7.5.4 details how isolated planning units (Sewell-Moresby south, Peel- Moresby north, and Louise Islands) have minimum volume requirements before the timber supply model can access/harvest these areas in order to reflect operational viability. Once these criteria are met (e.g. 333,000m^3 of available volume over a 10-year period for Sewell/Peel, and 250,000m^3 over the same period for Louise Island) then these areas contribute to the overall volumes of their respective management units.

This sensitivity analysis partitions, or excludes the volumes from these isolated planning units, effectively taking them out of the THLB in order to determine what their contribution is to the broader planning unit.

8.2.5.5 No restriction on isolated planning unit

This sensitivity removes all constraints or model restrictions imposed upon the isolated planning units (Sewell-Moresby south, Peel- Moresby north, and Louise Islands) in order to explore a hypothetical situation that these planning units had an unbiased contribution to their respective management unit.

8.2.5.6 High Cost Access Exclusion

The base case reference scenario uses the road cost model outlined in section 7.6, whereby a relative cost surface model, accounting for physiographic factors like slope, wetlands and distance to sorts, directs a least-cost decision sequence for the building of future roads. Most of the THLB (95.8%) has an access cost of <=10% of the maximum access cost in the THLB. In other words, 4.2% of the THLB has an access cost between 10% and 100% of the maximum cost for the THLB. These areas, characterized by steep slopes or isolated timber, typically have never had road or development access, and may represent a continual future challenge to access (see figure 8.2.5.6).

Figure8.2.5.6. Modelled high access cost areas

A sensitivity analysis was completed where these areas were removed from the THLB.

8.2.6 Minimum Harvest Criteria

Stand age is typically used to determine minimum harvest criteria for timber supply analyses (see section 7.1) however in reality other factors contribute towards harvest entry decisions.

While the timber supply base case has age preferences set to meet culmination mean annual increment, often times stands are harvested more on an *economic rotation* age (typically much younger than CMAI). Similarly, there has been interest in evaluating an *extended rotation* scenario, whereby wood quality is a condition for logging as opposed to volume.

For the base case or reference scenario, the minimum harvest age was set to 95% of Culmination Mean Annual Increment (CMAI). The weighted area CMAI age within the THLB for future managed stands is 98 years. For existing managed stands, the weighted area CMAI age within the THLB is approximately 101 years.

8.2.6.1 Economic rotation age

Stands are often logged based upon economic opportunism, rather than a biological optimum criterion. Species composition, timber accessibility, mean log diameter and stand volume are common variables that forest managers use to determine whether to log a second growth stand. Many of these variables are already accounted for in the timber supply model: the model already factors in access into the harvest queue (regardless of stand age), and; minimum harvest volume is also an existing parameter in the model (see section 7).

Over the last 10 years, the average age of 2nd growth stand harvested on Haida Gwaii has been approximately 60 years old. However a single age model parameter is not ideal as every stand and site type reaches a volume or log diameter at different ages. In addition, higher productivity sites (valley bottoms) were commonly logged first, and these higher productivity sites (leading to harvest criteria being met earlier) may not be representative of all second growth sites on Haida Gwaii.

Timber supply considerations

Existing and future managed stand curves were analyzed to determine the age where minimum log diameter of 30cm was reached.

Not all analysis units reach this diameter threshold before Culmination Mean Annual Increment (CMAI), which presupposes that not all stands are capable of being targeted for an economic rotation. Generally this diameter threshold is only met before CMAI for richer sites therefore a standard decrease in minimum harvest age does not make sense.

Table 8.2.6.1 Age where minimum log diameter targets are met (TIPSY) for forested site series on Haida Gwaii. Grey rows indicate ages below CMAI.

Site Series	Age 30cm dia is met	CMAI age	% Difference
CWHwh1 01	80	80	0%
CWHwh1 02	80	90	11%
CWHwh1 03	70	70	0%
CWHwh1 04	110	100	-10%
CWHwh1 05	50	70	29%
CWHwh1 06	60	90	33%
CWHwh1 10	n/a (does not reach 30cm)	130	n/a
CWHwh2 01	90	110	18%
CWHwh2 02	150	120	-25%
CWHwh2 03	90	100	10%
CWHwh2 04	110	120	8%
CWHwh2 05	260	180	-44%
CWHwh2 06	230	140	-64%
CWHvh2 01	100	110	9%
CWHvh2 03	140	130	-8%
CWHvh2 04	70	70	0%
CWHvh2 05	50	80	38%
CWHvh2 06	50	80	38%
CWHvh2 07	50	90	44%
CWHvh2 11	190	160	-19%
MHwh 01	140	180	22%
MHwh 02	170	170	0%
MHwh 03	230	170	-35%
MHwh 04	160	170	6%
MHwh 05	260	170	-53%
MHwh 06	220	170	-29%
MHwh 07	260	170	-53%
MHwh 09	220	170	-29%

For a timber supply sensitivity analysis within the existing managed and future managed stands, the minimum harvest age was lowered for each analysis unit that met the minimum diameter target before CMAI, otherwise the MHA was kept at CMAI (as per base case).

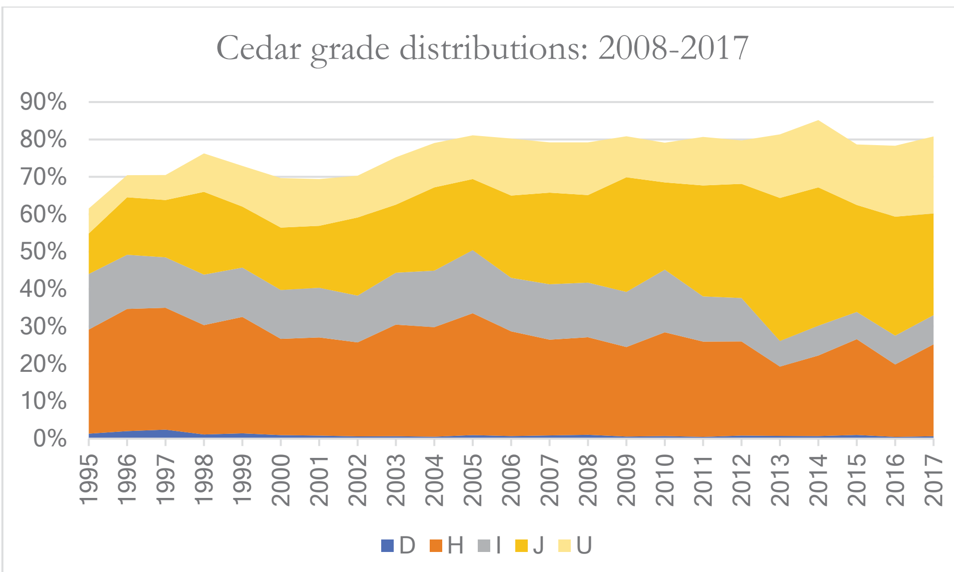
For this sensitivity analysis, the weighted average minimum harvest age of future managed stands within the THLB was 94 years, and for existing managed stands within the THLB was 77 years. The likely reason for this difference in ages is that existing managed stands include a higher proportion of richer sites (e.g. biased or preferred harvest sites) which therefore reach the minimum diameter at a younger age.

8.2.6.2 Extended rotation age

An extended rotation age can better represent the natural forest age distribution on Haida Gwaii, but also may be a management consideration to increase log qualities, increase carbon sequestration and improve the availability of habitat for late seral dependent wildlife.

Historic harvests provide an empirical basis to define merchantability, and the 2012 Timber Supply Review introduced a product-based assessment approach that references actual grades harvested over the last timber supply period (decade), using this grade distribution to review predictions from TIPSY model outputs. This approach allows for the comparison between the assumed minimum harvest age (e.g., 95% culmination mean annual increment) to the age reached when the target grade distribution is met.

While historic grade distributions do largely represent products from old forest, it provides an empirical benchmark for the marketability of timber. Therefore establishing a grade distribution target that is largely based on old forest provides a reasonable benchmark for setting an extended rotation age target. Log grade distributions from Harvest Billings System were used to generate the following charts.



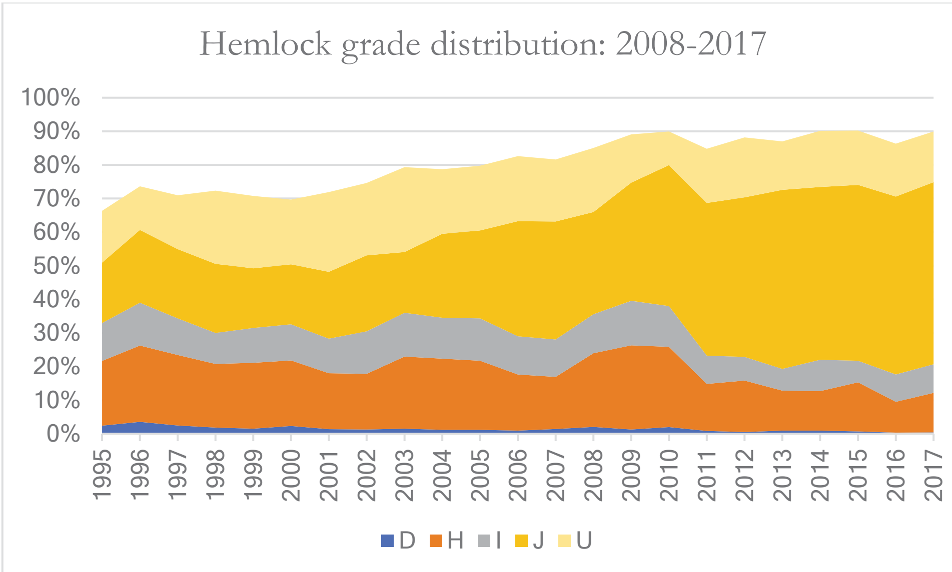
Average decadal distributions

	2008-2017	1998-2007
D	1%	1%
H	24%	28%
I	11%	14%
J	30%	20%
U	15%	12%

Figure 8.2.6.2.1 Cedar log grade distributions 2008-2017

Source: Harvest Billing System

D: High grade/custom cut/peeler; H: Merch/custom cut; I: Merch/standard; J: Shingle/gang/sawlog U: Utility sawlog

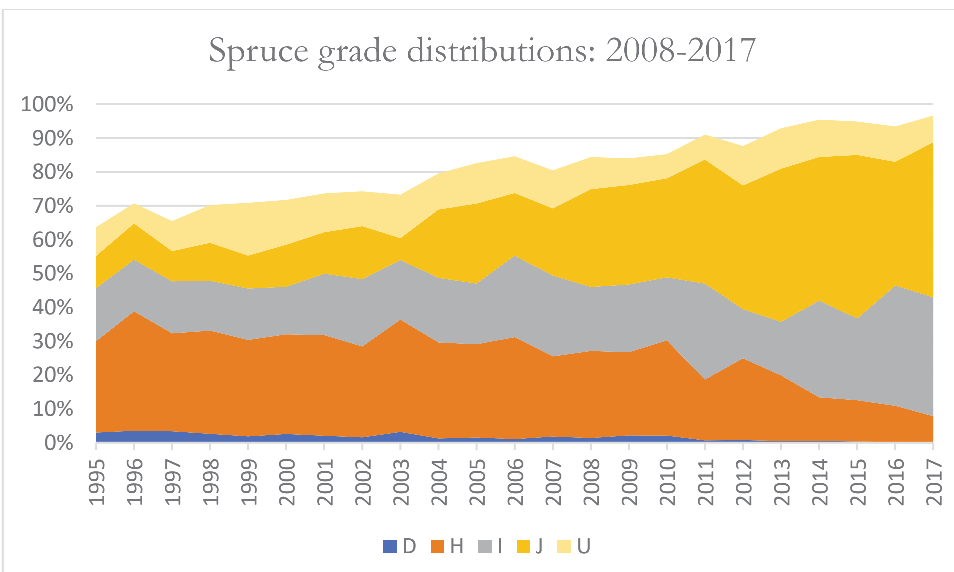


Average decadal distributions

	2008-2017	1998-2007
D	1%	1%
H	16%	19%
I	9%	11%
J	46%	24%
U	16%	21%

Figure 8.2.6.2.2 Hemlock log grade distributions 2008-2017

Source: Harvest Billing System
D: High grade/custom cut/peeler; H: Merch/custom cut; I: Merch/standard; J: Shingle/gang/sawlog U: Utility sawlog



Average decadal distributions

	2008-2017	1999-2007
D	1%	2%
H	18%	29%
I	24%	18%
J	38%	15%
U	9%	12%

Figure 8.2.6.2.3. Spruce log grade distributions 2008-2017

Linking these broad aggregations of log grade distributions to actual inventory stands is not feasible, given the high variability in site types, species composition and block blending by timbermark (the common variable within HBS). Timber supply is not meant to estimate the actual harvest age of each inventory stand, but to explore the implications of minimum harvest criteria applied to average stand conditions. In addition, not all individual stands can produce the aggregate grade distribution target (e.g., poor stands will never yield a significant proportion of high grade logs). Therefore, in order to approximate actual grade distributions with TIPSY, analysis units were grouped into leading species strata.

While 'J' grade is the most common quality log harvested, it may be a poor extended rotation indicator as stands can produce this lower log grade at younger ages. 'H' grade, the highest grade predicted as an output of TIPSY, takes the longest for a stand to achieve and therefore is a limiting factor worth using as a target indicator for exploring extended rotation ages.
The objective of the analysis was to determine *what age are future inventory stands predicted to have a log grade distribution that approximates the actual Haida Gwaii log grade distribution?*
The follow steps were completed:

- The grade distribution target from 2008-2017 was calculated for each species strata, and also aggregated (all species, as reported above).

Table 8.2.6.2.4 Actual log grade distribution on Haida Gwaii from 2008-2017. Source: Harvest Billings System

Grade	**Hemlock**	**Cedar**	**Spruce**	**Pine**	**Combined**
D	1%	1%	1%	0%	1%
H	16%	24%	18%	10%	19%
I	9%	11%	24%	2%	13%
J	46%	30%	38%	1%	38%
U	16%	15%	9%	78%	14%

- The TIPSY predicted log grade distribution (for grades 'H', 'I', 'J') was referenced for each analysis unit/site unit curve at a specific age (year 120, 150, 200, 300);

- The percent contribution of each analysis unit to the THLB was spatially calculated;

- For each analysis unit, the area-weighted average of the grade distribution was calculated for both leading species strata and combined (all species).

This provides the TIPSY-predicted ages when strata approximate target grade distributions within the THLB at select ages for both different strata (Cw, Hw, Ss leading units) and combined analysis units (all species blended) (see figure 8.2.6.2.4).

Extended rotation analysis results

The results show that the grade distribution targets for cedar strata cannot be met at any harvest age. This is likely because second growth cedar leading strata tend to be poor growing sites. In reality, higher quality cedar will come from those analysis units (such as zonal or richer) that are represented by the second growth spruce or hemlock leading strata. As a result, trying to achieve empirical log grade distribution by second growth leading species strata would not be possible. Therefore, using a combined (aggregation of all species) grade distribution target, meant that overall predicted log grades approximate the empirical log grade distribution by age 150.

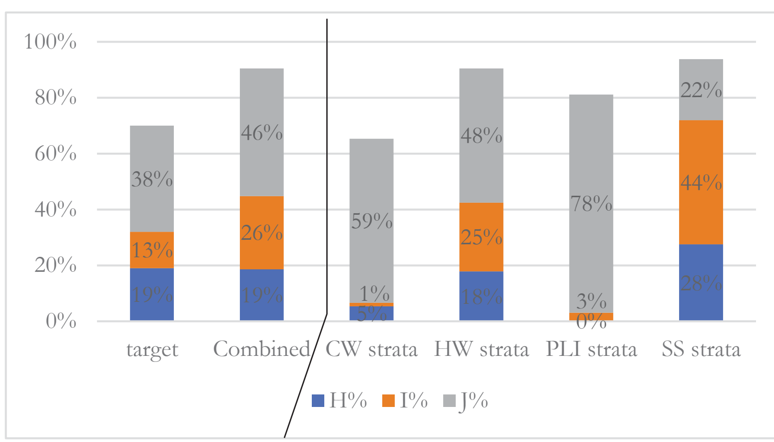


Figure 8.2.6.2.4 Distribution of predicted (TIPSY) log grades and target (HBS 2008-2018 average) log grades, by strata and combined (all species) at curve age 150.

Using this combined grade distribution target may initially underestimate a target for higher grade cedar (currently 'H' grade makes up 24% of the log profiles), however there is a clear decline in higher quality grades over time (see figure 8.2.8.2.1). When averaged across all species, the 150 year target would achieve a TIPSY future managed stand predicted distribution of 19% of 'H' grade logs and 26% distribution of 'I' grade logs for existing managed stands.

Timber supply considerations
All existing and future managed stand had a minimum harvest age constraint set to 150 years or maintained the CMAI age if it was over 150. While some units have a minimum harvest age above 150, the weighted average MHA for the THLB was 150.4.

8.2.6.3 No minimum harvest volumes
As described in section 7.1.2, the base case reference scenario removes all areas that do not have, or will not have, a minimum volume of 250m^3 per hectare (areas removed from the THLB). A sensitivity scenario was applied where the minimum harvest volume constraint was removed, allowing the model to harvest low productive forest (e.g.<250m^3/ha).

8.2.6.4 No minimum harvest age constraint
As referenced in section 7.1.1, the base case sets a minimum harvest age as the age where 95% of the Culmination Mean Annual Increment volume is achieved. This scenario explores an option where there are no constraints related to minimum harvest age but maintains the base case minimum harvest volume constraints of 250m^3 per hectare.

8.2.6.5 Minimum harvest volume increase
As discussed in section 7.1.2, past timber supply reviews have defined low volume stands as 350m^3 per hectare. This volume threshold also aligned with an analysis of volumes harvested over a recent 10-year period where 95% of the inventory volume from all second growth openings amounted to 350m^3 per hectare. Therefore, this scenario applies a minimum harvest volume of 350 m3/ha for existing managed and future stands while maintaining a minimum harvest age (95% of culmination age).

8.2.6.6 No old growth logging
At different times throughout BC there has been public discourse on the benefits and shortcomings of logging old growth forest. While no specific policy from the CHN or the Province has mandated this dialogue for Haida Gwaii, the HGMC was interested in a scenario that restricts the model from harvesting stands over 250 years old (old growth) forest to better understand the contribution old growth forest to timber supply.

8.2.7 Harvest preference
As detailed in section 7.1.3, harvest preferences are model parameters that help the model decide on the chronological sequence of harvest over time. The base case reference scenario is guided by logging the highest value relative to CMAI. Three sensitivity scenarios were explored:

(i) Preference to log stands with the highest volume relative to CMAI;
(ii) Preference to log stands that are oldest first relative to CMAI;
(iii) Randomized order: no age, volume or value preference (as long as other minimum harvest criteria are met)

8.2.8 Alternate Timber Harvesting Land Base scenarios

8.2.8.1 Risk-managed Land Use Objectives

The Haida Gwaii Land Use Objectives Order and the Haida Gwaii Strategic Land Use Agreement established 'default' and 'risk-managed' provisions for managing different values (HGMC, 2019). The majority of objectives have risk-managed provisions that allow for alternative management practices to be employed, generally offering greater operational flexibility while meeting key criteria for safeguarding or mitigating impacts on a particular value. All risk-managed applications are submitted to and tracked at the Solutions Table ahead of decisions from the CHN and Province of BC.

Data from 6 years of Solutions Table submissions was compiled and reviewed in order to determine the level of risk-managed applications and the associated implication (assumed upward pressure) on Timber Supply. Table 8.2.8.1 summarizes the objectives where risk-managed strategies were applied:

Table 8.2.8.1 HGLUOO risk managed applications submitted to the Solutions Table and implemented (2013-2018)

Objective	Description
Removal of monumental cedar >120cm (HGLUOO section 9.4)	8 monumental removed (reserve and management zones) 4 management zones reduced
Reduction of cultural cedar stand management zones (HGLUOO section 9.7/ 9.8)	2 cultural cedar stand management areas reduced
Haida Traditional Forest Feature reserve reduction (HGLUOO section 6.5)	3 management areas of class 1 Haida Traditional Forest Features were reduced
Haida Traditional Heritage Feature reserve reduction (HGLUOO section 5.6)	4 management areas were reduced
Forest reserve reduction or amended (HGLUOO section 23.2/23.3)	39 hectares of forest reserve were amended (moved to other areas- no increase in THLB)
Cedar Stewardship Areas (HGLUOO section 3.2)	3 hectares of CSA were harvested. 1 area reduced to accommodate road building.

Timber Supply implications
Table 8.2.8.1 represents risk-managed applications that were implemented between 2013-2018, however do not represent the suite of risk-managed opportunities afforded under the HGLUOO. However, in line with timber supply representing current management practices, the results of 6 years of operations amount to approximately 20 hectares of additional THLB available through the risk managed provisions (~3 hectares per year). Given that this is such a small annual increase in THLB (+0.002%) this provision was not modelled, but results reported to the HGMC as a factor consideration in their AAC determination.

8.2.8.2 Wildlife Tree Retention Areas (WTRA)

Some licensees have been retaining area in excess of FPPR requirements in the TSA and TFL 60 (see section 6.5.1 above). A sensitivity analysis was performed in which additional THLB exclusions are applied to account for the current practice for WTRA designs: 7.1% in the TSA and 11.3% in TFL 60.

Table 8.2.8.2. In-block retention netdowns by management unit.

		Base case		Sensitivity	
		LUOO retention	in-block THLB inclusion factor	additional WTRA retention	in-block THLB inclusion factor
TFL 60/FLTC	Old growth	10.89%	0.8911	11.6%	0.7751
	2nd growth	6.1%	0.93	11.6%	0.823
TSA	Old growth	10.89%	0.8911	7.1%	0.8201
	2nd growth	6.1%	0.93	7.1%	0.868
TFL 58	Old growth	10.89%	0.8911	-	-
	2nd growth	6.1%	0.93	-	-

8.2.8.3 Roads

The base case reference scenario excludes all permanent, mainline and branch roads from the THLB. Concern was expressed from a licensees that abandoned branch roads do support trees and forest cover. While this contested by data from several second growth developments (that did not support merchantable trees), a sensitivity analysis explored how timber supply is affected by regenerating roads. Note that while roads are de-commissioned on Haida Gwaii, they are not re-habilitated (e.g. not re-contoured).

Input was sought from provincial soil scientists[61] regarding natural ingress and stocking on roads. Opinions aligned with the experience from the HG Natural Resource District and CHN Foresters that:

- Red alder is typical ingress species for abandoned secondary roads (branches);
- Road prisms tend to have less productive soil versus adjacent forest stands;
- Regeneration is delayed compared to adjacent openings;

Therefore, an analysis unit was designed in TIPSY with the following criteria for branch roads:

- 100% red alder composition;
- Natural regeneration @ 4,444 stems per hectare (TASS default for natural regeneration, amounting to 1.5m spacing)
- 4 year regeneration delay
- Site index of 21 (20% less productivity then the TIPSY average site index for alder sites on Haida Gwaii).

This results in a Culmination Mean Annual Increment for this analysis unit of 6.7m^3 at year 30.

8.2.8.4 Terrain stability

Section 6.8 details the methods for excluding areas of unstable terrain from the THLB. This was done using a preference ratio that determines the frequency of development on unstable terrain based on a sample of blocks from the last 10 years. A sensitivity analysis was proposed to determine the frequency of development on unstable terrain based on a sample of blocks since 1996 (after the Forest Practices Code took effect).

[61] M.Kranabetter, R.Kabzems (Ministry of Forests, Lands, Natural Resource Operations and Rural Development).

While the base case reference scenario calculated the ratio of unstable terrain within the THLB (which is relatively unchanged in the last 10 years), the current THLB cannot be used when extending the logged area sample back to 1996. In this case the Forest Managed Land Base (FMLB), or simply the forested area within the jurisdiction of the management units, was used in the preference ratio calculation.

The following tables document the area logged by management unit since 1996. The THLB inclusion factor used for this sensitivity represents more frequent access to unstable terrain as these areas were historically harvested more frequently than current practice.

Table 8.2.8.4.1. Inputs into the terrain stability exclusion calculation or preference ratio for TFL 60

	Total area (ha)	Proportion of FMLB	Area logged in since 1996 (ha)	% that was logged	THLB inclusion factor
Class 4 terrain in FMLB	9,565	8%	618	6%	0.74
Class 5 terrain in FMLB	10,928	9%	415	4%	0.443
FMLB	127, 484		11,082		

Table 8.2.8.4.2 Inputs into the terrain stability exclusion calculation or preference ratio for TSA

	Total area (ha)	Proportion of FMLB	Area logged in since 1996 (ha)	% that was logged	THLB inclusion factor
Class 4 terrain in FMLB	22,847	8%	1,257	6%	0.76
Class 5 terrain in FMLB	26,225	9%	434	2%	0.23
FMLB	291,559		21,029		

Table 8.2.8.4.3. Inputs into the terrain stability exclusion calculation or preference ratio for TFL 58

	Total area (ha)	Proportion of FMLB	Area logged in since 1996 (ha)	% that was logged	THLB inclusion factor
Class 4 terrain in FMLB	2,543	11%	201	8%	0.76
Class 5 terrain in FMLB	2,307	10%	119	5%	0.50
FMLB	23,397		2,433		

8.2.9 Forest cover constraints

Forest cover constraints are conditions within a specific area associated with a management objective that must be met prior to the model harvesting in that area.

8.2.9.1 No constraints applied

A sensitivity scenario was explored the overall timber supply implications of forest cover constraints. This scenario is primarily to test to see how the model interacts with these constraints in part to verify that the model is performing as intended. In this case the forest cover cosntraints for watersheds (Community Watersheds, Sensitive Watersheds and Upland Stream Areas), Wildlife Habitat Areas, Marbled Murrelet habitat targets and visuals quality objectives were disabled.

8.2.9.2 Wetlands not considered "recovered forests"

Section 6.10.6 above describes the constraints applied to meet the Upland Stream Area objectives of the HG LUOO. For this objective, which requires 70% of the forests in upland stream areas to be hydrologically recovered, the model used the entire watershed (forested and non-forested) as the denominator since the entire drainage basin forms the hydrological response to water inputs (Church & Eaton, 2001). Concern has been raised that the intent of this objective was to exclude non-forest (e.g. wetlands) from this calculation. This may affect timber supply in those low-relief areas within the TSA that are made up of bogs and mature cedar-leading stands. The effect of non-forest (alpine, parkland, wetlands) is being studied on the central coast's Kwakshua Channel watersheds on Calvert Island (https://www.viu-hydromet-wx.ca/watershed-monitoring/kwakshua-watersheds-program/), and is expected to contribute to our understanding of the role of coastal wetland bogs on regulating peak flows.

To help scope the affect that this uncertainty may have in timber supply a sensitivity scenario was designed where the denominator excludes wetlands in upland stream areas. This therefore set a constraint to ensure 70% of forested areas outside of Type I and Type II Fish Habitat buffers were hydrologically recovered within each of the Schedule 6 Upland Stream Area sub-basins.

8.2.10 Harvest flow

The base case reference scenario follows a non-declining flow, or even flow, principle (the long run sustained yield average of all species combined). This sensitivity allows short-term harvest level to increase such that steps to reach mid-term level cannot be more than 10% per decade.

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Appendix 3:
Haida Gwaii Management Council - Timber Supply Review Results Report Final (November 2019)

Haida Gwaii Timber Supply Review Analysis Report

Haida Gwaii Timber Supply Review Technical Working Group Report for the Haida Gwaii Management Council
2019

Date
November 2019

Citation
Technical Working Group. 2019. Haida Gwaii Timber Supply Review Analysis Report. Report for the Haida Gwaii Management Council. Old Massett, Haida Gwaii, B.C.

The Technical Working Group (TWG) was co-chaired by Nick Reynolds, RPF (CHN) and Christine Fletcher, RPF (Forest Analysis and Inventory Branch), and included members David Stuart, RPF (Forest Analysis and Inventory Branch) and Sean Muise, RPF (Haida Gwaii Natural Resource District) and Ted McRae (Forest Analysis and Inventory Branch). The TWG received substantial and invaluable support from Dr. Andrew Fall (Gowlland Technologies).

Contents

Executive Summary

This report details the results from the analysis to support the 2019 Haida Gwaii Timber Supply Review and Allowable Annual Cut determination by the Haida Gwaii Management Council for Haida Gwaii. Results from these analyses are intended to further support the Chief Forester's Determinations for Tree Farm Licence 60, Tree Farm Licence 58, and the Timber Supply Area #25. The Haida Gwaii Timber Supply Review Data Package (referred to herein as the Data Package) offers details on model inputs and assumptions that were used in this analysis.

The long-term Timber Harvesting Land Base (THLB) is anticipated to be approximately 147,746 hectares, or approximately 51% of the area of Haida Gwaii. The area-weighted mean annual increment across all of the THLB is approximately 7.5 m^3 per year.
The base case reference projection follows a non-declining flow. For the first 100 years, the level is 842,781 m^3/year, which is projected to increase to 926,600 m^3/year at that time, and then to 939,700 m^3/year after 240 years. The base case reference results in a major decline in the contribution from old or existing natural forest until decade 8, signifying a transition to managed forest/second growth on the Timber Harvesting Land Base.

The amount of cedar being logged has been in decline since the 1990's, however its percentage contribution to the annual cut has been relatively stable (see figure 1.2.4), hovering around 50% of the cut. Currently, most of the cedar in the THLB on Haida Gwaii is mature and old (figure 1.1.1). The contribution to the projected harvest level from cedar (both western red cedar and yellow cedar) is anticipated to continue to decline until decade 4. Its current contribution to the cut across all forest tenures (since the cedar partition in 2017) is approximately 40%, this is anticipated to decline to 22% in 20 years, 14% in 40 years before stabilizing at 20% in 80 years. In contrast, the cedar growing stock, which represents second growth cedar in the THLB, is expected to increase from its current amount of approximately 337,900 m^3 to 3.3 million m^3 by decade 4, 6.7 million m^3 by decade 8 and then stabilizing at over 10 million m^3 by decade 20.

Managing mature and old cedar so there is a non-declining or even flow would amount to managing the current mature/old forest within the THLB until second growth cedar stands have regrown to a merchantable age. In effect this amounts to determining a long-term harvest level for cedar. An even flow harvest level for cedar results in a harvest of cedar not exceeding 146,371 m^3 annually for all of Haida Gwaii. This results in an overall even-flow harvest level (all species) of 762,731 m^3 for all management units.

A series of timber supply scenarios were completed and documented in this report to explore alternatives in policy, markets and forest operations. Some key findings include:

Isolated operating areas, especially those that are considered difficult to access with a high proportion of young second growth forest, such as Peel/ Sewell Inlets and Louise island contribute 77,624 m^3/year to the projection in the TSA and 40,550 m^3/year in TFL 60.

Managing Northern Goshawk nesting habitat to the Federal Recovery Strategy targets, which aim for 38 active territories, would result in a 1.3% reduction in timber supply, while managing nesting habitat while assuming full territory occupation (67 territories) would result in a 1.8% decrease in timber supply, amounting to 827,344 m^3/year.
Managing Norther Goshawk foraging habitat to the Federal Recovery Strategy targets, whereby 5,564 hectares of suitable habitat is retained or recruited for 38 territories, would result in a 4.8% reduction in timber supply.

Extending rotation ages (the time before a forest is logged) up to a minimum of 150 years, when log qualities begin to approximate old forest grades, results in a 79% (667,837m^3/year) reduction in timber supply. Conversely, shortening the rotation based on economic criteria also reduces the timber supply, resulting in a 3.5% (29,837 m^3/year) reduction in timber supply.

The exclusion of the Mosquito Lake Watershed or Slatechuck Creek from the Timber Harvesting Land Base results in a 3% (25,250 m^3) reduction in timber supply.
Approximately 60 sensitivity analyses were conducted for this timber supply review, with the majority of results presented in this report.

Introduction
The analysis report details the results from the 2019 Haida Gwaii Timber Supply Review (TSR) analysis. The Haida Gwaii Management Council (HGMC) has the responsibility for setting the Allowable Annual Cut for Haida Gwaii and has tasked a technical working group (TWG) made up of technical representatives for the Council of the Haida Nation and the Province of BC. The Haida Gwaii TSR Data Package provides in depth background on the process, inputs and methods used in the timber supply analysis. This report focusses exclusively on the results of those analyses to support both the HGMC and the Chief Forester in their subsequent determinations for the Allowable Annual Cut on Haida Gwaii.

The report begins with descriptive statistics of the state of forests on Haida Gwaii as well as reporting on a series of indicators that illustrate model performance over time. These are supported by the results of 60 separate model scenarios, known as sensitivity analyses, to explore a variety of uncertainties. All of the model scenarios have been completed using a spatial computer model. This model uses the *Spatial Timber Supply* software which is a module of the *Spatially Explicit Lanscape Event Simulator* (SELES). Modelling forest management tends to extend over huge time periods as a result of the long-life of trees. In this timber supply analysis, the 'planning horizon' is 400 years. While there are major uncertainties in how resources will be managed in coming decades, the 400-year timeframe helps ensure there aren't shortfalls, pinch points or 'crashes' in forest inventory when analyzing different rates of cut over time.
These long-term uncertainties can in part be addressed by renewed timber supply analyses every 10 years or less.

TSRs include the technical analyses and reporting, consultations (public, stakeholders, licensees) as well as the determination process. **This Analysis Report is only that part of the TSR that reports on the results of the timber supply analysis.**

Other key documents that support the TSR process include:
- (i) The Data Package: the documentation of inputs and approaches used in the timber supply analysis;
- (ii) A Public Discussion Paper: An amalgamation of key timber supply inputs, approaches and findings, as well as a description of the TSR process and timelines;
- (iii) A Socio-Economic Analysis Report: a detailed socio-economic evaluation of the forest industry on Haida Gwaii;
- (iv) The AAC rationales: The final determination document by decision makers that sets the AAC.

1.0 Base case reference scenario

In timber supply analysis it is common to create a model scenario that best reflects the current inventory, area available for logging (known as the Timber Harvesting Landbase), tree growth rates and current practice as defined by current forest management policy. This scenario is often called the 'base case'. For this timber supply analysis, the base case is best considered a *reference* scenario that can be used to compare the results from the variety of *sensitivity* scenarios. While the base case is an important point of reference, by no means should it be construed as an *AAC*, which in turn is a decision that will account for a large variety of factors, including public feedback, that will be considered to address uncertainties.

Some key inputs and methods in the timber supply review include:

- The newest and seamless Vegetation Resource Inventory data as well as key inventory attributes from LiDAR (termed LiDAR Enhanced Forest Inventory, or LEFI) and detailed silviculture records (RESULTS), formed the basis for forest inventory;
- Tree age and height relationships (site index) were based on ecological and forest mensuration plot data that was regionally specific to Haida Gwaii (enhanced SIBEC);
- Updated ecosystem mapping informed site productivity estimates;
- Growth and yield models (VDYP7 and TIPSY 4.4), developed by the Forest Analysis and Inventory Branch, were used to model stand growth over time;
- Aside from LEFI, LiDAR data was used to map fans and floodplains and update certain areas for terrain stability mapping;
- Natural disturbance factors, such as windthrow and landslides, were stochastically and spatially incorporated into timber supply modelling;
- Haida Gwaii Land Use Objectives Order (HGLUOO) and all other forestry regulations were applied in the model environment.
- A spatially explicit Timber Harvesting Land Base was developed and used in this timber supply analysis;
- Where possible, regionally specific empirical information was used to inform inputs and methods;
- The Spatial Timber Supply Model which runs on the SELES software platform was used;
- A non-declining flow, whereby the long-term harvest level at the end of the planning period (400 years) is the same as the beginning, was used in this timber supply analysis;
- Harvest criteria where stands can only be harvested at age where the volume is within 95% of the Culmination Mean Annual Increment and if stands are over 250m^3 per hectare.

The Data Package provides a detailed record of inputs and methods used. Appendix 8 of the Data Package summarizes inputs and methods applied within this TSR analysis.

Towards the end of this analysis, the policy for how monumental cedar are classified was changed. This change was through a deliberative process towards amending the *Cultural Features Identification* (CFI) *Standards* manual (v.5). The amendments, administered through the Council of the Haida Nation, were mandated by a Haida House of Assembly Resolution and direction from the Hereditary Chiefs Council to better align the classification of monumental cedar with cultural practice and use. Through consultation with Haida experts, carvers and CFI surveyors, the classification was refined to minimize subjectivity and better represent past use and current cultural practice. Defining cultural features is a responsibility of the Haida Nation. Identifying those cultural features in forest management is also the authority of the Haida Nation, as described in section 4 of the Haida Gwaii Land Use Objectives Order. The management of those features are jointly determined through the Haida Gwaii Land Use Objectives Order, which in turn is authorized by the Haida Gwaii Management Council. This new standard for monumental tree identification will impact the amount of monumental cedar that is required to be retained under the LUOO. Because this is considered current policy, the base case now reflects this new management approach.

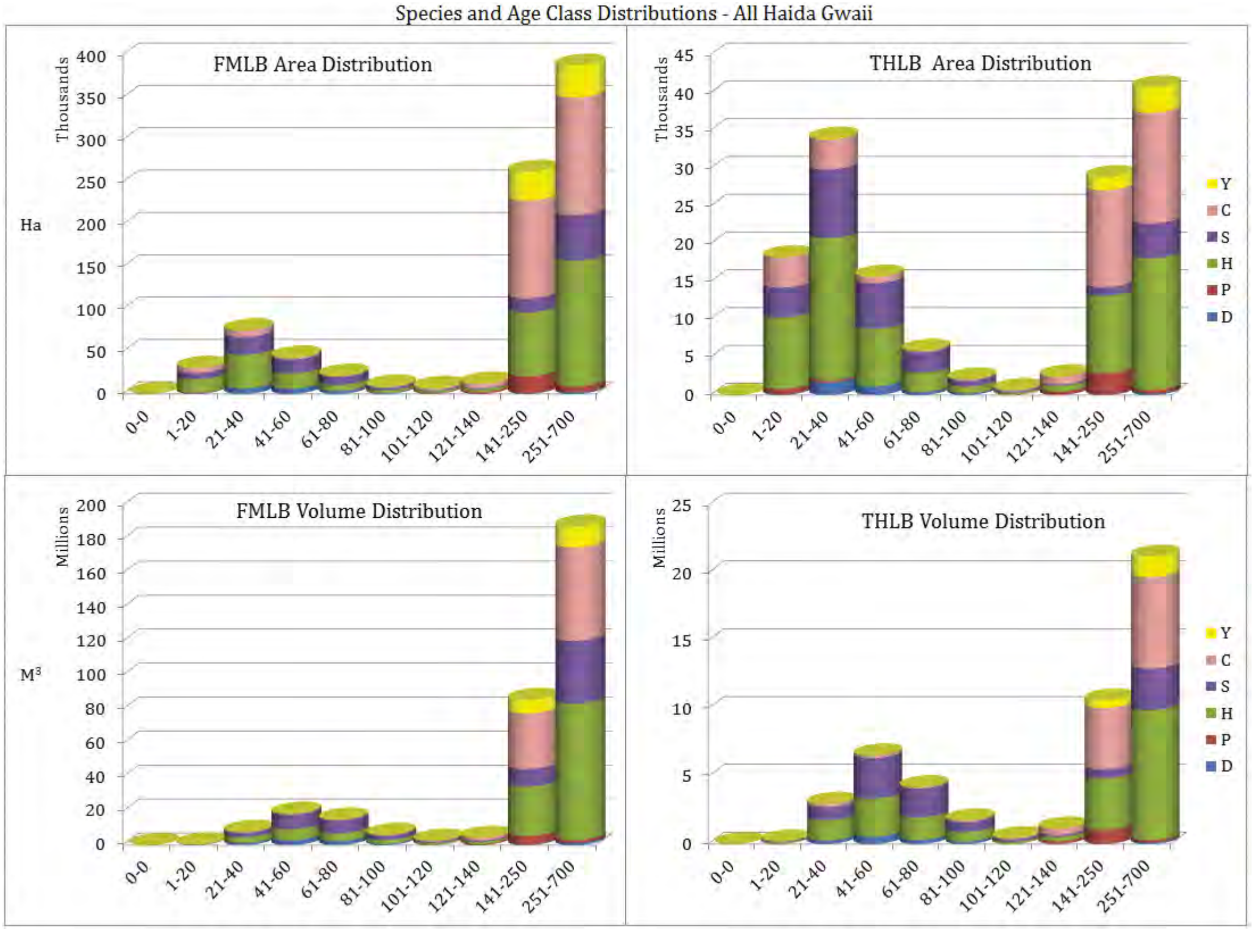

Figure 1.1.1. Tree species and ages for the forested area of Haida Gwaii (Forest Managed Land Base) and the Timber Harvesting Land Base (THLB), expressed in area (hectares) and volume (m³). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

While protected areas cover approximately 50% of Haida Gwaii, approximately 89% of the area and 88% of the current volume of mature and old forest (greater than 140 years) are outside of the THLB. The THLB makes up approximately 147,746 ha or 15% of Haida Gwaii. For western red cedar, approximately 87% of the current mature and old volume, accounting for the species composition of all stand types, is outside the THLB. Major species distribution gaps are evident, particularly for red and yellow cedar, in stands under 140 years old.

Within the THLB (across all management units), mature and old red and yellow cedar make up 42% of the volume of mature and old forests, whereas hemlock makes up 42% and Sitka spruce makes up 22% of the volume of mature and old forests.

While 53% of the THLB is second growth (under 140 years) by area, this second growth represents 35% of the volume in the THLB.

The following graphs present the same information but by management unit.

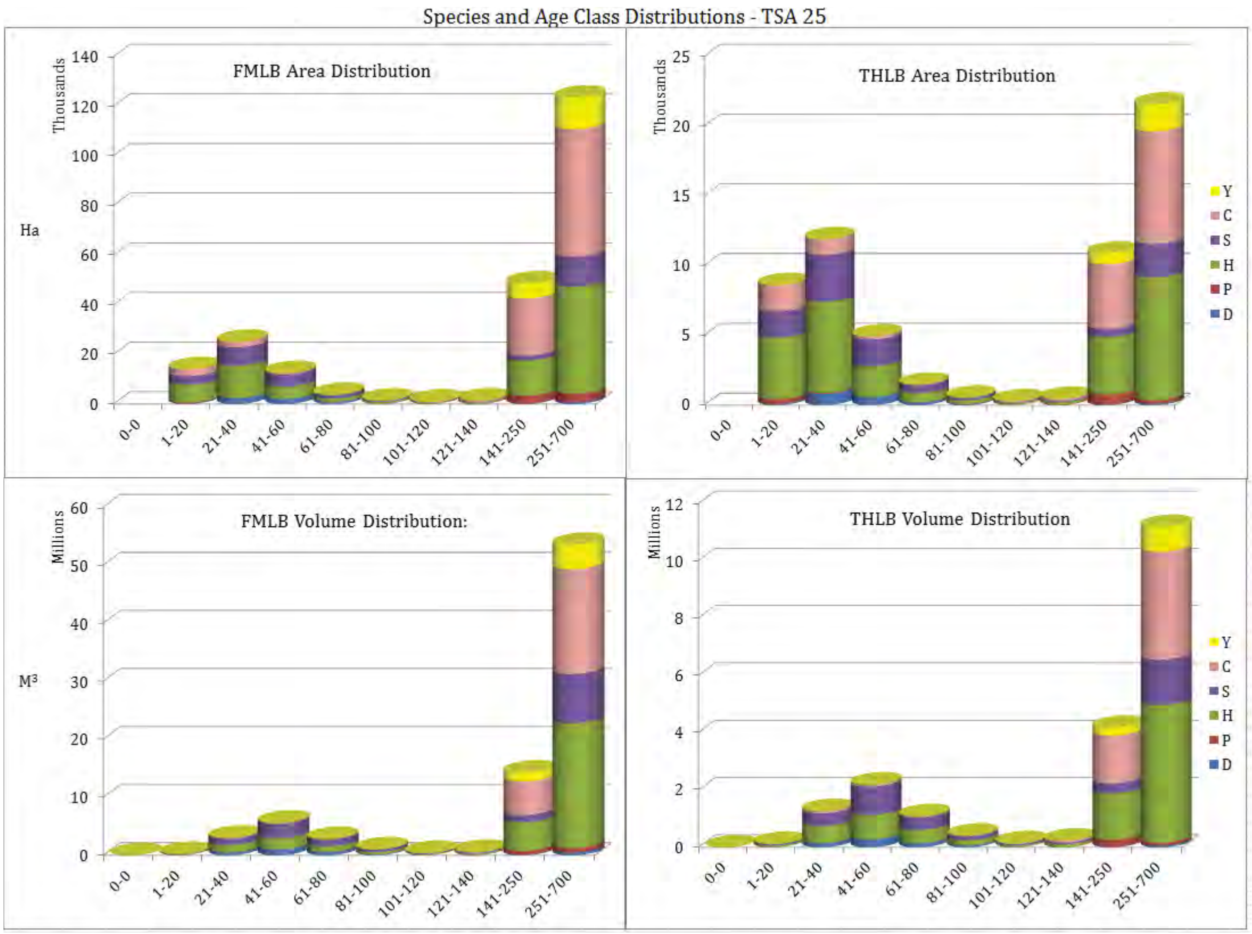

Figure 1.1.2. Tree species and ages for the forested area (FMLB) and the Timber Harvesting Land Base (THLB) for the Timber Supply Area (TSA), expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

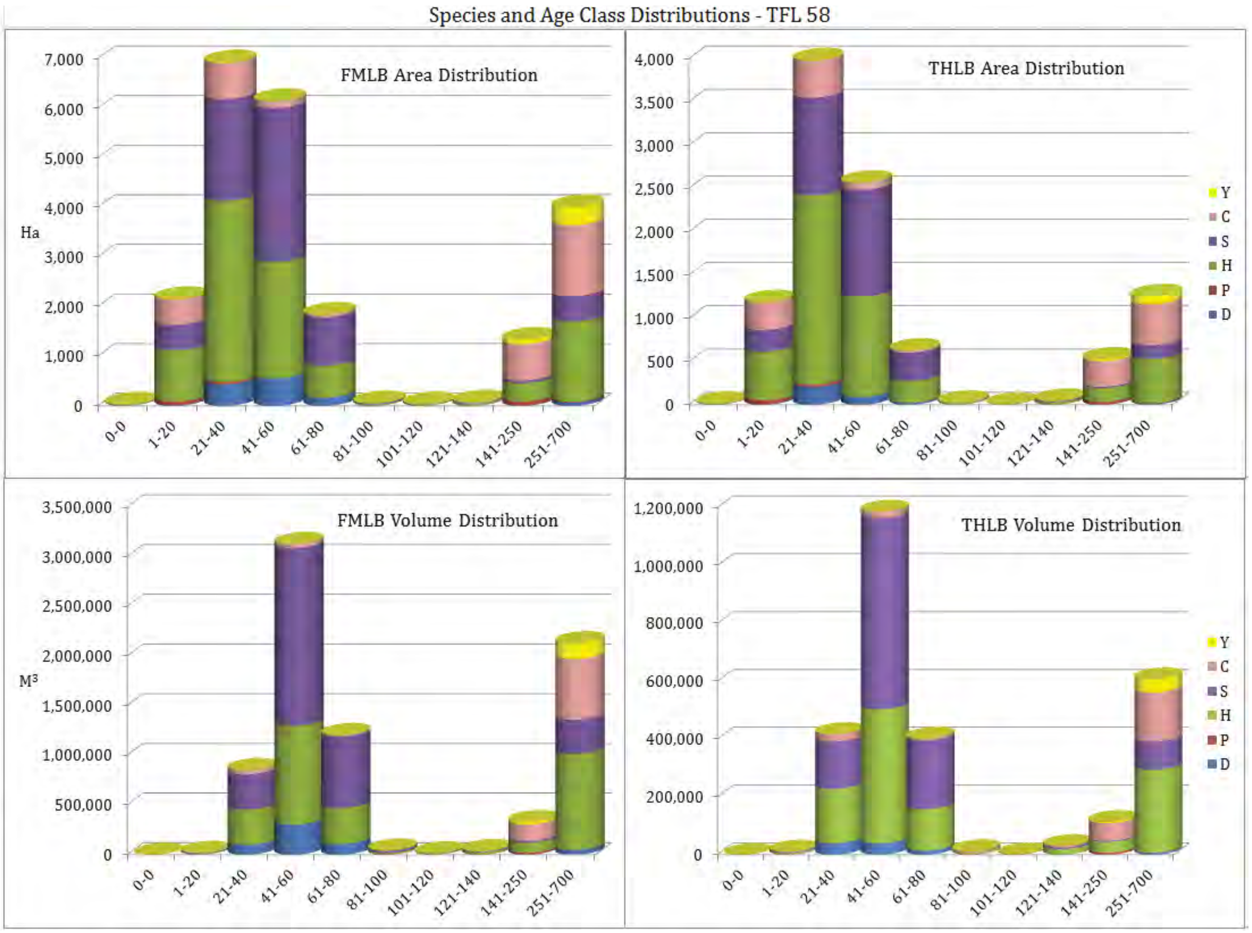

Figure 1.1.3. Tree species and ages for all the forested area (FMLB) and the Timber Harvesting Land Base (THLB) of Tree Farm Licence 58, expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

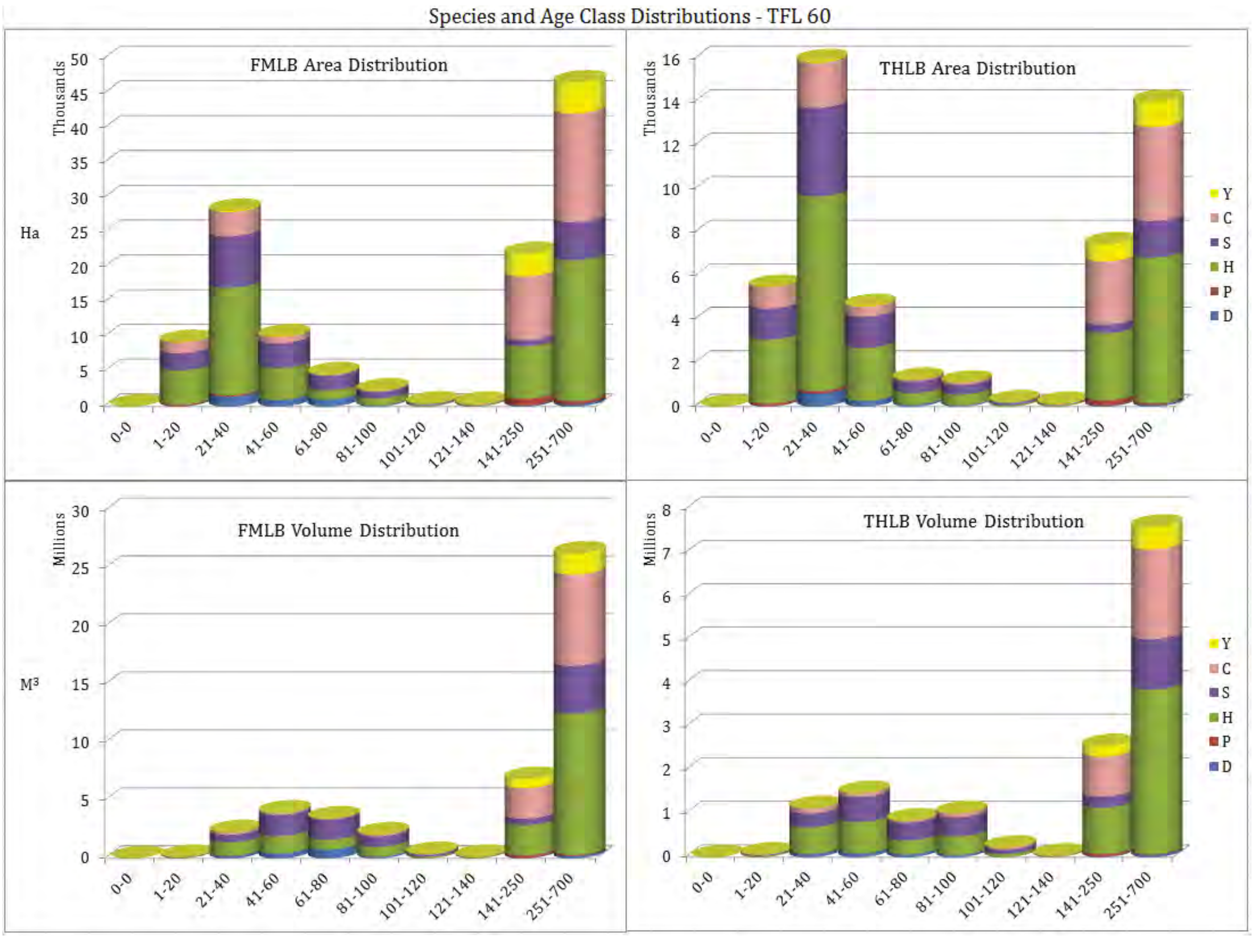

Figure 1.1.4. Tree species and ages for all the forested area (FMLB) and the Timber Harvesting Land Base (THLB) of Tree Farm Licence 60, expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

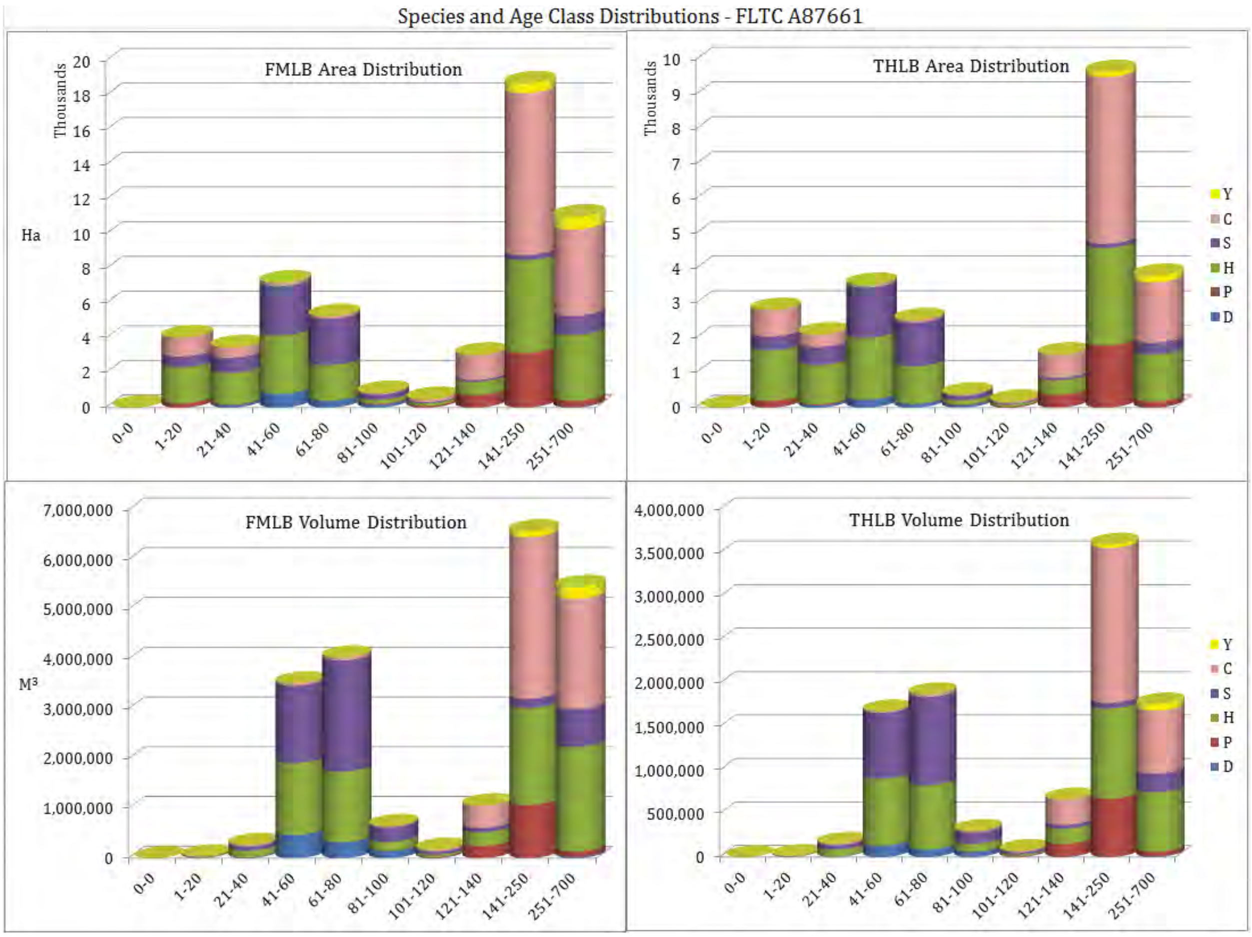

Figure 1.1.5. Tree species and ages for all the forested area (FMLB) and the Timber Harvesting Land Base (THLB) of Forest Licence to Cut A87661 (Taan Forest Products) expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

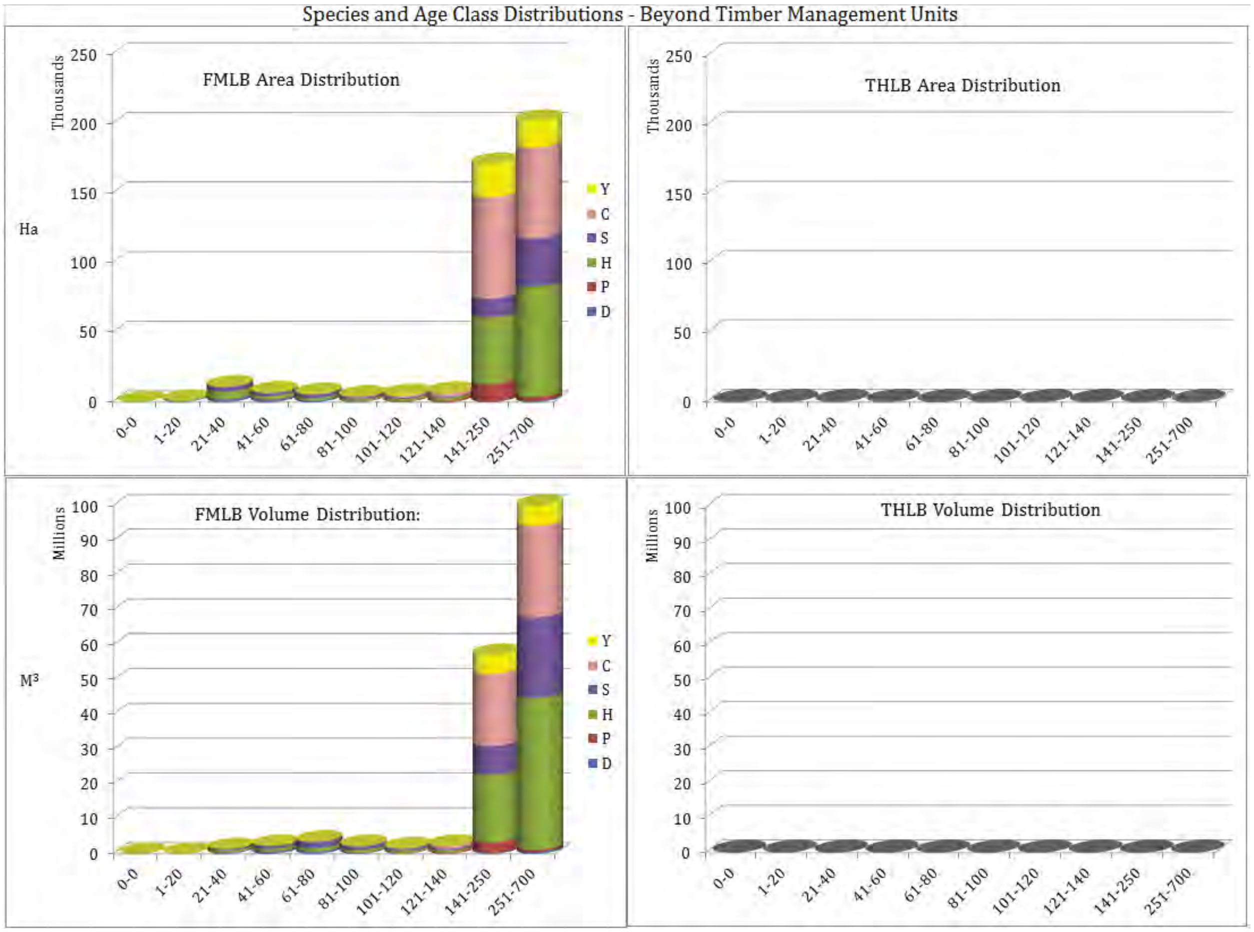

Figure 1.1.6. Tree species and ages for all the forested area (FMLB) <u>in protected areas,</u> expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

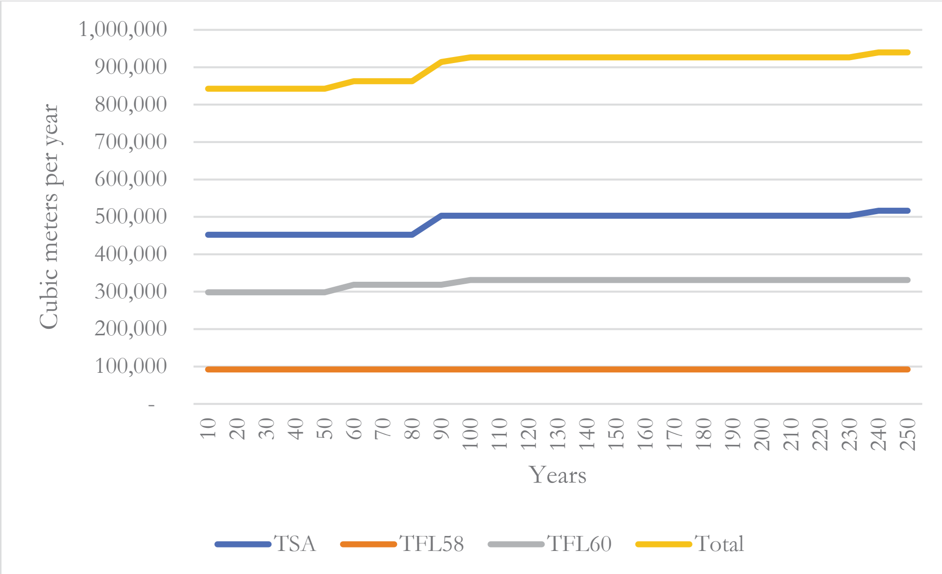

Figure1.1.7. Non-declining flow base case across all three management units.

Figure 1.1.7 illustrates a short-mid term harvest flow of 842,781 m³, with a slight increase in sustained yield between decade 8 and 9 for both TFL 60 and the TSA. This increase primarily as a result of thrifty second-growth stands coming into harvestable age. For the TSA this amounts to 425,287 m³ per year, for TFL 58 this amounts to a harvest of 91,169 m³ and for TFL 60 a harvest level of 298,325 m³. The total long-term harvest level is expected to increase to 926,600 m³ after decade 10 before another small increase to 939,700m³ in decade 24.

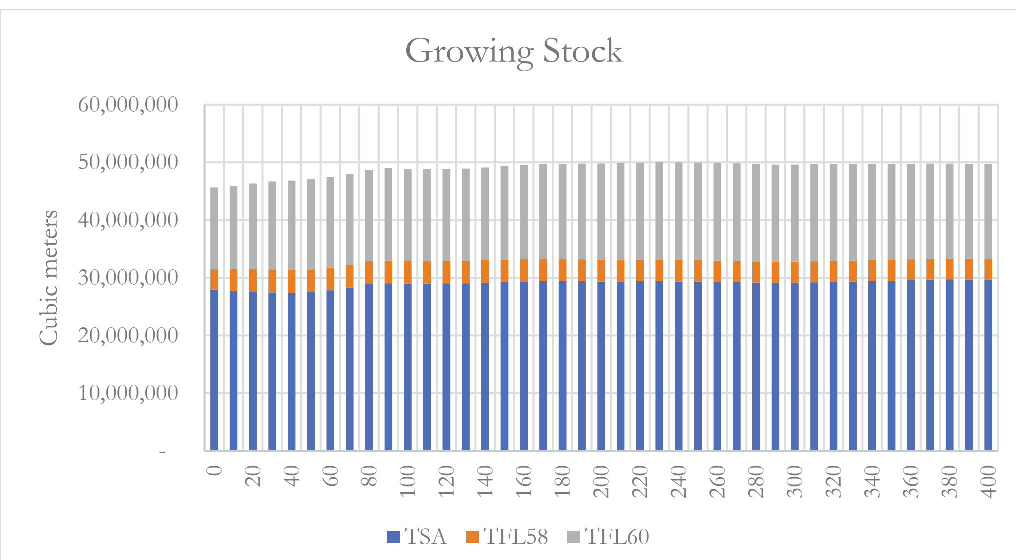

Figure1.1.8. Base case growing stock in the THLB by management unit

Growing stock, which is considered the sum of all the volume of the forest within the THLB, is expected to increase slightly until decade 88, before reaching a steady-state of approximately 49 million cubic metres by decade 8. A relatively flat growing stock is a strong indicator for a sustainable harvest level over the long term.

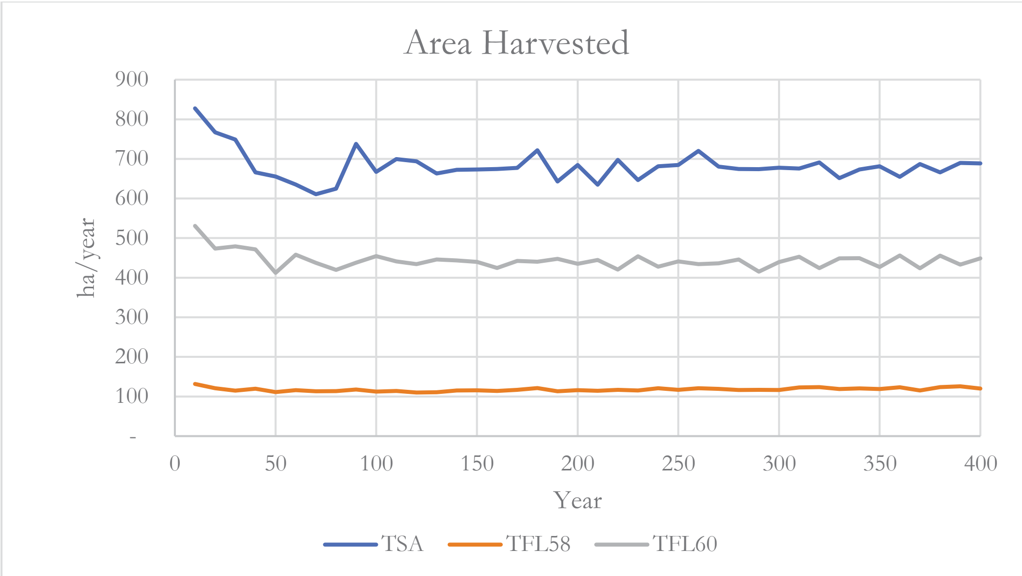

Figure 1.1.9. Base case area harvested by Management Unit over the planning horizon

The area harvested decreases for both TFL 60 and the TSA until decade 8 (figure 1.1.9). This decrease is because of more second growth coming online in these units. Second growth generally have higher volumes per hectare, resulting in less area harvested but maintaining consistent volumes harvested. TFL 58's harvest profile is primarily second growth from the beginning of the planning period and subsequently has a relatively stable ha/year harvested.

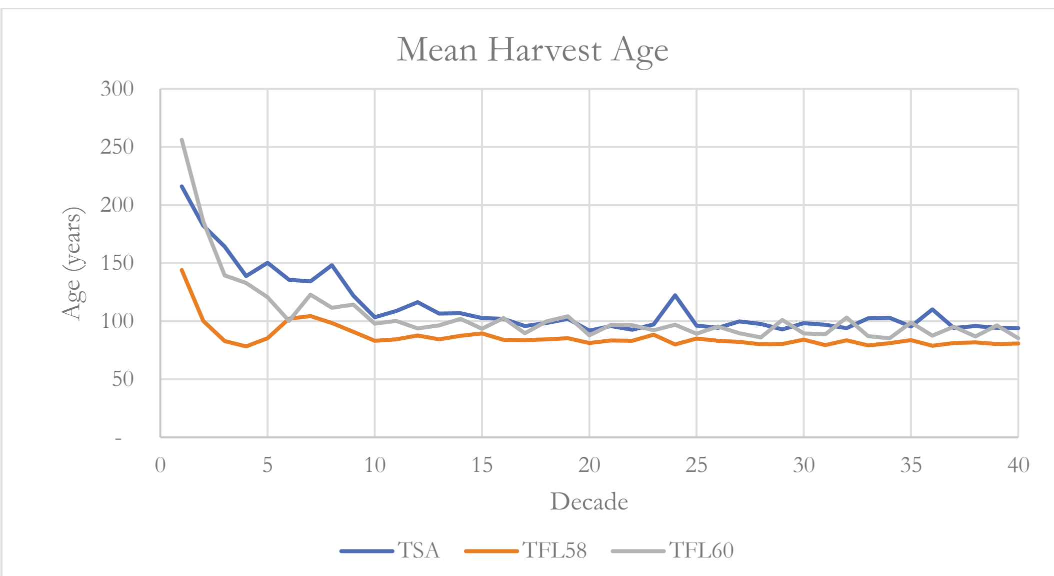

Figure 1.1.10. Base case mean harvest age by Management Unit over the planning horizon

The modelled mean harvest age declines for the first 10 decades (figure 1.1.10), representing the transition from older forest to second growth, before settling on long-term averages ranging from 80-100 years. TFL 58 has consistently younger mean harvest ages as a result of that management unit having generally higher productivity (stands reach Culmination Age sooner).

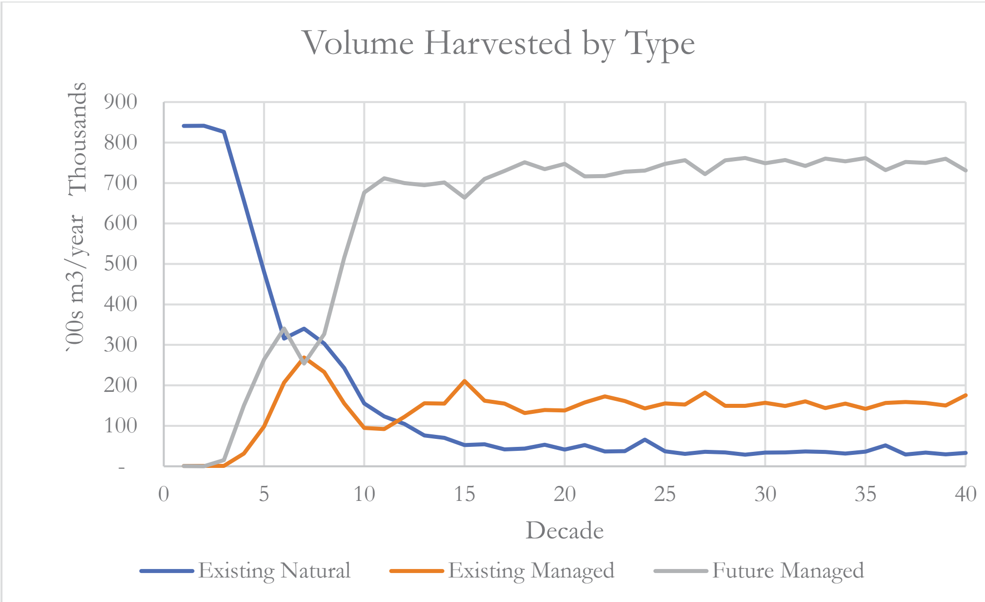

Figure1.1.11. Base case volume harvested by growth and yield curve category. Existing Natural (VDYP model), Existing Managed and Future Managed stands (TIPSY).

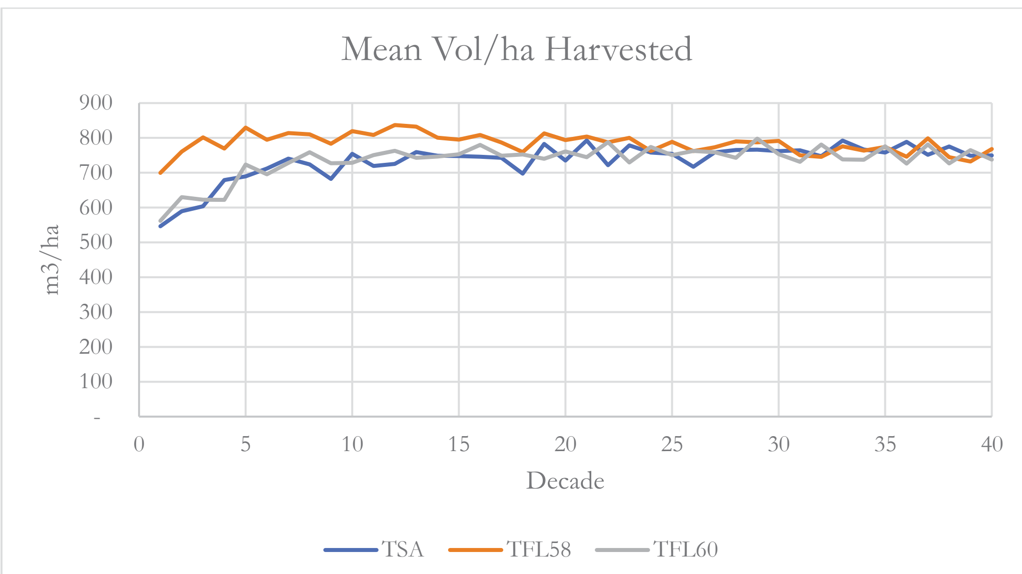

Figure1.1.12. Base case mean volume per hectare harvested by Management Unit over the planning horizon.

All units see an increase in m^3 per hectare harvested over time, which is a function of an increased proportion of second growth harvest over time.

Section 7.6 of the data package describes the application of a relative value model for tracking value as opposed to volume over time and guiding harvest preference in the timber supply model to better reflect current and anticipated future harvest planning. A relative value index, derived from average market prices by species between 2008-2017 and linked to forest inventory, helps gauge relative market values (as a relative index, not dollar value) over time in figure 1.1.13.

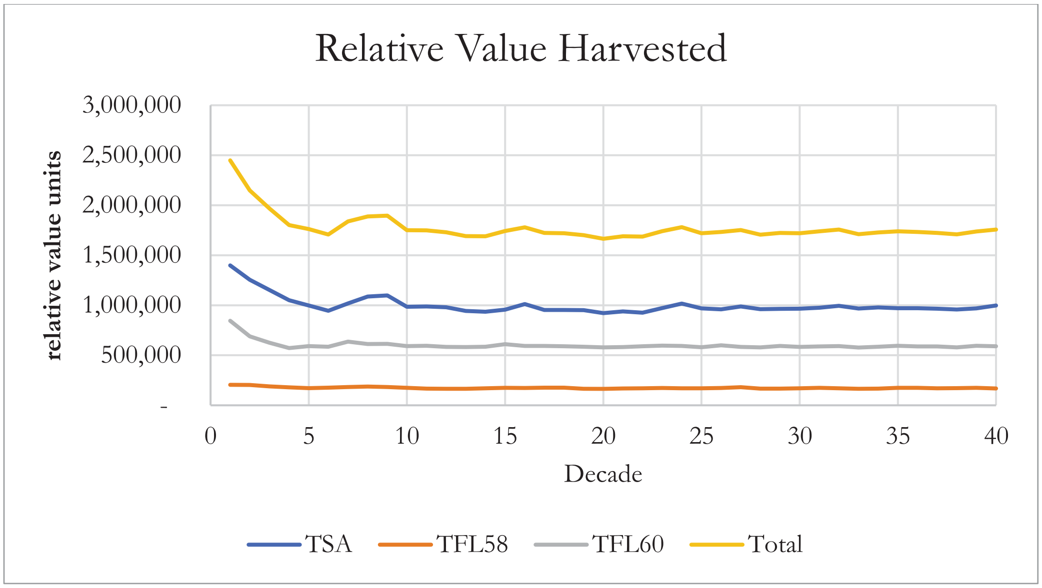

Figure 1.1.13. Relative value associated with harvest over time, based on market value indices from 2008-2017.

The anticipated trend in relative value is anticipated to decline, contrasting with the overall non-decline in volume. This decline is associated with the decrease in existing natural cedar volume in the base case.

Understanding the projected age class distribution provides insight into the projected reliance on existing natural (old) forest versus second growth forest over time. The following three charts illustrates projected harvest by age class and by management over the planning horizon.

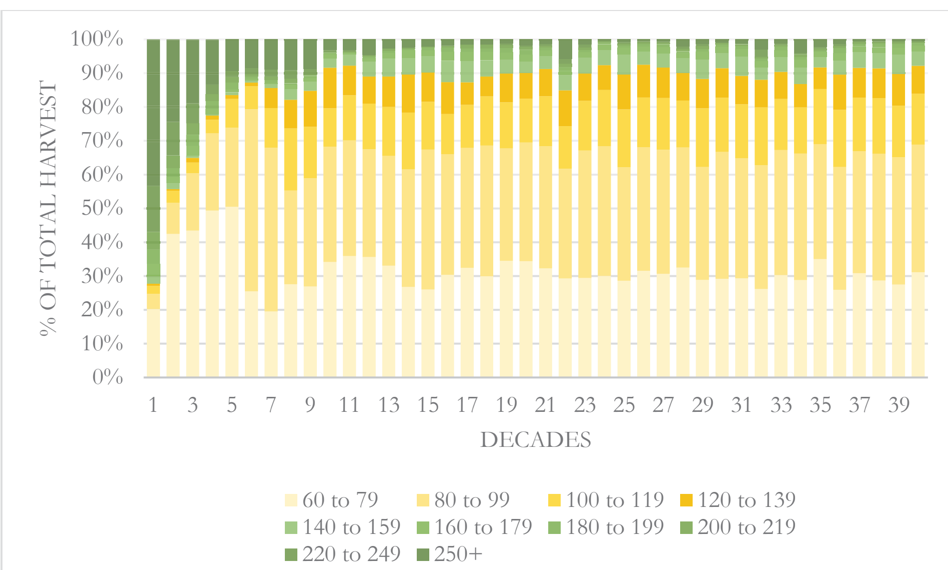

Figure 1.1.14. Harvest age class distribution by 20-year forest age increments over 40 decades for all the management units on Haida Gwaii.

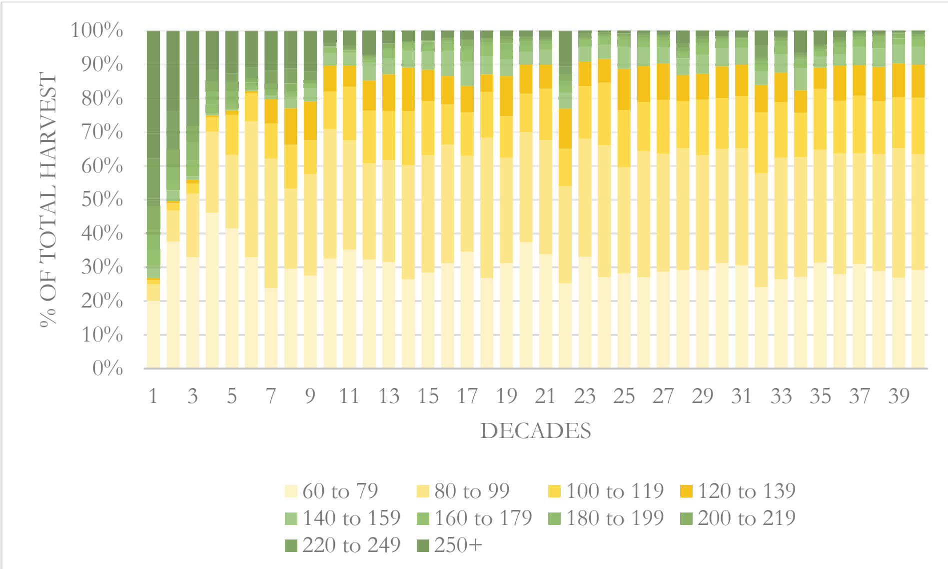

Figure 1.1.15. Harvest age class distribution by 20-year forest age increments over 40 decades for the TSA.

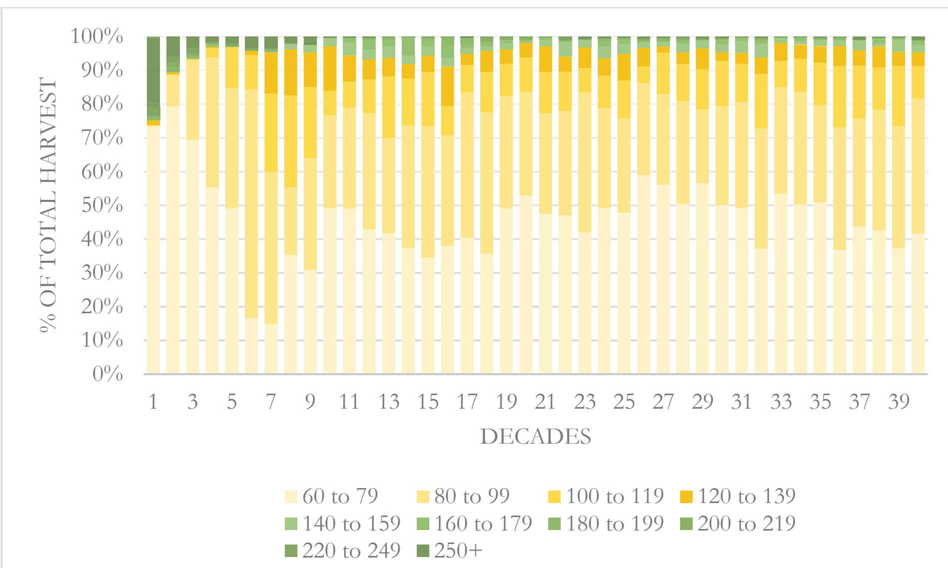

Figure 1.1.16. Harvest age class distribution by 20-year forest age increments over 40 decades for TFL 58.

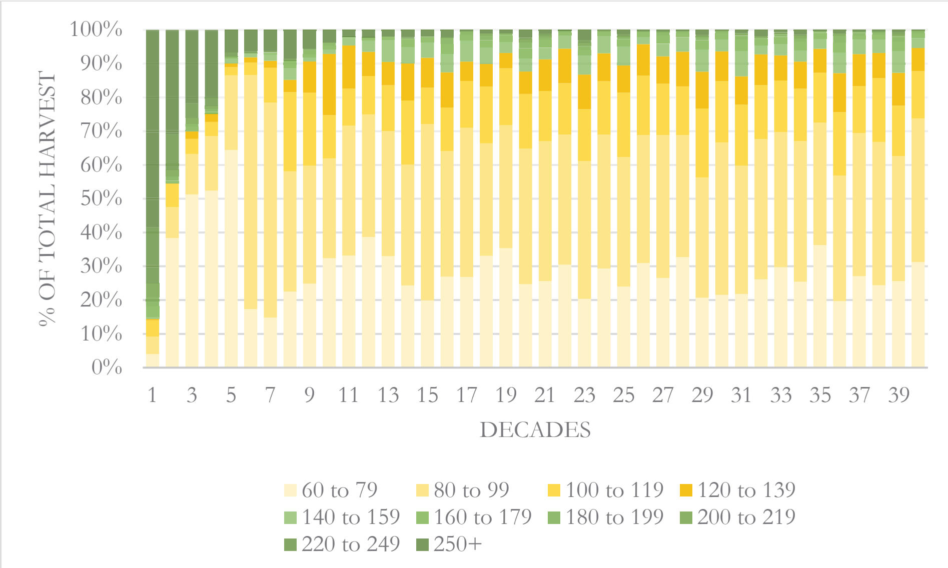

Figure 1.1.17. Harvest age class distribution by 20-year forest age increments over 40 decades for TFL 60.

1.2 Cedar harvest over time (base case)

Particular attention has been paid to the amount and timing of cedar harvest for this timber supply analysis. For both the base case reference scenario and the supporting sensitivity analyses, the species contribution was calculated using the percentage contribution by species in the inventory (not just leading species). Inventories are made up of complex polygons, typically attributing three or more species and their proportions in each polygon. Considering the social, cultural and economic importance of cedar it was deemed important to quantify all the species within a polygon, especially as cedar often is a secondary species.

Throughout this section cedar refers to western red (Cw) unless otherwise specified.

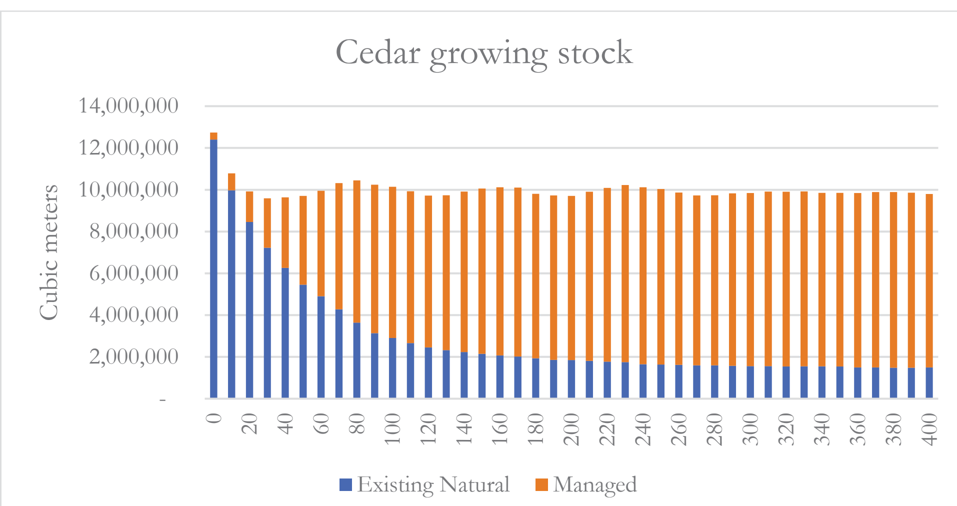

Figure 1.2.1. Base case cedar growing stock by existing natural and managed stands over time on the THLB.

In the base case reference scenario, cedar growing stock, which represents all the forest volume of cedar in the THLB, declines to decade 4, before increasing and stabilizing to just over 10 million m^3 by decade 8.

This same information is presented in figure 1.2.2 and 1.2.3 by management units.

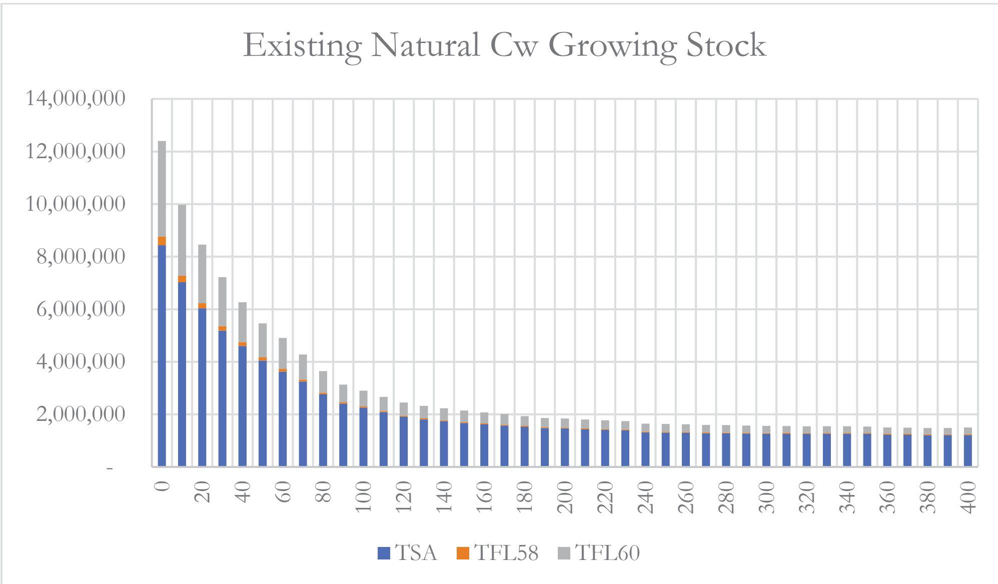

Figure 1.2.2. Existing natural (old growth) western red cedar growing stock by management units over time on the THLB.

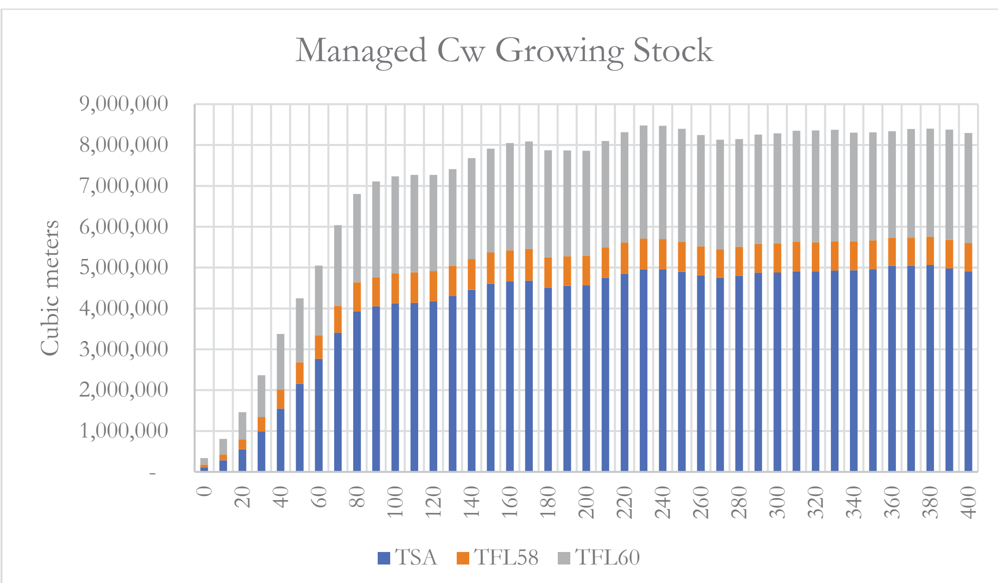

Figure 1.2.3. Managed (second growth) western red cedar growing stock by management unit over time on the THLB.

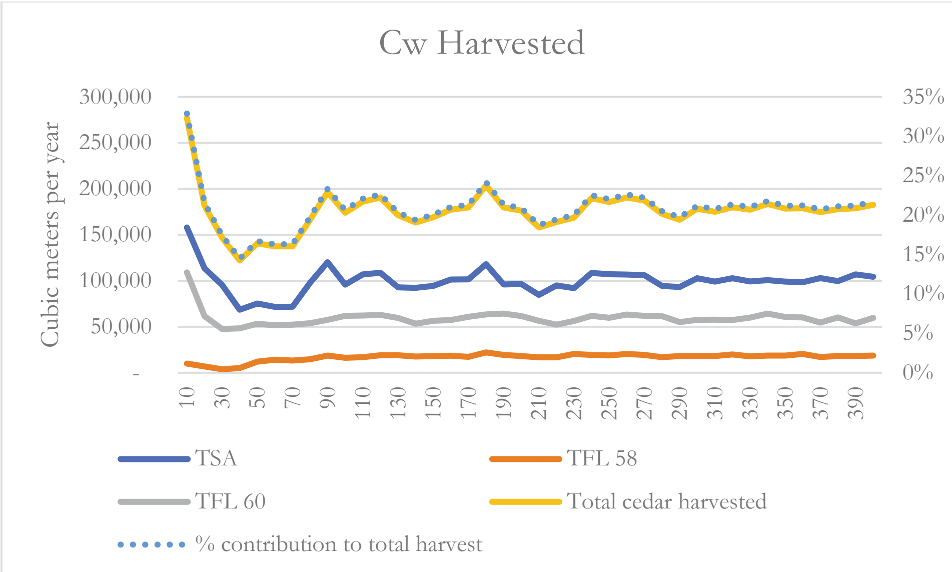

Figure1.2.4. Base case cedar volume harvest by management unit. over time.

As figure 1.2.4 indicates, cedar harvests start at just over 277,000 m³ before declining significantly down to 122,000 m³ at decade 4 in the base case reference scenario, before their contributions increases to an approximate average of just over 176,000 m³ by decade 8. Its current contribution to the cut across all forest tenures (since the cedar partition in 2017) is approximately 40%, this is anticipated to decline to 22% in 20 years, 14% in 40 years before stabilizing and being approximately 20% of the harvest in 80 years.

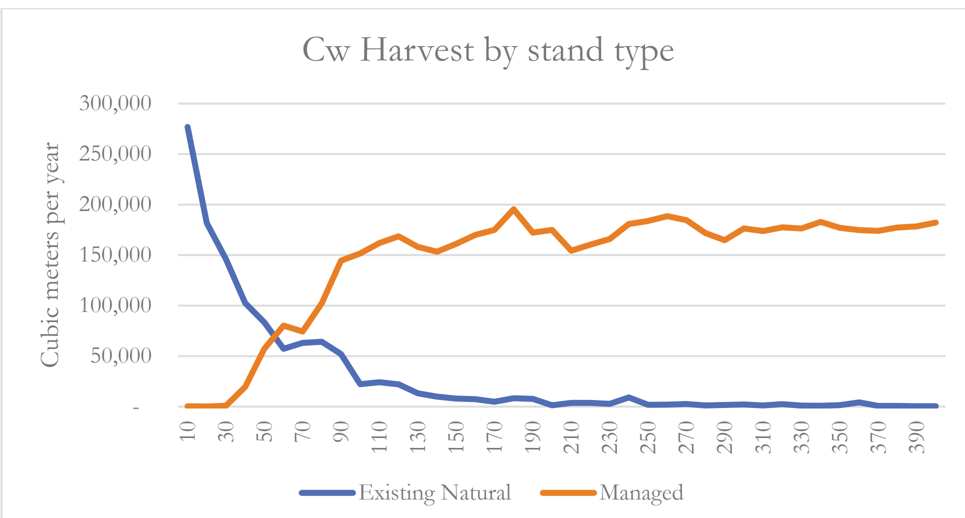

Figure1.2.5. Base case cedar harvest by stand type

As illustrated in figure 1.2.5, there is a significant reliance on existing natural (old forest) until decade 5, which is when the proportion of the cedar harvest that comes from second growth begins to surpass the proportion from old forest. Understanding where this volume comes from is of interest for long term planning.

General roadsheds or woodsheds, illustrated in figure 1.2.6 can be used to track species and volume contributions to the cut over time. These boundaries are not formal administrative timber supply units, but general groupings of operating areas to understand the anticipated flow of volume over time. Figure 1.2.7 provides the cedar volumes from the base case reference scenario by woodshed. While the amount harvested declines significantly in the first 40 years before stabilizing in 80 years, the proportional contribution from each woodshed over time remains relatively consistent. The smallest volumes come from Moresby North (Peel inlet) and North Narrows (1,100 m^3 and 1,300m^3 respectively per year), modest volumes continue to come from areas like Naden Harbour and Masset Inlet West (Collison point) at an average of 11,600 m^3 and 11,900m^3 respectively per year, contrasting with Juskatla woodshed which has the highest average around 64,400m^3 per year.

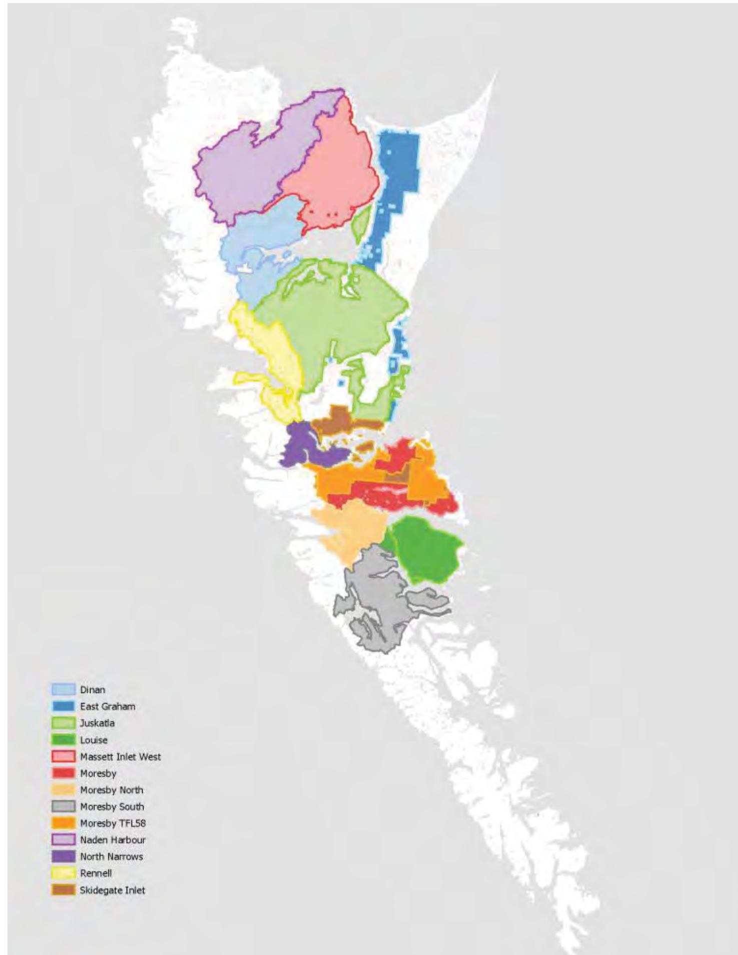

Figure1.2.6. Roadsheds/woodsheds used in the cedar sensitivity analysis

Figure 1.2.8 illustrates the contribution of cedar to the overall harvest using data from the last 24 years and the base case reference harvest projection. It shows that the fall-down in timber supply for cedar has been occurring since at least 1995, however its contribution to the cut has increased to ~50% between 1995-2015 before decreasing to 40% in 2017 (likely as a result of the Cedar Partition).

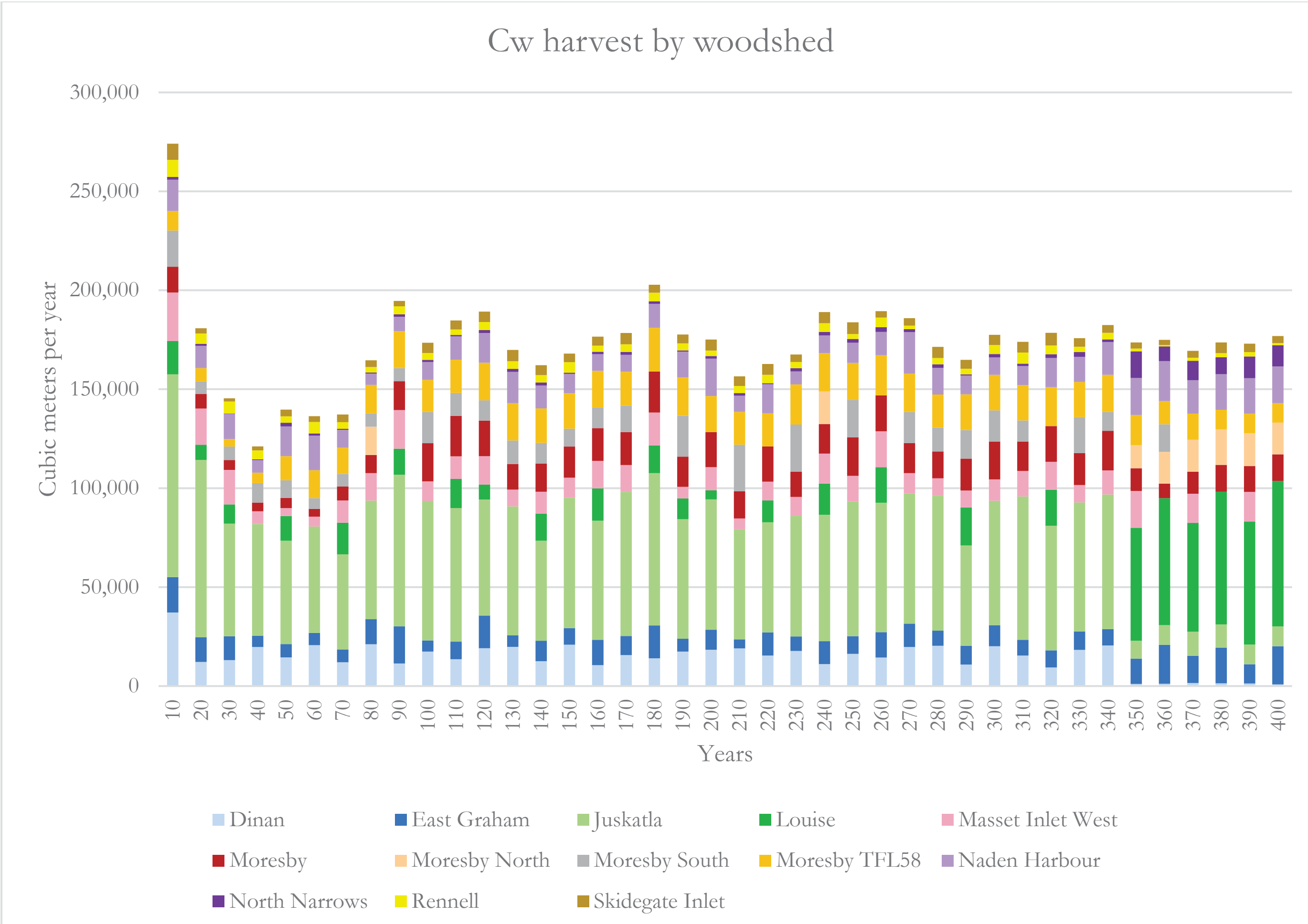

Figure 1.2.7 Base case reference cedar volumes harvested by woodshed

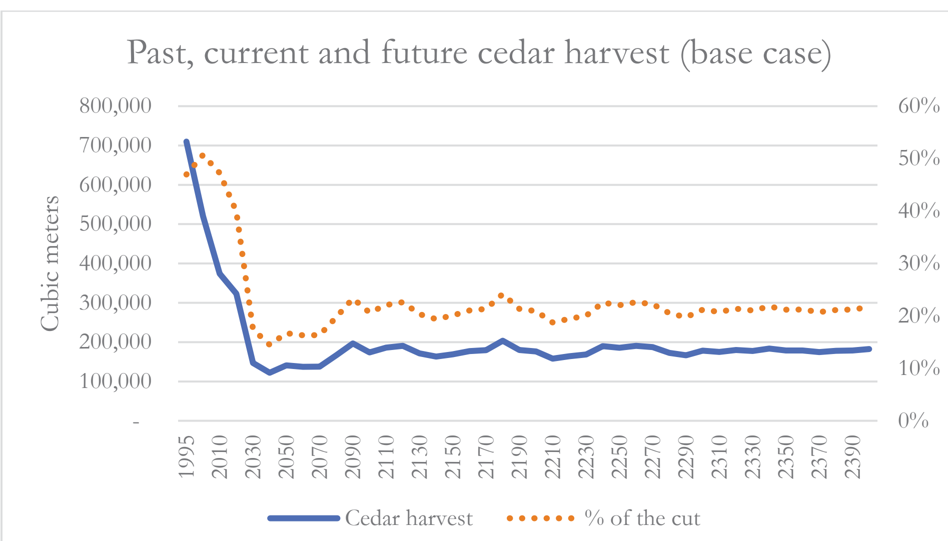

Figure1.2.8. Past, current (HBS 1995-2018) and the future projected base case cedar volume harvested annually over the analysis horizon, as well as the % contribution to cedar over the analysis horizon.

2.0 Sensitivity analysis

While the base case scenario aims to represent a reasonable estimate of the THLB, best available inventory data, growth and yield assumptions as well as current forest management practices, there are inevitably many uncertainties. Uncertainties exist within technical elements of timber supply (e.g. data inputs, model assumptions, model performance) but there are also uncertainties in forest policy and markets. Sensitivity analyses aim to increase understanding of the implications of these uncertainties by exploring a variety of changes to inputs and methods for analysis.

2.1 Cedar management

A pivotal element of the current timber supply analysis is to explore how cedar can be managed in the future. Cedar is considered a critical species for Haida culture and economy as well as playing a key role in the viability of the forest industry on Haida Gwaii. A 'fall down' effect, where there is a steady decrease in commercial timber supply for cedar, has been apparent for many years. A 2017 Chief Foresters partition was put in place on the TSA to help mitigate this fall-down effect. The current partition however does not resolve the cedar fall-down.

Sensitivity analyses were designed to determine what rate of cut would result in a non-declining flow of cedar. As most of the current volumes of cedar are in mature and old forests, this scenario is analogous to equally allocating the remaining mature/old volumes until second growth cedar volumes become merchantable.

2.1.1 Even flow for Cedar

The even flow scenario results in an average even flow for cedar of 146,371 m^3. This is composed of 88,280 m^3 from the TSA, 15,245 m^3 from TFL 58 and 49,299 m^3 from TFL 60 (figure 2.1.1.1). Applying an evenflow cedar harvest requirement results in an overall timber supply projection of 762,731m^3 per year, a 9.5% reduction relative to the base case.

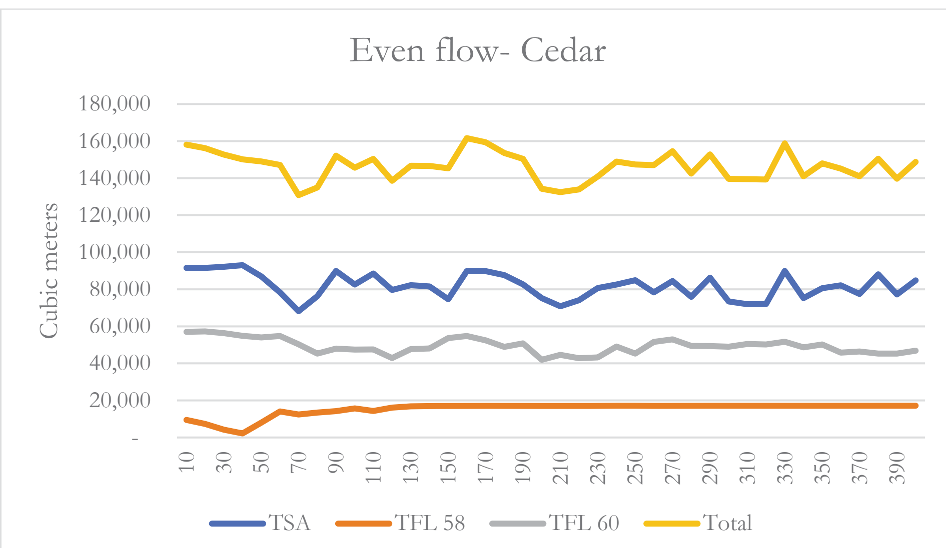

Figure 2.1.1.1 Even flow for Cedar by management unit.

The cedar harvest projections are not perfectly flat because the timber supply model allows for continued cedar harvest from stands with low cedar composition (less than 10%) after the even flow requirement is reached.

Table 2.1.1. Timber supply based upon an even flow for cedar, for all species and for cedar by management unit.

Factor	Total	TSA	TFL58	TFL60
All species forecast with even flow cedar	762,731	412,387	86,319	264,025
% diff from base case (all species)	9.5%	8.8%	6.3%	11.5%
Even flow Cw volume	146,371	81,827	15,245	49,299

Under this scenario, the growing stock, which represents the total volume of cedar on the THLB, also declines just below 11 million cubic meters until decade 4 before increasing and stabilizing to to over 15 million by decade 32 (figure 2.1.1.2), which is almost 50% higher than in the base case.

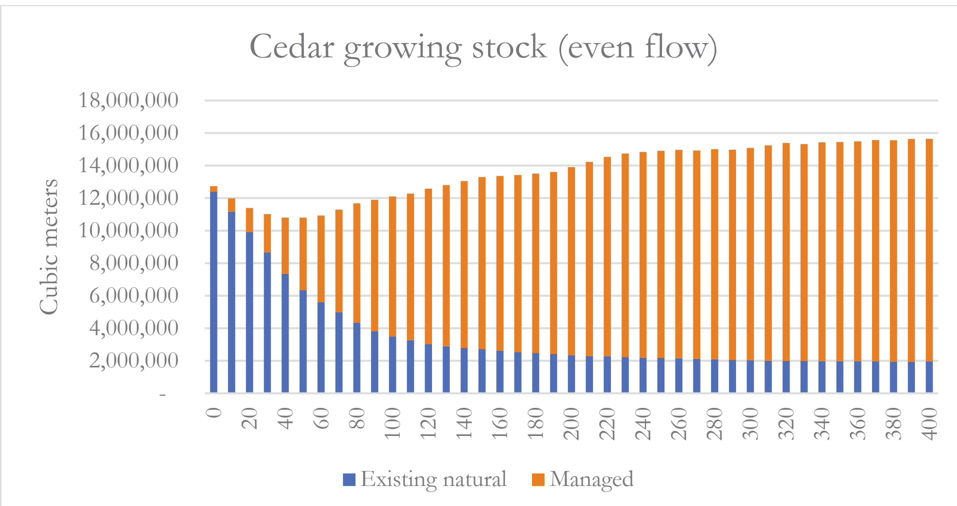

Figure 2.1.1.2. Growing stock for the Cedar even flow scenario.

2.1.2 Evenflow for Cedar +/- 10%

Variations to the long run average yield of cedar both above and below the base case were explored in 10% increments. For +10% and -10% increments, this amounted to an average harvest of cedar volume of 152,577m^3 and 138,172 m^3 respectively (figure 2.1.2). The projected harvest for all units ranged from a 5.7% decrease from the base case (794,744 m^3/year) to a 14.7% decrease from the base case (718,581 m^3/year).

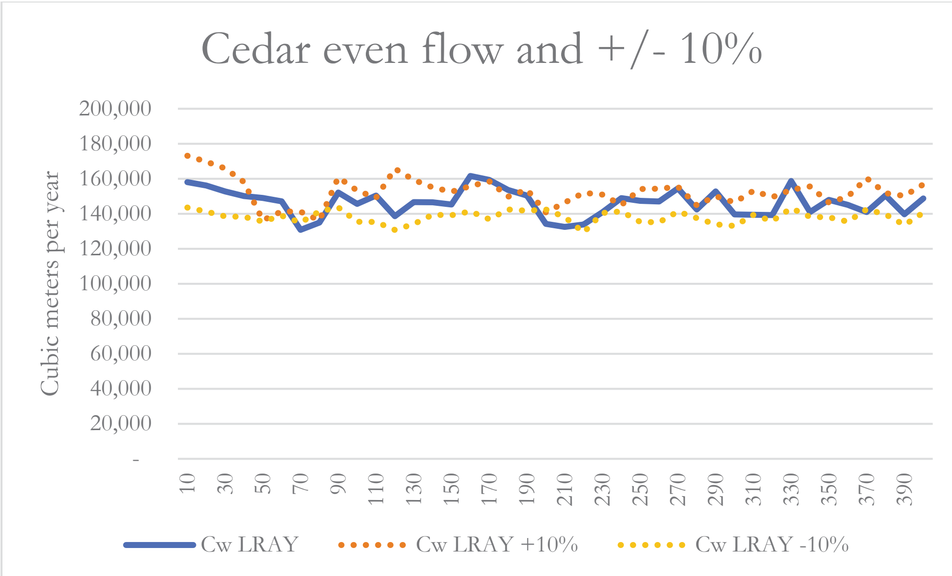

Figure 2.1.2. Cedar even flow (long run average yield~LRAY) compared with +/-10%

2.1.3 Intermediate flow for cedar

The base case reference scenario, outlined in section 1.2, represents a declining flow for cedar which contrasts from the even flow sensitivity described in section 2.1.1. There was interest in exploring an intermediate flow for cedar, whereby the supply would begin in between the two aforementioned scenarios in an attempt to both mitigate the reduction in timber supply and the cedar fall down.

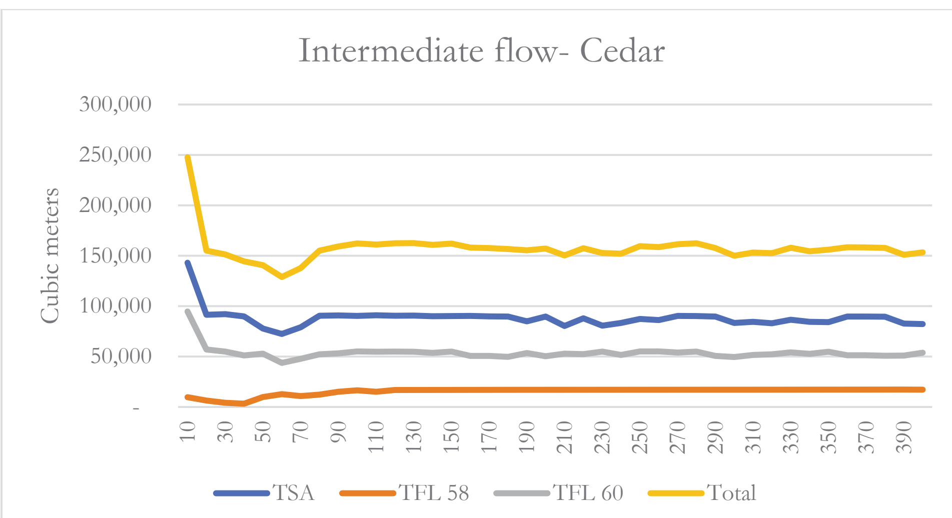

Figure 1.2.1.3. Harvest levels for cedar using an intermediate flow (starting between base case and even flow harvest levels).

Table 2.1.3. Timber supply based upon an intermediate flow for cedar, for all species and for cedar by management unit.

Factor	Total	TSA	TFL58	TFL60
All species forecast with intermediate flow cedar	822,656	445,313	86,719	290,625
% diff from base case (all species)	2%	2%	6%	3%
Intermediate flow Cw volume long range average	157,288	88,280	15,340	53,668

This scenario projects the cedar harvest beginning at 247,692 m^3 for the first decade, and then dropping to 155,113 m^3 (close to the long -range average) in the second decade. In this scenario, the lowest projected cedar harvest level is approximately 129,000 m^3/year in decade 6.

2.2 Alternative management units

At the time of timber supply analysis, Haida Gwaii was comprised of three management units: Tree Farm Licence 60, Tree Farm Licence 58 and the Timber Supply Area.

There are two distinct tenure awarding processes that in turn move area from the TSA into a First Nation Woodland Licence (FNWL) and into a Community Forest Agreement (CFA). The area of the FNWL is the same geographic extent as the area of the current Forest Licence to Cut (FLTC) A87661 currently managed by Taan Forest Products combined with TFL 60. An area for the CFA has been offered to the Misty Isles Economic Development Society (MIEDS) through the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, however the offer has not yet been accepted.

Factor	Total	TSA	TFL58	TFL60	FNWL/CFA
FNWL	848,307	271,763	92,169	n/a	484,375
CFA	829,444	393,675	92,169	295,275	48,325

For the FNWL scenario, the overall projection increased by 0.7% or 5,526 m^3 from the base case. This is because, when combining TFL 60 and the FLTC A89661 there is greater flexibility in harvest options which results in a small increase in timber supply. As this volume comes out of the TSA, it represents a 40% reduction in volume from the TSA.

Modeling the CFA as a separate unit results in a small 1.6% decrease in overall timber supply when compared to the base case. This is due to introducing a small management unit, reducing flexibility in harvest options. This volume comes out of the TSA, causing a 13% reduction in volume from the TSA.

2.3 Economic operability

Section 7.5 of the Haida Gwaii TSR Data Package describes in detail the economic operability modelling undertaken as part of the base case. In short, the base case applied a relative cost and marginal value model whereby surrogate indices for both operational cost and value were used to spatially approximate operational limitations. For the base case scenario, a least-cost road access model was developed that utilizes enduring features to assign a relative cost index (for example steep slopes are always more expensive than flat areas, wetlands are always more expensive than dry areas). 10-years of market values were averaged by species to attain a relative value index which were applied across the present and future inventory. This 10-year average (2008-2017) was meant to encapsulate the market high and low values. However given that markets are uncertain, there was interest in results from assuming prolonged strong markets and prolonged weak markets. This was explored by using the maximum and minimum market value indices within this 10-year period.

Such an analysis also helps decision makers understand how sensitive timber supply is to large fluctuations in market values. This in turn tries to account for value as a key variable.

2.3.1 Maximum market conditions

This scenario uses the maximum value index (or high market) for all species. Value index was derived from the 10-year average (2009-2017).

	Total	TSA	TFL58	TFL60
Maximum markets	842,131	454,687	92,169	295,275

There was a 650 m^3 or 0.1% increase from the base case. Under maximum market conditions slightly more stands are available for harvesting, since lower volume stands and/or more distant stands are economically viable.

2.3.2 Minimum market conditions

This scenario uses the minimum value index (or low market) for all species. Value index was derived from the 10-year average (2009-2017).

	Total	TSA	TFL58	TFL60
Minimum markets	814,106	433,313	91,769	289,025

There was an 28,675m^3 or 3.4% decrease from the base case. Under the minimum market conditions fewer stands are economically accessible.

2.3.3 No road operability constraints for combined MU's

This scenario 'turns off' the economic operability model, with the results, in effect, representing a biophysical timber supply model (no accounting for economic constraints associated with access).

	Total	TSA	TFL58	TFL60
No road operability	879,557	478,013	92,169	309,375

There was an 36,776 m^3 or 4.4% increase from the base case.

2.3.4 Isolated planning units

Section 7.6.4 of the Data Package describes the assumptions used to explore the timber supply contributions of isolated planning units of Sewell, Peel Inlet and Louise Island. These units are known to have higher operating costs and as a result licencees provided thresholds of volumes needed to be accessible prior to mobilizing efforts towards harvesting in these areas. Operational feedback indicates that Tasu/Sewell and Peel roadsheds require at least 100,000 m^3/year for 3 consecutive years, and Louise requires 50,000 m^3/year over 2 consecutive years. Scaled to a 10-year model step would mean 333,000 m^3 for Tasu/Sewell and Peel, and 250,000 m^3 for Louise would need to be accessible prior to harvesting. Sensitivity analyses were run to determine the long run average yields anticipated to come from these areas, particularly as these areas have had little to no access, but still contribute to the overall timber supply projection in the base case reference projection.

	Total	TSA	TFL58	TFL60
Isolated units excluded	723,844	374,663	91,406	257,775

There was an 118,937 m³ or 14.1% decrease from the base case when these units were excluded from the THLB. Of this, 77,624 m³ came from the Sewell Inlet and Peel Inlet operating areas, and 40,550 m³ came from Louise Island.

The Sewell inlet operating area has not seen logging operations since 2007. Since 2015 Louise Island has had consistent forestry development, and Peel inlet has seen moderate development in its northern and most accessible areas.

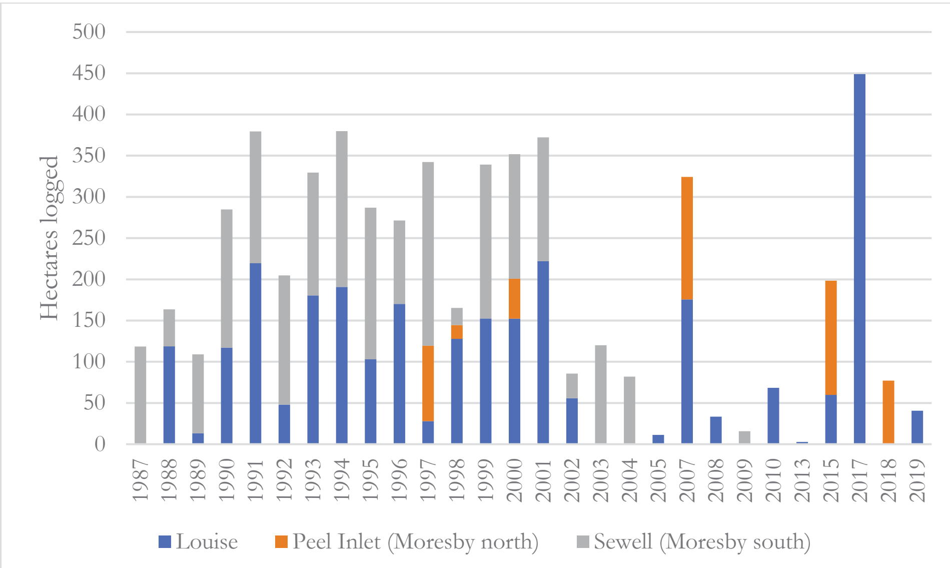

Figure 2.3.4. Area logged within isolated planning units (RESULTS)

2.3.5 No restriction to isolated planning units

This sensitivity assumes the Sewell, Peel Inlet and Louise Island planning units are not operationally constrained in any way.

	Total	TSA	TFL58	TFL60
No restrictions on isolated units	868,581	468,637	92,169	307,775

There was a 25,800m³ or 3.1% increase from the base case. This demonstrates that the access constraints (described in section 7.6.4 of the data package) have a small downward effect on timber supply.

2.3.6 High cost access exclusions

As detailed in section 8.2.5.6 of the data package, approximately 96% of the THLB has an access cost that is less than or equal to 10% of the maximum access cost in the THLB. The area of the THLB with considerably higher relative access cost (~4%) does not have a history of commercial forestry access and may prove to be continually challenging to log due to isolation and/or steep slopes. In this sensitivity these areas were removed from the THLB.

	Total	TSA	TFL58	TFL60
High access cost exclusion	838,206	442,913	92,169	303,125

There was a 4,574 m^3 or 0.5% decrease from the base case

2.4 Minimum Harvest Criteria

2.4.1 Extended rotation
An extended rotation sensitivity analysis was completed in order to explore the effects on timber supply if harvest age was increased. Extending rotation ages may have beneficial effects on non-timber values (from wildlife habitat, carbon sequestration, etc.) and increase timber values. Section 8.2.6 of the Data Package details the rationale and methods for determining a rotation age set at 150 years where analysis units had culmination mean annual increment ages under 150, otherwise CMAI-based ages were maintained.

	Total	TSA	TFL58	TFL60
Extended rotation	174,944	107,813	3,106	64,025

There was a 667,837m^3 or 79.2% decrease from the base case when extending rotation ages to a minimum of 150 years.

2.4.2 Economic rotation
The decision to harvest a stand is often based upon economic opportunity instead of culmination mean annual increment. Section 8.2.6 of the Data Package details an analysis of stand ages when the average log diameter reaches 30 cm. This generally results in lower harvest ages for richer stand types (30 cm diameter is met before CMAI). These ages were used as a minimum harvest rule to represent an economic rotation sensitivity.

	Total	TSA	TFL58	TFL60
Economic rotation	812,944	435,713	89,806	287,425

There was an 29,837 m^3 or 3.5% decrease from the base case when applying economic rotation criteria. For this sensitivity analysis, the weighted average minimum harvest age of future managed stands within the THLB was 94 years, and for existing managed stands within the THLB was 77 years. The likely reason for this difference in ages is that existing managed stands include a higher proportion of richer sites (e.g. biased or preferred harvest sites) which therefore reach the minimum diameter at a younger age.

2.4.3 No minimum harvest age or volume
This sensitivity examines how the timber supply model responds without any constraint on harvest age or volume. This is to contrast the base case which has a minimum harvest criteria in which stands must not be harvested before reaching 95% of the culmination mean annual increment and 250 m^3/ha (detailed in section 8.2.6 of the Data Package). The reason be4hind this sensitivity analysis was to check if the minimum harvest ages had a significant effect beyond the harvest preference rules applied in the base case reference scenario (i.e., higher priority given to relatively higher-value stands).

	Total	TSA	TFL58	TFL60
No MHA or MHV	912,406	499,163	86,719	326,525

There was an 69,625 m^3 or 8.3% increase from the base case when no minimum harvest age or volumes were applied, which shows that the minimum ages did affect the projection.

2.4.4 Minimum harvest volume constraint raised to 350m³ for managed stands

The base case minimum harvest volume was based on an analysis of harvest history in relation to the forest inventory. However, the majority of this harvest history is based on logging old forest and there is an expectation that second growth stands may warrant higher minimum volume requirements due to their relatively lower values. As a result, a sensitivity analysis was conducted in which the minimum harvest criteria rule was set to 350m³ for managed stands.

	Total	TSA	TFL58	TFL60
MHV 350	834,169	447,487	91,406	295,275

There was a 8,612 m³ or 1.0% decrease from the base case.
This volume threshold also aligned with an analysis of volumes where 95% of the volume harvested from 2nd growth in the last 10 years came from stands with 350 m³/ha or more.

2.4.5 Maximum harvest age not exceeding 250 years

This scenario explores the evenflow harvest of a non-declining projection resulting from limiting harvest to stands under 250 years. This represents a scenario where no old growth forest is logged.

	Total	TSA	TFL58	TFL60
Second growth only	671,019	367,913	87,481	215,625

There was an 171,762 m³ or 20.4% decrease from the base case.

2.5 Harvest preference

Harvest preference includes sensitivity analyses that set preferences for harvesting stands in the model, in turn training the model to log based on various parameters ranging from forest volumes, ages or values.
Chapter 7 of the Data Package provides further details on model assumptions and rationale.

2.5.1 Relative volume harvest

Whereas the base case scenario set a preference to log based on stand value relative to volume at Culmination Mean Annual Increment (CMAI), the relative volume scenario is defined by stand volume relative to volume at culmination of mean annual increment (CMAI). In other words, stands with higher volumes at CMAI will be preferred to be logged by the model.

	Total	TSA	TFL58	TFL60
Relative volume	840,131	452,287	92,569	295,275

There was a 2,650 m³ or 0.3% decrease from the base case.

2.5.2 Oldest first relative to CMAI

This scenario sets a model preference to log the oldest stand relative to 95% of age at culmination age. This therefore focuses on old growth forest being harvested ahead of any second growth harvests.

	Total	TSA	TFL58	TFL60
Relative oldest first	856,656	456,863	92,169	307,625

There was a 13,875 m^3 or 1.6% increase from the base case.

2.5.3 Randomized order of harvest
This harvest preference is not limited by value, volume or age but sequentially random. This provides an indication of the relative timber supply effects of the other harvest preference scenarios.

	Total	TSA	TFL58	TFL60
Random harvest order	803,831	426,563	89,844	287,425

There was a 38,950 m^3 or 4.6% decrease from the base case.

2.6 Haida Nation policies

The Haida Nation sets law and policy through the annual House of Assembly, mandates from seasonal sessions (quarterly sittings of the CHN), or political direction from the CHN Executive Committee. Those policies that directly affect timber supply have been explored and their results detailed below.
Methods and rationale are further detailed in section 8.2.3 of the Data Package.

2.6.1 Mosquito Lake
This sensitivity analysis removed the area of the Mosquito Lake watershed from the Timber Harvesting Land Base following the 2014 directive of the Haida Nation's House of Assembly to protect the Mosquito Lake Watershed. The boundaries of the watershed were provided for TSR analysis through the CHN Executive Committee in August 2019.

	Total	TSA	TFL58	TFL60
Mosquito lake	822,981	435,937	91,769	295,275

There was a 19,800 m^3 or 2.3% decrease from the base case that results from a 1,845 hectare reduction to the THLB.

2.6.2 Slatechuck Creek
West of Daajing Giids/ Village of Queen Charlotte, Slatechuck Creek contains an important traditional quarrying site for argillite for the Haida Nation. Development planning in the area has been contested by the Nation, with pressures to keep the area free of industrial activity. Despite no formal land use policy mandate, a sensitivity analysis was conducted to determine the effect on timber supply if the Slatechuck Creek watershed was reserved in perpetuity.

	Total	TSA	TFL58	TFL60
Slatechuck	837,331	449,887	92,169	295,275

There was a 5,450 m^3 or 0.6% decrease from the base case that results from a 203 ha reduction of the THLB.

2.6.3 Monumental cedar protection
A 2018 House of Assembly Resolution mandated the CHN to conserve all monumental cedar. Currently only trees with a diameter at breast height of over 120 cm or trees in Cultural Cedar Stands are 100% protected. Otherwise 10% of trees between 100-120cm are protected and if harvested made available to the Haida Nation.

There is currently no operational data to analyze the effect from the recently updated changes to the classification of monumental cedar. Section 6.10.19 of the data package describes the inputs and methods for netting down 70% of all monumental cedar (base case reference). Assuming that 100% of monumental cedar are retained leads to a net reduction of 28,410 hectares.

	Total	TSA	TFL58	TFL60
100% monumental retention	804,194	424,163	91,006	289,025

There was a 38,587 m^3 or 4.6% decrease from the base case.

A new version of the Cultural Feature Identification Standards Manual was released in late October 2019. The standards were designed to implement the LUOO requirements as currently written, not to revise the LUOO. A preliminary estimate of the frequency of monumental cedar was applied in the base case, and sensitivity provided here. However, some uncertainties remain, including: how many cedar trees with diameters over 100-cm meet monumental cedar criteria; and how monumental cedar will be managed and harvested. In response to these uncertainties, the HGMC through the Technical Working Group will be compiling additional information and undertaking analysis to explore: (1) the likelihood that a broader range of log grades than estimated for the base case will contribute monumentals; (2) indications that younger ages classes than assumed for the base case will contain monumental cedar; (3) timber supply implications of various levels of retention of monumental trees from harvesting. Given the recent release of the new standards, these analyses are ongoing. The results will be available for the HGMC for its determination of the Haida Gwaii AAC.

2.6.4 Former Monumental cedar identification standards

The Council of the Haida Nation has amended the Cultural Feature Identification standards for the identification of monumental cedar. The previous classification was in place during the implementation of the LUOO between 2011-2019, and as such benefits from extensive operational data, specifically the number of monumental features and the area of management and reserve zones established to protect them. As described in 8.2.3.5 of the data package, when using data sampled between 2012-2016 this amounted to a net reduction in the THLB of 1.9% (with 92% of the reduction in existing natural stands).

	Total	TSA	TFL58	TFL60
Former Monumental standards	937,444	508,537	94,531	334,375

There was a 94,663m^3 or 10% increase from the base case.

2.7 Northern Goshawk

Requirements to manage northern goshawk currently only extend to reserving known nesting areas on Haida Gwaii. However the number of known breeding/nesting areas is anticipated to increase over time, thereby warranting a sensitivity analysis to examine this effect. In addition, the Federal Government has published policy targets to manage foraging habitat, which may align with the Haida Nation's mandate to manage foraging habitat. There are uncertainties regarding how foraging habitat management will be implemented, given the Haida Nation's strategy is not completed and the Provincial government is reviewing forage habitat management in 2020. As detailed in section 8.2.4 of the Data Package, a range of sensitivity analyses were completed to explore these uncertainties.

2.7.1 Nesting reserves

Three separate sensitivity analyses were completed to explore increasing the netdowns from predicted nesting reserves. All three analyses use the base case nesting reserves (accounting for 22 currently known breeding areas) and then additional nesting habitat based on a predicted territory model and randomly assigned 200-hectare reserves from the 2017 Provincial nesting suitability model centered within each predicted territory. Choosing which predicted territories are included in the scenarios is based upon a ranking of territories with the highest amount of suitable habitat.

2.7.1.1 Provincial nesting target

This scenario assumes that a total of 25 breeding areas will have nesting areas reserved. 25 breeding areas is based upon BC's 2018 *Implementation Plan for the Recovery of Northern Goshawk, laingi Subspecies (Accipiter gentilis laingi) in British Columbia*. This represents an additional three predicted territories and associated 200 ha nesting reserves netted out of the THLB.

	Total	TSA	TFL58	TFL60
25 nest areas reserved	839,331	452,287	91,769	295,275

There was a 3,450 m^3 or 0.4% decrease from the base case.

2.7.1.2 Federal nesting target

This scenario assumes a total of 38 breeding areas will have nesting areas reserved, based upon implementation targets set in the Federal Governments 2018 *Recovery Strategy for the Northern Goshawk laingi subspecies (Accipiter gentilis laingi) in Canada*. This represents an additional 16 predicted territories and associated 200 ha nesting reserves netted out of the THLB.

	Total	TSA	TFL58	TFL60
38 nest areas reserved	831,994	445,313	91,406	295,275

There was a 10,787 m^3 or 1.3% decrease from the base case.

2.7.1.3 Full occupancy target

This scenario assumes that all predicted territories that have ≥40% suitable foraging habitat are considered occupied. Based upon a 2018 Provincial territory nesting model, this increases the number of breeding areas on Haida Gwaii to 67[1]. This represents an additional 45 predicted territories that each had 200 ha nesting reserves netted out of the THLB.

	Total	TSA	TFL58	TFL60
67 nest areas reserved	827,344	445,313	91,406	290,625

There was a 15,437 m^3 or 1.8% decrease from the base case.

2.7.2 Foraging habitat

A total of five timber supply scenarios were completed to explore the effects of managing Goshawk foraging habitat. These range from implementing the Federal Recovery Strategy of maintaining 65.5% (5,564 ha) of suitable foraging habitat for known breeding areas, to managing foraging habitat if assuming full occupancy

[1] Personal communication, Darryn McConkey, BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development

of territories on Haida Gwaii. This set of sensitivity analyses also explores managing for a range of habitat thresholds (45%, 55% and 65.5%).

In all scenarios a 'first-recruit' method was used. This method is based upon a foraging capability model that is built with the TSR forest inventory and growth and yield curves to assign an age that each one-hectare cell across Haida Gwaii becomes suitable habitat, based upon Habitat Suitability Index parameters[2]. Suitable habitat is then reserved outside the THLB to meet the foraging habitat area targets per territory. If there is a deficit of suitable habitat outside the THLB, then suitable habitat inside the THLB is reserved. If there is still a deficit of suitable habitats (due to young forest ages) then the model reserves enough area of capable habitat, based on earliest recruitment to suitable habitat, until targets have been met. With the target preference set for habitat outside the THLB then, if these targets are met over time outside the THLB, then those areas previously reserved within the THLB once again become available to harvest. Methods and assumptions are further detailed in section 8.2.4 of the Data Package.

2.7.2.1 Federal foraging target for known breeding areas (22 territories)

This scenario reserves 5,564 hectares (65.5% of a territory) of suitable or, if suitable habitat is not sufficient, capable habitat within the 22 known breeding areas on Haida Gwaii. Preference is set to reserve habitat outside the THLB and where recruitment of capable habitat is necessary, recruiting area that becomes suitable soonest.

	Total	TSA	TFL58	TFL60
Foraging habitat (22 territories)	838,244	445,313	91,406	301,525

There was a 4,537 m^3 or 0.5% decrease from the base case.

2.7.2.2 Federal foraging target for 25 territories

This scenario reserves 5,564 hectares (65.5% of a territory) of suitable or, if sufficient suitable habitat is not available, capable habitat within the 22 known breeding areas on Haida Gwaii and an additional three predicted territories. Choosing which additional three predicted territories are included in the scenarios is based upon a ranking of territories with the highest/most suitable habitat to the lowest/least amount of suitable habitat. Preference is set to reserve habitat outside the THLB and where recruitment of capable habitat is necessary, recruiting area that becomes suitable soonest.

	Total	TSA	TFL58	TFL60
Foraging habitat (25 territories)	832,857	438,113	91,769	302,975

There was a 9,924 m^3 or 1.2% decrease from the base case.

2.7.2.3 Federal foraging target for 38 territories

This scenario reserves 5,564 hectares (65.5% of a territory) of suitable or, if sufficient suitable habitat is not available, capable habitat within the 22 known breeding areas on Haida Gwaii and an additional 16 predicted territories. Choosing which additional 16 predicted territories are included in the scenarios is based upon a ranking of territories with the highest/most suitable habitat to the lowest/least amount of suitable habitat.

[2] Mahon, T., McClaren, E., & Doyle, F. (2015). *Northern Goshawk (Accipiter gentilis laingi) Habitat Models for Coastal British Columbia.* Nanaimo, B.C. : Report for the Habitat Recovery Implementation Group of the Coastal Northern Goshawk Recovery Team

Preference is set to reserve habitat outside the THLB and where recruitment of capable habitat is necessary, recruiting area that becomes suitable soonest.

	Total	TSA	TFL58	TFL60
Foraging habitat (38 territories)	802,043	428,737	84,281	289,025

There was a 40,738 m^3 or 4.8% decrease from the base case.

2.7.2.4 Federal foraging target for full occupancy (67 territories)
This scenario reserves 5,564 hectares (65.5% of a territory) of suitable or, if unavailable, capable habitat within the 22 known breeding areas on Haida Gwaii and an additional 45 predicted territories. Choosing which additional 45 predicted territories are included in the scenarios is based upon a ranking of territories with the highest/most suitable habitat to the lowest/least amount of suitable habitat. Preference is set to reserve habitat outside the THLB and where recruitment of capable habitat is necessary, recruiting area that becomes suitable soonest.

	Total	TSA	TFL58	TFL60
Foraging habitat (67 territories)	689,656	417,187	52,344	220,125

There was a 153,125 m^3 or 18.2% decrease from the base case.

2.7.2.5 Reduced foraging target (55% suitable habitat per territory) for full occupancy
This scenario reserves 4,672 hectares of suitable or, if unavailable, capable habitat within the 22 known breeding areas on Haida Gwaii and an additional 45 predicted territories. This represents a foraging habitat threshold where 55% of each territory has suitable habitat. Choosing which additional 45 predicted territories are included in the scenarios is based upon a ranking of territories with the highest/most suitable habitat to the lowest/least amount of suitable habitat. Preference is set to reserve habitat outside the THLB and where recruitment of capable habitat is necessary, recruiting area that becomes suitable soonest.

	Total	TSA	TFL58	TFL60
55% target (67 territories)	821,094	445,313	91,406	284,375

There was a 21,487 m^3 or 2.6% decrease from the base case.

2.7.2.6 Reduced foraging target (45% suitable habitat per territory) for full occupancy
This scenario reserves 3,823 hectares of suitable or, if unavailable, capable habitat within the 22 known breeding areas on Haida Gwaii and an additional 45 predicted territories. This represents a foraging habitat threshold where 45% of each territory has suitable habitat. Choosing which additional 45 predicted territories are included in the scenarios is based upon a ranking of territories with the highest/most suitable habitat to the lowest/least amount of suitable habitat. Preference is set to reserve habitat outside the THLB and where recruitment of capable habitat is necessary, recruiting area that becomes suitable soonest.

	Total	TSA	TFL58	TFL60
45% target (67 territories)	824,944	442,913	91,406	290,625

There was a 17,837 m^3 or 2.1% decrease from the base case.

2.8 Forest cover constraints

Some management objectives are best modelled for timber supply by placing conditions within areas that must be met prior to an area being logged. Examples of forest cover constraints include: Visual Quality Objectives; Wildlife Habitat Area seral targets; Sensitive watersheds; upland stream areas or Community Watersheds. As detailed through the Data Package, these generally include a minimum amount of area to meet a 'green-up' height requirement (e.g. a minimum stand height) over a prescribed area.

2.8.1 Wetlands not considered 'recovered' forests

The HG LUOO contains provisions for managing Upland Stream Areas whereby 70% of the forests in Upland Stream Areas (watersheds defined by Schedule 6 of the HG LUOO) must be hydrologically recovered. Current practice has been to manage Upland Stream Areas so that wetlands are considered areas that contribute toward hydrologic recovery. There are some uncertainties about the role of coastal wetlands acting as buffers to peak flows and how they should be considered as contributing to hydrological recovery. To address this, a sensitivity was completed so that wetlands were not considered hydrologically recovered, and only the forested area (site index ≥5) contributed towards hydrologic recovery.

	Total	TSA	TFL58	TFL60
Wetlands not recovered	834,281	435,937	92,169	306,175

There was a 8,500m^3 or 1.0% decrease from the base case.

2.8.2 All forest cover constraints disabled

This scenario was primarily conducted in order to test how well the timber supply model accounts for the interaction from forest cover constraints, however there is no intention that the requirements be removed.

	Total	TSA	TFL58	TFL60
No forest cover constraints	930,393	510,937	94,531	324,925

There was a 87,612 m^3 or 10.4% increase from the base case. Results indicate that forest cover constraints do indeed affect timber supply.

2.9 Harvest flow

The Haida Gwaii Management Council has established a preferred approach for timber supply projections that inform the AAC determination are non-declining. This timber supply rule means that the timber supply does not drop below the starting level at any time in the projection but may increase above that level later in the horizon, as long as the increase is sustainable. A sensitivity analysis was completed to explore the implications to the long term when harvesting higher levels in the short term.

2.9.1 Short term uplift

This sensitivity allows a short-term uplift to a maximum level subject to (a) downward steps of not more than 10%/decade and (b) mid-term not less than 100% of maximum even flow. Effectively this analysis looks into whether there is flexibility in the short-term timber supply.

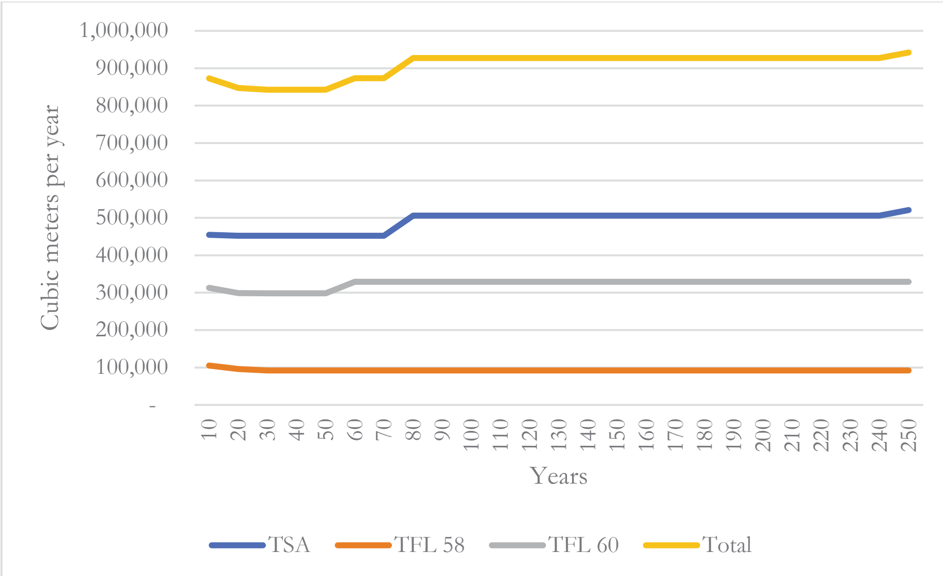

Figure 2.9.1 Long term harvest flow (declining) sensitivity results for all management units.

There was a 30,000 m^3 or 4% increase from the base case for the first decade, before dropping to base case levels by decade 3, suggesting very limited flexibility in the short-term supply.

2.10 Alternate Timber Harvesting Land Base (THLB)

The THLB is defined by regulatory boundaries but also accounts for exclusions of areas that reflect current practice. This current practice may be dictated by individual licencee behaviour that in turn further constrains or increases the actual or realized THLB. The following sets of sensitivity analyses are intended to explore this uncertainty.

2.10.1 Increased Wildlife Tree Retention Areas

The Forest Planning and Practices Regulation (FPPR) requires licencees to establish 7% of the area in cutting permits over a 12-month period as Wildlife Tree Retention Areas (WTRA). During the 5-year period between 2012-2016 that was used as a sample to represent post-LUOO current practice, Taan Forest Products Ltd., BCTS and Husby Forest Products established more WTRA than are required by the FPPR. While much of this retention overlapped with Land Use Objective Order features, a significant amount of WTRA was established that had no other overlaps with other regulated objectives. If this current practice continues within the TSA and TFL60 (including FLTC A87661), then the realized THLB would be smaller by 7.1% and 11.6% respectively. Section 8.2.8 of the Data Package details the analysis and methods used to determine these reductions.

	Total	TSA	TFL58	TFL60
Increased WTRA retention	754,006	398,213	91,769	264,025

There was a 88,774m^3 or 10.5% decrease from the base case under this scenario.

2.10.2 Alternate access to unstable terrain

The contribution of area that is classified as unstable terrain in the THLB was estimated by how often licencees log in either Class 4 or Class 5 terrain relative to logging in areas of stable terrain. This ‘preference ratio’ is detailed in section 6.8 of the Data Package. While the base case reference scenario looked at the last 10 years of licencee behaviour to represent current practice in these areas, a sensitivity analysis was completed to see how often licencees accessed these areas since the 1996 Forest Practices Code came into effect. The last changes in forest policy that affected how unstable terrain is managed came from the 1996 Forest Practices Code.

	Total	TSA	TFL58	TFL60
Increase unstable terrain access	864,331	468,637	92,569	303,125

There was a 21,550m^3 or 2.6% increase from the base case associated with incorporating information from the longer time period.

2.10.3 Land Use Objectives Order risked-managed targets

The HG LUOO contains provisions to risk-manage different objectives contingent upon various conditions (including Inter-Governmental Processes or IGP) being completed. Six years of operational applications from the Solutions Table (2013-2018) were analysed to determine the effect that this may have on timber supply. Table 2.10.3 summarizes these risk-managed applications and the associated increase in the timber harvesting land base.

Table 2.10.3 HGLUOO risk managed applications submitted to the Solutions Table and implemented (2013-2018)

Objective	Description
Removal of monumental cedar >120cm (HGLUOO section 9.4)	8 monumental removed (reserve and management zones) 4 management zones reduced
Reduction of cultural cedar stand management zones (HGLUOO section 9.7/ 9.8)	2 cultural cedar stand management areas reduced
Haida Traditional Forest Feature reserve reduction (HGLUOO section 6.5)	3 management areas of class 1 Haida Traditional Forest Features were reduced
Haida Traditional Heritage Feature reserve reduction (HGLUOO section 5.6)	4 management areas were reduced
Forest reserve reduction or amended (HGLUOO section 23.2/23.3)	39 hectares of forest reserve were amended (moved to other areas- no increase in THLB)
Cedar Stewardship Areas (HGLUOO section 3.2)	3 hectares of CSA were harvested. 1 area reduced to accommodate road building.

Table 2.10.3 represents risk-managed applications that were implemented between 2013-2018, however do not represent the suite of risk-managed opportunities afforded under the HGLUOO. However, in line with timber supply representing current management practices, the results of 6 years of operations amount to approximately 20 hectares of additional THLB available through the risk managed provisions (~3 hectares per year). Given that this is such a small annual increase in THLB (+0.002%) this provision was not modelled, but results reported to the HGMC as a factor consideration in their AAC determination.

2.11 Roads

Roads, including permanent roads, mainlines and branchlines were removed from the THLB for the base case reference scenario. This was based upon the assumption that, while smaller forestry roads (branchlines) may grow trees during a rotation, that their volumes are not considered merchantable.
A sensitivity analysis, detailed in section 8.2.8 of the Data Package, was completed that assumes that branchlines do contribute to timber supply.

2.11.1 Old roads contributing to timber supply

This sensitivity analysis was designed so that branchlines had their own growth and yield table, assuming that roads were established with red alder, at natural (not planted) densities, after a delayed (4 year) regeneration and moderately reduced (-20%) site index.

There was an approximate 3,000m^3 per year or 0.4% increase from the base case.

Appendix 4:
Haida Gwaii Management Council - Timber Supply Review Socio Economic Report (November 2019)

Socio-Economic Analysis in support of the Haida Gwaii Timber Supply Review

Prepared for:

Haida Gwaii Management Council

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1 Executive Summary

1.1 Introduction

Under the authority of Section 3(3) of the *Haida Gwaii Reconciliation Act*, the Haida Gwaii Management Council (HGMC) initiated a Timber Supply Review (TSR) for the Haida Gwaii Management Area (HGMA). The HGMA is defined in Section 1(1) of the *Haida Gwaii Reconciliation Act* as all of Haida Gwaii except for private lands, Indian Reserves (IRs) and municipalities.

The purpose of this socio-economic analysis report within the timber supply review process is to:

- assemble and present recent historical information and data on the Haida Gwaii forest sector, including its position within the overall Haida Gwaii economy; and
- analyze the effects of certain key timber supply related matters on Haida Gwaii current and future social and economic conditions.

This socio-economic analysis is divided into two parts. The first part is a situation analysis that looks at the recent socio-economic experience of the Haida Gwaii forest sector and as such the time period of the past decade 2008-2017 is primarily referenced in this section. The second part of the report examines several key issues that have influenced the socio-economic performance of the Haida Gwaii forest sector and are likely to be important issues going forward as well.

1.2 Situation Analysis

HAIDA GWAII POPULATION

Declining population, -12.8% over the 2006-2016 period

Based on Census of Canada data, the 2016 population of Haida Gwaii was 4,198, a 12.8% decrease over the 2006 population of 4,812, and a 28.0% decrease over the 1996 population. By comparison, the overall population of BC rose by 12.2% over the 2006-2016 period.

The five main communities by population in 2016 are Queen Charlotte (852), Skidegate (Higaagilda) (837), Masset (793), Old Massett (Gaw) (555), and Port Clements (282); these communities account for about 80% of the overall population on Haida Gwaii. The remaining 20% of the population inhabits other areas of Haida Gwaii including the unincorporated communities of Tlell, rural Graham Island, and Sandspit. Skidegate was the only Haida Gwaii community or area that registered a population gain for the 2006-2016 period. The main reason for the Haida Gwaii population decline is that out-migration from the islands has greatly exceeded its in-migration. For the 2006-2016 period, Haida Gwaii had a small natural population increase (i.e. births exceeding deaths).

Almost half of the Haida Gwaii population identifies as Aboriginal/Indigenous

In 2016, an estimated 47.5% of the Haida Gwaii population identified as an Aboriginal/Indigenous person. The Aboriginal/Indigenous population of Haida Gwaii was an estimated 1,915 in 2016, a 1.6 % increase over the 2006 Indigenous population of 1,885. Although demonstrating a positive trend, the Haida Gwaii Indigenous population increase of 1.6% trailed, by a large margin, the 38% increase in the overall BC Aboriginal/Indigenous population during the 2006-2016 period.

HAIDA GWAII LABOUR FORCE

Shrinking labour supply

The islands resident labour force decreased from an estimated 2,830 workers to 2,290 workers over the 2006-2016 period, a decline of 19.1%.[1]

Aging population and labour supply

The median age of the Haida Gwaii population increased from 39.7 years to 45.1 years over the 2006-2016 period, By comparison, the estimated 2006 median age on the islands was similar to that of the province (40.8 years) whereas by 2016, the estimated Haida Gwaii median age (45.0) was higher than the BC median of 43.0 years.

People aged 25 to 54 years old are considered of core working-age because of their strong attachment to the labour market. The estimated number and percentage share of persons residing on Haida Gwaii in the prime working age group of 25 to 54 years declined from 2,217 (45.7%) in 2006 to 1,669 (39.0%) in 2016.

The resident labour forces of each of Haida Gwaii's main economic sectors, forestry, tourism and public services, have contracted

Haida Gwaii's economy is narrowly focused on forestry (mainly logging), tourism (mainly sport fishing, Haida culture and Haida Gwaii ecological experiences) and public services, including elementary and high school education, health care and government administration. The resident labour force in 2016 totalled 2,290 workers, a 19.1% decline from the 2006 total of 2,830. Worker numbers in the tourism and forestry sectors declined over the 2006-2016 period, 9.4% and 10.8%, respectively, but by a lesser amount than in the public services sector and in the overall local economy. Table ES-1 presents Haida Gwaii's labour force numbers and percentage shares by major sector for 2016 and 2006.[2]

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[1] This labour force data is from the Census of Canada and based on "place of residence", i.e. these workers constitute the labour force members who had their usual place of residence (i.e. permanent residence) on Haida Gwaii at the times of Census enumeration.

[2] This labour force data are from the Census of Canada and is based on "place of residence", i.e. the workers who constitute the labour force members who had their usual place of residence (i.e. permanent residence) on Haida Gwaii.

Table ES-1: Haida Gwaii Labour Force, 2016 and 2006[3]

Sector	2016 #	2016 %[4]	2006 #	2006 %	% change 2016 vs 2006
Tourism	387	16.9	427	15.1	-9.4%
Forestry	290	12.7	325	11.5	-10.8%
Public Services	640	27.9	795	28.1	-19.5%
Other Sectors	973	42.5	1,283	45.3	-24.2%
Total	2,290	100	2,830	100	-19.1%

Source: Statistics Canada 2007 and 2017; unpublished runs of Statistics Canada 2006 and 2016 labour force data supplied to BC Stats; and author's calculations

Data challenges in estimating Haida Gwaii economic activity

The preceding table focused on the resident labour force. Both the forestry and tourism sectors on Haida Gwaii have historically utilized non-resident workers who either reside seasonally or long distance commute for periods or one or more weeks to Haida Gwaii. Generally, less data and information are available on this group of workers but a survey conducted for this timber supply review indicates that the on islands resident share of Haida Gwaii forestry employment has risen in recent years. This shift appears to be largely due to the efforts of Haida Gwaii headquartered Taan Forest Products Ltd. (Taan) to utilize Haida Gwaii resident workers and contractors. Fishing resort lodges (an estimated 16 in 2018) have collectively been an important factor in the Haida Gwaii tourism sector since the 1990s but they have relied as a group on a significant number of off islands seasonal and full-time workers. A new study (expected to report in 2019) may show a greater reliance on local workers at these lodges, in part due to Haida Gwaii-headquartered Haida Enterprise Corporation's (HaiCo's) entrance into the fishing lodge sector and its efforts to hire Haida Gwaii resident workers for its lodges.[5]

FACTORS DRIVING HAIDA GWAII TIMBER HARVESTING

The basic economic activity that underpins the overall performance of the Haida Gwaii forestry sector, whether considered on an annual or a decade basis, is local timber harvesting

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3 The labour force question relates to the individual's job held during the week of Sunday, May 1 to Saturday, May 7, 2016. However, if the person did not work during that week but had worked at some time since January 1, 2015, the information relates to the job held longest during that period. Employment at Haida Gwaii resorts is higher in the summer months than in May but the framing of the question captures workers who may not be working in May but who will likely be working in a month or so.

4 The percentage share shown in this table is the percentage or share of the total labour force. In the 2009 BC Stats reports, the percentage or share of only the "basic sector" is shown, i.e. forestry's percentage/share of the basic sector.

5 The Marine Plan Partnership for the North Pacific Coast (MaPP) has a research project underway that is expected to include a survey of Haida Gwaii fishing lodge operators, which will provide an up-to-date estimate of total employment and its characteristics in this key part of the Haida Gwaii tourism sector.

Three factors have had the greatest influence on the timber harvesting performance of the Haida Gwaii forestry sector, two factors on the timber supply side and one factor on the timber demand side.

Demand for wood products in external markets drives Haida Gwaii forest sector economic activities

External market demand for softwoods products (including logs) that matches with the Haida Gwaii log supply profile is a critical factor pushing forward Haida Gwaii forest sector economic activities. Demand conditions in two markets drive the overall commercial harvest on Haida Gwaii Management Area (HGMA) lands. The key longstanding market factor is US housing market demand for cedar wood products and the newer market factor is the demand in China for whitewood logs for input into the manufacture in China of lower value structural wood products, such as cement form materials.

On the supply side, a primary influence on timber harvesting levels has been the regulated Annual Allowable Cuts (AACs) for the Haida Gwaii Management Area (HGMA) and the Haida Gwaii Timber Supply Area (TSA) and Timber Forest Licences (TFLs), which have set the upper limits on the potential total timber harvest in these Haida Gwaii timber harvesting management units. The other very important supply side factor has been the commercially operable volume of Old Growth western redcedar on HGMA lands and on private lands. This factor is directly tied to the cost of timber harvesting and transport on Haida Gwaii.

The intersection of the regulated Haida Gwaii timber supply AACs and the commercially operable western redcedar volumes with the demand for Haida Gwaii timber has driven Haida Gwaii timber harvesting volumes, which has fed through to effects on Haida Gwaii forest sector employment and employment income, log prices, sales revenues and stumpage and goods and services purchasing activity. Shifts in one or more of the three cited key supply and demand factors soon result in distinct economic effects in the Haida Gwaii forest sector and the overall Haida Gwaii economy.

Rising Vancouver Log Market prices reflect strong lumber market demand conditions in the US house building and home renovation markets

Log prices reflect demand conditions for the wood-based end use products that incorporate the logs extracted from coastal BC forests. The annual average price of western redcedar (Old Growth) logs on the Vancouver Log Market (VLM)[6], taking into consideration all log grades, climbed from a low of $101 in 2009 to $233 in 2017, a more than doubling of the

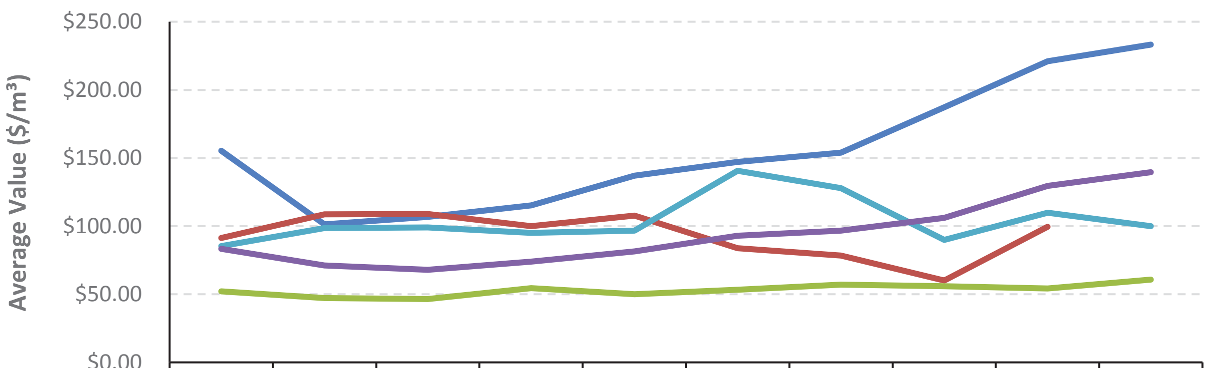
[6] In BC, the functioning log marketplace is organized on a coast-wide basis. Implementation of the BC Government's Forest Revitalization Plan starting in 2003 reinforced this coast-wide marketplace, which facilitates price and quality competition for Haida Gwaii timber along with the timber of other coastal TSAs, TFLs and private lands. Transactions of logs between non-related, Coastal BC-based forest industry parties, such as between a market logger and a wood processing facility, occur within the Vancouver Log Market (VLM), which is a longstanding but informal institution that does not have a centrally organized administrative structure. The selling, buying and trading of logs between entities occurs throughout coastal BC, including Haida Gwaii, but log prices are typically adjusted as necessary to reflect transport costs to the Howe Sound-Fraser River area.

2009 average price when demand conditions in the US housing market were at a low ebb because of the 2008 financial crisis.

Trends in the US housing market are the main factor that feeds back into the demand for Haida Gwaii cedar timber. In BC, about 75% of the province's cedar lumber exports are directed to the US, 95% of its cedar siding exports go to the US and 95% of cedar shake and shingle exports are US-bound (Gregory, McBeath and Filipescu 2018).

Hemlock log prices were largely stagnant over the 2008-2017 and well below Haida Gwaii per m^3 harvest and transport costs. VLM prices for Sitka spruce logs have been relatively strong (taking into consideration all log grades), peaking at about \$140/m^3 in 2013. These log price trends largely reflect conditions in key log and wood product markets and demonstrate that commercial viability of timber harvesting on Haida Gwaii is substantively determined by the amount of cedar and/or spruce in stands. Figure ES-1 shows the recent trend in cedar, spruce and hemlock Old Growth log prices on the VLM.

Figure ES-1: Old Growth Log Average Price by Species (\$/m^3)[7], Vancouver Log Market, 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cedar	$155.28	$101.29	$106.69	$115.23	$137.00	$147.23	$153.91	$187.26	$220.98	$233.21
Cypress	$91.33	$108.65	$108.89	$99.91	$107.64	$83.83	$78.44	$60.07	$99.60	
Hemlock	$52.24	$47.21	$46.49	$54.48	$50.00	$53.38	$57.10	$55.94	$54.28	$60.75
Spruce	$85.35	$98.48	$99.02	$95.02	$96.66	$140.62	$127.95	$89.82	$109.89	$99.94
All	$83.34	$71.19	$67.94	$74.00	$81.50	$92.99	$96.76	$106.01	$129.54	$139.58

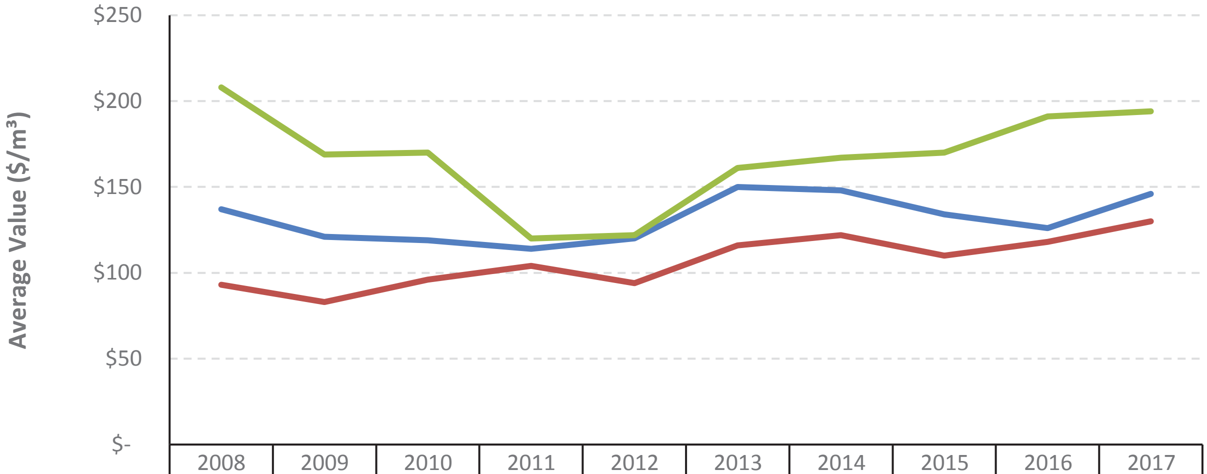
Source: Timber Pricing Branch BC MFLNR 2018 and author's calculations

Export log prices, driven by wood product demand conditions in China (hemlock), Japan (spruce) and the US (western redcedar), have generally exceeded VLM log prices

Figure ES-2 shows the recent trend in and levels of average annual prices of BC export logs by species that are sourced from Haida Gwaii.

[7] All dollar amounts in this report are reported in current Canadian dollars unless otherwise noted.

Figure ES-2: BC Export Log Average Price by Species ($/m^3), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spruce	$137	$121	$119	$114	$120	$150	$148	$134	$126	$146
Hemlock	$93	$83	$96	$104	$94	$116	$122	$110	$118	$130
Cedar	$208	$169	$170	$120	$122	$161	$167	$170	$191	$194

Source: BC Stats and author's calculations

The higher prices in export markets for hemlock and spruce logs than the prices for these species in the Vancouver Log Market have been a key factor in the diversion of an increasing portion of the Haida Gwaii log harvest from domestic markets over to buyers in China, Japan and South Korea.

HAIDA GWAII AACS AND APPORTIONMENT

From an economic perspective, the HGMC determined AAC sets a maximum allowed annual timber harvesting level for HGMA lands

Table ES-3 shows recent AACs for Haida Gwaii management units TSA 25, TFL 58, and TFL 60. The sum of the Haida Gwaii management unit AACs determined in 2012 was 931,000 m^3, a decline of 47.5% from the previous total AAC of 1,772,616 m^3. The four woodlot licences contribute an additional 9,293 m^3 of AAC.

Table ES-3: Recent AACs for Haida Gwaii Management Units (m^3)

Management Unit	AAC determined in 2012 (m^3)	Prior AAC (m^3)	% change in AAC
TSA 25	512,000	869,748	-41.1%
TFL 58	79,000	100,000	-21.0%
TFL 60	340,000	802,868	-57.7%
All Units	931,000	1,772,616	-47.5%

Source: Sutherland 2012

Haida Gwaii based ownership of Haida Gwaii tenures has greatly increased in recent years

Haida Gwaii-headquartered Taan Forest Products Ltd. is the holder of the TFL 60 tenure, which has an AAC of 340,000 m^3 and is predominantly located on Graham Island with smaller portions located on Moresby Island and on Louise Island. Taan completed the acquisition of the TFL 60 tenure (then called TFL 39 Block 6) from Western Forest Products (WFP) in June 2012 (Taan Forest 2016). Taan also holds a non-replaceable forest licence-First Nations (an area based forest licence to cut), which was obtained in 2010, and accounts for TSA 25's second largest volume apportionment with an AAC commitment of 120,000 m^3.[8] In addition, Taan manages. jointly with BCTS. a volume of 14,210 m^3.[9] These Taan controlled volumes account for approximately 50% of the sum of the Haida Gwaii management unit AACs, a total of 474,210 m^3.

Table ES-4 presents the current AAC apportionment and commitments for TSA 25.

Table ES-4: TSA 25 AAC Apportionment and Commitments (m^3 & % of TSA 25 AAC)

Form of Agreement	m^3	% of AAC
Replaceable Forest Licences	213,632	41.7
Husby Forest Products Ltd. (A16869)	192,044	37.5
A&A Trading (Haida Gwaii) Ltd. (A16870)	13,632	2.7
Dawson Harbour Logging Ltd. (A75084)	7,956	1.6
Non-Replaceable Forest Licences	14,210	2.8
BCTS Partnership (Taan Forest Products)	14,210	2.8
Non-Replaceable Forest Licence – First Nations	120,000	23.4
Haida Tenure (Taan Forest Products)	120,000	23.4
BCTS Timber Sale Licence/ Licence to Cut	81,658	15.9
Community Forest Agreement	80,000	15.6
Forest Service Reserve	2,500	0.5
Total Allowable Annual Cut	512,000	100.0

Source: BC MFLNR 2018b

8 This tenure is administered as a forest licence to cut (FLTC). Discussions have been underway between the BC Government and Haida Nation associated parties for the conversion of the Taan held FLTC and TFL 60 into an area-based First Nations Woodland Licence, and the arrangements to establish this new licence are expected to be soon finalized.

9 Joint planning on harvest planning roadbuilding and auctioning.

HGMA TIMBER HARVEST

The average annual harvest of 831,172 m³ over the 5-year 2013-17 period, which coincides with the April 2012 HGMC determination, shows a shortfall of about 10% relative to the HGMA AAC

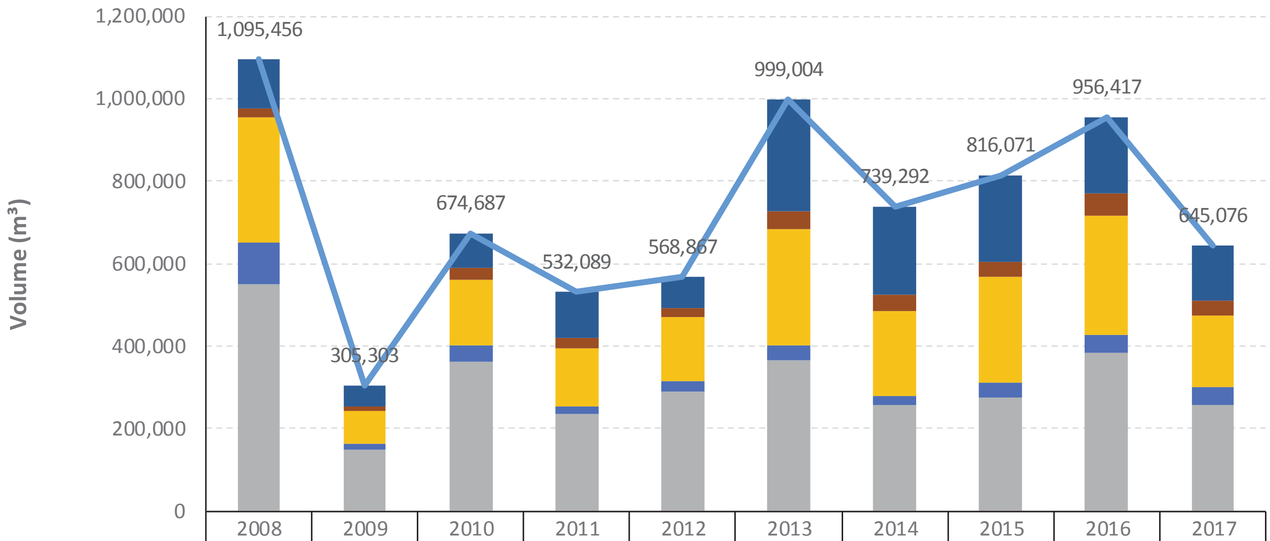
Although the available timber supply for annual harvesting was in the 1.2–1.8 million m^3 range over the 2000–2012 period, the amount of timber harvested by commercial operators and supplied into domestic and international markets fell well short of these levels due to target market demand conditions, cost constraints, and administrative and policy parameters on the Haida Gwaii timber supply side.

The most recent 3-year 2015-17 annual average harvest in the HGMA, 805,854 m^3, exceeded the 10-year 2008-2017 annual average of 733,226 m^3 but was under the 5-year 2013-2017 annual average harvest of 831,172 m^3 because of the harvest volume dip in 2017 to 645,076 m^3.

During the 10-year 2003-2012 period prior to the initial AAC determination of the HGMC, the Haida Gwaii annual timber harvest averaged approximately 780,000 m^3, well below the cumulative total of the then current Haida Gwaii AACs and below the average annual harvest for the 5-year 2013-2017 period.

Over the 2008-2017 decade, the harvest of red and yellow cedar annually averaged approximately 351,000 m^3, accounting for an almost half share (47.8%) of the total HGMA harvest. Over the 5-year 2013-2017 period, the cedar share of the HGMA total harvest was lower (41.4%) compared to the 10-year average share. Historically, stands with substantial percentage shares of Old Growth western redcedar volumes have formed a substantial portion of the commercially operable timber harvesting landbase of Haida Gwaii. This accessible local cedar supply in combination with the strong and large scale demand for cedar logs and cedar wood products in Canadian, US and international markets over the past couple of decades have resulted in attractive prices for cedar logs and wood products and substantial cedar timber harvests on both HGMA lands and Haida Gwaii private lands. Figure ES-3 outlines in a graph and a table the HGMA billed harvest volume by species over the 10-year 2008-17 period.

Figure ES-3: HGMA Timber Harvest Volume by Species (m³), 2008 - 2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spruce	118,455	51,192	85,031	112,329	75,143	270,736	214,499	212,189	187,211	134,050
Other Species	20,394	9,989	29,083	24,286	23,739	44,403	39,024	36,984	51,329	37,436
Hemlock	304,876	79,393	160,100	142,452	153,689	282,740	207,896	255,562	290,507	171,455
Cypress	101,987	16,471	36,380	17,978	25,343	35,601	18,517	34,197	43,522	44,462
Red Cedar	549,744	148,258	364,093	235,045	290,953	365,525	259,356	277,140	383,848	257,673
Total	1,095,456	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations

The percentage shares by species of the HGMA harvest for the 2008-2017 period are presented in Table ES-5.

Table ES-5: HGMA Timber Harvest Share by Species (%), 2008 - 2017

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	10-year average
Red Cedar	50.2%	48.6%	54.0%	44.2%	51.1%	36.6%	35.1%	34.0%	40.1%	39.9%	42.7%
Yellow cedar (Cypress)	9.3%	5.4%	5.4%	3.4%	4.5%	3.6%	2.5%	4.2%	4.6%	6.9%	5.1%
Hemlock	27.8%	26.0%	23.7%	26.8%	27.0%	28.3%	28.1%	31.3%	30.4%	26.6%	27.9%
Spruce	10.8%	16.8%	12.6%	21.1%	13.2%	27.1%	29.0%	26.0%	19.6%	20.8%	19.9%
Other	1.9%	3.3%	4.3%	4.6%	4.2%	4.4%	5.3%	4.5%	5.4%	5.8%	4.3%

Source: Harvest Billing System 2018 and author's calculations

LOG EXPORTS

As throughout coastal BC, the log export volume from Haida Gwaii has increased markedly over the past decade

The volume and share of the timber harvest on HGMA lands that was exported climbed from 61,552 m³ and a 9.1% share of the HGMA lands harvest in 2010 to 267,873 m³ and a

41.5% share in 2017. Lower value whitewood species accounted for the vast majority of coastal BC export logs because the Government of BC limits the award of export permits for cedar logs to ceremonial or religious uses (incorporation into construction of a religious temple for example). No red or yellow cedar logs harvested on HGMA lands over the 2010-2017 period were given a Government of BC export permit; the HGMA lands harvest that was exported was comprised of whitewood logs.

From the supply side, the main factor influencing Haida Gwaii log exports has been the BC Government order-in-council (OIC) that effectively allows for exporting of Haida Gwaii whitewood logs harvested on BC public lands and BC private lands in any current year equivalent to 35% of the prior year's total harvest volume (excluding waste volumes) from these BC lands. This OIC came into force in 2010 and is part of the longstanding log export regulation systems at the federal and BC government levels.

Another supply side factor was the sale of the private lands portion of TFL 39 Block 6, approximately 10,000 ha, in 2004 by WFP to BC Investment Management Corporation.

FORESTRY RESIDUES

To date, commercially viable market opportunities for Haida Gwaii logging and wood processing residues have proven to be limited but residue utilization initiatives for Haida Gwaii are in the planning stages

Avoidable logging wastes associated with HGMA harvests accounted for about 960,000 m^3 of fibre over the 2008-2017 decade, an annual average of about 96,000 m^3 and 13% of the Haida Gwaii TSA and TFL harvests (HBS 2018 and author's calculations).[10] The Haida Gwaii level of residues is less than the 19% level of avoidable wastes for the overall coastal BC region. Several small Haida Gwaii forestry enterprises have salvage harvest agreements with major tenure holders and/or access small scale salvage licences (for example: Tree Surgeon, Watchman, North Pacific Timber, Maximum Cedar, Against the Grain and Silva).

Plenty of local interest and determination has been shown in recent years to improve Haida Gwaii forestry residues utilization and new efforts have been discussed and a few moved to the planning level.

- A 2012 renewable energy REOFI process for Haida Gwaii was terminated by BC Hydro but HaiCo subsequently submitted biomass fueled generation proposals to BC Hydro
- Taan/HaiCo has conducted business planning for a Haida Gwaii wood processing facility that would incorporate a biomass fueled cogeneration unit
- A fibre recovery tenure on Haida Gwaii was awarded but has not been utilized to date

[10] Avoidable waste volumes are counted as harvest volume against licensee AACs.

- Two small community biomass fueled energy systems on Haida Gwaii currently use externally sourced wood pellets
- A wood fibre briquette making plant at Masset was opened in 2015 but shuttered soon thereafter
- Directing hemlock from Haida Gwaii to southwest BC pulp mills presents cost challenges but pulp log prices are increasing due to sawmill residue constraints in the BC Interior
- Saltwater constraints are generally present for use of coastal log residues in the manufacture of pellets

FOREST SECTOR EMPLOYMENT TRENDS

Both timber harvesting and wood processing employment of Haida Gwaii residents declined since the early 2000s

Estimated Haida Gwaii timber harvesting employment, based on surveys of Haida Gwaii industry participants, shows a decline in the 2015-17 period over the 2002-04 period due to a lower average harvest, greater log export volume and higher logging productivity in the more recent period. Haida Gwaii residents had a higher share of Haida Gwaii direct harvesting employment however in the more recent 2015-17 period, an estimated 81% vs 60% in 2002-04. Table ES-6 compares average annual Haida Gwaii harvests, harvesting employment co-efficients, and harvesting employment for these two time periods.

Table ES-6: Haida Gwaii Timber Harvesting Employment Metrics, 2015-2017 and 2002-2004

Metric	2015-2017	2002-2004
Average annual harvest (m^3)	805,854	1,037,193
Haida Gwaii employment co-efficient (PYs/'000 m^3 of harvested timber)	0.335	0.337
BC employment co-efficient (PYs/'000 m^3 of harvested timber)	0.414	0.557
Haida Gwaii employment (PYs) [11]	270	349
BC employment (PYs)	392	578

Source: survey of HGMA tenure holders, BC MFLNR 2018; Pierce and Lefebvre Consulting 2005; and author's calculations

Timber processing activity and associated employment has historically been relatively low on Haida Gwaii and dropped in recent years

The estimated total amount of Haida Gwaii timber that was processed on the islands was small (5%) in 2002-2004 by comparison to the Haida Gwaii volume processed elsewhere. In the 2015-2017 period, the portion of the Haida Gwaii harvest annually processed on the islands was yet smaller, an estimated 0.6%. The main factor in the further reduction of wood

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[11] Employment is stated in person-years (PYs), which is defined as one person working the equivalent of one full year, which is defined as 180 days of work. A person working for 90 days accounts for 0.5 PYs. Full-time equivalents (FTEs) is a term that is used inter-changeably with PYs.

processing activity and associated employment on Haida Gwaii is the combination of adverse operational and financial challenges faced by Haida Gwaii Forest Products (formerly Abfam), which has a small sawmill in Port Clements. This facility was shuttered in 2017 but discussions have taken place between the owners and potential investors about renovating and re-opening this Port Clements mill.

The portion of the Haida Gwaii harvest processed in BC and controlled by Haida Gwaii focused operations did increase significantly, however, due mainly to Taan's establishment of a custom cut program, which was an addition to the well-established custom cut programs of O'Brien & Fuerst and Husby Forest Products Ltd.[12] The custom cut programs of these Haida Gwaii focused harvesting operators accounted for the majority of the Haida Gwaii logs that stayed in BC for processing (and supported associated mill employment in southwest BC).

During the 2015-2017 period, the annual average direct employment on Haida Gwaii based on harvesting and processing HGMA timber was an estimated 285 PYs, and the majority of this direct employment, 270 PYs (95%), was in harvesting activities including log transport

In terms of total employment on Haida Gwaii, which also includes an estimate of the employment supported by forestry firms purchasing goods and services and the employment supported by forest sector connected households locally buying goods and services, the average annual employment impact of the local forest sector on Haida Gwaii was an estimated 414 PYs during the 2015-2017 period.

The employment effects connected to harvesting and processing Haida Gwaii timber more than double when they are considered on a province-wide basis

During the 2015-2017 period, the estimated annual average direct employment in the province based on harvesting and processing HGMA timber was 622 PYs and the total employment effect was an estimated annual average of 1,244 PYs. Although Haida Gwaii resident workers accounted for the largest share of harvesting direct employment (81%), on islands workers held less than half of the total (harvesting and processing) direct employment (43%) because of the small amount of wood processing activity on Haida Gwaii.

HAIDA GWAII TIMBER HARVESTING OPERATING COSTS

Haida Gwaii is a high cost logging location competing in a global market

The higher Haida Gwaii harvesting and transport costs are due to the difficult terrain in certain Haida Gwaii harvesting locations, the cost of barging logs from Haida Gwaii to

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[12] Custom cutting programs on coastal BC are based on market logging or log trading operations renting capacity and services at southwest BC sawmills in order to process their harvested logs (mainly cedar logs), to sell the resulting lumber products to wholesalers and retailers in Canada, the U.S. and internationally and to gain a financial return on the sale of wood products manufactured from their harvested logs. Custom cut programs are an alternative to owning and operating wood processing facilities.

Lower Mainland and Vancouver Island timber processing facilities, EBM requirements associated with on islands timber harvesting and use of the FSC certification system (by Taan).

A wide range of logging costs is evident on Haida Gwaii but harvesting of Old Growth timber versus 2nd Growth timber and their associated terrain characteristics is the main point of on islands cost differentiation in recent years and will remain so over the next couple of decades. In the researched examples, helicopter logging is the most expensive ($172/m^3$), followed by cable logging of Old Growth timber ($96/m^3$). Mechanized falling and yarding of 2nd Growth timber presents as the lowest cost harvesting system on Haida Gwaii ($79/m^3$).[13*]

1.3 Key Issues Going Forward

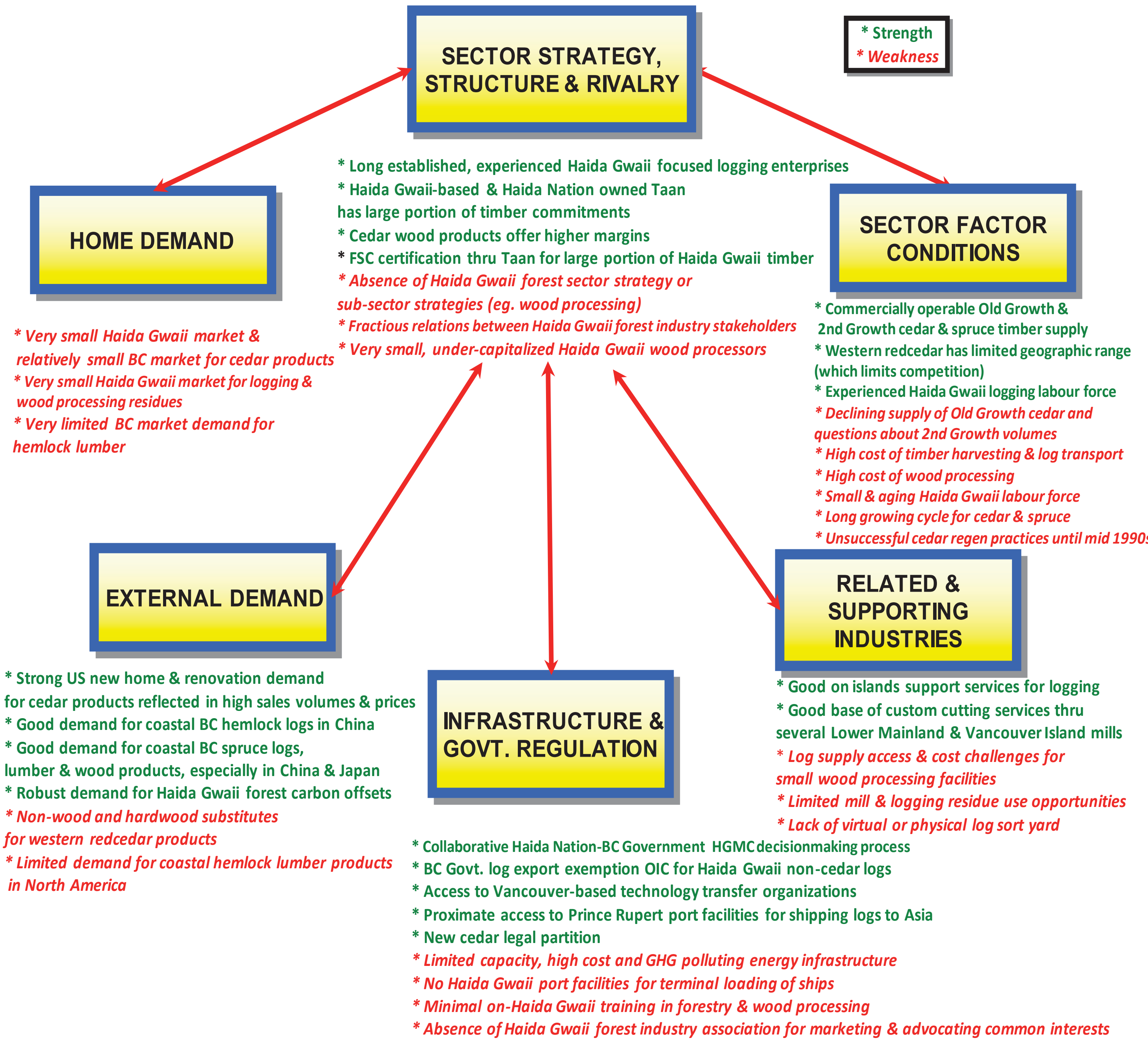
The RFP for this socio-economic report included a Part II in which six questions were framed around issues that look forward at potential effects on the Haida Gwaii forest sector or potential effects of the local forest sector on Haida Gwaii communities and peoples. The six questions were as follows.

- [What is the] Role of cedar as an ongoing economic mainstay (i.e., sustainable supply of economic cedar)?
- What elements of community stability are dependent on timber supply?
- What contribution does wood provide to local versus regional/provincial markets?
- What are the variables and thresholds for second growth forests being economically viable?
- What are the barriers or enablers of fibre flow to local producers? Which barriers have the largest impact on the health of the islands economy?
- What is required (levels of harvest) to provide a security of investment for operators?

Figure ES-1 summarizes the Haida Gwaii forest sector situation analysis and sets much of the context for this review "going forward" issues.

[13] The shown costs are representative estimates and are not average costs based upon a survey of costs of harvesting a sample of Haida Gwaii timber stands. Cost estimates include layout/planning, road construction, felling, skidding/yarding, processing, trucking, and barging, sorting, scaling, and log storage. In general, timber harvesting costs on Haida Gwaii vary by terrain, equipment used, timber types, past development, and geographic location (which affects travel time, difficulty of access, and camp requirements).

Figure ES-1: Summary of strengths and weaknesses of Haida Gwaii Forest Sector

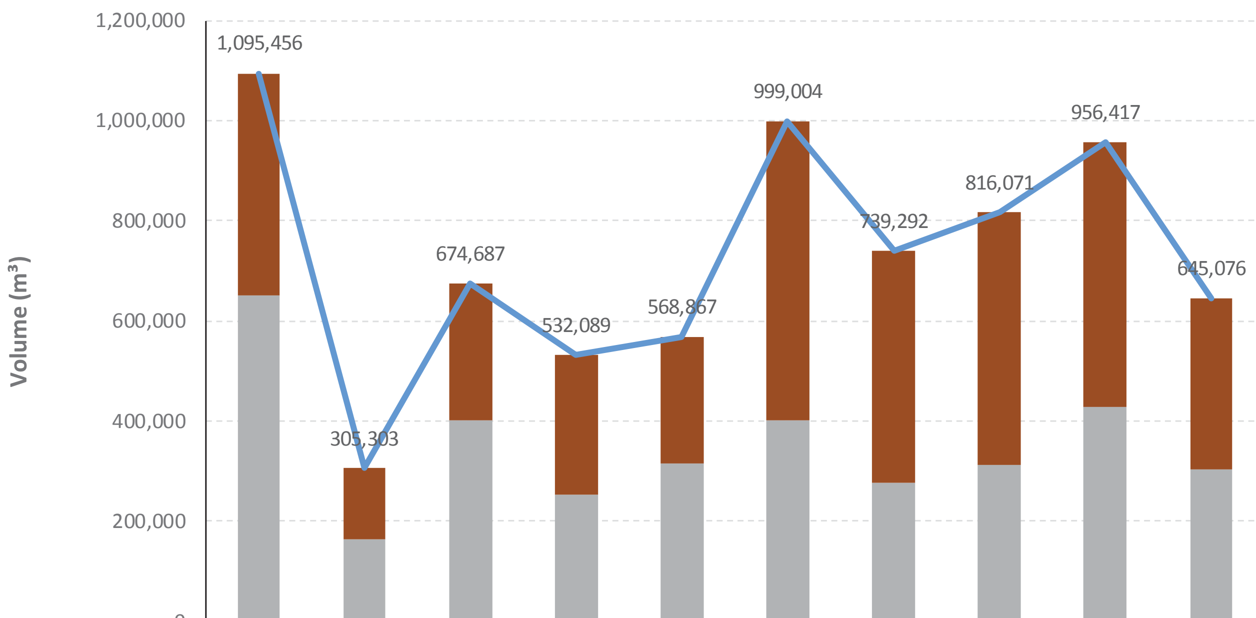


ROLE OF CEDAR

Harvesting cedar has been the "straw that stirs the drink" for the Haida Gwaii forest sector since the mid-1990s. The limited global supplies of western redcedar and yellow cedar are manufactured into specialty or niche products sought by buyers who appreciate cedar's structural, visual and durability qualities. Cedar timber's manufacture into consumer-oriented products is a key distinguishing feature from other coastal BC softwood species that are primarily used for internal (not visible) structural purposes. A question in the RFP for this socio-economic project was [What is the] role of cedar as an ongoing economic mainstay (i.e. sustainable supply of economic cedar)?

The annual average cedar harvest on HGMA lands over the 10-year 2008-2017 period was approximately 351,000 m^3, approximately 48% of the annual average total harvest. Cedar's share of the HGMA harvest ranged from approximately 38% to 60% over this decade. The annual average for the 5-year 2013-2017 period was slightly lower, about 344,000 m^3. Figure ES-4 summarizes the harvest of cedar versus the harvest of other species on Haida Gwaii over the 2008-2017 decade.

Figure ES-4: HGMA cedar harvest versus harvest of other species (m^3), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Other Species	443,725	140,574	274,215	279,066	252,571	597,878	461,419	504,735	529,047	342,941
Cedar	651,731	164,729	400,472	253,023	316,296	401,125	277,873	311,336	427,370	302,135
Total	1,095,456	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations

In a weak or limited whitewoods export log situation, cedar largely carries the commercial operability of logging in TSA 25 and TFL 60. A substantive decrease in the prices for cedar logs and/or the available supply for commercial harvesting would deeply challenge the financial viability of timber harvesting on Haida Gwaii due to the the relatively high cost of harvesting on and transport from Haida Gwaii.

The Technical Working Group for the current timber supply review has put forward an analysis base case timber supply projection that incorporates applicable forest management rules for the HGMA, including the Haida Gwaii LUOO, and a non-declining timber supply flow over a 400 year projection period. The analysis base case annual timber supply for the HGMA is 842,781 m^3 until the 10^{th} decade whereupon the annual timber supply is projected to increase to 926,000 m^3 and remains at that level in subsequent decades.

This HGMA base case projection incorporated a declining flow timber supply projection for cedar, the target starting point of which was the maximum cedar harvest level from the previous chief forester AAC determinations. The annual timber supply volume of cedar in the base case starts (in the 1st decade) at 277,000 m^3, steeply declines to an annual volume of 122,000 m^3 by the 4th decade and then increases and stabilizes to approximately 176,000 m^3 by the 8th decade.[14]

The base case annual cedar volume projection starts slightly lower than the average annual cedar harvest (for the 2008-2017 period) of approximately 351,000 m^3 and lower than the sum of the maximum cedar harvest levels expressed by the chief forester of 360,000 m^3. Within 30 years, the base case annual cedar volume projection shows a cedar harvest level of about 147,000 m^3, which would be almost the same harvest as that experienced in only one year, 2009, in the past 10. This level would likely be in place for about 10 years, and then drop further yet.

These projections (notably the projected steep declines in cedar volumes and increasing share of hemlock in the HGMA timber supply in the next few decades) and the anticipated increase in market values per m^3 due to the shrinking supply of Old Growth Coastal BC timber indicate that policy and administrative approaches for the management of cedar timber supply over time will be an important consideration for the HGMC and the Chief Forester in HGMA related AAC determinations now and well into the future. At a high level, the current and near term timber stock and supply situation of TFL 58 provides a glimpse into the timber stock and supply situation in 30 years of the other Haida Gwaii management units. Relative to TSA 25 and TFL 60, TFL 58 currently has a lower share of cedar and a higher share of managed stands in its timber stock and supply.

[14] If a long run average yield (LRAY) approach was taken to projecting cedar timber supply in the HGMA base case then the cedar volume projection would be an average 146,371 m^3 (Technical Working Group 2019). (Technical Working Group 2019).

COMMUNITY STABILITY AND TIMBER SUPPLY

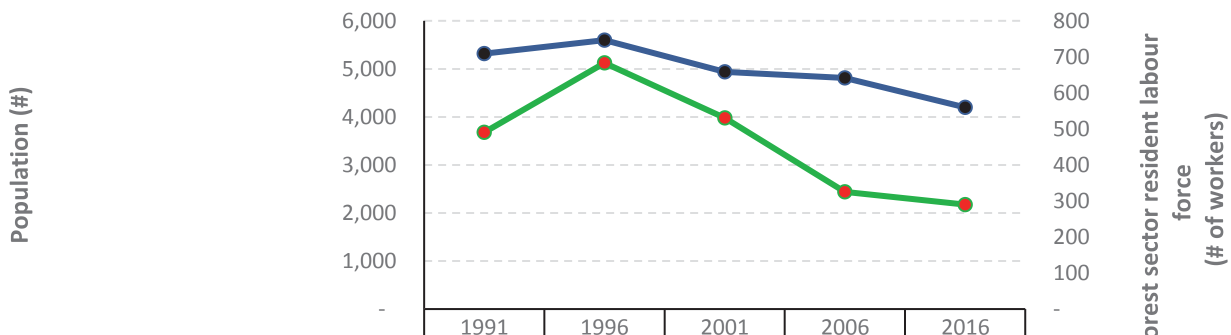
A question in the RFP for this socio-economic project was "What elements of community stability are dependent on timber supply?"

The forest sector employees residing on the islands create both a demand for public services in health, municipal infrastructure, schools and recreation but also contribute to a residential tax base and a critical mass or base of residents who can support the public services of small organized communities. These forest worker households also contribute to creating a customer and client base sufficient to support a small but reasonably broad range of retail and professional services, food and beverage businesses and even public services, such as public schools, spread across the Haida Gwaii communities.

Forest sector related employment is the main pathway through which the forest sector has direct effects on community stability on Haida Gwaii. As forest sector employment contracts some affected individuals and families permanently leave Haida Gwaii to seek or accept new employment resulting in local population decline and shrinkage in the residential tax base and fewer residents to support on islands community activities and to patronize local retailers and public services, such as schools.

Figure ES-5 shows the direct correlation between Haida Gwaii's population levels and the number of local workers employed in the Haida Gwaii forest sector. Both Haida Gwaii's population and the Haida Gwaii forest sector have declined for the shown years since 1996. The decrease in population has not been as sharp in percentage terms as for the forest sector labour force because a portion of the terminated forest sector workers either retire or switch to work in another sector on Haida Gwaii rather than move elsewhere.

Figure ES-5: Trend Comparison of Haida Population and Forest Sector Resident Labour Force by Census Year



	1991	1996	2001	2006	2016
Population (by Census Year)	5,316	5,598	4,935	4,812	4,198
Forest sector resident labour force	490	683	530	325	290

Source: Census of Canada

CONTRIBUTIONS OF HAIDA GWAII WOOD TO HAIDA GWAII, BC AND INTERNATIONAL MARKETS

From a wood products market perspective, the Haida Gwaii situation is consistent and in accord, in a broad sense, with other areas of BC in that the vast majority of Haida Gwaii timber fibre is ultimately sold into international markets. The local Haida Gwaii demand for wood products, especially cedar products, is vibrant in that wood is the focus of local structural and exterior building materials, but the local marketplace is nevertheless very small. In the case of Haida Gwaii, the vast majority of its timber is sold either as cedar lumber products into the US or as whitewood logs into China and a few other Asian countries.

A question in the RFP for this socio-economic project was "What contribution does wood provide to local versus regional/provincial markets?"

A distinct characteristic of the Haida Gwaii situation is that very little Haida Gwaii timber is milled on Haida Gwaii into wood products but a large portion of the processing of Haida Gwaii timber is controlled by Haida Gwaii focused enterprises. Both Husby and O'Brien & Fuerst have long had established custom cutting programs whereby they have maintained control of the processing and marketing of their Haida Gwaii timber through rental of capacity at Lower Mainland mills and log trades. Taan, which now controls the largest share of the HGMA AACs (approximately 50%), has created a custom cutting program using Lower Mainland sawmills over the past few years. The volume and share of the Haida Gwaii timber harvest that is directed through the custom cut programs of Husby, O'Brien & Fuerst and Taan varies on a year to year basis due to several supply and demand factors, including the proportion of cedar in the total harvest, but in broad terms, the HGMA lands harvest share processed in Lower Mainland mills through the custom cut programs of these three enterprises amounts to about 40% in the past few years.

From the supply side, the main factor influencing Haida Gwaii log exports has been the 2010 BC Government order-in-council (OIC) that effectively allows for exporting of Haida Gwaii whitewood logs harvested on BC Crown lands and BC private lands in any current year equivalent to 35% of the prior year's total harvest volume (excluding waste volumes) from these BC lands.

Since the 2010 introduction of the Haida Gwaii exemption order, whitewood log exports from Haida Gwaii to Asian destinations have greatly increased, driven by the considerable gap in whitewood log prices between offshore and Coastal BC markets, and here the Haida Gwaii logs are processed into, mainly, structural lumber products. All current parties holding major Haida Gwaii tenures are whitewood log exporters. In January 2019, the BC Government extended the Haida Gwaii log export OIC but only until July 31, 2019 and communicated that a plan or strategy to address BC log export policy and TSL bidding is forthcoming. An elimination of this Haida Gwaii OIC would not change log demand conditions in Chinese, South Korean and Japanese markets but would negatively alter the commercial viability of harvesting stands on Haida Gwaii with low cedar and/or spruce components. The matter of log exports and Coastal BC log processing is exceedingly complex and its dimensions and characteristics vary along the BC Coast. Definitive conclusions aren't yet possible about potential effects to the Haida Gwaii forest sector since the contents of the BC Government's log export policy changes are not known at this juncture but the Haida Gwaii case should be looked upon as highly sensitive to alterations in the current OIC given the relatively high cost structure of harvesting and transport of Haida Gwaii timber.

SECOND GROWTH FORESTS ECONOMIC VIABILITY

Second Growth timber on Haida Gwaii presents different challenges for the local forest sector on both cost and revenue sides of the financial ledger. A question in the RFP for the socio-economic project focused on Second Growth forests, "What are the variables and thresholds for second growth forests being economically viable?"

Considerable experience has already developed on Haida Gwaii with both harvesting and marketing Second Growth forests. Within an overall coastal BC context, the BC Government and forest industry organizations, such as FPInnovations, have led research and policy-making on challenges, opportunities and strategies to understand and address the shift from harvesting and processing Old Growth timber to Second Growth timber throughout the BC Coast.[15]

On the cost side, in general, harvesting Second Growth stands presents cost advantages. Based on Haida Gwaii examples, the harvest and transport cost for a Second Growth focused logging system is estimated as approximately \$79/m^3, which is about 80% of the estimated \$96/m^3 cost for an Old Growth focused harvesting system. Specific stands will vary in their costs based on stand volume, terrain, location proximity to a forest road, etc. but this comparison conveys the relative cost advantage presented by harvesting Haida Gwaii Second Growth stands.

The lower per m^3 harvesting cost would largely be captured at the expense of employment as more mechanized harvesting and less road and bridge development would reduce labour requirements. A transition to more mechanized harvesting also reinforces a movement towards larger development volumes to spread out the new overhead capital costs.

On the other side of the ledger, Second Growth cedar logs capture a lower price in the Vancouver Log Market than Old Growth cedar logs. Using 2015-2017 average log prices for comparison purposes, Second Growth logs captured a price in the Vancouver Log Market that was about 82% of the recent average prices for Old Growth cedar logs.

We focus here on log costs and prices but milling cost, lumber recovery rates and wood products (including types that can be manufactured, product quality and wholesale and retail price) vary by use of Second Growth and Old Growth logs as the fibre input. A thorough understanding of many of these Second Growth cedar lumber product issues is an important matter needing additional research and development. FP Innovations undertook a couple of short research exercises on a few Second Growth cedar lumber product issues and the researchers concluded that additional research is needed, "A comprehensive research task

[15] The "BC Coastal Forest Sector Hem-Fir Initiative" is possibly the most well-known effort, see http://www.bccoastalinitiative.ca/index.html. This program included a "Coastal Cedar Focus".

force approach is recommended to provide definitive answers to questions and contradictions obscuring a clear understanding of the properties and potential of second-growth redcedar. The task force should be similar to those undertaken on the coast for Douglas-fir and western hemlock." (Middelton and Munro 2013).

TIMBER FLOW TO LOCAL PRODUCERS

A longstanding concern on Haida Gwaii, but also a general concern in several other areas of the province, has been the challenges that small- and medium-sized mills face in acquiring timber to process into wood products. For example, a Canadian Forest Service study issued in 2000 observed that "The key hurdle identified by local QCI manufacturers is a lack of consistent fibre supply. This is the message repeated in virtually all of the reports done on the QCI forest sector. Local processors contend that if wood supply problems could be resolved, they could cope with other challenges…" (Wilson and Stennes 2000). Fibre supply access challenges for micro and small mills are still very much a top of mind issue based on the interviews with small scale Haida Gwaii forestry enterprises undertaken for this project. A question that was raised in the RFP for this socio-economic study was as follows, "What are the barriers or enablers of fibre flow to local producers? Which barriers have the largest impact on the health of the islands economy?"

The barriers of fibre flow to local wood processors that were identified in the interviews conducted for this socio-economic project were the following.

- Market-based log pricing asked by licensees.
- Payment conditions for acquiring logs from licensees.
- Absence of secure, long-term fibre access arrangements for small scale processors.
- Lack of BCTS Category 2 program auctions on Haida Gwaii for local enterprises with micro- or small-scale wood processing operations.
- Financial challenges of Haida Gwaii small scale wood processors to successfully compete in BCTS TSL and Category 2 program auctions.
- No Haida Gwaii log sort operation to direct fibre to local processors along the lines of the monumental cedar log sort operated by the Ministry.
- No organized notification of available fibre via a website or other means.

The matter of access and cost of fibre for Haida Gwaii wood processors was also raised in the 2015 [Haida Gwaii] Forestry Strategy Forum and its background discussion paper, which also pointed out a few other matters that also have substantial effects for the competitiveness of small scale wood processing on Haida Gwaii, "The lack of a stable, vibrant manufacturing sector is usually attributed to the lack of long-term availability of a supply of high quality logs, the inability to secure capital and lines of credit, the small local market, the lack of a stable trained work force, energy and waste issues, and the lack of information about, and access to, off-island markets." (Moore Resource Management 2015a).

At a minimum, the log availability issue could be quickly addressed in part by using current (and fairly modest) website capabilities to set up a "virtual log sort yard" for Haida Gwaii. On a longer term basis, consideration ought to be given to developing a Haida Gwaii strategy focused on log supply to local micro mills and small wood processors.

TIMBER HARVEST NEEDS FOR FINANCIAL SUSTAINABILITY

A question was posed in this project's RFP about the level of annual average timber harvest in relation to investment security, "What are required (levels of harvest) to provide a security of investment for [harvest] operators?". This question is often discussed throughout the BC forest industry because of the substantial capital and workforce investments that are required to sustain operations over a time period in which investments can be recouped along with a suitable profit in line with the financial risk assumed by the enterprises.

In terms of the level of annual harvest that would be desirable to financially sustain a market logging enterprise on Haida Gwaii, the responses from Haida Gwaii forest sector participants who were interviewed varied between an annual average of 75,000 m^3 and 100,000 m^3. Location of harvesting, specifically terrain conditions, and stand species and age composition, would be important influencers on the amount of desirable operable volume in the Haida Gwaii context but this 75-100,000 m^3 range is a good basis for consideration of the average annual volume that's needed to sustain a viable market logging enterprise over the long term.

2 Introduction

2.1 Project Purpose

Under the authority of Section 3(3) of the *Haida Gwaii Reconciliation Act*, the Haida Gwaii Management Council (HGMC) has initiated a Timber Supply Review (TSR) for the Haida Gwaii Management Area (HGMA). The HGMA is defined in Section 1(1) of the *Haida Gwaii Reconciliation Act* as all of Haida Gwaii except for private lands, Indian Reserves (IRs) and municipalities. The objectives of this TSR are to:

- examine the impact of current legal requirements and demonstrated forest management practices on the timber supply, economy, environment and social conditions of Haida Gwaii and the province of BC;
- consider that the new update forest inventory and information about cedar harvest
- receive input from Haida citizens, forest licensees, other forest sector participants and the greater public on timber supply related matters;
- support the deliberations of the Haida Nation and BC Government members of the HGMC in their determination of an AAC for the HGMA: and
- identify information to be improved for and possibly incorporated into future timber supply reviews.

The purpose of this report within the timber supply review process is to:

- assemble and present recent historical information and data on the Haida Gwaii forest sector, including its position within the overall Haida Gwaii economy; and
- analyze the effects of certain key timber supply related matters on Haida Gwaii current and future social and economic conditions.

This socio-economic analysis is divided into two parts. The first part looks at the recent socio-economic experience of the Haida Gwaii forest sector and as such the time period of the past 2008-2017 decade is primarily referenced in this section. The second part of the report examines several key issues that have influenced the socio-economic performance of the Haida Gwaii forest sector and are likely to be important issues looking forward as well. These key issues were listed in the request for proposals for this project issued by the Haida Gwaii Management Council and are as follows.

- Role of cedar as an ongoing economic mainstay (i.e., sustainable supply of economic cedar)
- What elements of community stability are dependent on timber supply?

- What contribution does wood provide to local versus regional/provincial markets?
- What are the variables and thresholds for second growth forests being economically viable?
- What are the barriers or enablers of fibre flow to local producers? Which barriers have the largest impact on the health of the islands economy?
- What is required (levels of harvest) to provide a security of investment for operators?

This socio-economic report is the first one undertaken in connection with a timber supply review process in support of a HGMC determination of the Haida Gwaii Management Area AAC. The HGMC determined an initial AAC for the HGMA of 929,000 m^3, which became effective April 4, 2012 (HGMC 2012). A comprehensive socio-economic research report was not prepared as part of the 2011-2012 timber supply review although the HGMC released a public discussion paper that included basic socio-economic profile information and data along with a summary of a technical analysis of the then current timber supply (Haida Gwaii Management Council 2011). As well, a socio-economic report was not prepared as a background document as part of the analysis process in support of the Chief Forester's September 20, 2012 rationale for and determination of AACs for Timber Supply Area 25, Timber Forest Licence 58 and Timber Forest Licence 60.

Neither the *Haida Gwaii Reconciliation Act* nor the *Forest Act* provide factors that the HGMC should take into consideration in determining the HGMA AAC but the HGMC in its April 2012 AAC rationale outlined that "…the procedure used by recent chief foresters of identifying and considering specific individual factors that are relevant in defining timber supply provides a sound basis for determining a reliable AAC" (HGMC 2012). Section 8 of the *Forest Act* requires the Chief Forester to consider several factors[16] in determining AACs for timber supply areas (TSAs) and Tree Farm Licences (TFLs), which includes reference to social and economic conditions. In addition, a July 4, 2006 letter from the Minister of Forests and Range to the Chief Forester outlined the social and economic objectives of the Crown that the Chief Forester should incorporate into decisionmaking about AAC determinations (Sutherland 2012).

The most recent socio-economic analysis in connection with a Haida Gwaii timber supply analysis process was completed in 2006 when the BC Government's Integrated Land Management Bureau commissioned a socio-economic assessment of land use scenarios to help provide an understanding of potential impacts of proposed agreements and alternate viewpoints resulting from the Haida Gwaii/Queen Charlotte Islands Community Planning Forum process and the January 2006 Haida Gwaii/Queen Charlotte Islands Land Use Plan

[16] The rate of timber production that may be sustained in the area under study; the short and long term implications to British Columbia of alternative rates of timber harvesting from the area; the economic and social objectives of the BC Government for the area, for the general region and for BC; and abnormal infestations and devastations (such as major wildfires) of and major salvage programs planned for the area under study.

Recommendations Report (Pierce Lefebvre Consulting 2006). A couple of years earlier, a socio-economic "base case", which described the Haida Gwaii forest sector, was prepared by a BC Government commissioned consultant as a background document in support of the then underway Haida Gwaii/Queen Charlotte Islands Land Use Plan process (Holman 2004).[17]

Information from this 2019 socio-economic report will be used by the HGMC to help inform its deliberations on determining a new AAC for the HGMA and to help inform the Haida Nation, forest licensees, BC Government staff and the general public during and after the public discussion period of the Haida Gwaii timber supply review process on socio-economic matters connected to timber harvesting and processing on Haida Gwaii.

2.2 Study Approach and Methodology

This report draws upon past practices in BC for preparing socio-economic impact assessments of land use planning processes (BC Ministry of Agriculture and Lands 2007; Horne 2007).

In broad terms, the information for this report was developed from two groups of sources; one is secondary source material consisting of print materials and internet sourced documents, and the second is primary research undertaken (1) through an email-based survey of major Haida Gwaii forest sector operators and (2) via phone and in-person interviews with several Haida Gwaii forest sector stakeholders. In addition, several parties with expertise about BC and international forest sector matters were contacted to provide information on Coastal BC log and wood product markets, logging systems, timber harvesting and log transport costs and forest sector regulation.

Reports and studies with information on Haida Gwaii forest sector matters were accessed and reviewed as part of this project's research process, including but not limited to the following.

- Cortex Consultants and HiMark Forest Consultants Ltd., Second-Growth Timber Opportunities on Haida Gwaii, June 2004
- Council of the Haida Nation, How forestry works on Haida Gwaii, March 2017
- Ecora Resource Group Ltd., Haida Gwaii TSA Economic Operability Assessment, 2015
- Gowgaia Institute, Forest Economy Trends and Economic Conditions on Haida Gwaii, 2007
- Haida Gwaii Management Council, AAC Rationale for Haida Gwaii, April 2012

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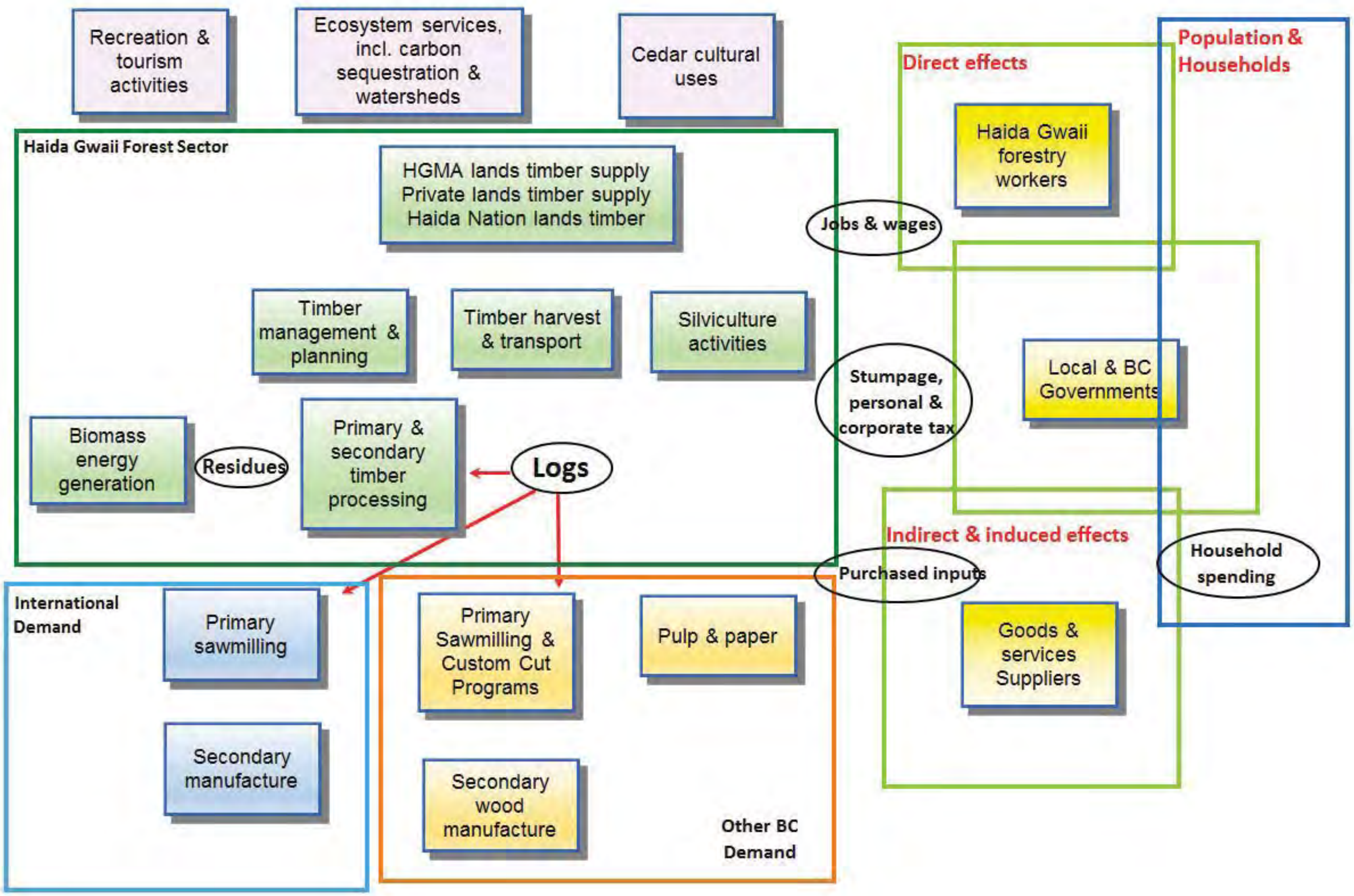
17 A base case is the current status and anticipated trends in population and the economy.

- Haida Gwaii Management Council, Developing a Forest Strategy for Haida Gwaii: A proposed pathway to defining the long term future of sustainable forests, communities and the forest businesses on the Islands, November 2013
- Holman, G., HG/QCI Land Use Plan Socio-Economic Base Case (Final Draft), 2004
- Joint Technical Working Group, Haida Gwaii Timber Supply Review Timber Supply Analysis Report, April 2012
- Lions Gate Consulting Inc. et al, Haida Gwaii/Queen Charlotte Islands Community Viability Strategy, May 2007
- Markey, S., Economic Development on Haida Gwaii: "Ounces, not Pounds", March 2012
- Misty Isles Economic Development Society, Economic Development Plans on Haida Gwaii, April, 2016
- Moore Resource Management, A Summary of the Forestry Strategy Forum, 2015
- Moore Resource Management, The Offer of a Community Forest for MIEDS Information, Evaluation, Options for Decision and Next Steps, 2016
- Pierce Lefebvre Consulting, Socio-Economic Assessment of Haida Gwaii / Queen Charlotte Islands Land Use Viewpoints, March 2006
- Stennes, B. and Wilson. B. The Queen Charlotte Islands – A Discussion of Forest Sector Development, 2000
- Sutherland, J., AAC Rationale for TFL 58, TFL 60 and TSA 25, September 2012

On Haida Gwaii, timber harvesting is the basic economic activity that underpins the overall performance of the Haida Gwaii forest sector. Therefore, changes in the overall Haida Gwaii timber harvest, along with changes in the harvest by species and age category flow through to changes in other key economic variables, including but not limited to employment and employment income, purchases of goods and services at suppliers, and forest company revenues and BC government revenues. Figure 2-1 outlines and summarizes the socio-economic analysis framework used for this project.

Figure 2-1: Socio-economic analysis framework



An estimate of employment and employment income connected to harvesting and processing of Haida Gwaii timber was developed for this report. The estimates of forest industry direct employment are based mainly upon a questionnaire administered to holders of TSA 25 Forest Licences and Timber Sale Licences and holders of TFL 58 and 60 tenures and to a questionnaire administered to operaters of certain Haida Gwaii wood processing operations.

Timber harvesting and processing employment is tied to the volume of harvested timber so is calculated as an employment per 1,000 m^3 of harvested timber co-efficient.[18] This approach allows for a ready estimate of forest sector employment and income impacts based on timber harvest level changes. Responses to these questionnaires provide the basis for calculating direct employment per m^3 associated with Haida Gwaii and BC timber harvesting and processing.

Indirect and induced employment impacts were calculated by applying multipliers to the direct employment figures (Horne 2007). Local area multipliers were calculated by BC Stats, based on the BC input/output model, for all areas of the province except the Lower Mainland (Horne 2009a). Indirect employment occurs in businesses supplying goods and services to forest sector companies, while induced employment occurs in businesses supported by the spending of direct and indirect employment income.

This report examines all forest industry uses of Haida Gwaii timber, including harvesting, processing, sales to domestic and international markets, silviculture activities such as re-planting, harvesting and processing residue use and carbon storage.

2.3 Context

Several Haida Gwaii specific initiatives occurring over the past fifteen years underlie or have substantively influenced important shifts in local timber harvesting and processing activity levels and their associated economic results on Haida Gwaii.[19] The cumulative impact of these

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[18] Employment is stated in person-years (PYs), which is defined as one person working the equivalent of one full year, which is defined as 180 days of work. A person working for 90 days accounts for 0.5 PYs. Full-time equivalents (FTEs) is a term that is used inter-changeably with PYs.

[19] Using 15 years as the look backwards at key events affecting the Haida Gwaii forest sector was based on starting with the commencement of the land and resource use planning that ultimately led to several fundamental changes in regulation and management of Haida Gwaii timber resources. These changes include but are not limited to the following: implementation of ecosystem-based management; creation of the Haida Nation-BC Government collaborative decisionmaking through the Haida Gwaii Management Council; the major entry of the Haida Nation into the local forest industry through the creation of Taan Forest Products Ltd. and securing major Haida Gwaii forest tenures; and the 2012 AAC determination for the Haida Gwaii Management Area. Prior to 2003, important events unfolded on Haida Gwaii that had direct effects on the local forest sector, communities and peoples, and these include the Gwaii Haanas Agreement, the 1996 ICSI Consensus document and the 2000 TSR and the local protests in response to aspects of this TSR process.

initiatives has resulted in a transformation of the Haida Gwaii forest sector in terms of forestry regulation and forest sector economic structure and participation. These initiatives were spearheaded either by the Haida Nation, the Government of BC or both in collaboration, and collectively extend beyond a reform of either regulation or timber tenure holdings into a structural transformation, which is still in process. In rough chronological order, these key initiatives or undertakings are the following.

- In September 2003, the Council of the Haida Nation and the Province of BC jointly initiated and led a land and resource use management (LRMP) planning process, incorporating an ecosystem-based management (EBM) framework into plan development. This consensus seeking effort to develop a strategic land use plan ended in February 2005 with agreement on several land and resource use issues and no agreement on several other matters.
- In 2004, the Supreme Court of Canada ruled that the Province of BC has a duty to undertake meaningful consultation with affected First Nations when considering a grant or renewal of a tree farm licence. This ruling was in connection with a case brought forward by the Haida Nation on the lack of consultation in regard to the renewal of TFL 39. This Supreme Court of Canada ruling has become the leading judicial precedent on the Crown's duty to consult with First Nations over decisions where Indigenous interests may be affected.
- In 2004, Western Forest Products completed a process of removing approximately 10,000 ha of private lands in the vicinity of Yakoun Lake on Haida Gwaii from TFL 39 Block 6 and selling these lands to BC Investment Management Corporation (BCIM).[20]
- In 2004, a protocol agreement between the Council of the Haida Nation and the municipalities of Port Clements and Masset was signed. Similar agreements between the Haida Nation and the Village of Queen Charlotte and the Skeena-Queen Charlotte Regional District Electoral Area D Regional District were subsequently signed in 2006. The agreements committed the signing parties to jointly "work together in designing a future that will support a healthy environment and create a sustainable islands economy" and to undertake several specified collaborative initiatives.
- The Haida Nation organized and led the Island Spirit Rising movement in Spring 2005, which culminated in several undertakings, including the BC Government using Part 13 of the *Forest Act* protection orders to help implement the Haida Land Use Vision, commitments to implement a Haida Gwaii land use plan that reflects the Haida Land Use Vision, development of an area based forest tenure that would be

[20] BC Investment Management Corporation is the entity managing BC Government and other BC public sector pension plan assets and was created under the *Public Sector Pensions Plan Act*.

direct awarded to the Haida Nation, expediting of a new Haida Gwaii Timber Supply Review, and an initial payment by the BC Government of $5 million as resource revenue sharing to the Haida Nation.

- In 2007, after government-to-government negotiations, the Haida Nation and the Province of BC signed the Haida Gwaii Strategic Land Use Plan Agreement, which incorporated provisions for co-management of Haida Gwaii lands and resources by the Haida Nation and the Province of BC and for use of ecosystem-based management (EBM) in Haida Gwaii forested land management and timber harvest planning.
- On March 22, 2008, the Province of BC and the Haida Nation signed an "Interim Forest Revenue-Sharing Agreement" that provides for annual interim payments by the Province of BC to the Haida Nation as an accommodation of the potential infringements of the economic component of the Haida Nation's Aboriginal interests arising from or as a result of forest and range development. This agreement was amended in 2014 and 2018 and has a current termination date of March 31, 2019.
- To further this new relationship outlined in the Haida Gwaii Strategic Land Use Plan Agreement, the Kunst'aa Guu – Kunst'aayah Reconciliation Protocol between the Haida Nation and the Province of BC was formalized two years later in December 2009. This protocol establishes that decisions about resource development and land use on Haida Gwaii are to be jointly shared by the Haida Nation and the Province of BC.
- The Haida Gwaii Management Council, consisting of two Haida Nation representatives,two BC Government representatives and a chairperson appointed by both parties, was provided for in the 2009 'Kunst'aa Guu – Kunst'aayah' Reconciliation Protocol and established in Haida law through the KaayGuu Ga ga Kyah ts'as – Gin 'inaas 'laas 'waadluwaan gud tl'a gud giidaa Haida Stewardship Law and established in provincial statute through the *Haida Gwaii Reconciliation Act* in June 2010. The initial Haida Gwaii Management Council was formed in 2011.
- In January 2010, the BC Government deleted Block 6 (Haida Gwaii) from TFL 39, then held by Western Forest Products Ltd. (WFP), and created TFL 60 from the former Block 6 area.
- With the June 2010 royal assent for the *Haida Gwaii Reconciliation Act*, the islands formally referred to as the Queen Charlotte Islands by the BC Government were re-named as Haida Gwaii for Province of BC purposes.
- In 2010, Taan Forest Products Ltd. (Taan) was created as a division of HaiCo (Haida Enterprise Corporation) to manage Haida Nation timber harvesting interests.
- In December 2010, the Haida Gwaii Land Use Objectives Order ("HGLUOO"), which establishes legal objectives for forest-based values to support implementation

of ecosystem-based management and to protect important Haida cultural values, was agreed to by the Haida Nation and the Province of BC and came into effect. The HGLUOO outlines land use objectives reflecting the intents expressed in the Haida Gwaii Strategic Land-Use Plan Agreement and establishes land use objectives specific to Haida Gwaii under the authority of the Haida Gwaii Reconciliation Act for the purposes of the Forest and Range Practices Act. Also at this juncture, 11 new protected areas were created.

- In a July 2010 letter to the Executive Director of Misty Isles Economic Development Society (MIEDS), then Minister of Forests and Range Bell invited MIEDS to apply for a community forest agreement (CFA). An undated memorandum from then Minister of Forests, Lands and Natural Resource Operations Thompson set out an allocation of 80,000 m^3 from the Haida Gwaii TSA 25 for a Haida Gwaii CFA (Moore Resource Management 2016).
- In 2011, Taan Forest Products Ltd. began to manage TFL 60, assuming the TFL management responsibilities formerly handled by WFP.
- In 2011, Taan completed a series of assessments and reports to become a Forest Stewardship Council (FSC) certificate holder.
- In March 2012, the province of BC and the Haida Nation concluded an "Atmospheric Benefit Sharing Agreement" that awards ownership of offset credits created through any offset projects on Haida Gwaii connected to the implementation of the Haida Gwaii Strategic Land Use Agreement and provides the basis for a sharing of offset credit revenues between the two parties.
- In the April 2012 AAC rationale, the HGMC set forth an AAC of 929,000 m^3 for Haida Gwaii, a 47.8% reduction from the previous level of 1,780,092 m^3 (HGMC 2012).
- In June 2012, Taan completed the purchase of TFL 60 from WFP (Taan 2016).
- In September 2012, the Chief Forester set forth determinations of AACs for each of TSA 25, TFL 58 and TFL 60, which were consistent in the aggregate with the HGMA AAC determination of the HGMC. In addition, the Chief Forester, in his AAC rationale, set out direction in the form of targets with respect to the harvesting of cedar on the Haida Gwaii TSA and TFLs (Sutherland 2012).
- Between 2012 and 2016, the HGMC sponsored a forestry strategy development process, which included a detailed background discussion paper released in 2013 and revised in 2015, and a community forum in 2015, which resulted in a follow-up summary document. However, a Haida Gwaii forestry strategy has not moved past this last stage to date.

- (Haida Nation owned) Great Bear Carbon Credit Limited Partnership's carbon offset project plan was accepted in June 2013. This project documented greenhouse gas (GHG) emission reductions realized by avoiding the release of carbon associated with timber harvesting, road building, and other forestry operations in the newly created Haida Gwaii conservancies (referred to as Haida Heritage Sites) and implementation of ecosystem-based management (EBM) operating areas relative to a timber harvesting baseline without these two measures (Offsetters 2016). The life of the project extends from January 2011 to December 2035, and the project is expected to annually generate approximately 400,000 offset credits that can be marketed and sold into regulated and voluntary offset credit markets.
- In December 2016, A&A Trading (Haida Gwaii) Ltd. completed the purchase from Teal Cedar of TFL 58, located on Moresby Island, and Forest Licence A16870.
- In an October 24, 2017 letter, the Chief Forester acknowledged that the logging of cedar in TSA 25 "has exceeded the levels outlined in the chief forester's 2012 management unit AAC determinations", and established a partition of no more than 195,000 m^3 of cedar within TSA 25's AAC of 512,000 m^3. On August 24, 2018, the minister followed up this step by signing a cedar focused partition order under Section 8(5) of the *Forest Act* applicable to TSA 25 eligible licences (which are replaceable forest licences). This order included direction to BCTS to follow up on the intent of the cedar partition order.
- In a December 2017 letter from the Regional Executive Director of the West Coast Forest region to the Chair of MIEDS, the Province of BC invited MIEDS to submit an application for a Community Forest Agreement (CFA). The offer included a specific mapped area, an offer of a transitional tenure with an AAC of 80,000 m3, and a condition that 55,000 m^3 per year of the Haida Gwaii area-based CFA's AAC would be re-directed to BCTS for the purposes of entering into one or more BCTS licences.
- In August 2018, the BC Court of Appeal issued a decision upholding a January 4, 2017 Labour Relations Code decision that Section 2 of the Woodlands Letter of Understanding (WLOU) that forms part of the Collective Agreement between United Steelworkers Local 1-1937 and Western Forest Products and its successor Taan Forest Products was discriminatory against members of the Haida Nation in the context of their forest industry employment with Taan Frest Products on Haida Gwaii. The decision upholds Taan's initiatives to use multiple and/or non-union contractors who are either Haida Nation members or are companies with Haida Nation member ownership to undertake timber harvesting related work on TFL 60.

3 Haida Gwaii Socio-Economic Setting

3.1 Introduction

Haida Gwaii is an archipelago of more than 150 islands to the north of Vancouver Island, from which it is separated by Queen Charlotte Sound and Hecate Strait. The mainland north coast of BC lies 80 km to the east across Hecate Strait, and the state of Alaska lies to the north across Dixon Entrance. Haida Gwaii's total landmass of just over a million hectares is situated mostly in two main islands, Graham Island to the north and Moresby Island to the south.

Haida Gwaii is the current, historical and ancient home of the Haida people. Two major Haida communities are located on Graham Island, Old Massett at the north end on the shores of Massett Inlet and Skidegate in the island's southeast corner. Three incorporated municipalities are located on Haida Gwaii; Village of Queen Charlotte on the southern shore of Graham Island, Port Clements on the eastern shores of Massett Inlet and Masset on the northern shores of Massett Inlet. Electoral Area D of the North Coast Regional District encompasses Graham Island and its surrounding islands. The unincorporated communities of Tlell and Tow Hill are situated on Graham Island. Electoral Area E of the North Coast Regional District encompasses Moresby Island and its surrounding islands. The unincorporated community of Sandspit is situated on Moresby Island.

The islands' largest airport is located at Sandspit. Air Canada operates a daily flight between Vancouver and Sandspit. Inland Air operates daily float plane flights on weekdays between Prince Rupert and Masset. Pacific Coastal Airlines operates a daily flight between Masset Municipal Airport and the Vancouver Airport's South Terminal. A BC Ferries vessel traverses Hecate Strait twice per week during the fall, winter and spring months between Prince Rupert and Skidegate, and five times per week during the summer months. BC Ferries provides about 10 crossings per day on a 20-minute ferry route between Skidegate and Alliford Bay that links Graham and Moresby islands.

Other than logs, most commercial goods are transported to and from Haida Gwaii in trucks that travel on the BC Ferries service. Seaspan offers a flat deck towed barge service that transports logs between Haida Gwaii and the Port of Prince Rupert and between Haida Gwaii and the Lower Mainland. North Arm Transportation operates a bulk fuel barge service and a freight barge service between Masset and Mitchell Island (Vancouver) and has a bulk freight storage facility at Masset. Wainwright Marine offers a freight and equipment barge service between Haida Gwaii and Prince Rupert. Port Clements-based O'Brien & Fuerst also has two barges. Haida Gwaii has no port facilities.

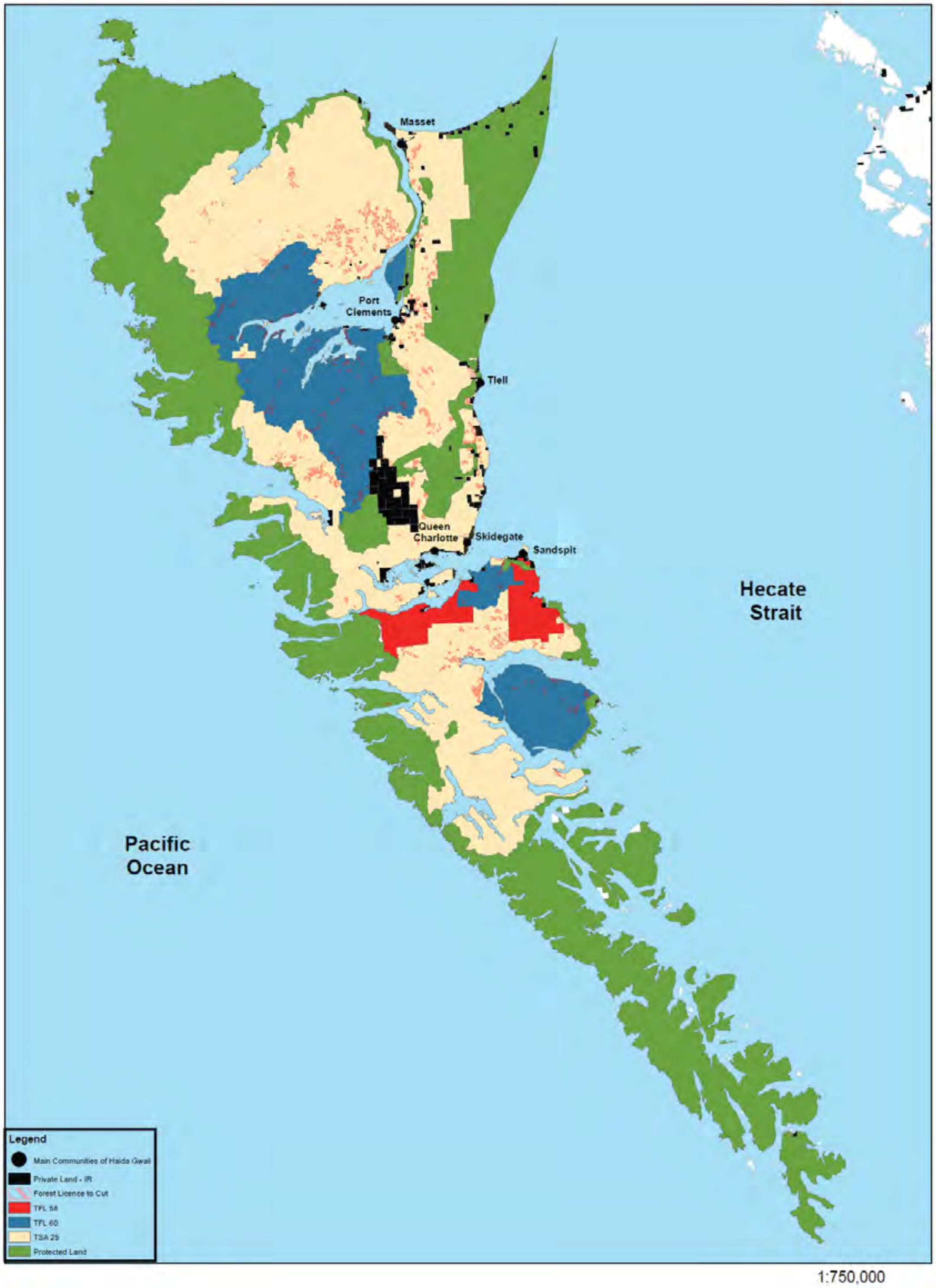
Approximately half of Haida Gwaii is in a protected status, such as a provincial park or a conservancy. About 148,000 hectares are considered currently suitable and available for harvesting timber. Nearly 478,008 hectares are in protected areas collaboratively managed by the Haida Nation and the Province of BC. Haida Gwaii protected areas also include the 145,700 ha Gwaii Haanas National Park Reserve and Haida Heritage Site, which was established in 1988. This area, on the southern end of Moresby Island and numerous smaller adjacent islands is cooperatively managed by the Haida Nation and the Government of Canada.

The vast majority of the lands on which timber harvesting is allowed is contained within three areas, Haida Gwaii Timber Supply Area (TSA) and Tree Farm License 58 (TFL 58) and Tree Farm License 60 (TFL 60). The Haida Gwaii TSA is located primarily on Graham Island, with a smaller portion on northern Moresby Island. The TSA has a gross area of 339,000 hectares, and a long-term timber harvesting land base estimated at 77,900 hectares. TFL 58 is held by A&A Trading (Haida Gwaii) and comprises the land in the former Moresby Block, which was subdivided from TFL 47 on December 1, 2006, and which is located immediately adjacent to the community of Sandspit. The TFL's gross area is 23,900 hectares, with a long-term timber harvesting land base of 10,400 hectares.

TFL 60 is held by Haida Nation-owned Taan Forest Ltd. and comprises the land which was formerly in Block 6 of TFL 39 that was subdivided from that TFL effective January 15, 2010. The TFL has a gross area of 134,500 hectares, with a long-term timber harvesting land base of 48,000 hectares.

Below is a map of Haida Gwaii showing the extent of its protected areas, main communities, and the boundaries of Haida Gwaii TSA, TFL 58 and TFL 60.

Figure 3-1: Map of Haida Gwaii



Source: BC MFLNR 2018a

3.2 Population and Demographics

Declining population, -12.8% over the 2006-2016 period

Haida Gwaii's population has been on a steady decline since its most recent peak in 1996 (at approximately 5,600). Based on Census of Canada data, the 2016 population of Haida Gwaii was 4,198, a 12.8% decrease from the 2006 population of 4,812, and a 25.0% decrease from the 1996 population. By comparison, the overall population of BC rose by 12.2% over the 2006-2016 period.[21]

BC Stats' population estimate for the Queen Charlotte local health area of 4,848 in 2006 and 4,280 in 2016 are similar to population estimates based on Census of Canada data.[22]

All but one of Haida Gwaii's communities or electoral areas registered a population decline over the 2006-2016 period. Skidegate was the exception as its estimated population grew modestly from 781 to 837 over this decade. Port Clements experienced the largest drop in population (-35.9%) from an estimated 440 in 2006 to 282 in 2016. Table 3-1 presents the 2006 and 2016 populations of Haida Gwaii and its communities.

Table 3-1: Population of Haida Gwaii and Haida Gwaii Communities and Electoral Areas, 2006 and 2016

	2016	2006	Percentage Change
Haida Gwaii	4,198	4,812	-12.8 %
Skidegate	837	781	7.2 %
Old Massett	555	694	-20.0 %
Village of Queen Charlotte	852	948	-10.1 %
Village of Masset	793	940	-15.6%
Village of Port Clements	282	440	-35.9 %
Electoral Area D, North Coast Regional District (Graham Island)	539	607	-11.2%
Electoral Area E, North Coast Regional District (Moresby Island)	340	402	-15.4%

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21 Statistics Canada does not present a population figure for Haida Gwaii based on Census of Canada data. In order to estimate the population of Haida Gwaii, the populations of the Haida communities of Skidegate and Old Massett, Village of Queen Charlotte, Village of Masset, Village of Port Clements, and Electoral Areas D (Graham Island) and E (Moresby Island) of North Coast Regional District (formerly Skeena-Queen Charlotte Regional District) must be summed together.

BC Stats however estimates populations by local health area and school district by year. The Queen Charlotte local health area (LHA 050) and School District no. 50 encompass the whole of Haida Gwaii.

22 Census of Canada population statistics are relied upon in this report because they are available for all Haida Gwaii communities (including Haida Nation communities) and because detailed demographic data by Haida Gwaii communities are also available through the Census of Canada databases. The Census population estimates typically demonstrate a small undercount of approximately 2%.

Source: Statistics Canada 2007 and 2017 and author's calculations

The main reason for the Haida Gwaii population decline is that out-migration from the islands has greatly exceeded its in-migration. Haida Gwaii had a small natural population increase (i.e. births exceeding deaths) over the five-year 2013-17 period; Haida Gwaii's natural increase averaged approximately 15 persons (average of approximately 46 births and 31 deaths). By comparison, the growth in the BC population over this recent five-year period occurred mainly through a net increase in the province's migration, both from other provinces and other countries. The net increase in the province's population due to migration has been about five times larger than the province's natural increase.

BC Stats prepares population (historical) estimates and (forward) projections by local health area and school district using Census data and data from other sources. The BC Stats projections show the Haida Gwaii local health area's population increasing by a nominal amount over the short-term (for example, 1.5% over the five-year 2016-2020 period).[23] BC Stats has projected a small population increase for Haida Gwaii in the recent past that has not panned out. As previously mentioned, a very small natural increase (i.e. births exceeding deaths) is present within the Haida Gwaii population but the author of this report forsees the future Haida Gwaii population in the short- and medium-terms being stable at best and the Haida Gwaii population may decrease if out-migration continues to outweigh in-migration by a large margin on the islands.

Almost half of the Haida Gwaii population identifies as an Aboriginal/Indigenous person

In 2016, an estimated 47.5% of the Haida Gwaii population identified as an Aboriginal/Indigenous person.[24] The Aboriginal/Indigenous population of Haida Gwaii was an estimated 1,915 in 2016 and is growing (a 1.6 % increase for the 2006-2016 period), unlike the non-Aboriginal/Indigenous population of the islands. However, this Haida Gwaii Indigenous population growth of 1.6% trailed, by a large margin, the 38% increase in the overall BC Aboriginal/Indigenous population.

Both Skidegate and Old Massett are amongst the small group of larger Aboriginal/Indigenous communities within the province but the Haida Gwaii Aboriginal/Indigenous population makes up only about 0.7% of the province's total Aboriginal/Indigenous population. Table

[23] See https://www.bcstats.gov.bc.ca/apps/PopulationProjections.aspx

[24] The Census of Canada data for estimates of the Aboriginal/Indigenous population are based upon voluntary disclosure of Aboriginal/Indigenous identity and voluntary participation in the Census of Canada. The shown estimate of the Aboriginal/Indigenous population is therefore likely to be an under-estimate of the actual Aboriginal/Indigenous population of Haida Gwaii and its communities. The shown percentage share is based upon the Haida Gwaii residents who answered the question about Aboriginal/Indigenous identification, which is a slightly smaller number of Haida Gwaii residents (4,030) than who participated in the Census of Canada (4,198 persons) in 2016.

3-2 presents estimates of the Aboriginal/Indigenous population of Haida Gwaii and its communities and electoral areas for 2016 and 2006.

Table 3-2: Aboriginal/Indigenous population of Haida Gwaii and its communities and electoral areas, 2006 and 2016

	2016	2006	Percentage Change
Haida Gwaii	1,915	1,885	1.6 %
Skidegate	720	710	1.4 %
Old Massett	540	670	-17.9 %
Village of Queen Charlotte	140	135	3.7 %
Village of Masset	350	320	9.4 %
Village of Port Clements	50	10	400 %
Electoral Area D (Graham Island)	100	20	400 %
Electoral Area E (Moresby Island)	25	20	24 %

Source: Statistics Canada 2007 and 2017 and author's calculations

Population of Haida Gwaii is older

The estimated median age of the Haida Gwaii population increased from 39.7 years to 45.1 years over the 2006-2016 period. By comparison, the estimated 2006 median age on the islands was similar to that of the province (40.8 years) whereas by 2016, the estimated Haida Gwaii median age (45.0) was higher than the BC median of 43.0 years.

The median age of the Village of Queen Charlotte went up from 41.1 years to 45.8 years over the 2006-2016 period (11.4%), and the median age of Port Clements went from 43.2 years in 2006 to 52.2 years in 2016 (20.8%). In terms of the Haida Gwaii population age exceeding the BC median age, the Haida community of Skidegate is the exception on the islands although its median age also increased over the 2006-2016 period, going from 36.8 years to 40.0 years in 2016.

Excepting Port Clements and Electoral Area E (Moresby Island), the median ages of Haida Gwaii communities in 2006 were near or well below the provincial median age. In 2016 only the Haida communities of Skidegate and Old Massett had median ages near or below the provincial median age. This upward shift over the 2006-2016 period in the median ages of Haida Gwaii communities was due to weak in-migration to Haida Gwaii and the Haida Gwaii population having a lower birth rate (because of its aging population). Table 3-3 shows the median ages of the Haida Gwaii communities and electoral areas.

Table 3-3: Median Ages of Haida Gwaii Communities and Electoral Areas (years), 2006 and 2016

	2016	2006	Percentage Change
Haida Gwaii	45.0 years	39.7 years	13.3%
Skidegate	40.0	36.8	8.9 %
Old Massett	42.4	35.2	20.5 %
Village of Queen Charlotte	45.8	41.1	11.4 %
Village of Masset	46.2	40.7	13.5 %
Village of Port Clements	52.2	43.2	20.8 %
Electoral Area D (Graham Island)	45.6	38.5	18.4 %
Electoral Area E (Moresby Island)	50.9	45.5	11.9 %

Source: Statistics Canada 2007 and 2017 and author's calculations

Stable core population but limited in-migration

Haida Gwaii and BC have similar levels of medium-term community stability based on duration of residency. The percentage of BC residents who resided within the same community over the 2012-2016 period was 79.1%. This level indicates a high level of medium-term community stability. The percentage of Haida Gwaii residents residing within the same community over the same 5-year period was slightly higher, 82.0% (Statistics Canada 2017).[25]

Comparing this indicator of community stability with the decline in population for Haida Gwaii points to out-migration exceeding in-migration on the islands (i.e. a core group of residents is staying on Haida Gwaii but some persons are leaving to reside elsewhere and few are coming to the islands to reside for the long-term on Haida Gwaii).

3.3 Labour Market

Introduction

Labour market, as applied in this report, is defined as the exchange of the supply of labour by workers for the demand of labour by employers. Labour is supplied by workers with the relevant skills and associated occupational training, and is drawn from Haida Gwaii residents, as well as workers from other areas. Labour demand correlates with the number of positions of the necessary skills at the time required to carry out forest industry activities. Total labour demand also incorporates labour demand of supplier industries (i.e., indirect employment) connected to the expenditures on goods and services by forest sector enterprises and organizations and labour demand by consumer industries (i.e., induced employment)

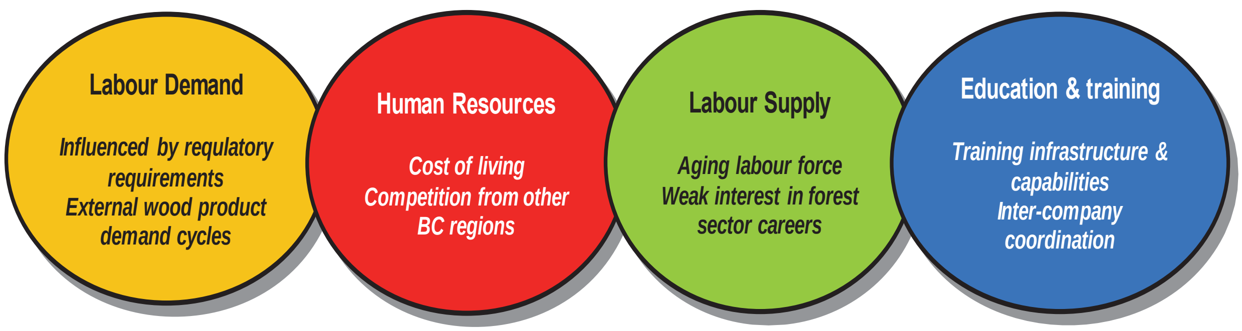
[25] This determination of community stability is based on mobility status data, which refers to the status of a person with regard to a person's place of residence on the reference day of May 10, 2016 in relation to the place of residence on the same date five years earlier.

connected to the household expenditures of forest sector associated direct and indirect workers.

Labour markets are fluid and dynamic; they fluctuate both in terms of the numbers of labour force participants and the number of positions available through employers. These fluctuations often create periods of labour scarcity or labour surplus. Labour market forces (e.g., changing terms of employment and labour mobility) typically establish a balance between supply and demand. Provincial and federal initiatives supporting workers and employers also contribute to effective labour market functioning.

The human resource management activities of companies provide a key linkage between matching up sectoral labour demand and labour supply and reducing frictions between the two economic forces. Education and training initiatives delivered by companies to employees and by government entities and specialized non-governmental organizations have fundamental implications for improving the quality of labour supply and shaping labour supply to the labour demand of various sectors. Figure 3-2 is a graphic that presents several of the main issues or challenges in the Haida Gwaii labour market as identified through the interviews with key informants carried out for this project and a review of secondary sources, such as the Haida Gwaii Labour Market Information Report (Astute Management Consulting 2011), Human Resource Development on Haida Gwaii (Mills 2012), BC Forest Sector Labour Market & Training Needs Analysis (LMI Insight and Malatest 2013), and Labour Market Supply Side Environmental Scan for BC's Natural Gas Sector (Ingenia Consulting 2012).

Figure 3-2: Haida Gwaii labour market issues and challenges



Shrinking labour supply

Haida Gwaii's declining population over the 2006-2016 period was largely driven by the contraction in its resident labour supply. The islands resident labour force decreased from an estimated 2,830 workers to 2,290 workers over this period, a decline of 19.1%.[26]

All Haida Gwaii communities excepting Skidegate registered sizeable contractions in their labour supply during this period. The Haida Gwaii communities with the largest drops were Electoral Area D (Graham Island), -45.5%, and Electoral Area E (Moresby Island), -45.3%, and the labour supply contractions in these communities were associated with lower numbers of residents holding down positions in logging, public administration and retail trade in 2016 compared to 2006. The growth (24.7%) in the Skidegate labour force was likely due in large measure to the emergence and development of HaiCo and its subsidiaries.

Table 9-1 and Table 9-2 in Appendix II present data on the Haida Gwaii labour force for 2006 and 2016 by industry (at the 2 digit North American Industry Classification System (NAICS) level).

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[26] This labour force data is from the Census of Canada and based on "place of residence", i.e. these workers constitute the labour force members who had their usual place of residence (i.e. permanent residence) on Haida Gwaii at the times of Census enumeration. Statistics Canada also collects and reports labour force data by "place of work". Sometimes the "place of residence" and "place of work" labour force data are used interchangeably, which can be misleading in many BC situations. Within BC metropolitan regions, extensive daily commuting between communities is present, for example Surrey to Vancouver. As well, substantive volumes of long distance commuting also occurs between far flung areas in BC and between BC and Alberta. For example, a portion of Elk Valley coal mine workers have their permanent residence in Alberta and a portion of Alberta oil sands facility operations and construction workers have their permanent residences in BC. The workers who engage in long distance commuting are often referred to as "mobile workers" and several studies have been undertaken of this group of workers by Statistics Canada and a several year multi-university research project, entitled the "On the Move Partnership" (see http://www.onthemovepartnership.ca/about/) has yielded multiple publications on the topic.

The place of work by industry labour force data does not accurately identify or describe the total labour force of an area because a portion of the labour force reports "no fixed workplace address" as the location or address of their usual workplace. In the 2016 Census, overall in BC, 14.1% of workers reported having "no fixed workplace" (Statistics Canada 2017a). The workers reporting no fixed workplace are not included in the reporting of the place of work labour force data by industry for a community or rural area. This situation results in an underreporting of the total labour force of an industry when a portion of an area's or a community's labour force reports "no fixed workplace" in the Census. The usual place of work labour force data for a community can be divided into workers having local addresses and those with a permanent residence outside the local community in order to indicate the scale of non-local workers but this data breakdown does not include the workers with "no fixed workplace". The reporting of workplace location by Haida Gwaii residents gives an indication of the scale of this matter on Haida Gwaii. For example, in the 2016 Census, 19.6% of the labour force residing in Haida Gwaii reported having "no fixed workplace" (Statistics Canada 2017b). As an example of this matter, 24.4% of workers who reside in Port Clements reported in the 2016 Census as having "no fixed workplace address". Given the longstanding prominence of logging in the Port Clements area this response is expected. These workers residing in Port Clements likely work in the forested lands of Electoral Area D but, because they are reported as having "no fixed workplace address" they would not be itemized in the Place of Work labor force data for Electoral Area D. The same issue also pertains to mobile workers who work part-time or seasonally on Haida Gwaii and report "no fixed workplace address". The result of this situation is an underreporting of the place of work by location data for Haida Gwaii.

Higher unemployment

The Haida Gwaii unemployment rate as of the 2016 Census of Canada was 9.5%. At that time, the provincial unemployment rate was considerably lower at 6.7%. The Haida community of Old Massett had the highest unemployment rate (18.6%) on the islands at that time. This high unemployment rate was a decrease from the 33.8% rate at the time of 2011 Census of Canada. The unemployment rate in the adjacent Village of Masset at the 2016 Census of Canada however was the lowest on Haida Gwaii, 3.6%

Haida Gwaii's participation rate of 67.5% in 2016 was higher than the BC rate of 63.9%, which shows a slightly higher attachment to the work force on the islands than in the province.

The proportion of the labour force having a full-time job and the average number of weeks worked were other areas in which the Haida Gwaii employment situation in 2016 was weaker than that of the province. Of those Haida Gwaii residents who worked in 2016, 36% did so at a full-time position and 64% worked either part-time or for part of the year. Considerably more BC residents who worked in 2016 held a full-time job, 46%. The average number of weeks worked in Haida Gwaii in 2016 was 38.1, almost 4 weeks less than the BC average of 41.8 weeks. This difference in full-time employment between Haida Gwaii and the province is due to the narrow focus of the economic structure of the islands on the tourism, forestry and public administration sectors. The local tourism sector especially has a high proportion of seasonal workers. A factor may also be a preference of some Haida Gwaii residents for part-time employment, which was reported in the 2011 Haida Gwaii labour market information report (Astute Management Consulting 2011).

Aging labour supply

People aged 25 to 54 years old are considered of core working-age because of their strong attachment to the labour market. A concerning aspect in general for the Haida Gwaii economy is the decline in Haida Gwaii residents of prime working age population. The estimated number and percentage share of persons residing on Haida Gwaii in the prime working age group of 25 to 54 years declined from 2,217 (45.7%) in 2006 to 1,669 (39.0%) in 2016. The decrease of 24.7% in Haida Gwaii's prime working age group was twice as much as the drop in the overall Haida Gwaii population. Over the same period, the 25 to 54 years age group in the province grew by 3.9%.

Static education levels

When compared to provincial education levels, the Haida Gwaii situation differs markedly in two categories, persons with no educational certificate and persons with a university degree. In 2016 in BC, 29.9% of the adult population held a university degree whereas a much lower portion of Haida Gwaii residents did so, 16.2%. An estimated 9.6% of BC adults in 2016 did not have an educational certificate (such as a high school diploma) but in Haida Gwaii the share of adult residents without an educational certificate stood at 23.1%, which was more than double the provincial level.

When considered on a community basis, Village of Queen Charlotte has a similar educational makeup to that of the province. The other communities and areas of Haida Gwaii have higher percentages of adults without an educational certificate and lower percentages who hold a university degree. Table 3-4 presents the percentage distribution of highest education achievement for Haida Gwaii, BC, Queen Charlotte and the rest of Haida Gwaii for 2016.

Table 3-4: Percentage distribution of highest education achievement for Haida Gwaii, BC, Queen Charlotte and the rest of Haida Gwaii (%), 2016

	No certificate, diploma or degree	High school diploma (or equivalent)	Apprenticeship or trades qualifications	College certificate or diploma	University qualification below bachelor degree level	University graduation
Haida Gwaii	23.1%	25.5%	12.2%	20.5%	2.4%	16.2%
BC	9.6	26.5	9.1	20.9	3.9	29.9
Village of Queen Charlotte	13.8	19.1	6.4	25.5	2.1	33.0
Rest of Haida Gwaii	25.5	27.2	13.7	19.2	2.5	11.8

Source: Statistics Canada 2017 and author's calculations

The numbers of local grade 12 students and high school graduates also have a general effect on the Haida Gwaii labour supply as this group is an important source of entry level part-time and full-time workers. In recent years the number of Haida Gwaii grade 12 students averaged about 47 and the number of high school graduates averaged about 35, which represents a very modest potential addition to the local labour force, especially given that a proportion of these young people will opt to reside elsewhere for educational and career reasons.[27]

As well, the high school graduation rate on Haida Gwaii lags the province-wide rate but oscillates widely on a year to year basis. The five-year range, 2012-13 to 2016–17, for the six-year Dogwood Diploma completion rate for Haida Gwaii was 60-82% and 75-90% for the middle 50% of BC school districts.[28]

Only a limited number of forest sector specific education and training opportunities are available on the islands. Possibly the most prominent of which are the 14 week programs for university students that are delivered in a partnership between the non-profit Haida Gwaii Higher Education Society (HGHES) and the University of BC faculty of forestry.[29]Starting

27 See http://www.bced.gov.bc.ca/reports/pdfs/graduation/050.pdf

28 See http://www.bced.gov.bc.ca/reporting/systemperformance/?evidence=completion-rates&sd=050

29 See http://hghes.ca/

from the first offering in 2010, this Haida Gwaii program has grown and become a unique higher education offering focused on resource management and community development.

The implications of this smaller labour supply, in combination with an aging population and lower education levels, for the local economy has been discussed and described on the islands (Mills 2012). The locally developed "Human Resource Development on Haida Gwaii Strategies and Action Plan" included the following observations

- Decline in the core labour pool will challenge Haida Gwaii employers in filling future occupational demand from the Island labour pool.
- Anecdotally there is a paucity of senior management, leadership, administration, project management and operational management skills on Island.
- A shortage of business/management skills on Island will impede full development of self-employment and entrepreneurial opportunities.

A Haida Gwaii labour market research project commissioned by Gwaii Trust is underway (pers. comm. C. Lutner 2018). This labour market study is expected to be publicly available in 2019.

3.4 Economic Structure

The resident labour forces of each of Haida Gwaii's main economic sectors of forestry, tourism and public services have contracted in recent years

Haida Gwaii's economy is narrowly focused on forestry (mainly logging), tourism (mainly sport fishing, Haida culture and Haida Gwaii ecological experiences) and public services, including elementary and high school education, health care and government administration. They are the main sectors bringing in revenues and employing Haida Gwaii residents (and long distance commuters) which support spending by local businesses and residents at local retail outlets, on local real estate, on locally provided professional services and on other locally provided services. In 2016 (based on Census of Canada resident labour force data) the forestry sector accounted for 12.7% of the Haida Gwaii economy, the tourism sector for 16.9%, and the public services sector for 27.9%.[30]

[30] Statistics Canada neither organizes nor presents its labour force data to include figures for a "tourism sector". BC Stats developed an approach to estimate tourism sector employment by community and local area (including for Haida Gwaii) using Statistics Canada labour force data (Horne 2009b). BC Stats has not created an estimate for 2016 for the labour force of the tourism sector by local area. For its 2009 report, BC Stats also created specific definitions for the "forestry sector" and a "public sector".

This BC Stats estimation approach was used for this report to estimate the labour forces of the Haida Gwaii tourism, forestry and public sectors for 2006 and 2016. The 2006 figures reported here are slightly different than those reported by BC Stats in its 2009 report because the underlying datasets used for this socio-economic report, although also originally sourced from Statistics Canada, are different from the ones used by BC Stats.

Table 3-5 presents Haida Gwaii's labour force numbers and percentage shares by major sector for 2016 and 2006.[31]

Table 3-5: Haida Gwaii Labour Force (# of workers), 2016 and 2006[32]

Sector	2016 #	2016 %[33]	2006[34] #	2006 %	% change 2016 vs 2006
Total	2,290	100	2,830	100	-19.1%
Tourism	387	16.9	427	15.1	-9.4%
Forestry	290	12.7	325	11.5	-10.8%
Public Services	640	27.9	795	28.1	-19.5%
Other Sectors	973	42.5	1,283	45.3	-24.2%

All accommodation employment is typically categorized as being part of the tourism sector. However, some employment in several other sectors, including food services, recreation, transportation and retail trade, is due to tourism activity. The BC Stats approach is based on multiplying the accommodation services employment data by an estimated factor to capture the employment in other sectors that is supported by tourist visitation in order to estimate direct employment for the overall tourism sector. Areas with accommodation services (such as full-service resort hotels) that provide a range of services, such as food services, recreation, local transport and retail in addition to accommodation, have lower tourism direct employment factors. This estimated factor differs by area largely on the basis of the main types of accommodation facilities and the type and scale of the major recreation facilities. In areas where the accommodation facilities offer a full range of services in addition to overnight accommodation then the revenues and employment in other industries tends to be lower, and accordingly the direct tourism ratio or factor is lower. In BC, we see this in the major ski resort areas and in the areas with fishing resort and backcountry lodges.

The forestry sector is defined here in a similar way that BC Stats adopted for its aforementioned 2009 study. The forest sector is defined as comprising the following North American Industry Classification System (NAICS) code industries: 113 Forestry and Logging, 1153 Support activities for forestry, 3211 Sawmills and wood preservation, 3212 Veneer, plywood and engineered wood product manufacturing, 3219 Other wood product manufacturing, 322 Paper manufacturing, and 337 Furniture and related product manufacturing.

The public sector is defined here in a similar same way that BC Stats adopted for its aforementioned 2009 study. The public sector comprises the following NAICS code industries: 621 Ambulatory health care services, 622 Hospitals, 623 Nursing and residential care facilities, 61 Educational services, 9111 Defense services, 9112 Other federal services (9112 to 9119), 624 Social assistance, 912 Provincial and territorial public administration, 913 Local, municipal and regional public administration, and 914 Aboriginal public administration.

31 This labour force data are from the Census of Canada and is based on "place of residence", i.e. the workers who constitute the labour force members who had their usual place of residence (i.e. permanent residence) on Haida Gwaii.

32 The "# of workers" term refers to both full-time and part-time workers. The labour force question used by Statistics Canada relates to the individual's job held during the week of Sunday, May 1 to Saturday, May 7, 2016. However, if the person did not work during that week but had worked at some time since January 1, 2015, the information relates to the job held longest during that period. Employment at Haida Gwaii resorts is higher in the summer months than in May but the framing of the question captures workers who may not be working in May but who will likely be working in a month or so.

33 The percentage share shown in this table is the percentage or share of the total labour force. In the 2009 BC Stats reports, the percentage or share of only the "basic sector" is shown, i.e. forestry's percentage/share of the basic sector.

34 The 2006 data shown in this table differs slightly from the employment tables by sector shown in the 2006 Economic dependency tables for forest districts published by BC Stats and reproduced in the 2012 Haida Gwaii Timber Supply Review Public Discussion Paper. The difference is mainly due to different labour force source data.

Source: Statistics Canada 2007 and 2017; unpublished runs of Statistics Canada 2006 and 2016 labour force data supplied to BC Stats; and author's calculations

The labour force numbers and percentage shares for these leading local sectors declined substantively between the 2006 and 2016 Census years. The tourism sector's labour force went from an estimated 427 workers in 2006 to 387 workers in 2016, a 9.4% decrease. The forest sector's labour force decreased from an estimated 325 to 290 workers, a 10.8% decline and the public services labour force also went down from an estimated 795 workers in 2006 to 640 workers in 2016, a 19.5% decrease. These labour force figures include full-time, part-time and seasonal workers. A sectoral breakdown by duration of employment is not available for Haida Gwaii but in BC, the forestry and public administration sectors have a much higher share of full-time workers than does the tourism sector.

BC Government forestry related employment in the Haida Gwaii offices of BC MFLNR and BCTS is categorized by Statistics Canada in the "public administration" industry and not within a forest sector industry so this government related forestry employment appears within the public services sector and not within the forestry sector in Table 3-5. Over the 2015-2017 period, BC MFLNR has maintained an average annual staffing level of 22 full-time employees and 1 to 4 part-time employees (pers. comm. D. Sherban 2018).

Another way of looking at labour force trends is by examining 2 digit NAICS code industry data that is publicly reported by Statistics Canada for census years. The labour force data based on the 2 digit NAICS code description of industries shows a similar pattern of contraction for the main Haida Gwaii industries or sectors excepting for the health care and social assistance industry (11.5% increase). The Haida Gwaii resident labour force for accommodation and food services outlets decreased by 35.6%, a lower figure than the -9.4% estimate for the overall tourism sector. This is likely due to lower food service employment and higher employment in some other tourism related outlets, such as the Haida Heritage Centre at Ḵay Llnagaay. The manufacturing sector's labour force, which includes wood processing and fish and seafood processing, contracted by more than half over the 2006-2016 period, 57.6%. Table 9-1 and Table 9-2 in Appendix II shows the estimated labour forces by all 2 digit NAICS code industries and Haida Gwaii communities and electoral areas, as well as for Haida Gwaii, for 2016 and 2006. Table 3-6 below summarizes labour force data by key Haida Gwaii industries at the 2-digit NAICS code level.

Table 3-6: Haida Gwaii labour force for selected industries at 2 digit NAICS code level, 2006 and 2016

2 digit NAICS code Industry	2016 #	2016 %	2006 #	2006 %	% change 2016 vs 2006
Total (all industries)	2,290	100	2,830	100	-19.1%
Accommodation and food services	190	8.3	295	10.4	-35.6%
Agriculture, forestry, fishing and hunting[35]	320	14.0	360	12.7	-11.1%
Manufacturing	70	3.1	165	5.8	-57.6%
Educational services	175	7.6	235	8.3	-25.5%
Health care and social assistance	290	12.7	260	9.2	11.5%
Public administration	225	9.8	300	10.6	-25.0%
Construction	145	6.3	175	6.2	-17.1%
Retail trade	250	10.9	275	9.7	-9.1%

Source: Statistics Canada 2007 and 2017; and author's calculations

Both timber harvesting and wood processing employment of Haida Gwaii residents fell over the 2006-2016 period. The main factors contributing to declines in timber harvesting employment were as follows.

- lower Haida Gwaii AACs in response to creation of new protected areas and land use regulatory changes
- 2008 financial crisis that lowered demand for wood products in key markets (U.S. housing for example) resulting in less timber harvesting and associated forestry employment that recovered but not to the pre-financial crisis levels
- more use of mechanized (less labour intensive) harvesting methods
- timber harvest permitting challenges
- efforts to adhere to Chief Forester recommended cedar harvesting targets
- local sourcing challenges for forestry labour supply

The main factor in the reduction of wood processing employment on Haida Gwaii in 2016 compared to 2006 is the combination of adverse operational and financial challenges faced by Haida Gwaii Forest Products (formerly Abfam), which has a two-line sawmill at Port Clements. This facility was the only small scale, multi-species sawmill on the islands for several years but was shuttered in 2017 although re-opening and renovation of this facility are currently the subject of discussions between its owners and potential investors (pers. comm. D. Edgars 2018).

A current factor (and likely to be a more worrisome factor going forward) is the aging Haida Gwaii workforce in general and specifically in the local forest sector. This situation was

[35] Wood products manufacturing is part of the Manufacturing industry at the 2-digit NAICS code level

brought up by a few of the Haida Gwaii forest sector participants interviewed for this project. As well, the aging forest sector workforce is a well understood situation in the overall Coastal BC forest industries. For example a report providing a scan of coastal BC mayors' perceptions about the forest sector, observed that "Over the next decade the forest industry's aging workforce will lead to shortages in the professional, production management and skilled trade occupations, as well as a wide range of production workers who harvest and transport products from the forest to the market. An estimated 25,000 new recruits will be required in the sector or about 2,500 per year due to anticipated turnover rates of 60 per cent for forestry and logging and 40 per cent for the solid wood and pulp and paper sectors in BC." (The Truck Loggers Association 2016).

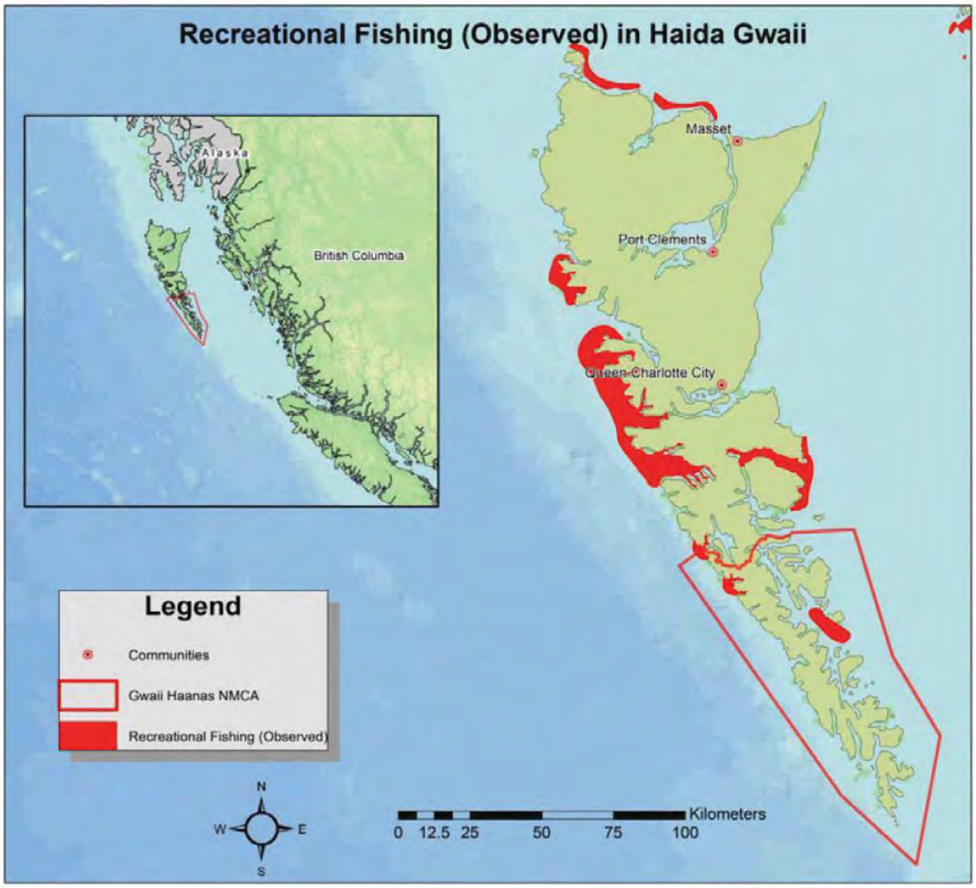
The factors affecting timber harvesting and processing activities are further discussed in later sections of this report (Section 4.6 Haida Gwaii Timber Harvest, Section 4.9 Haida Gwaii Forest Sector Operations, Section 4.10 Forest Sector Employment and Section 4.11 Haida Gwaii Timber Harvest Operating Costs).

Fishing resort lodges remain a driver of the Haida Gwaii tourism sector but the Haida culture and Haida Gwaii ecological tourism experiences have become important drivers of visitation to the islands over the past decade

The Haida Gwaii tourism industry has evolved since the late 1980s into what is now one of the islands' largest industries in terms of labour force size. The scaling up of this industry on Haida Gwaii was given a boost with the establishment of the first fishing lodge resort in 1985 on Langara Island, followed by the development of several others in the late 1980s, and with the signing of the South Moresby Agreement and the establishment of South Moresby National Park Reserve in 1988, followed by the Gwaii Hanaas Agreement in 1993 and the framing of the park reserve as Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site.

Sport fishing activities on the islands largely occur off the west and northwest coasts of Graham Island. Sport fishing resort guests target chinook and coho salmon but other fish and seafood species, such as halibut, are harvested by recreational fishers as well. Based on anecdotal information, Figure 3-3 shows the main Haida Gwaii marine areas of recreational and sport fishing activities.

Figure 3-3: Main Haida Gwaii areas of Recreational and Sport Fishing Recreation



Source: Hillier et al 2007

A few of the major fishing resorts are owned by entities that also have major forest industry interests too.[36]

The long-term high level planning for marine based tourism on Haida Gwaii is now guided by the Haida Gwaii Marine Plan published in 2015 and developed through a collaborative process led by the Council of Haida Nation and the BC Government and, as well as, by the resort development policies and planning of each of the BC Government and the Haida Nation (Haida Nation and Province of BC 2015). The Marine Plan Partnership for the North

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36 Husby, through a subsidiary, owns and operates Peregrine Lodge at Naden Harbour and Haida Nation-owned HaiCo, which owns Taan Forest Products, also owns and operates Ocean House, a fly-in fishing lodge, and Westcoast Resorts, which includes the Lodge at Englefield Bay and the Lodge at Hippa Island. The owner of North Arm Transportation, which provides barge services to the forest sector, developed Langara Fishing Adventures, which operates Langara Fishing Lodge and Langara Island Lodge.

Pacific Coast (MaPP) was established as a collaborative process for implementing marine plans completed in 2015 for the coastal and marine areas of four sub-regions of B.C. including Haida Gwaii. The Haida Gwaii Marine Plan is being implemented by the Province of British Columbia and the Council of the Haida Nation

Table 3-7 sets out a recent listing of 16 fishing lodges on Haida Gwaii. This list does not itemize all tourist accommodation facilities or fishing charter boat operations on Haida Gwaii.

Table 3-7: Haida Gwaii Fishing Lodge Resorts

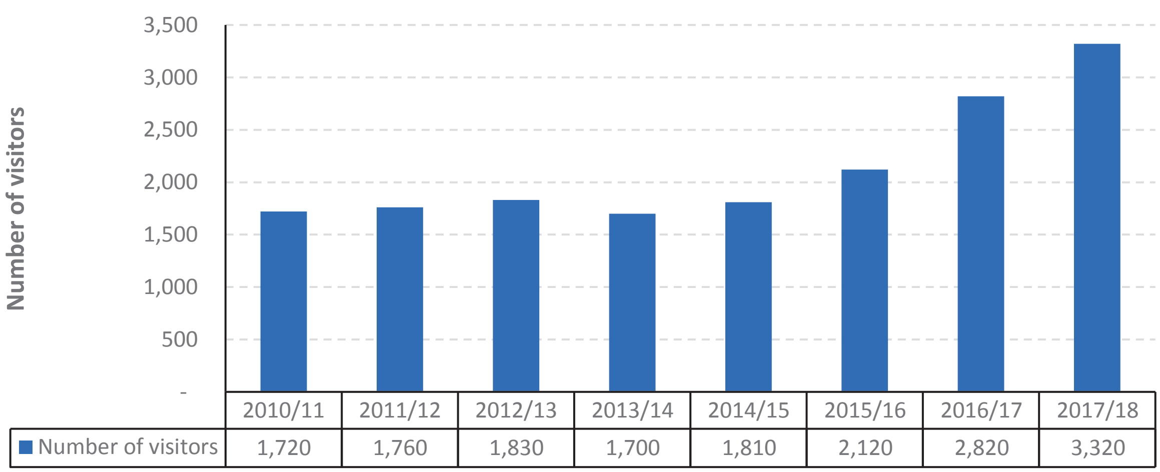
Lodge	Location	Company	Type
The Outpost	Port Louis	West Coast Fishing Club	On land
North Island Lodge	Langara Island (Beal)	West Coast Fishing Club	Floating
The Clubhouse	Langara Island (Henslung)	West Coast Fishing Club	On land
Langara Island Lodge	Langara Island (Henslung)	Langara Fishing Adventures	On land
Langara Fishing Lodge	Langara Island (Henslung)	Langara Fishing Adventures	Floating
Alaska View Lodge	Tow Hill Road	Langara Fishing Adventures	On land
Kumdis River Lodge	Port Clements	Langara Fishing Adventures	On land
The Lodge at Englefield Bay	Douglas Inlet	Westcoast Resorts (HaiCo)	Floating
The Lodge at Hippa Island	Nesto Inlet	Westcoast Resorts (HaiCo)	Floating
Queen Charlotte Lodge	Naden Harbour (SW side)	Queen Charlotte Lodge	On land
Peregrine Lodge	Naden Harbor (SE side)	Husby Forest Products	On land
Samson Lodge	Naden Harbor (NE side)	Samson Marine Resources	Floating
Queen Charlotte Safaris	Sandspit	NA	On land
Sandspit Adventures	Sandspit	NA	On land
Naden Lodge	Masset	NA	On land
Escott Lodge	Masset	NA	On land

Source: MFLNR 2018

A study of Haida Gwaii fishing lodges listed 18 facilities as of 2002 A 1996 report estimated that Haida Gwaii had 13 fishing lodges in 1994 (GS Gislason & Associates 2003). The 2003 report estimated that 115 jobs (50 PYs) at these Haida Gwaii fishing lodges were held by Haida Gwaii residents out of a total employment of 520 jobs (245 PYs), which means a modest 22% local share of fishing lodge total employment. In 2001, the overall Haida Gwaii tourism sector was estimated to account for employment of 292 Haida Gwaii resident workers (Horne 2009b). The estimated 115 jobs held by Haida Gwaii residents at the Haida Gwaii fishing lodges would have accounted for about 40% of the Haida Gwaii resident tourism labour force at that time.

The overall Haida Gwaii tourism sector has expanded since the early 2000s. For example, the estimated number of local workers in the Haida Gwaii tourism sector's labour force was about 390 in 2016. New or renovated infrastructure connected to tourism experiences and accommodations focused on Haida culture and the ecological and wilderness features of the islands have opened in recent years, which has somewhat lessened the relative economic importance of the fishing resort lodges within the Haida Gwaii tourism sector. For example, HaiCo opened two eco/Haida culture lodges in recent years, Ocean House at Peel Inlet in 2018 and Haida House at Tllaal in 2012 and the Haida Nation opened the Haida Heritage Centre at Kay Linagaay in 2007. In recent years, indicators of visitation show an upward trend for Haida Gwaii after a dip over the 2009-2011 years. For example, the number of visitors at the Queen Charlotte-Sandspit Visitor Information centre almost doubled to 10,116 in 2018 from 5,462 in 2011. In 2009 the number of visitors at this info centre had reached 10,448 (Destination BC 2019). The number of short-term rental units in private housing have increased. A recent report on Queen Charlotte housing observed that, as of March 2018, 39 rentals were listed on the Airbnb website versus 29 listings in December 2017 (Co+Host 2018). Another example of the growth in visitation connected to Haida culture and Haida Gwaii ecology and wilderness is the upward trend in visitation to Gwaii Haanas National Park. Over the 8-year 2010-11 to 2017-18 period, annual visitation to Gwaii Haanas National Park and Haida Heritage Site almost doubled from 1,720 to 3,320 visitors (see Figure 3-4).

Figure 3-4: Annual visitation to Gwaii Haanas National Park and Haida Heritage Site (number of visitors)



Source: Statista.com 2019

A new estimate of Haida Gwaii fishing lodge employment is in preparation. The MaPP issued a request for proposals in 2018 for a study of recreational service providers on Haida Gwaii that would develop up to date data on recreational fishing operations on Haida Gwaii, including employment, and a methodology to estimate the limits of acceptable change to priority values affected by activities undertaken by recreational fishing service providers and implement the methodology for Haida Gwaii. Given the participation of HaiCo in the fishing resort lodge industry since its purchase in 2011 of a controlling interest in Westcoast Resorts and HaiCo's emphasis on local hiring, along with the interest of some other resort properties in local hiring, the Haida Gwaii resident share of fishing resort employment in recent years is likely to be higher than the 22% level reported in the 2003 study. The MaPP commissioned report is due to be completed in mid-2019 (MaPP 2018).

Data challenges in estimating Haida Gwaii economic activity

At the small area level, only labour force and employment by industry data are available through publicly available sources, such as Statistics Canada and BC Stats, to describe economic activity. In the Haida Gwaii case, Statistics Canada does not report data on a Haida Gwaii area basis so the data for the municipalities, electoral areas and Haida communities have to be aggregated or summed in order to create an estimate for Haida Gwaii. A challenge in this situation is that labour force and employment data for electoral areas and First Nation communities are not reported by Statistics Canada at the same granular level as for municipalities.

Another challenge with Haida Gwaii labour force data is the relatively high proportion of part-time workers. Many of these part-time workers work for the fishing resort lodges, the fish and seafood processing facilities, the retail outlets or in fish harvesting. In fact, many Haida Gwaii workers have a couple of part-time jobs over the course of the year. And some owner-operators are in a similar position as they have two or even three businesses or they have a part-time business and they work for another entity on a part-time or seasonal basis. At the time of the Census of Canada enumeration, persons who work in two or three different industries over the course of the year are identified with only one industry, such as accommodation services, so the reporting of labour force or employment by industry tends to be accurate in terms of the overall labour force figure but not accurate in terms of the labour force of industries that rely on sizeable numbers of part-time workers.

Yet another challenge related to assessing or estimating the Haida Gwaii labour force and its characteristics is that a portion of the workers in certain Haida Gwaii operations or industries, especially the fishing lodges and certain forestry activities, are filled by mobile workers (i.e. long distance commuters to Haida Gwaii) who have their permanent residence elsewhere in BC (or in Alberta in some cases). These mobile workers may stay on Haida Gwaii for a several month season or commute back and forth for shorter stays. Because their place of work on Haida Gwaii consists of one or more remote locations, many of these mobile workers will report "no fixed workplace address" in the Census enumeration so the labour force data by place of work for Haida Gwaii is much underreported.

In part, understanding the total employment and its key characteristics in the Haida Gwaii forestry and tourism sectors is met through surveys of employers in these sectors. For this socio-economic report, a survey of the main employers in the Haida Gwaii forestry sector was undertaken and its results are reported in Section 4.9. As mentioned above, the MaPP has a research project underway that is expected to include a survey of Haida Gwaii fishing lodge operators, which will provide an up-to-date estimate of total employment and its characteristics in this key part of the Haida Gwaii tourism sector.

These data challenges do not negate the value of the Haida Gwaii labour force or employment data but these challenges suggest that interpretation of this data should focus on differences in scale (i.e. 50 vs 100) and on direction in temporal trends (i.e. positive or negative) and not on the precision or accuracy of the data.

The Haida Gwaii economy showed increasing diversity over the 1991-2006 time period[37]

A 2009 BC Stats study calculated an economic diversity index to compare economic diversity between areas in the province and change in an area's diversity over the 1991-2006 period. Haida Gwaii's diversity index in 2006 was similar to the typical range for most areas around the province (the provincial mean diversity value in 2006 was 69, the same diversity index value that Haida Gwaii scored). This movement towards greater economic diversity was due to increasing employment on Haida Gwaii in both the tourism and public administration sectors and a steep decline in forest sector employment. Over the 1991-2006 period, the share of Haida Gwaii's forest sector employment income within the overall Haida Gwaii economy fell by a substantial margin, a decrease in the same range as the decline in the Alberni, Port Hardy and Lake Cowichan areas on Vancouver Island.

This study also determined location quotients for areas throughout BC based on 2006 Census of Canada data (BC Stats 2009). Calculating location quotients is a way to identify areas of economic sector specialization or concentration within and between economies. A location quotient measures the concentration of industry sectors in an area relative to the concentration of the sector in the provincial economy. Haida Gwaii's tourism sector location quotient of 1.41 was relatively high within the province, and in the same range as Parksville-Qualicum, Penticton and the Gulf Islands for example, but well below the tourism sector concentration in the Squamish-Whistler, Invermere and Golden areas.[38]

A shift/share analysis was also prepared in the 2009 BC Stats study. This type of analysis uses employment data to isolate three broad determinants of economic change within an area: change occurring within the overall province, change occurring due to overall change within an industry (such as wood processing) and change due to local circumstances. Large local employment effects in either a positive or negative direction indicate that change in a sector

[37] The calculation of this diversity index takes into account the 1997 standing down of Canadian Forces Station (CFS) Masset.

[38] The BC tourism sector would be rated as 1 within the overall BC economy. An area with a location quotient of 1 for its tourism sector would have a tourism sector of roughly similar economic importance to its economy as the BC tourism sector is within the overall BC economy.

industry cannot be easily explained by overall provincial employment changes or by changes in the industry. [39]

The shift/share analysis results for the 2001-2006 period showed a large positive local effect for the Haida Gwaii tourism sector, which suggests change pushed by local factors (rather than as a byproduct of positive change in the overall provincial tourism sector). The situation was the reverse for the Haida Gwaii forest sector; based on the shift/share analysis results, a large negative change in the Haida Gwaii forest sector for the 2001-2006 period was driven by negative local factors (Horne 2009a).

Although the Haida Gwaii tourism sector accounts for the largest share of the local labour force the tourism sector does not have the largest share of income

A 2009 BC Stats study of local economic dependencies based on 2006 Census data showed that the tourism sector of Haida Gwaii had employment and (before tax) income shares of 21% and 10%, respectively (Horne 2009b).[40] The economic importance of the resource extraction industries is more noticeable when the focus is on employment income. This study listed the Haida Gwaii forestry sector's shares of employment and income as 15% and 14%, respectively. The lower share of income for the Haida Gwaii tourism sector (compared to the forest sector) is due to its higher levels of seasonal and part-time employment and lower average hourly and weekly pay rates. The public sector accounted for the largest share of employment income on the islands, 33%, at the time of this study.

A key factor driving the higher employment income levels in the forest sector versus tourism is the considerably higher wage and salary structure in the various parts of the forest sector. A reason for the higher wage and salary (and benefit) levels, at least in certain parts of the forest sector, is the higher levels unionization amongst Coastal BC timber harvesting companies and in the larger wood processing facilities. For example, forest industry employers with current or recent Haida Gwaii operations , which are parties to the Collective Agreement with United Steelworkers Local 1-1937 include the following.

- A&A Trading (Haida Gwaii) Ltd.
- C.N.R. Salvage Ltd.
- DVR Trucking Ltd.

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[39] A key determinant of whether a region can develop its industry sectors is its ability to utilize comparative advantages, relative to other economies. For example, if a sector's main competitive factor is price and a region has access to a low cost supply of a commodity critical to that sector, then the region has a comparative advantage. A location quotient of 1.0 for a sector indicates that the region employs the same proportion of its labour force in that sector as the province does, and that the region has no comparative advantages or disadvantages. A location quotient of greater than 1.0 indicates that relatively more people are employed in that sector, and that there are comparative advantages at work. Conversely, a location quotient of less than 1.0 indicates that there are relatively fewer people employed in that sector, and that there are likely comparative disadvantages hampering further development.

[40] Most recently available BC Stats estimate of both tourism sector employment and income.

- Husby Forest Products Ltd.
- Island Timberlands Limited Partnership
- The Teal-Jones Group
- Watchmen Forest Products Ltd.

A survey of wages or salaries by industry for Haida Gwaii is not available but the province-wide averages by industry provide general information on the scale of the gap in employment income between industries. The average weekly earnings in the BC logging industry in 2017 was estimated by Statistics Canada as $1,225.50 whereas the average weekly earnings in the accommodations and food services sector was much lower, $395.19.[41] A wide variety of enterprises operate within the tourism sector so the range of employment incomes varies widely by enterprise type and geographic location but the low level of unionization and higher levels of seasonal work mean that tourism sector employment incomes (including those in the resort lodge industry) are lower compared to incomes in the forestry sector.

Although direct employment in the Haida Gwaii forest sector has slipped in recent years, this sector remains a considerably stronger generator of employment than the transport, construction and retail sectors of Haida Gwaii. The indirect and induced employment generated by the direct economic activity[42] of the logging (1.42 indirect + induced jobs per 1 direct job) and wood products manufacturing (1.45) sectors of Haida Gwaii is estimated to be much higher than that of tourism (1.16) and slightly higher than that of the public sector (1.32). The indirect and induced employment associated with each direct logging industry job is estimated to be three times greater than that associated with each direct tourism sector job. Table 3-8 lists indirect and combined indirect and induced multipliers by economic sector for Haida Gwaii.[43]

41 Statistics Canada. Table 14-10-0204-01 Average weekly earnings by industry annual.

42 The local employment supported by spending of firms and their employees.

43 Although the shown indirect and induced employment multipliers were calculated using 2006 data, these multipliers are relevant today because the characteristics of the Haida Gwaii business establishments remain largely the same today as in 2006. For example, a new type of and/or large-scale wood processing facility is not now present on Haida Gwaii, i.e. the types of Haida Gwaii wood processing facilities today are broadly similar in scale and technology as in 2006.

Table 3-8: Haida Gwaii employment multipliers, 2006

Industry	Indirect Multiplier	Indirect/ Induced[44] Multiplier
Logging	1.19	1.42
Wood products manufacturing	1.28	1.45
Construction	1.25	1.43
Public Sector	1.14	1.32
Tourism	1.05	1.16

Source: Horne 2009a

Small, interconnected economy

In relative terms, Haida Gwaii's economy is small. Only Haida Gwaii's forest and tourism sector's stand out within a provincial economy context; the islands have very modest levels of economic activity in other sectors, whether in other resource development areas, such as commercial fish and seafood harvesting , or in technology development or service sectors, such as higher education and health care. The small population of approximately 4,200 year-round residents and remoteness as islands separated from mainland BC by Hecate Strait provides a small base of year-round consumers that can support only a small service sector.

And even within the BC context, the primary drivers of the Haida Gwaii forest and tourism sectors are important yet still modest in size. The maximum potential timber harvest on Haida Gwaii as represented by the management unit AAC total of of 929,000 m^3 amounts to 6.2% of the coastal BC AAC (and 1.4%% of the overall BC AAC).[45] The context story is similar for fishing tourism based employment. A 2003 study reported the number of fishing lodges on Haida Gwaii as 18, a couple more than the 16 fishing lodges reported by BC MFLNR for 2018 (GS Gislason & Associates 2003); BC MFLNR 2018). In the 2003 study, the Haida Gwaii fishing lodge employment was estimated as 520 jobs and 245 PYs of employment.[46] Based on data reported in a 2007 study of BC's ocean economic sectors, direct employment in BC supported by tourism spending to undertake saltwater angling annually averaged approximately 2,168 PYs over the 2002-2005 period (GS Gislason & Associates et al 2007). In this context, Haida Gwaii's fishing lodge employment amounts to a little over 10% of BC's tourism-based saltwater angling direct employment.

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[44] Assumes out-migration in the event of lay-offs

[45] The total of Coastal BC AACs for TSAs and TFLs in 2017 was 14,878,739 m^3 and the total of BC AACs for TSAs and TFLs was 64,181,421 m^3, see https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut

[46] The majority of Haida Gwaii fishing lodge workers are full-time seasonal employees, such as dockworkers, housekeeping staff, guides and chefs, who work on-site for a 4-5 month season. The total number of seasonal on-site jobs was estimated at 425 in this study. The year-round positions in head office administration, marketing and management was estimated as totaling 95, and that about 15% of the year-round employees worked part-time.

The oft reported employment and GDP data and indicators are typically reported by direct industries or sectors, and this does not convey the level of connectedness and even dependencies between sectors. The many suppliers that the various forestry enterprises tap into for goods and services are often the same suppliers that tourism facilities utilize and as well the suppliers to forestry and tourism enterprises overlap with many of the suppliers patronized by local households. These suppliers include building supply and hardware outlets, tire stores, fuel suppliers, electrical contractors, etc. This economic interconnectedness, which is heightened in a small and remote economy, means that the shifting economic tides simultaneously affect “all boats sharing the same waters”. The wellbeing of the main drivers of the Haida Gwaii tourism sector is important to Haida Gwaii forest sector enterprises and vice versa because both sectors must perform reasonably well to drive a local level of spending on goods and services that can financially help sustain the service sectors of the islands.

In a metropolitan area, this interconnectedness is also present but much less vital to the wellbeing of the overall metropolitan economy. Within the Haida Gwaii context, sustaining a reasonably vibrant local service sector is important, not only to keep costs down through avoiding the financial and time costs of sourcing off islands, but also to help retain Haida Gwaii residents and attract new ones by having basic services on the islands that contribute to an attractive quality of life.

Income levels are below the province-wide level

Excepting for Village of Queen Charlotte, the median (before tax) household incomes in Haida Gwaii communities sat well below the BC median household income level in both 2005 and 2015. In 2015, Queen Charlotte residents had the highest median household income on Haida Gwaii at $69,120 and residents of the Haida community of Old Massett had the lowest at $30,208. The median household income for the province in 2015 was $69,995.

In general, lower income persons are at higher risk of poorer health outcomes as there is less money available for quality housing, nutritious food, accessible recreation activities, and other elements (Public Health Agency of Canada 2013). The Low Income Measure (LIM)[47] was used to assess the prevalence of low incomes on Haida Gwaii (i.e. proportion of the residents of Haida Gwaii communities who are considered as living in low income households). Based on the Low Income Measure, Queen Charlotte (15.1%) and Port Clements (12.3%) had proportionately fewer low income residents compared to the province-wide level of 15.5%. Masset, Electoral Area D (Graham Island) and Electoral Area E (Moresby Island) had higher levels of the prevalence of low income residents by comparison to the province-wide yardstick. Data for Haida communities were not available for this measure of low income.

[47] The indicator shows the percentage (i.e. prevalence or proportion) of low income persons in a community. Low income is based on the low income measure (LIM), which is a dollar threshold that delineates low-income in relation to median income after tax. The LIM is 50% of median adjusted economic family income, where "adjusted" indicates that family needs are taken into account.

Table 3-9 presents data on median household incomes and prevalence of low incomes for several Haida Gwaii communities and BC.

Table 3-9: Median household income, 2005 and 2015, and Prevalence of Low Incomes, 2015

	Queen Charlotte	Masset	Port Clements	Skidegate	Old Massett	Electoral Area D (Graham Island)	Electoral Area E (Moresby Island)	BC
Median household income (2015)	$69,120	$59,968	$58,120	$48,612	$30,208	$63,424	$52,480	$69,995
Median household income (2005)	$51,117	$42,845	$48,255	$35,541	$28,256	$40,112	$43,190	$52,709
% increase, 2015 median income over 2005 level	35.2%	40.0%	20.4%	36.8%	6.9%	58.1%	21.5%	32.8%
Prevalence of low incomes (2015)	15.1%	19.5%	12.3%	NA	NA	19.6%	16.9%	15.5%

Source: Source: Statistics Canada 2015 and 2018; and author's calculations

4 Situation Analysis - Haida Gwaii Forestry Sector

4.1 Introduction

The basic economic activity that underpins the overall performance of the Haida Gwaii forestry sector is on-islands timber harvesting. Therefore, changes in the overall Haida Gwaii timber harvest, along with changes in the harvest by species and age category flow through to changes in other key economic variables, including but not limited to employment and employment income, purchases of goods and services at suppliers, and forest company and BC government revenues.

Three factors have had the greatest influence on the timber harvesting performance of the Haida Gwaii forestry sector, two factors on the timber supply side and one factor on the timber demand side. In regard to the latter, over the past few decades, the demand for western redcedar-based wood products in the very large US house building and home renovation markets has been especially important for the Haida Gwaii forest sector. Demand for whitewoods-based commodity products, including logs, in China and some other very large international markets are important too but western redcedar product demand has been the main driver of the fortunes of the Haida Gwaii forest sector over the past decade.

On the supply side, a primary influence on timber harvesting levels has been the regulated AACs for the Haida Gwaii Management Area and the Haida Gwaii TSA and TFLs, which have set the upper limits on the potential total timber harvest in these Haida Gwaii timber harvesting management units. The other very important supply side factor has been the commercially operable volume of Old Growth western redcedar on the Haida Gwaii Timber Harvesting Landbase and private lands. This factor is directly tied to the cost of timber harvesting and transport on Haida Gwaii.

The intersection of the regulated Haida Gwaii timber supply AACs and the commercially operable western redcedar volumes with the demand for Haida Gwaii timber has driven Haida Gwaii timber harvesting volumes, which has fed through to effects on Haida Gwaii forest sector employment and employment income, log prices, sales revenues and stumpage and goods and services purchasing activity. Shifts in one or more of the three cited key supply and demand factors soon result in distinct economic effects in the Haida Gwaii forest sector and the overall Haida Gwaii economy.

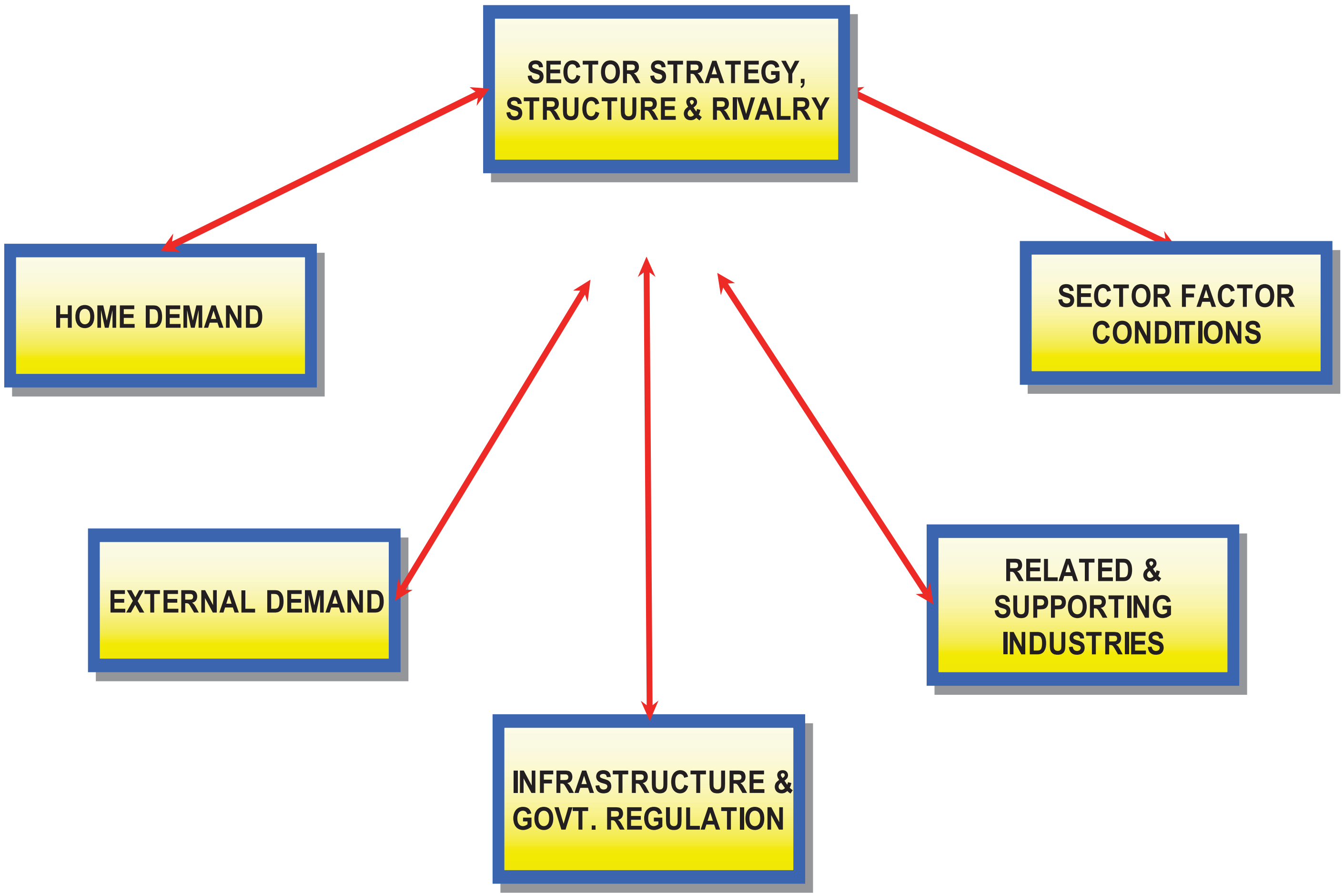
Several other supply and demand factors (both internal and external to Haida Gwaii) have important push and pull effects on the Haida Gwaii forest sector and economy, including but not limited to the following.

- Availability and cost of wood processing on Haida Gwaii (as well as in relation to wood processing availability and cost in other jurisdictions)
- Countervail duties and trade agreements

- Changes in other wood product demand factors, such as rising incomes in China
- Changes in non-Haida Gwaii timber supply factors, such as a prohibition on logging in natural forests in China
- Development and marketing of alternative products to western red cedar-based products, such as wood composites for decking materials
- Haida Gwaii marine transport infrastructure
- Haida Gwaii LUOO
- BC MFLNR and BCTS timber supply regulation and administration practices, such as TSL planning, roadbuilding and competitive auctions, Haida Gwaii log export exemption OIC and cutting permit issuance
- Haida Gwaii labour force availability and qualities
- Silviculture policies, strategies and practices on Haida Gwaii
- Monetization of forest carbon storage

The situation analysis undertaken for this socio-economic report was structured to examine the Haida Gwaii forest sector within six factors that underlie its long-term socio-economic viability: home demand for its wood products, external demand for its wood products, infrastructure and government regulation (such as AAC determinations and log export regulation), related and supporting industries that support ongoing operations, sector factor conditions and the strategy, structure and rivalry (between forestry enterprises) of the sector. The situation analysis framework is summarized in Figure 4-1. This framework is used in the summary and conclusions section (4.12) to lay out in a graphic figure the current status of the Haida Gwaii forest sector.

Figure 4-1: Situation analysis framework



In the following sections, current and historic Haida Gwaii conditions of each of the dimensions of the Haida Gwaii forest sector are presented.

4.2 Home (Haida Gwaii and BC) Demand

A very long cultural tradition of utilizing cedar fibre in a wide range of applications has been present on Haida Gwaii and this source of local demand for cedar fibre is being responded to through the Cultural Wood Access program[48] and other on-islands sources.

The local demand in total for lumber products is modest however because of the small population of the islands, approximately 4,200 in 2016. In broad terms, the local demand for lumber can be estimated by reference to the Canadian per capita consumption of lumber products, which was an estimated 0.68 m^3 per capita in 2017.[49] Using this parameter as a basis for helping to estimate Haida Gwaii lumber consumption then Haida Gwaii lumber product consumption in 2017 totalled approximately 2,900 m^3. The Haida Gwaii level was likely somewhat higher than this figure because of the local traditions for incorporating visual wood features into new building construction and renovations and some of the local specialized demand coming through Gwaii Haanas and BC Parks, Haida and municipal offices for boardwalks and community buildings, and the fishing resorts but the local demand for lumber products is nevertheless relatively small compared to the local harvest timber volume (see Section 4.6.1).

Demand from local parties, such as local resorts, for mainly non-structural appearance quality cedar wood products are largely satisfied by approximately 10 micro mills and an unknown number of backyard log cutting units on Haida Gwaii. They mainly focus on filling custom cut orders and making lumber products for local customers. The local micro mills are described in Section 4.9.7. The remoteness of Haida Gwaii and the associated transport cost to ship lumber products from other areas of BC to the islands act as a protective cost barrier for local wood product makers.

Even within the province, the BC forest sector is highly dependent on sales to outside of the province. Figure 4-2 shows the annual levels, and the 2008-2017 decade trend, for total sales of all wood products manufactured in the province versus value of exports of BC manufactured wood products. Over the 2008-2017 period, BC wood product exports accounted for 79-87% of BC wood product sales. This chart understates the relative importance of outside BC sales of BC forest products as it incorporates neither sales to other areas of Canada nor export log sales.

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48 See http://www.haidanation.ca/?page_id=48

49 Calculated from lumber shipment, import and export and population data.

Figure 4-2: BC wood product sales compared to BC exports of wood products (excluding logs) ($B), 2008-2017

Source: BC MFLNR 2018e

4.3 External Demand

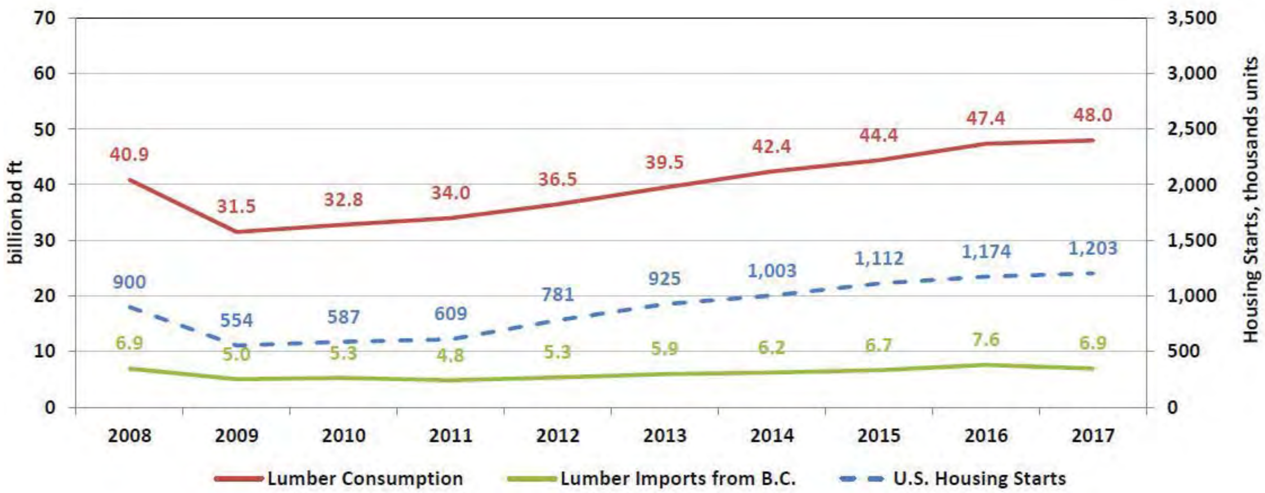
4.3.1 Introduction

Demand for wood products in external markets drives Haida Gwaii forest sector economic activities

External market demand for softwoods products (including logs) that matches with the Haida Gwaii log supply profile is a critical factor pushing forward Haida Gwaii forest sector economic activities. Demand conditions in two markets drive the overall commercial harvest on HGMA lands. The key longstanding market factor is US housing market demand for cedar products and the newer market factor is the demand in China for whitewood logs for input into the manufacture of lower value structural wood products, such as cement form materials.

Trends in the US housing markets are the main factor that feeds back into the demand for cedar timber harvested on Haida Gwaii. About 75% of BC cedar lumber exports are directed to the US, 95% of cedar siding exports go to the US and 95% of cedar shake and shingle exports are US-bound (Gregory, McBeath and Filipescu 2018). The following chart shows the tight relationship or correlation between the 10-year 2008-2017 trend in the volume of US imports of BC lumber products and the US housing starts trend. The shown 2008-09 downtick in US lumber imports from BC corresponded with the downturn in the US housing market and the 2017 downtick in US lumber imports from BC corresponded with the expiry of the Softwood Lumber Agreement (SLA) and the imposition of temporary countervail duties. The figure also shows the US housing market recovering from the 2008-09 trough levels and the transition from a supply driven to a demand driven lumber market that resulted in improved pricing for wood products, including logs (See Section 4.3.2).

Figure 4-3: Trend in US imports of BC lumber products compared to trend in US housing starts



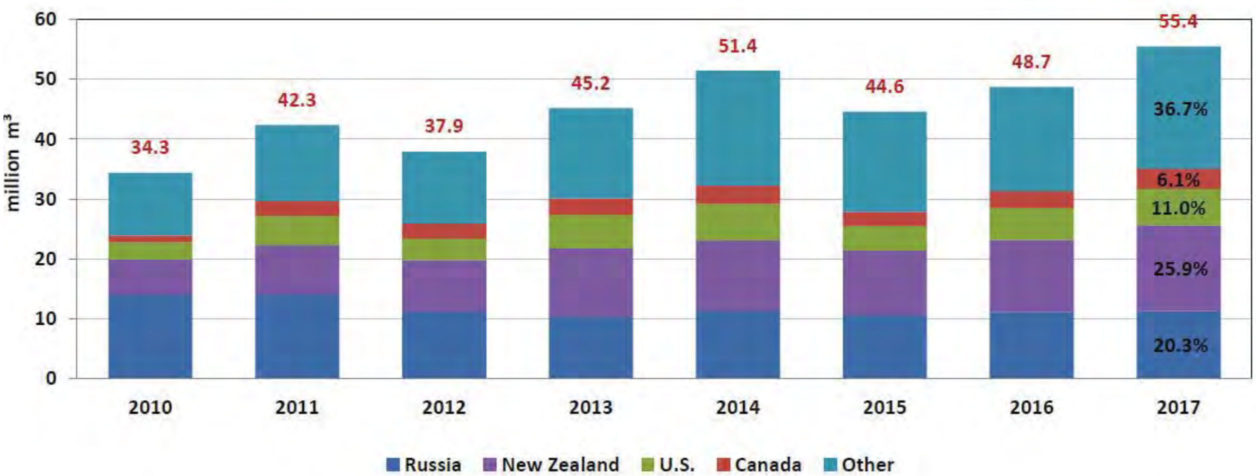
Source: Source: BC MFLNR 2018e (data sourced from Western Wood Products Association and US Census Bureau)

Western Forest Products (WFP) manufactures the largest volume of cedar products on Coastal BC and is a public company that is followed by investment analysts. The following quote from a well-known forest industry analyst captures the fundamental linkage between WFP's overall financial success and WFP's success in selling cedar products into the US (and WFP's access to the US market). "We had previously upgraded Western FP on June 5, 2017 when the shares were trading at $2.17 due to the company's positioning on the trade file in a strong cedar market, attractive valuation and upside to a potential new quota-based SLA (which could result in structurally higher margins for WFP)…." (Patel 2017). This quote also communicates the substantive importance of the lumber product (including cedar products) trading arrangements between the US and Canada, which are currently based on short-term countervail duties.

China imported record high volumes of softwood logs and lumber in 2017 and is now the world's largest log importer and the second largest lumber importer. Over the recent decade, China's log imports are up by approximately 75%. The Canadian share of China log imports (which is essentially completely sourced from BC forests) has stayed within a narrow band for several years and stood at 6.1% in 2017. In recent years, New Zealand and its fast growing plantations have been China's largest log supplier with a 25.9% market share in 2017, followed by Russia with a 20.3% share.

The driving forces behind the upward trend in China's softwoods log demand is two-fold; a deficit of domestic timber requires China to rely on imports and increased urbanization and associated increased wealth have increased demand for structural lumber products. Between 2010 and 2025, 300 million Chinese people are projected to move from rural to urban areas with attendant new residential demand (WFP 2018). Figure 4-4 shows the trend in Chinese log imports by supplier country.

Figure 4-4: Chinese log imports by supplier country (million m³), 2010-2017



Source: BC MFLNR 2018e (data sourced from Wood Markets China Bulletin)

4.3.2 Vancouver Log Market Prices

Introduction

Shifts in harvesting volume on Haida Gwaii can be due, as previously mentioned, to AAC changes, but also due to:

- seasonal weather conditions, i.e. less harvesting in winter and early spring months
- a shift in a sizeable cost driver, such as a labour cost increase,
- but the primary driving factor in harvesting activity shifts is due to shifts in BC log marketplace prices.[50]

In part, the relative importance of BC log prices on harvesting activity is due to the regulation of log exports outlined in Section 4.5.2.

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50 However the scope of the shift in harvest volume, i.e. the supply of Coastal BC (and Haida Gwaii) logs into the various log marketplaces, is linked to the concept of price elasticity, both own-price elasticity of supply and cross-price elasticity. The most recent elasticity of supply study for Coastal BC logs concluded that Coastal BC logs are price inelastic (in the short-run and the long-run) (Sun, Niquidet and Clapper 2015). However, the researchers also concluded that elasticities of supply are higher in remote districts, where the logging cost is higher and manufacturing facilities are fewer. Essentially, this researcher's results indicate that shifts in Coastal BC log prices result in relatively modest shifts in timber harvests (log supply). Price inelasticity points to buyers being relatively unresponsive to log price increases or decreases. The inelastic price for Coastal BC logs (and by inference Haida Gwaii logs) is due to two factors: slow growth of the Coastal BC timber "crop" (new supply comes on stream very slowly), harvest volume regulatory limits (i.e. AAC limits which means log supply shifts are capped in the short and long run) A caveat is that only a limited amount of research has been undertaken on price elasticity of supply for Coastal BC logs and almost no research for logs by species, such as western redcedar, and also no research on cross-price elasticity. A recent study of the BC cedar industry recommended that research be undertaken on cross-price elasticity of cedar products (Gregory, McBeath and Filipescu 2018).

The log prices in turn reflect demand conditions for the wood-based end use products that incorporate the logs extracted from coastal BC forests. In this section, the recent history of log and wood product prices that directly help drive shifts in timber harvesting on Haida Gwaii are considered.

In BC, the functioning log marketplace is organized on a coast-wide basis. Implementation of the BC Government's Forest Revitalization Plan starting in 2003 reinforced this coast-wide marketplace, which facilitates price and quality competition for Haida Gwaii timber along with the timber of other coastal TSAs, TFLs and private lands. [51]

Transactions of logs between non-related, Coastal BC-based forest industry parties, such as between a market logger and a wood processing facility, occur within the Vancouver Log Market (VLM), which is a longstanding but informal institution that does not have a centrally organized administrative structure. The selling, buying and trading of logs between entities occurs throughout coastal BC, including Haida Gwaii, but log prices are typically adjusted as necessary to reflect transport costs to the Howe Sound-Fraser River area. The collection and publication of Vancouver Log Market prices and volumes are currently undertaken by the Timber Pricing Branch of the BC MFLNR. Every month, the Timber Pricing Branch asks Coastal BC-based forest industry parties, including parties operating on Haida Gwaii, to report their log trading volumes and prices and then collates, adjusts and reports the collected price data as Vancouver Log Market data and makes the reports available on a website.[52]

Rising Vancouver Log Market prices reflect strong lumber market demand conditions in the US house building and home renovation markets

The annual average price of western redcedar (Old Growth) logs, taking into consideration all log grades, climbed from a low of $101 in 2009 to $233 in 2017, a more than doubling of the average price in 2009 when demand conditions in the US housing market were at a low ebb because of the 2008 financial crisis.

Trends in the US housing market are the main factor that feeds back into the demand for Haida Gwaii cedar timber. In BC. about 75% of the province's cedar lumber exports are directed to the US, 95% of its cedar siding exports go to the US and 95% of cedar shake and shingle exports are US-bound (Gregory, McBeath and Filipescu 2018). Export value and volumes of red cedar lumber, the main cedar product category, mirror the trend in Vancouver Log Market prices.

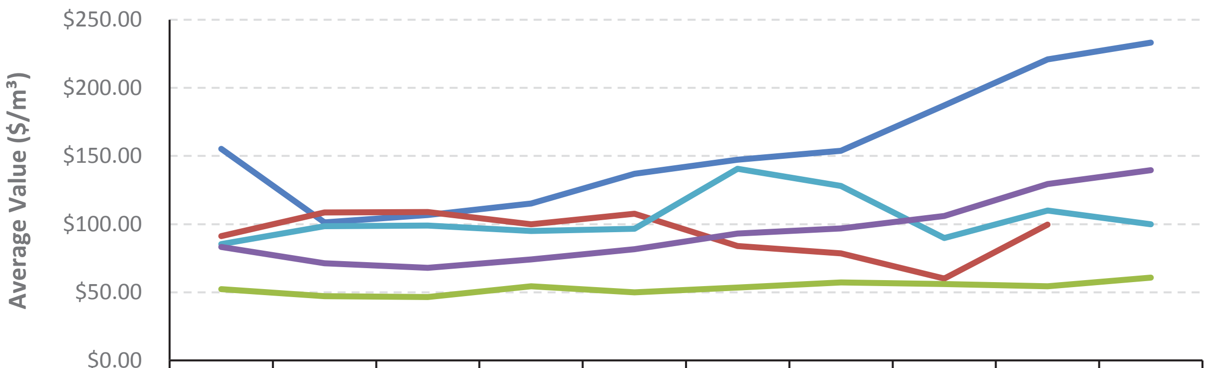
Hemlock log prices were largely stagnant over the 2008-2017 and well below Haida Gwaii per m^3 harvest and transport costs. Prices for Sitka spruce logs have been relatively strong (taking

[51] Reinforcement because the greater distance from Lower Mainland and Vancouver Island fibre processing capacity, remote harvesting locations and somewhat harsher growing climate already places Haida Gwaii logs at a cost disadvantage and sometimes at a quality disadvantage.

[52] See https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/coast-timber-pricing/coast-log-market-reports

into consideration all log grades), peaking at about \$140/m³ in 2013. These log price trends largely reflect conditions in key log and wood product markets and demonstrate that commercial viability of timber harvesting on Haida Gwaii is substantively determined by the amount of cedar and/or spruce in stands. Figure 4-5 and Figure 4-6 show the recent trends in Old Growth and Second Growth log prices, respectively, on the VLM.

Figure 4-5: Old Growth Log Average Price by Species (\$/m³)[53], Vancouver Log Market, 2008-2017

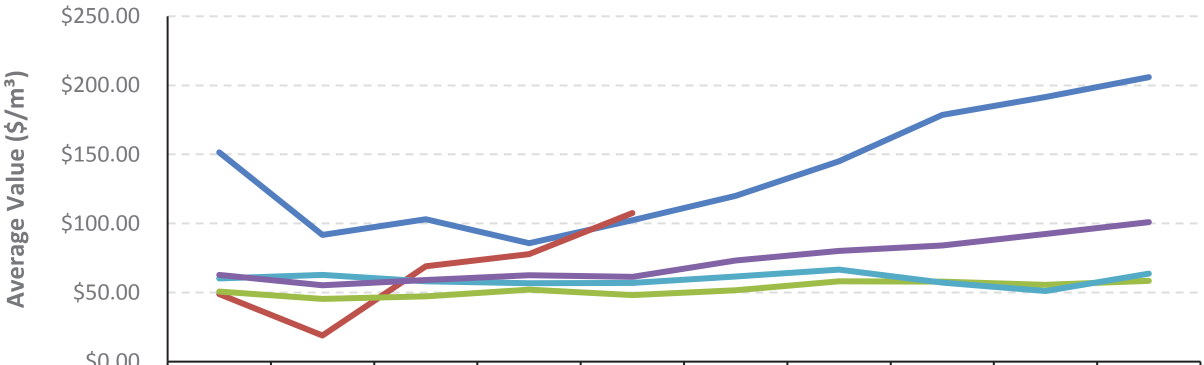


	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cedar	\$155.28	\$101.29	\$106.69	\$115.23	\$137.00	\$147.23	\$153.91	\$187.26	\$220.98	\$233.21
Cypress	\$91.33	\$108.65	\$108.89	\$99.91	\$107.64	\$83.83	\$78.44	\$60.07	\$99.60	
Hemlock	\$52.24	\$47.21	\$46.49	\$54.48	\$50.00	\$53.38	\$57.10	\$55.94	\$54.28	\$60.75
Spruce	\$85.35	\$98.48	\$99.02	\$95.02	\$96.66	\$140.62	\$127.95	\$89.82	\$109.89	\$99.94
All	\$83.34	\$71.19	\$67.94	\$74.00	\$81.50	\$92.99	\$96.76	\$106.01	\$129.54	\$139.58

Source: Timber Pricing Branch BC MFLNR 2018 and author's calculations

[53] All dollar amounts in this report are reported in current Canadian dollars unless otherwise noted.

Figure 4-6: Second Growth Log Average Price by Species ($/m³), Vancouver Log Market, 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cedar	$151.38	$91.80	$103.10	$85.73	$102.48	$120.02	$144.99	$178.62	$191.57	$205.92
Cypress	$48.85	$18.91	$69.09	$77.75	$107.55					
Hemlock	$50.74	$45.41	$47.26	$52.21	$48.08	$51.67	$58.05	$57.89	$55.49	$58.48
Spruce	$60.18	$62.74	$58.25	$56.79	$57.05	$61.69	$66.61	$57.10	$51.11	$63.78
All	$62.66	$55.29	$59.16	$62.50	$61.32	$73.16	$80.08	$84.15	$92.45	$100.98

Source: Timber Pricing Branch BC MFLNR 2018 and author's calculations

Generally, average prices for Second Growth western redcedar and spruce logs in the Vancouver Log Market trailed their Old Growth log prices over the 2008-2017 period

The gap between the average prices for Second Growth and Old Growth western redcedar logs was relatively modest over the 2008-2017 decade, which suggests that the transition to a greater share of Second Growth cedar will be financially viable on a per m³ basis. Second Growth VLM log prices as a percentage of Old Growth VLM Log Prices are shown in Table 4-1.

Average prices for Second Growth and Old Growth hemlock logs were similar over this decade.

Unlike cedar and hemlock, the price gap between Second Growth and Old Growth Sitka spruce logs was especially wide (approximately 30 to 56 percentage points) during the 2008-2017 period. shows Second Growth average log prices as a percentage of Old Growth average log prices in the Vancouver Log Market.

Table 4-1: Second Growth VLM log prices as percentage of Old Growth VLM Log Prices, 2008-2017

	Red Cedar	Hemlock	Spruce
2008	97.5%	97.1%	70.5%
2009	90.6%	96.2%	63.7%
2010	96.6%	101.7%	58.8%
2011	74.4%	95.8%	59.8%
2012	74.8%	96.2%	59.0%
2013	81.5%	96.8%	43.9%
2014	94.2%	101.7%	52.1%
2015	95.4%	103.5%	63.6%

2016	86.7%	102.2%	46.5%
2017	88.3%	96.3%	63.8%

Source: Timber Pricing Branch BC MFLNR 2018 and author's calculations

4.3.3 Export Log Market Prices

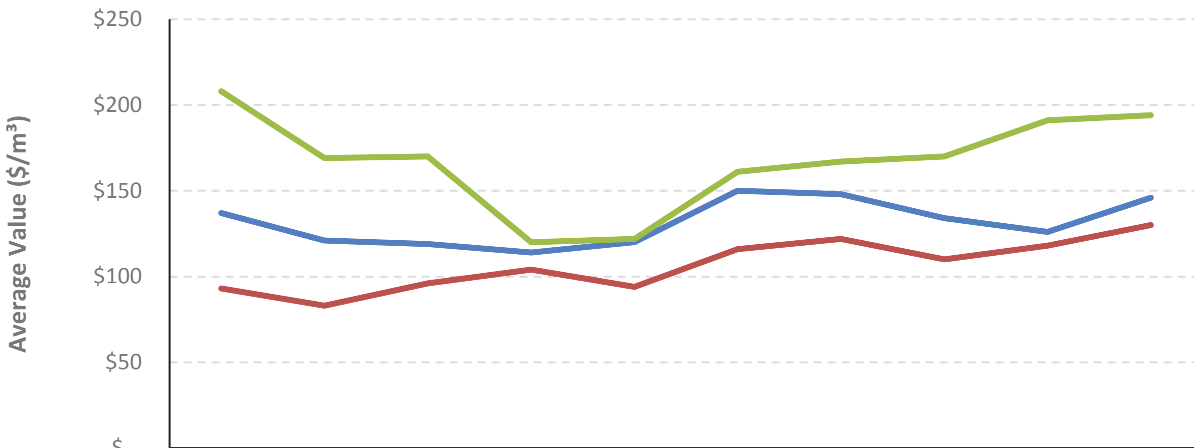
Rising softwood log prices has been the trend in export markets post the 2008 global financial crisis

As outlined in Section 4.6.4, Haida Gwaii timber destined for export has formed a substantial and increasing portion of the total Haida Gwaii harvest over the 2008-2017 decade. The BC-based supply side factors contributing to the increase in Haida Gwaii log exports are reviewed in Section 4.5.2. The demand side factors driving the growth in log exports are the demand for wood-based end products in the country markets sourcing BC logs, mainly China, Japan, South Korea and the US.

Export log prices, driven by wood product demand conditions in China (hemlock), Japan (spruce) and the US (western redcedar), have generally exceeded VLM log prices

Another important factor has been the high prices for export logs relative to Vancouver Log Market prices, especially for hemlock logs, which rose from a low of $83/m^3 in 2009 to $130/m^3 in 2017. Prices for export spruce logs, which also benefited from the 2010 Haida Gwaii Timber Exemption Order, dipped for a few years post the global financial crisis that began in 2008 but recovered by 2013, a pattern seen across the three main Haida Gwaii export log species. Table 4-9 shows the recent trend in and levels of average annual prices of BC export logs by species that are sourced from Haida Gwaii.

Figure 4-7: BC Export Log Average Price by Species ($\$/m^3$), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spruce	$137	$121	$119	$114	$120	$150	$148	$134	$126	$146
Hemlock	$93	$83	$96	$104	$94	$116	$122	$110	$118	$130
Cedar	$208	$169	$170	$120	$122	$161	$167	$170	$191	$194

Source: BC Stats and author's calculations

The higher prices in export markets for hemlock and spruce logs than their prices in the Vancouver Log Market have been a key factor in the diversion of an increasing portion of the Haida Gwaii log harvest from domestic markets over to buyers in China, Japan and South Korea.

Over the 2008-2017 period, the average export price for hemlock logs ranged between 176% and 217% greater than the average VLM prices for Old Growth hemlock logs and between 183% and 225% greater than the average VLM prices for Second Growth hemlock logs. The average export price for spruce logs also superceded the VLM prices for Old Growth and Second Growth spruce logs by a considerable margin.

The margin between export prices and VLM prices for western redcedar logs showed a different pattern over the 2008-2017 decade. The gap between the export prices and the VLM prices for cedar logs narrowed after 2010 whereas the margin between export and VLM prices was wider to start with and grew for hemlock and spruce logs over the decade. The differences between these three species in the gap between their export and VLM prices are due to the following reasons.

- The improved strength of the US residential building and renovation markets post 2010 pushed up the demand (and prices) in the US for cedar products within a limited cedar log supply situation.
- The willingness of these US residential building and renovation markets to accept a price premium for the value of the visual and durability attributes of cedar products.

- The more limited demand in Asian markets for cedar wood products compared to North America and the direct competition from tropical hardwoods in Asian markets.

Table 4-2 presents average export log prices as a percentage of average Vancouver Log Market prices by species for Old Growth and Second Growth logs.

Table 4-2: Export Log Prices as Percentage of Vancouver Log Market Prices by Species for Old Growth and Second Growth logs, 2008-2017

	Old Growth Red Cedar	Old Growth Hemlock	Old Growth Spruce	Second Growth Red Cedar	Second Growth Hemlock	Second Growth Spruce
2008	134%	178%	161%	137%	183%	228%
2009	167%	176%	123%	184%	183%	193%
2010	159%	206%	120%	165%	203%	204%
2011	104%	191%	120%	140%	199%	201%
2012	89%	188%	124%	119%	196%	210%
2013	109%	217%	107%	134%	225%	243%
2014	109%	214%	116%	115%	210%	222%
2015	91%	197%	149%	95%	190%	235%
2016	86%	217%	115%	100%	213%	247%
2017	83%	214%	146%	94%	222%	229%

Source: BC MFLNR 2018; BC MFLNR 2018; and author's calculations

4.4 Haida Gwaii Commercial Harvest Timber Supply

4.4.1 Haida Gwaii Management Area Annual Allowable Cut

From an economic perspective, the HGMCdetermined AAC sets a maximum allowed annual timber harvesting level for HGMA lands

This chapter begins with a review of the regulated allowable annual cut (AAC) levels and AAC management on Haida Gwaii as they place an upper boundary on annual timber supply volume from HGMA lands that can be directed into local, other BC and international log markets and wood processing facilities. Regulatory decisionmaking for setting AAC levels on Haida Gwaii generally incorporates but is not limited to:

- a timber supply analysis and its inputs of available harvesting landbase, inventory and growth and yield data,
- planning or legal designations, such as those provided for under the *Land Act*, the *Forest and Range Practices Act* (FRPA) and the Haida Gwaii Land Use Objectives Order, and
- information on local social and economic conditions.

The HGMC's AAC determination sets the overall upper limit for the sum of AACs applicable to HGMA lands of five types of forestry management units. The forestry management units are as follows.

- TSA (excepting the portion of a TSA situated in a municipality)
- TFL (excepting the portion of a TSA situated in a municipality)
- woodlot licences (excepting the private lands portion)
- community forest agreements[54]
- First Nations woodland tenures

Section 8(11) of the *Forest Act* prescribes that the aggregate of AACs for the management units situated within the HGMA boundaries cannot exceed the HGMA's AAC. The forested land management units currently present in the HGMA are as follows.

- TSA 25 (Haida Gwaii)
- TFL 58
- TFL 60
- Woodlot Licences W1841, W1840, W0162 and W0161

The current AAC for the Haida Gwaii Management Area (HGMA) is 929,000 m^3 and was determined by the Haida Gwaii Management Council (HGMC) and became effective as of April 4, 2012 (HGMC 2012).

The areas of the management units not in the HGMA (and the estimated annual AAC contribution from each), i.e. the municipal areas in TSA 25 (7,500 m^3) and TFL 60 (2,000 m^3) and the private lands in Woodlot Licences W1841, W1840, W0162 and W0161 (1,817 m^3), were not included in the determination of the HGMA AAC by the HGMC (Sutherland 2012). 921,550 m^3 is the aggregate of the AACs for TSA 25, TFL, 58 and TFL 60 and 7,450 m^3 is the aggregate of the AACs for the four woodlot licences that the HGMC used in its HGMA determination of 929,000 m^3.

From an economic perspective, the HGMA AAC sets a maximum allowed (and maximum potential) annual timber harvesting level on HGMA lands that is then Provincially regulated over a cut control period and therefore places an upper boundary on log supply (from HGMA lands) into local, other BC and international log buying and wood processing markets. The AAC therefore sets out a potential timber harvest and supply of logs from HGMA lands, which takes into account regulatory requirements and policy guidance, including ecosystem-based management (EBM), and assumptions about commercial

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[54] Neither a First Nations woodland tenure nor a community forest agreement is in place in the HGMA although establishment of both tenures in the HGMA are the focus of ongoing proposals and discussions (see Sections 4.4.4 and 4.4.5, respectively).

operability of logging activities. The actual harvest is determined in broad terms however by the following.

- Log and wood product demand forces in key markets such as the US and China.
- Other timber supply considerations, mainly the cost of harvesting and transporting timber on Haida Gwaii and the match of available Haida Gwaii timber with market demands.
- Winter and summer weather conditions.
- Political protests at or near current or prospective cut blocks.
- Administration- and policy-based decisions and actions on timber harvest plans and permits by entities holding Haida Gwaii timber tenures and by authorities with regulatory responsibilities for Haida Gwaii forests.[55]

As an initial observation, a modest decrease or increase in the HGMA AAC from the current level would not necessarily translate to changes in timber harvesting and associated economic activity because the full amount of AACs of management units around the province are often not utilized due to weak demand in key wood product markets, species focused partitions and/or administrative reasons, such as incomplete cut block planning. However, a larger decrease in the HGMA AAC (even within the context of weak log markets) or a modest increase in AAC when demand in key wood product markets is strong would likely result in substantive harvest level shifts from recent levels and associated changes in economic activity on Haida Gwaii.

The HGMC's April 2012 decision was the first time that non-ministry persons determined an AAC for BC public forest lands. This was also the first time that an AAC was developed for the public forested landbase on Haida Gwaii. Prior to the HGMC's 2012 determination, the Chief Forester of BC determined a separate AAC for each of the Haida Gwaii Timber Supply Area (TSA) and tree farm licenses (TFLs) and the Haida Gwaii Forest District manager provided an AAC for Haida Gwaii Woodlot Licences (WLs).

AACs in force prior to that decision for TSA 25, TFL 58 and TFL 60 and for the lands of the four Haida Gwaii woodlots need to be aggregated from the perspective of describing the maximum allowed harvest on HGMA lands prior to the HGMC's 2012 decision. The aggregated total of the AACs for these management units prior to the HGMC's 2012 decision was 1,780,092 m^3.[56] The 2012 determination of 929,000 m^3 represented a 47.8% reduction

[55] This would include decisions about availability of and use of Haida Gwaii contractors, labour supply and equipment and use of non-local workers and contractors.

[56] 1,772,616 m^3 for the sum of the TSA 25, TFL 58 and TFL 60 AACs and 7,476 m^3 attributable to Crown lands of the four woodlots (9,293 m^3 is the sum of the AACs for the four woodlots on Haida Gwaii, 1,817 m^3 is attributable to their private lands and 7,476 m^3 attributable to their Crown lands).

from this prior total allowed annual timber harvest (which had been in place since 2009, see Appendix III).

4.4.2 AACs of Haida Gwaii Forest District Management Units TSA 25, TFL 58 and TFL 60

Each of the 2012 Haida Gwaii TSA and TFL AAC determinations entailed significant decreases from the previous levels, ranging from -21.0% to -57.7%

Under Section 8 of the *Forest Act*, the Chief Forester determines AACs for TSAs and TFLs throughout BC, including TSA 25 and TFLs 58 and 60 on Haida Gwaii. Subsequent to the April 2012 determination of the initial AAC for the HGMA, the Chief Forester determined new AACs for TSA 25 (512,000 m^3), TFL 60 (79,000 m^3) and TFL 58 (340,000 m^3) effective September 20, 2012. These new AACs for the Haida Gwaii management units sum to a total of 931,000 m^3.

The new Haida Gwaii AACs reflected the requirement of Section 8(11) of the *Forest Act* that the aggregate of AACs for the TSA, TFLs, woodlot licences, community forest agreements, and First Nations woodland tenures applicable to the HGMA not exceed the HGMA's AAC. The 931,000 m^3 figure incorporates the estimated annual 9,500 m^3 contribution from the municipal land areas of TSA 25 and TSA 60.[57]

Each of the 2012 Haida Gwaii TSA and TFL AAC determinations entailed significant decreases from the previous levels, ranging from -21.0% to -57.7%. The September 2012 and prior AACs for these management units and the gap between them are presented in Table 4-3.

Table 4-3: Recent AACs for Haida Gwaii Management Units (m^3)

Management Unit	AAC effective September 20, 2012 (m^3)	Prior AAC (m^3), in effect since 2009	Change in AAC (m^3 and %)
TSA 25	512,000	869,748	-357,748 / -41.1
TFL 58	79,000	100,000	-21,000 / -21.0
TFL 60	340,000	802,868	-462,868 / -57.7[58]
All units	931,000	1,772,616	-841,616 / -47.5

57 The non-municipal land areas of TSA 25, TSA 58 and TFL 60 accounted for a total AAC contribution of 921,500 m^3 (Sutherland 2012).

58 The shape and area of TFL 60 changed significantly between the 2012 and previous AAC determination which, in part, is a contributor to the shrunken AAC.

Source: Sutherland 2012

Haida Gwaii-headquartered Taan Forest Products Ltd. is the holder of the TFL 60 tenure, which has an AAC of 340,000 m^3 and is predominantly located on Graham Island with smaller portions located on Moresby Island and on Louise Island. Taan completed the acquisition of the TFL 60 tenure (then called TFL 39 Block 6) from WFP in June 2012 (Taan Forest 2016).

TFL 58 is located on Moresby Island. Vancouver-headquartered A&A Trading (Haida Gwaii) Ltd. (A&A) is the holder of the TFL 58 tenure, which has an AAC of 79,000. A&A Trading completed the purchase of the TFL 58 tenure from Surrey-headquartered Teal Cedar Products Ltd. in December 2016.

Through their replaceable and non-replaceable forest licences in TSA 25, Haida Gwaii-headquartered Taan, Delta-headquartered Husby Forest Products Ltd. (Husby), and Vancouver-headquartered A&A, and BC Timber Sales through its apportionment, are the main holders of TSA 25 AAC committed volume. TSA 25 is predominantly located on the west and east sides of Graham Island with a small area on the northwestern portion of Moresby Island.

The AACs for the Haida Gwaii TSA and TFL management units have been altered between timber supply processes due to timber tenure ownership changes, collaborative planning processes involving the BC Government, Haida Nation and sometimes local entities, and BC Government policy and administrative decisions.

Over the past two decades, prior to the 2012 AAC determiations, the total of the AACs for the Haida Gwaii TSA and TFLs stood at a high point of 1,786,000 m^3 in 2000 and dipped to a low of 1,224,116 m^3 over the three-year 2006-09 period due to reductions stemming from land use objectives and new protected areas contemplated in the Haida Gwaii Strategic Land Use Agreement (SLUA) that the Province of British Columbia and the Council of the Haida Nation entered into on December 12, 2007.[59] The changing levels of the AACs for the Haida Gwaii TSA and TFLs over the 2000-17 period are summarized in Appendix III.

Under Section 75 of the *Forest Act*, holders of BC government awarded timber agreements and tenures can exceed their tenure's AACs by a limited amount over a multi-year "cut control" period without being penalized. However, any harvest above the cumulative AAC for the cut control period must be counted as harvest during the next period. As a consequence, within a larger management area, such as Haida Gwaii or another forest district, actual harvests can exceed an area's AAC by up to a speciefied percentage (10% in forest licences and TFLs) without the licensee being penalized under the *Forest Act*.

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[59] Under Part 13 of the *Forest Act*, the Government of BC can designate areas of Crown land for up to 10 years and then suspend or vary permits, licences and plans in force within the area, and the Chief Forester can temporarily reduce the AAC of a timber tenure by an amount attributable to the designated Part 13 area. Part 13 is generally applied in support of land and resource use planning.

Cut control regulation sets a maximum (but not a minimum) on the timber harvest margin by which a tenure holder can exceed the tenure's AAC over a specified multi-year period and not incur a penalty. In general, a cut control period of five years is used for tenures with a term greater than five years. Harvest in relation to AAC for tenures with a term of five years or less are reconciled over the term of the tenure. The upper acceptable harvest exceedance is typically determined as a percentage of the aggregated AACs for the cut control period. For replaceable and non-replaceable forest licences (with an AAC greater than 10,000 m^3) and Tree Farm Licences the upper limit is 110% of the sum of AACs in the cut control period (typically five years). For Woodlot Licences, the upper limit is 120%.

If cumulative harvests are below the AAC over a cut control period, Section 75.8(1) of the *Forest Act* prohibits the carry forward of unharvested volume from one cut control period to a subsequent cut control period by a licensee (BC MFLNR 2017b).[60]

4.4.3 TSA 25 AAC Apportionment and Commitments and Licence Ownership

Haida Gwaii based ownership of Haida Gwaii tenures has greatly increased through the creation and expansion of Taan Forest Products Ltd.

Within the AAC parameter set down by the Chief Forester for a TSA (TSA 25 in the case of Haida Gwaii), under Section 10 of the *Forest Act*, the Minister has the authority to apportion (i.e. allocate) portions of the TSA's AAC to an agreement or licence tenure category (such as the Replaceable Forest Licence tenure category). This ministerial exercise is referred to as "apportionment" and typically occurs within a few months of an AAC determination for a TSA. The apportionment establishes the portion of a TSA's total AAC that can ultimately be committed to or specified in agreements or licences within each tenure category (BC MFLNR 2018b). Each timber harvesting agreement/licence in a TSA has a specified AAC or rights to harvest a specified volume of timber, with obligations to meet forest management requirements and pay stumpage to the province.

Several agreements with AAC commitments are typically in place when a new apportionment is set out for a TSA. The AACs of existing licences in the TSA are not altered due to the minister's apportionment decision.[61] The apportionment decision circumscribes however the timber harvest volume that can be allocated by the responsible ministry officials for future licence awards within a tenure category, such as the volume that BC Timber Sales can auction via Timber Sale Licences.

The minister may issue one or more new apportionment decisions between TSA AAC determinations, and, as well, new licences with specified AAC commitments may be awarded

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[60] Under Section 75.8(2), the undercut (unharvested volume) may be disposed of to a person (other than the licensee) by way of a forestry licence to cut, a timber sales licence, or a non-replaceable forest licence (BC MFLNR 2018c).

[61] However, licences are subject to reductions if the TSA AAC is reduced (*Forest Act* Section 63 proportionate reduction).

and old licences may expire. The ministry typically issues an apportionment and commitment status report on an annual basis.

Because some forest licences are in place within a TSA and have AAC "commitments", the sum of AAC commitments may not align with the apportionment. As a result, commitments for a licence category can exceed or fall short of the AAC apportionment allocated by the minister and the sum of licence commitments can exceed the AAC for the TSA as a whole as determined by the Chief Forester.

The current apportionment for tenure types in TSA 25 became effective August 1, 2013 and the replaceable forest licences category accounts for the largest volume of the six listed tenure/licence categories at 213,632 m^3 or 41.7% of the TSA's AAC of 512,000 m^3 (BC MFLNR 2018b).**Error! Reference source not found.** Table 4-4 presents the current AAC apportionment and commitments for TSA 25.

Table 4-4: TSA 25 AAC Apportionment and Commitments (m^3 & % of TSA 25 AAC)

Form of Agreement	m^3	% of AAC
Replaceable Forest Licences	213,632	41.7
Husby Forest Products Ltd. (A16869)	192,044	37.5
A&A Trading (Haida Gwaii) Ltd. (A16870)	13,632	2.7
Dawson Harbour Logging Ltd. (A75084)	7,956	1.6
Non-Replaceable Forest Licences	14,210	2.8
BCTS Partnership (Taan Forest Products)	14,210	2.8
Non-Replaceable Forest Licence – First Nations	120,000	23.4
Haida Tenure (Taan Forest Products)	120,000	23.4
BCTS Timber Sale Licence/ Licence to Cut	81,658	15.9
Community Forest Agreement	80,000	15.6
Forest Service Reserve	2,500	0.5
Total Allowable Annual Cut	512,000	100.0

Source: BC MFLNR 2018b

At this time, three replaceable forest licences are held with commitments for TSA 25 timber volume, two are controlled by Husby and one by A&A. Forest Licence A16869 is directly held by Husby and has a commitment of 192,044 m^3. A Husby subsidiary, Dawson Harbour Logging Co. Ltd., holds forest licence A75084 that has a smaller commitment of 7,956 m^3 so the AAC commitments for Husby's two forest licences account for almost 40% of TSA 25's AAC and 21.9% of the HGMA's AAC. A&A holds Forest Licence A75084, which has a commitment of 13,632 m^3 (BC MFLNR 2018b). A&A acquired the licence in 2017 from Teal, which had held this forest licence and the TFL 47/58 tenure between 1999 and 2017.

The province also signed a Haida Forest Agreement with the Council of the Haida Nation in 2014 to provide a First Nations Woodland Licence over a specified mapped area for a volume of up to 120,000 m^3/year. In the interim while work is underway on that licence, a short term non-replaceable forestry licence to cut has been issued to Taan over the area. This area accounts for 23.4% of the TSA's AAC. This area also includes a small amount of volume apportioned to BCTS (14,210 m3/year)..[62] The BC Government awarded this volume to Taan in June 2010.[63] In addition, Taan manages jointly with BCTS a volume of 14,210 m^3, which accounts for a further 2.8% of the TSA's AAC.[64] These Taan controlled volumes account for a total of 134,210 m^3 or 26.2% of TSA 25's AAC.

Taan controlled volumes account for approximately 50% of the sum of the Haida Gwaii TSA and TFL AACs, a total of 474,210 m^3.

Discussions have been underway between the BC Government and Haida Nation associated parties for the conversion of the Taan held FLTC and TFL 60 into an area-based First Nations Woodland Licence, and the arrangements to establish this new licence are expected to be soon finalized (pers. comm. Mosher, J. 2018).

TimberWest Forest Corp. (TimberWest) acquired a 60,000 m^3 forestry licence to cut in 2011 that Teal managed for TimberWest. This licence expired in 2018.

The direct apportionment for the BCTS Timber Sale Licence category stands at 81,658 m^3 or 15.9% of the TSA's AAC and 8.9% of the HGMA's AAC.

As a planning tool and policy instrument, apportionments of TSA AAC volume may be allocated by the minister for proposed and possibly under negotiation community forest agreements, woodlot licences and First Nations Woodland Licences.

The minister allocated an apportionment of 80,000 m^3 for a proposed Haida Gwaii community forest agreement (CFA) in the minister's May 18, 2011 apportionment determination for TSA 25 and this CFA apportionment volume has remained in subsequent (annual) ministerial apportionment determinations. Depending on the CFA arrangements between the BC Government and Haida Gwaii's CFA proponent (see Section 4.4.5) all or part of the CFA apportionment may be removed from TSA 25 upon the establishment of a Haida Gwaii CFA and this would likely trigger a commensurate reduction in the ministerial AAC apportionment determination for TSA 25.

Upon the completion of the conversion of the Taan-held FLTC to a First Nations Woodland Licence, the expected AAC of 120,000 m^3 for the new area-based licence would be removed from the AAC of TSA 25.

4.4.4 Haida Gwaii Woodlot Licences

Four longstanding woodlot area-based licences with AACs totalling 9,293 m^3 are located on Haida Gwaii. Their AACs were not altered after the initial HGMA AAC determination. The

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62 This tenure is administered as a forest licence to cut (FLTC).

63 Under Section 47.3 of the *Forest Act,* the Minister can award certain types of tenures, such as a forestry licence to cut and forest licence, directly to a First Nation "to implement or further an agreement between the First Nation and government respecting treaty-related measures".

64 Joint planning on harvest planning roadbuilding and auctioning.

Haida Gwaii woodlot licence AACs and general locations are summarized in Table 4-5**Error! Reference source not found.**.

Table 4-5: Haida Gwaii Woodlot Licences

Licence no.	Woodlot Licence holder	Area & AAC	General location
W1841	Old Massett Village Council	478 ha & AAC of 2,120 m^3	Near Port Clements
W1840	Skidegate Band Council	422 ha & AAC of 2,000 m^3	Near Jungle Creek
W0162	G. Lavoie	465 ha & AAC of 2,445 m^3	Lawn Hill Area
W0161	D. Younger	477 ha & AAC of 2,728 m^3	Near Port Clements

Source: BC MFLNR undated

4.4.5 Community Forest

Communications between the Province of BC, Haida Gwaii communities and the Haida Nation about the establishment of a community forest on Haida Gwaii started in the mid 1990s with a memorandum of understanding between the BC Government and – signed in 1996 which included an offer of 56,000 m^3 and a rider that a further 25,000 m^3 would be identified through a new AAC determination process.These communications between the Government of BC and Haida Gwaii parties about the establishment of a community forest on Haida Gwaii have been (intermittently) ongoing over the following years.[65]

The Province of BC's offer was broadened in 2010 to a Community Forest Agreement for all island communities, and with Misty Isles Economic Development Society (MIEDS) as the Haida Gwaii CFA proponent. This offer incorporated a volume of 80,000 m^3 per year provided that the communities enter into a partnership with BCTS to deliver the entire 80,000 m^3 to help support the province-wide market pricing delivered through the BCTS auctions of Timber Sale Licences (TSLs).

[65] Abbreviated summaries of several events or milestones between 1996 and to date about creating and establishing a Haida Gwaii community forest are presented on the Haida Gwaii Community Forest web site (see https://haidagwaiicommunityforest.com/community-forest-timeline/). The information in the sub-section of this socio-economic report summarizes the current status of the Haida Gwaii community forest and a few past events but does not recapitulate all events and milestones. Parties interested in additional information should review the cited web pages and the community forest options report prepared by a Haida Gwaii-based consultant for Misty Isles Economic Development Society (Moore Resource Management 2016).

This proposal was the basis for the minister for the first time (in May 2011) apportioning TSA 25 AAC volume (80,000 m^3) to the community forest agreement category in a ministerial apportionment determination. This TSA 25 apportioned volume of 80,000 m^3 for a community forest agreement has remained in all subsequent annual apportionment status reports.[66]

Over the 2012-204 period, in advance of setting up and finalizing a CFA, the Ministry provided a transitional volume of 125,000 m^3 to MIEDS in order to mitigate the effects that designated areas associated with the Haida Gwaii Strategic Land Use Plan implementation had on the earlier 2004 invitation from the Government to the Village of Masset to apply for a community forest.. This volume was tenured to MIEDS as a Forestry Licence To Cut and Non-Replaceable Forest Licence and delivered by BCTS under three business-to-business agreements between MIEDS and BCTS. Under the agreements BCTS paid MIEDS a monetary consideration of approximately $600,000 or an average of $4.80/$m^3$ over three years (pers. comm. T. Johnson 2018).

In 2016, Misty Isles Economic Development Society commissioned a consultant to research and write a report on potential options for a Haida Gwaii community forest agreement (Moore Resource Management 2016). At a January 2017 meeting with ministry representatives, Misty Isles Economic Development Society representatives asked that the Province of BC issue a formal offer for a Haida Gwaii community forest. Subsequently, in a December 2017 letter from the Regional Executive Director of the West Coast Forest region to the Chair of Misty Isles Economic Development Society, the Province of BC invited Misty Isles Economic Development Society to submit an application for a Community Forest Agreement.

The December 2017 BC Government CFA proposal included a specific mapped area for the community forest and an offer of approximately 80,000 m^3/year with a reduced volume condition in which 55,000 m^3 per year would be sold by BCTS to help support the province-wide market pricing system.[67] The net revenue on the BCTS portion of the CFA would be shared between BCTS and MIEDS on a 50:50 basis in accordance with regulation (Hadway 2017). This latest invitation to submit a CFA application has since been extended by the Ministry to July 2019. Under the reduced volume condition, BCTS is responsible for silviculture obligations on TSLs that BCTS auctions (pers. comm. T. Johnson 2018).

The largest part of the BC Government proposed CFA area is on the east side of Massett Inlet, in the Drizzle/Watt/Loon Lake area between Masset and Port Clements. Other areas

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[66] The harvest planning and administration for this 80,000 m^3 of CFA category volume in TSA 25 has been managed to date by BCTS.

[67] The typical practice is for the offered CFA AAC apportionment to be removed from a TSA upon signing of the Community Forest Agreement similar to the way in which all area-based agreements are handled. Given the proposed re-direction of 55,000 m^3 of the Haida Gwaii community forest's AAC to BCTS management, this 55,000 m^3 is likely to remain as an apportioned TSA 25 AAC volume.

include an area south of Tlell, the Honna River area from west of Queen Charlotte to north of Skidegate, as well as the Sewell/Tasu and Skidegate Lake areas on Moresby Island.

The subsidiary established by Misty Isles Economic Development Society to manage the local community forest, Haida Gwaii Community Forest, prepared a draft management plan to facilitate discussions with Haida Gwaii stakeholders, the BC Government and Haida Nation (Misty Isles Economic Development Society 2018). At this time, Misty Isles Economic Development Society continues to discuss this latest Community Forest Agreement proposal and potential revisions to it with local stakeholders, the Haida Nation and the Ministry.

4.5 BCTS Timber Sales

Haida Gwaii-focused forestry companies have won the majority of BCTS' competitive auctions for Haida Gwaii TSLs over the 2008-2017 period

BCTS' competitive auction system for Timber Sale Licences (TSLs) provides the basis for collecting the market price information used to help determine BC Government stumpage rates. On a province-wide basis BCTS has annual targets of auctioning a Section 20 TSL volume that is equivalent to a minimum 20% of the total projected provincial harvest volume for the year. For the 2017-18 fiscal year, BCTS auctioned 19% of the projected coastal BC public lands harvest and 20% of the projected BC Interior harvest (BCTS 2018b).

The recent experience on Haida Gwaii shows that over the four-year 2013-2016 period following the initial HGMA AAC determination BCTS auctioned an annual average of approximately 132,000 m^3 of TSL volume which represented about 15% of the HGMA lands average annual harvest (for the 2013-2016 period) and about 75% of the total of the BCTS AAC apportionment, the CFA AAC apportionment and the BCTS-Taan NRFL commitmentand (BCTS undated).

The BCTS AAC apportionment on Haida Gwaii has shifted up and down over the 2008-2017 periodand is shown in Table 4-6.

Table 4-6: BCTS' AAC apportionment for TSA 25 (m^3), 2008-2017[68]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
BCTS AAC	91,978	91,978	62,661	174,819	174,819	81,658	81,658	81,658	81,658	81,658

Source: BC MFLNR various

Parties associated with Haida Gwaii-focused forestry companies made the majority of TSL winning bids in BCTS's Haida Gwaii timber auctions over the 2008-2017 period, an estimated

[68] By apportionment effective date as stated in BC MFLNR's annual reports on TSA 25's AAC, Apportionment and Commitments

47 of the 57 TSL auctions.[69] These winning bids by Haida Gwaii-focused forestry operations account for an estimated TSL volume of 1,040,022 m^3, 79.0% of the total TSL volume of 1,316,267 m^3 that BCTS awarded on Haida Gwaii over the 2008-2017 period. The subset of Haida Gwaii headquartered forestry enterprises accounted for an estimated 760,736 m^3 and 38 TSL winning bids, 57.9% of the BCTS awared volume(BCTS 2018a).[70]

In large measure, this result for Haida Gwaii TSL auctions was likely due to the cost competitiveness and bidding prowess of the Haida Gwaii focused logging operations through their knowledge of local logging and transport operating conditions and timber fibre attributes and having Haida Gwaii resident employees and Haida Gwaii-based equipment which translates into transport cost savings. The winning bidders of BCTS Timber Sale Licence auctions for Haida Gwaii and the location and volumes of these timber sale licenses over the 2008-2017 period are listed in Appendix IV.

4.5.1 Cedar Timber Supply and Cedar AAC Targets

A cedar partition on Haida Gwaii influences the total harvest on the islands because harvest planning and decisions by most Haida Gwaii tenure holders are greatly influenced by the volume of commercially operable cedar in stands being considered for harvesting

In its initial April 2012 AAC rationale, the HGMC recommended that the Chief Forester set up a legal AAC partition or allocation for the harvesting of cedar, inclusive of (Ts'uu) western redcedar and (Sgaahlan) yellow cedar, in the Haida Gwaii TSA and TFLs (HGMC 2012). In the September 2012 AAC rationale, the Chief Forester acknowledged this HGMC recommendation but opted instead to introduce non-legal maximum cedar havest levels (targets) with respect to the harvesting of red and yellow cedar in the Haida Gwaii TSA and TFLs (Sutherland 2012). The cedar AAC targets were as follows.

- 195,000 m^3 in TSA 25, (equivalent to 38% of the new AAC512,000 m^3);
- 32,000 m^3 in TFL 58 (equivalent to 41% of the new AAC of 79,000 m^3); and
- 133,000 m^3 in TFL 60 (equivalent to 39% of the new AAC of 340,000 m^3).

The AAC cedar targets for the three Haida Gwaii management units totalled to 360,000 m^3.

The overall harvest of most Haida Gwaii tenure holders was directly influenced by their attempts to manage their cedar harvest in order to comply with the maximum cedar harvest levels attached to the overall AAC allocation.

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[69] The Haida Gwaii focused forestry enterprises residents that made winning bids for TSLs over the 2008-2017 decade was comprised of Taan Forest Products, O'Brien & Fuerst (several persons), Abfam, C Gamble, I. Crosby, Husby and Infinity West (including A Lowen).

[70] The Haida Gwaii headquartered forestry enterprises or residents that made winning bids for TSLs over the 2008-2017 decade are Taan Forest Products, O'Brien & Fuerst (several persons), Abfam, Gamble and I. Crosby.

The harvesting of red and yellow cedar was monitored in these management units over the subsequent three years. The Haida Nation and the Province of BC jointly found that harvesting of cedar by TSA 25 licensees cumulatively exceeded this "soft" partition and that the TFL 58 and 60 tenure holders were in compliance with the cedar maximums.

In an October 24, 2017 letter, the Chief Forester observed that cedar harvest levels in TSA 25 continued to exceed the 2012 direction and that no cedar management strategy had been developed for Haida Gwaii as per the request in the 2012 Chief Forester rationale. In the October letter, the Chief Forester established a partition under section 8(5) of the *Forest Act* of no more than 195,000 m^3 of cedar within TSA 25's AAC of 512,000 m^3. On August 24, 2018, the minister followed up this step by signing a cedar focused partition order applicable to TSA 25 eligible licences (which are replaceable forest licences). Accompanying this order was a letter from the Minister directing BCTS to limit cedar harvesting in the TSA to their proportionate share of the cedar partition.[71] In conjunction with the Chief Forester's October 2017 establishment of a cedar partition, Taan issued a cedar strategy for the Haida Tenure that obligates Taan, starting January 1, 2018 and for a five-year period, to limit the cedar harvest in the Haida Tenure as per the Chief Forester's direction (Mosher undated). Similarly, Husby issued a cedar strategy for its TSA 25 forest licences that obligates Husby, starting January 1, 2018 and for a five-year period, to limit the cedar harvest in the Haida Tenure as per the Chief Forester's direction (Husby 2018).

4.5.2 Log Export Regulation

Supply of Haida Gwaii timber into both BC markets and international export markets, and therefore the overall timber harvest and its associated economic effects, is directly influenced by BC Government and federal government log export regulatory systems

Regulation of log exports at both the federal and BC Government levels has been in place since the 1880s and both jurisdictions have revised their log export regulations several times over the intervening decades (Shinn 1993; Dumont and Wright 2006). Since the early 1900s, the BC Government, and, since the late 1940s, the federal government have relied mainly on a manufacture surplus test approach to help control log exports and thereby assist BC timber processing facilities to have access to BC logs at a BC market price.

The BC and federal government systems differ markedly in the regulation of cedar log exports, however. In general, prospective log exports harvested on either private lands classified as non-exportable Crown grant (i.e. provincial export jurisdiction private lands) or BC public lands are subject to a manufacture surplus test, a fee in lieu of manufacture and either an explicit or implicit prohibition on export of red and yellow cedar logs. Logs harvested from private lands classified as exportable Crown grant (i.e. federal export

[71] The Minister may issue partition orders that are only applicable to forest licences that have an AAC of greater than 10,000 m^3. The *Forest Act* does not provide the authority for the Minister to issue partition orders to other types of tenures, such as a TSL or a FLTC.

jurisdiction private lands) must pass a manufacture surplus test prior to their export but log owners are not subject to paying a fee in lieu of manufacture and, as well, since 1998, red and yellow cedar logs harvested on these federal jurisdiction private lands have not been prohibited from export.[72]

Logs harvested on Indian Reserve lands are not subject to a manufacture surplus test and are generally eligible for export subject to applicable band council and DIAND authorization.

Another key difference in log export regulation between the Province of BC and the federal government is that, starting in the mid-1980s, the BC Government began issuing exemptions from the manufacture surplus test and reducing fees in lieu of manufacture for defined regions, time periods and timber harvest volumes.[73] These exemptions were awarded on the basis that a region had little local wood processing capacity and in general had a weaker economy. Therefore, region specific export log regulation has been present in BC for about 30 years and Haida Gwaii specific export regulation of logs harvested on public lands and provincial export jurisdiction private lands has been in place for approximately eight years.

In 2010, the Minister and the BC Cabinet issued an exemption order-in-council applicable to Haida Gwaii.[74] The Haida Gwaii Timber Exemption Order allows for a proportion of timber harvested on HGMA lands and provincial export jurisdiction private lands, other than red cedar and cypress (yellow cedar) timber, to be "considered surplus to requirements of timber processing facilities in British Columbia" and therefore not subject to the surplus manufacture test (Government of BC 2010).[75] The volume of timber considered to be surplus is capped at 35% of a tenure holder's total harvest volume (including scaled waste and red and yellow cedar volume).[76] A reduced fee in lieu of manufacture specified in the order-in-council must be paid to the BC Government by the export log owner for the exempted volume (Government of BC 2015). In addition, parties can attempt to export logs that result in an exceedance of the 35% cap by submitting these additional log volumes into the BC Government's manufacture surplus test process. This OIC is currently due to expire on July 31, 2019.

4.6 Haida Gwaii Timber Harvest

4.6.1 HGMA Timber Harvest Volume

72 Between 1984 and 1998, export of cedar logs from federal jurisdiction private lands were prohibited from export.

73 Through an order-in-council

74 Orders made in 2015 and 2018 extended the time period of the original 2010 Haida Gwaii order. Between the mid-80s and 1992, there were several OICs, often called "market logger" OICs, which provided smaller, coastal BC operators an exemption from the manufacture surplus test for about 15% of their harvests (subject to certain restrictions).

75 This OIC and similar ones for other Coastal BC areas are sometimes referred to as "blanket exemptions".

76 If the cedar volume is 40% of total volume then the tenure holder can effectively export 58% of the remaining 60%.

The 5-year average harvest of 831,172 m^3 for the 2013-17 period, which coincides with the April 2012 HGMC determination, shows a shortfall of about 10% relative to the HGMA AAC

The billed timber harvest level in the Haida Gwaii Management Area was 645,076 m^3 in 2017, and an annual average of 733,226 m^3 over the 10-year 2008-17 period. The 2017 harvest level is 30.1% (283,924 m^3) below the current HGMA AAC of 929,000 m^3. The 2017 harvest on HGMA lands was the lowest by a large margin within the 5-year 2013-17 period.

The 2016 harvest of 956,471 m^3 and the 2013 harvest of 999,004 m^3 both exceeded the April 2012 HGMA AAC. However, the 5-year average harvest of 831,172 m^3 for the 2013-17 period, which coincides with the April 2012 HGMC determination, shows an undercut of about 10% relative to the HGMA AAC. The 877,696 m^3 average harvest for the 4-year 2013-16 period stands at about 95% of the HGMA AAC.

The most recent 3-year 2015-17 annual average harvest in the HGMA, 805,854 m^3, exceeded the 10-year 2008-2017 annual average of 733,226 m^3 but was under the 5-year 2013-2017 annual average harvest of 831,172 m^3 because of the harvest volume dip in 2017 to 645,076 m^3.

The average annual harvest over the earlier 2008-2012 period was 635,280 m^3. Every annual total timber harvest in the earlier 5-year period of 2008-2012 for the Haida Gwaii TSA, TFLs and WLs was below the sum of their AACs (which ranged from 1,231,592 m^3 to 1,780,092 m^3). In four of those years, 2009 through 2012, the Haida Gwaii harvest averaged only 520,336 m^3 per year i.e. only 30% of the then allowed maximum harvest. This gap between actual harvest and potential harvest primarily reflected weakness on the demand side due to the severe downturn in US housing starts and the general global economic downturn precipitated by the 2008 financial crisis, along with local administrative and planning constraints on finalizing and issuing plans and cutting permits and developing harvest infrastructure due to on islands land use planning, political protests and changes in tenure control. Another factor is that weak demand in end use markets for cedar, hemlock and spruce wood products feeds back into downward pressure on demand for Haida Gwaii timber because the comparatively higher cost Haida Gwaii harvest competes against lower cost timber options.

The shortfall between the actual harvest and a potential harvest (as represented through the AAC) is a general situation across the province and not unique to Haida Gwaii.[77]

During the 10-year 2003-2012 period prior to the initial HGMC AAC determination, the Haida Gwaii annual timber harvest averaged approximately 780,000 m^3, well below the

77 For a graph and data showing the BC timber harvest compared against the total AAC for BC see the Government of BC's online State of the Environment report for the timber harvest indicator, http://www.env.gov.bc.ca/soe/indicators/land/timber-harvest.html

cumulative total of the then current Haida Gwaii AACs and below the average annual harvest for the 5-year 2013-2017 period

Although the available timber supply for annual harvesting was in the 1.2M – 1.8M m^3 range over 2000 – 2012, the amount of timber harvested by commercial operators and supplied into domestic and international markets fell well short of these levels due to target market demand conditions, cost constraints, and administrative and policy parameters on the Haida Gwaii timber supply side.

This ten-year 2003-2012 period includes intervals of strong demand for cedar and spruce log and wood products in target markets that bookended a period of weak demand due to the crash in the US housing market and the 2008 global financial crisis. The introduction of the Haida Gwaii Exemption Order in 2010 gave a strong boost to the offshore demand for local hemlock and spruce logs but was especially important in terms of improving the overall financial viability of harvesting Haida Gwaii stands with their heavy hemlock components as the offshore prices for hemlock logs well outstripped their domestic prices.

Demand conditions for specific species, whether western redcedar or hemlock, and demand conditions in specific sectors (such as new housing) in specific markets (such as the US) and supply conditions in more cost competitive markets (Russian softwood logs to China for example) were the main factors determining the Haida Gwaii harvest during the 2003-2012 period. Constraints on timber supply due to local protests and associated administrative and policy decisions by BC Government and Haida Nation entities, including the introduction of and adjustment to EBM and the Haida Gwaii Land Use Order were very important factors affecting the Haida Gwaii harvest starting in 2005.[78]

Haida Gwaii's timber harvest and transport costs, across species, sit at the upper end of a cost curve that includes harvest and transport costs for equivalent softwood fibres (and substitutable non-wood materials) from other regions (See Section 4.10). This high timber supply cost situation on Haida Gwaii exerts a strong downward pressure on demand for Haida Gwaii hemlock timber, which accounts for around half of the HGMA timber supply, and sets up a difficult competitiveness challenge for Haida Gwaii harvesters of hemlock logs. The much higher prices for Old Growth and Second Growth cedar logs and Old Growth spruce logs compared to hemlock log prices, even in weak demand markets, help buoy up the viability of Haida Gwaii timber harvesting despite the relatively high Haida Gwaii harvest and transport costs.

As outlined in Section 4.3, the Haida Gwaii harvest, over the past couple of decades, has been largely pulled along by the demand in US housing and home renovation markets for products

[78] These local supply side constraints are encapsulated in the following observation in Taan's FSC Management Plan, "Harvest levels in the past have been significantly lower than the Annual Allowable Cut as a result of poor economic conditions and curtailed operations and implementation of the Land Use Order." (Taan FSC Management Plan May 2018)

made from Old Growth western redcedar fibre. However, the evolution of the markets for commodity softwoods fibre in China has transformed the financial viability of harvesting Haida Gwaii hemlock although cost competition is intense in this market from softwoods suppliers in Russia, especially, along with New Zealand and Australian plantation suppliers (and even from other BC suppliers of hemlock logs having lower harvesting and transport costs).

The Haida Gwaii AACs represent a potential maximum commercial harvest and the shortfalls between the actual Haida Gwaii harvest and this maximum allowable harvest is to be expected in weaker demand markets. The shortfalls may even occur in years when log prices are relatively strong because of Haida Gwaii's higher costs of logging, processing and transport, the administrative and policy constraints influencing local timber supply availability. and the targeting of of cedar timber in making decisions on the commercial viability of logging Haida Gwaii stands. The overall Haida Gwaii harvest experience up to 2017 compared against the 2012 AAC determinations, given the relatively good markets for Haida Gwaii timber, suggests that the maximum potential harvest (represented through these 2012 AACs) during this 2013-2017 period was appropriate from an economic or commercial perspective (along with ecological and cultural perspectives) given the local supply side constraints in making timber available for harvest on Haida Gwaii.

Timber Harvest by Management Unit

The TSA 25 average annual harvest over the 5-year 2013-2017 period subsequent to the initial HGMA AAC determination was 551,590 m^3, which exceeds the AAC of 512,000 m^3 for TSA 25 by about 7.8%.[79]

The shortfall between the HGMA harvest and AAC over this 5-year period cited in the previous section was due to annual harvesting in TSA 58 and TSA 60 being below their AACs (79,000 m^3 and 340,000 m^3, respectively). From a management unit perspective, the gap between the actual HGMA harvest and maximum potential harvest as represented via the AAC appears to be due primarily to the shortfall in TFL 60, which had an annual average harvest of 186,364 m^3 for the 5-year 2013-2017 period (55% of its AAC).

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79 In addition to harvesting to cut control limits, a couple of administrative factors can push a TSA harvest over a TSA AAC within a cut control period. The harvest figures can include TSLs that had been sold up to four years prior to a current year and that are just being harvested in a current year. Another possibility is that timber may have been logged prior to the AAC coming into effect but the (commercial and waste) timber was billed and registered in the Harvest Billing System after the AAC came into effect. Temporally identifying actual harvest activity using harvest billing system data is a complex matter.

Figure 4-8 outlines in a graph and a table the HGMA billed/invoiced harvest volume by management unit over the 10-year 2008-17 period.[80]

Figure 4-8 HGMA Timber Harvest by Management Unit (m^3), 2008 - 2017

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Woodlots	4,184	10,199	4,346	5,613	20,531	12,661	16,880	7,261	20,061	2,215
TFL 60 Haida Gwaii	90,580	124	46,503	90,285	69,017	173,781	137,748	196,546	258,527	165,219
TFL 58 Morseby Island	140,560	64,651	90,299	17,732	42,362	126,082	105,778	65,900	24,269	23,594
TFL 39 Haida	446,127	62,801	123,738	73,400	36,627	4,186	2,500	0	0	0
TFL 25 Naka	25,599	650	2,140	540	0	54,696	0	0	0	0
Haida Gwaii TSA 25	388,406	166,877	407,661	344,519	400,329	627,598	476,385	546,363	653,560	454,047
Total	1,095,456	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations[81]

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80 Harvest data in this socio-economic report is from the BC Government's Harvest Billing System and is the harvest by date of invoice. The harvest data reported herein includes avoidable waste volumes as per standard reporting practice. The harvest data reported in this socio-economic report was downloaded by and directly supplied to the report's authors by an employee of the Ministry's Timber Pricing Branch.

Harvest data in the Harvest Billing System is also available by scale date. The timing of the harvest volume varies slightly by year between the two datasets but the amount of the harvest is almost the same in each dataset over a 10-year period. Invoicing typically occurs roughly a month after scaling. The date of invoice dataset is used in this socio-economic report because revenue data is also reported upon.

81 In regard to TFL 25 Naka, in the early 2000s TFL 25 covered 480,000 hectares of forests in 5 blocks in the following areas: Jordan River, Loughborough Inlet, Naka Creek on Vancouver Island, Bella Bella and Kitimat on the Central Coast, and on Haida Gwaii's Moresby Island. In 2010, Block 6 (Haida Gwaii) was deleted from TFL 25 and added to the Haida Gwaii Timber Supply Area. Currently TFL 25 is comprised of the blocks near Loughborough Inlet and Bella Bella and covers approximately 196,000 hectares. Block 1 (Jordan River) and Block 3 (Naka Creek) were also deleted from TFL 25. WFP holds the TFL 25 tenure today and held it when this TFL included an area on Moresby Island.

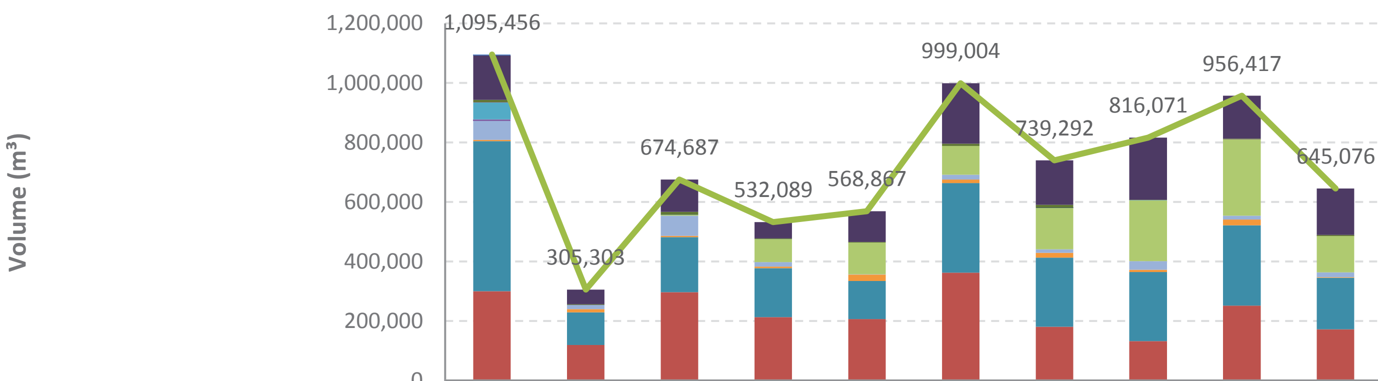
Timber Harvest by Tenure Type

Over the 2013-2017 period, the timber harvest by Timber Sale Licensees was an annual average of 171,896 m^3, slightly greater than the sum of the AAC apportionments for BCTS and the CFA of 161,658 m^3.

The combined harvest of TSA 25 forest licensees averaged 185,592 m^3 during the 2013-2017 period, slightly below the AAC apportionment of 213,632 m^3 for replaceable forest licences. In the earlier 2008-2012 period, the TSA 25 forest licensees had an annual average harvest of 226,849 m3, which was below the AAC apportionment for replaceable forest licences in most of those years.

The FLTC with cutting permits tenure averaged an annual harvest over the 7-year 2011-2017 period of 143,375 m^3.. Figure 4-9 outlines in a graph and a table the HGMA billed harvest volume by tenure type over the 10-year 2008-17 period.

Figure 4-9: HGMA Timber Harvest by Tenure Type (m^3), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SB TSL S21 Bid Proposal single mark	2,946	0	0	0	0	0	0	0	0	0
SB TSL S20 single mark	149,763	49,914	108,084	54,652	103,151	202,997	148,894	208,269	143,491	155,833
Forestry Licence to Cut	6,934	1,933	9,424	2,005	2,795	7,728	9,395	1,117	1,401	3,199
Occupant Licence To Cut, Short Form	1,436	0	0	0	0	0	0	40	379	426
Occupant Licence To Cut	0	0	0	0	0	0	1,209	0	0	0
Road Permit	56,592	103	413	79	0	0	231	1,369	497	133
SB TSL S21 Bid Proposal multi-mark	4,847	0	0	0	0	0	0	0	0	0
Forestry Licence to Cut with Cutting Permits	0	0	3,149	77,440	106,491	96,698	138,872	204,634	257,242	122,252
Timber Licence	63,990	14,206	67,697	15,316	1,156	15,970	11,435	28,486	12,189	16,081
Woodlot Licence	4,184	10,199	4,346	5,613	20,531	12,661	16,880	7,261	20,061	2,215
Tree Farm Licence	504,939	109,284	184,993	164,732	128,818	301,094	231,860	232,921	269,878	172,599
Forest Licence	299,826	119,664	296,581	212,252	205,924	361,855	180,515	131,974	251,278	172,337
Total	1,095,456	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations

4.6.2 HGMA Timber Harvest by Species

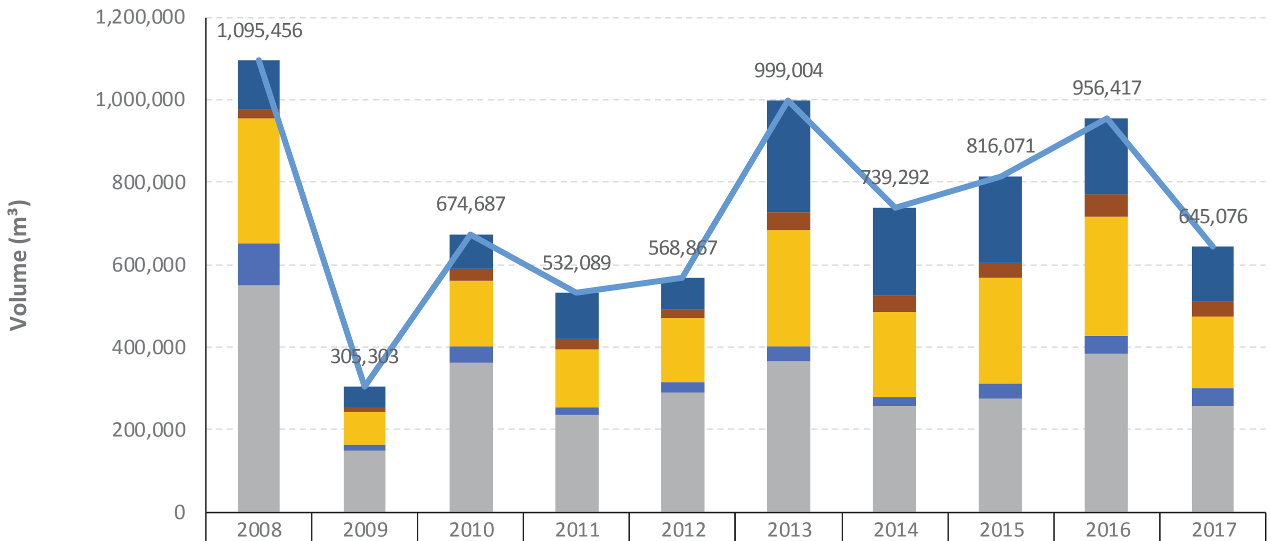
Harvesting of cedar timber in response to strong demand in external markets for cedar wood products has largely pulled along the overall Haida Gwaii timber harvest

Historically, timber stands with substantial percentages shares of Old Growth western redcedar volumes have formed a large portion of the operable harvesting landbase of Haida Gwaii. This accessible local cedar supply in combination with the strong and large scale external demand for cedar logs and wood products in Canadian, US and international markets over the past couple of decades, have resulted in attractive prices for cedar logs and wood products and substantial cedar timber harvests on both HGMA lands and Haida Gwaii private lands.

Over the 2008-2017 decade, the harvest of red and yellow cedar annually averaged approximately 351,000 m^3, accounting for an almost half share (47.8%) of the total HGMA harvest. Red and yellow cedar's share of the total harvest fluctuated within a wide band of more than 20 percentage points over this period, a high of 59.5% in 2008 and a low of 37.6% in 2014. The HGMA's red cedar harvest share peaked in 2010 at 54% and the yellow cedar harvest at 9.3% in 2008. The highest cedar harvest volume in the HGMA occurred in 2008 at 651,731 m^3, followed by the harvest of 427,370 m^3 in 2016.

Over the 5-year 2013-2017 period, the cedar share of the HGMA total harvest was lower (41.4%) compared to the 10-year average share.

Figure 4-10: HGMA Timber Harvest Volume by Species (m^3), 2008 - 2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spruce	118,455	51,192	85,031	112,329	75,143	270,736	214,499	212,189	187,211	134,050
Other Species	20,394	9,989	29,083	24,286	23,739	44,403	39,024	36,984	51,329	37,436
Hemlock	304,876	79,393	160,100	142,452	153,689	282,740	207,896	255,562	290,507	171,455
Cypress	101,987	16,471	36,380	17,978	25,343	35,601	18,517	34,197	43,522	44,462
Red Cedar	549,744	148,258	364,093	235,045	290,953	365,525	259,356	277,140	383,848	257,673
Total	1,095,456	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations

Excepting the 2010 harvest, hemlock's share of the HGMA harvest stayed within a narrow band of between 23.7% to 31.3% and averaged 27.9% during the 2008-2017 decade. Spruce accounted for 19.9% of the HGMA harvest, on average, and the years of its peak share (2014) and low share (2008) overlapped in the reverse with that of the two cedar species. The percentage shares by species of the HGMA harvest for the 2008-2017 period are presented in Table 4-7.

Table 4-7: HGMA Timber Harvest Share by Species (%), 2008 - 2017

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	10-year average
Red Cedar	50.2%	48.6%	54.0%	44.2%	51.1%	36.6%	35.1%	34.0%	40.1%	39.9%	42.7%
Yellow cedar (Cypress)	9.3%	5.4%	5.4%	3.4%	4.5%	3.6%	2.5%	4.2%	4.6%	6.9%	5.1%
Hemlock	27.8%	26.0%	23.7%	26.8%	27.0%	28.3%	28.1%	31.3%	30.4%	26.6%	27.9%
Spruce	10.8%	16.8%	12.6%	21.1%	13.2%	27.1%	29.0%	26.0%	19.6%	20.8%	19.9%
Other	1.9%	3.3%	4.3%	4.6%	4.2%	4.4%	5.3%	4.5%	5.4%	5.8%	4.3%

Source: Harvest Billing System 2018 and author's calculations

As a consequence of the large-scale cedar timber harvest on HGMA lands and private lands, management of the cedar harvest on the islands has been a long-standing focus of research, discussion, negotiation and sometimes political conflict.

The portion of the HGMA AAC affected by the cedar partition limits set out in 2012 summed to 360,000 m^3. The annual average cedar harvest in the HGMA was slightly lower at 343,968 m^3. Cedar harvesting was within the maximum partition limits in TFL 60 and TFL 58 but not in TSA 25. In October 2017, the Chief Forester acknowledged that the logging of cedar in TSA 25 "has exceeded the levels outlined in the chief forester's 2012 management unit AAC determinations". As described in Section 4.5.1, via this October 2017 letter the Chief Forester established a partition under section 8(5) of the *Forest Act* of no more than 195,000 m^3 of cedar within TSA 25's AAC of 512,000 m^3 and associated measures were taken to provide for compliance by TSA 25 tenure holders.

4.6.3 HGMA Harvest Residues

To date, commercially viable market opportunities for Haida Gwaii logging and wood processing residues have proven to be limited but residue utilization initiatives for Haida Gwaii are in the planning stages

Avoidable logging wastes associated with HGMA harvests accounted for about 960,000 m^3 of fibre over the 2008-2017 decade, an annual average of about 96,000 m^3 and 13% of the Haida Gwaii TSA and TFL harvests (HBS 2018 and author's calculations).[82] The Haida Gwaii level of residues is less than the 19% level of avoidable wastes for the overall coastal BC region. This lower level of avoidable wastes on Haida Gwaii is likely due to the relatively high quality of the Old Growth hemlock and Sitka Spruce fibres on the islands and the long-established salvage operations on Haida Gwaii. Over the past decade on coastal BC avoidable wastes accounted for an annual average of approximately 2.6M m^3 of fibre or about 1 m^3 for every 4.25 m^3 of cut and removed timber (Rudson 2018).

Several small Haida Gwaii forestry enterprises have timber salvage harvest agreements with major tenure holders and/or they access small scale salvage licences. These small enterprises are removing commercially viable logs and cedar blocks from blowdown areas and old cutblocks. Periods of high winds on Haida Gwaii create substantial annual volumes of blowdown timber, anecdotal reports suggest 40,000 to 50,000 m^3 annually (Stirling 2012). The main companies on Haida Gwaii that are engaging in timber salvage at this time are the following: Watchmen Forest Products Ltd., North Pacific Timber, Maximum Cedar Recovery, Tree Surgeon, Against the Grain Forest Products, Haida Gwaii Log Salvage & Towing and Silva Services.

Several bioenergy facilities in BC were built to take advantage of sawmill residuals, the lowest cost source of fibre, however they acquire ground or chipped debris, a more expensive

82 Avoidable waste volumes are counted as harvest volume against licensee AACs.

feedstock, when sawmill and shake and shingle mill production decreases or to fill specific fibre requirements or to leverage the sunk costs of underutilized generation capacity (Industrial Forestry Service 2015). In 2008, the BC Government issued a bioenergy strategy with a goal of producing half of the province's renewable energy production from BC-made biofuels by 2020. The BC Bioenergy Network funded through this initiative has invested in 18 pilot and technology demonstration projects to date.[83]

As well the BC Government has facilitated several measures to help improve the use of post-harvest debris, including establishing fibre recovery zones (for planning processes) and fibre recovery tenures.[84] A large volume of logging debris is present in BC, an estimated average of 3.8 million m^3 per annum over the 2010-2024 period and an average of 6 million m^3 per annum in recent years.[85] Although the physical supply of logging debris at the roadside is very large in the province, the economic supply, the amount that can be supplied at prices energy facility operators can pay, is much smaller. The supply of roadside residues for bioenergy feedstock purposes varies by region and economic accessibility.[86] There are a variety of potential end use buyers of processed logging debris. An example of how this niche business is starting to expand within the BC forest industry on a business-to-business basis is the acquisition in late 2011 of Renew Resources by a unit of the BC-headquartered Ledcor Group of Companies. Renew Resources was a company of approximately 200 employees that produced wood chips and hog fuel in Merritt, and trucks the ground and chipped materials to a Mission re-load facility on the Fraser River where the chips are barged to Howe Sound Pulp and Paper (HSPP) on the Sunshine Coast. The ground fibre helps fuel HSPP's 400 GWh combined heat and power (CHP) facility that supplies electricity to BC Hydro and heat for its paper-making.[87] Ledcor has created a vertically integrated fibre sourcing, processing and transporting operation to meet the biomass input needs of mills that combine CHP and pulp and paper production.

[83] See http://bcbioenergy.ca/

[84] See the following for additional descriptions, https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-tenures/fibre-recovery/topic_2__initiatives__to_utilize_post_harvest_residual_fibre.pdf

[85] Author's calculation to convert annual available biomass from GWh/year to m^3/year. GWh/yr data is from a recent study commissioned by BC Hydro, which estimated the supply of roadside residues in BC, see pg 14 in Industrial Forestry Service, M.D.T. Ltd. and Murray Hall Consulting Ltd. 2010.

[86] The cited BC Hydro commissioned study provides a breakdown by region of total roadside residue supply.

[87] In the press release announcing the acquisition, the president of the Ledcor unit said "…Ledcor Resources and Transportation is creating significant employment opportunities to utilize and create value from marginal wood fibre that would have otherwise been slash burned or left on the forest floor. Instead of doing nothing about a waste disposal problem that compromises our environment, we are producing woodchips and hog fuel for pulp and paper making and green energy production. ", see http://www.ledcor.com/resources/file/Ledcor%20Marine%20and%20Transportation_Media%20Release_30Nov11.pdf

A fibre recovery tenure on Haida Gwaii was awarded to Haida Gwaii Green Diesel but has not been utilized to date by the tenure holder.

A couple of small bioenergy facilities have been established on Haida Gwaii but both currently use externally sourced wood pellets as the fuel input.

- The Village of Port Clements installed a100-kilowatt biomass boiler system that heats the Port Clements multiplex building, fire department and school gymnasium
- Old Massett Village installed a 720-kilowatt biomass boiler, which was commissioned in March 2017, to heat community buildings

In addition, other Haida Gwaii-focused bioenergy related projects have been proposed or are in the planning stages. Examples include but are not limited to the following.

- In 2014, a multi-year BC Hydro renewable energy Request for Expressions of Interest (REOFI) process for Haida Gwaii was terminated but a wide range of proponents submitted a total of 29 renewable energy projects to BC Hydro, several of which featured bioenergy.[88]
- Subsequent to the termination of BC Hydro's Haida Gwaii REOFI process, HaiCo submitted biomass fueled generation proposals to BC Hydro.
- Taan and HaiCo have conducted business planning for a Haida Gwaii wood processing facility that would incorporate a biomass fueled cogeneration unit (pers. comm. D. Cheung 2018).

Financially successful medium- and large-sized sawmills throughout BC convert as much as possible of their wood fibre residues into either revenue streams or into a low-cost energy input for their mill in order to improve overall commercial viability and to comply with BC Government residue disposal requirements. However, this strategy has proven elusive for Haida Gwaii mill operators and initiatives have been either stalled in the planning stages or have not worked out as originally envisioned. The parties behind Haida Gwaii Wood Products set up a wood fibre briquette making plant that opened in 2015 at Port Clements with the intention to utilize residues from its mill as the primary input for manufacturing briquettes, which would be used as a fuel input in local wood combustion energy systems. This briquette making facility was shuttered shortly after opening due to technical challenges in producing the briquettes. The expectation of the Old Masset Village council is that the proposed new partner in Haida Gwaii Wood Products will also participate in funding improvements to and re-opening and operating this briquette plant (pers. comm. D. Edgars 2018).

[88] The BC Hydro process was pursuant to a Haida Gwaii community electricity plan (CEP) issued by the Council of Haida Nation in 2008, and that was developed with consulting from the Sheltair Group and with the participation of all Haida Gwaii communities, BC Hydro and the Ministry of Energy, Mines and Petroleum Resources (see https://www.bchydro.com/work-with-us/selling-clean-energy/closed-offerings/haida-gwaii-rfp.html?WT.mc_id=rd_hgqci)

Transport cost challenges severely constrain the viability of directing low value hemlock logs from Haida Gwaii to southwest BC pulp mills but pulp log prices are increasing due to pulp log and mill residue constraints in the BC Interior because of the mountain pine beetle induced timber supply reduction and associated sawmill closures. The estimated 700,000 m^3 reduction in Interior BC fibre input sources for coastal BC pulp mills is anticipated to rapidly improve the economics of utilizing coastal BC pulp logs (Girvan 2018).

4.6.4 **Haida Gwaii Private Lands Timber Harvest**

The viability of Haida Gwaii forest sector enterprises and their employees is a function of the timber harvests on both HGMA lands and private lands

4.6.4.1 Introduction

Although private forested lands are not part of the HGMA, the timber harvest on private lands is an important part of the Haida Gwaii forest sector as the private lands harvest is both a longstanding source of logging, transportation and silviculture employment and a buyer of locally provided goods and services. Haida Gwaii companies that participate in the local forest sector often provide services and goods in connection with harvesting, transport and sometimes processing of both HGMA land and private land timber. From an economic perspective, the underlying viability of the Haida Gwaii forest sector is tied directly into its overall timber harvesting landbase, both HGMA lands and private lands.

The Statistics Canada labour force data collected and compiled as part of the Canada Census does not distinguish between forest industry employment on private lands and public lands. The local labour force data for Haida Gwaii are shown in Section 3.3 and have to be interpreted as characterizing the forest sector labour force residing on Haida Gwaii and that works on both public and private lands.

The largest holding of private lands on Haida Gwaii used for forestry purposes was, prior to 2005, managed as part of TFL 39 and therefore incorporated into the Chief Forester's basis for the determination of TFL 39 Block E's AAC and subject to then applicable land and resource use regulation of public forested lands. The private lands portion of TFL 39 Block E, approximately 10,000 ha, was sold in 2004 by the TFL 39 tenure holder, WFP, to BC Investment Management Co. Albeit these private lands situated near Yakoun Lake are now neither part of the HGMA nor subject to a HGMC AAC determination, past estimates of Haida Gwaii TSA and TFL-based employment would've included employment connected to the timber harvest of these private lands. Subsequent to the sale of these private lands, the new owners and their contractors undertook certain planning activities so the harvest on these lands only started up in earnest in 2007 under the new ownership (about 65,000 m^3 in 2007).

Non-HGMA lands are defined herein as having two parts, Indian Reserves and private lands. The latter is further subdivided herein into two categories of private land based upon their log export regulatory conditions as follows.

- Exportable Crown Grant or federal export jurisdiction private lands[89], which are fee simple private lands that the Crown granted prior to March 12, 1906 and are subject to federal government log export regulation
- Non-exportable Crown Grant or BC provincial export jurisdiction private lands, which are private lands that the Crown granted after March 12, 1906 and are subject to federal government log export regulation [90]

The timber harvest on Haida Gwaii Indian Reserve lands was nominal over the 2008-2017 period.

4.6.4.2 Private land harvest volumes

The total timber harvest on Haida Gwaii private lands is relatively large, averaging 93,476 m^3 per year over the 2008-2017 decade, which equates to 11.3% of the total harvest on Haida Gwaii for this period (826,702 m^3).

Although private land holdings are found in and near the incorporated and unincorporated communities of Haida Gwaii, BC Investment Management Corporation owns the largest tracts of Haida Gwaii private forested lands, amounting to about 10,000 hectares, which are located north and east of Yakoun Lake.

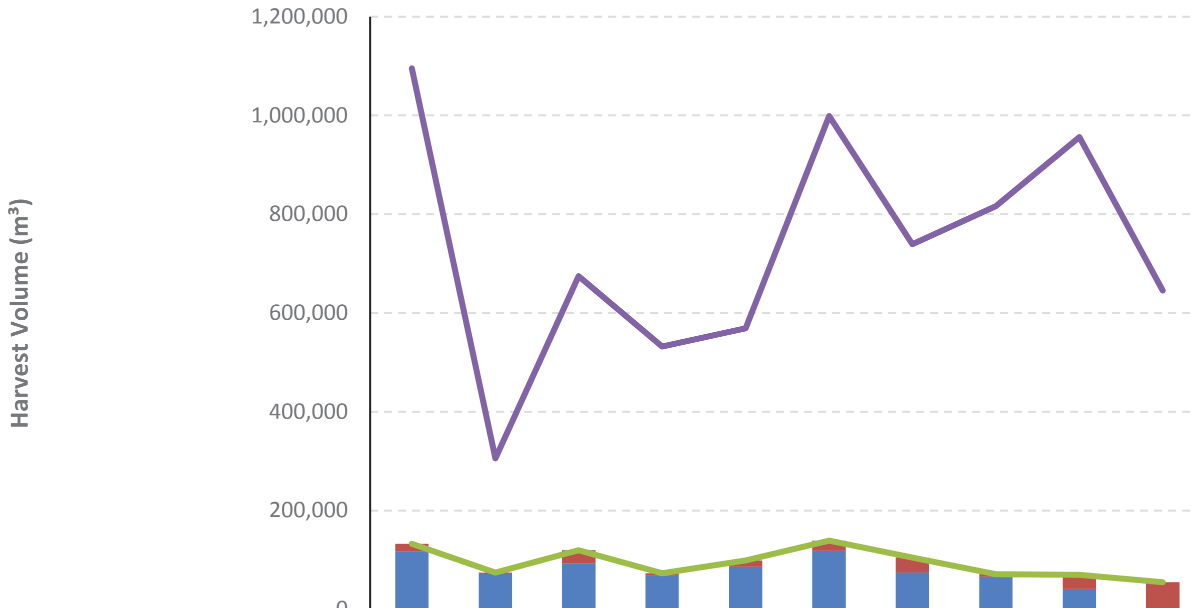
These lands were sold by the Province of BC in 1891 so are categorized as exportable Crown grant lands because they were originally transferred from the BC Government to a private person prior to 1906 and are therefore subject to federal government export regulation.

Excepting 2017, the harvest on federal export jurisdiction private lands on Haida Gwaii was much greater each year over the 2008-2017 decade than the harvest on provincial export jurisdiction private lands. The harvest on the federal export jurisdiction private lands on Haida Gwaii peaked in 2013 at 118,200 m^3, the same year that the total harvest in the HGMA peaked (999,004 m^3). The 2008-2017 annual average harvest on the federal export jurisdiction private lands amounted to 73,531 m^3, almost 80% of the harvest on total private lands (i.e. federal export jurisdiction plus provincial export jurisdiction private lands) on Haida Gwaii. Figure 4-11 shows the Haida Gwaii private lands harvest along with the Crown lands harvest for the 2008-2017 decade.

[89] The reference to "federal jurisdiction private lands" pertains to the federal government's jurisdiction over log exports over certain fee simple private lands. These are not federal government lands.

[90] The trigger for this categorization was the reorganization of the regulation of log exports from BC through a new BC Government statute the *Timber Manufacture Act*, which came into effect on March 12, 1906. The new rules applied to timber harvested on Crown lands granted after March 12, 1906, as well as to timber cut on Crown lands.

Figure 4-11: Haida Gwaii Private Lands Timber Harvest (m³), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-exportable Crown Grant	14,867	1,378	26,854	4,783	13,064	20,616	30,660	5,256	28,453	53,521
Exportable Crown Grant	117,251	72,355	92,791	67,625	85,782	118,200	73,961	65,561	40,779	1,008
Total Private Lands	132,117	73,732	119,643	72,407	98,846	138,817	104,621	70,817	69,232	54,528
Total Crown Lands	1,095,4	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations

4.6.4.3 Private Lands Timber Harvest by Species

In broad terms, the cedar harvest share of the overall Haida Gwaii private lands timber harvest mirrors the Crown lands situation

Cedar timber accounted for 51.0% of the private lands harvest over the 2008-16 period[91] on what is categorized as the exportable Crown grant or federal export jurisdiction private lands (compared to the HGMA annual average of 48.4%). For the private lands categorized as non-exportable Crown grant or federal export jurisdiction private lands, the annual average of 45.2% was also in line with the average cedar share of the total HGMA harvest.

The cedar harvest share on the federal export jurisdiction private lands peaked in 2010 at 75.9%, and the western redcedar timber share stood at 60.2% in that year, which was also a peak year for the HGMA in terms of its red cedar harvest share.

The hemlock harvest share see-sawed over the 2008-2016 period on federal export jurisdiction private lands from a low of 16.6% in 2010 to a high of 44.1% in 2014. The spruce harvest accounted for a steady share of the federal export jurisdiction private lands harvest, staying within the 10-20% range. The percentage shares by species of the timber harvest on federal and provincial export jurisdiction private lands for the 2008-2017 period are presented in Table 4-8.

Table 4-8: Haida Gwaii Private Lands Timber Harvest Share by Species (%), 2008 - 2017

Species Group	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Annual Average
Federal export jurisdiction/ Exportable Crown Grant Private Land											
Red Cedar	39.6%	42.8%	60.2%	41.8%	53.8%	36.8%	29.3%	55.9%	49.4%	99.7%	41.0%
Yellow Cedar (Cypress)	14.0%	23.1%	15.7%	10.6%	4.7%	11.4%	14.1%	1.3%	5.3%	0.3%	10.0%
Hemlock	35.5%	23.4%	16.6%	32.4%	31.7%	37.8%	44.1%	26.6%	25.5%	0.0%	27.4%
Spruce	10.9%	10.6%	7.5%	15.2%	9.2%	14.0%	12.4%	16.2%	19.5%	0.0%	11.6%
Other Species	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.1%	0.0%	0.2%	0.0%	0.1%
Provincial export jurisdiction/ Non-exportable Crown Grant Private Land											
Red Cedar	39.5%	2.5%	52.1%	42.3%	63.1%	53.1%	50.1%	75.1%	46.4%	27.3%	45.2%
Yellow Cedar (Cypress)	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

[91] 2008-16 was used rather than 2008-2017 to determine the annual average because the 2017 harvest for federal export jurisdiction private lands was much lower than in the other years. The 2017 harvest was much reduced over prior years because BC Investment Management Corporation directed its woodlands operator to much reduce harvesting in the Yakoun area pursuant to a request by the Haida Nation to BC Investment Management Corporation to do so.

Hemlock	32.1%	18.9%	17.0%	32.5%	15.1%	23.3%	26.8%	10.6%	46.5%	12.0%	23.5%
All Species	28.4%	78.6%	30.7%	25.0%	21.8%	23.5%	23.1%	14.3%	7.0%	60.7%	31.3%

Source: Harvest Billing System 2018 and author's calculations

4.6.5 **Log Exports**

As throughout coastal BC, log export volume from Haida Gwaii has increased markedly over the past decade

Over the 2010-2017 period, exports of Haida Gwaii logs increased sharply both in terms of annual export volume and the share of the total Haida Gwaii harvest. The estimated export share of the total Haida Gwaii harvest went from 13.8% in 2010 to a peak of 42.9% in 2014 and was only slightly lower in 2017 at 41.6%. The Haida Gwaii total export volume peaked in 2015 at approximately 375,000 m^3. The 2017 total Haida Gwaii export volume of about 291,000 m^3 was a 166% increase over the 2010 level (109,552 m^3).

The increase in Haida Gwaii log exports was due to BC-based timber supply factors and demand factors in Asian markets. Between 2004 and 2010, three supply side factors much increased the potential amount of export eligible Haida Gwaii timber as follows.

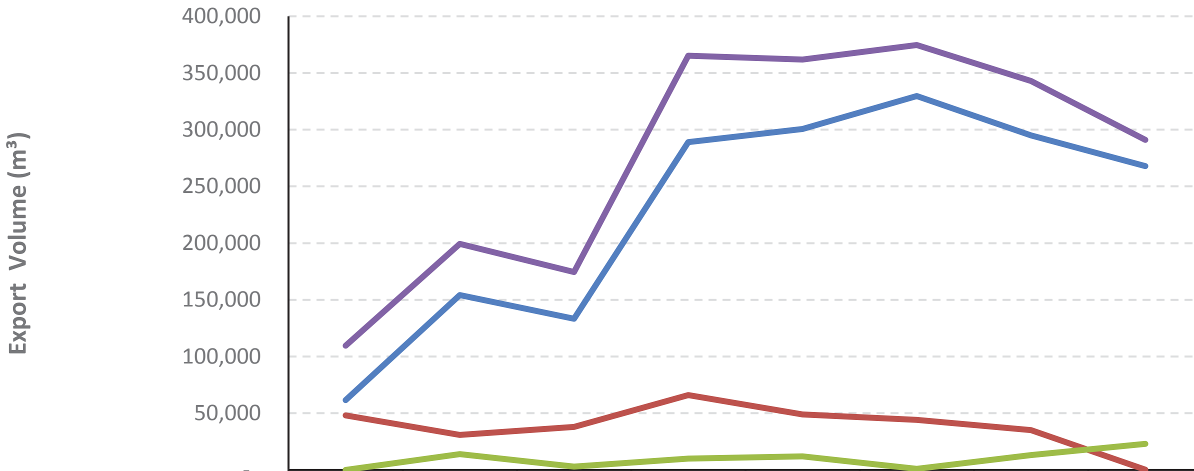
- The elimination of the manufacture surplus test requirement for Haida Gwaii Crown land and provincial jurisdiction private land timber (see Section 4.5.2) played a role by easing export supply constraints on non-cedar timber.
- The transfer of the private lands of TFL 39 Block E from *Forest Act* and *Lands Act* regulation to *Private Forest Management Land Act* regulation eliminated the TFL AAC constraint set forth by the Chief Forester in relation to the removed private land.
- The removal of the TFL 39 private lands (which were Crown granted pre-1906) resulted in cedar logs harvested from this area becoming eligible for export under the federal government export log regulatory system.[92]

The volume and share of the timber harvest on HGMA lands that was exported climbed from 61,552 m^3 and a 9.1% share of the Crown land harvest in 2010 to 267,873 m^3 and a 41.5% share in 2017. The export of logs from federal export jurisdiction private lands averaged approximately 44,500 m^3 over the 2010-2016 years. Figure 4-12 presents the 2010-2017 trend in log exports from the Haida Gwaii timber harvests on Crown lands, provincial export jurisdiction private lands and federal export jurisdiction private lands.[93]

[92] While associated with a TFL, all private land is subject to provincial export log regulation including the restriction on cedar log export despite when it was Crown granted.

[93] Note that these volumes refer to permitted volume, but we can't confirm that all permitted logs were exported, but our understanding is that the vast majority were exported.

Figure 4-12: Log Exports by Export Regulation Jurisdictional Control (m^3), 2010-2017



	2010	2011	2012	2013	2014	2015	2016	2017
Crown lands	61,552	154,217	133,349	289,142	300,726	329,662	295,011	267,873
Federal private lands	48,000	31,000	38,000	66,000	49,000	44,000	35,000	200
Prov. Private lands	-	14,000	3,000	10,000	12,000	1,000	13,000	23,000
Total export	109,552	199,217	174,349	365,142	361,726	374,662	343,011	291,073

Source: Trade and Export Policy Branch of BC MFLNR 2018 and author's calculations

Over the past few years, Haida Gwaii's log export volume share has substantially exceeded the share registered on Coastal BC

In 2017, 267,873 m^3 of Haida Gwaii logs harvested on HGMA lands were exported, which amounts to 41.5% of the HGMA 2017 harvest.[94] Lower value whitewood species account for the vast majority of Haida Gwaii (and Coastal BC) export logs because the BC Government blocks the export of almost any red and yellow cedar logs and higher value whitewood logs. The BC Government does allow for the award of export permits for cedar logs destined for ceremonial or religious uses (incorporation into construction of a religious temple for example). No red or yellow cedar logs harvested on HGMA lands over the 2010-2017 period were given a BC Government export permit.

Over the 5-year 2013-2017 period, the share of log exports in the overall Haida Gwaii harvest averaged 41.7% whereas coastal BC log exports averaged 31.1% over the same period. This 5-year average log export share on Haida Gwaii was reduced because of the big drop in the 2017 timber harvest on federal jurisdiction private lands (due to discussions between the Haida Nation and the owner and managers of these private lands). In 2010, Haida Gwaii

[94] Some of this 2017 export volume will have been harvested in 2016 and some of the 2017 HGMA harvest will be exported in 2018.

exported a much lower share of logs (13.8%) than did the overall coastal BC region (23.6%). Table 4-9 contains a comparison of log exports between Coastal BC and Haida Gwaii.

Table 4-9: Comparison of BC Coastal Log Exports and Haida Gwaii Log Exports, 2010-2017

	2010	2011	2012	2013	2014	2015	2016	2017
Coastal BC total log export (m^3)	3,866,795	5,826,338	5,753,212	6,273,387	6,014,436	5,228,136	6,009,864	5,201,671
Coastal BC total log export as % of total harvest	23.6	30.9	31.6	30.2	31.4	29.5	32.6	31.9
Haida Gwaii total log export	109,552	199,217	174,349	365,142	361,726	374,662	343,011	291,073
Haida Gwaii total log export as % of total harvest	13.8	33.0	26.1	32.1	42.9	42.2	33.4	41.6

Source: HBS, Trade and Export Policy Branch BCMFLNR 2018 and author's calculations

From the supply side, the main factor influencing Haida Gwaii log exports has been the BC Government order-in-council (OIC) that effectively allows for exporting of Haida Gwaii whitewood logs harvested on BC Crown lands and BC private lands in any current year equivalent to 35% of the prior year's total harvest volume (excluding waste volumes) from these BC lands. This OIC came into force in 2010 and is part of the longstanding log export regulation systems at the federal and BC government levels.

Another supply side factor was the sale of the private lands portion of TFL 39 Block 6, approximately 10,000 ha in 2004 by WFP to BC Investment Management Corporation. These lands are pre-1906 Crown grant (or federal) private lands and as such, with the removal of these private lands from the TFL, the new owners were able to export red and yellow cedar logs harvested on these lands. The export volume from these private lands owned by BC Investment Management Co. averaged 44,500 m^3 over the 2010-2016 period.

Strong demand and associated high prices for whitewood logs in China has been the driving force on the demand side. China accounted for 50-60% of BC total log exports over the 2013-2017 period, about 3.6M m^3 per year on average.

Red and yellow cedar logs harvested on pre-1906 Crown grant (or federal) private lands and Indian Reserve lands are not subject to measures preventing their export so these lands comprise the main sources of export volumes of red and yellow cedar logs. However, red and yellow cedar logs account for relatively small portions of BC's total log export volume, for example, 0.7% and 0.1%, respectively, in 2017 because timber harvests on BC Crown and private lands greatly exceed timber harvest amounts on federal private lands and because the BC Government rarely issues export permits for red and yellow cedar logs (Trade and Export Policy Branch BCMFLNR 2018).

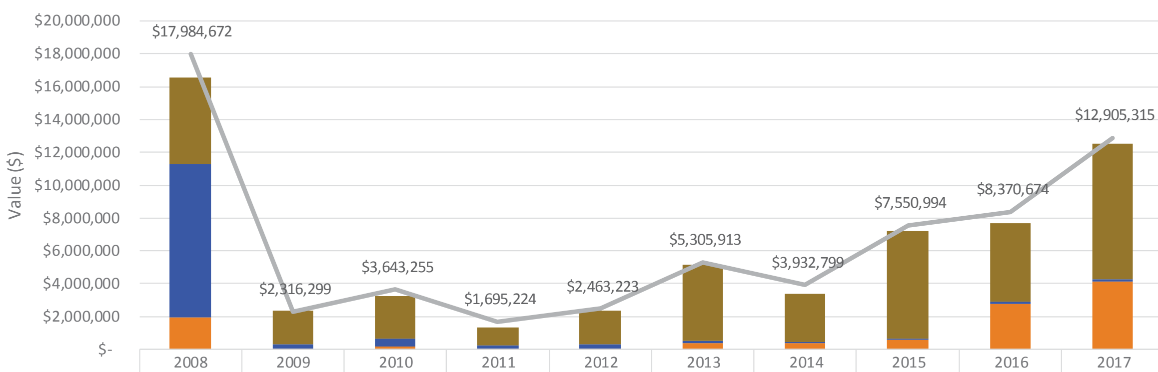
4.7 Stumpage Revenues

Except for the 2008 and 2017 years, the average stumpage revenues per m³ for Haida Gwaii moved up and down within a fairly narrow and low range of $3.19 to $9.25

Figure 4-13 presents stumpage revenues associated with each of the major tenure types and the overall HGMA harvest for the 2008-2017 decade. The BCTS TSL harvest generated 60.8% of the total HGMA stumpage revenues for this decade (but this is not a net figure that takes account of BCTS's costs that other licensees are responsible for). Forest licence stumpage revenues accounted for 17.7% of the HGMA total stumpage revenues over the 2009-2017 period, and TFLs accounted for a 3.5% share of total HGMA total stumpage revenues.

In general, the 2008-2017 trend in Haida Gwaii stumpage revenues followed the trend in the harvest with the 2008 global financial crisis and its aftermath having a strong negative effect on both total harvest volume and total stumpage. The correlation between the two trends is general because the market pricing based stumpage system reflects marketplace sentiments and because the Ministry's approach to applying its calculated stumpage rates has a built in lag of about a year. In some years, the stumpage rate can weigh more heavily than harvest volume on total stumpage revenues as in 2010 and 2016 for example. Another factor affecting Haida Gwaii stumpage revenues is that, except for the beginning and ending years of the 2008-2017 decade, a large portion of the HGMA whitewoods harvest was subject to the $0.25 per m³ minimum stumpage rate.

Figure 4-13: HGMA stumpage revenues by major tenure type ($), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SB TSL S20 single mark	$5,257,694	$2,082,094	$2,569,097	$1,064,878	$2,014,667	$4,639,512	$2,967,019	$6,545,240	$4,803,475	$8,258,365
Tree Farm Licence	$9,322,590	$263,370	$514,440	$193,007	$267,130	$123,529	$68,005	$60,053	$113,950	$104,966
Forest Licence	$1,978,678	$31,570	$149,427	$51,458	$51,756	$378,107	$352,018	$592,259	$2,771,759	$4,135,664
HGMA	$17,984,672	$2,316,299	$3,643,255	$1,695,224	$2,463,223	$5,305,913	$3,932,799	$7,550,994	$8,370,674	$12,905,315

Source: Harvest Billing System 2018 and author's calculations

Table 4-10 shows the stumpage revenues per m^3 for the BCTS TSL tenures, TSA 25 and the overall HGMA. The average Haida Gwaii stumpage revenues per m^3 generally tracked the Coastal BC trend over the 2008-2017 decade with the differences on a year by year basis likely due to higher (or lower) Ministry determined red cedar stumpage rates for the Haida Gwaii Forest District relative to the red cedar rates applicable to other Coastal BC districts. .

Table 4-10: Stumpage revenues per m^3 for BCTS TSL (TSA 25), overall TSA 25, HGMA and Coastal BC harvests ($/$m^3$), 2008-2017

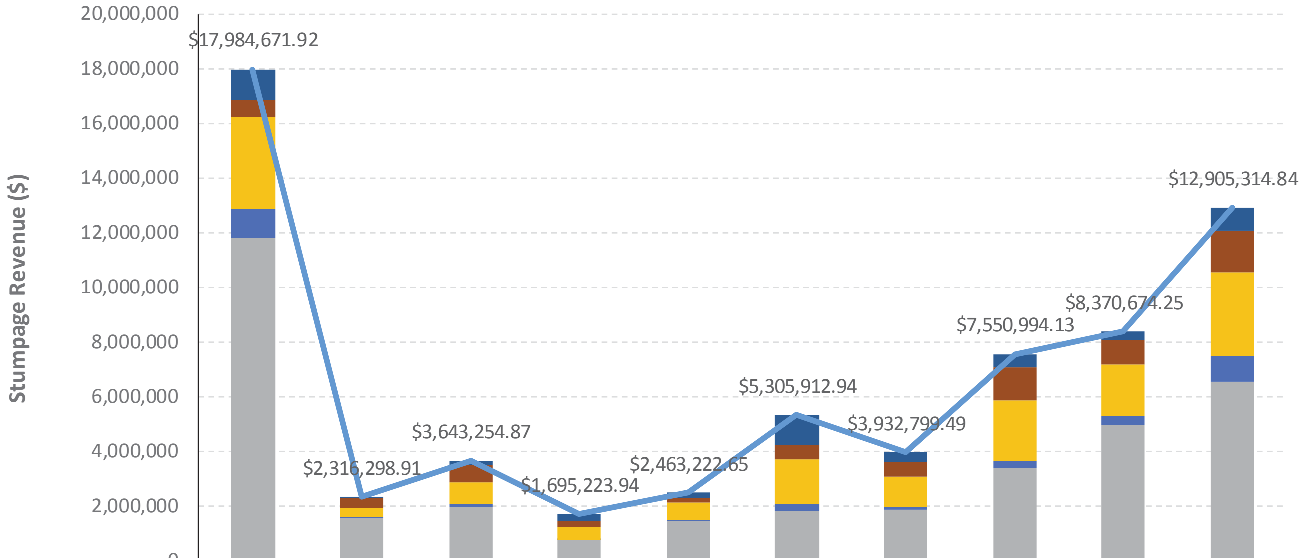
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
BCTS TSL (S20 single mark)	$35.11	$41.71	$23.77	$19.48	$19.53	$22.86	$19.93	$31.43	$33.48	$52.99
TSA 25	$13.73	$11.95	$6.63	$4.32	$4.92	$6.72	$8.09	$13.69	$12.56	$28.18
HGMA	$16.42	$7.59	$5.40	$3.19	$4.33	$5.31	$5.32	$9.25	$8.75	$20.01
Coastal BC	$17.90	$5.50	$4.60	$4.30	$4.20	$6.10	$8.20	$8.50	$12.00	$13.80

Source: Harvest Billing System 2018, author's calculations and BC MFNR 2018e

Over the 2008-17 decade, western redcedar timber accounted for 54% of Haida Gwaii stumpage revenues

From the low point in 2011, Haida Gwaii stumpage revenues, both overall and for western redcedar timber only, climbed steadily reaching a peak of $12.9M and $6.5M, respectively in 2017. Red cedar was 48% of HGMA harvest volume over the 2008-2017 decade, and accounted for 54 % of stumpage revenues. Excepting the 2013 harvest year, the share of red cedar stumpage revenues within all Haida Gwaii stumpage revenues stayed within a narrow band of 43.5% to 66.6%, indicating the relatively substantial importance of this species as a stumpage revenue source on Haida Gwaii. Stumpage revenues derived from harvesting hemlock timber picked up markedly in 2013 and were driven over the 2013-2016 years by an increased hemlock havest volume and in 2017 mainly by a higher stumpage rate. Figure 4-14 presents stumpage revenues by tree species in the HGMA for the 2008-2017 decade.

Figure 4-14: HGMA Stumpage Revenues by Species ($), 2008-17



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spruce	1,119,628	57,998	157,628	289,459	200,137	1,102,745	357,820	483,381	291,839	848,751
Other Species	638,988	384,483	643,537	193,414	158,031	528,905	516,343	1,239,992	935,183	1,517,765
Hemlock	3,355,323	301,774	812,533	461,798	607,823	1,635,560	1,115,990	2,167,668	1,872,980	3,067,051
Cypress	1,068,852	29,023	91,672	13,468	72,923	229,456	95,702	307,450	312,197	956,340
Red Cedar	11,801,881	1,543,020	1,937,885	737,084	1,424,309	1,809,248	1,846,945	3,352,504	4,958,475	6,515,408
All	17,984,672	2,316,299	3,643,255	1,695,224	2,463,223	5,305,913	3,932,799	7,550,994	8,370,674	12,905,315

Source: Harvest Billing System 2018 and author's calculations

Stumpage revenues per m³ for Haida Gwaii cedar have been relatively high, especially in 2008 and 2017 but dipped during the 2010-2014 period. Hemlock stumpage revenues per m³ were pulled along by the bonus bids in BCTS TSL auctions, which reflected high VLM cedar log values and high export whitewood log values over the 2010-2017 period. Table 4-11 shows the per m³ average stumpage revenues for the HGMA by species over the 2008-2017 decade.

Table 4-11: HGMA Average Stumpage Revenues by Species ($/m³), 2008-2017[95]

Species Group	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Red Cedar	$21.47	$10.41	$5.32	$3.14	$4.90	$4.95	$7.12	$12.10	$12.92	$25.29
Cypress	$10.48	$1.76	$2.52	$0.75	$2.88	$6.45	$5.17	$8.99	$7.17	$21.51

95 The average stumpage revenues per m³ are not equivalent to the "average sawlog stumpage rates by species", which is a Ministry calculated and published figure.

Hemlock	$11.01	$3.80	$5.08	$3.24	$3.95	$5.78	$5.37	$8.48	$6.45	$17.89
Spruce	$9.45	$1.13	$1.85	$2.58	$2.66	$4.07	$1.67	$2.28	$1.56	$6.33
All	$16.42	$7.59	$5.40	$3.19	$4.33	$5.31	$5.32	$9.25	$8.75	$20.01

Source: Harvest Billing System 2018 and author's calculations

4.8 Fee in Lieu of Manufacture Revenues

Parties issued a permit to export logs from BC Crown lands must pay a "fee in lieu of manufacture". A schedule applicable to Haida Gwaii logs is included in the BC Cabinet issued order-in-council, the Haida Gwaii Timber Exemption Order, which allows for a proportion of timber harvested on Haida Gwaii Crown lands and provincial jurisdiction private lands, other than red cedar and cypress (yellow cedar) timber, to be "considered surplus to requirements of timber processing facilities in British Columbia" and therefore not subject to the surplus manufacture test (see Section 4.5.2). The applicable fee schedule for Haida Gwaii is as follows.

- 15% of the domestic log values for Douglas fir, all grades
- 10% of the domestic log value for all other coastal coniferous species and grades J and higher, 5% for lower grades of coniferous species other than Douglas fir
- a minimum fee rate of $1.00/m³ where the above fee calculation is less than $1.00/m³
- a fee in lieu rate of $1.00/m³ for deciduous species of timber

The BC Government does not make available data on fee in lieu of manufacture revenues by provincial management units, such as natural resource districts or TSAs. A high level estimate of fee in lieu of manufacture revenues for the HGMA was therefore calculated for this socio-economic report.[96]The annual revenues from this source on Haida Gwaii are estimated to have peaked in 2014 at approximately $1.7 million (within the 2010-2017 period). By way of comparison, stumpage revenues derived from the HGMA in 2014 totaled approximately $3.9 million.[97] The stumpage revenues high point over the 2010-2017 years was $12.9 million in 2017. Table 4-12 presents a high level estimate for 2010-2017 period of fee in lieu of manufacture revenues derived from export logs harvested on Haida Gwaii Crown lands.

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[96] The estimate is based on the actual volume by species of export logs harvested on Haida Gwaii Crown lands, average annual VLM prices by species and an average percentage rate applied to the domestic log values that is based on the schedule for determining the fee in lieu of manufacture as stated in the Haida Gwaii Timber Exemption Order. The estimated revenues produced through this calculation approach provide an accurate representation of the scale and trend of these revenues for Haida Gwaii export logs harvested from Crown lands. Additional calculations would be required in order to obtain a more accurate estimate.

[97] Parties exporting logs harvested from Haida Gwaii Crown lands pay the applicable fee in lieu of manufacture in addition to the applicable stumpage amount.

Table 4-12: Estimated fee in lieu of manufacture revenues for the HGMA

	2010	2011	2012	2013	2014	2015	2016	2017
Total Crown lands log exports (m^3)	61,552	154,217	133,349	289,142	300,726	329,662	295,011	267,873
Estimated fee in lieu of manufacture revenues ($)	$250,000	$722,000	$545,000	$1,573,000	$1,720,000	$1,615,000	$1,438,000	$1,387,000

Source: Timber Pricing Branch BC MFLNR 2018, Trade and Export Policy Branch of BC MFLNR 2018 and author's calculations

4.9 Haida Gwaii Forest Sector Operations

4.9.1 Introduction

The Haida Gwaii timber harvest has supported a substantial yet changing forest sector economy. The timber harvest on the islands, which drives the bulk of forest sector revenues, employment and goods and services purchasing, did not change much in response to the reduced AACs introduced in 2012. The average harvest over the 5-year 2013-2017 period was 831,172 m^3. The average harvest over the prior 10-year 2003-2012 period was approximately 780,000 m^3. The forest sector economy has changed however in terms of the main participants both in terms of control of the harvest and the parties undertaking the harvest. The sector also has changed, at least in the recent past, through a lower (overall) level of on Haida Gwaii wood processing, albeit the amount of on Haida Gwaii processing of logs has always been relatively low since the introduction of industrial forestry on the islands. The total volume processed on Haida Gwaii is lower but anecdotal reports suggest that the number of small micro mills and backyard log cutting activity is up over the past few years.

A number of relatively small enterprises on Hiada Gwaii provide a variety of services that help support the ongoing operations of stump to dump logging, forestry management and timber processing. These services include but are not limited to log and cedar block salvage, re-planting, road building, maintenance and deactivation, watershed restoration, block layout, scaling, falling, crew marine transport and road and barge log, equipment, fuel and supplies transport.

In 2011, forest carbon offsets and their associated revenues became a part of the Haida Gwaii forest sector with the creation of a large-scale forest carbon offset project based on the implementation of the Haida Gwaii Land Use Objectives Order (signed December 16, 2010).

In the following sub-sections are short profiles of the main parties engaged with Haida Gwaii harvesting and wood processing, an overview of Haida Gwaii forest carbon offsets and estimates of direct and indirect employment and employment income supported on Haida Gwaii and in BC through the harvesting of Haida Gwaii timber.

4.9.2 Husby Forest Products[98]

Husby has operated continuously on Haida Gwaii since 1985 and controls the largest share of TSA 25's AAC through AAC commitments for its two forest licences (a total of 200,000 m^3, currently 21.5% of TSA/TFL AAC). As well, in recent years, Husby has been one of the main harvesting contractors for the BCIM owned and Islands Timberlands/Mosaic Forest Management managed private lands on Haida Gwaii.[99]

Over the past few years, Husby employees stay on Haida Gwaii during operating shifts and many are permanent residents of the Islands (Morreau 2016).

The predecessor company to Husby Forest Products started out as Husby Trucking in 1970 and then became Husby Allison Trucking and focused on log and gravel hauling in the early years, later expanding into road building. With the purchase in 1985 of CFIP, a Japanese company, which held two Haida Gwaii forest licences and had a camp-based logging operation at Naden Harbour, the company entered into the market logging business and was re-named as Husby Forest Products. The company has since operated continuously on Haida Gwaii and has had the largest share of TSA 25's AAC through its forest licence commitments since the mid-1980s. Until 2011, the Naden Harbour/Eden Lake area formed the operating area on Haida Gwaii for this company. Starting in 2011, the Collison Point area became Husby's main operating area.

In 1997, the company entered the wood processing industry by directing its Haida Gwaii red and yellow cedar logs and a portion of its hemlock and spruce logs to Greater Vancouver located mills for custom cut services. Husby subsequently set up, in 2000, a Delta, BC company, J&G Logworks, to expand this new business. Husby/ J&G Logworks rents log cutting services at four Lower Mainland mills that use Husby/ J&G Logworks milling specifications to convert Husby's logs into wood products as per the orders of Husby/ J&G Logworks's customers, which are mainly wholesalers and lumber remanufacturers. Husby directs its logs to a Lower Mainland mill based on a mill's equipment to process certain types of logs and available capacity. Supplied mainly with Husby's Haida Gwaii logs, the Husby/ J&G Logworks custom milling operation manufactures annually, in recent years, from 60 to 90 million board-feet of lumber products.

Husby was an early entrant into the custom cut niche of coastal BC wood processing. This niche is based on a company directing its own logs, supplemented with purchased logs, to rented BC milling capacity in order to fill custom orders for wood products. Processing of

98 Information presented in this section is based on a phone interview and email communications with Rob Sandberg and information sourced from Husby websites and from forest industry publications.

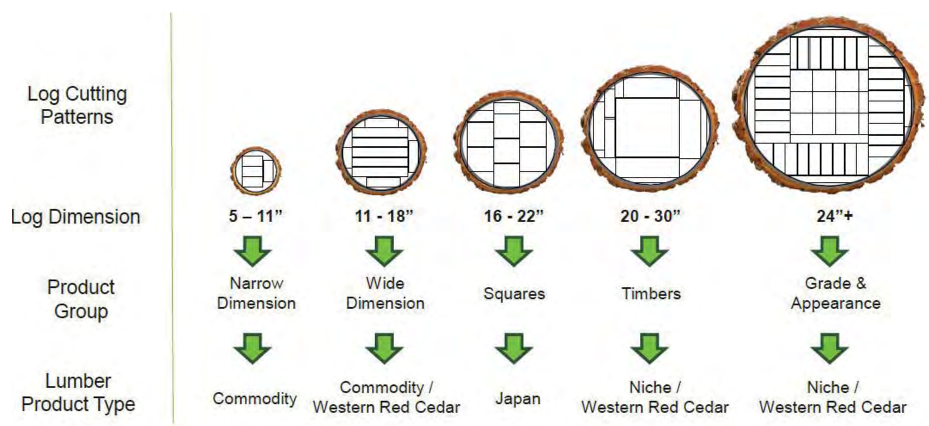
99 In November 2018, the owners of TimberWest Forest Corporation (BCIM and Public Sector Pension Investment Board) and Island Timberlands (BCIM and Alberta Investment Management Corporation) entered into an agreement to provide for shared use of facilities. Mosaic Forest Management was created to manage this affiliation of the two companies, and is responsible for harvest planning and operations, marketing and sales.

western redcedar logs is the main focus of the coastal custom cutting programs but companies also direct lesser amounts of their spruce and hemlock logs to these contracted mills. The custom cut processing option is now used by several other BC-based operations with timber harvesting rights and no self-owned log cutting or milling facilities. Processing of Haida Gwaii timber is reflective of the relative importance of custom cut programs to milling of Coastal BC timber. Both Husby and O'Brien & Fuerst are longtime operaters of custom cut programs, and Taan implemented a custom cut program soon after taking over TFL 60 from Western Forest Products.

Industrial scale sawmills in coastal BC that provide custom cutting services include but are not limited to the following.

- S&R Sawmills (Surrey, BC), the largest custom cut focused operation in BC, comprising four sawmills and a chip mill, which cuts all Coastal BC softwood species and log sizes. S&R Sawmills says that it can produce approximately 240 different sorts of lumber of different lengths, thicknesses and grades.[100]
- Anderson-Pacific Forest Products Ltd. (Maple Ridge, BC), owned by Canadian Overseas Group
- JCI Touchwood Sawmills Ltd. (Terrace, BC), has a big log mill and a small log mill, which processes western redcedar, yellow cedar, spruce and hemlock logs
- Mainland Sawmill (Richmond, BC) owned by Terminal Forest Products
- Cowichan Lumber Ltd. (North Vancouver, BC)
- Delta Cedar Mill (Delta, BC), owned by Delta Cedar Specialties, focuses on western redcedar decking and siding products

[100] The diverse fibre characteristics of coastal BC by species, age and log size offer a large range of in-demand wood products but also require a range of milling capabilities. The following figure characterizes at a high level how species, log diameter and margin are integrated into the wood product manufacturing decision with coastal BC logs (Western Forest Products 2018).



- Halo Sawmill (Delta, BC), owned by Delta Cedar Specialties, has a big log mill, and focuses on western redcedar decking and siding products
- Stag Timber, (Surrey, BC), owned by Teal-Jones Group

The primary advantages of a custom cut program are that a market logging company's financial resources are not tied up in long-term investments in processing facilities and operations and their logs can be directed to a processing facility based on the facility's milling capabilities and available capacity. The disadvantages of custom cut programs are that they facilitate the concentration of Coastal BC timber processing facilities (and their employment) in the Lower Mainland and mid-Vancouver Island areas and that some wood products milled in a custom cut program have to be sold at a loss because the owner of the custom cut logs does not have inventory or distribution storage space.[101]

Husby has expanded into other business enterprises based on either its operational capabilities or ownership of resource assets.

Husby created a fishing resort from its Naden Harbour logging camp. In 1985, Husby shifted its logging camp from Naden Harbour to a camp at Eden lake, and subsequently opted to develop a corporate retreat fishing lodge for Husby's guests at the Naden Harbour camp location, which opened in 1987. Husby started to market its fishing lodge, named Peregrine Lodge, into the commercial sport fishing market in 1989, and has since further developed it into one of Haida Gwaii's world class fishing resorts.

[101] Larger logs will yield multiple products, a portion of which will have immediate customers, and another portion of a large log's products will require storage awaiting purchase at a suitable price. A mill typically has adjacent or nearby storage space for finished products whereas a market logger using a custom cut program may not have storage facilities for finished products. In this case, some finished products may have to be sold at a loss in parallel with the products that have suitable and timely sales arrangements.

4.9.3 O'Brien & Fuerst[102]

Operating on Haida Gwaii since 1974, Port Clements-based O'Brien & Fuerst has largely focused on logging and road building on the islands. The company acquires TSLs through competing in BCTS's TSL auctions. Over the 2008-2017 period, the company's related parties were awarded an estimated 22 TSLs having a total harvest rights volume of approximately 620,000 m^3 (see Appendix IV).

To a large extent, O'Brien & Fuerst uses its own Haida Gwaii based employees to harvest its Haida Gwaii TSLs. The size of the company's forestry-focused employee group varies based on harvesting activity levels but is typically in the range of 20-25 workers. The company also undertakes forestry road development and maintenance work for other parties on Haida Gwaii.

In the mid-80s, the company entered the wood processing industry by directing its Haida Gwaii cedar logs and whitewood sawlogs to Lower Mainland sawmills for custom cutting of up to three million board-feet per year. The company established a cedar pole processing facility at its Port Clements property in 2002 utilizing fire origin Second Growth cedar timber. At its peak, this operation had an annual production capacity of approximately 12,000 poles, and employed about 12 full-time workers, but was shuttered in 2012 due to a change in the management of the fire-origin cedar area of TSA 25.

The company sells cedar logs, up to 3,500 per year, for log home manufacture. The main customer has been Pioneer Log Homes of Williams Lake, BC, which was featured for several years in the "Timber Kings" reality TV show.

The company acquired a barge and tug to facilitate the transport of its cedar poles, and since has acquired a second barge. These barges are used to transport their logs to the Lower Mainland and Prince Rupert and are contracted out to other parties.

In 1988, an O'Brien & Fuerst subsidiary, O'Brien Road and Bridge Maintenance Ltd., was awarded the contract by the BC Government for year-round maintenance of non-municipal public roads and highways on Haida Gwaii and in the Prince Rupert area (Service Area 27 – North Coast). This company has approximately 20 employees.

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[102] Information presented in this section is based on phone interviews with Randy O'Brien, Gloria O'Brien and Travis O'Brien and information sourced from the O'Brien & Fuerst website and from forest industry publications.

4.9.4 Taan Forest Products[103]

A relatively new Haida Gwaii forest sector operator, established in 2010, Taan Forest Products Ltd. was created as a division of HaiCo to manage Haida Nation logging interests. Taan has quickly grown and now controls the largest share of the Haida Gwaii AAC, holding commitments under BC Government awarded tenures for approximately half of the Haida Gwaii AAC. In September 2010, Taan and BC Timber Sales (BCTS) signed a Cooperative Management Agreement to manage approximately 14,000 m^3. In 2011, Taan Forest Products Ltd. began to manage TFL 60, assuming the TFL management responsibilities formerly handled by WFP, and in June 2012, Taan completed the purchase of TFL 60 from WFP (Taan 2016).

To date, Taan has participated in on and off Haida Gwaii timber processing. Taan undertook a joint venture with Skidegate Band Council in a cedar pole peeling plant at Ferguson Bay from 2012 thru late 2016 that was supplied with fire origin Second Growth cedar logs. Taan has operated a custom cutting program using Lower Mainland sawmills to process its Haida Gwaii cedar logs and also some of its whitewood logs. The company has also utilized a few Haida Gwaii micro mills, such as Tanu Wood Products and Eaglecrest Enterprises, to fill small custom cut orders for wood products such as bridge timbers. Starting in 2012, Taan had an agreement with Haida Gwaii Wood Products (HWWP) to supply logs on commercial terms to HWWP's Port Clements mill. However, little fibre was directed to this mill by Taan due to HWWP's operational challenges in recent years. At the time of this report's preparation, HWWP is in the midst of negotiating both a new log purchasing agreement with Taan and an ownership re-structure that will lead to a resumption of operations in 2019 of HWWP's Port Clements mill.

Taan has undertaken planning for a new Haida Gwaii timber processing facility that would be supplied through a re-direction of a portion of Taan's logs from its Lower Mainland-based custom cut program.

Consistent with HaiCo's strategic plan, Taan strives to strike a "…balance between managing the forest resources entrusted to us, providing well-paying jobs and running a profitable business".[104] Taan uses public RFPs and associated evaluation criteria to emphasize Haida Gwaii presence and experience in selection of its contractors.[105] Taan's focus on securing a

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103 Information presented in this section is based on phone interviews with Jeff Mosher, Bill Crocker and Dave Cheung of Taan and information sourced from the HaiCo and Taan websites and from Taan and HaiCo publications.

104 See https://www.taanforest.com/our-team

105 For example, Taan used the following criteria and weighting in a RFP to secure a logging contractor. Local employment - 25% (15% local Haida Gwaii, 10% Haida Ancestry), local ownership of company - 15%, machinery to conduct work - 25%, ability/ Experience to complete work - 20%, past performance with Taan - 10%, and hourly rates - 5%

high proportion of Haida Gwaii representation or content in its employment, contracting and goods and services purchases has resulted in a high percentage of its employees, contractors and suppliers being sourced from Haida Gwaii. In 2017, Taan estimates that 91% of its logging contractors are based in Haida Gwaii and that 65% of Taan employees are Haida Gwaii residents.[106] Employees of Taan contractors account for the larger share of Taan's direct workforce. The following table shows, for the 2011-2017 period, the percentage share of logging phase contractors engaged and of employees hired by Taan who are Haida Gwaii-based.

Table 4-13: Haida Gwaii share of logging phase contractors engaged and employees hired by Taan, 2011-2017

	2011	2012	2013	2014	2015	2016	2017
Share of total Taan contractors with Haida Gwaii based operations (%)	89%	89%	91%	80%	91%	94%	91%
Share of total Taan employees who are Haida Gwaii residents (%)	43%	73%	93%	80%	71%	75%	65%

Source: Taan Forest Products Ltd. 2018

The following table shows the number of Taan suppliers having Haida Gwaii operations and the percentage share held by suppliers having Haida Gwaii operations of Taan's total spend on goods and services over the seven-year 2011-2017 period. As Taan's operations have expanded so too has its base of suppliers, but the company has managed to sustain a Haida Gwaii share of this supplier base in terms of the total spend in the 50-60% range.

Table 4-14: Taan suppliers having Haida Gwaii operations, 2011-2017

	2011	2012	2013	2014	2015	2016	2017
# of local vendors	35	59	53	77	75	80	89
Haida Gwaii share as % of Taan's total supply spend	52%	51%	57%	59%	63%	48%	54%

Source: Taan Forest Products Ltd. 2018

4.9.5 A&A Trading (Haida Gwaii) Ltd. [107]

A&A purchased TFL 58 and FL A16870 in December 2016 from Teal Jones Group. A&A is a well-established coastal BC forestry company, operating for more than 30 years and managing current harvesting operations in the Nootka Sound, Sunshine Coast, Powell River, North Coast and Mid-Coast areas, as well as on Haida Gwaii. For the past decade, A&A has established business relationships with several Coastal BC First Nations, and the company is an active member of the province's major forest industry association, BC Council of Forest Industries (COFI).

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[106] Haida Gwaii residents or permanent residents are defined here as persons who have their principal residence on Haida Gwaii.

[107] Information presented in this section is based on a phone interview and email communications with Marty Locker and information sourced from the A&A website and from forest industry publications.

A&A's broad operational parameters on Haida Gwaii differ from the approaches used by Teal Jones Group in that A&A largely relies on contractors (rather than company employees) to undertake timber harvesting and A&A sells its Haida Gwaii logs to wood processing operations or to log buyers in both the Lower Mainland and in Asian export markets (whereas Teal Jones Group primarily directed its Haida Gwaii logs to its Surrey, BC sawmill). In general, A&A intends to focus its Haida Gwaii operations on whitewoods log export sales and contract sales of cedar logs and hemlock pulp logs into the Lower Mainland.

A&A has contracted Sandspit-based CNR to be its stump to dump contractor.[108]

Since acquiring the Haida Gwaii tenures in December 2016, A&A has done (up to late 2018) only a limited amount of Haida Gwaii harvesting (a Timberwest TL and a purchased private property) and focused on upgrading the infrastructure of its TFL.

A&A has engaged with local micro mills in order to communicate A&A's willingness to sell cedar fibre to local wood processers.

4.9.6 Silva Services / Timo Johnsson Contracting[109]

As mentioned in Section 4.6.3, several Haida Gwaii based enterprises engage in salvage logging. Silva Services is a longtime operator in this niche but the company and the owner, Timo Johnsson, offer an example of a Haida Gwaii small business that provides or has provided a few forest sector services over a long period of time. Other similar examples of these small longtime forest sector operators are present on Haida Gwaii so an overview of Silva Services follows but this should be seen as representative in only a broad way of other small Haida Gwaii forestry enterprises.

Johnsson started as a silviculture contractor with a crew of about a dozen workers on Haida Gwaii in the late 1970s doing juvenile spacing, spending April through October on Haida Gwaii and working in other areas of BC as well. In the early 1990s, he began to undertake salvage of logs (mainly cedar), cants and shake bolts on the islands, contracting to Western Forest Products and other tenure holders. In the early years, this salvage included using helicopters to transport cedar blocks or cants to the roadside for trucking to beach sites for loading logs on barges. A somewhat smaller operation now, Silva is still in the salvage business and uses a survey crew to identify suitable sites in blowdown areas and old cutblocks as well as buckers and fallers in the salvage operations. At this time, Silva sells cants, logs and shake bolts into the VLM for the most part, and the salvaged fibre is delivered to a beach site where the buyer assumes responsibility for transport to the Lower Mainland. Silva sells some cedar blocks and cants to a few local micro mills when there is a demand for such.

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[108] Taan also uses CNR (for logging on Moresby and Louise Islands) as one of its two current Haida Gwaii stump to dump contractors.

[109] Information presented in this section is based on an interview with Timo Johnsson and information sourced from forest industry publications.

Johnsson purchased a small mill at Alliford Bay from MacMillan Bloedel in the mid 1990s when this major operator left Haida Gwaii. The mill was in business for about a dozen years and closed in 2008. Annual log consumption amounted to about 2,000 m^3 of logs, with daily one shift production of 1,500 board feet and 360,000 board feet annually over a season of approximately 210 days. The milling operation employed 3 to 5 workers. The fibre supply was sourced from the major TFL operators, Weyerhaeuser and WFP, and from salvage sales through BCTS.

In 2010, Johnsson began contracting excavator services to Taan, performing road maintenance and dryland sort cleaning and watershed restoration, including road deactivation, removing wooden culverts, pulling back old landings and sloping roads. Johnsson also has a contract to remove contaminated soils from an old fuel storage site at a Lousie Island logging camp.

Johnsson also acquired a barge for transporting salvaged cedar shake bolts from remote locations but also now transports logging equipment.

At this juncture, the full-time (10 months) crew comprises four workers (including Mr Johnsson) plus three part-time crew members working about 100 days per year.

4.9.7 Wood Processing Enterprises

Four categories or types of wood processing enterprises have been (or are currently) present on Haida Gwaii:

- small, multi-species mills,
- cedar pole peeling plants,
- 1 to 5 person operated micro mills, and
- "backyard" timber cutting units.

Each of the largest Haida Gwaii focused timber harvesting operators, Husby, O'Brien & Fuerst and Taan, have fairly large custom cutting programs in which they rent capacity/services at Lower Mainland sawmills in order to process their Haida Gwaii harvested logs (mainly cedar logs) (which are described in Sections 4.9.2, 4.9.3 and 4.9.4).

Haida Gwaii Forest Products[110]

The only small, multi-species mill on Haida Gwaii is Haida Gwaii Forest Products (formerly Abfam Enterprises Ltd.) in Port Clements. HGFP was started by Jim Abbott, a long-time Haida Gwaii resident, but in 2015 the Old Massett Village Council became a joint venture partner in this operation. This Port Clements mill has been inactive since mid-2017.

The Port Clements mill has a total production capacity of an estimated 12 million board-feet, six million board-feet for cedar and six million for whitewoods and is a head rig mill with 2 lines and has a kiln and planers.

In recent years, the owners have purchased logs to supply the facility but the company had a 10-year non-renewable 40,000 m^3 per year licence from the mid-80s through the mid-90s, which was the basis for establishing the Port Clements facility and supported a decade of steady mill production and employment. The owners have secured four TSLs at BCTS auctions but have expressed concerns many times over the years about unsatisfactory access to fibre and cost of fibre to feed its mill.

Average annual employment at the Port Clements mill over the 3-year 2015-17 period amounted to an estimated 6 full-time workers and 18 part-time workers.

O'Brien & Fuerst and Taan Forest Products

O'Brien & Fuerst have a shuttered cedar pole peeling plant on their Port Clements property (see Section 4.9.3). The pole peeling facility owned and operated by Taan and Skidegate Band Council at Ferguson Bay between 2012 and 2016 has since been dismantled and sold (see Section 4.9.4).

Micro Mills[111]

Micro mills have been a longstanding feature of Haida Gwaii wood processing activity. For example, a directory of Haida Gwaii forest sector focused enterprises published in 1999 listed 14 micro mills (Kellie and Associates 1999). A few of the owner-operators on this 1999 list operate a Haida Gwaii micro mill today (albeit in a different configuration). These mills are business enterprises but the owner-operator typically also has one or two other business activities underway on a part-time or seasonal basis as well. The fibre consumption of these micro mills is in the annual range of 200 m^3 to 2,000 m^3 depending on the milling equipment and the timber supply sources of the owner-operator. The processing configuration of these

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110 Information presented in this section is based on interviews with Randy Friesen, Rhonda Abbott, Danny Abbott, and Duffy Edgar and information sourced from forest industry publications.

111 Information presented in this section is based on interviews with Art Pearson, Jean-Marc Cyr, Tim Fennell and Timo Johnsson, email communications with other Haida Gwaii residents, information sourced from forest industry publications, and internet searches.

micro mills varies; Eaglecrest Enterprises is an example of a longstanding Haida Gwaii micro mill operator and its current operation includes a circular mill and a bandsaw mill, plus an edger, a kiln and a moulder at the industrial park in Port Clements.

Western redcedar is the main milled tree species. The customers of the Haida Gwaii micro mill are primarily local businesses (such as fishing lodges), organizations (such as community halls) and residents (new homes and renovations), and generally these small mills will offer custom cut services as well as mill their own logs and sell the resulting products. Taan appears to be the only Haida Gwaii licensee utilizing these local micro mills. Taan has contracted a few local micro mills to fulfil small, custom cut orders (such as producing bridge timbers). A few of these micro mills make some off islands sales of specialty wood products, such as timbers for new residences.

In addition to the owner-operator these micro mills hire 1 to 5 workers when they are operating.

The current enterprises and Haida Gwaii locations in the micro mill wood processing category include (but are not limited to) the following.[112]

- Lawnhill Sawmill (Queen Charlotte)
- Jean-Marc Cyr (Sandspit)
- Eaglecrest Enterprises (Port Clements)
- Tanu Wood Products (Skidegate)
- Lagace Lumber (Queen Charlotte)
- Pinneault Welding and Fabricating (Queen Charlotte)
- Brasier Mill (Masset);
- Chown River Mill (Masset); and
- Moonlight Milling (Sandspit).

In addition to these micro mills, several parties on Haida Gwaii have small band saw and circular saw machines (such as Wood-Mizer units) on their residential property that they use for processing their own harvested timber and acquired logs into wood products (decking and siding panels for example) for personal use and for sale to other local residents. As well, these "backyard" log sawing units are also used to custom cut logs owned by other local residents.

[112] Based on anecdotal and published sources, such as business websites and community website business directors. Other micro mills may be present on Haida Gwaii in addition to the ones named herein.

4.9.8 Forest Offset Credits

The contraction of the Haida Gwaii THLB through creation of new protected areas led to the creation of a Haida Gwaii forest carbon project and the monetization of the forest carbon storage services of the new protected areas

The Haida Nation is part of the Great Bear Initiative Society, an umbrella group of Coastal BC First Nations, which enables the First Nations to discuss and engage in matters that are relevant for a larger region within the Great Bear Rainforest. This organization has been working together on the land use planning decisions that were enacted along the coast and is the proponent of the Great Bear Forest Carbon Project. The overall Great Bear Forest Carbon Project was developed as three separate projects, including a Haida Gwaii project (entitled "Great Bear (Haida Gwaii) Forest Carbon Project").

In 2011, forest carbon offsets and their associated revenues became a part of the structure of the Haida Gwaii forest sector with the creation of a large-scale forest carbon offset project based on the implementations of the Haida Gwaii SLUA and the Haida Gwaii LUOO (Offsetters 2013). The SLUAled to the creation of several additional protected areas (conservancies) on Haida Gwaii and the LUOO led to the establishment of special management areas to address a range of EBM objectives (such as cultural western redcedar and northern goshawk conservation objectives). Although Haida Gwaii's THLB and AACs contracted as a direct result of these measures, a large annual stream of approximately 400,000 carbon credits was created through this forest carbon offset project that was premised on a reduced timber harvest (and increased carbon storage) compared to the likely timber harvest in the absence of the new conservancies and special management areas.

The original arrangements set up between the Province of BC and coastal First Nations to facilitate the creation and sale of coastal BC forest carbon offsets have since been refined and expanded and now include the following.[113]

- "The Atmospheric Benefit Sharing Agreement, re-negotiated in 2016 with the Province of British Columbia, which allows Coastal First Nations to use atmospheric benefits for socio-economic gain" and the 2019 Haida Nation Indigenous Atmospheric Benefit Agreement
- "The Offset Purchase Agreement, signed in 2015, which allows for the purchase of 2.89 million tonnes of carbon credits over six years" (by the Government of BC)
- "The Carbon Credit Transfer Agreement, signed in 2016, which authorizes the Great Bear Carbon Credit Corporation to market and sell carbon credits"

[113] See http://greatbearcorp.ca/subsidiaries/great-bear-carbon-credit-corporation/

- "The Great Bear Initiative Society Atmospheric Benefit Sharing Agreement, signed in 2016, which allows the proceeds from the sale of a portion of additional carbon credits to benefit land and marine use projects"

Under the Atmospheric Benefit Sharing Agreements between the BC Government and coastal First Nations, the carbon offsets from this Haida Gwaii forest carbon project are split between the BC Government (approximately 20%) and Haida Nation (approximately 80%). The Great Bear (Haida Gwaii) Forest Carbon Project is expected to generate approximately 12 million carbon offsets (or tonnes of CO_2e emissions reductions) over a 25-year project period. Annual volumes of carbon offsets are expected to range from approximately 300,000 to a maximum of 584,000 (Offsetters 2013).

The primary buyer of these Haida Gwaii offset credits at this juncture is the BC Government, which is using these credits to assist in meeting the compliance objectives of the Carbon Neutral Government Program.[114] The acquisition of these Haida Gwaii offset credits is publicly reported on an annual basis by the BC Government. In 2016, this Haida Gwaii based offset project sold 276,258 offset credits to the BC Government at a price of $12 each for total proceeds of $3,315,096 (BC Ministry of Environment and Climate Change Strategy 2017).[115]

Purchases of Haida Gwaii forest carbon offsets may qualify for compliance use by regulated entities seeking qualifying offset credits in order to assist with their compliance with the Government of Canada's Federal Carbon Pollution Pricing System (which had a January 1, 2019 start date). If these Haida Gwaii offset credits are approved for sale into this marketplace then they are likely to capture a higher price than the above reported $12 (per offset credit) because these offset credits will be acquired by regulated GHG emitting entities at a small discount to the compliance price (i.e., the Carbon Levy).[116]

4.10 Forest Sector Employment

4.10.1 Timber Harvesting Employment Estimates

Both timber harvesting and wood processing employment of Haida Gwaii residents declined since the early 2000s

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[114] Legislated under the Climate Change Accountability Act (formerly the *Greenhouse Gas Reduction Targets Act*) and the Carbon Neutral Government Regulation

[115] This total is a gross figure and is shared on an 80:20 basis between the Haida Nation and the Government of BC. In addition, annual administrative and management costs are associated with the offset project's operation and need to be netted out of the gross to arrive at net proceeds.

[116] The federal government's Carbon Levy will apply to regulated emitters use of prescribed liquid, gaseous, and solid fossil fuels at a rate that is equivalent to $10 per tonne of CO_2e in 2018, increasing annually, until it reaches $50 per tonne of CO_2e by 2022.

Estimated Haida Gwaii associated forestry employment, based on surveys of Haida Gwaii industry participants, shows a decline in the 2015-17 period over the 2002-04 period due to a lower average harvest, greater log export volume and higher logging productivity in the more recent period. Haida Gwaii residents had a higher share of Haida Gwaii direct harvesting employment however in the more recent 2015-17 period, an estimated 81% vs 60% in 2002-04, which is largely due to Taan's employment and contracting practices.

The scale of Haida Gwaii's available annual cut per capita within the context of a small population and labour force underlies the basis for the forest sector occupying a prominent position in the Haida Gwaii economy. The broad factor that has generated the bulk of the forest sector employment opportunities on Haida Gwaii is the demand in certain external markets for Haida Gwaii logs (as described in Section 4.3). An indication of the importance of log market demand conditions compared to timber supply conditions is that the average annual harvest in the 5-year 2013-17 period was much higher (831,172 m^3) when a lower AAC has been in effect compared to the 635,280 m^3 average annual harvest in the 5-year 2008-12 period when the sum of the TSA and TFL AACs (representing the maximum potential commercial timber supply) was much higher but also when market demand factors such as the 2008 financial crisis were in play.

The average annual timber harvesting direct employment supported by the HGMA timber harvest for the 2015-2017 period was an estimated 270 PYs for Haida Gwaii resident workers. In addition to the direct employment in undertaking harvest planning, cut block layout, falling, yarding, truck and marine transport and several other harvest related activities, the HGMA timber harvest supports indirect employment, which arises from the purchases of goods and services by forest industry companies (an example would be the purchase of fuel by a stump to dump logging contractor) and induced employment, which arises through the purchasing of goods and services by the households of forest industry employees, an example would be their grocery purchases.

Another 122 PYs of indirect and induced employment on the islands was supported through the HGMA timber harvest, and a total annual average employment impact on Haida Gwaii of 392 PYs.

The direct employment effect in the overall province of harvesting HGMA timber is an estimated annual average of 333 PYs. The incremental difference of 63 PYs between the Haida Gwaii and provincial impacts is accounted for by the workers who work on Haida Gwaii but have their permanent residences elsewhere in the provice. Including the indirect and induced employment supported by HGMA timber harvesting along with the direct employment estimates yields a total employment effect of an annual average of 663 PYs in the province for the 2015-2017 period.

Table 4-15 presents estimates of the annual average employment over the 2015-2017 period supported by the HGMA timber harvest, including a breakdown by broad harvesting related activity. Direct employment is reported as an annual average estimate and as the intensity of direct employment in person-year units (PYs) per '000 m³ of harvested timber. The intensity figure is reported as a co-efficient, which is used to calculate potential direct employment effects based on levels of timber harvesting activity. The annual average employment levels and direct employment co-efficients are reported at the Haida Gwaii and BC levels.

Table 4-15: Estimated average annual employment impacts for Haida Gwaii workers and in the province that is supported by harvesting HGMA timber, 2015-2017

HGMA annual avg. harvest (m^3)	805,854			
Activity	**Haida Gwaii**		**BC**	
	Employment (PYs)	**Employment Co-efficient[117] (PYs/'000 m^3)**	**Employment (PYs)**	**Employment Co-efficient (PYs/'000 m^3)**
Direct employment				
Harvesting	206	0.256	255	0..317
Log transport	20	0.025	27	0.033
Road construction & maintenance	28	0.034	35	0.044
Silviculture	16	0.020	16	0.020
Total direct employment	270	0.335	333	0.414
Indirect/induced employment[118]	122	1.42 (total multiplier)	330	1.99 (total multiplier)

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[117] The direct employment co-efficients are calculated from data obtained through a survey of tenure holders undertaken for this socio-economic project. The survey respondents supplied data for the 2015-2017 period. The employment estimates based on using these co-efficients reflect the standard practices used by public sector entities for estimating forest sector employment in BC but the shown figures should not be interpreted as precise estimates to single digits. The estimates are considered to be accurate (and reliable for policy-making purposes) because the underlying basis for them are actual results reported by tenure holders and actual invoiced timber harvest data. A reasonable way to view the accuracy of the estimates is to view them as accurate within $\pm$ 5% so, on this basis, direct Haida Gwaii harvesting employment associated with the HGMA harvest could be between 284 PYs and 256 PYs.

[118] The total multipliers used to estimate indirect and induced employment are the ratio of total employment to direct employment. Total employment is the sum of direct + indirect + induced employment. The shown BC total multiplier for "forestry and logging" is based on detailed industry data extracted from the BC Input-Output Model (BCIOM), which is maintained by BC Stats to analyze project and program spending in the province. This model has data by industry for employment, employment income, gross domestic product, economic output, and government taxation revenues in BC. While use of the BCIOM has limitations, its commodity and industry relationships are based on a very large database accumulated over several years and the model has been found to generate effect estimates that are indicative of realized economic effects. As well, the total multipliers for BC calculated for use in this socio-economic report incorporated direction on their construction as outlined in a BC Stats publication (Horne 2004).

The Haida Gwaii area multipliers were sourced from a research project commissioned by BC Stats that developed economic multipliers by key industries for small areas throughout the province (Horne 2009a). Although the Haida Gwaii multipliers are based on 2006 Census of Canada data, they are considered to be relevant although they likely understate more recent indirect and induced effects connected to Haida Gwaii harvesting activities. This observation about understing indirect and induced effects is based on the noted higher level of Haida Gwaii residency of timber harvesting workers so more household spending is expected for the 2015-2017 period versus 2006 resulting in higher induced employment effects. As well, Taan did not operate in and around 2006 as noted in Section 4.9.4, and this company has made a concerted effort to use local suppliers of goods and services so indirect employment connected

Total employment	392		663	

Source: survey of HGMA tenure holders and author's calculations

To help determine the residency of forest industry workers, tenure holders were asked to supply basic information about the "usual place of residence" (i.e. permanent residence) of their own employees and of the employees of their contractors (such as a stump to dump contractor).[119] Based on the survey information, an estimated 81% of Haida Gwaii timber harvesting related employment during the 2015-2017 period resided on Haida Gwaii. This level of Haida Gwaii residency of timber harvest employment for the 2015-2017 period is substantially higher than the level of 60% for the 2002-2004 period, which was recorded the last time that a survey of the harvesting related employment of Haida Gwaii forest tenure holders was undertaken (Pierce Lefebvre Consulting 2005).

A Haida Gwaii residency level of 81% for the workforce harvesting HGMA timber is characterized herein as a high level because specialist work is required for certain aspects of timber harvesting, such as archaeology and tree falling, and because the Haida Gwaii population and labour force are small (compared to other areas and communities in BC and in relation to the Haida Gwaii AAC). In certain specialist fields, firms based in larger centres, such as North Vancouver and Nanaimo, contract their services throughout the coastal BC forest industry. In regard to the Haida Gwaii population of labour force relative to its AAC, for context here, the ratio of the Haida Gwaii AAC to its population can be compared against the ratio for the province or another major timber harvesting region. The AAC volume per capita on Haida Gwaii is relatively substantial, an estimated 222 m^3 per person, much higher than the average AAC volume per capita in BC of approximately 16 m^3/person.

The main factor that underlies the increase in the Haida Gwaii share of Haida Gwaii timber harvesting direct employment is the creation of Taan Forest Products and its policies and actions to use local workers and local supplier businesses to harvest its tenures as much as possible within the constraints of finding suitably qualified workers and businesses (see Section 4.9.4).

to HGMA timber harvesting effects are likely higher in the 2015-2017 period than in 2006. And induced employment would also be slightly higher as it is based on spending by the households of both direct and indirect workers. From a structural standpoint, the Haida Gwaii service sector was not marked by large additions or deletions between 2000 and 2016 so the basic or structure make-up of the local service sector was similar over this period. The shown annual average indirect and induced employment estimate for Haida Gwaii could be up to about 20% higher as a result of the described situation.

119 Usual place of residence is a Statistics Canada term, and refers to the community of a person's long-term home or permanent residence. Long distance commuting occurs on Haida Gwaii and elsewhere in Canada so long distance commuters can have both a place of work residence and a usual place of residence. We are interested in distinguishing between Haida Gwaii forest industry workers who have their permanent residence on Haida Gwaii and those who have their permanent residence elsewhere.

The forest sector employment estimates include neither BC MFLNR employment nor BCTS employment on Haida Gwaii.[120] A considerable number of forest/natural resource districts and forest/natural resource district offices have been consolidated across the province but Haida Gwaii has retained its own administrative district and district office. Over the 2015-2017 period, BC MFLNR has maintained an average annual staffing level of 22 full-time employees and 1 to 4 part-time employees in its Haida Gwaii office. Within this BC MFLNR total staff level are 4 to 5 BCTS staff positions (pers. comm. T. Johnson 2018). Table 4-16 shows MFLNR's Haida Gwaii office employment for the 2015-2017 years.

Table 4-16: Haida Gwaii MFLNR employment including BCTS staffing, 2015-2017

Year	Full Time	Part Time
2015	23	1
2016	22	1
2017	21	4

Source: pers. comm. D. Sherban 2018

The estimated direct employment supported by the HGMA (i.e. Crown lands) timber harvest declined from an annual average of 578 PYs in the 2002-2004 period to the level of 333 PYs during the 2015-2017 years on a province-wide basis (and from 349 PYs of Haida Gwaii resident workers to 270 PYs of Haida Gwaii resident workers). The decline between these two time periods, separated by a dozen years, was due to a lower harvest level and to higher logging productivity (i.e. fewer PYs/m^3 harvested) in the more recent time period. Haida Gwaii residents had a higher share of Haida Gwaii associated timber harvesting direct employment in the more recent 2015-2017 period, 81% versus 60% in 2002-04. Table 4-17 presents a comparison of the annual average harvesting related direct employment supported by the HGMA lands timber harvest during these two time periods.

Table 4-17: Comparison of HGMA timber harvesting related direct employment during 2015-2017 versus 2002-2004

	2015-2017	2002-2004
HGMA annual avg. harvest (m^3)	805,854	1,037,193
BC employment co-efficient (PYs/'000 m^3)	0.414	0.557
Haida Gwaii employment co-efficient (PYs/'000 m^3)	0.335	0.337
Other BC employment co-	0.079	0.220

[120] BC MFLNR and BCTS employment are not included as part of direct forest industry employment because they are directly related to the Ministry's administration and statutory roles and responsibilities. As mentioned in Section 3-4, BC MFLNR employment is categorized in Statistics Canada's labour force and employment data under "public administration" and not under a forest sector industry category.

efficient (PYs/'000 m^3)		
Annual avg. employment in BC (PYs)	333	578
Annual avg. employment of Haida Gwaii workers (PYs)	270	349
Annual avg. employment of other BC workers (PYs)	63	229

Source: survey of HGMA tenure holders, BC MFLNR 2018; Pierce and Lefebvre Consulting 2005; and author's calculations

4.10.2 Wood Processing Employment Estimates

4.10.2.1 Employment Estimates for Processing of Haida Gwaii Logs on Haida Gwaii

The amount of wood processing direct employment on Haida Gwaii supported by the HGMA timber harvest is estimated to have been relatively modest during the 2015-2017 period, an annual average of approximately 15 PYs[121]

The current status of the Haida Gwaii wood processing industry is laid out in Section 4.9.7. The annual average estimated direct employment level of the Haida Gwaii wood processing operations for the 2015-2017 period of 15 PYs is a decline from the estimated amount of 54 PYs in the earlier 2002-2004 period (Pierce Lefebvre Consulting 2005). The structure of the local wood processing industry did not fundamentally change between these two periods as during both time periods a small sawmill operated in Port Clements and approximately a dozen micro mills were located in the main communities of the islands. The main differences between the two time periods in terms of the number and type of processing operations was the downsizing of the Abfam/HGWP mill in Port Clements and that O'Brien & Fuerst operated a small pole peeling facility at Port Clements and Timo Johnsson operated a larger micro mill at Sandspit during the earlier time period (but not during the 2015-2017 years). The difference in local processing employment between the two time periods was due to the Haida Gwaii mills processing, in aggregate, a larger amount of timber, an estimated annual average of approximately 55,000 m^3, in the earlier time period versus an estimated annual average of approximately 3,000 m^3 during the 2015-2017 period.[122] More Haida Gwaii timber

[121] The estimate of 15 PYs is based on employment and timber input data for the 2015-2017 period provided by Haida Gwaii Forest Products and interviews with a few of the operators of small Haida Gwaii micro mills. A majority of these PYs are based on persons working part-time in wood processing so the number of workers in wood processing is greater than 15.

[122] The total timber throughput of Haida Gwaii processing facilities was estimated as approximately 37,000 m^3 for local sawmills and another 20,000 m^3 for local shake and shingle production (Pierce Lefebvre Consulting and D.A. Ruffle & Associates 2003).

got milled locally in the 2002-2004 time frame because of the presence of the aforementioned Port Clements pole peeling plant and the Sandspit mill and because the Abfam/HGWP sawmill was processing a larger timber volume than in the 2015-2017 years.

Nevertheless, the total amount of Haida Gwaii timber processed on the islands was small in 2002-2004 by comparison to the Haida Gwaii volume processed elsewhere, which is also the current situation. In the 2002-2004 period, an annual timber volume equivalent to about 5% of the Haida Gwaii public lands harvest (that was processed in BC) got processed locally.[123] In the 2015-2017 period, the portion of the HGMA lands harvest annually processed on the islands was lower yet, an estimated 0.6%.

The portion of the Haida Gwaii harvest processed in BC but controlled by Haida Gwaii focused operations did increase significantly, however, from the early 2000s period to the more recent period via Taan's acquisition of Haida Gwaii tenures and establishment of its custom cut program, which is in addition to the custom cut programs of O'Brien & Fuerst and Husby.

4.10.2.2 Employment Estimates for Processing of Haida Gwaii Logs in other BC Areas

The cedar logs from HGMA lands are being processed in BC, mainly in Lower Mainland sawmills via the custom cut programs of the Haida Gwaii forest sector operators, Taan, Husby and O'Brien & Fuerst

In the survey of Haida Gwaii tenure holders for this socio-economic report, they were asked for data on the BC processing facility destinations and export market destinations in 2017 for their logs.[124] An estimated 42.6% of the total log volumes of the Haida Gwaii survey respondents in 2017 was comprised of cedar logs directed to BC wood processors.

A distinct difference between the early 2000s and recent years is in the share of Haida Gwaii timber that was exported and so directed to wood processing facilities outside of BC; for example, in 2017, the estimated export volume from HGMA lands was 267,813 m^3, equivalent to 41.5% of the HGMA 2017 harvest.[125] The average annual export volume over the 2015-2017 period relative to the HGMA lands harvest was 36.9%. In the earlier 2002-2004 time period, only an annual average of 7.3% of the public lands harvest was exported. This shift in the destination of Haida Gwaii timber between the two time periods is due to the increased demand for BC softwoods timber in China and the associated Haida Gwaii log export exemption order that was initially put in place in 2010. This shift was also affected by

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[123] A small but unknown portion of the locally processed timber came from Haida Gwaii private lands so this figure is a slight overstatement of the portion of the Haida Gwaii Crown land harvest processed locally.

[124] Data was requested for only 2017 in order to simplify the effort for survey respondents. The 2017 year is considered representative of the recent processing and exporting situation on Haida Gwaii. The vast majority of the 2017 HGMA harvest is accounted for via the harvests of the survey respondents.

[125] Some of this 2017 export volume will have been harvested in 2016 and some of the 2017 HGMA harvest will be exported in 2018.

the low TFL 58 harvest during the 2015-2017 period as Teal Jones withdrew from Haida Gwaii.

The re-direction of a large portion of the Haida Gwaii hemlock and spruce harvests in recent years to export markets has resulted in reduced employment in other areas of BC that are based on processing Haida Gwaii timber. This shift to export markets reflects both strong demand conditions in Asian markets for hemlock and spruce logs and a weak competitiveness performance of the Coastal BC sawmill industry in making and selling hemlock and spruce wood products. Over the 2000-2016 period, the number of Coastal BC lumber mills has decreased by half, from 36 to 18 facilities and their fibre input has similarly decreased from 13.8M m^3 in 2000 to approximately 7M m^3 in 2016 (BC MFLNR 2018f). On Coastal BC, not a single new sawmill of significant size has been built since the Teal Jones Group built a small log mill in Surrey in 2003. In August 2018, the San Group Inc. announced a planned investment to upgrade a shuttered sawmill that this company purchased in Port Alberni.

Pulp logs directed to BC pulp and paper mills accounted for a small portion, 1.8%, of the total processed and exported HGMA log volumes in 2017 (based on the Haida Gwaii industry survey responses collected for this socio-economic report). This low pulp log share is due to both the high quality of Old Growth hemlock and spruce fibres on the islands and the relatively high cost of barge transporting logs from Haida Gwaii to southwestern BC. However, residual fibre created through the milling of Haida Gwaii logs into wood products at Lower Mainland mills is directed to BC pulp and paper making facilities and supported a substantial portion (approximately one-third) of the total processing direct employment connected to HGMA lands timber over the 2015-2017 period.[126]

In the 2015-2017 period, the majority of the wood processing employment in BC that was based on the input consumption of Haida Gwaii logs was located in the BC Lower Mainland as this is the location of the mills that Taan, Husby and O'Brien & Fuerst have been using for their custom cutting programs. The custom cutting programs of these Haida Gwaii harvesting operators accounted for the majority of the Haida Gwaii logs that stayed in BC for processing. These Haida Gwaii harvesting operators sold a small portion of their logs into the VLM and when Teal Jones operated on Haida Gwaii, this company, primarily, either directed its Haida Gwaii logs to its own Lower Mainland processing facilities or traded its Haida Gwaii logs to acquire other coastal BC logs for processing in its mills.

For the 2015-2017 years, the estimated average annual wood processing direct employment in BC outside of Haida Gwaii that was the result of processing timber harvested within the HGMA was an estimated 274 PYs. Most of the wood processing direct employment supported by Haida Gwaii logs was in facilities manufacturing cedar lumber products, such as

[126] Residual fibre volumes are a function of lumber manufacturing recovery rates, about 40% for Coastal BC lumber mills, and bark volume (about 12%) leaving almost half of log volume as useable residual fibre, comprising about 36% in chips and 23% in hog fuel and sawdust (Pierce Lefebvre Consulting and D.A. Ruffle & Associates 2002).

siding and decking components, an estimated 146 PYs. In addition, a portion of the cedar lumber products are further processed in BC remanufacturing plants.[127]

The direct employment based on milling Haida Gwaii hemlock and spruce logs in BC (outside of Haida Gwaii) was relatively small, an estimated 31 PYs. The residual fibres resulting from the milling of Haida Gwaii logs in the Lower Mainland are estimated to have supported an annual average of 94 PYs of employment at BC pulp and paper making facilities. Only 3 PYs of the estimated processing employment was based on chipping Haida Gwaii pulp logs and using the chips in BC pulp and paper mills. Table 4-18 shows the estimates of annual average employment supported by the processing of HGMA harvested logs in mills in other areas of BC.

Table 4-18: Estimated annual average employment supported by processing of HGMA harvested logs in other BC Areas, 2015-2017

	Employment (PYs)	Employment Co-efficient (PYs/'000 m^3) [128]	Total multipliers[129]
Cedar wood products manufacture			
Direct employment	146	0.418	-
Indirect and induced employment	124	-	1.85
Total employment	270	-	-
Spruce & hemlock wood products manufacture			
Direct employment	31	0.34 6	-
Indirect and induced employment	36	-	1.85
Total employment	67	-	-
Pulp & paper manufacture			
Direct employment	97	0.206	-
Indirect and induced employment	119	-	2.23
Total employment	216	-	-
All wood processing			
Direct employment	274	-	-
Indirect and induced employment	279	-	-
Total employment	553	-	-

[127] An estimate for BC remanufacturing plant employment is not included here as information is not available on the portion of cedar lumber products made in BC that are further processed in BC remanufacturing plants. A federal government study estimated coastal and Fraser Valley employment in remanufacturing plans as totaling an estimated 247 employees based on a 2012 survey of these facilities (Gregory, McBeath, and Filipescu 2018).

[128] The employment co-efficients are used to estimate direct employment, and are based on a study of coastal BC woodflow ((Pierce Lefebvre Consulting and D.A. Ruffle & Associates 2002). The co-efficients are multiplied by an estimate of the annual average timber volume by species processed in other areas of BC over the 2015-2017 period. The difference in the employment co-efficients between processing of cedar and hemlock-spruce timber is that a portion of the cedar harvest is processed in more labour intensive processing facilities, such as shake and shingle mills.

[129] Total multipliers are used to estimate indirect and induced employment. The shown BC total multipliers for "wood product manufacturing" and "pulp and paper manufacturing" are based on detailed industry data extracted from the BC Input-Output Model (BCIOM), which is maintained by BC Stats to analyze project and program spending in the province.

Source: survey of HGMA tenure holders, BC MFLNR 2018; Pierce and Lefebvre Consulting 2005; and author's calculations

The total estimate incorporates indirect and induced employment along with the direct mill-based employment. An annual average of 553 PYs of total employment are connected to the processing of Haida Gwaii logs in southwest BC mills. Although cedar wood products manufacture has the largest share of direct wood processing employment (approximately 53%), the indirect and induced employment in the pulp and paper sector is higher than in cedar products manufacture because of the higher level of spending of pulp and paper mills on goods and services and the higher income levels of pulp and paper mill employees.

The 2002-2004 employment estimate based on the Haida Gwaii harvest indicated a higher annual average level of wood processing direct employment (588 PYs) for outside of Haida Gwaii than is estimated herein (274 PYs) for the 2015-2017 years. The difference in wood processing direct employment between the two periods is due to three factors. One factor is that the average public lands harvest was about 20% higher during the 2002-2004 years. Another key factor is that the share of the Haida Gwaii public lands harvest shipped to export markets was much smaller over the 2002-2004 period so a much larger share of Haida Gwaii logs went to BC wood processing facilities during this earlier period than in recent years. The third factor is that this estimate for the 2015-2017 period incorporated a breakdown by species of the manufacture of Haida Gwaii logs.

4.10.3 Total Employment Estimates based on Harvesting and Processing HGMA Timber

During the 2015-2017 period, the estimated annual average direct employment in BC based on harvesting and processing HGMA timber was 622 PYs, and the majority of this direct employment, 333 PYs (53%), was in harvesting activities including log transport. However, although Haida Gwaii resident workers accounted for the largest share of harvesting direct employment (81%), on islands workers held less than half of the total (harvesting and processing) direct employment (43%) because of the very small amount of wood processing activity on Haida Gwaii (local workers accounted for only 5% of the direct employment supported by milling HGMA harvested timber). However as described in Section 4.10.2.2, Haida Gwaii focused forest sector operators control a significant portion of the processing and marketing of wood products based on HGMA timber that is manufactured in the province through their Lower Mainland-based custom cutting programs. Table 4-19 shows the estimated annual average employment supported by the harvesting and processing of HGMA timber of the 2015-2017 period.[130]

[130] The Haida Gwaii forest sector direct employment total estimate itemized in this table of 285 PYs (annual average for the 2015-2017 period) is in accordance with the estimate of a labour force in the Haida Gwaii forest sector of 290 workers (for 2016) that was itemized in Table 3-5 of Section 3.4. The latter estimate includes full-time and part-time workers. In addition, the Haida Gwaii forestry workers covered in Table 3-5 include workers who harvest timber on

Table 4-19: Estimated annual average employment supported by harvesting and processing HGMA timber, 2015-2017

	Direct Employment (PYs)	Indirect and Induced Employment (PYs)	Total Employment (PYs)
Haida Gwaii			
Harvesting	270	122	392
Wood Processing	15	7[131]	22
Total	285	129	414
Rest of BC			
Harvesting	63	208[132]	271
Wood Processing	274	285[133]	559
Total	337	493	830
BC			
Harvesting	333	330	663
Wood Processing	289	292	581
Total	622	622	1,244

Source: survey of HGMA tenure holders, BC MFLNR 2018; Pierce and Lefebvre Consulting 2005; and author's calculations

A similar level of annual average indirect and induced employment of 622 PYs is estimated to have been generated in the province as a result of harvesting and processing HGMA timber during the 2015-2017 period. The estimated direct and total employment effects of 622 PYs and 1,244 PYs, respectively, for the 2015-2017 period were lower than the direct and total employment estimates of 1,220 PYs and 2,393 PYs, respectively, which were calculated for the earlier 2002-2004 period (Pierce and Lefebvre Consulting 2006). The difference in employment levels between these two periods is primarily due to the following factors.

- Average Haida Gwaii Crown land harvest was about 20% higher during the 2002-2004 years compared to the 2015-2017 annual average level of 805,854 m^3.

Haida Gwaii private lands and process some of that private lands timber. The focus in Table 4-19 is only on harvesting and processing employment connected to HGMA lands timber.

The former estimate in Table 4-19 is based on person-years (PYs) of employment which aggregates the working time of full-time and part-time workers into a full-time position equivalent. The labour force or employment estimate based on number or workers, jobs or positions for a sector or industry should be slightly higher than an estimate of person-years of employment or full-time equivalent (FTE) positions.

131 Indirect and induced effects on Haida Gwaii only.

132 The indirect and induced employment in the rest of BC is positively affected by the large amount of direct harvesting activity that occurs on Haida Gwaii. The multiplier effect in the rest of BC connected to the on islands harvesting activity is higher than for Haida Gwaii because the service sectors in the Lower Mainland and in the main communities on Vancouver Island are more developed than the Haida Gwaii service sectors.

133 The indirect and induced effects in the rest of BC associated with wood processing are higher (285 PYs) in this table than in Table 4-19 (279 PYs) because the latter table only considers the indirect and induced effects associated with processing activity that occurs outside of Haida Gwaii. The small amount of processing activity on Haida Gwaii generates a small amount of indirect and induced effects in the rest of BC as well as having some indirect and induced economic effects on Haida Gwaii.

- The share of the HGMA lands harvest directed to export markets was much smaller over the 2002-2004 period so a much larger share of Haida Gwaii logs were processed in BC mills during this earlier period than in recent years.
- Improved labour productivity of harvesting operations on Haida Gwaii.
- The estimate for the 2015-2017 period incorporated a breakdown by species of the manufacture of Haida Gwaii logs so likely represents a slightly more accurate estimate of processing employment.

4.11 Haida Gwaii Timber Harvest Operating Costs

4.11.1 Introduction

Forest harvesting includes all phases involved in delivering a tree (log) to a processing facility. On Haida Gwaii, these phases typically include layout/planning, road construction, felling, skidding/yarding, processing, trucking, and barging, sorting, scaling, and log storage. In general, timber harvesting costs on Haida Gwaii can vary by terrain, equipment used, timber types, past development, and geographic location (which affects travel time, difficulty of access, and camp requirements).

Harvesting Coastal BC timber is relatively expensive by comparison to harvesting of softwoods timber in competing regions in the rest of North America, Europe and Asia. Table 4-20 summarizes a ranking of Coastal BC sawmills (as a group) against sawmills in other regions around the globe on four key factors, including delivered log costs. Albeit the comparative log cost situation for Coastal BC has improved over the 2002-2014 period used in this table, from 29th and worst in 2002, Coastal BC still sat well behind other regions on the dimension of delivered log costs in 2014, 11th, and sits behind all North American regions on this dimension.

Table 4-20: Coastal BC "Average" Sawmill Competitiveness Ranking in Global Survey, 2002, 2008 and 2014 (1 = best and 29 = worst)

Competitiveness factor	2002	2008	2014
Delivered log costs	29th	11th	15th
Sawmill costs	29th	12th	23rd
Lumber revenue	7th	15th	2Second
Earnings (EBITDA)	19th	19th	16th

Source: Taylor 2016

Timber harvesting on Haida Gwaii is often more expensive than in more southerly Coastal BC locations because of the difficult terrain in certain Haida Gwaii harvesting locations, the cost of barging logs from Haida Gwaii to Lower Mainland and Vancouver Island timber processing facilities, EBM requirements associated with on islands timber harvesting and use of the FSC certification system (by Taan).[134] These relatively high logging and log (or lumber) transport costs result in higher input costs for Coastal BC wood processing facilities (including Haida Gwaii mills) as log input costs account for the biggest portion of their total costs.

Sawmilling costs on Coastal BC are also relatively high, in the global ranking outlined in Table 4-20, sawmill costs on Coastal BC were ranked 23rd (of 29 countries/regions). Again, as is the case with timber harvesting, wood processing costs on Haida Gwaii have been observed by various parties as more expensive than in southern coastal BC locations. A local mill has to contend with the cost of shipping its wood products to off island locations via truck transport and BC Ferries or a suitably equipped barge as the islands do not have a container port or direct links to railway services, electricity and fossil fuel costs are higher and opportunities for utilization of milling residues are limited.

Currently on Haida Gwaii, a significant portion of the landbase (approximately 40%) has been previously logged and is regenerating. A portion of these stands are currently old enough to harvest for the second time and have a different cost and fibre production profile than Old Growth stands. For example, Second Growth stands tend to be on gentler terrain, have shorter haul distances to market, have existing infrastructure in place that can be reused or upgraded (vs new construction), have high volume per ha with little rot, and stand types tend to be well suited for mechanized harvesting (more uniform with smaller diameters than old growth). These factors all tend to lead to lower harvesting costs for Second growth stands when compared to Old Growth stands.

The following sections describe each of the harvesting phases in more detail and provide estimated average costs experienced on Haida Gwaii. The cost estimates provided in this section are compiled from a review and synthesis of a few sources; the past experience of Forsite Consulting Ltd. in preparing Coastal BC timber harvesting cost analyses, a 2015 Haida Gwaii economic operability report (Ecora 2015), 2017 Coast Appraisal Manual (Timber Pricing Branch 2018), and personal communications with strategic planning foresters working on Haida Gwaii.[135]

4.11.2 **Layout/Planning**

Prior to the application for a cutting or road permit, a process of development planning occurs, which includes the planning of blocks and roads that are consistent with the following.

- commitments in Forest Stewardship Plans

[134] Taan is one of fourFSC certified forestry operations in BC; the others are Canfor (Prince George Division), Ecotrust Canada, and Harrop-Proctor Community Co-operative (Forest Products Association of Canada 2019).

[135] The shown cost estimates are estimates based on the author's synthesis of several sources of data and information and not as average costs or median costs based on a survey of harvesting operations.

- requirements of the FRPA and its regulations and of the Haida Gwaii Land Use Objectives Order
- engineering to locate planned roads and blocks in the field
- preparation of site plans/prescriptions
- timber cruising

The application for a cutting permit will then occur and an appraisal will take place to establish the stumpage rate applicable to the permit.

Specific to Haida Gwaii, planning and layout costs are higher than some other areas of Coastal BC due to the assessments required by the Haida Gwaii Land Use Objectives Order and the expense of flying in professionals to do this assessment work (such as for terrain, wildlife, and archaeology purposes) when Haida Gwaii professionals are not available to perform this work.

Typical layout and planning costs on Haida Gwaii are estimated as within a range of the following.

- Forest administration and planning: \$8-10/m^3
- Layout of Old Growth cut blocks: \$7-9/m^3 (less for ground-based harvesting systems and more for cable and helicopter harvesting systems)
- Layout of Second Growth cut blocks: \$5-6/m^3 (as above for Old Growth layout work, less for ground-based harvesting systems and more for cable and helicopter harvesting systems)

4.11.3 Road Construction, Maintenance and Deactivation

Road construction costs can vary widely according to whether an old road bed is present and, for new roads, by the terrain type and the number and type of stream crossings. Road building costs for accessing Second Growth timber can often be much lower because old road beds can be reactivated. New roads built through limited slope terrain that requires only hauled gravel ballast, culverts and digging for culverts only are at the lower end of the cost spectrum. At the high end, new roads on steep, rocky slopes or those with longer and/or more complicated stream crossings can cost over \$200,000/km. The following table summarizes typical road construction costs on Haida Gwaii by the steepness of the terrain and the presence or absence of an old road bed.

Table 4-21: Typical Road Costs (\$/km)

Cost Type	0-40% Slope	40-60% Slope	>60% Slope
New Construction (\$/km)	\$60-90,000	\$120,000	\$150,000
Reactivation (\$/km)	\$25,000 - \$65,000 (includes culverts)		

4.11.4 Falling

Tree falling "by hand" on Coastal BC is often undertaken by independent contractors who provide their services throughout Coastal BC (rather than being done by an employee of a market logger or of a stump to dump contractor). Hand falling with chain saws is required on steeper slopes and/or in diverse stands having large diameter trees (typically Old Growth timber). On Haida Gwaii, the cost for hand falling lies generally in the \$12-15/m^3 range.

Mechanized falling using harvesters or feller bunchers is safer and more efficient than hand falling but can only be used in stands with smaller and more uniform diameter timber (typically Second Growth timber). The cost for mechanized falling on Haida Gwaii is typically in the \$6-8/m^3 range.

4.11.5 Skidding and Yarding

On Haida Gwaii, three primary methods are utilized for moving felled trees from the stump (harvest area) to the forest roadside landing area: hoe chucking, grapple yarding, and helicopter yarding.

Hoe Chucking

This system uses hydraulic log loaders high ground clearance to 'swing' or 'chuck' logs to the roadside. The hoe-chucker operator moves logs, either individually or in small bunches, one swing at a time before repositioning the machine. Hoe chucking is the least cost method of yarding logs to the roadside (\$8-10/m^3) but can only be used on gentle terrain (generally defined as less than 30% slopes).

Grapple Yarding

This system uses a large mobile tracked unit equipped with a tower, winches, wire rope (cables), and a large grapple designed to grab and pull (yard) logs from the stump to the roadside landing area. This system can be used on steep terrain as long as roads can be constructed that allow for the landing of logs and maintaining yarding distances (between the felled trees and roadside) below 300m. On Haida Gwaii, grapple yarding costs are typically in the \$16-20/m^3 range.

Helicopter Yarding

Helicopter yarding utilizes large helicopters to lift and air transport logs from the stump to either a roadside landing or a water drop site. The maximum weight of logs for an individual lift is less than what can be accommodated with cable logging systems but logs can be moved by helicopter up to 1.5 kilometres. The costs for helicopter vary by cycle time (distance), elevation change between the cut block and the landing site, landing site type (water or land), and log weight or payload per cycle. This system is used for high value timber growing on difficult to access by road and/or environmentally sensitive terrain. Cut blocks can be small and spatially dispersed without significantly impacting costs of helicopter yarding. Where existing roads or water drops can be used, helicopter costs are offset by reduced road building and water dump site costs. Costs of helicopter yarding on Haida Gwaii range from \$80-95/m^3.

4.11.6 Sorting, Primary Processing and Loading

The primary processing of felled trees plays an important role because this process ensures better conditions for superior wood valuing, economically and ecologically efficient wood harvesting, and full valuing of the marketable volume of marked trees. Once logs are moved to the roadside landing area, they are sorted, processed (bucked and delimbed) and loaded onto trucks. Bucking cuts the tree into merchantable logs, which is a significant activity affecting the potential value of the log. When felling is done by hand, bucking is usually done by the faller as well. As the tree is limbed, it is cut into log lengths of the greatest value.

Sorting ensures that trucks contain a log load destined for the same end point, while bucking to specific log lengths and delimbing is required to maximize log loads on trucks. The costs to complete these activities on Haida Gwaii is typically in the range of \$7-10/m^3.

4.11.7 Transportation Costs

Loaded trucks transport logs from the roadside landing areas via forest roads and highways to where they are loaded onto barges for transport to the Port of Prince Rupert or Lower Mainland destinations, including Port of Vancouver terminals. Most Haida Gwaii Second Growth logs are transported by barge to the Port of Prince Rupert for export via bulk container ships to Asia and most Old Growth logs are transported by barge to booming areas or wood processing facilities located along Lower Mainland stretches of the Fraser River.

Booming and towing of logs as performed in Strait of Georgia waters is not a viable option for Haida Gwaii logs because of the difficult Hecate Strait waters between Haida Gwaii and Prince Rupert and the distance between Haida Gwaii and Vancouver.

Total trucking costs vary due to hauling distance but per m^3 trucking costs are estimated as about \$0.15/m^3/km (so a 100 km haul would cost about \$15/m^3). The majority of logging truck transport occurs on forest roads on Haida Gwaii because of the relatively modest distance of highways on the islands.

The cost of barge transport from Haida Gwaii to Vancouver, including operating water dumps and dryland sorts, is in the \$18-20/m^3 range while the cost of barging from Haida Gwaii to Prince Rupert is in the \$12-16/m^3 range.

4.11.8 Dump, Sort, Scale, Boom and Storage

At water dump sites, the cost of dropping ground anchors and installing boomsticks in a new area will be about \$1/m^3.

The logging company or its agents sort logs prior to their scaling (for non-cruise-based sales) at scaling sites. Scaled logs are stored in booms or on land at Prince Rupert and in the Vancouver area.

The dump, sort, scale and boom costs amount to a cost of about \$12/m^3. The storage costs vary by the term and site of storage but typically amount to a cost of about \$4/m^3.

4.11.9 Miscellaneous costs including pile burning, insurance and contingency

In general, pile burning costs on Coastal BC are in the \$0.25/m^3 range. While insurance costs can vary widely in percentage terms, in absolute terms they account for a small amount of the total cost of harvesting. A range of insurance cost is \$0.25 - \$1.00/m^3. In practice, the tenure holder would build a contingency amount into their proforma budget for estimating costs associated with logging of a cutting permit area. A figure of \$1/m^3 for contingency is used herein.

4.11.10 Total Harvesting Costs

Haida Gwaii is a high cost logging location competing in a global market

A wide range of logging costs is evident on Haida Gwaii but harvesting of Old Growth timber versus Second Growth timber and their associated terrain characteristics is the main point of cost differentiation in recent years and will remain so over the next couple of decades. Representative examples of total harvesting costs on Haida Gwaii for each of mechanized harvesting of Second Growth timber, hand falling and cable yarding of Old Growth timber and helicopter logging of Old Growth timber are shown in the tables below. In the shown examples, helicopter logging is the most expensive (\$172/m^3), followed by cable logging of Old Growth timber (\$96/m^3). Mechanized falling and yarding of Second Growth timber presents as the lowest cost harvesting system on Haida Gwaii (\$79/m^3).

Expenditures for stumpage, fee in lieu of manufacture (for exported logs), silviculture, management overhead and camp operations (if applicable) would be in addition to the costs shown in these tables.

Table 4-22: Mechanized Second Growth Harvest ($/m^3)

Total Costs	Plan & layout	New & reactivated road construction	Road maintenance & deactivation	Falling (mechanized)	Yarding (hoe chucking)	Loading & truck hauling	Dump, sort, scale & boom	Pile burn, insurance & contingency	Barge transport (to Greater Vancouver)	Store
$79	$7	$7	$1.50	$7	$9	$10	$12	$1.50	$20	$4

Table 4-23: Cable Logging Old Growth Harvest ($/m^3)

Total Costs	Plan & layout	New & reactivated road construction	Road maintenance & deactivation	Falling (hand)	Yarding (cable)	Loading & truck hauling	Dump, sort, scale & boom	Pile burn, insurance & contingency	Barge transport (to Greater Vancouver)	Store
$96	$7	$7	$1.50	$15	$18	$10	$12	$1.50	$20	$4

Table 4-24: Helicopter Logging Old Growth Harvest ($/m^3)

Total Costs	Plan & layout	Road construction	Road maintenance & deactivation	Falling (hand)	Yarding (helicopter)	Truck hauling	Dump, sort, & boom[136]	Pile burn, insurance & contingency	Barge transport (to Greater Vancouver)	Scale and store
$172	$20	$0	$1.50	$15	$90	$0	$12	$1.50	$20	$12

Source: Timber Pricing Branch 2018; Ecora 2015; personal communications with logging operators; and author's calculations

4.11.11 Forest Regeneration and Silviculture

Silviculture costs include site preparation, planting, and survey work required to monitor and declare the stands successfully regenerated.

HGMA TSA and TFL licensees are responsible for basic silviculture (i.e. establishment of a free-growing stand) on areas harvested under major licences. BC MFLNR is responsible for silviculture on areas harvested by BCTS award holders and on backlog not satisfactorily restocked (NSR) areas. If an area is harvested in the early summer, planning and site preparation work will often occur in the fall and planting in the following spring.

Regeneration practices on Haida Gwaii are tied to the tree species of the silviculture prescription for logged cut blocks. Natural regeneration (no planting) is used for hemlock and planting of nursery raised seedlings is used for Sitka spruce and western redcedar regeneration.

To be consistent with the Haida Gwaii Land Use Order, red or yellow cedar is planted into stands where they were previously present. Silviculture costs for planted cedar are significantly

[136] Cost of dropping booming ground anchors and installing boomsticks in a new area

higher than for other species because a protective cone must be placed over each cedar seedling to prevent deer from browsing (eating) the seedling. The estimated cost for adding and maintaining the cones is $5 per tree.

The 2017 BC Coast Appraisal manual uses a basic silviculture cost for Haida Gwaii of $5.11/m^3. Where cedar is regenerated, silviculture costs would be $6.11/m^3, i.e. about $1/m^3 higher. In the case of cut blocks logged with helicopters the silviculture cost would be $1/m^3 higher due to the distance of these logged areas from forest roads. Table 4-25 presents the cost for basic silviculture by coastal BC forest district as shown in the 2017 Coast Appraisal Manual.

Table 4-25: Basic silviculture cost in 2017 Coast Appraisal Manual for BC Coast forest districts ($/m^3)

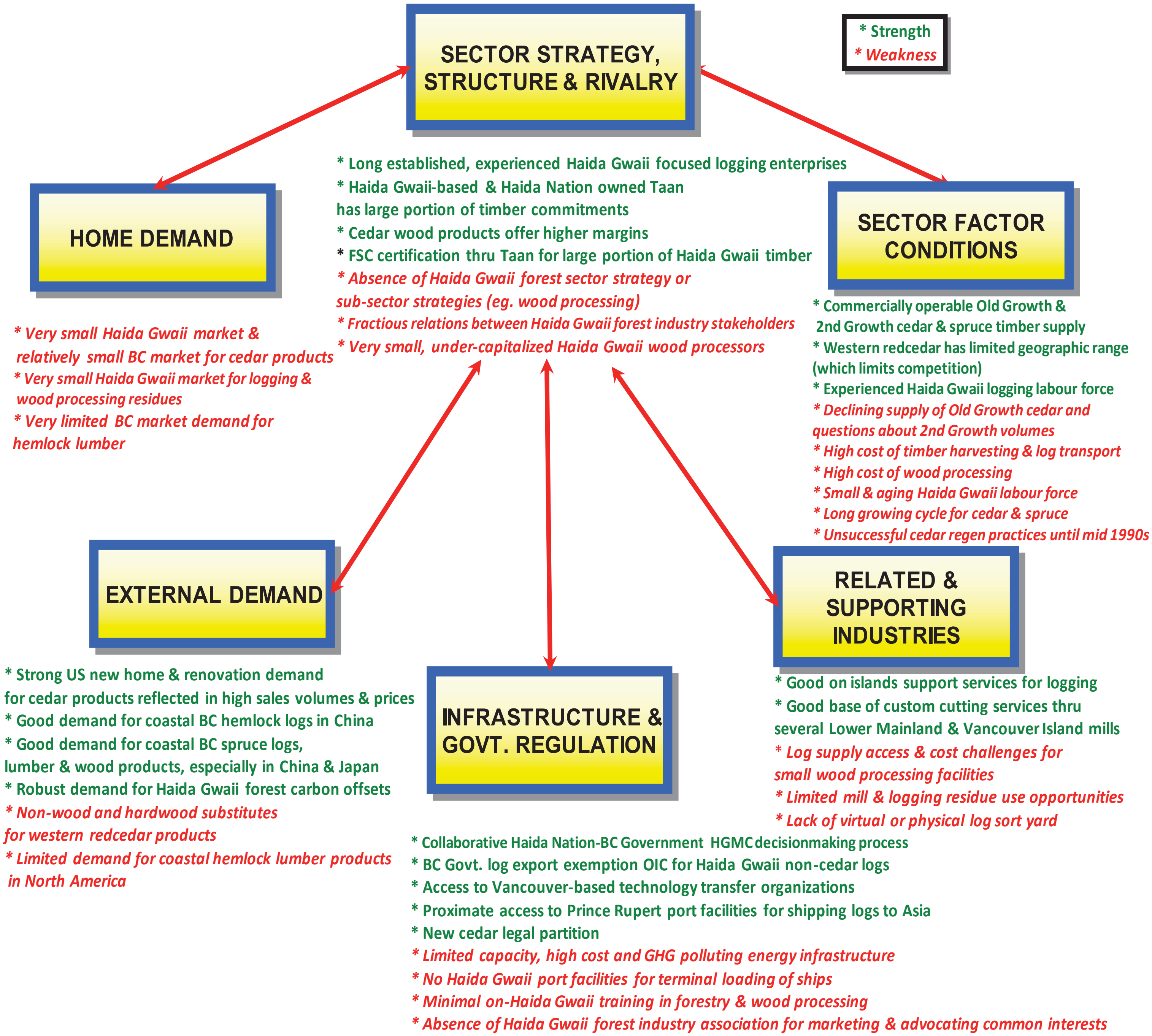
Forest District	$/*m^3
Haida Gwaii	5.11
Coast Mountain (North Coast)	10.64
Sea to Sky (Squamish)	6.05
Chilliwack	5.02
Sunshine Coast	3.95
South Island	3.43
Campbell River	3.18
North Island – Central Coast	3.01

Source: BC MFLNR 2018c

4.12 Situation Analysis Strengths and Weaknesses Summary

In Figure 4-15, the summary for the Haida Gwaii forest sector situation analysis is laid out on the basis of identified socio-economic strengths and weaknesses.

Figure 4-15: Summary of strengths and weaknesses of Haida Gwaii Forest Sector



5 Key Issues Going Forward

5.1 Introduction

The RFP for this socio-economic report included a Part II in which six questions were framed around issues that look forward at potential effects on the Haida Gwaii forest sector or potential effects of the local forest sector on Haida Gwaii communities and peoples. The six questions were as follows.

- [What is the] Role of cedar as an ongoing economic mainstay (i.e., sustainable supply of economic cedar)?
- What elements of community stability are dependent on timber supply?
- What contribution does wood provide to local versus regional/provincial markets?
- What are the variables and thresholds for second growth forests being economically viable?
- What are the barriers or enablers of fibre flow to local producers? Which barriers have the largest impact on the health of the islands economy?
- What is required (levels of harvest) to provide a security of investment for operators?

5.2 Role of Cedar

Harvesting cedar has been the "straw that stirs the drink" for the Haida Gwaii forest sector since the mid-1990s. The limited global supply of western redcedar and yellow cedar is manufactured into specialty or niche products sought by buyers who appreciate cedar's structural, visual and durability qualities. Cedar timber is distinct from other Coastal BC softwood species that are primarily used for internal (not visible) structural purposes. Cedar is used for outdoor landscape elements such as decks, planters, fences, screens, garden furniture and sheds and for exterior siding, roof tiles, interior wall and ceiling panelling, house timbers, doors and windows, and a variety of joinery items. The supply of western redcedar is essentially limited to northwest North America which caps the supply against a large base of demand for the specific and valued structural and visual qualities of this species.

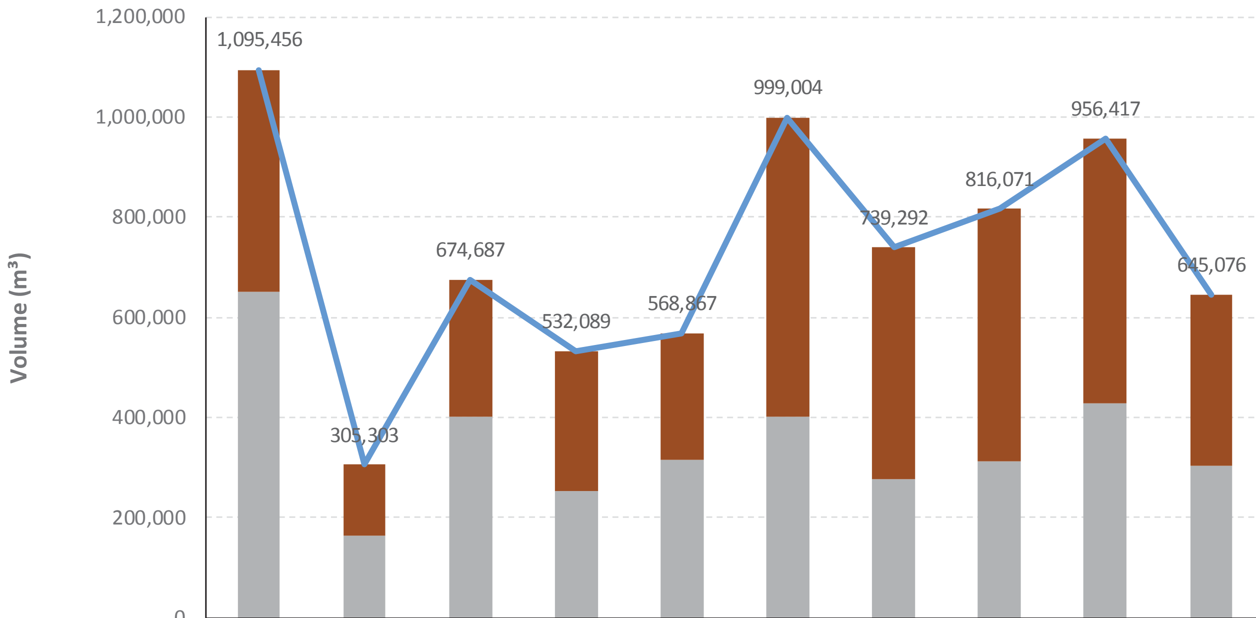
The relative importance of cedar is not limited to Haida Gwaii; a recent federal government study of the BC cedar industry estimated that in 2015, 18% of Coastal BC lumber primary manufacturing employment was based on processing cedar logs, 501 workers. In addition, another estimated 415 workers were employed in remanufacturing plants and shake and shingle mills in Coastal BC that were making cedar products (Gregory, McBeath, and Filipescu 2018).

A question in the RFP for this socio-economic project was [What is the] role of cedar as an ongoing economic mainstay (i.e. sustainable supply of economic cedar)?

The recent harvests of cedar on Haida Gwaii were laid out in Section 4.6. The annual average cedar harvest on HGMA lands over the 10-year 2008-2017 period was approximately 351,000 m^3, approximately 48% of the annual average total harvest. Cedar's share of the HGMA harvest ranged from approximately 38% to 60% over this decade. The annual average for the 5-year 2013-2017 period was slightly lower, about 344,000 m^3 (and a 41.4% share of the HGMA total harvest for this 5-year period).

A high level shift in the pattern of the HGMA harvest is seen starting in 2013 when the harvest for other tree species was greater than the cedar harvest. During this latest period, 1.4 m^3 of other species were harvested for every 1 m^3 of harvested cedar. In part, this recent high level harvest pattern reflects the attractiveness of prices in offshore markets for whitewoods logs and the presence of the Haida Gwaii log export OIC. In the earlier 5-year 2008-2012 period, the harvest pattern was reversed with only 0.8 m^3 of other species being harvested for every 1 m^3 of harvested cedar. This earlier harvest pattern was heavily influenced by the 2008 global financial crisis and its aftermath; the niche cedar products demand recovered quicker than the demand for whitewood products. Figure 5-1 summarizes the harvest of cedar versus the harvest of other species on Haida Gwaii over the 2008-2017 decade.

Figure 5-1: HGMA cedar harvest versus harvest of other species (m^3), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Other Species	443,725	140,574	274,215	279,066	252,571	597,878	461,419	504,735	529,047	342,941
Cedar	651,731	164,729	400,472	253,023	316,296	401,125	277,873	311,336	427,370	302,135
Total	1,095,456	305,303	674,687	532,089	568,867	999,004	739,292	816,071	956,417	645,076

Source: Harvest Billing System 2018 and author's calculations

In a weak or limited whitewoods export log situation, cedar carries the commercial operability of logging on Haida Gwaii. A substantive decrease in the prices for cedar logs and/or the available supply for commercial harvesting would deeply challenge the financial viability of timber harvesting on Haida Gwaii due to the relatively high cost of timber harvesting on and transport of logs from Haida Gwaii (see Section 4.10). An unusually large downward shift in cedar prices is not likely because of the strong market presence and demand for cedar products in the US and the already limited (global) supply of western redcedar and yellow cedar timber. If cedar timber supply were to be reduced, for instance for the purpose of managing the supply of cedar timber over time, then the operability on Haida Gwaii of hemlock and spruce would be strongly dependent on continuing access to and price strength in export markets as domestic prices for hemlock and spruce logs have not been (and are not foreseen to be) at levels that can support Haida Gwaii harvesting and transport costs.

While cedar timber supply indeed is a mainstay of the Haida Gwaii forest sector, of substantive importance too is access to export markets for whitewoods. If the current dynamics that make up the foundation of the Haida Gwaii forest sector are substantively altered then many forest stands that are currently operable are likely to become uneconomic to harvest resulting in lower forest sector employment on Haida Gwaii, and associated reductions in spending at local suppliers of goods and services and, very likely, a population decrease due to an out-migration of some workers seeking employment elsewhere and bringing along their families (See Section 5.3).

In practice, timber rights holders will use the dictates of market demand as much as possible to determine what, where and when they log. Timber rights holders will select harvesting situations with species and costs that are sustainable under expected market conditions. However, the following table was constructed to offer a high-level account of the importance of western redcedar to the financial viability of timber harvesting on Haida Gwaii. Table 5-1 uses average logging and stumpage cost along with average VLM log prices by species to indicate the importance of the relative level of red cedar within Haida Gwaii harvesting. The figures in the table should be interpreted as indicative and represent neither the financial results for harvesting a specific stand (with a specific species mix, tenure, terrain conditions, etc.) nor the financial results for the overall 2017 HGMA harvest.[137]

Table 5-1: Net revenue example based on average cost and log value for Haida Gwaii, 2017

Species	Average logging & transport cost[138]	Average stumpage	Logging + Stumpage	Average VLM log value	Average net value per m³	Species Distribution[139]	Average net value by species distribution
Red Cedar	$96.00	$21.56	$117.56	$191.57	+ $74.01	46.8%	+ $34.64
Spruce	$96.00	$6.33	$102.33	$63.78	- $38.55	20.8%	- $8.01
Hemlock	$96.00	$17.89	$113.89	$58.48	- $55.49	26.6%	- $14.76

Sources: Harvest Billing System 2018; Source: Timber Pricing Branch 2018; Ecora 2015; personal communications with logging operators; and author's calculations

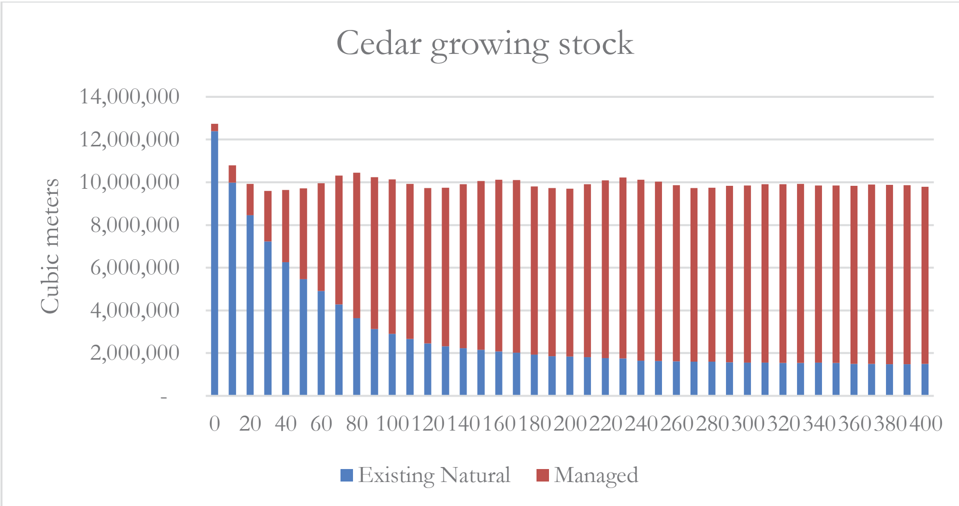
The HGMC's 2012 AAC determination referenced an anticipated mid-term shortage or fall down of cedar on Haida Gwaii as does the analysis work undertaken for the latest Haida Gwaii timber supply review (HGMC 2012; Technical Working Group 2019). Figure 5-2 shows the projected decline over the next 40 years in the overall stock of cedar and the steep decline in stock of Old Growth cedar over at least the next 100 years in the HGMA for the analysis base case of the current timber supply review.

137 As specific stands will vary by terrain, species composition, timber age, log grade distribution and distribution of log sales between export and domestic markets.

138 Assume cost for cable logging of Old Growth timber

139 Based on average harvest volume

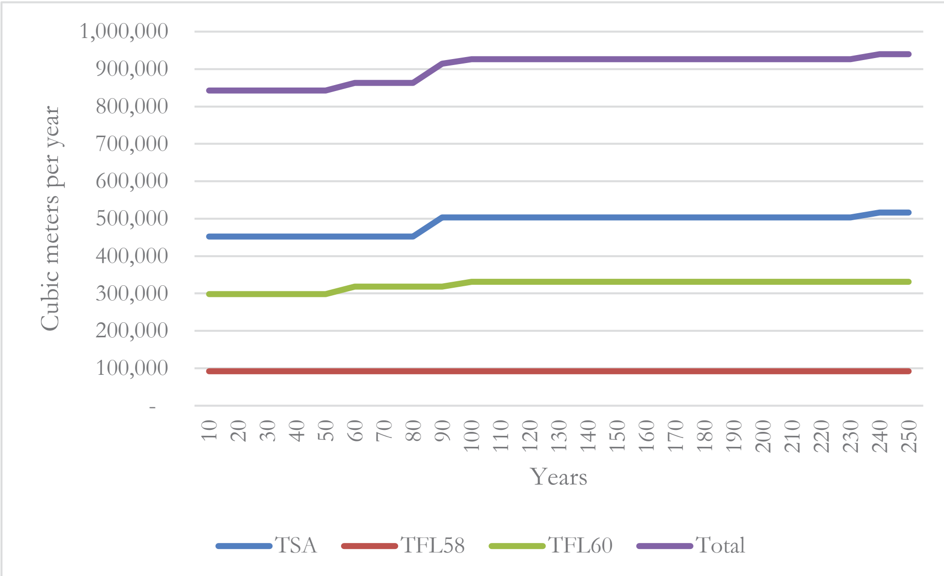
Figure 5-2: HGMA Lands Base Case Cedar Growing Stock, Natural Stands and Managed Stands (m3)



Source: Technical Working Group 2019

The Technical Working Group for the current timber supply review has put forward an analysis base case timber supply projection that incorporates applicable forest management rules for the HGMA, including the Haida Gwaii LUOO, and a non-declining timber supply flow over a 400-year projection period. The HGMC will use the analysis base case as a starting point for its review of information leading to an AAC determination and will consider other information and timber supply projections as well. Therefore, the base case neither presumes nor presents a decision on the AAC. The analysis base case annual timber supply for the HGMA is 842,781 m^3 until the 10^{th} decade whereupon the annual timber supply is projected to increase to 926,600 m^3 and remain at that level in subsequent decades. Figure 5-3 shows the HGMA base case timber supply projection by management unit.

Figure 5-3: HGMA Base Case Timber Supply Projection by Management Unit, m^3



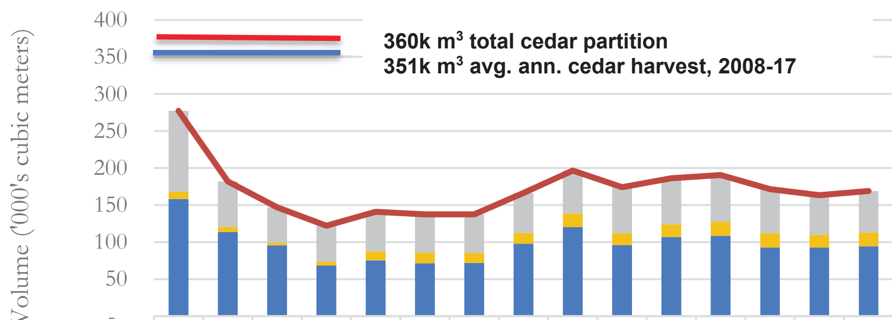
Source: Technical Working Group 2019

This HGMA base case projection incorporated a declining flow timber supply projection for cedar, the target starting point of which was the maximum cedar harvest level from the previous chief forester AAC determinations. The annual timber supply volume of cedar in the base case starts (in the 1st decade) at 277,000 m^3, steeply declines to 122,000 m^3 by the 4th decade and then increases to approximately 176,000 m^3 by the 8th decade .[140]

The base case annual cedar volume projection starts slightly lower than the average annual cedar harvest (for the 2008-2017 period) of approximately 351,000 m^3 and lower than the sum of the maximum cedar harvest levels expressed by the chief forester of 360,000 m^3. By the 6th decade, the cedar share by volume of the HGMA base case timber supply is substantively different (about 10% cedar/90% other species) than the cedar partition share of the current AAC determination (about 39% cedar/61% other species). As well, by the 8th decade, the cedar growing stock is almost evenly split between unmanaged and managed stands, and thereafter the managed cedar stock volume increasingly outstrips the cedar unmanaged stand volume. Figure 5-4 shows the cedar volume projection for the HGMA base case by management unit.

[140] If a long run average yield (LRAY) approach was taken to projecting cedar timber supply in the HGMA base case then the cedar volume projection would be an average 146,371 m^3 (Technical Working Group 2019). (Technical Working Group 2019).

Figure 5-4: Cedar Volume in HGMA Base Case Timber Supply ('000 m³) by Year



	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
TFL60	109	61	48	48	53	52	52	54	58	62	62	63	60	53	56
TFL58	10	7	4	5	12	14	13	15	19	16	17	19	19	18	18
TSA25	158	114	95	69	75	72	72	98	120	96	107	109	93	92	95
Total	277	182	147	122	141	137	138	166	197	174	186	191	171	163	169

TSA25 TFL58 TFL60 Total

Source: Technical Working Group 2019

Within 30 years, the base case cedar volume projection shows an annual cedar harvest level of about 146,848 m³, which would be almost the same harvest amount as that experienced in only one year, 2009, in the past 10. This annual level would likely be in place for about 10 years, and then drop further yet.

The shown projected shifts in annual cedar timber supply volume would be subject to regular review and potentially revisions through the timber supply review process (which must occur at least every 10 years). These projections (notably the projected steep declines in cedar volumes and increasing share of hemlock in the HGMA timber supply in the next few decades) and the anticipated increase in market values per m³ due to the shrinking supply of Old Growth Coastal BC timber indicate that policy and administrative approaches for the management of cedar timber supply over time will be an important consideration for the HGMC and the Chief Forester in HGMA related AAC determinations now and well into the future.

At a high level, the current and near-term timber stock and supply situation of TFL 58 provides a glimpse into the timber stock and supply situation in 30 years of the other Haida Gwaii management units. Relative to TSA 25 and TFL 60, TFL 58 currently has a lower share of cedar and a higher share of managed stands in its timber stock and supply. Therefore, the TFL 58 situation will offer, in the short-term, a window on key socio-economic aspects of the TSA 25 and TFL 60 timber supply situations in a few decades. However, the ownership and marketing of logs from TFL 58 changed in 2017 so it is too early to make observations about the socio-economic ramifications of a low cedar/high managed stands timber supply in the Haida Gwaii context based on the TFL 58 experience. The TFL 58 situation may not be generally applicable because of its substantial spruce component,smaller timber supply and (current) absence of a custom cut program, but, at a minimum, the TFL 58 situation will provide an early indication in a few years of how an experienced Coastal BC tenure holder opts to deal with the implications of handling a low cedar/high managed stand timber supply on Haida Gwaii.

5.3 Community Stability and Timber Supply

Harvesting of cedar trees on Haida Gwaii has been occurring for as long as the Haida have populated the archipelago. Haida have used cedar timber for making longhouses, totem poles, large canoes, household goods, and articles of clothing. The arrival of colonizers in the late 1800's and early 1900's introduced steam driven machinery along with crosscut saws to the islands. Subsequently, the technology introduced to the islands became much more productive and cost efficient from an industrial perspective and by the late 1970s and 1980s large volumes of timber were being harvested on Haida Gwaii and barge transported to southwest BC booming grounds and mills (Gowgaia Institute 2007).

During the latter part of the 20th century, forestry grew into one of the key local economic sectors, and along with commercial fishing, mining and the defence installation at Masset, contributed to population growth in the Haida Gwaii communities of Port Clements, Masset, Queen Charlotte and Sandspit. The population of the islands peaked in the early and mid-1990s.

The following table presents the distribution (i.e. percentage share) of income by major source for Haida Gwaii over the 1991-2006 period and shows the significant importance of forest sector employment income on the islands in the 1990s and 2000s and then the relative decline of this source in the 2006 figures.

Table 5-2: Percentage share distribution of income by employment and non-employment income source for Haida Gwaii, 1991, 2001 and 2006

Year	Forestry	Mining	Fishing	Agri-food	Tourism	Public Services	Other Basic sectors	Transfer Payments	Other non-employment income
2006	14	0	7	1	11	31	7	18	12
2001	33	0	4	1	7	30	8	11	6
1996	34	0	0	0	8	32	4	9	6
1991	26	1	3	0	6	36	8	12	8

Source: Horne 2009a

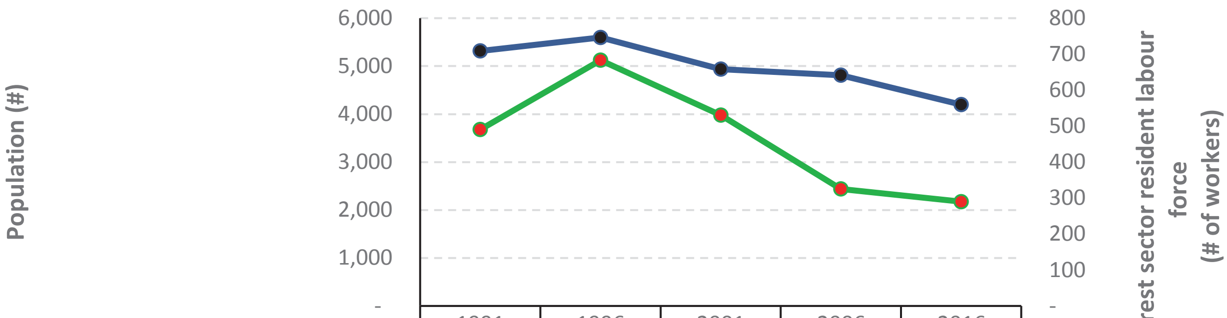
A question in the RFP for this socio-economic project was "What elements of community stability are dependent on timber supply?"

The forest sector employees residing on the islands create both a demand for public services in health, municipal infrastructure, schools and recreation but also contribute to a residential tax base and a critical mass or base of residents that could support the public services of small organized communities. These forest worker households also contribute to creating a customer and client base sufficient to support a small but reasonably broad range of retail and professional services and food and beverage businesses spread across the Haida Gwaii communities. Although the industrial tax base connected to the Haida Gwaii forest sector has always been relatively small because a medium- or large-scale sawmill has never been established on the islands, public sector services have been supported by the commercial property taxes paid by the local forestry related enterprises. As well, the demand for goods and services by the main forestry enterprises has helped to support the commercial viability of some key businesses serving the islands, such as the fuel barge transport service.

A few elements of community stability on Haida Gwaii are directly tied to timber supply decisions and timber harvesting levels. As portrayed in the previous paragraph, forest industry employment has been a key driver in the development of Haida Gwaii communities through their contributions to the local tax base but also through the households of forest industry workers making up a significant part of the population of a few Haida Gwaii communities. Their presence in these communities helped create a demand for basic public sector, retail, financial and basic professional services that assisted in their development and helped to sustain their operation over the past few decades. The commercial property taxes of forest industry related enterprises have also helped support local public services. The shrinkage in the Haida Gwaii forest sector has particularly affected Port Clements because of the sector's greater importance in the economy of this small community. As families leave the community, fewer children are enrolled in the local elementary school for example and the smaller school population adds to the challenge of attracting professionals and families to the community (pers. comm. G. O'Brien 2018).

Forest sector related employment is the main pathway through which the forest sector has direct effects on Haida Gwaii population levels and ultimate effects on the islands' community stability. Table 5-2 shows the direct correlation between Haida Gwaii's population levels and the number of local workers employed in the Haida Gwaii forest sector. Both Haida Gwaii's population and the Haida Gwaii forest sector have declined for the shown years since 1996. The decrease in population has not been as sharp in percentage terms as for the forest sector labour force because a portion of the terminated forest sector workers either retired or switched to work in another sector on Haida Gwaii rather than move elsewhere and because local tourism sector related employment rose (but not enough to offset the effects of the decline in forest sector related employment).

Figure 5-5: Trend Comparison of Haida Population and Forest Sector Resident Labour Force by Census Year



	1991	1996	2001	2006	2016
Population (by Census Year)	5,316	5,598	4,935	4,812	4,198
Forest sector resident labour force	490	683	530	325	290

Source: Census of Canada

5.4 Contributions of Haida Gwaii Wood to Haida Gwaii, BC and International Markets

From a wood products market perspective, the Haida Gwaii situation is consistent and in accord, in a broad sense, with other areas of BC in that the vast majority of Haida Gwaii timber fibre is ultimately sold into international markets. The local Haida Gwaii demand for wood products, especially cedar products, is vibrant in that wood is the focus of local structural and exterior building materials, but the local marketplace is nevertheless very small. In the case of Haida Gwaii, the vast majority of its timber is sold either as cedar lumber products into the US or as whitewood logs into China and a few other Asian countries.

Several economic dimensions of Haida Gwaii timber and wood products were examined in this socio-economic report.

- Haida Gwaii and BC demand for wood products in Section 4.2
- External market demand, including VLM and export log prices in Section 4.3
- Export log volumes in Section 4.6.9
- Haida Gwaii wood processing sector overview in Section 4.9.7
- Market destinations of Haida Gwaii timber in Section 4.10.2.2
- Haida Gwaii and other BC harvesting and processing employment in Section 4.10

A question in the RFP for this socio-economic project was "What contribution does wood provide to local versus regional/provincial markets?"

A distinct characteristic of the Haida Gwaii situation is that very little Haida Gwaii timber is milled on Haida Gwaii into wood products but a large portion of the processing of Haida Gwaii timber is controlled by Haida Gwaii focused enterprises. However, the processing situation in regard to Haida Gwaii timber has evolved over the past decade in that a larger portion of the processing of Haida Gwaii timber is now controlled by Haida Gwaii focused enterprises. A brief overview of the not widely known practice of custom cutting in BC was given in Section 4.9. Both Husby and O'Brien & Fuerst have had long established custom cutting programs whereby they have maintained control of the processing and marketing of their Haida Gwaii timber through rental of capacity at Lower Mainland mills and log trades. Taan now controls the largest share of the HGMA AAC and it created a custom cutting program using Lower Mainland sawmills as well. The volume and share of the Haida Gwaii timber harvest that is directed through the custom cut programs of Husby, O'Brien & Fuerst and Taan varies on a year to year basis due to several supply and demand factors, including the proportion of cedar in the total harvest, but in broad terms, the share is about 40% in recent years.

From the supply side, the main factor influencing Haida Gwaii log exports has been the 2010 BC Government order-in-council (OIC) that effectively allows for exporting of Haida Gwaii whitewood logs harvested on BC Crown lands and BC private lands in any current year equivalent to 35% of the prior year's total harvest volume (excluding waste volumes) from these BC lands.

Since the 2010 introduction of the Haida Gwaii exemption order, whitewood log exports from Haida Gwaii to Asian destinations have greatly increased, driven by the considerable gap in whitewood log prices between offshore and Coastal BC markets, and here the Haida Gwaii logs are processed into, mainly, structural lumber products. All current parties holding major Haida Gwaii tenures are whitewood log exporters.

Red and yellow cedar logs harvested on pre-1906 Crown grant (or federal export jurisdiction) private lands and Indian Reserve lands are not subject to measures preventing their export so these lands comprise the main sources of export volumes of Haida Gwaii red and yellow cedar logs. The main factor here was the sale in 2004 of the private lands portion of TFL 39 Block 6, approximately 10,000 ha by WFP to BC Investment Management Co. These lands are pre-1906 Crown grant (or federal) private lands and as such, with the removal of these private lands from the TFL, the new owners were able to export red and yellow cedar logs harvested on these lands. The export volume from these private lands owned by BC Investment Management Co. averaged 44,500 m^3 over the 2010-2016 period.

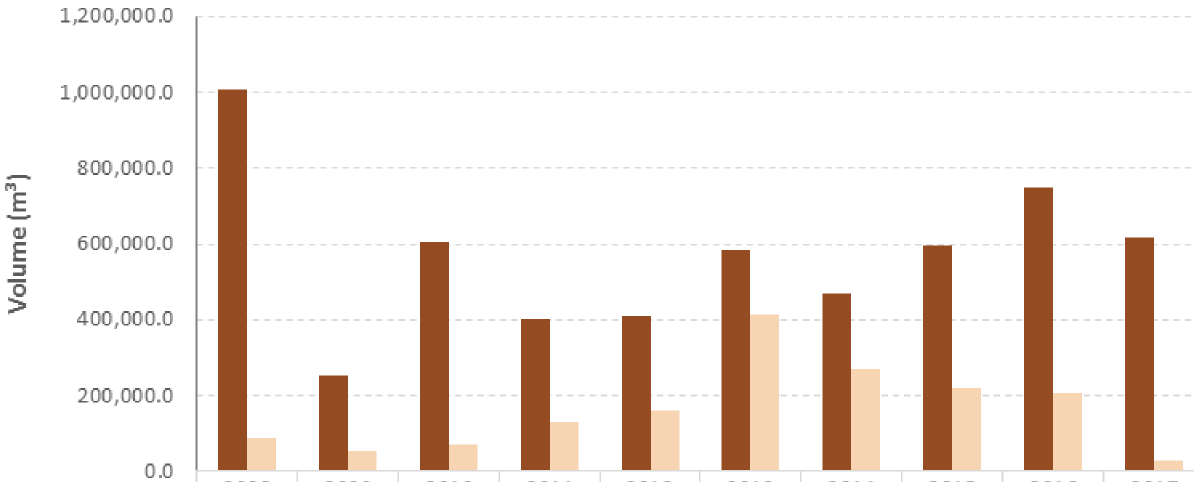
In January 2019, the BC Government extended the Haida Gwaii log export OIC but only until July 31, 2019 and communicated that a plan or strategy to address BC log export policy and TSL bidding issues is forthcoming. An elimination of this Haida Gwaii OIC would not change log demand conditions in Chinese, South Korean and Japanese markets but would negatively alter the commercial viability of harvesting stands on Haida Gwaii with low cedar and/or spruce components. Removal of the Haida Gwaii OIC is likely to lessen the demand for Haida Gwaii hemlock timber and contribute to softening VLM prices for whitewoods, thereby leading to a reduction in the Haida Gwaii timber harvest and associated employment. Because little volume of whitewoods is processed on the islands and any future expansion in local processing is likely to focus on cedar products, the main beneficiaries of an elimination of the Haida Gwaii OIC are owners (and employees) of mills in south Coastal BC.The matter of log exports and Coastal BC log processing is exceedingly complex and its dimensions and characteristics vary along the BC Coast. Definitive conclusions aren't yet possible about potential effects to the Haida Gwaii forest sector since the contents of the BC Government's log export policy changes are not known at this juncture but the Haida Gwaii case should be looked upon as highly sensitive to alterations in the current OIC given the relatively high cost structure of harvesting and transport of Haida Gwaii timber.

5.5 Second Growth Forests Economic Viability

A significant portion of the Haida Gwaii THLB (approximately 40% has been previously logged and is regenerating. A portion of these stands are currently old enough to harvest for the second time. Over the 2008-2017 period, a total volume of approximately 1.6M m^3 of Second Growth timber or an annual average of 164,208 m^3, has been harvested within the HGMA.[141] Figure 5-6 compares the harvest volume of HGMA Second Growth timber to the Harvest of Old Growth timber over the 2008-2017 decade. Second Growth timber accounted for 22.4% of the total HGMA harvest volume during this decade.

[141] The Second Growth harvest drops from approximately 200,000 m^3 in 2016 to 29,000 m^3 in 2017. A factor in this decrease was the transition in ownership of TFL 58 from Teal Jones to A&A.

Figure 5-6: Comparison of HGMA Old Growth and Second Growth Timber Harvests (m^3), 2008-2017



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Old Growth	1,007,38	253,042	603,845	400,941	410,683	584,464	469,926	595,595	748,417	615,885
Second Growth	88,069	52,262	70,842	131,148	158,183	414,539	269,366	220,476	208,001	29,191

Source: Harvest Billing System 2018 and author's calculations

Second Growth timber on Haida Gwaii presents different challenges for the local forest sector on both cost and revenue sides of the financial ledger. A question in the RFP for the socio-economic project focused on Second Growth forests, "What are the variables and thresholds for second growth forests being economically viable?"

Considerable experience has already developed on Haida Gwaii with both harvesting and marketing Second Growth forests. Within an overall Coastal BC context, the BC Government and forest industry organizations, such as FPInnovations, have led research and policy-making on challenges, opportunities and strategies to understand and address the shift from harvesting and processing Old Growth timber to Second Growth timber throughout the BC Coast.[142]

On the cost side, in general, harvesting Second Growth stands presents cost advantages. In Section 4.11.11, the costs on Haida Gwaii of operating harvest systems for both Second Growth and Old Growth stands were documented. Based on the shown examples, the harvest and transport cost for the Second Growth focused system was approximately $79/m^3 and 82% of the approximate $96/m^3 cost of the Old Growth focused harvesting system. Specific stands will vary in their costs based on stand volume, terrain, location proximity to a

[142] The "BC Coastal Forest Sector Hem-Fir Initiative" is possibly the most well-known effort, see http://www.bccoastalinitiative.ca/index.html. This program included a "Coastal Cedar Focus".

forest road, etc. but this comparison conveys the relative cost advantage presented by harvesting Haida Gwaii Second Growth stands.

The lower per m^3 harvesting cost would largely be captured at the expense of employment as more mechanized harvesting and less road and bridge development would reduce labour requirements. A transition to more mechanized harvesting also reinforces a movement towards larger timber volumes for harvesting operations in order to spread out the new overhead capital costs, associated with acquiring mechanized harvesting equipment, over a larger scale of production.

On the other side of the ledger, Second Growth cedar logs realize a lower price in the Vancouver Log Market than Old Growth cedar logs. The VLM log price data presented in Section 4.3.1 shows the value gap in average terms between Second Growth and Old Growth cedar logs. Over the 2015-2017 period, the price of Second Growth cedar logs was between $178 and $205, and an average of $191 whereas the range for Old Growth logs was $187 to $233, and an average of $213. Using these recent average log prices for comparison purposes, Second Growth logs captured a price in the VLM that was about 82% of the recent average prices for Old Growth cedar logs.

We focus here on log costs and prices but milling lumber recovery rates and costs and wood products, including types that can be manufactured, their quality and wholesale and retail price vary by whether Second Growth or Old Growth logs are used as the fibre input. Understandings about many of these Second Growth cedar lumber product issues are still in development. FPInnovations undertook a couple of short research exercises in these areas, one on milling and another on competitiveness and one of the conclusions was that additional research is needed, "A comprehensive research task force approach is recommended to provide definitive answers to questions and contradictions obscuring a clear understanding of the properties and potential of second-growth redcedar. The task force should be similar to those undertaken on the coast for Douglas-fir and western hemlock." (Middelton and Munro 2013).

5.6 Timber Flow to Local Producers

A longstanding local concern on Haida Gwaii, but also a general concern in several parts of the province, has been the challenges in acquiring timber that small- and medium-sized mills face in acquiring timber to process into wood products. A question that was raised in the RFP for this socio-economic study was as follows, "What are the barriers or enablers of fibre flow to local producers? Which barriers have the largest impact on the health of the islands economy?"

The barriers of fibre flow to local wood processors that were identified in the interviews conducted for this socio-economic project were the following.

- Market-based log pricing for logs used by licensees. Some respondents thought that VLM pricing less a barging and distribution cost adjustment made logs too expensive for local small-scale processors given the higher price structure in the VLM in recent years and expressed a preference for log pricing to local processors based on harvesting cost plus local delivery cost.
- Payment conditions for acquiring logs from licensees. A few respondents thought that local processors were not in a cash flow position to pay for acquired logs until they received payment for selling wood products.
- Absence of secure, long-term fibre access arrangements for small-scale processors.
- Lack of BCTS Category 2 program auctions on Haida Gwaii for for local enterprises with micro- or small-scale wood processing operations.
- Financial challenges of Haida Gwaii small-scale wood processors to compete with more financially competitive bidders in BCTS TSL and Category 2 program auctions.
- No Haida Gwaii log sort operation to direct fibre to local processors along the lines of the monumental cedar log sort operated by the Ministry.
- No organized notification of available local fibre via a website or other means.

Certain licensees, Taan and A&A, make efforts to communicate their willingness to sell logs to local enterprises and to respond to requests for fibre from local processors. An awareness of the efforts of these licensees to make fibre available to local processors appears to be generally present within the local forest sector.

The issue of access to and cost of fibre for small- and medium-scale wood processors on Haida Gwaii is longstanding. In the late 1990s, Forest Renewal BC (FRBC) funded a few reports on growing wood processing activity on Haida Gwaii (Queen Charlotte Adventures 1998a; Queen Charlotte Adventures 1998b; and Dunn and Quass 1999). One of these reports was a "Directory of Logs for Sale on QCI / Haida Gwaii" (Dunn and Quass 1999). The directory was promoted as a kind of "virtual log yard". All the licencees on the islands set out volume and species availability along with pricing conditions in this directory. One of the then licensees, MacMillan Bloedel Ltd., offered 5-year renewable agreements for annual 25-30,000 m^3 volumes to local sawmills.

The matter of access and cost of fibre for Haida Gwaii wood processors was also raised in the 2015 Forestry Strategy Forum and its background discussion paper, which also pointed out a few other matters that also have substantial effects for the competitiveness of small scale wood processing on Haida Gwaii, "The lack of a stable, vibrant manufacturing sector is usually attributed to the lack of long-term availability of a supply of high quality logs, the inability to secure capital and lines of credit, the small local market, the lack of a stable trained work force, energy and waste issues, and the lack of information about, and access to, off-island markets." (Moore Resource Management 2015a).

"[Local] access to secure and suitable long-term wood supplies" was identified in the Summary of the 2015 Forestry Strategy Forum as one of four issues that needed addressing in the short-term (Moore Resource Management 2015b).

Prior to 2003, for several years the BC Government operated the Small Business Forest Enterprise Program (SBFEP). This program incorporated a 10M m^3 per year initiative established in 1978 to provide access to timber to entities with less than 10,000 m^3 per year of renewable tenure and the Section 21 initiative was later added that provided competitive access to market loggers and wood processors without tenure to approximately 3M m^3 of timber per year. The Abfam/Haida Gwaii Wood Products mill in Port Clements was established through accessing a SBFEP tenure. This program however was shuttered in 2003 when BCTS was established and its Category 2 program was created but the Category 2 program allows access to bidding by wood processors with tenure.

A province-wide industry organization, Independent Wood Processors Association, has represented the interests of its medium-scale wood processor members that do not have long-term tenures. Between 2001 and 2018, 54 of the 107 non-tenured, family owned, member companies of the Independent Wood Processors Association closed their operations (Independent Wood Processors Association 2018).

In 2016, the BC Government published a "B.C. Forest Sector Competitiveness: Value Added Action Plan" but this initiative included neither a new fibre access initiative for wood processors without a long-term tenure nor an overhaul of the BCTS Category 2 program.

Secure access to at least 50% of a wood processing facility's[143] fibre input is critical in the Haida Gwaii context as the fibre basket is effectively limited from a financial standpoint by the geographic isolation of the islands. The Haida Gwaii situation should be viewed as distinct in this regard within the BC context. In the BC Southern Interior, BC Northern Interior and even on Vancouver Island, mills do run up against log cost challenges based on transport distance but their commercially viable fibre baskets are relatively large by comparison to Haida Gwaii mills.

The issue of access on Haida Gwaii however is inextricably bound up with a few other very important challenges as was observed in the background paper for the (Haida Gwaii) Forestry Strategy Forum. Availability of qualified workers (who are cost effective, i.e. are not long distance commuters) is a current and will be a growing consideration given Haida Gwaii's demographic challenges. The lack of an adequate marine terminal creates a big competitiveness cost challenge. But the main challenges are the financial capability of mill operators to access logs within the parameters of the domestic log market and BC

[143] Whether a large, medium or small-scale mill. The secure access could vary by scale of processing facility. For example, a small or micro scale mill may be viable with a long-term salvage arrangement that offers a satisfactory flow of fibre that can be processed or traded.

Government policies and programs for stumpage and market pricing and the directly related challenge of the overall financial viability of manufacturing and marketing wood products from the remote location of Haida Gwaii.

A few respondents in the interviews conducted for this socio-economic project suggested that Haida Gwaii logs should be made available to Haida Gwaii wood processors on what can be termed a cost plus basis rather than using a VLM price as a starting point. This approach would be distinct within the BC Government public lands timber management context as it is not available to communities, First Nations and business enterprises engaged in wood processing on Vancouver Island or elsewhere in the province. If this arrangement was formalized through a BC Government policy or administrative direction and the wood products made from logs sold in this manner were shipped to the US then this type of log sale arrangement could have a legal impact within the lumber trade arrangements between the Canadian and US federal governments.

At a minimum, the log availability issue could be quickly addressed in part by using current (and fairly modest) website capabilities to set up a "virtual log sort yard" for Haida Gwaii. This idea was mentioned in the summary of the Forestry Strategy Forum and has been tried in a few locations in BC. A physical monumental cedar sort is operating on Haida Gwaii and Infinity West had started to set up a physical log sort at Port Clements but subsequently has put the project on hold (pers. comm. D. Froese 2018).

On a longer term basis, consideration ought to be given to developing a Haida Gwaii strategy focused on log supply to local micro mills and small wood processors. The broader Haida Gwaii forestry strategy did not move beyond the 2015 Forestry Forum stage but a strategy making exercise narrowly focused on this one forest sector issue may provide a basis for the various parties engaged and affected by the log supply issue to identify and work out some practices that provide the basis for improved local log supply arrangements and the growing and strengthening of Haida Gwaii micro mills and small sawmills.

5.7 Timber Harvest Needs for Financial Sustainability

A question was posed in this project's RFP about the level of annual average timber harvest in relation to investment security, "What is required (levels of harvest) to provide a security of investment for [harvest] operators?". This question is often discussed throughout the BC forest industry because of the capital and workforce investments that are required to sustain operations over a time period in which investments can be recouped along with a suitable profit in line with the financial risk assumed by the enterprises. In the RFP, the question is focused on market logging operations but the question could also be considered in the context of wood processing operations and stump to dump contractors.[144]

[144] Referred to as truck loggers on coastal BC and also referred to, in many instances, as Section 13 contractors.

In 2017, the BC Government commissioned a "Logging Contractor Sustainability Review", which reported in May 2018 with 13 recommendations to improve the competitiveness of logging contractors. A subsequent facilitation exercise led to a January 2019 announcement that the BC Government will amend the Timber Harvesting Contract and Subcontract Regulation of the *Forest Act* in line with the facilitator's recommendations.[145]

In terms of the level of annual harvest that would be desirable to financially sustain a market logging enterprise on Haida Gwaii, the responses varied between an annual average of 75,000 m^3 and 100,000 m^3. Location of harvesting, specifically terrain conditions, and stand species and age composition, would be important influencers on the amount of desirable operable volume in the Haida Gwaii context but this 75-100,000 m^3 range is a good basis for consideration of the average annual volume that's needed to sustain a viable market logging enterprise over the long term. The lower parameter of this range is similar to TFL 58's AAC of 79,000 m^3, similar to the 80,000 m^3 AAC apportionment for a Haida Gwaii CFA and is likely reflective in general terms of the annual average of the O'Brien & Fuerst market logging operation in the 2000-2015 period on Haida Gwaii.

[145] The recommendations focus on: improving transparency by requiring the parties to jointly develop rate models; improving work predictability and mutual recognition of changed circumstances where rates can be reassessed; establishing a timely and effective arbitration process based on the rate model; and requiring mandatory data collection to improve access to information. See https://news.gov.bc.ca/releases/2019FLNR0010-000056

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Randy Friesen		Haida Gwaii Forest Products	
Dave Froese	Co-owner	Infinity West Enterprises	Langley, BC and Port Clements, BC
Shane Harsch	Chairperson	Western Red Cedar Lumber Association	Vancouver, BC
Domenico Iannidinardo	Vice-President, Sustainability & Chief Forester	Timberwest	Duncan, BC
Tom Johnson	Woodlands Manager	BCTS	Chilliwack, BC
Timo Johnsson	Owner-operator	Silva	
Marty Locker		A&A Trading	Sandspit, BC
Gup McDonald	Owner-operator		
Jeff Mosher		Taan Forest Products	Skidegate, BC
Sean Muise	Stewardship/Revenue Officer	BC MFLNR	Queen Charlotte, BC
Randy O'Brien	Owner	O'Brien & Fuerst	Port Clements, BC
Travis O'Brien	Owner	O'Brien & Fuerst	Port Clements, BC
Gloria O'Brien	Owner	O'Brien & Fuerst	Port Clements, BC
Art Pearson	Owner-operator	Tanu Wood Products	
Nick Reinhardt	Project Manager	Chartwell	North Vancouver, BC
Nick Reynolds	Stewardship Planning Coordinator	Council of the Haida Nation	Old Massett, BC

Danny Robertson	Co-owner	North Pacific Timber Company	Skidegate
Rob Sandberg	Vice-President	Husby Forest Products	Delta, BC
Daryl Sherban		BC MFLNR	Queen Charlotte, BC
Mark Salzl	Authorizations Officer	BC MFLNR	Queen Charlotte, BC

8 Appendix I – Forest Sector Economic Impact Estimation Methodology

An estimate of employment and employment income connected to harvesting and processing of Haida Gwaii timber was developed for this report. The estimates of forest industry direct employment are based mainly upon a questionnaire administered to holders of TSA 25 Forest Licences and holders of TFL 58 and 60 tenures and to a questionnaire administered to Haida Gwaii wood processing operations.

Timber harvesting and processing employment is tied to the volume of harvested timber so is calculated as an employment per 1,000 m^3 of harvested timber co-efficient.[146] This approach allows for a ready estimate of forest sector employment and income impacts based on timber harvest level changes. Responses to these questionnaires provide the basis for calculating direct employment per m^3 associated with Haida Gwaii timber harvesting and processing.

Indirect and induced employment impacts were calculated by applying multipliers to the direct employment figures (Horne 2007). Local area multipliers were calculated by BC Stats, based on the BC input/output model, for all areas of the province except the Lower Mainland (Horne 2009a and 2009b). Indirect employment occurs in businesses supplying goods and services to forest sector companies, while induced employment occurs in businesses supported by the spending of direct and indirect employment income. Table 8-1 shows the indirect/induced multipliers for Haida Gwaii.

Table 8-1: Haida Gwaii indirect/induced forest industry multipliers

Industry	Harvesting & Silviculture	Pulp & paper	Other Wood Processing
Multiplier*	1.42	-	1.45

Source: Horne 2009a

Note: * This multiplier incorporates the assumption that employment insurance and other social safety net programs to employed and displaced workers will temporarily encourage them not to leave the community, thereby reducing the induced impacts of a lower harvest level.

Table 8-2 presents province-wide indirect/induced multipliers for the forestry, wood saw milling and pulp and paper processing industries.

[146] Employment is stated in person-years (PYs), which is defined as one person working the equivalent of one full year, which is defined as 180 days of work. A person working for 90 days accounts for 0.5 PYs.

Table 8-2: Province-wide indirect/induced forest industry multipliers

Industry	Harvesting & Silviculture	Pulp & paper	Other Wood Processing
Multiplier	1.99	2.23	1.85

Source: author's calculations based on Horne 2007

The impact estimates presented in the report are intended as indicators of the magnitude of change, rather than as precise estimates. The following qualifications apply:

- In using co-efficients and multipliers to calculate impacts, the employment changes are shown as immediate and in direct proportion to the change in the harvest level. While this is likely accurate for the harvesting sub-sector, it may not be the case for the sawmilling and pulp/paper sub-sectors, which have weaker links to harvest levels and where employment changes are more likely to occur at threshold levels, at which shifts are added or dropped, or mills are closed. Also, indirect and induced impacts would likely occur over a longer period of time, as business and consumer spending levels adjust.

- The co-efficients were derived from a survey of TSA Forest Licensees, and reflect prevailing productivity, harvest practices and forest management for the survey time frame (2015-17). The co-efficients may not reflect future conditions. While there has been a long-term trend of reduced employment co-efficients due to mechanisation and increased labour productivity, increased requirements for planning and more sensitive harvesting methods could result in higher employment co-efficients.

- The employment multipliers are derived from assumptions regarding which sectors are basic to a region which sectors are non-basic; those assumptions may not always be valid. Also, multipliers are based on a static snapshot, and do not reflect the ability of communities to adjust over time to changes in the economic base.

- Economic forecasts are subject to increasing uncertainty, particularly as the time horizon extends beyond a decade.

9 Appendix II – Haida Gwaii Labour Force, 2006 and 2016

Table 9-1: Haida Gwaii Labour Force, 2006

2006	Masset	Queen Charlotte	Port Clements	Electoral Area D	Electoral Area E	Old Massett	Skidegate	Haida Gwaii
Total – Industry (2-digit NAICS code)	545	605	250	440	265	360	365	2,830
11 Agriculture, forestry, fishing and hunting	45	35	55	85	50	40	50	360
21 Mining and oil and gas extraction	0	0	0	0	0	0	0	0
22 Utilities	10	0	0	0	15	0	10	35
23 Construction	20	30	20	25	20	20	40	175
31-33 Manufacturing	55	10	10	20	0	70	0	165
41 Wholesale trade	0	15	0	10	0	0	10	35
44-45 Retail trade	55	75	20	45	10	40	30	275
48-49 Transportation and warehousing	10	25	15	25	30	10	15	130
51 Information and cultural industries	0	0	0	0	0	0	10	10
52 Finance and insurance	10	15	0	0	0	0	10	35
53 Real estate and rental and leasing	0	15	0	10	10	0	0	35
54 Professional, scientific and technical services	30	30	10	10	0	10	0	90
55 Management of companies and enterprises	0	0	0	0	0	10	0	10
56 Administrative and support, waste management and remediation services	10	30	15	25	10	10	15	115
61 Educational services	95	45	15	30	10	20	20	235
62 Health care and social assistance	35	65	30	55	10	20	45	260

	Masset	Queen Charlotte	Port Clements	Electoral Area D	Electoral Area E	Old Massett	Skidegate	Haida Gwaii
71 Arts, entertainment and recreation	35	10	0	25	20	30	20	140
72 Accommodation and food services	50	85	30	35	35	45	15	295
81 Other services (except public administration)	40	30	20	15	5	10	10	130
91 Public administration	45	90	10	25	40	25	65	300

Source: Statistics Canada 2007 and subsequent releases along with author's revisions (eg. aggregating areas to create total Haida Gwaii figures)

Table 9-2: Haida Gwaii Labour Force, 2016

2016	Masset	Queen Charlotte	Port Clements	Electoral Area D	Electoral Area E	Old Massett	Skidegate	Haida Gwaii
Total – Industry (2-digit NAICS code)	415	515	225	240	145	290	460	2,290
11 Agriculture, forestry, fishing and hunting	40	45	75	40	30	30	60	320
21 Mining and oil and gas extraction	0	0	0	0	0	0	0	0
22 Utilities	10	0	0	10	0	0	10	30
23 Construction	35	20	20	25	0	20	25	145
31-33 Manufacturing	20	10	0	0	0	30	10	70
41 Wholesale trade	10	0	0	10	0	10	10	40
44-45 Retail trade	35	65	25	30	10	35	50	250
48-49 Transportation and warehousing	25	30	0	10	35	15	30	145
51 Information and cultural industries	0	10	0	0	0	0	0	10
52 Finance and insurance	0	15	10	10	0	0	10	45

2016	Masset	Queen Charlotte	Port Clements	Electoral Area D	Electoral Area E	Old Massett	Skidegate	Haida Gwaii
53 Real estate and rental and leasing	10	0	0	0	0	0	0	10
54 Professional, scientific and technical services	0	30	0	0	0	0	15	45
55 Management of companies and enterprises	0	0	0	0	0	0	0	0
56 Administrative and support, waste management and remediation services	25	25	10	0	30	10	20	120
61 Educational services	35	55	20	15	10	20	20	175
62 Health care and social assistance	70	90	15	35	10	25	45	290
71 Arts, entertainment and recreation	10	35	0	15	0	25	55	140
72 Accommodation and food services	35	30	30	25	10	30	30	190
81 Other services (except public administration)	10	0	10	0	0	10	30	40
91 Public administration	45	55	10	15	10	30	10	225

Source: Statistics Canada 2017 and subsequent releases along with author's revisions (eg. aggregating areas to create total Haida Gwaii figures)

10 Appendix III – Haida Gwaii TSA and TFL AACs, 2000-2017

Table 10-1: Haida Gwaii TSA and TFL AACs (m^3), 2000 - 2017

Year	TSA 25	TFL 25 (Block 6)	TFL 47 (Moresby Block), now TFL58	TFL 39 (Block 6), Now TFL 60	Haida Gwaii Total
2000	361,000 m³ (due to Part 13 reduction of 114, 000 m³, Dec 1999)	115,000 m³ (from 1998 incorporation of ex-TFL 24)	100,000 m³ (from Dec 1996 determination)	1,210,000 m³ (from 1996 determination – not official partition)	1,786,000 m³
2001				1,150,000 m³ (contrib in Nov 2001 determination – not an official partition)	1,726,000 m³
2002					1,726,000 m³
2003	No change, but 114,000 m³ Part 13 reduction replaced		100,000 m³ (re-determined in Aug 200		1,726,000 m³
2004				1,082,616 m³ (Oct 2004, due to private land removal – not an official partition)	1,658,616 m³
2005					1,658,616 m³

Year	TSA 25	TFL 25 (Block 6)	TFL 47 (Moresby Block), now TFL 58	TFL 39 (Block 6), Now TFL 60	Haida Gwaii Total
2006	245,000 m³ (Part 13 reduction of 116,000 m³)	106,500 m³ (Part 13 reduction of 8,500 m³ Oct 2006)	83,000 m³ (Part 13 reduction of 17,000 m³ Oct 2006; TFL 58 formed Dec '06	789,616 m³ (Part 13 reduction of 293,000 m³ Oct 2006)	1,224,116 m³
2007					1,224,116 m³
2008		106,500 m³ (base level and Part 13 reduction re-affirmed in Feb 2008 determination)			1,224,116 m³
2009	475,000 m³ (Part 13 reductions end Dec 31, 2009)	115,000 m³ (Part 13 reductions end Dec 31, 2009)	100,000 m³ (Part 13 reductions end Dec 31, 2009)	1,082 616 m³ (Part 13 reductions end Dec 31, 2009)	1,772,616 m³
2010	869,748 m³ (115 000 m³ added from TFL 25; 279,748 m³ added from TFL 60, Dec 2010)	TFL 25 Block 6 added to TSA 25	100,000 m³	802,868 m³ (Dec 2010; Jan 2010, TFL 39 Blk 6 deleted, TFL 60 formed)	1,772,616 m³
2011					1 772 616 m³
2012 thru 2017	512,000 m³ ("soft" partition, cedar harvest should not exceed 38%, i.e. 195,000 m³)		79,000 m³ ("soft" partition, cedar harvest should not exceed 41%, i.e. 32,000 m³)	340,000 m³ ("soft" partition, cedar harvest should not exceed 39%, i.e. 133,000 m³)	931,000 m³ ("soft" partition for cedar harvest)

Source: Sutherland 2012

11 Appendix IV – BCTS TSL awards on Haida Gwaii, 2008-2017

Table 11-1 itemizes the TSL awards by BCTS on Haida Gwaii over the 2008-2017 period. The table's data includes the TSL numbers, timber sale bid winners, general location of the TSL areas, TSL volumes, TSL issuance dates and TSL activity status. The codes used in the table to indicate TSL activity status are as follows: HI – pre-worked but harvesting not started or harvesting underway; HX – cancelled; and HC – closed.

Table 11-1: BCTS TSL awards for the Haida Gwaii TSA, 2008-2017

TSL	Licensee	Operating Area	Volume (m^3)	TSL Issued Date	TSL File Status
A83896	Abfam enterprises	New Year Lake	1,645	10/26/2009	HC
A85757	Abfam enterprises	Loon Lake	14,707	2/9/2011	HC
A90732	Abfam enterprises	Loon Lake	34,389	12/3/2013	HC
A85507	Abfam enterprises	Loon lake	15,342	3/30/2010	HC
A93121	O'Brien & Fuerst (Dennis Reindl)	Delkatla	15,427	3/31/2016	HI
A86082	O'Brien & Fuerst (Dennis Reindl)	East Coast	29,832	3/30/2016	HC
A93736	O'Brien & Fuerst (Dennis Reindl)	Naikoon	14,289	3/22/2016	HC
A83752	O'Brien & Fuerst (Dennis Reindl)	Collison Point	18,961	6/16/2010	HC
A83750	O'Brien & Fuerst (Dennis Reindl)	New Year Lake/Kumdis	16,925	6/9/2010	HC
A83751	O'Brien & Fuerst (Dennis Reindl)	New Year lake	19,667	6/21/2010	HC
A83862	O'Brien & Fuerst (Gloria O'Brien)	Mosquito lake	10,603	4/27/2009	HX
A88589	O'Brien & Fuerst (Gloria O'Brien)	Rennell Sound	20,487	3/26/2012	HC
A68395	O'Brien & Fuerst (Gloria O'Brien)	Rennell Sound	16,397	3/31/2015	HC
A91146	O'Brien & Fuerst (Gloria O'Brien)	Masset Inlet	24,904	3/31/2015	HC
A83859	O'Brien & Fuerst (Gloria O'Brien)	Masset Inlet	24,454	4/15/2009	HC
A90716	O'Brien & Fuerst (Randy O'Brien)	Rennell Sound	18,767	3/28/2013	HC
A88156	O'Brien & Fuerst (Randy O'Brien)	Rennell Sound	37,488	7/6/2011	HC
A85304	O'Brien & Fuerst (Randy O'Brien)	East Coast	89,611	6/28/2012	HC
A90553	O'Brien & Fuerst (Travis O'Brien)	Tlell River	34,620	11/13/2012	HC

TSL	Licensee	Operating Area	Volume (m^3)	TSL Issued Date	TSL File Status
A83253	O'Brien & Fuerst (Travis O'Brien)	New Year	26,347	12/1/2008	HC
A83757	O'Brien & Fuerst (Travis O'Brien)	Loon Lake	26,597	3/26/2012	HC
A85374	O'Brien & Fuerst (Travis O'Brien)	Lawn Hill North	25,301	12/19/2017	HI
A93566	O'Brien & Fuerst (Travis O'Brien)	Skidegate Lake	49,584	1/26/2017	HI
A85561	O'Brien & Fuerst (Travis O'Brien)	Loon Lake	27,459	12/30/2014	HC
A82245	O'Brien & Fuerst (Travis O'Brien)	Lawn Hill	48,959	3/31/2014	HC
A91147	O'Brien & Fuerst (Travis O'Brien)	Rennell Sound	25,759	3/31/2015	HX
A85504	Cam Gamble	East Coast	22,094	11/1/2011	HC
A68535	I. Crosby	Rennell Sound	24,304	12/8/2010	HC
A83559	Taan Forest Ltd.	Skidegate Lake	25,817	12/6/2011	HC
A88784	Husby Forest Products	Collison Point	17,374	3/8/2016	LC
A88783	Husby Forest Products	Collison Point	21,921	12/31/2013	HC
A93738	Inifinity West (Alfred Loewen)	Nadu	29,901	12/11/2017	HI
A93737	Inifinity West (Alfred Loewen)	Hangover Creek	26,356	1/24/2017	HI
A93735	Inifinity West (Alfred Loewen)	Naikoon	18,933	3/9/2016	HC
A83756	Inifinity West (Alfred Loewen)	Lawn Hill North	108,890	10/31/2011	HC
A92922	Infinity West	Drizzle Lake	15,209	9/21/2015	HC
A90971	Infinity West	Delkatla	18,079	10/7/2013	HC
A85508	Infinity West	Loon Lake	22,623	6/30/2010	HC
A93120	Cromwell Projects (Forestry) Ltd	Naikoon	75,383	9/29/2016	HC
A91148	Cromwell Projects (Forestry) Ltd	Naikoon	61,097	11/4/2014	HC
A90975	Cromwell Projects (Forestry) Ltd	Masset Inlet	20,156	3/27/2014	HC
A92174	Delta Cedar Services Ltd	East Coast	23,687	12/10/2015	HC
A85373	Alexander Orest Pawliuk	Jungle	15,152	11/30/2010	HC
A82248	Ashlaur Trading	Mosquito lake	20,018	5/21/2008	HC
A69185	Ashlaur Trading	Masset Inlet	5,822	2/2/2008	HC
A89774	FDH Timber Ltd.	Loon Lake	18,723	9/11/2012	HC
A83864	H&M Forest Products Inc.	Skidegate Lake	28,879	1/13/2012	HC
A83749	Western Forest Products	Loon Lake	7,328	4/30/2008	HC
			1,316,267		

Source: BCTS 2018a

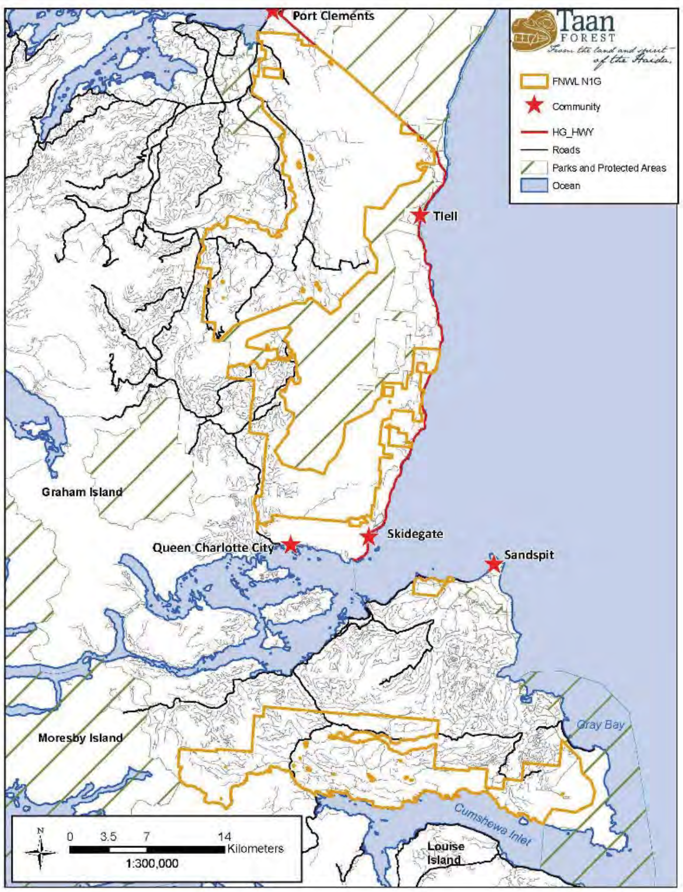
Appendix 5:
Taan FNWL Management Plan
Consultation Package

Taan FOREST
From the land and spirit of the Haida.

Notice is hereby given that Taan Forest is submitting a First Nation Woodland Licence Management Plan (FNWL) to convert the Haida Tenure FLC A87661 to a First Nation Woodland Licence FNWL N1G.

The Management Plan is necessary to enact the First Nation Woodland Licence and replace FLC A87661 which expires in September 2020.

The FNWL area covers: Graham Island between Queen Charlotte Village and the Yakoun River as the North West boundary to Port Clements and Moresby Island North of Mosquito Lake, around Skidegate Lake and along Cumshewa Inlet to Gray Bay. See map:



The Management Plan proposes an annual cut of 153,524m3. This proposed annual cut is based on the current Timber Supply Review (TSR) being undertaken by the Haida Gwaii Management Council. TSR documents can be found on the HGMC's website: HaidaGwaiiManagementCouncil.ca .

In accordance with the license agreement, Taan Forest invites persons using the FNWL for non-timber harvesting activities to provide comment on the Management Plan.

The Management Plan is available for review and comment at

- Taan Forest website www.taanforest.com
- Taan Forest's office in Skidegate: Unit #3 Commercial Centre 848 Highway 16
- Haico's Office in Old Massett:. 415 Frog Street (Old Haida Rose Café location)

The review and comment period shall commence Feb 1, 2020. Comments regarding this plan are welcome and must be received by April 1, 2020.

WWW.TAANFOREST.COM | 848 HWY 16 UNIT 3 COMMERCIAL CENTRE
BOX 1384 SKIDEGATE, BC | V0T 1S1
PH 250.559.2337 FX 250 559 2367

Comments should be submitted to:

Jeff Mosher, RPF, Taan Forest. P.O. Box 1384, Unit #3, Commercial Centre, 848 Highway 16, Skidegate, Haida Gwaii. V0T 1S1

By e-mail: FNWL@Taanforest.com

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The Haida Gwaii Observer has multiple opportunities for community columnists and part-time reporters. These are paid positions.

Columnists need to know their community well and convey to the rest of Haida Gwaii what's on people's minds each week — tell us about an event that occurred over the weekend, give us the inside scoop of an incident, or just tell us a good story. There are endless ways to approach a community column and we can help you flesh it out.

The reporters positions are part time, at your own hours. There are two spots available, one for coverage of the southern part of Graham Island and the other for the north. This is a multimedia role, so video and photography skills are a plus.

For more information on any of these opportunities please email observer@haidagwaiiobserver.com

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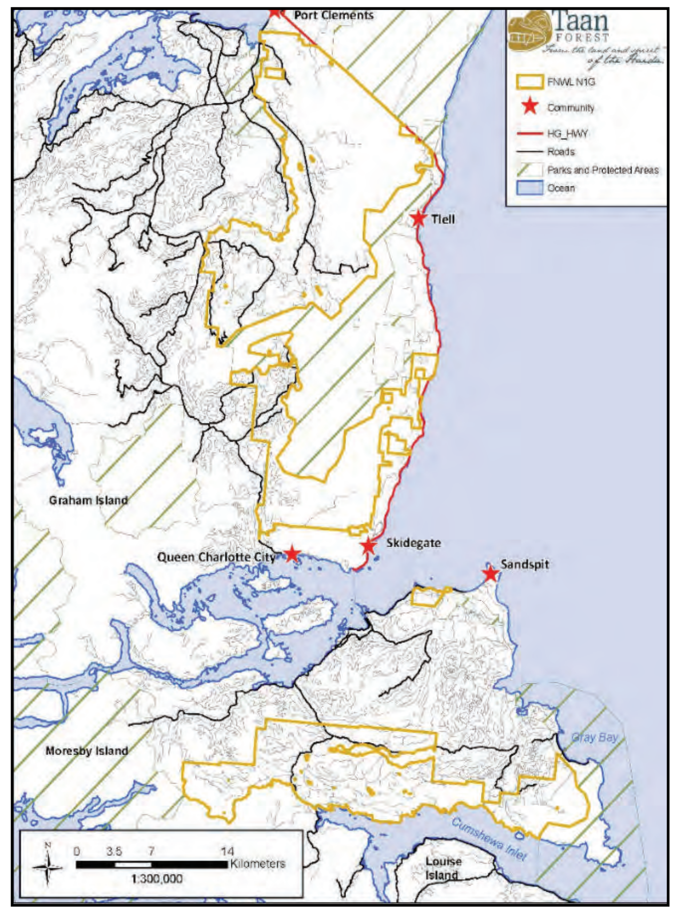

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haidagwaiimanagementcouncil.ca

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- Haico's Office in Old Massett:. 415 Frog Street (Old Haida Rose Café location)

The review and comment period shall commence Feb 1, 2020. Comments regarding this plan are welcome and must be received by April 1, 2020.

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Jeff Mosher, RPF, Taan Forest
P.O. Box 1384, Unit #3, Commercial Centre, 848 Highway 16, Skidegate, Haida Gwaii. V0T 1S1
By e-mail: **FNWL@Taanforest.com**
By Phone: **250-559-2337**

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OBSERVER

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For more information on any of these opportunities please email observer@haidagwaiiobserver.com

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LAND ACT:

Notice of Intention to Apply for a Disposition of Crown Land

Take notice that I, WEYL Power Ltd. from **Vancouver, BC**, have applied to the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), North Island Natural Resource District for a Investigative License – Ocean Energy situated on provincial Crown land located in the vicinity of Skidegate.

The Land File Number that has been established for this application is **Crown Land File** 1414565.

Written comments concerning this application should be directed to: Jasmine Soles, Natural Resource Authorizations Officer, Haida Gwaii Natural Resource District, Ministry of Forests Lands Natural Resource Operations and Rural Development, 1229 Oceanview Drive, Queen Charlotte, B.C. V0T 1S0, or emailed to:

FrontcounterHaidaGwaii@gov.bc.ac

Be advised that any response to this advertisement will be considered part of the public record. Be advised that any response to this advertisement will be considered part of the public record.

Comments will be received by FLNRO up to February 24, 2019. FLNRO may not be able to consider comments received after this date.

Please visit our website: **https://comment.nrs.gov.bc.ca/**

Legal **Legal** **Legal** **Legal** **Legal**

Legal Notices **Legal Notices** **Legal Notices** **Legal Notices** **Legal Notices**

LAND ACT:

Notice of Intention to Apply for a Disposition of Crown Land

Take notice that I, WEYL Power Ltd. from Vancouver, BC, have applied to the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), North Island Natural Resource District for a Investigative License – Ocean Energy situated on provincial Crown land located in the vicinity of Masset Sound.

The Land File Number that has been established for this application is Crown Land File 1413766.

Written comments concerning this application should be directed to: Jasmine Soles, Natural Resource Authorizations Officer, Haida Gwaii Natural Resource District, Ministry of Forests Lands Natural Resource Operations and Rural Development, 1229 Oceanview Drive, Queen Charlotte, B.C. V0T 1S0, or emailed to:

FrontcounterHaidaGwaii@gov.bc.ac

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The Land File Number that has been established for this application is Crown Land File 1413744.

Written comments concerning this application should be directed to: Jasmine Soles, Natural Resource Authorizations Officer, Haida Gwaii Natural Resource District, Ministry of Forests Lands Natural Resource Operations and Rural Development, 1229 Oceanview Drive, Queen Charlotte, B.C. V0T 1S0, or emailed to:

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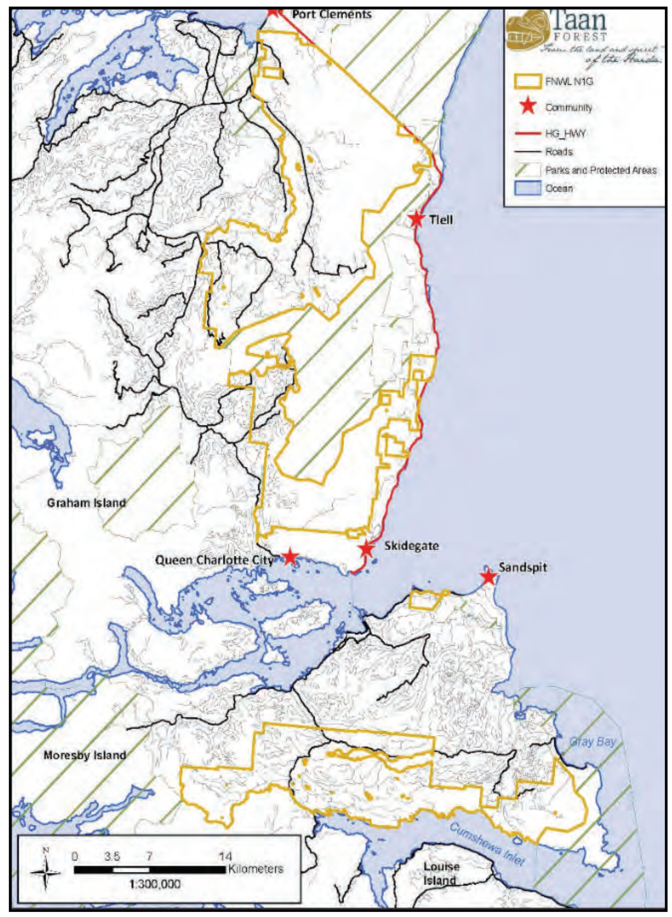
Taan FOREST
From the land and spirit of the Haida.

Notice is hereby given that Taan Forest is submitting a First Nation Woodland Licence Management Plan (FNWL) to convert the Haida Tenure FLC A87661 to a First Nation Woodland Licence FNWL N1G.

The Management Plan is necessary to enact the First Nation Woodland Licence and replace FLC A87661 which expires in September 2020.

The FNWL area covers: Graham Island between Queen Charlotte Village and the Yakoun River as the North West boundary to Port Clements and Moresby Island North of Mosquito Lake, around Skidegate Lake and along Cumshewa Inlet to Gray Bay. See map:



The Management Plan proposes an annual cut of 153,524m3. This proposed annual cut is based on the current Timber Supply Review (TSR) being undertaken by the Haida Gwaii Management Council. TSR documents can be found on the HGMC's website:

haidagwaiimanagementcouncil.ca

In accordance with the license agreement, Taan Forest invites persons using the FNWL for non-timber harvesting activities to provide comment on the Management Plan.

The Management Plan is available for review and comment at

- Taan Forest website **www.taanforest.com**
- Taan Forest's office in Skidegate: Unit #3 Commercial Centre 848 Highway 16
- Haico's Office in Old Massett:. 415 Frog Street (Old Haida Rose Café location)

The review and comment period shall commence Feb 1, 2020. Comments regarding this plan are welcome and must be received by April 1, 2020.

Comments should be submitted to:
Jeff Mosher, RPF, Taan Forest
P.O. Box 1384, Unit #3, Commercial Centre, 848 Highway 16,
Skidegate, Haida Gwaii. V0T 1S1
By e-mail: **FNWL@Taanforest.com**
By Phone: **250-559-2337**

Appendix 6:
Taan FNWL Management Plan
1:65,000 map

NAIKOON PARK
YAGUUN GANDLAAY PROTECTED AREA
DUU GUUSD PROTECTED AREA
TLELL PROTECTED AREA
YAAGUUN SUU PROTECTED AREA
DAAWUUXUSDA PROTECTED AREA
KUNXALAS PROTECTED AREA
FLTC A87661
TFL 60
Taan FOREST
Taan Operations
N1G
Planning Map
LEGEND
Boundaries
NSR / Harvested
Stocked / Regen
Free Growing
Greened Up
Non Greened
Taan Tenure
Roads
Mainline
Secondary Road (Status Unknown)
Highway
Other Features
Dryland Sorts/Camps
Foreshore Leases
Park/Protected Area
Ecological Corridors and Reserves
Cedar Stewardship Area
Forest Reserve
WHA
Waterbody
Sensitive Watershed
Northern Saw-Whet Owl Reserve
Watershed Boundary
Upland Stream Sub-Unit
Goshawk Nest
Goshawk Reserve
1:65,000
0 1 2 3 4
Kilometers
N
NAD 83 BC Albers
Map Printed 14/11/2019
Print at 35 x 43