Haida Gwaii Timber Supply Review Analysis Report

Haida Gwaii Timber Supply Review Technical Working Group Report for the Haida Gwaii Management Council
2019

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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

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.

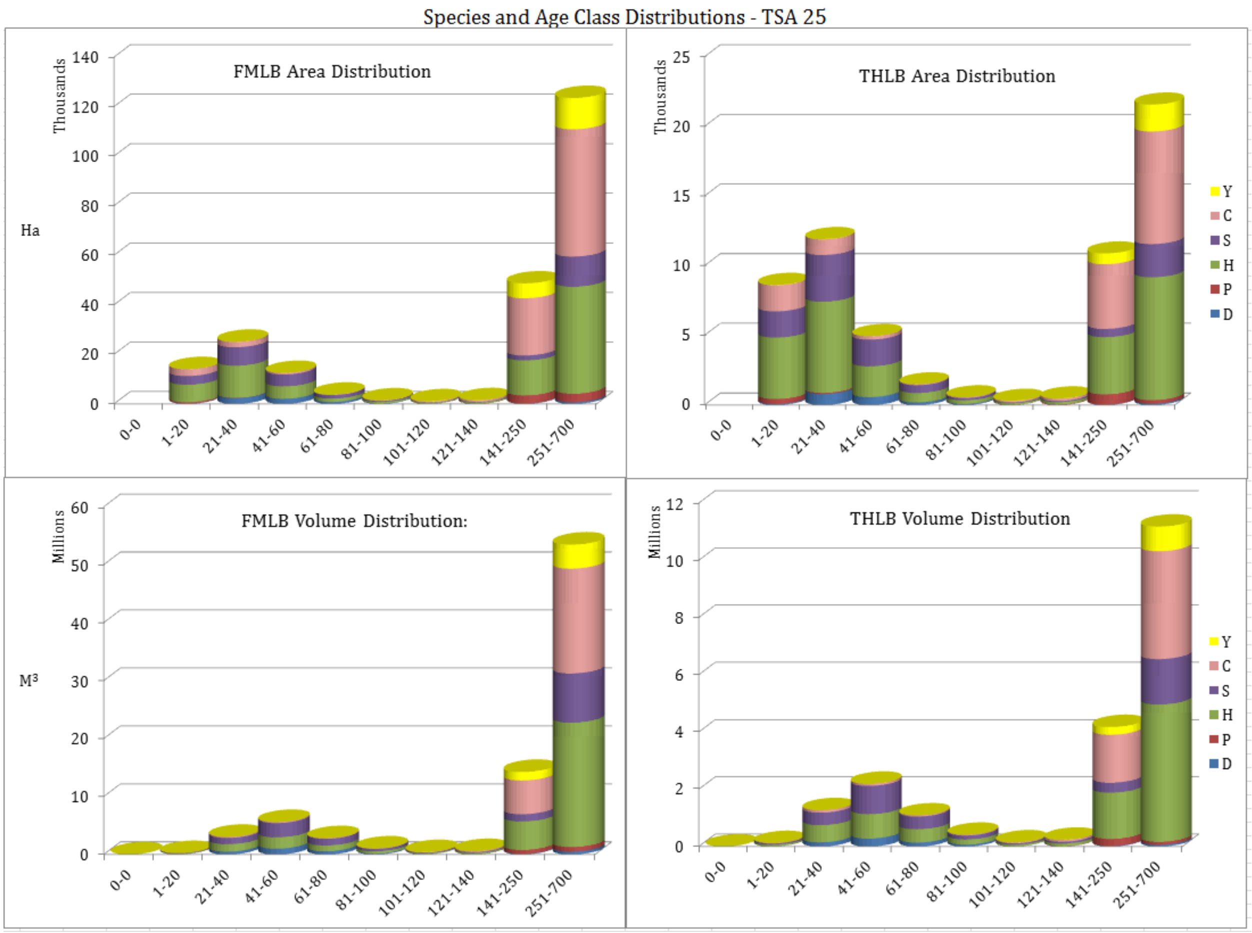

Figure 1.1.2. Tree species and ages for the forested area (FMLB) and the Timber Harvesting Land Base (THLB) for the Timber Supply Area (TSA), expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

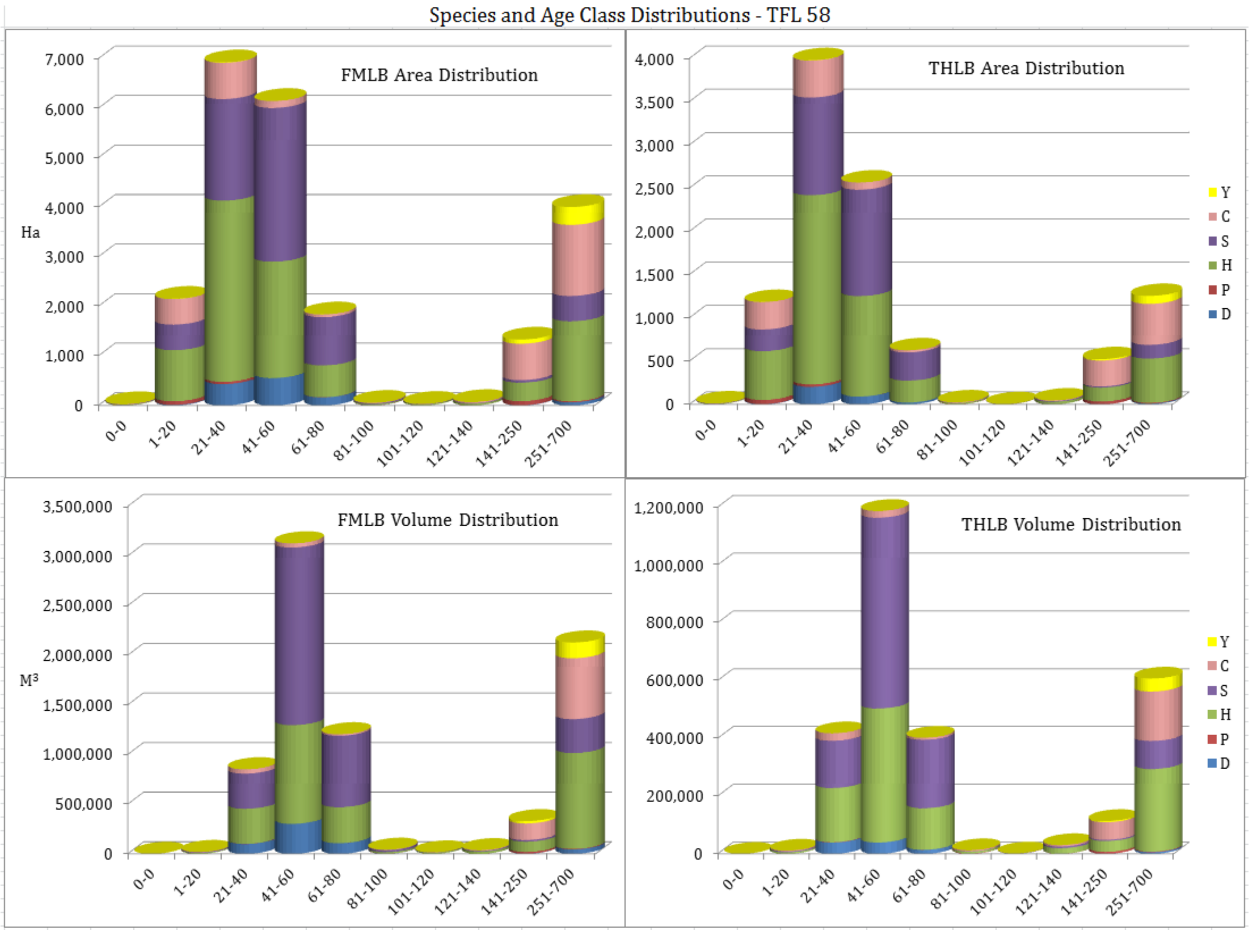

Figure 1.1.3. Tree species and ages for all the forested area (FMLB) and the Timber Harvesting Land Base (THLB) of Tree Farm Licence 58, expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

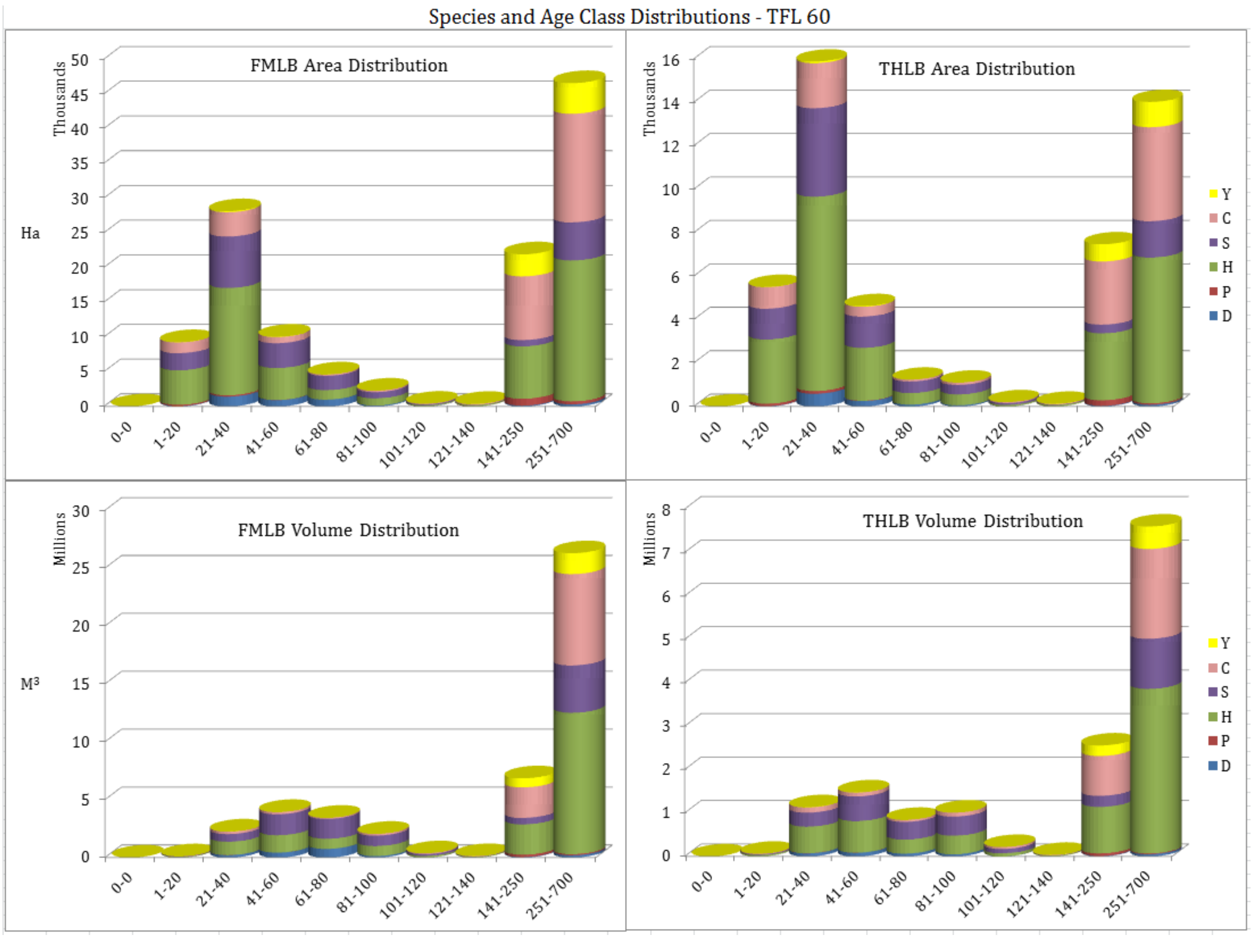

Figure 1.1.4. Tree species and ages for all the forested area (FMLB) and the Timber Harvesting Land Base (THLB) of Tree Farm Licence 60, expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

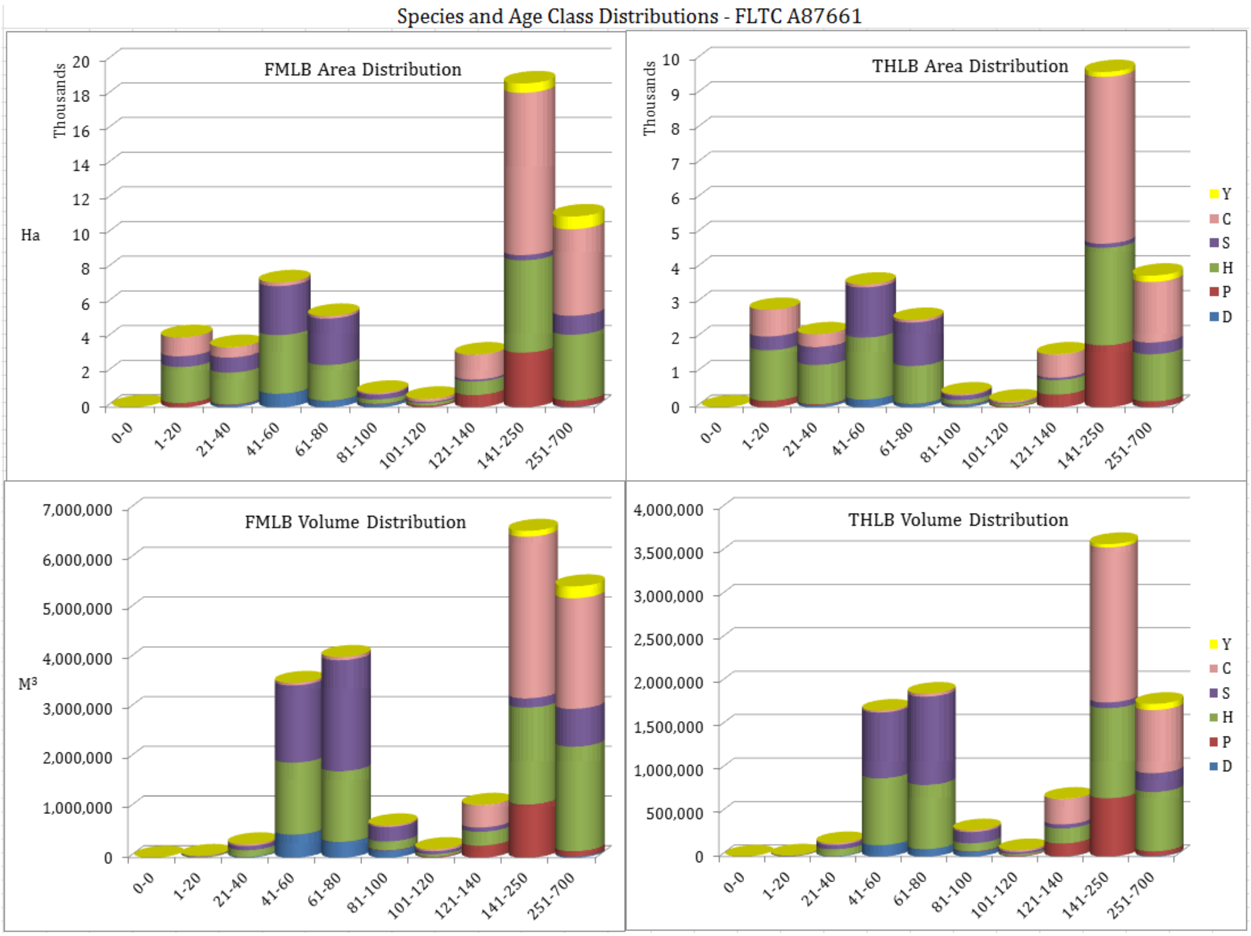

Figure 1.1.5. Tree species and ages for all the forested area (FMLB) and the Timber Harvesting Land Base (THLB) of Forest Licence to Cut A87661 (Taan Forest Products) expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

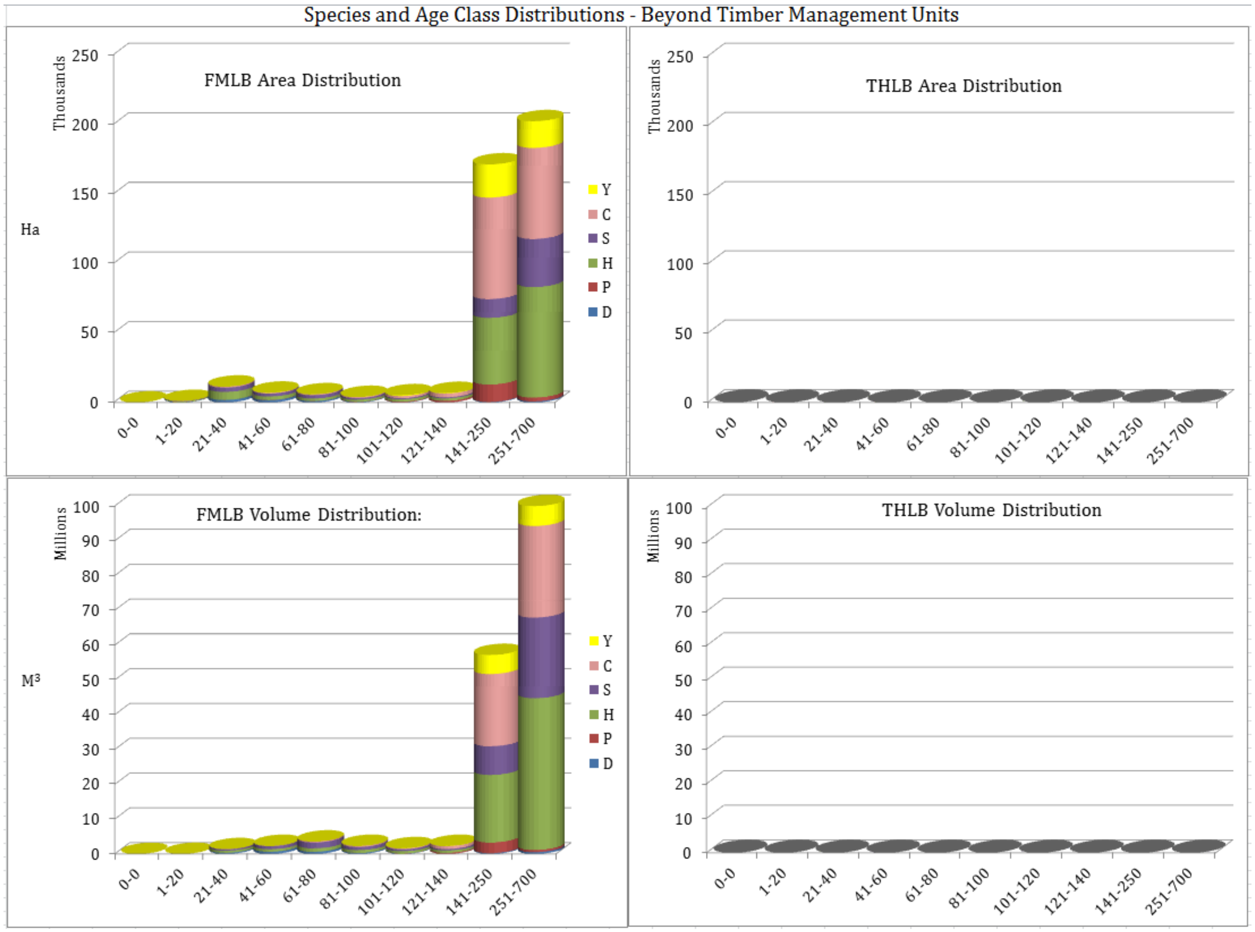

Figure 1.1.6. Tree species and ages for all the forested area (FMLB) <u>in protected areas,</u> expressed in area (hectares) and volume (m3). Y= yellow cedar, C= red cedar, S= Sitka spruce, H= hemlock, P= lodgepole pine, D= red alder.

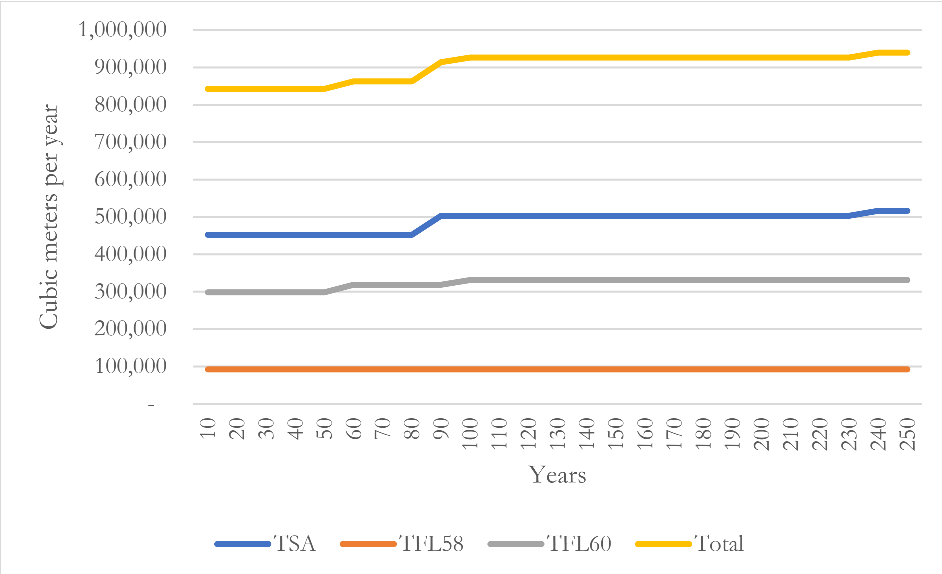

Figure1.1.7. Non-declining flow base case across all three management units.

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.

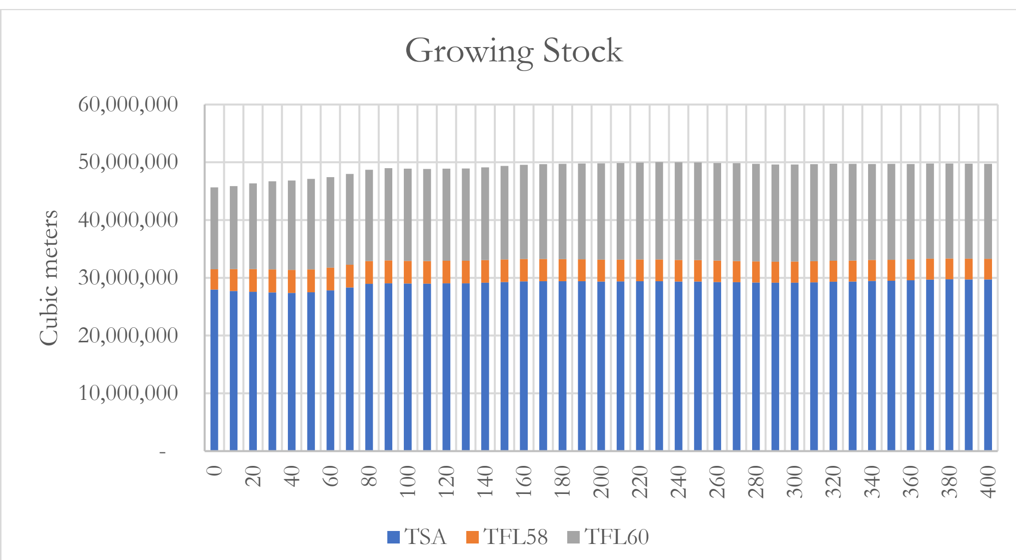

Figure1.1.8. Base case growing stock in the THLB by management unit

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.

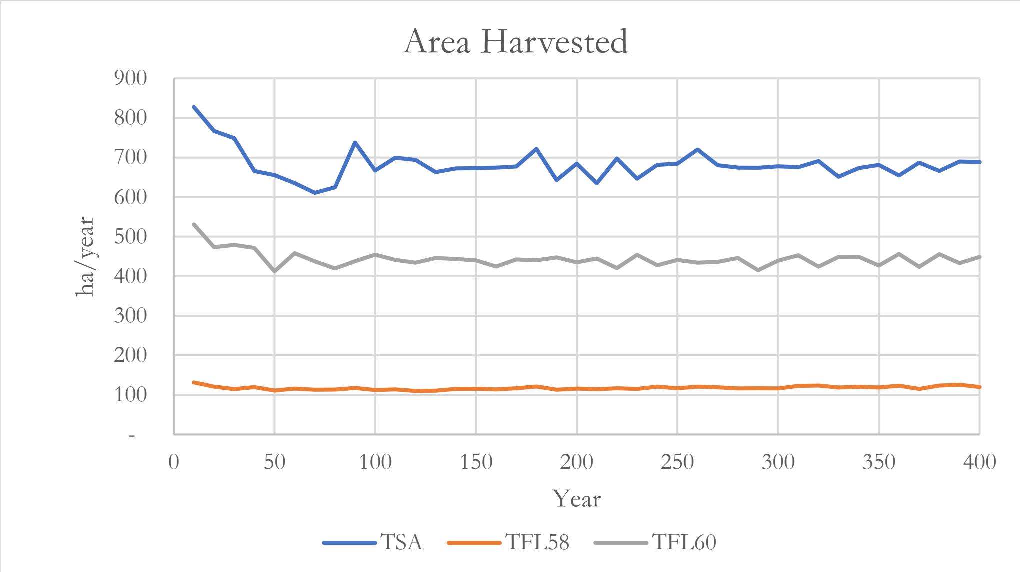

Figure 1.1.9. Base case area harvested by Management Unit over the planning horizon

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.

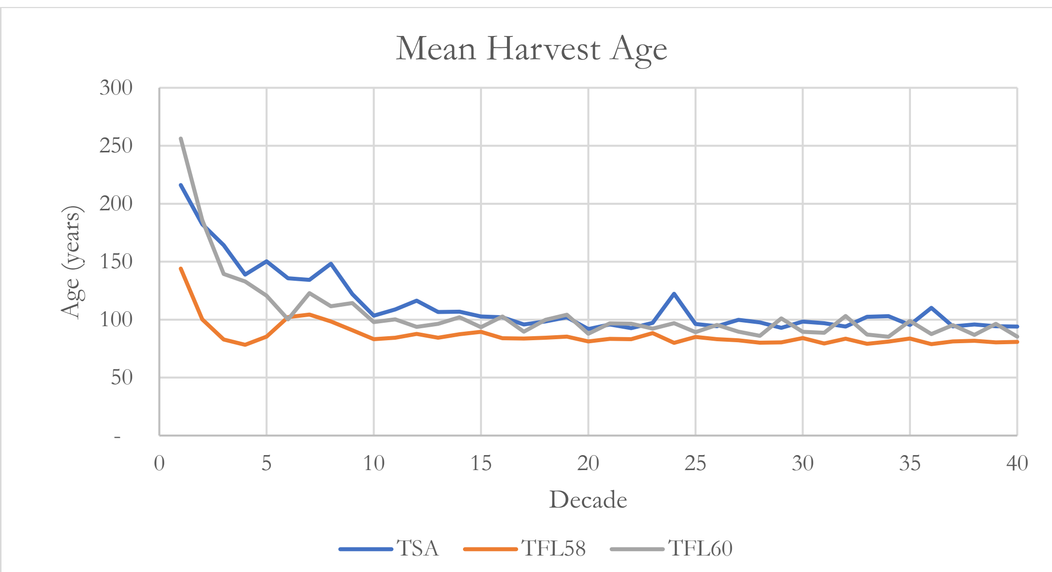

Figure 1.1.10. Base case mean harvest age by Management Unit over the planning horizon

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).

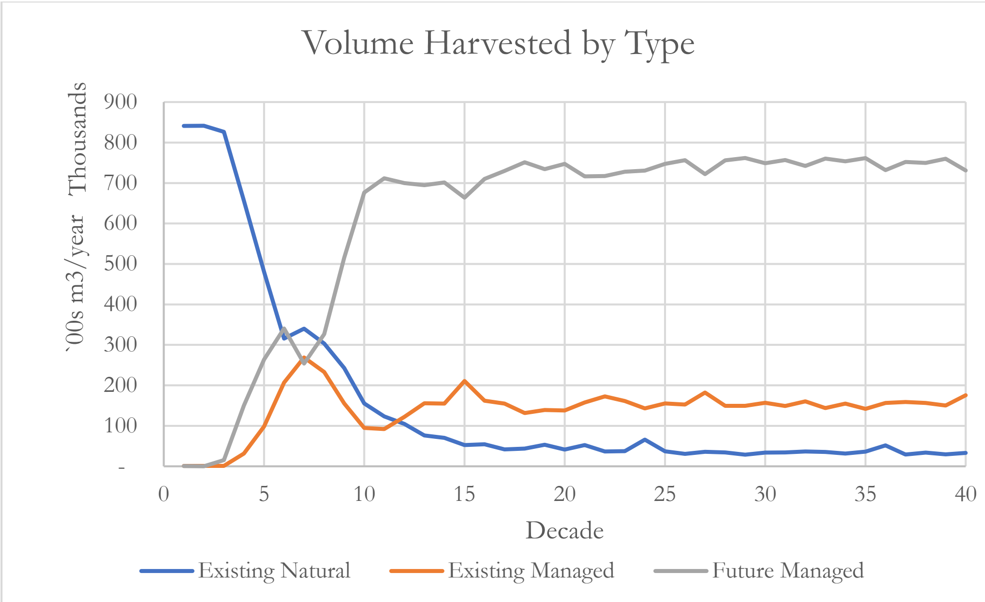

Figure1.1.11. Base case volume harvested by growth and yield curve category. Existing Natural (VDYP model), Existing Managed and Future Managed stands (TIPSY).

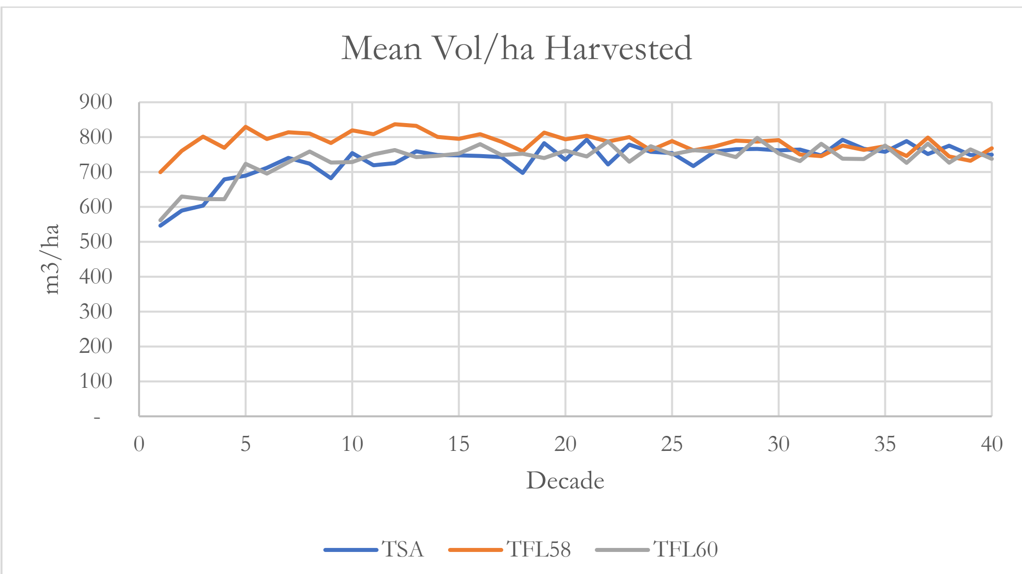

Figure1.1.12. Base case mean volume per hectare harvested by Management Unit over the planning horizon.

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.

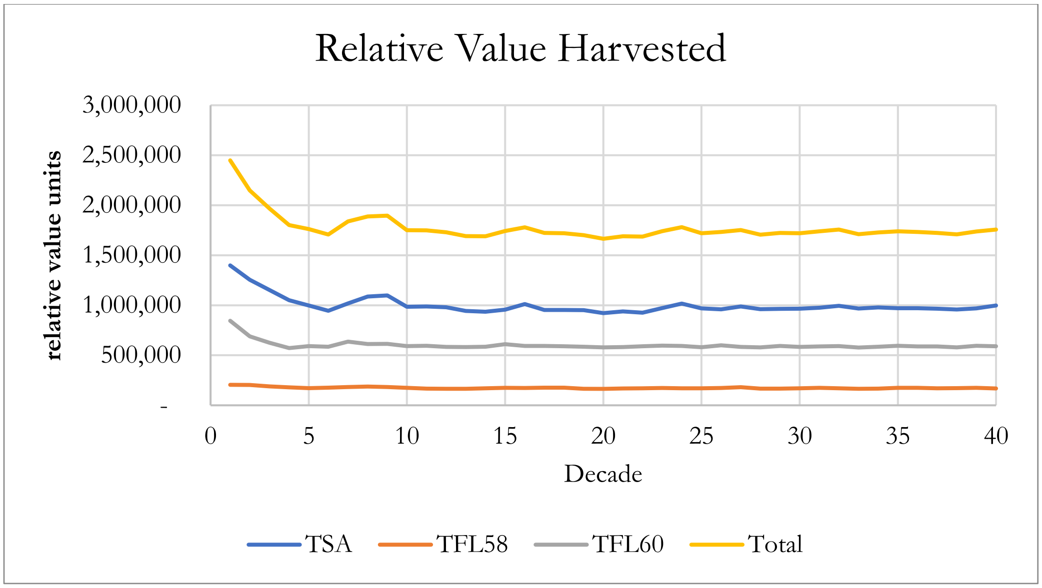

Figure 1.1.13. Relative value associated with harvest over time, based on market value indices from 2008-2017.

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.

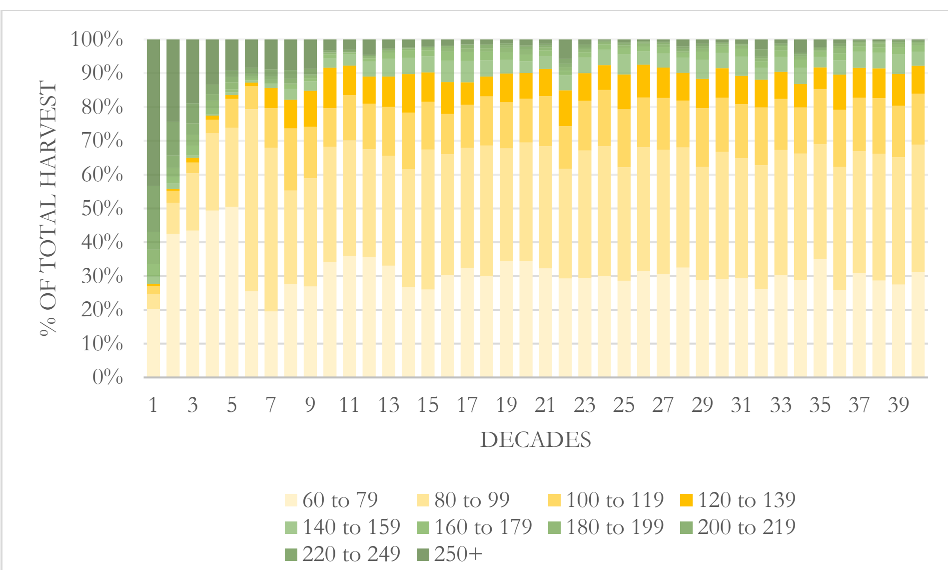

Figure 1.1.14. Harvest age class distribution by 20-year forest age increments over 40 decades for all the management units on Haida Gwaii.

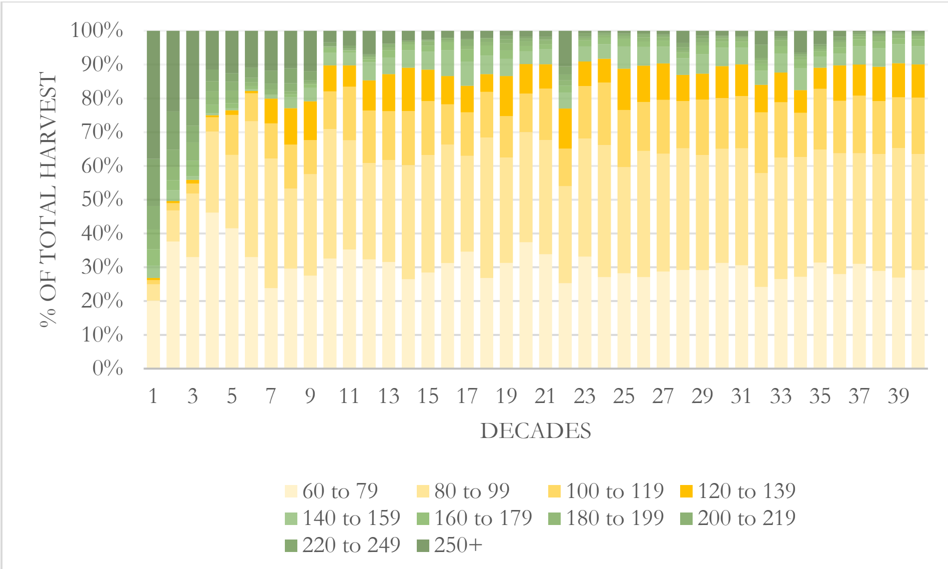

Figure 1.1.15. Harvest age class distribution by 20-year forest age increments over 40 decades for the TSA.

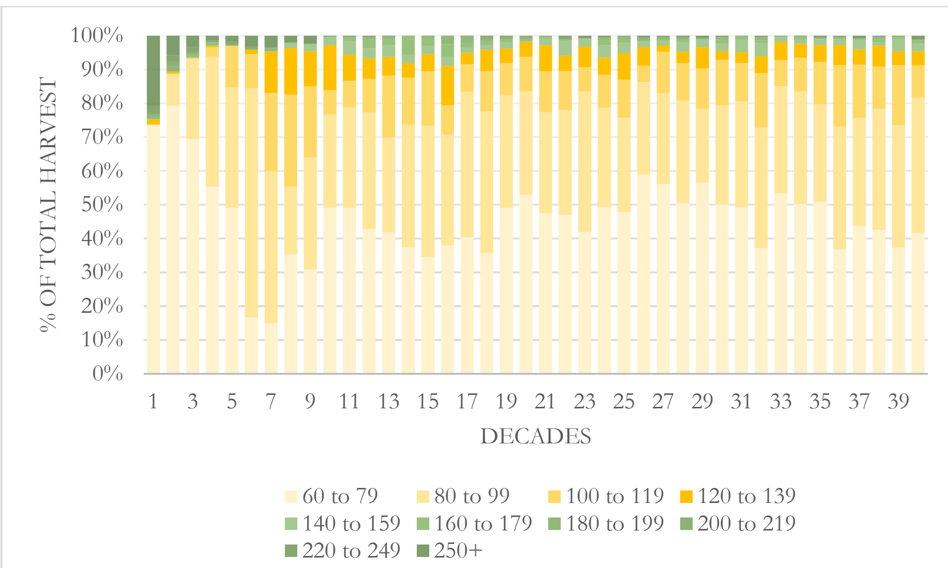

Figure 1.1.16. Harvest age class distribution by 20-year forest age increments over 40 decades for TFL 58.

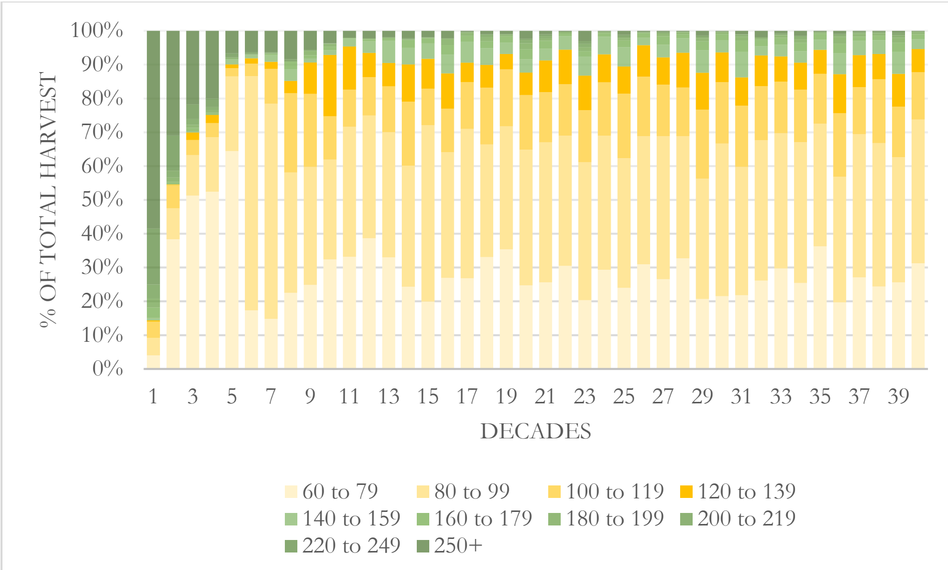

Figure 1.1.17. Harvest age class distribution by 20-year forest age increments over 40 decades for TFL 60.

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.

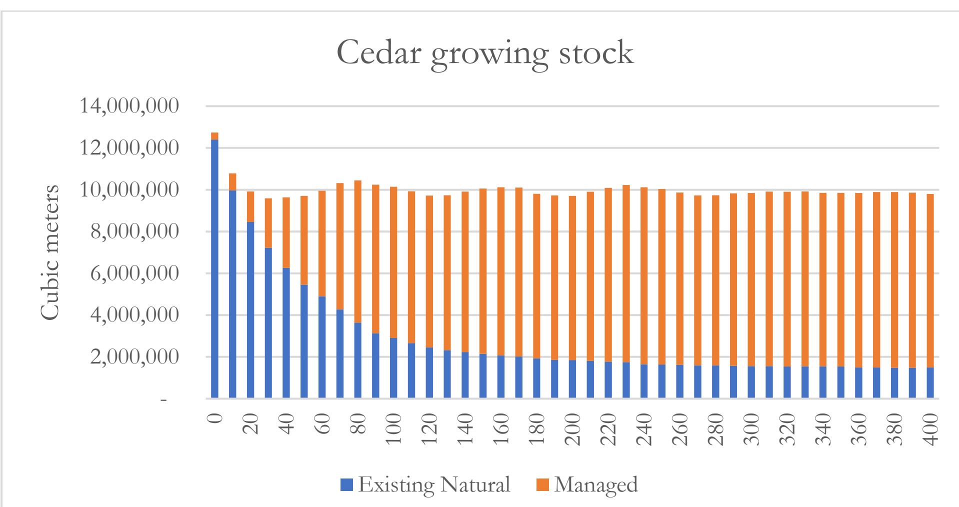

Figure 1.2.1. Base case cedar growing stock by existing natural and managed stands over time on the THLB.

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.

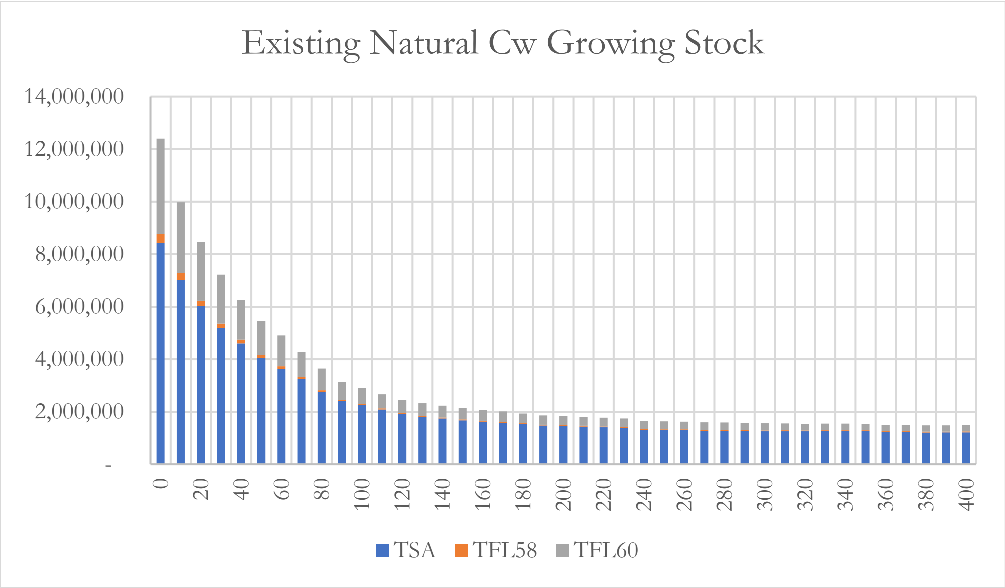

Figure 1.2.2. Existing natural (old growth) western red cedar growing stock by management units over time on the THLB.

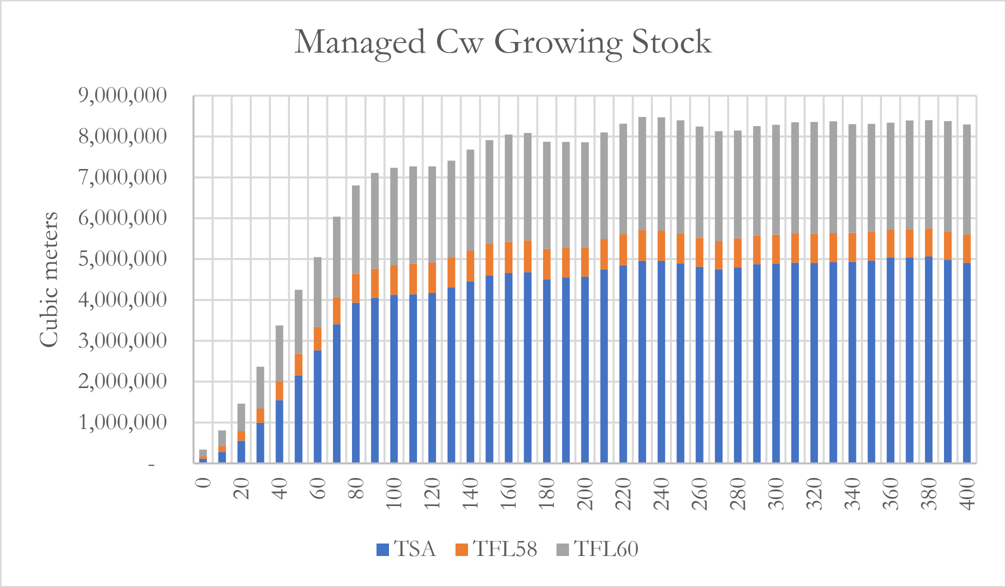

Figure 1.2.3. Managed (second growth) western red cedar growing stock by management unit over time on the THLB.

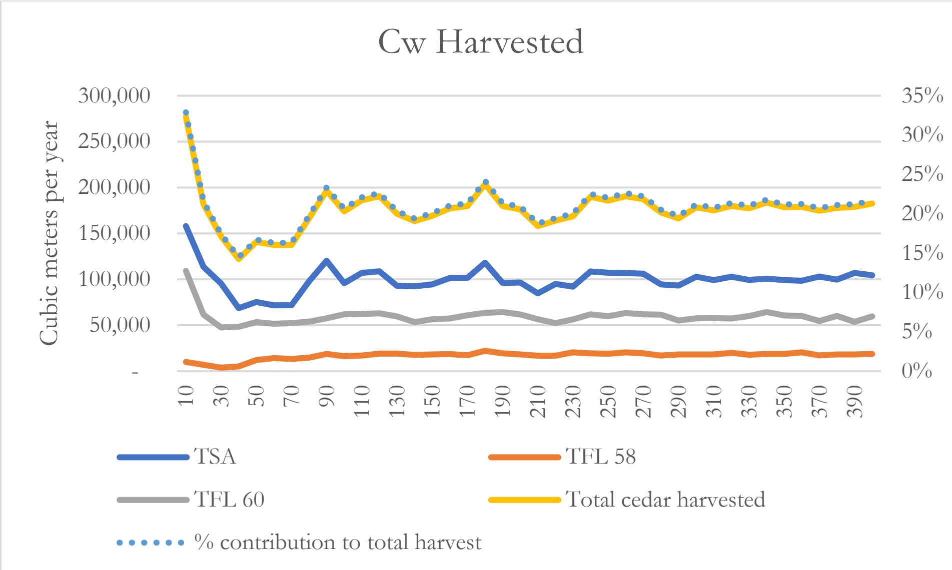

Figure1.2.4. Base case cedar volume harvest by management unit. over time.

As figure 1.2.4 indicates, cedar harvests start at just over 277,000 m^3 before declining significantly down to 122,000 m^3 at decade 4 in the base case reference scenario, before their contributions increases to an approximate average of just over 176,000 m^3 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.

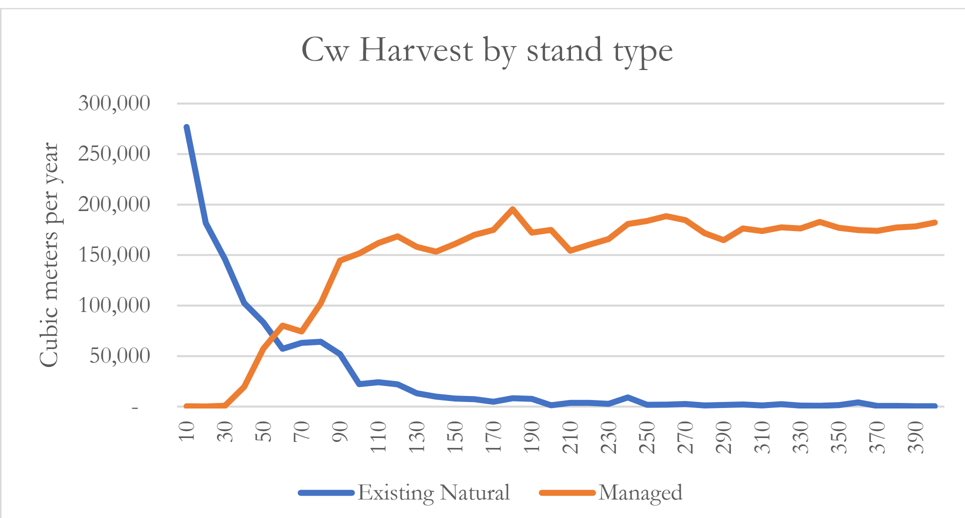

Figure1.2.5. Base case cedar harvest by stand type

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.

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).

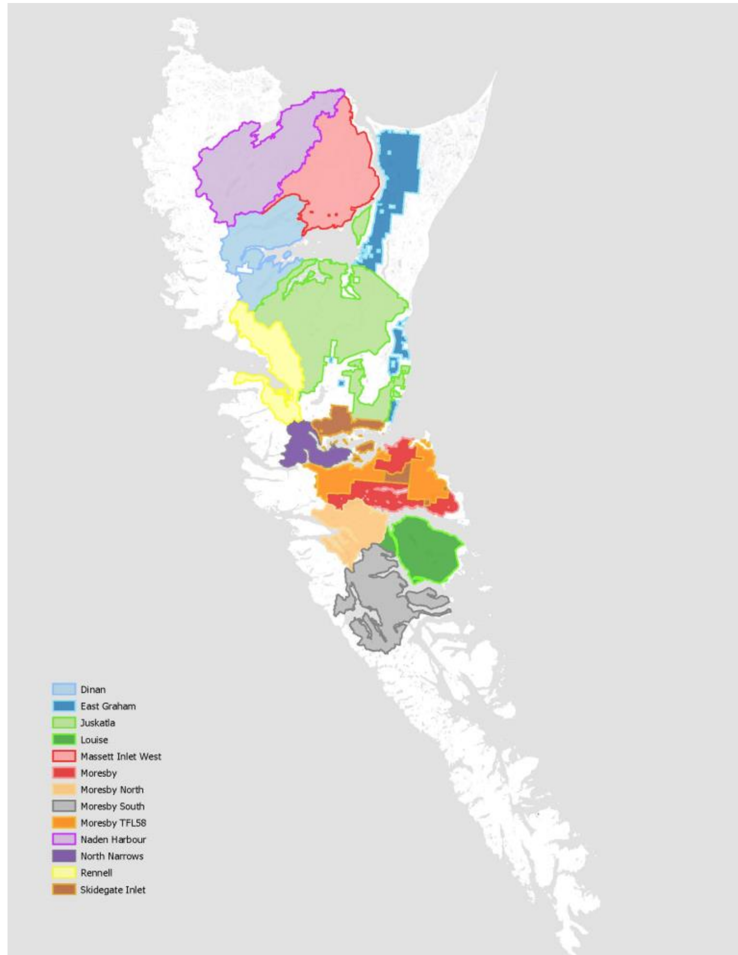

Figure1.2.6. Roadsheds/woodsheds used in the cedar sensitivity analysis

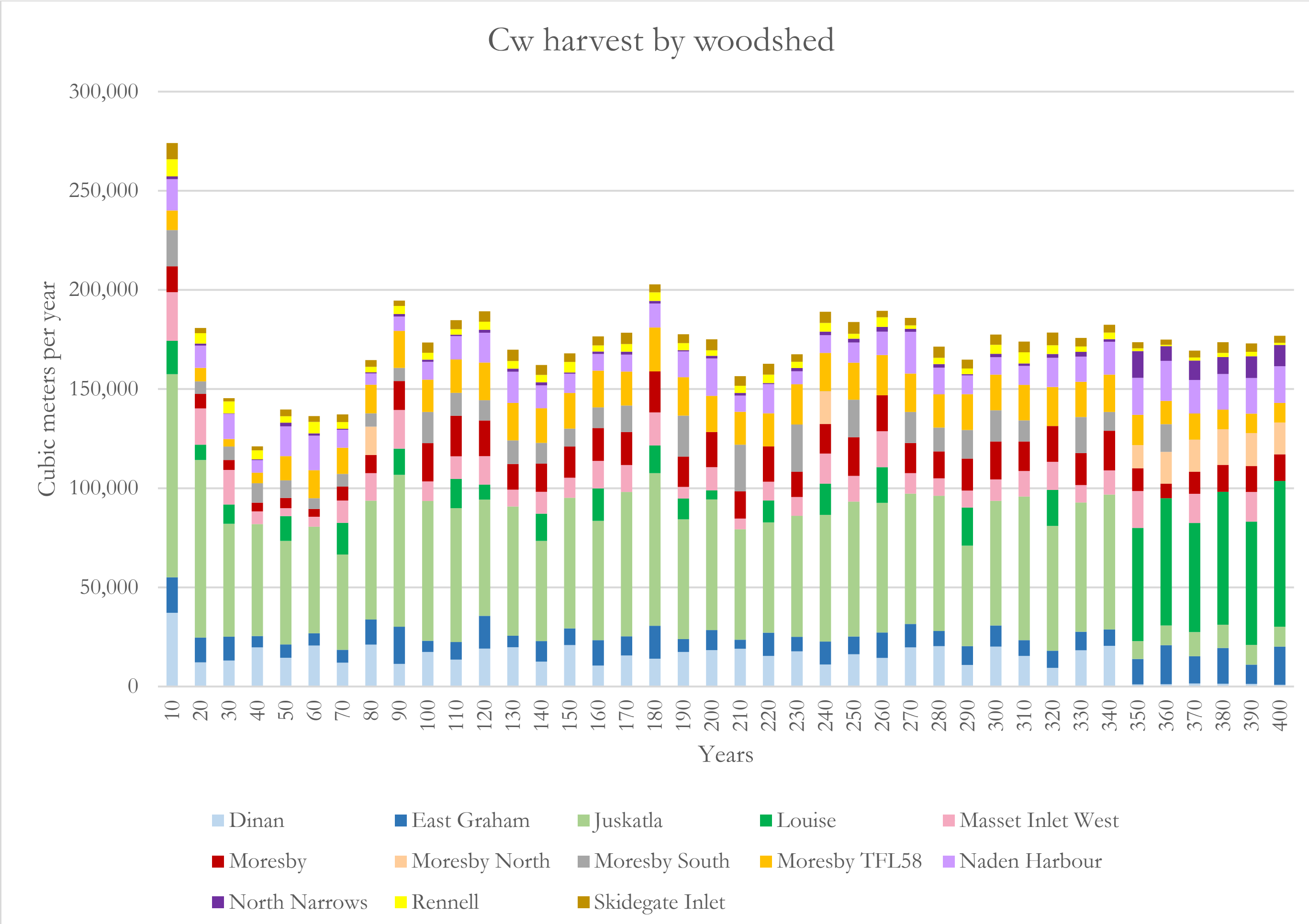

Figure 1.2.7 Base case reference cedar volumes harvested by woodshed

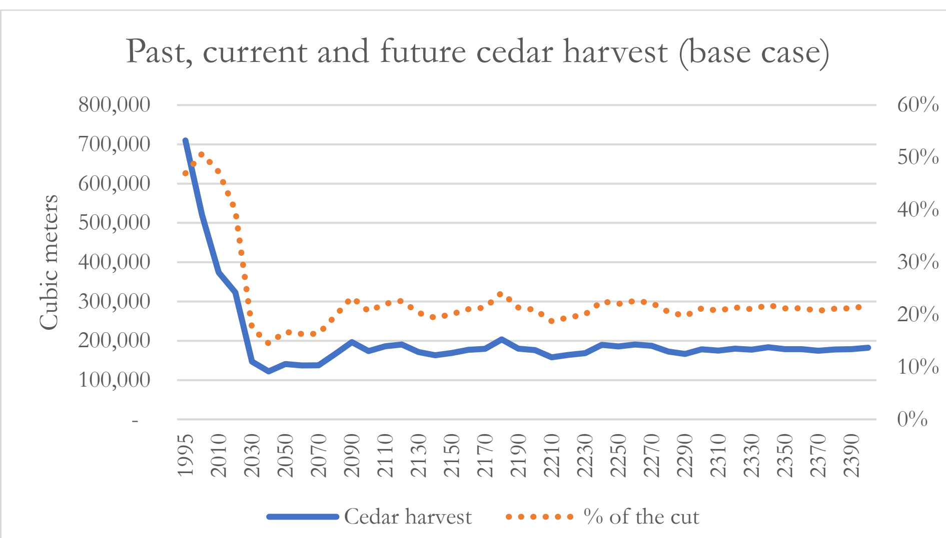

Figure1.2.8. Past, current (HBS 1995-2018) and the future projected base case cedar volume harvested annually over the analysis horizon, as well as the % contribution to cedar over the analysis horizon.

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.

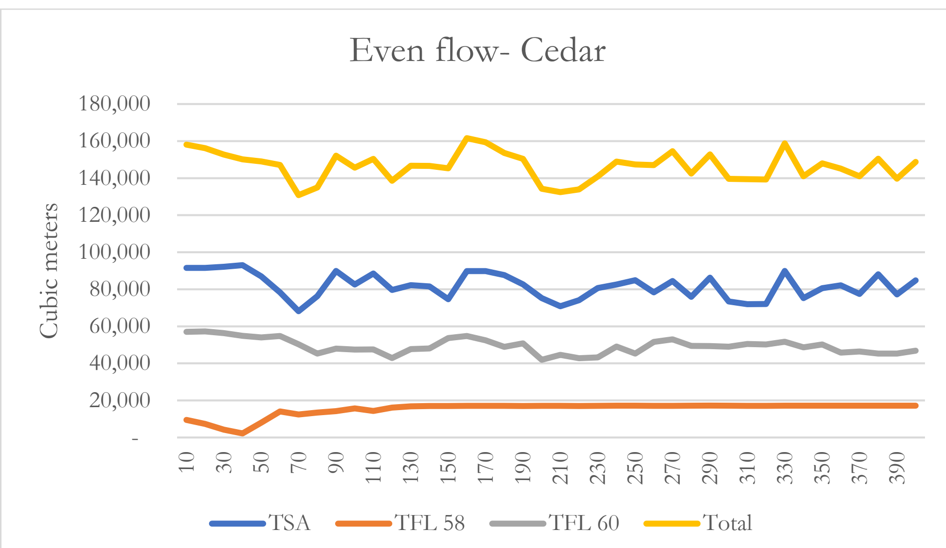

Figure 2.1.1.1 Even flow for Cedar by management unit.

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.

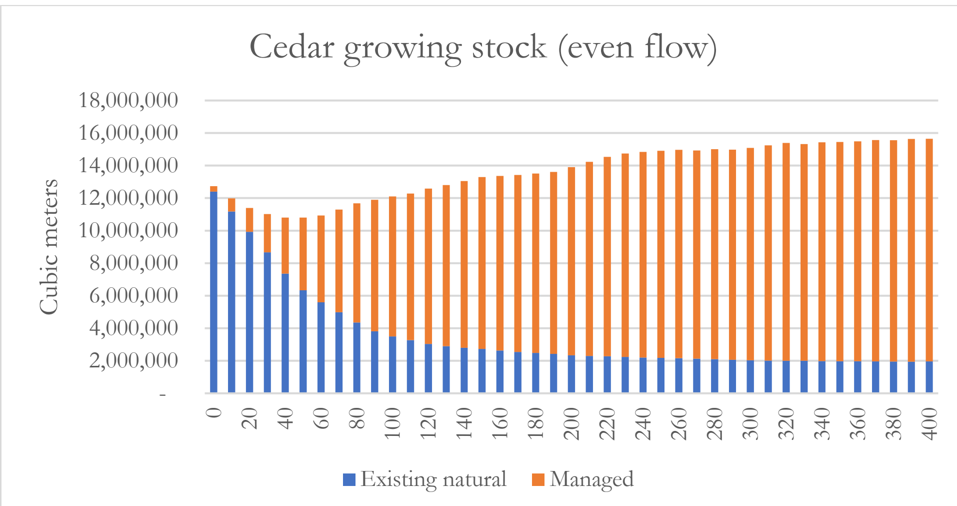

Figure 2.1.1.2. Growing stock for the Cedar even flow scenario.

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).

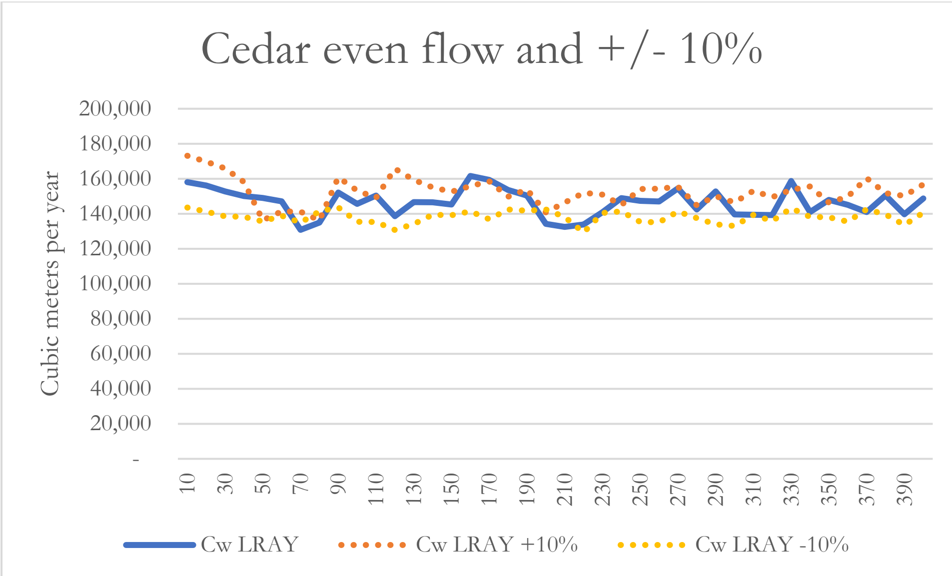

Figure 2.1.2. Cedar even flow (long run average yield~LRAY) compared with +/-10%

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.

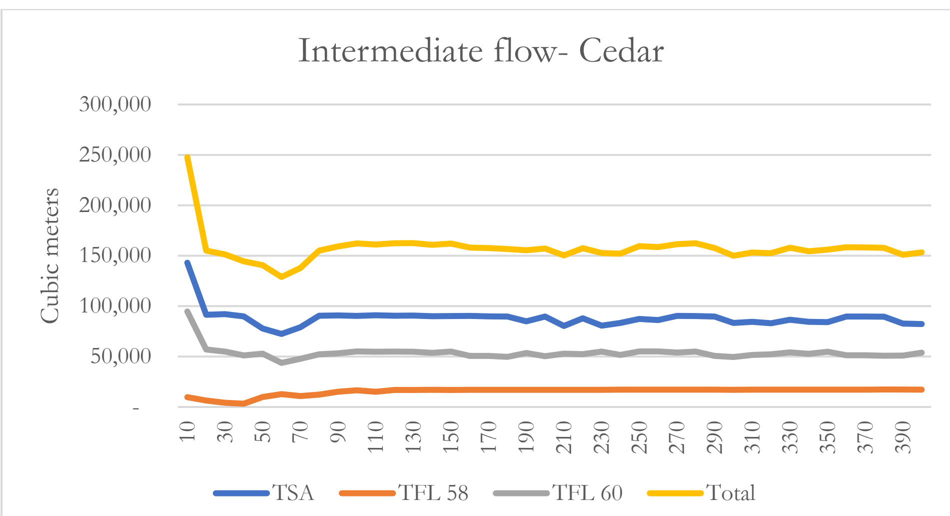

Figure 1.2.1.3. Harvest levels for cedar using an intermediate flow (starting between base case and even flow harvest levels).

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 m^3 or 14.1% decrease from the base case when these units were excluded from the THLB. Of this, 77,624 m^3 came from the Sewell Inlet and Peel Inlet operating areas, and 40,550 m^3 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.

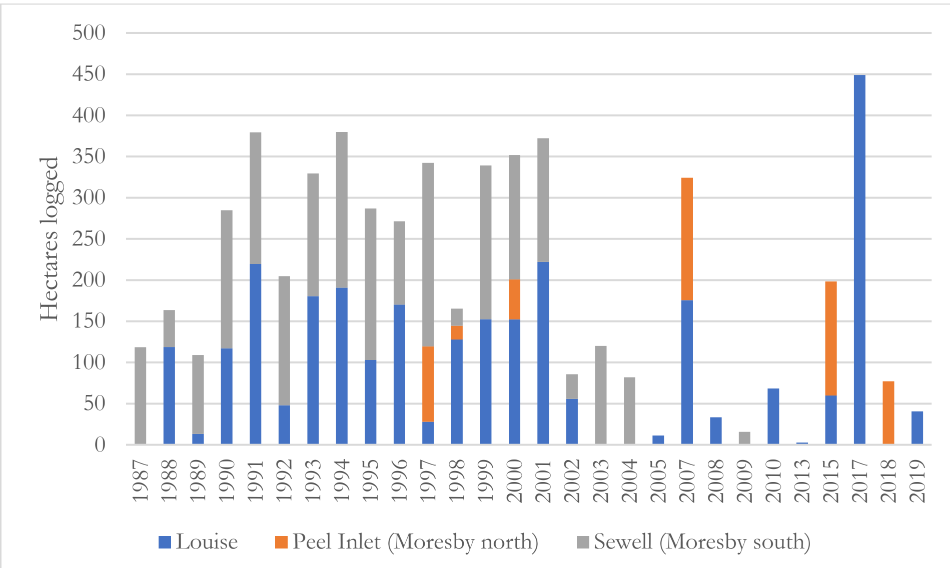

Figure 2.3.4. Area logged within isolated planning units (RESULTS)

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 25,800m^3 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 $350m^3$ for managed stands.

	Total	TSA	TFL58	TFL60
MHV 350	834,169	447,487	91,406	295,275

There was a 8,612 m^3 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 m^3/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 m^3 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 m^3 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 8,500m³ 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 m³ 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.

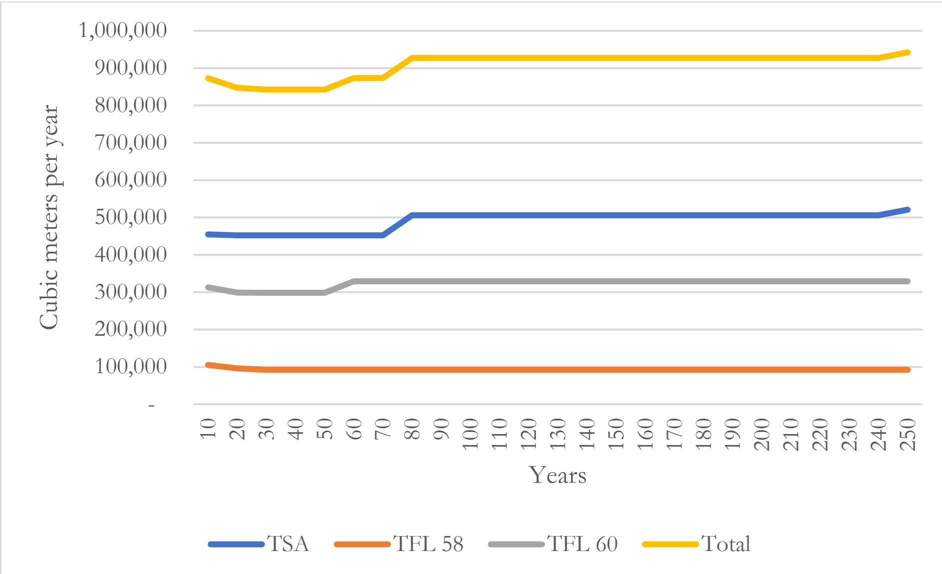

Figure 2.9.1 Long term harvest flow (declining) sensitivity results for all management units.

There was a 30,000 m³ 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 88,774m³ 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 21,550m³ 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.