

BRITISH COLUMBIA
MINISTRY OF FORESTS, LANDS,
NATURAL RESOURCE OPERATIONS AND RURAL
DEVELOPMENT

Tree Farm Licence 44

Rationale for
Allowable Annual Cut (AAC)
Partition

Effective December 8, 2020

Diane Nicholls, RPF
Chief Forester

Objective of this Document

This document provides an accounting of the factors I have considered and the rationale I have employed as Chief Forester of British Columbia (BC) in making my decision, under Section 8 of the *Forest Act*, of the amendment of the allowable annual cut (AAC) partitioning for Tree Farm Licence (TFL) 44.

Acknowledgement

For preparation of the information I have considered in this determination, I thank staff of the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (herein referred to as “the Ministry”) in the South Island Natural Resource District, West Coast Natural Resource Region and the Forest Analysis and Inventory Branch (FAIB). I am also grateful to the First Nations and licensees who have provided input.

Statutory Framework

Subsection 8(5) of the *Forest Act* states that the chief forester may, at any time, specify that portions of the allowable annual cut are attributable to one or more of the following:

- (a) different types of timber or terrain in different parts of Crown land within a timber supply area or tree farm licence area;
 - (a.1) different areas of Crown land within a timber supply area or tree farm licence area;

Subsection 8(5.1) states that the chief forester may, at any time, amend or cancel a specification made under subsection (5).

Specifications under the *Forest Act* Section 8(5)(a) are commonly referred to as AAC partitions.

Description of TFL 44

TFL 44 is located on west central Vancouver Island in the vicinity of the Alberni Inlet and Barkley Sound. It extends from Strathcona Park in the north to Walbran Creek in the south. The TFL area includes land ranging from the Pacific Ocean to the Beaufort Range and Mount Arrowsmith.

The TFL is held by TFL 44 Limited Partnership which is a partnership between Western Forest Products Inc. and Huu-ay-aht First Nation. The TFL is administered by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) South Island Natural Resource District.

At the time of this determination, TFL 44 occupies 141 566 hectares of land, of which 125 135 hectares are forested. The current timber harvesting land base (THLB) is 80 409 hectares, or 57 percent of the total TFL area. The forests of TFL 44 are mostly located within the wetter and very dry maritime Coastal Western Hemlock biogeoclimatic zone, and the dominant tree species are western hemlock, western redcedar, amabilis fir, Douglas-fir and yellow-cedar.

Communities within or adjacent to the TFL include Port Alberni, Bamfield, Anacla, Nitinat and Kildonan. While economic activities in and around these communities include aquaculture, commercial fishing, recreational fishing and tourism, forestry activities provide for the majority of employment in the area.

Allowable Annual Cut Determination

The last AAC determination for TFL 44 was made May 5, 2011, when the AAC was set to 800 000 cubic metres. There were no partitions set at that time.

The rationale for AAC determination for TFL 44 included the following implementation instructions:

- *Operational Adjustment Factors (OAFs)* - I expect the licence holder to develop OAF 1 and OAF 2 values that accurately reflect site occupancy, endemic pests and diseases, and decay, waste and breakage in managed stands in order to localize managed stand yield projections.
- *Monumental cedar* - I expect the licence holder to work with local First Nations regarding their needs for monumental cedar.

Further information, regarding the current AAC determination and implementation instructions, are described in the *Tree Farm Licence 44, Rationale for Allowable Annual Cut Determination* (Effective May 5, 2011).

On December 17, 2015, the AAC was reduced by 6400 cubic metres to account for *Forest Revitalization Act* order # 3(4) 27-4, which removed 797 hectares from the TFL. This resulted in the current AAC of 793 600 cubic metres.

The legislated deadline, for the next AAC determination for TFL 44, is May 5, 2021, which is 10 years from the previous determination. The licence holder has initiated the timber supply review process and is working with FLNRORD staff to prepare a timber supply analysis in support of the next AAC determination.

Reasons for Partition

TFL 44 Limited Partnership (the licence holder) requested that I consider establishing two AAC partitions in advance of the next AAC determination. The partitions are intended to ensure that harvesting is aligned with the timber profile of the economically operable land base, and the harvest of second-growth stands is within a sustainable level.

Following an economic operability evaluation of the TFL, concerns were raised by the licence holder regarding the economic harvest profile of the management unit. In 2020, the licence holder completed an economic analysis of the land base, using forest inventory data (including LiDAR) and current economic data. This analysis compared the modelled haul costs, estimated average phase costs and estimated timber value of projected harvest blocks in the TFL. Timber values were derived using current market prices and species-specific log sorts. Results of the

analysis showed that a significant component of the old-growth forest in the TFL, particularly in helicopter-operable areas, is uneconomic to harvest under current and foreseeable conditions.

The licence holder proposed that an AAC partition be implemented to ensure the future harvest profile matches the timber profile of the TFL, avoiding a disproportionate amount of the total AAC from being harvested from the economic land base.

The licence holder also expressed concerns regarding the potential overharvest of second-growth stands, as the expected transition from old-growth to second-growth harvesting approaches. Results of the timber supply analysis, that supported the 2011 AAC decision, indicate a timber supply shortfall 15 to 40 years from now, if the transition to second-growth harvesting occurs sooner than projected.

In April 2020, the licence holder made a presentation to me and Forest Analysis and Inventory Branch (FAIB) staff, which resulted in a request for further discussions and additional analysis. On May 4, 2020, the licence holder provided me with a memo that included the results of further analysis requested by the Ministry and clarification about the requested partition levels.

The analysis indicated that 29.1 percent of the merchantable growing stock volume in the TFL is potentially uneconomic to harvest due to the costs (associated with harvesting and transportation), which exceed the average market value of the timber for these stands. This growing stock was assumed to contribute to the timber supply when the AAC was last determined. The licence holder estimated, on a proportional basis, that 230 940 cubic metres of the current AAC (of 793 600 cubic metres) is attributed to the potentially uneconomic land base, and 562 660 cubic metres is attributed to economic land base.

The partition request for second-growth stands was also derived using a timber supply analysis completed by the licence holder. The analysis indicated that the current AAC could not be supported if more than 20 percent of short-term harvest was directed to stands classified as 61 to 120 years old in the revised forest inventory. From these results, the licence holder asserts that no more than 20 percent of the remaining AAC attributed as economic should be harvested from second growth without risking sustainability. The licence holder estimated, on a proportional basis, that a maximum of 112 530 cubic metres of the economic AAC of 562 660 cubic metres could be attributed to the second-growth growing stock.

In order to address uncertainties associated with the economic analysis, the partition values were adjusted downward by approximately five percent. The final partition levels recommended by the licence holder are: 535 000 cubic metres attributable to the economic land base, and 110 000 cubic metres attributable to second growth (stand age less than 121 years). These recommendations were confirmed by FAIB staff, using data from the Harvest Billing System (for the period from 2016 to 2020).

First Nations Consultation

The Crown maintains a duty to consult with, and accommodate (as necessary), those First Nations for whom it has knowledge of claimed Aboriginal Interests that may be impacted by a proposed decision, including strategic-level decisions such as AAC determinations.

Fifteen First Nations have traditional territories that overlap with TFL 44: Cowichan Tribes, Halalt First Nation, Lyackson First Nation, Penelakut Tribe, Stz'uminus First Nation, Ts'uubaa-asatx First Nation, Ditidaht First Nation, Huu-ay-aht First Nation, Toquaht First Nation, Uchucklesaht First Nation, Ka:'yu:'k't'h'/Che:k'tles7et'h', Ucluelet First Nation, Pacheedaht First Nation, Tseshah First Nation, and Hupacasath First Nation.

South Island Natural Resource District staff members initiated consultation through a letter sent to each of the First Nations on July 13, 2020. The letter provided background information on the AAC partition request and explained how the decision to amend the AAC with new partitions fits in the context of the ongoing TSR process for TFL 44. A request for further clarification was received from Stz'uminus First Nation, to which district staff responded by providing further information. The Pacheedaht First Nation responded stating no exception to the decision.

In reviewing the First Nations consultation process with district staff, I conclude that the First Nations, with territories overlapping TFL 44, were consulted in accordance with current provincial guidance and applicable case law. I am satisfied that consultations have been carried out in good faith and the Crown's process of seeking to understand potential impacts to First Nations values and interests was reasonable.

Determination

As chief forester, in making an AAC decision, I must determine a harvest rate that appropriately protects timber and non-timber values, sufficiently mitigates impacts to the constitutionally protected rights and title of Indigenous peoples, and respects public interests, while supporting the provincial and regional economies.

Having considered the information in '*Reasons for Partition*', I conclude that the requested partitions promote good stewardship of the TFL and protect the sustainability of the current AAC. I note that a partition placed on the economic land base will limit the rate of harvesting in high-productivity old-growth stands until such time as I determine a new AAC that reflects the new economic analysis. Therefore, I have determined that it is appropriate to amend the AAC for TFL 44 by establishing two new AAC partitions.

The total AAC for TFL 44 of 793 600 cubic metres per year remains in place and will not change until a new timber supply review is completed and a new AAC is determined. I specify, under Section 8(5)(a) of the *Forest Act*, the following geographic and timber profile partitions to the current AAC:

- 535 000 cubic metres of the AAC is attributed to the economic land base, spatially delineated in the *2020 Economic Analysis* for TFL 44; and,

- 110 000 cubic metres of the AAC is attributed to the economic land base in stands with an age less than 121 years, as indicated in the *2020 Economic Analysis* for TFL 44.

In the period following this decision and leading to the subsequent AAC determination, I expect Ministry staff and licensees to continue to complete the implementation instructions provided in the *2011 AAC Rationale*. These projects are important to reduce the risk and uncertainty associated with key factors that affect the timber supply.



Diane Nicholls, RPF
Chief Forester



December 8, 2020

**BRITISH COLUMBIA
MINISTRY OF FORESTS**

Tree Farm Licence 44

held by

Tsawak-qin Forestry Limited Partnership

Rationale for Allowable Annual Cut (AAC) Determination

Effective June 26, 2023

**Albert Nussbaum, RPF
Deputy Chief Forester**

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Objective of this document

This document provides an accounting of the factors I have considered and the rationale I have employed in making my determination, under Section 8 of the *Forest Act*, of the allowable annual cut (AAC) for Tree Farm Licence (TFL) 44. This document also identifies where new or better information is needed for incorporation in future determinations.

Acknowledgement

For preparation of the information I have considered in this determination, I am indebted to staff of the BC Ministry of Forests (the ‘Ministry’) in the South Island Natural Resource District (SINRD) and the Forest Analysis and Inventory Branch (FAIB). I am also grateful to the First Nations, local residents, individuals, and Tsawak-qin Forestry Limited Partnership who contributed to this process.

Statutory framework

Section 8 of the *Forest Act* requires the chief forester to consider a number of specified factors in determining AACs for Timber Supply Areas (TSAs) and TFLs. Section 8 of the *Forest Act* is reproduced in full as Appendix 1 of this document. For the purposes of this AAC determination in accordance with Section 23(3) of the *Interpretation Act* the deputy chief forester is expressly authorized to carry out the functions of the chief forester (including those required under Section 8 of the *Forest Act*).

Description of the TFL

TFL 44 is located in west-central Vancouver Island in the vicinity of the Alberni Inlet and Barkley Sound. It extends from Strathcona Park in the north to Walbran Creek in the south, including land from the Pacific Ocean to the Beaufort Range and Mount Arrowsmith covering a total of 136 900 hectares.

The forests of TFL 44 predominantly lie within the wetter and very dry maritime Coastal Western Hemlock biogeoclimatic zone. The major tree species include western hemlock, western redcedar, balsam (amabilis fir), Douglas-fir, and yellow-cedar. Annual precipitation levels reach 3,000 to 5,000 mm. At sea level, the climate is characterized by short winters with intermittent wet snowstorms. At the highest elevations a prolonged snowpack may persist. The summer period from July to September can be dry and warm.

The topography of TFL 44 is varied, with mountainous, steep formations dominating the landscape on the west side of the Alberni Inlet (Great Central Lake and Henderson Lake vicinities) and more rolling gentle terrain on the east side of the Alberni Inlet. The licence area is drained by numerous rivers and streams. Many streams support significant anadromous (migratory, such as salmon) and non-anadromous (resident, such as rainbow trout) fish populations. Large animals, notably Roosevelt elk and Columbia black-tailed deer are abundant throughout the licence area. Numerous other large and small animals, reptiles, amphibians, and birds can also be found.

The TFL 44 administrative boundary overlaps the traditional territories of the Maa-nulth First Nations, which include Huu-ay-aht First Nation, Ka:'yu:'k't'h'/Che:k'tles7et'h' First Nations, Toquaht Nation, Uchucklesaht Tribe, and Yuutu?il?ath First Nation. TFL 44 is also within the traditional territories of the following First Nations: Ahousaht First Nation, Cowichan Tribes, Ditidaht First Nation, Halalt First Nation, Hupačasath First Nation, Lyackson First Nation, Pacheedaht First Nation, Penelakut Tribe, Stz'uminus First Nation, Tseshah First Nation, and Ts'uubaa-asatx Nation (formerly Lake Cowichan).

Communities within or near TFL 44 include: Port Alberni, Bamfield, Anacla, and Nitinaht.

History of the AAC

Forest Management Licences (FMLs) No. 20 (Tofino) and No. 21 (Alberni) were originally awarded in 1955. FMLs were later renamed Tree Farm Licences (TFLs). TFL 44 was created in 1984 with the consolidation of TFL 20 and TFL 21. The licence holder has changed over time with successive corporate acquisitions and mergers.

In March 2019, the management of the TFL 44 changed from Western Forest Products Inc. (WFP) to TFL 44 Limited Partnership (TFL 44 LP). TFL 44 LP is a limited partnership between Huumiis Ventures Limited Partnership (Huumiis) and WFP. Huumiis is a limited partnership beneficially owned by Huu-ay-aht First Nations. In October 2021, TFL 44 LP changed its name to Tsawak-qin Forestry Limited Partnership (Tsawak-qin Forestry LP, or Tsawak-qin), to be referred to as Tsawak-qin throughout this document.

The notable changes in the timber supply analysis for TFL 44 since the last timber supply review include:

- In June 2010, a portion of TFL 44 (Sproat Lake and Nahmint) was deleted via the Instrument 50 in accordance with the *Forest Revitalization Act* Order 3(4)27-1 for the creation of a British Columbia Timber Sales' Operating Area.
- In July 2010, a portion of TFL 44 was deleted via Instrument 52 for the creation of the Huu-ay-aht Community Forest.
- In April 2014, a portion of TFL 44 was deleted via Instrument 53 for the Maa-Nulth First Nations' Final Agreement (treaty).
- In December 2015, a portion of TFL 44 was deleted via the *Forest Revitalization Act* Order 3(4)27-4 for the creation of the Hupacasath First Nations Woodland Licence.
- In October and December 2016, a portion of TFL 44 was deleted via the *Forest Act* Section 60.2 Order for the creation of the Thunderbird's Nest (T'iitsk'in Paawats) Protected Area.
- In March 2020, a portion of TFL 44 was deleted via Instrument 55 in the Malachan Block B parcel.
- Overall, there has been a reduction of the timber harvesting land base (THLB) from 80 409 hectares in the 2011 determination to 74 058 hectares currently.

On December 8, 2020, a geographic and timber profile partition came in effect, based on an economic analysis conducted by Tsawak-qin. Specifically, a spatially delineated economic operability dataset was supplied in the analysis for classifying the economic and uneconomic land base. Currently, 535 000 cubic metres per year of AAC is attributed to the economic land base, while 110 000 cubic metres per year of AAC is attributed to stands less than 121-year-old in the economic land base.

The current AAC of 793 600 cubic metres has been in effect since December 7, 2020.

New AAC determination

Effective June 26, 2023, the new AAC for TFL 44 will be 642 800 cubic metres. This AAC is approximately 19.0 percent lower than the AAC in place prior to this determination.

In making this AAC determination, I specify, under Section 8(5)(a) of the *Forest Act*, two partitions:

1. Economic land base: A maximum of 484 600 cubic metres per year, or 75 percent of the AAC, is attributable to the economic land base, spatially delineated in the 2022 economic analysis of TFL 44. The economic land base partition is to remain in place for a 10-year period.
2. Economic land base with a stand age less than 121 years: A maximum of 225 400 cubic metres per year (35 percent of the AAC) is attributable to the economic land base in stands with an age less than 121 years, as indicated in the 2022 economic analysis for TFL 44.

Although the partition for stands with a stand age less than 121 years is set for a period of 10 years, I will monitor and review harvest performance in the interim and evaluate the need to continue this partition five years following my AAC decision.

This AAC will remain in effect until a new AAC is determined, which must take place within 10 years of this determination. If additional significant new information is made available to me, or major changes occur in the management assumptions upon which I have predicated this decision, then I am prepared to revisit this determination sooner than the 10 years required by legislation.

Role and limitations of the technical information used

Section 8 of the *Forest Act* requires the chief forester, in determining AACs, to consider biophysical, social and economic information. Most of the technical information used in determinations is in the form of a timber supply analysis and its inputs related to inventory, growth and yield, and management. The factors used as inputs to timber supply analysis have differing levels of uncertainty associated with them, due in part to variation in physical, biological and social conditions. The AAC determination is a strategic-level decision for which the Crown maintains a duty to consult and accommodate, as necessary, those First Nations for whom it has knowledge of claimed Aboriginal Interests that may be impacted by a proposed decision. The chief forester must consider the information provided by First Nations through engagement and the consultation process.

Computer models cannot incorporate all the social, cultural, and economic factors that are relevant when making forest management decisions. Technical information and analysis, therefore, do not necessarily provide the complete answers or solutions to forest management issues that must be considered when making decisions such as AAC determinations. Such information does provide valuable insight into potential impacts of different uncertainties about or changes to resource information and management practices, and thus forms an important component of the information I must consider in AAC determinations.

In determining this AAC, I have considered the technical information provided, including any known limitations.

Guiding principles for AAC determinations

Given the substantial number of periodic AAC determinations required for BC's many forest management units, administrative fairness requires a reasonable degree of consistency of approach in addressing relevant factors associated with AAC determinations. In order to make my approach in these matters explicit, I have considered and adopted the following body of guiding principles, which have been developed over time by BC's chief foresters and deputy chief foresters. However, in any specific circumstance in a determination where I consider it necessary to deviate from these principles, I will explain my reasoning in detail.

When considering the factors required under Section 8, I am also aware of my obligation as a steward of the forests of British Columbia, of the mandate of the Ministry of Forests ("the Ministry") as set out in Section 4 of the *Ministry of Forests and Range Act*, and of my responsibilities under the *Forest Act*, *Forest and Range Practices Act* (FRPA), and the *Professional Governance Act*.

AAC determinations should not be construed as limiting the Crown's obligations under court decisions in any way, and in this respect, it should be noted that AAC determinations do not prescribe a particular plan of harvesting activity within the management units. They are also independent of any decisions by the Minister of Forests with respect to subsequent allocation of timber supply.

These guiding principles establish a framework for AAC decision-making with consideration to the following: advancing reconciliation with Indigenous people; responding to uncertainties; the incorporation of forest landscape planning information (including any legal orders associated with forest management), cumulative effects, and climate change.

Reconciliation with Indigenous people

The Government of BC has committed to true and lasting reconciliation with Indigenous people. The *Declaration on the Rights of Indigenous Peoples Act* of 2019 (the '*Declaration Act*') creates the path forward for aligning provincial laws with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Recognizing that reconciliation and changes to policies, programs, and legislation take time, any interim processes undertaken for AAC determinations should be responsive to the information and issues raised by Indigenous people to the extent possible within the existing legislative framework for AAC determinations. Interim collaborative engagement processes will seek to move beyond the legal duty to consult, align with relevant agreements between First Nations and the Province (including commitments regarding stewardship or resource management), promote capacity building within Indigenous communities, and provide a clear and transparent understanding of the decision-making process.

Where the nature, scope and geographic extent of Aboriginal rights and title have not been established, the Province has a constitutional obligation to consult with First Nations in a manner proportional to the strength of any claimed Aboriginal rights (including title) and the degree to which they may be affected by the decision. The Province also has an obligation to consult with First Nations regarding their treaty rights. In this regard, when making an AAC determination I will give consideration to the following information:

- (i) information provided to First Nations to explain the timber supply review process and analysis results;
- (ii) information, including Indigenous Knowledge, brought forward through consultation or a collaborative engagement process with respect to Aboriginal Interests, and how these interests may be impacted by an AAC decision;
- (iii) any strategic level plans, operational plans, or management information that describe how Aboriginal Interests are addressed through specific actions and forest practices;

- (iv) existing relevant agreements and policies between First Nations and the Province; and,
- (v) other information regarding the potential impact of an AAC decision on the ability of Indigenous communities to meaningful exercise of Section 35 rights as recognized in the *Constitution Act* (1982), such as information about cumulative effects.

Aboriginal Interests that may be impacted by AAC decisions will be addressed consistent with the scope of authority granted to the chief forester under Section 8 of the *Forest Act*, and with consultation obligations defined in court decisions. When information is brought forward that is outside of the chief forester's scope of statutory authority, this information will be forwarded to the appropriate decision makers for their consideration. Specific considerations identified by First Nations in relation to their Aboriginal Interests that could have implications for the AAC determination are addressed in the various sections of this rationale where it is within the statutory scope of the determination.

The timber on established Aboriginal title lands (meaning Aboriginal title declared by a court or defined under an agreement with necessary federal and provincial implementation legislation), Treaty Settlement Lands or Indian Reserves, is no longer provincial timber. Consequently, it does not contribute to the AAC of the management unit overlapped by those lands. Prior to establishment of Aboriginal title, it is not appropriate for the chief forester to speculate on how potential establishment of Aboriginal title in an area could affect timber supply, given uncertainties about the scope, nature and geographic extent of title. Unless land has been established to be Aboriginal title land, Treaty Settlement Land or reserve land it remains as provincial land managed by the Province and will contribute to timber supply. However, where there is clear intent by government to recognize lands as title land that are yet to be finalized, I will consider information that is relevant to the decision in a manner that is appropriate to the circumstances. The requirement for regular AAC reviews will ensure that future determinations address ongoing changes to the land base.

Information uncertainty

Given the complex and dynamic nature of forest ecosystems coupled with changes in resource use patterns and social priorities there is always a degree of uncertainty in the information used in AAC determinations. The following are two ways of addressing they uncertainty of information available to support an AAC determination:

- (i) undertaking analyses to evaluate the significance of uncertainties associated with available information and assessing the social, economic, and environmental risks associated with a range of possible decisions; and,
- (ii) re-determining AACs regularly to ensure they incorporate current information and knowledge, and greater frequency in cases where projections of short-term timber supply are not stable and/or substantial changes in information and management are occurring.

In considering the several factors that Section 8 of the *Forest Act* requires the chief forester to take into account in determining AACs, it is important to reflect those factors that (as closely as possible) are a reasonable extrapolation of current practices. It is not appropriate to base decisions on proposed or potential practices that could affect the timber supply but are not consistent with legislative requirements and not substantiated by demonstrated performance.

It is not appropriate to speculate on timber supply impacts that may eventually result from land-use designations not yet finalized by government. Where specific protected areas, conservancies, or similar areas have been designated by legislation or by order in council, these areas are deducted from the timber harvesting land base (THLB) and are not considered to contribute harvestable volume to the timber supply in AAC determinations, although they may

contribute indirectly by providing forest cover that helps meet resource management objectives such as biodiversity.

Where appropriate, the chief forester will consider information regarding the types and extent of planned and implemented silviculture practices as well as relevant scientific, empirical and analytical evidence on the likely magnitude and timing of their timber supply effects.

I acknowledge the perspective that an alternative strategy for dealing with information uncertainty is to generally reduce AACs in the interest of caution. On its own, this precautionary approach is not a complete framework for decision making under uncertainty. It is one tool that could be used to address the risk of serious harms in situations of deep uncertainty or significant deficiencies in information. However, the precautionary approach does not consider the full spectrum of values or extensive range of research and information utilized by the chief forester. For these reasons, AAC determinations more appropriately follow a decision process utilizing analyses of current land and management practices and the exploration of the potential effects of uncertainties, rather than relying on an overriding precautionary approach.

In making a determination, allowances may need to be made to address risks that arise because of uncertainty by applying judgment as to how the available information is used. Where appropriate, the social and economic interests of the government, as articulated by the Minister of Forests, can assist me in evaluating this uncertainty.

Forest landscape planning

In addressing the factors outlined in Section 8 of the *Forest Act*, I will consider relevant available information on timber and non-timber resources in the management unit, including information on the interactions among those resources and the implication for a sustainable timber supply.

AAC determinations will be made in the context of new forest landscape plans and legal orders that establish forest management expectations. These plans and orders direct forestry activities and guide the stewardship of BC's public land and resources, have been established with an understanding of the relationships among the various components of forest management systems, and follow deliberative processes and laws designed to achieve a balance of natural resources values and benefits.

As is the case for land use and management planning in general, it is beyond my statutory authority to speculate on final outcomes where there are preliminary but not yet finalized and formalized land use zones or management objectives. If the timber supply implications of final designations are substantial, application of the Allowable Annual Cut Administration Regulation to reduce a management unit AAC between Section 8 determinations, or a new AAC determination prior to the legislated deadline may be warranted.

In some cases, even when government has made a formal land-use decision, it is not necessarily possible to fully analyze and immediately account for the consequent timber supply impacts in an AAC determination. Many of government's land-use decisions must be followed by detailed implementation decisions requiring, for instance, further planning or legislated designations such as those provided for under the *Land Act* and *Forest and Range Practices Act* (FRPA). In cases where government has been clear about the manner in which it intends land-use decisions to be implemented, but the implementation details have yet to be finalized, I will consider information that is relevant to the AAC in a manner that is appropriate to the circumstance. The requirement for regular AAC reviews will ensure that future determinations address ongoing plan implementation decisions.

Cumulative effects

Cumulative effects (CE) are changes to environmental, social and economic values caused by the combined effect of past, present and potential future human activities and natural processes. In the context of AAC determinations, I am aware of the mandate provided by the Minister of Forests (FOR) which tells me to ensure that my AAC determinations continue to incorporate the best available information on the CE of multiple activities on the land base. Where the CE of timber harvesting and other land-based activities indicate a risk to natural resource values, my determinations should identify those risks for consideration in land-use planning. I am also asked to consider ways in which my AAC determinations could encourage actions or practices to mitigate risks to natural resource values.

Section 8 of the *Forest Act* only authorizes the chief forester to make decisions on allowable harvest levels, not to change or institute new management regimes for which other statutory decision makers have specific authority. However, cumulative effects information can highlight important issues and uncertainties in need of resolution through land use planning which I can note and refer to those responsible for such planning.

Where a cumulative effects assessment has suggested that an important value is at risk and that a reduced harvest level or implementation of an AAC partition could help to reduce that risk, I will appropriately factor these into my AAC determination. I may also identify actions or implementation instructions that would mitigate risk or accommodate potential impacts to Aboriginal Interests. In this case, I will include expectations that Ministry staff work with relevant interests to address the issues identified and encourage forest licensees to follow the recommendations of CE assessments.

As with all management issues, additional information and any changes can be incorporated into subsequent AAC determinations.

Climate change

One key area of uncertainty relates to climate change. There is substantial scientific agreement that climate is changing and that the changes will affect forest ecosystems. Forest management practices will need to be adapted to the changes and can contribute to climate change mitigation by promoting carbon uptake and storage. The potential rate, amount, and specific characteristics of climate change in different parts of the province are uncertain. This uncertainty means that it is not possible to confidently predict the specific, quantitative impacts on timber supply.

When determining AACs, I consider available information on climate trends, potential impacts to forest ecosystems and communities that depend on forests and related values, and potential management responses. As research provides substantiated predictions on climate change and its effects, I will incorporate the new information in future AAC determinations. Where forest practices are implemented to mitigate or adapt to the potential effects of climate change on forest resources, or where monitoring information indicates definite trends in forest growth and other dynamics, I will consider that information in my determinations.

I note, however, that even with better information on climate change, in many cases there will be a range of reasonable management responses. For example, it is not clear if either increases or decreases to current harvest levels would be appropriate in addressing potential future increases in natural disturbance due to climate change, which are likely in some areas. Hypothetically, focused harvests in at-risk forests could forestall losses of timber and allow for planting of stands better adapted to future conditions. Conversely, lower harvest levels and the use of partitions in my AAC decisions could provide buffers against uncertainty. The appropriate mix of timber supply management approaches is ultimately a social decision.

Due to the uncertainty surrounding impacts on the AAC from climate change, it is important to encourage dialogue to develop climate change mitigation and adaption strategies and remain open to new opportunities for forest management. Deciding on the preferred management approach will involve consideration of established climate change strategies, and available adaptation and mitigation options together with social, economic, cultural, and environmental objectives. The timber supply analysis is a useful tool to determine the potential changes to the frequency, intensity, and scope of natural disturbances under climate change; and for exploring options and trade-offs. Any management decisions about the appropriate approach and associated practices will be incorporated into future AAC determinations. The requirement for regular AAC reviews will ensure continuous improvement of the information and knowledge on climate change and ensure the development of a responsive decision-making process to emerging natural resources issues.

The role of the base case

In considering the factors required under Section 8 of the *Forest Act* to be addressed in AAC determinations, I am assisted by timber supply forecasts provided to me through the work of the Timber Supply Review (TSR) program for TSAs and TFLs.

For most AAC determinations, a timber supply analysis is carried out using an information package including data and information from three categories: land base inventory, timber growth and yield, and management practices. Using this set of data and a computer simulation model, a series of timber supply forecasts can be produced, reflecting different starting harvest levels, rates of decline or increase, and potential trade-offs between short- and long-term harvest levels.

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

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

Therefore, much of what follows in the considerations outlined below is an examination of the degree to which all the assumptions made in generating the base case forecast are realistic and current, and the degree to which any adjustments to its projections of timber supply must be made, if necessary, to more properly reflect the current situation.

These adjustments are made on the basis of informed judgment using currently available information about forest management, and that information may well have changed since the original information package was assembled. Forest management data are particularly subject to change during periods of legislative or regulatory change, or during the implementation of new policies, procedures, guidelines or plans.

Thus, in reviewing the considerations that lead to the AAC determination, it is important to remember that the AAC determination itself is not simply a calculation. Even though the timber supply analysis I am provided is integral to those considerations, the AAC determination is a synthesis of judgment and analysis in which numerous risks and uncertainties are weighed. Depending upon the outcome of these considerations, the AAC determined may, or may not, coincide with the base case. Judgments that in part may be based on uncertain information are essentially qualitative in nature and, as such, are subject to an element of risk. Consequently,

once an AAC has been determined, no additional precision or validation would be gained by attempting a computer analysis of the combined considerations.

Base case for TFL 44

The timber supply analysis for TFL 44 was prepared by Tsawak-qin as part of the *Tree Farm Licence 44 Management Plan #6*. The modelling software used for the analysis was Patchworks™ which has been approved by FAIB for use in timber supply reviews. Patchworks is a spatially explicit forest estate model used to project timber harvesting activities following current management practices including objectives for non-timber values such as biodiversity, wildlife habitat, cultural heritage resources, recreation, and visual quality. Based on the review by Ministry staff, as well as my own experience reviewing results from similar models, I am satisfied that Patchworks can provide an appropriate projection of timber supply.

Harvest flow objectives in the base case were set to achieve the maximum long-term timber supply, while maintaining other values on the land base. The timber supply forecast attempted to achieve the long-term harvest potential and minimize the rate of change during the transition from the current level of harvest to the mid- and long-term sustainable levels.

The base case begins in 2020 and the harvest levels are reported for 300 years. An initial harvest level of 715 200 cubic metres per year is sustained for five years before declining to 678 900 cubic metres per year for a second five-year period. Since my AAC determination may remain in effect for 10 years, I will use the 10-years average harvest level from the projection, 697 000 cubic metres per year, as the basis for my determination. I note that this level is 12.2 percent lower than the AAC that was in place prior to my determination.

The projected harvest level declines on average 5.1 percent per five-year period over the following 15 years, reaching 612 000 cubic metres per year through to 2039. The harvest level stays at this rate for 40 years, before increasing to a long-term harvest level estimate of approximately 738 700 cubic metres per year.

In my determination, I have also considered several sensitivity analyses. A sensitivity analysis examines how changes in base case assumptions affect the projected timber supply. These analyses have been helpful as I made specific considerations and reasoning in my determination as documented in the following sections. I am satisfied that the base case, and the other analyses as noted and described, represent the best information available to me respecting various aspects of the current projection of the timber supply in this TFL, and as such they are suitable for reference in my considerations in this determination.

Consideration of factors as required by Section 8(8) of the *Forest Act*

I have reviewed the information for all of the factors required to be considered under Section 8 of the *Forest Act*. Where I have concluded that the modelling of a factor in the base case is a reasonable reflection of current legal requirements, demonstrated forest management and the best available information, and uncertainties about the factor have little influence on the timber supply projected in the base case, no discussion is included in this rationale. These factors are listed in Table 1.

Table 1. List of accepted factors

<i>Forest Act</i> section and description	Factors accepted as modelled
8(8)(a)(i) the composition of the forest and its expected rate of growth on the area	• <i>Non-forest and non-productive forest</i> • <i>Low productivity sites</i> • <i>Economic operability</i> • <i>Riparian management areas</i> • <i>Ungulate winter ranges</i> • <i>Old growth management areas</i> • <i>Deciduous-leading stands</i> • <i>Recreation features</i> • <i>Existing stand-level reserves</i> • <i>Terrain stability</i> • <i>Caves and karst</i> • <i>Volume estimates for natural stands</i> • <i>Site productivity estimates</i>
8(8)(a)(ii) the expected time that it will take the forest to become re-established following denudation	• <i>Genetic gain</i> • <i>Fertilization</i> • <i>Non-satisfactorily restocked areas</i> • <i>Regeneration assumptions</i>
8(8)(a)(iii) silviculture treatments to be applied to the area	• <i>Silviculture systems</i>
8(8)(a)(iv) the standard of timber utilization and the allowance for decay, waste, and breakage expected to be applied with respect to timber harvesting on the area	• <i>Timber utilization standards</i> • <i>Decay, waste, and breakage for unmanaged stands</i> • <i>Deciduous volume</i>
8(8)(a)(v) constraints on the amount of timber produced by use of the area for purposes other than timber production	• <i>Higher level plans</i> • <i>Maximum cutblock size and adjacency</i> • <i>Research sites</i> • <i>Fisheries sensitive watersheds</i>
8(8)(a)(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber	
8(8)(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area	• <i>Alternative rates of timber harvesting</i>
8(8)(d) Economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia	• <i>Summary of public input</i> • <i>Reference to Minister's letter</i>
8(8)(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area	• <i>Non-recoverable losses</i>

For other factors, where more uncertainty exists or where public or First Nations' input indicates contention regarding the information used, modelling, or some other aspect under consideration, this rationale incorporates an explanation of how I considered the essential issues raised and the reasoning that led to my conclusions.

Forest Act Section 8 (8)

In determining an allowable annual cut under this section the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area

Land base contributing to the timber harvest

- general comments

The timber harvesting land base (THLB) is an estimate of the land where timber harvesting is considered both available and economically feasible, given the objectives for all relevant forest values, existing timber quality, market values and applicable technology. It is a strategic-level estimate developed specifically for the timber supply analysis and as such could include some areas that may never be harvested or could exclude some areas that may be harvested.

The total area of TFL 44 is 136 900 hectares of which 120 970 hectares are classified as productive forest. It is estimated that 74 058 hectares which can support the economic harvest of timber. The THLB is approximately 54 percent of the land base of TFL 44.

Forest composition and growth

- forest inventory

Three different forest inventories were included in the TFL 44 analysis, Forest Cover (FC), Vegetation Resource Inventory (VRI), and Light Detection and Ranging (LiDAR) individual tree inventory (ITI). The base case analysis for the TFL 44 utilized the FC inventory updated for harvesting, silviculture activities, and survey results to December 31, 2019. The FC inventory is maintained by Tsawak-qin and was first completed for TFL 44 in 1956. Since then, it has been maintained and improved by new cruises of both mature and immature forest.

VRI is a photo-based, two-phased vegetation inventory design consisting of photo interpretation and ground sampling. A VRI Phase I photo interpretation update project was initiated in 2014 for the South Island Forest District. Aerial photo imagery was acquired by the Ministry of Forests for Crown land, including TFL 44. Subsequently, photo interpretations were conducted to re-delineate stand boundary and the associated attribute information. The updates were gradually incorporated into the Provincial VRI dataset. To date there has not been a VRI Phase II ground sampling adjustment project completed.

The licensee has invested in LiDAR data to improve the strategic inventory for TFL 44. LiDAR is a remote sensing technology that utilizes pulsed laser light to collect very detailed information about forest structures and key attributes. In addition to the conventional bare earth (Hillshade) dataset and canopy height model (CHM), WFP's LiDAR research and development efforts have also been extended to the creation of an ITI.

Tsawak-qin Forestry conducted a study to test the difference and relative accuracy of the three inventories utilized in the TFL 44 analysis. The inventory datasets were evaluated using both cruise plot and harvest data for 101 blocks that were cruised after the licensee's LiDAR acquisition in 2016. The study found that VRI was the least accurate inventory dataset of the three tested using both cruise and harvest data. VRI consistently underestimated volume across

the range of forest ages and was consistently the least accurate at determining species composition. FC was generally accurate at predicting volume, however the accuracy varied by age class. It underpredicted volume in stands less than 120 years of age and overpredicted in stands greater than 119 years of age. As a result, FC volume estimates were generally less precise than VRI, indicating that while the results should be more accurate at a land base scale, at the stand level accuracy is likely to be mixed. The ITI significantly underestimated volume, particularly in stands greater than 119 years of age. Nevertheless, it was the most precise estimator of volume and the most accurate predictor of species composition. Tsawak-qin acknowledged that cutblock data used in the study only reflects economically operable stands that meet the operable harvest criteria in TFL 44.

I note that there is uncertainty with all three inventory methods utilized in the analysis and that the study conducted by Tsawak-qin was based on a biased sample. While I am encouraged to see the use of LiDAR in the analysis, I note that there needs to be increased validation and ground truthing. The Inventory Section of FAIB completed a general review of the ITI methodology provided by Tsawak-qin and noted an insufficient sample size, a limited range of stand volumes for comparison, and overall lack of peer review research. As there has not been a VRI Phase II ground sample audit it is difficult to know the accuracy of the VRI inventory. As summarized under **'Implementation'** I ask Tsawak-qin to carry out a random inventory sample of TFL 44 and use it to validate the inventory that is intended to be used in the next timber supply review.

While I have determined that the FC is the best available inventory to use in the analysis, it overestimates volume in stands greater than 119 years of age, and the timber supply is dependent on these mature stands over the next 10 years. Therefore, I conclude that there is an unquantified downward pressure in the short-term timber supply, which I will discuss further under **'Reasons for Decision'**.

- existing and future roads

In the base case analysis classified roads were spatially identified and removed from the land base contributing to timber supply using LiDAR. The total buffer widths used in the base case varied by road type as follows: highways, forest service roads, mainlines 11 metres, spurs, and unclassified roads 3 metres, and powerlines 15 metres. The existing road buffers were based on the proportion of the 20-metre-wide sample buffer that is occupied by vegetation less than 10 metres in height. A total area of 1592 hectares was removed from the base case analysis land base for existing roads.

An estimate of the forest area that will eventually be removed from production due to future roads was conducted by Tsawak-qin. Utilizing LiDAR data, a physical operability inventory for TFL 44 was updated and the projection of future roads to develop conventional harvest opportunities was completed. A total of 203 hectares was removed from the base case analysis to account for future roads.

I recognize the work completed by Tsawak-qin to utilize LIDAR to estimate road widths, but I note that the analysis was a LiDAR and GIS exercise and was not supported by field sampling or statistical validation. As summarized under **'Implementation'** I ask Tsawak-qin to calibrate their LiDAR road width estimates through a ground sampling program as additional validation of the species composition and the deciduous and sub-merchantable component within the road buffer area is needed. Until LiDAR road widths are validated with ground sampling and statistical validation, it is prudent to use the road widths that were utilized in the previous Management Plan #5. The road buffer widths in Management Plan #5 were as follows: super mainlines 30 metres, mainlines 15 metres, and all other road types 11 metres. Utilizing the previous analysis buffer road widths results in a one percent overestimate in short-term timber

supply for existing roads and 0.2 percent overestimate in the mid- to long-term timber supply for future roads as discussed under '**Reasons for Decision**'.

- physical operability

The amount of productive forest land that is economically accessible by forestry operators using conventional and non-conventional harvesting systems is a key consideration in determining the available timber supply for TFL 44. LiDAR was utilized to classify the land base as conventional, non-conventional, and inoperable. Conventional areas are accessible by ground and cable based harvesting systems, while non-conventional areas are suitable for helicopter logging. Inoperable areas were identified based on safety considerations, operational performance, environmental sensitivity, and local knowledge.

When operational planning is conducted adjacent to federal and provincial parks, harvest units are developed with consideration given to protecting these features. To safeguard parks, a 30 metre harvest buffer (approximately one tree length) is operationally applied, allowing for wind throw mitigation treatments to occur and the removal of danger trees outside of the net harvest area for safety purposes. The base case analysis did not account for this current management practice, resulting in a 1.8 percent overestimate of the timber supply as discussed under '**Reasons for Decision**'.

- cultural heritage resources

A cultural heritage resource (CHR) is defined under the *Forest Act* as “an object, site or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people”. CHRs include, but are not limited to, archaeological sites and traditional use sites. Culturally modified trees (CMTs) are the most common CHR feature found within TFL 44. An archaeological overview assessment (AOA) was completed for TFL 44 in 2008 and 2009 and is utilized to identify and assess archaeological resource potential with particular attention to sites that contain CMTs. Once potential archaeological sites have been field verified, they are protected and recorded in the Remote Access to Archaeological Data (RAAD) online GIS application. A total area of 120 hectares were identified as archaeological sites registered in RAAD, this includes 99 hectares within the THLB, which was excluded from the base case.

On March 14, 2013, a Government Actions Regulation (GAR) Order was established to designate the Thunder Mountain area as a CHR – resource feature. Thunder Mountain is the focus of a traditional use by an Indigenous people and is not regulated by the *Heritage Conservation Act*, requiring special management that is not otherwise provided by the *Heritage Conservation Act* or other enactment. There are 847 hectares overlapping Thunder Mountain within TFL 44, including 667 hectares that are within the THLB. Despite this area being legislatively defined as part of the Crown forest, no timber harvesting has taken place since the GAR Order was established in 2013. Given the cultural significance of the area and the fact that no timber harvesting is taking place, Thunder Mountain is practically not contributing to the timber supply. Removing the harvest contribution from Thunder Mountain reduces the base case timber supply by 3.8 percent, as discussed further in my '**Reasons for Decision**'. As noted under '**Implementation**' I expect Tsawak-qin to work with First Nations and Ministry staff to monitor harvest performance in the Thunder Mountain GAR Order area. I will evaluate the harvest performance, and if necessary, consider further adjustment to the AAC for the next determination.

The Ditidaht First Nation is engaging with the Government of British Columbia in the British Columbia treaty process. Negotiations are currently at Stage 5 and an Agreement-In-Principle (AIP) Offer Lands area has been identified within their territory. The AIP area overlap with TFL 44 is 1621 hectares, of which 1017 hectares are classified as THLB. I note that the AIP is

not yet approved by the respective parties, and I will not be making any reductions to the AAC at this time. If the timber supply implications of the final treaty negotiation lands are substantial, application of the Allowable Annual Cut Administration Regulation to reduce the TFL 44 AAC between Section 8 determinations may be warranted.

- future stand-level reserves

Managing for stand-level biodiversity provides important structural attributes in managed stands such as coarse woody debris, tree species diversity, and wildlife trees. Future wildlife tree retention area (WTRA) targets are specified in the *Notice of Order Establishing Land Use Objectives* for the Renfrew area on Southern Vancouver Island, covering the Caycuse, Nitinat, and Walbran landscape units. Retention targets for the other landscape units within TFL 44 are specified through the Forest and Range Practices Regulation (FPPR), which states the minimum wildlife tree retention target of seven percent. Operationally, Tsawak-qin follows the Western Forest Products Stewardship and Conservation Plan (WSCP). The WSCP details the objectives for the retention silviculture systems, which represents approximately 59 percent of all harvest units in the TFL, with the remaining area being clearcut or clearcut with reserves.

Tsawak-qin identified an error in the base case analysis where only the WSCP portion of the retention requirement and not the FPPR WTRA retention requirements were applied in the land base netdown process. This results in a 0.6 percent overestimation in timber supply as discussed under '**Reasons for Decision**'.

- dead potential volume – 2006 coastal log grade changes

In 2006 the Ministry of Forests released a report titled *Summary of Dead Potential Volume Estimates for Management Units within the Coast Forest Region*. Data sources for the report came from inventory audit plots, VRI Phase II ground samples, permanent sample plots, and temporary sample plots. The base case analysis for TFL 44 did not account for dead potential volume, as growth and yield projections do not account for the volume of dead trees that could potentially be used as sawlogs.

Based on 59 plots within the Strathcona TSA, dead potential volume could be up to 6.3 percent of the green volume for the forested land base over 60 years of age within TFL 44. FAIB staff expect the sampling error around dead potential to be higher than 15 percent and indicate that the 6.3 percent represents the maximum amount of volume from dead timber but does not consider the utilization of the volume.

Due to sampling error and uncertainty around this volume, I have decided that the dead potential volume will be prorated to only include western redcedar, which comprises 18 percent of the total volume within TFL 44. Western redcedar is rot resistant and I consider that this volume is likely economical to harvest. Accounting for western redcedar dead potential volume results in a one percent underestimation in timber supply and I will discuss this further in '**Reasons for Decision**'. If endemic dead volume is utilized from other species, it will result in incremental timber supply that I did not include in my analysis and will generate a more robust timber supply.

- volume estimates for managed stands

Managed stands are those for which forest management treatments (e.g., planting, spacing) are implemented to improve the regeneration and growth of the stand. The Table Interpolation Program for Stand Yields (TIPSY 4.4) model was used to project the growth and yield of each individual managed stand in TFL 44.

All TIPSy projections of volume yields for managed stands are initially based on ideal conditions, assuming full site occupancy and the absence of pests, diseases, and significant brush competition. However, certain operational conditions, such as a less-than-ideal distribution of trees, the presence of small non-productive areas, endemic pests and diseases, or age-dependent factors such as decay, waste and breakage, may cause yields to be reduced over time. Two operational adjustment factors (OAFs) are therefore applied to yields generated using TIPSy, to account for losses of timber volume resulting from these operational conditions. OAF 1 is designed to account for factors affecting the yield curve across all ages, including small stand openings, uneven tree distribution, endemic pests, and other factors. OAF 2 accounts for factors whose impacts tend to increase over time such as decay, and waste and breakage.

In the 2011 AAC determination Chief Forester Jim Snetsinger recommended that the licensee “Develop OAF 1 and OAF 2 values that accurately reflect site occupancy, endemic pests and diseases, and decay, waste and breakage in managed stands in order to localize TIPSy yield projections”. To address the chief forester’s concerns, Tsawak-qin utilized LiDAR to undertake an analysis quantifying gaps in crown cover and non-productive areas within stands. Based on this analysis an OAF 1 value of 10.9 percent was used in the base case. The base case applied the provincial standard OAF 2 value of five percent.

A sensitivity analysis was completed using the provincial standard OAF 1 value of 15 percent. Using an OAF 1 value of 15 percent decreased the short-term timber by 3.9 percent. Without local field data, such as the data acquired through the Young Stand Monitoring program or similar studies, the default OAF 1 value is the best available information. I note that LiDAR can provide a detailed understanding of site occupancy and that validation over time will help improve OAF values. However, I recognize the need to better quantify the impact of active forest health issues on managed stand yields. Until uncertainty is reduced with the LiDAR derived OAF 1 value applied in the base case, I conclude that the provincial OAF 1 value of 15 percent represents the best available information. This results in a 3.9 percent overestimation in timber supply as discussed under ‘Reasons for Decision’.

Section 8(8)(a)(ii) the expected time that it will take the forest to become re-established on the area following denudation

As noted in Table 1, I have considered factors related to genetic gain, fertilization, non-satisfactorily restocked areas, and regeneration assumptions and I find them to have been appropriately accounted for in the base case, with no further comment required.

Section 8(8)(a)(iii) silviculture treatments to be applied to the area

As noted in Table 1, I have considered a factor related to silviculture assumptions and I find it to have been appropriately accounted for in the base case, with no further comment required.

Section 8(8)(a)(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area

- minimum harvestable criteria

Minimum harvestable criteria are used to define the age at which existing and future managed stands become merchantable and available for harvest. Most stands will not be harvested until well past the minimum criteria in order to meet forest level objectives where different resource values take precedence such as old forest retention for biodiversity.

The base case minimum harvestable criteria for TFL 44 used ages corresponding with the minimum average stand diameters that vary by harvesting system. The minimum diameter criteria are 30 centimetres for ground-based harvesting, 37 centimetres for cable harvesting, and 42 centimetres for helicopter harvesting. The minimum diameters vary by harvest system since larger piece sizes with higher value are required to offset more expensive harvest systems. The base case also included a minimum harvestable volume of 350 cubic metres per hectare for all stands.

Four sensitivity analyses were conducted to evaluate the impact that minimum harvestable criteria has on timber supply:

- Increase minimum diameter threshold by two centimetres;
- Decrease the minimum diameter threshold by two centimetres;
- Apply the 95 percent of culmination of mean annual increment (CMAI) age threshold, where CMAI age is less than 40 years, a minimum harvest age of 40 years was applied;
- Apply the 95 percent of CMAI age threshold, and where CMAI age is less than 40 years, a minimum harvest age of 40 years was applied, based on LiDAR adjusted attributes.

When the minimum diameter threshold is increased by two centimetres the timber supply is reduced by 11.7 percent over the first 30 years, and 1.3 percent through the remainder of the projection. If the minimum diameter threshold is decreased by two centimetres the timber supply is increased by 6.0 percent over the first 60 years and the long-term timber supply is increased by 0.4 percent relative to the base case.

If the diameter and volume criteria utilized in the base case is replaced with 95 percent of CMAI criteria, timber supply is increased by 9.3 percent in the first 40 years and 16.1 percent by year 60. Since the 95 percent CMAI age threshold was applied uniformly across all stands, the minimum harvest age is the same across the three harvest systems. Finally, when 95 percent CMAI age threshold is used in combination with LiDAR-based inventory attributes, the timber supply is increased by 15.4 percent over the first 60 years relative to the base case.

While I commend Tsawak-qin's efforts in attempting to identify operational thresholds and apply them to the minimum harvestable criteria, I note that the criteria are punitive and there is uncertainty regarding operability based on the economic criteria applied in the base case. Utilizing the 95 percent CMAI criteria to define the minimum harvestable criteria is common practice in timber supply reviews and better reflects the productive capacity of the land base. Applying the minimum harvestable criteria of 95 percent CMAI results in a 9.3 percent underestimation in the short-term timber supply, and I will discuss this further in '**Reasons for Decision**'.

Section 8(8)(a)(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production

Integrated resource management objectives

The Ministry is required, under the *Ministry of Forests and Range Act*, to manage, protect, and conserve the forest and range resources of the Crown. The Ministry is also required to plan the use of these resources so that the production of timber and forage, the harvesting of timber, grazing of livestock, and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated. FRPA and other legislation provide for, or enable, the legal protection and conservation of timber and non-timber values. Accordingly, the extent to which integrated resource management objectives for various forest resources and values affect timber supply must be considered in AAC determinations.

- *landscape level biodiversity – old growth*

Conserving landscape level biodiversity involves maintaining forests with a variety of patch sizes, seral stages, and forest stand attributes and structures, across a variety of ecosystems and landscapes. In the delineation and formal designation of landscape units for establishing biodiversity management objectives, three biodiversity emphasis options (BEO) are identified, 'lower', 'intermediate', and 'higher'. Each option is designed to provide a different level of natural biodiversity, and a different risk to the maintenance of elements of natural biodiversity, when finding an appropriate balance between biodiversity and timber supply in establishing the objectives.

The 2004 *Order Establishing Provincial Non-Spatial Old Growth Objectives* (NSOGO) specifies the minimum old growth retention requirements by biodiversity emphasis option, natural disturbance type, and Biogeoclimatic Ecosystem Classification (BEC) variant. For landscape units assigned a low BEO, the NSOGO allows for a temporary reduction ("drawdown") of the old forest minimum retention requirements by up to two-thirds, to the extent necessary to address timber supply impacts.

The Sarita and Henderson landscape units within TFL 44 are assigned a low BEO. For these two landscape units, the draft Old Growth Management Areas (OGMAs) achieve the old-seral drawdown target for the first rotation which is 80 years. The old-seral target for the end of the second rotation (160 years) is 2/3 of the full target, with the full old-seral target being achieved by the end of the third rotation at 240 years.

I am cognisant that most retention targets within TFL 44 are being met through the draft OGMAs and the non-contributing portions of the land base. I am also aware that through the implementation of the WSCP, Tsawak-qin is retaining higher than average retention levels throughout the landscape units. While the NSOGO allows for reduced retention levels in low BEO landscape units, the application of the old-seral drawdown should not further reduce the area of old forest. In the base case analysis, the target retention in some low BEO landscape units was below existing levels of old seral. Had the target retention matched the current level of retention, short-term timber supply may have been reduced. Therefore, there may be a small unquantified downward pressure of the timber supply as discussed under '**Reasons for Decision**'.

On June 10, 2021, a Ministerial Order established the Central Walbran Valley as an Old Growth Designated Area. Approximately 339 hectares of the Central Walbran Valley Old Growth Designated Area is within TFL 44. According to the Ministerial Order, harvesting in stands less than 212 years old within the Central Walbran Designated Area is permitted. In the base case stands greater than 211 years old were deferred from harvesting for the first decade in compliance with the Ministerial Order. However, any adjustments to the AAC necessary to address the temporary deferral of the Central Walbran Valley Designated Area will be made as part of a separate decision under Section 173 of the *Forest Act*. As such these stands should have been included in the base case projection.

A 2021 analysis conducted by the FAIB estimated that there were 266 hectares of old growth within the designated area. Of the 266 hectares, only 60 hectares were within the THLB, and 20 hectares were old growth within the THLB. Thus, the base case has been underestimated by a negligible amount.

- *scenic areas and visual resources*

A Government Actions Regulation Order established Visual Quality Objectives (VQOs) for the South Island Forest District on December 15, 2005. On December 30, 2011, the Order was amended. The VQOs modelled in the timber supply analysis were Retention, Partial Retention, and Modification. In the base case, blocks were determined to have met visually effective

green-up (VEG) when trees reached five metres in height. The disturbance limit (i.e., the area that has not achieved VEG) modelled within the base case for each VQO polygon is 5 percent, 15 percent, and 25 percent, respectively. These disturbance limits represent the upper extent of the allowable range for use in timber supply analysis.

The Provincial Timber Management Goals, Objectives, and Targets report for TFL 44 indicates that over the past five years Tsawak-qin has underperformed in the more restrictive Partial Retention and overperformed in the Modification VQO class. A sensitivity analysis was completed that applied the disturbance thresholds that correspond with the mid-point of allowable disturbance range. The mid-point maximum allowable disturbance limits for Retention, Partial Retention, and Modification were 3 percent, 10 percent, and 20 percent, respectively. The sensitivity analysis results showed that the short-term timber supply would be reduced by 3.8 percent over the first 50 years when the mid-point maximum disturbance thresholds are applied instead of the upper extent disturbance thresholds that were applied in the base case.

I conclude that the VQOs were adequately modelled in the base case based on legal requirements. I note however, that the highest range of percent disturbance was used in the analysis and currently harvesting is not occurring in the Partial Retention VQO class in proportion to the land base. The next timber supply review will need to evaluate whether performance has improved within the more restrictive VQO class and determine whether a partition is required.

- community watersheds

Water in community watersheds is a value identified under the FRPA. Licensees are required to specify results and strategies in their forest stewardship plan that meet the objectives set by government for water quality. Objectives for water in community watersheds are established under Section 8.2 of the FPPR.

There are four designated community watersheds located either completely or partially within the TFL 44 administrative boundary. These include the China Creek, Malachan Creek, Cousteau Creek, and Haggard Lake watersheds. The base case applied a forest cover constraint, where no more than one percent of the productive area within the Malachan Creek, Cousteau Creek, and Haggard Lake watersheds could be harvested in a single year. No constraints were applied to the China Creek watershed, which is the main water supply for the city of Port Alberni. Of the 5750 hectares in China Creek, TFL 44 overlaps with 392 hectares or 6.8 percent of the watershed, with the remainder of the watershed overlapping private forest land. I note that although the overlap is small, the China Creek watershed has significant value. Applying cover constraints to the China Creek community watershed results in a small unquantified downward pressure of the timber supply as discussed under '**Reasons for Decision**'.

- wildlife habitat areas

Wildlife Habitat Areas (WHAs) conserve habitat for designated species at risk. There are 43 legally established WHAs within TFL 44, totaling 3279 hectares of productive forest, with 47 hectares removed from the THLB. The majority of the WHAs were established to protect Marbled Murrelet but other focal species include Red-legged Frog, and Scouler's Corydalis.

There are currently three draft WHAs that overlap with TFL 44 that are focused on the protection of Northern Goshawk habitat. The three WHAs total 539 hectares of productive forest, with 131 hectares removed from the THLB in the timber supply base case. Consistent with my '*Guiding principles for AAC determinations*', I will not account in my AAC determination for

land use decisions to protect North Goshawk that have not yet been made. When those decisions are made, I can re-determine the AAC, if necessary, without a full new timber supply review. As discussed under ‘**Reasons for Decision**’ the three draft WHA’s were incorrectly removed from the base case THLB, resulting in a small 0.2 percent underestimation of timber supply.

The BC Marbled Murrelet Implementation Plan was released in February 2018. A key action from the plan was to issue an Order under the Land Use Objectives Regulation for suitable Marbled Murrelet habitat protection. The Order for the Recovery of Marbled Murrelet came into effect on December 2nd, 2021, excluding timber harvesting on all classes of habitat. In the base case, Tsawak-qin removed Marbled Murrelet habitat with a ranking of greater than three, from the THLB. However, the base case analysis did not remove habitat classes one to three, as directed in the Marbled Murrelet Order. Analysis completed by the licensee shows that applying the Marbled Murrelet Order to these additional habitat classes results in a 2.4 percent overestimation in timber supply. This is discussed further under ‘**Reasons for Decision**’.

Section 8(8)(a)(vi) any other information that, in the chief forester’s opinion, relates to the capability of the area to produce timber

Other information

- climate change

As discussed under my ‘*Guiding principles for AAC determinations*’, climate change is a key area of uncertainty for the TFL 44 timber supply review process. Climate change is predicted to impact forest ecosystems in several ways including a general increase in temperatures, change in precipitation patterns, and an increase in the frequency and severity of disturbances including wildfires, floods, landslides, and occurrences of insects and disease. While the trends are generally consistent, the specific magnitude of these changes, their spatial and temporal distribution, and impacts to timber supply are uncertain.

Utilizing the Pacific Climate Impact Consortium meteorology for northwest North America dataset, trends were evaluated for TFL 44 between the years of 1942 and 2012. There was no significant change in mean annual precipitation, nor any significant precipitation trends in any of the seasons. During the same time period, mean annual temperature increased significantly by 1.0° C. For seasonal change in mean temperature, winter and summer have warmed the most (1.1° C), followed by spring (0.9° C). There is currently no significant increase in extreme maximum temperatures in this historical analysis. Extreme annual minimum temperatures have increased significantly by 3.0° C, with the largest seasonal change in extreme minimum temperatures occurring in the winter (2.6° C) but also significantly in the spring (2.3° C).

Climate model projections for 2041 to 2070 for TFL 44 show minor increases in precipitation between the climate modelling period of 2041 to 2070 and the baseline period of 1961 to 1990. However, summer is projected to be approximately 23 percent drier. Mean annual temperatures may increase by 2.6° C with summer increasing the most (3.2° C), followed by fall (2.8° C), then winter and spring (2.3° C). Seasonal mean minimum temperatures may also increase the most in summer (3.4° C) and the least in winter (2.2° C). Extreme annual maximum temperatures may increase by 2.9° C and extreme annual minimum temperatures by 4.7° C. Seasonal mean maximum temperatures may increase the most in summer (3.0° C) and the least in the spring (2.3° C).

The large increases in temperature change and declines in summer precipitation are concerning for increasing wildfire and drought risk in TFL 44. Growing degree days and frost-free periods may both increase. However, so will demand for moisture as indicated by the large increase in the climate moisture deficit of 62.4 mm. Current climate trends of warmer winters are more

conducive to forest pest overwinter survival. Warmer conditions overall can mean some insects can shorten their life cycles and therefore increase populations. Wet and warm conditions in the spring can be a risk for increasing pathogens. Current potential declines in snow and a shortened snow season can increase the risk of frost damage for forests that need snow cover to protect roots from cold temperatures (e.g., cedar) and provide soil moisture storage available to trees during the growing season. The model projections indicate it is likely moisture demands from evaporation will increase, given the change particularly in the summer, and increase the risk of impact or mortality to a variety of tree species from drought. Increases in growing degree days and the frost-free period may mean some vegetation will see enhanced growth, again moisture availability may limit that potential. The potential for stressed trees due to hot dry conditions in the summer months will also limit natural defenses from other disturbances such as pests and wildfire, of which the climate projections are favourable for these to increase as well. Ecological drought may enhance warm season hydrological drought which may become more frequent under these climate change projections.

As part of the analysis for TFL 44, Tsawak-qin completed a climate change sensitivity analysis, exploring the timber supply impacts of substituting the current BEC classifications with the projected 2050 BEC classifications. The sensitivity analysis applied projected 2050 BEC zone, subzone, and variant information for Vancouver Island, obtained from the Climate BC model developed by Dr. Tongli Wang at the University of British Columbia. In the sensitivity analysis short-term timber supply was reduced by five percent, and long-term timber supply was reduced by approximately nine percent when compared with the base case.

I am encouraged to see that Tsawak-qin has conducted climate change modelling and is considering the impacts climate change may have on future timber supply. After reviewing the implications of the 2050 projected BEC zones I acknowledge that there is likely an unquantified downward pressure in the long-term timber supply. I note however, that modification in practices such as engaging in the provincial forest fertilization program, adopting the Climate Based Seed Transfer, managing forest fuels to reduce wildfire risks, and employing qualified forestry professionals who will consider climate change impacts when developing regeneration strategies will help to limit the negative impacts of climate change. As timber supply analyses are conducted at least every 10 years, the forest inventory is regularly updated to reflect the most recent disturbances and silviculture practices. As well, analysis methodology continues to evolve as new information is made available.

- cumulative effects

Cumulative effects are changes to social, economic, and environmental conditions caused by the combined impact of past, present, and potential human activities or natural events. The Government of British Columbia supports the phased implementation of the Cumulative Effects Framework (CEF) to provide relevant information and supporting policy. The framework will ultimately provide information related to 10 values including Grizzly Bear, Aquatic Ecosystems, Old Growth Forest, Marbled Murrelet, Northern Goshawk, Elk, Moose, Forest Biodiversity, Cultural Cedar, and Cutthroat Trout. The CEF provides resource managers with procedures and tools to inform decisions that support sustainable management and the needs of many different users. Cumulative effects assessments are being piloted across the province but currently a pilot project has not been established for TFL 44.

Specific assessments of the ten regionally important resource values are limited for TFL 44. In March 2022, the *Current Condition Report for Grizzly Bear in the West Coast Region* was published. This appears to be the only regional cumulative effects report available, however as grizzly bears are rarely found on Vancouver Island this report is not described here.

A Multiple Resource Value Assessment (MRVA) was completed for the South Island Natural Resource District in November 2013. The MRVA shows the results of the stand- and landscape-level monitoring carried out under the Forest and Range Evaluation Program, summarizing results for riparian, water quality, stand-level biodiversity, and visual quality within the South Island Natural Resource District. The results of the MRVA are summarized below:

Riparian areas

Of the 51 streams monitored, 61 percent were rated as having a “very low” or “low” harvest-related impacts: 37 percent of streams are Properly Functioning with a “very low” impact and 24 percent are Properly Functioning with a “low” impact. Twenty percent are Properly Functioning with a “medium” impact and 20 percent are Not Properly Functioning with a “high” impact.

Although data was provided for both Forest Practices Code and FRPA-era development impacts, the FRPA-era sample is small (14 stream reaches). However, this small sample may indicate a large improvement in the stream-reach quality. One of the 14 FRPA-era streams was in “high” impact condition due to windthrow, despite full Riparian Management Area retention.

Water quality

Of the 134 road segments assessed, 96 percent were rated as “very low” or “low” road-related impact. Site assessments show the range for potential sediment generation as 69 percent “very low” (“very low” impact), 27 percent “low” (“low” impact), 3 percent “moderate” (“medium” impact), 0 percent “high”, and one percent “very high” (“high” impact). For the five road segments that fell into “high” or “medium” impact categories, increased numbers of strategically placed culverts would have improved three of them. Too long a gradient leading into stream was the problem for another.

Stand-level biodiversity

Of 60 cutblocks sampled, 70 percent of sites were rated as “very low” or “low” harvest-related impact. Considering total retention, retention quality, and coarse woody debris quantity and quality, 33 percent of sites are rated as “very low” impact on biodiversity, 37 percent as “low,” 25 percent as “medium,” and 5 percent as “high.” Four additional cutblocks were sampled but could not be rated as three had patch retention and no tree data (likely a safety issue), and one was in a BEC subzone with insufficient baseline.

Visual quality

Of the 23 landforms assessed (all FRPA cutblocks), 60 percent were rated with “very low” or “low” harvest-related impacts on achieving the VQOs. VQOs were “well met” (“very low” impact) on 43 percent of landforms, “met” (“low” impact) on 17 percent, “borderline” (“medium” impact) on 17 percent, “not met” on 13 percent, and “clearly not met” (“high” impact) on 9 percent.

Although there are no CEF projects underway within TFL 44, there are many other planning and management practices that may mitigate the negative effects of forestry. Such objectives that are reflected in the TFL 44 timber supply analysis include: the Vancouver Island Land Use Plan Higher Level Plan Order objectives for Resource Management Zones, *Forest and Range Practices Act* objectives, Western Forest Products Stewardship and Conservation Plan, visual quality objectives, Non-Spatial Old Growth Objectives, cutblock adjacency objectives, riparian reserve and management zones, wildlife tree retention objectives, and reductions to the THLB for terrain stability, wildlife habitat areas, uneconomic stands, and known archaeological sites.

I have considered the available cumulative effects information and the potential implications to timber supply. I note that within TFL 44, the predominant land use activities include timber production, silviculture practices, and timber harvesting. Based on the MRVA information for the South Island Natural Resource District report, I note that the data is trending in a positive direction. I conclude that the base case reflects current management, the current status of the effects of past and present legal activity on the land base, and the legal objectives established by government for various non-timber resources. Based on this information, I will make no additional adjustments to the base case to account for cumulative effects.

- harvest performance

The current TFL 44 AAC is 793 600 cubic metres. Information from the Ministry's Harvest Billing System (HBS) shows that over the most recent five year cut control period from 2017 to 2021, the average harvest volume has been 492 302 cubic metres or 62 percent of the AAC.

Tsawak-qin's harvest performance is evaluated in the *Provincial Timber Management Goals, Objectives, and Targets for TFL 44* (PTMGOT) report. The report indicates that timber harvesting is occurring proportionately across all slope classes within TFL 44. A comparison of the leading species profile of the harvested cutblocks reported in the Ministry's HBS during the period of 2017 to 2021 to the leading species profile of stands older than 60 years in the VRI shows that the full species profile is not being proportionately harvested. There has been an overrepresentation of western redcedar and an underrepresentation of Douglas-fir. While I acknowledge that the PTMGOT report does not distinguish species profiles to specific portions of the land base, I note that recent performance is notably higher than the contribution of cedar to the short-term timber supply in base case harvest projection. It is important that the harvest of cedar is aligned with its proportion of growing stock.

I am pleased to see that harvesting is occurring proportional to the slope profile of TFL 44. However, as western redcedar forests contain many non-timber values, I am concerned that western redcedar growing stock is being disproportionately depleted. As summarized under '**Implementation**' I expect Tsawak-qin to report annually on their success of matching the inventory species profile to the harvested species composition.

- unharvested volume

In January 2018 the Ministry of Forests introduced a Policy Regarding the Administration of Unharvested Volumes, Uncommitted Volumes and Unused BCTS Volumes, collectively referred to as accumulated volume. One of the purposes of the policy is to provide guidance on the administration of accumulated volumes for forest licences, TFLs and woodlot licences in accordance with Section 75.8 of the *Forest Act*. The policy requires that prior to the AAC determination for a TFL, I must be provided with information regarding the total net volume of unharvested volume. As deputy chief forester I must consider the amount of unharvested volume as one of the factors (e.g., a pressure on the standing inventory) when determining the AAC for TFL 44. The minister may, in accordance with Section 75.8 and the principles outlined in the policy, issue a tenure based on unharvested volume.

Regional Tenures staff indicate that for TFL 44 there is an accumulation of approximately 1 463 810 cubic metres of unharvested volume. On June 13, 2023, the Deputy Minister approved a mandate for the disposition of up to 500 000 cubic metres to Indigenous Nations with traditional territory within the TFL. The remaining unharvested volume will not be available for new tenure opportunities.

Since a volume disposition mandate has been approved, it is necessary for me to account for the accumulated volume in the TFL that may be harvested under a licence other than the TFL over the term of the AAC. Consequently, I have removed 500 000 cubic metres from the analysis

which I expect to be allocated and harvested over the next 15 years. This results in a 4.8 percent overestimation of the timber supply as discussed under ‘**Reasons for Decision**’.

- recommended allowable annual cut scenario

Tsawak-qin has recommended an AAC that varies from the base case analysis. The recommended AAC is based on the ITI LiDAR-adjusted inventory attributes, as well as the revised minimum harvestable criteria which Tsawak-qin considers to be a better reflection of operational reality. The recommended AAC is 727 200 cubic metres per year with partitions for the economic land base, and the economic land base with stand age less than 121 years. The recommended AAC is 12 000 cubic metres per year and 48 300 cubic metres per year higher than the base case short-term timber supply for the first and second five-year periods, respectively.

As discussed under the ‘*Forest inventory*’ and ‘*Minimum harvestable criteria*’ sections, I have not accepted the ITI LiDAR-adjusted inventory or the 95 percent CMAI age threshold with LiDAR adjusted inventory attributes. I have considered Tsawak-qin’s recommended AAC scenario but have determined that the base case is a better reference point to apply the upward and downward timber supply pressures discussed throughout this document.

Section 8(8)(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area

As noted in Table 1, I have considered a factor related to alternative rates of timber harvesting and with no further comment required.

Section 8(8)(c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities

This section of the *Forest Act* has been repealed [2003-31-2 (B.C. Reg. 401/2003)]

Section 8(8)(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia

- First Nations engagement

The crown maintains a duty to consult with, and accommodate as necessary, those First Nations for whom it has knowledge of claimed Aboriginal rights and/or title (Aboriginal Interests) that may be impacted by a proposed decision, including strategic-level decisions such as AAC determinations. The AAC can affect various resource values and therefore the ability of Aboriginal Peoples to meaningfully exercise their Aboriginal rights or interests. Information gained through consultation with potentially affected First Nations has been considered in the development of this determination.

TFL 44 overlaps with the traditional territories of eleven First Nations and the harvest areas of the Maa-nulth First Nations.

The Licensee shared a *Draft Information Package, Management Plan, and Analysis Report* with potentially impacted First Nations. In a parallel process, Ministry of Forests district staff led the consultation process for the various TSR phases.

First Nation consultation on the TFL 44 TSR was initiated on December 17, 2019, with an overview letter sent to First Nations explaining the TSR process. No responses were received from First Nations.

First Nation consultation on the *Information Package* was initiated on June 22, 2021, with a request for a response within 60 days. Tseshah First Nation requested funding and additional information from Tsawak-qin. Tsawak-qin provided additional information and forwarded their

request for funding to the Ministry of Forests. Ditidaht First Nation requested and received a consultation period extension of just over a month. No further comments were received by any of the First Nations concerning the *Information Package*.

Consultation on the *Management Plan* was initiated on November 4, 2022, with a request for a response within 60 days. District staff reiterated the timber supply review process and requested to receive information from the First Nations regarding their Aboriginal Interests on TFL 44 and how they may be impacted by an AAC decision. Engagement with Maa-nulth First Nations was initiated via the Maa-nulth Connect online portal on November 7, 2022, and was conducted in accordance with the Maa-nulth Reasonable Opportunity Agreement.

A limited amount of funding was made available by FAIB to assist with the review of the *Management Plan and Timber Supply Analysis Report*. Due to this limitation, district staff prioritized which First Nations would be invited to apply for funding based on the overlap of the TFL with traditional territory, strength of claim, capacity and interest in the TSR. On January 18, 2022, district staff sent invitations to Ditidaht First Nation, Pacheedaht First Nation, Hupacasath First Nation, Tseshah First Nation, and the Uchucklesaht Tribe. Ditidaht First Nation and Pacheedaht First Nation applied and received funding for the review of both TFL 44 and TFL 46 *Management Plans and Timber Supply Analysis Reports*. No comments were received from either First Nation for the review of TFL 44.

Tsawak-qin received comments from Huu-ay-aht First Nation who felt it would be beneficial to have increased connectivity between ungulate winter ranges and have greater utilization of areas with low stems per hectare. Tsawak-qin met with Huu-ay-aht and provided them with additional information. Tsawak-qin explained to Ministry of Forests staff that they are working with Huu ay aht First Nation to develop an Integrated Resource Management Plan which will identify a larger comprehensive network that will have greater connectivity than is currently in place.

The Ministry of Forests received a comment from the Ts'uubaa-asatx Nation indicating that they were concerned for the identification and protection of bear dens. Tsawak-qin responded to their comment indicating that there are no known bear dens on the area of TFL 44 that overlap with their territory. Tsawak-qin also indicated that they have a bear den management standard that recognizes and retains bear dens in a functional state and prevents disturbance to hibernating bears. If any dens are identified, Tsawak-qin committed to sharing more detailed site level information regarding specific attributes and management of the bear den with affected First Nations during the information sharing stage of cutting and road permit applications.

In reviewing the First Nations consultation process with district staff, I conclude that the First Nations whose territories overlap with TFL 44 were consulted in accordance with current provincial guidance, applicable case law, and the signed agreements held by the affected First Nations. I am satisfied that these consultations have been carried out in good faith and the Crown's process of seeking to understand potentially outstanding issues and impacts was reasonable.

Section 8(8)(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area

As noted in Table 1, I have considered a factor related to non-recoverable losses assumptions and I find it to have been appropriately accounted for in the base case, with no further comment required.

Reasons for Decision

In reaching my AAC determination for TFL 44, I have considered all the factors required under Section 8 of the *Forest Act* and I have reasoned as follows.

The base case shows that an initial harvest level of 715 200 cubic metres per year can be maintained for five years before declining for the second five years of the 10-year horizon to 678 900, for an average 10-year harvest level of 697 000. The projected harvest level declines on average 5.1 percent per five-year period over the following 15 years, reaching 611 968 cubic metres per year in 2039. The harvest level remains at this rate for 40 years, before increasing to a long-term harvest level estimate of approximately 738 700 cubic metres per year for the remainder of the 300-year harvest projection.

I am satisfied that the assumptions applied in the base case, for most of the factors applicable to TFL 44, were appropriate including those detailed in Table 1 or as previously discussed in this rationale. However, I have identified some factors, which, considered separately, indicate that the timber supply may be either greater or less than that projected in the base case. Some of these factors can be readily quantified and their impact on harvest projections assessed with reliability. Others may influence timber supply by adding an element of risk or uncertainty to the decision but cannot be reliably quantified at this time.

I have identified the following factors that indicate a potential underestimation in the base case timber supply:

- *Dead potential volume* – Dead but potentially useable timber volume is not captured in natural stand volume estimates and was not accounted for in the base case. Accounting for dead potential western redcedar volume results in a one percent underestimation of the base case harvest level.
- *Minimum harvestable criteria* – Applying the minimum harvestable criteria of 95 percent CMAI results in a 9.3 percent underestimation in timber supply.
- *Northern Goshawk Wildlife Habitat Areas* – Three draft Northern Goshawk Wildlife Habitat Areas were incorrectly removed from the area contributing to timber supply resulting in a 0.2 percent underestimation in timber supply.

I have identified the following factors that indicate a potential overestimation in the base case timber supply:

- *Forest inventory* – The forest cover inventory used in the base case overestimates volume in stands greater than 119 years of age, and the timber supply is dependent on these mature stands over the next 10 years, resulting in an unquantified downward pressure of the timber supply.
- *Existing roads* – Utilizing the road widths that were used in the previous analysis results in a one percent overestimate in short-term timber supply for existing roads.
- *Physical operability* – Accounting for a 30-metre buffer adjacent to federal and provincial parks results in a 1.8 percent overestimate of the timber supply.
- *Cultural heritage resources* – There has been no harvesting since the GAR Order was initiated in 2013 within the culturally significant Thunder Mountain area. I will account for a 3.8 percent overestimation of the timber supply.
- *Future stand-level reserves* – Accounting for an error during the analysis where the FPPR retention requirements were not removed during the land base netdown process results in a 0.6 percent overestimation of the timber supply.
- *Volume estimates for managed stands* – Applying the provincial standard OAF 1 value of 15 percent results in a 3.9 percent overestimation of the timber supply.

- *Landscape-level biodiversity – old growth* – The modelling of landscape-level biodiversity is advancing and not all landscape unit targets are being met by the non-contributing land base alone, resulting in a potential small downward pressure of the timber supply.
- *Community watersheds* – Accounting for the lack of cover constraint modelling for the China Creek community watershed results in a small downward pressure of the timber supply.
- *Marbled Murrelet land use order* – The base case did not fully incorporate the Order for the recovery of Marbled Murrelet resulting in a 2.4 percent overestimation of the timber supply.
- *Unharvested volume* – I have removed 500 000 cubic metres from the analysis to account for the approved disposition of accumulated volume, resulting in a 4.8 percent overestimation of the timber supply.

When reviewing the factors that result in the underestimation and overestimation of timber supply in the base case, I conclude that the base case short-term harvest levels have been overestimated by 7.8 percent. Adjusting the base case to account for these overestimations results in an initial harvest level of 642 800 cubic metres per year.

Determination

I have considered and reviewed all the factors as documented above, including the risks and uncertainties of the information provided. It is my determination that a timber harvest level that accommodates objectives for all forest resources during the next 10 years, reflects current management practices, as well as the socio-economic objectives of the Crown, can be best achieved in TFL 44 by establishing an AAC of 642 800 cubic metres. This is about 19.0 percent lower than the current AAC of 793 600 cubic metres.

In making this AAC determination, I specify, under Section 8(5)(a) of the *Forest Act*, two partitions:

1. Economic land base: A maximum of 484 600 cubic metres per year or 75 percent of the AAC is attributable to the economic land base, spatially delineated in the 2022 economic analysis of TFL 44. The economic land base partition is to remain in place for a 10-year period.
2. Economic land base with stand age less than 121 years: A maximum of 225 400 cubic metres per year or 35 percent of the AAC is attributable to the economic land base in stands with an age less than 121 years, as indicated in the 2022 economic analysis for TFL 44.

The partition for stands with an age less than 121 years is set for a period of 10 years however harvest performance will be monitored in the interim and five years following this decision, I will evaluate the need to continue this partition.

This determination is effective June 26, 2023, and will remain in effect until a new AAC is determined, which must take place within 10 years of the effective date of this determination. If additional significant new information is made available to me, or major changes occur in the management assumptions upon which this decision is based, then I am prepared to revisit this determination sooner than the 10 years required by legislation.

Implementation

In the period following this decision and leading to the subsequent determination, I expect Ministry staff and licence holder staff to undertake or support the tasks and studies noted below,

the particular benefits of which are described in appropriate sections of this rationale document. I recognize that the ability of all parties to undertake or support these projects is dependent on provincial priorities and available resources, including funding. However, these projects are important to help reduce the risk and uncertainty associated with key factors that affect the timber supply in TFL 44. Prior to the next AAC determination:

1. *Inventory*: I ask Tsawak-qin to carry out a random inventory sample of TFL 44 and use it to validate the inventory that is intended to be used in the next timber supply review.
2. *Roads*: I ask Tsawak-qin to calibrate their LiDAR road width estimates through a ground sampling program as additional validation of the species composition and the deciduous and sub-merchantable component within the road buffer area is needed.
3. *Cultural heritage resource – Thunder Mountain*: I expect Tsawak-qin to work with First Nations and Ministry staff to monitor harvest performance in the Thunder Mountain GAR Order area. I will evaluate the harvest performance, and if necessary, consider adjustment to the AAC for the next determination.
4. *Harvest performance*: I expect Tsawak-qin to report annually on their success of matching the inventory species profile to the harvested species composition.
5. *Partition*: I ask Tsawak-qin to report annually on partition performance over the full 10-year decision time frame. Although the economic land base less than 120-year-old partition is only in place for five years, I expect Tsawak-qin to report on both partitions annually over the full 10-year period.



Albert Nussbaum, RPF
Deputy Chief Forester

June 26, 2023



Appendix 1: Section 8 of the *Forest Act*

Section 8 of the *Forest Act*, Revised Statutes of British Columbia 1996, c. 157, (current to May 10, 2023), reads as follows:

Allowable annual cut

- 8** (1) The chief forester must determine an allowable annual cut at least once every 10 years after the date of the last determination, for
- (a) the Crown land in each timber supply area, excluding the Crown land in the licence areas of area-based licences, and
 - (b) each tree farm licence area.
- (2) If the minister
- (a) makes an order under section 7 (b) respecting a timber supply area, or
 - (b) amends or enters into a tree farm licence to accomplish a result set out under section 39 (2) or (3),
- the chief forester must make an allowable annual cut determination under subsection (1) for the timber supply area or tree farm licence area
- (c) within 10 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and
 - (d) after the determination under paragraph (c), at least once every 10 years after the date of the last determination.
- (3) If
- (a) the allowable annual cut for the tree farm licence area is reduced under section 9 (3), and
 - (b) the chief forester subsequently determines, under subsection (1) of this section, the allowable annual cut for the tree farm licence area,
- the chief forester must determine an allowable annual cut at least once every 10 years from the date the allowable annual cut under subsection (1) of this section is effective under section 9 (6).
- (3.1) If, in respect of the allowable annual cut for a timber supply area or tree farm licence area, the chief forester considers that the allowable annual cut that was determined under subsection (1) is not likely to be changed significantly with a new determination, then, despite subsections (1) to (3), the chief forester
- (a) by written order may postpone the next determination under subsection (1) to a date that is up to 15 years after the date of the relevant last determination, and

- (b) must give written reasons for the postponement.
- (3.2) If the chief forester, having made an order under subsection (3.1), considers that because of changed circumstances the allowable annual cut that was determined under subsection (1) for a timber supply area or tree farm licence area is likely to be changed significantly with a new determination, he or she
 - (a) by written order may rescind the order made under subsection (3.1) and set an earlier date for the next determination under subsection (1), and
 - (b) must give written reasons for setting the earlier date.
- (4) If the allowable annual cut for the tree farm licence area is reduced under section 9 (3), the chief forester is not required to make the determination under subsection (1) of this section at the times set out in subsection (1) or (2) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 9 (2).
- (5) In respect of an allowable annual cut determined under this Act, the chief forester may, at any time, specify that portions of the allowable annual cut are attributable to one or more of the following:
 - (a) different types of timber or terrain in different parts of Crown land within a timber supply area or tree farm licence area;
 - (a.1) different areas of Crown land within a timber supply area or tree farm licence area;
 - (b) different types of timber or terrain in different parts of private land within a tree farm licence area.
 - (c) [Repealed 1999-10-1.]
- (5.1) The chief forester may, at any time, amend or cancel a specification made under subsection (5).
- (6) The minister must determine an allowable annual cut for each woodlot licence area in accordance with the woodlot licence for that area.
- (7) The minister must determine an allowable annual cut for
 - (a) each community forest agreement area in accordance with the community forest agreement for that area, and
 - (b) each first nations woodland licence area in accordance with the first nations woodland licence for that area.
- (8) In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider
 - (a) the rate of timber production that may be sustained on the area, taking into account

- (i) the composition of the forest and its expected rate of growth on the area,
 - (ii) the expected time that it will take the forest to become re-established on the area following denudation,
 - (iii) silviculture treatments to be applied to the area,
 - (iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,
 - (v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and
 - (vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,
 - (b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,
 - (c) [Repealed 2003-31-2.]
 - (d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and
 - (e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.
- (9) Subsections (1) to (4) of this section do not apply in respect of the management area, as defined in section 1 (1) of the *Haida Gwaii Reconciliation Act*.
- (10) Within one year after the chief forester receives notice under section 5 (4) (a) of the *Haida Gwaii Reconciliation Act*, the chief forester must determine, in accordance with this section, the allowable annual cut for
- (a) the Crown land in each timber supply area, except the areas excluded under subsection (1) (a) of this section, and
 - (b) each tree farm licence area
- in the management area, as defined in section 1 (1) of the *Haida Gwaii Reconciliation Act*.
- (11) The aggregate of the allowable annual cuts determined under subsections (6), (7) and (10) that apply in the management area, as defined in section 1 (1) of the *Haida Gwaii Reconciliation Act*, must not exceed the amount set out in a notice to the chief forester under section 5 (4) (a) of that Act.

Appendix 2: Section 4 of the *Ministry of Forests and Range Act*

Section 4 of the *Ministry of Forests and Range Act* (current to May 10, 2023) reads as follows:

Purposes and functions of ministry

4 The purposes and functions of the ministry are, under the direction of the minister, to do the following:

- (a) encourage maximum productivity of the forest and range resources in British Columbia;
- (b) manage, protect and conserve the forest and range resources of the government, having regard to the immediate and long term economic and social benefits they may confer on British Columbia;
- (c) plan the use of the forest and range resources of the government, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated, in consultation and cooperation with other ministries and agencies of the government and with the private sector;
- (d) encourage a vigorous, efficient and world competitive
 - (i) timber processing industry, and
 - (ii) ranching sectorin British Columbia;
- (e) assert the financial interest of the government in its forest and range resources in a systematic and equitable manner.

Appendix 3: Minister's letter of November 24, 2021



Reference: 268022

November 24, 2021

Diane Nicholls, R.P.F.
Assistant Deputy Minister and Chief Forester

Dear Diane Nicholls:

The *Forest Act* gives you the authority to determine an allowable annual cut (AAC) for each timber supply area and tree farm licence in the province and specifies what you must consider when determining an AAC. Included in these considerations are the economic and social objectives of the government, which are provided below. These government objectives are to be considered as part of the comprehensive timber supply review process that your office has developed and implemented to ensure that your AAC determinations consider many forest management objectives and aligns with provincial statutes and regulations. They replace the objectives provided to you by the former minister, Doug Donaldson, on October 30, 2017.

British Columbians expect a government focused on building a strong sustainable economy that works for everyone, providing a path for lasting and meaningful reconciliation with Indigenous peoples, and developing strategies to address climate change. Government has committed to delivering on these priorities while recognizing that healthy, resilient forests are essential to the social, economic, and environmental interests of current and future generations. To advance these commitments, natural resource ministries, Indigenous partners, and stakeholders are collaborating to develop and implement forest management strategies and policies that will be relevant to your AAC determinations. I ask that you remain mindful of these commitments and as government approves related objectives, that you ensure they are fully considered within the timber supply review process.

The British Columbia (BC) government has committed to full and lasting reconciliation with Indigenous Peoples. As the provincial government implements the *Declaration on the Rights of Indigenous Peoples Act* and works toward aligning provincial laws with the United Nations Declaration on the Rights of Indigenous Peoples, I ask that your AAC determinations fully consider relevant outcomes of that work. For greater certainty, please continue to ensure that your AAC determinations are consistent with relevant agreements that are in effect between First Nations and the BC government, and court decisions that define Aboriginal title and rights. I expect you to continue to find ways to advance engagement and collaboration with Indigenous Peoples throughout the timber supply review process. In making your AAC determinations, I also ask that you continue to carefully consider Indigenous knowledge and other input that could have implications for your AAC determinations from First Nations and organizations whose traditional territories overlap the management unit under consideration.

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Ministry of Forests, Lands,
Natural Resource Operations
and Rural Development

Office of the Minister

Mailing Address:
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Diane Nicholls, Assistant Deputy Minister and Chief Forester

BC's forests provide fibre for forest products, habitat for plants, fish and wildlife, and many other benefits essential to diverse and resilient communities. The capacity of these forests to support economic and environmental sustainability and reconciliation with Indigenous peoples is challenged by insect infestations, increasing levels of wildfire activity and other risks related to climate change. As healthy forests are essential for a healthy industry and province, I ask you consider how your determinations may encourage economic recovery and forest revitalization, improve forest health, and support approved strategies to reduce wildfire.

Since a sustainable and resilient timber supply supports BC's goals for a better, cleaner future and environmental sustainability, your AAC determinations should continue to incorporate, as appropriate, the best available information on climate change and forest health. When making your AAC determinations, please consider ways to encourage management practices that reduce greenhouse gas emissions and support forest resiliency. Practices that are consistent with established climate change strategies, adaptation, and mitigation practices, including practices that result in better fibre utilization and sector diversity, should be explored.

As new land use policies are developed and implemented to support BC's goals for economic activity, environmental sustainability, and reconciliation with Indigenous peoples, I ask that your determinations continue to incorporate, as appropriate, the best available information on the cumulative effects of multiple activities on the land base. Where the cumulative effects of timber harvesting and other land-based activities indicate a risk to natural resource values, your determinations should identify those risks for consideration in land-use planning. I also ask that you consider ways in which your AAC determinations could encourage actions or practices to mitigate the identified risks to natural resource values.

Forests are essential to build a strong, sustainable economy that supports people, communities and competitiveness and this government is focused on transitioning the forestry sector from high volume to high value production. As part of the timber supply review process, I ask that you consider ways to foster and encourage the value-added sector and increase the use of fibre. Please identify timber types that may not be reflected in harvest choice, and in your AAC determinations, examine opportunities for these timber types to sustain clean-energy jobs and value-added products or enhance ecosystem health and resiliency.

In making your AAC determinations, I ask that you consider the needs of local communities as expressed by the public during timber supply review process. This includes input that contribute to the economic recovery and sustainability of communities and is consistent with the government's broader objectives. To ensure a sustainable future for BC's forest-dependent communities, I also ask that when faced with necessary reductions in AAC's that wherever possible those reductions be no larger than necessary to avoid significant longer-term impacts.

Thank you, Diane, for your service and your care and attention to these important matters.

Sincerely,



Katrine Conroy
Minister

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Appendix 4: Information sources used in the AAC determination

The information sources considered in determining the AAC for TFL 44 include the following:

Legislation

Province of British Columbia. 2003. *Forestry Revitalization Act*. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03017_01. Current to May 10, 2023.

Province of British Columbia. 2004. Cut Control Regulation. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/17_578_2004. Current to May 23, 2023.

Province of British Columbia. 2004. *Forest Act*. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96157_00. Current to May 10, 2023.

Province of British Columbia. 2004. *Forest and Range Practices Act*. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/02069_01. Current to March 29, 2023.

Province of British Columbia. 2004. Forest Planning and Practices Regulation. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14_2004. Current to May 23, 2023.

Province of British Columbia. 2004. Government Actions Regulation. Victoria, BC.
http://www.bclaws.ca/civix/document/id/complete/statreg/582_2004. Current to May 23, 2023.

Province of British Columbia. RSBC 1996. *Heritage Conservation Act*. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96187_01. Current to May 10, 2023.

Province of British Columbia. RSBC 1996. *Land Act*. Victoria, BC.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96300_01. Current to May 10, 2023.

Province of British Columbia. RSBC 1996. *Ministry of Forests and Range Act*. Section 4 – Purposes and functions of Ministry.
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96300_01#section4. Current to May 10, 2023.

Licence Holder Plans and Information Package Review Documents

Canadian Forest Products Ltd. (2015). 2015 Canfor Forest Management Plan. Retrieved May 6, 2021, from <https://open.alberta.ca/publications/canadian-forest-products-ltd-2015-forest-management-plan>.

Canadian Forest Products Ltd. (2018). TFL 14 Management Plan #11. Prince George, BC: Canadian Forest Products Ltd.

Dymond, C. C. (2012). Forest carbon in North America: annual storage and emissions from British Columbia's harvest, 1965-2065. Carbon Balance and Management, 7, 8. Retrieved May 6, 2021, from <https://doi.org/10.1186/1750-0680-7-8>.

- Environment and Climate Change Canada. (2020). National Inventory Report 1990-2018; Greenhouse Gas Sources and Sinks in Canada. Canada's Submission to the United Nations Framework Convention on Climate Change. Ottawa: Library and Archives Canada.
- Forsite Consultants Ltd. (2018). Updating VRI From LiDAR-Derived Data - Backgrounder. Salmon Arm, BC: Forsite Consultants Ltd.
- Forsite Consultants Ltd. (2019). TFL 61 Timber Supply Analysis Information Package. Salmon Arm, BC: Pacheedaht Andersen Timber Holdings Limited Partnership.
- Jarron, L., Coops, N., MacKenzie, W., Tompalski, P., & Dykstra, P. (2020). Detection of sub-canopy forest structure using airborne LiDAR. *Remote Sensing of Environment*, 244.
- Kurz, W. A., Dymond, C. C., White, T. M., Stinson, G., Shaw, C. H., Rampley, G. J., Apps, M. J. (2009). CBM-CFS3: A model of carbon-dynamics in forestry and land-use change implementing IPCC standards. *Ecological Modelling*, 220(4), 480-504.
- Organization for Economic Co-operation and Development. (2001). Environmental indicators for agriculture 2001 (Vol.3). Paris: Organization for Economic Co-operation and Development.
- Province of British Columbia. (1998). The Procedures for Factoring Visual Resources into Timber Supply Analyses. Victoria: Province of British Columbia. Retrieved April 18, 2021, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vrm_procedures_for_factoring_timber_supply_analyses.pdf.
- Province of British Columbia. (2008). Glossary of Forestry Terms in British Columbia. Ministry of Forests and Range. Victoria: Province of British Columbia. Retrieved April 30, 2021, from <https://www.for.gov.bc.ca/hfd/library/documents/glossary/Glossary.pdf>.
- Province of British Columbia. (2009). Hardwood Management in the Coast Forest Region. Victoria: Province of British Columbia. Retrieved April 17, 2021, from [https://www.for.gov.bc.ca/ftp/rco/external!/publish/FMLT%20Publish/North%20Island%20Central%20Coast/April%2015%202015%20FMLT%20Meeting/Hardwood%20Management%20in%20the%20Coast%20Forest%20Region%205%20year%20review%20Final\(Janua....pdf](https://www.for.gov.bc.ca/ftp/rco/external!/publish/FMLT%20Publish/North%20Island%20Central%20Coast/April%2015%202015%20FMLT%20Meeting/Hardwood%20Management%20in%20the%20Coast%20Forest%20Region%205%20year%20review%20Final(Janua....pdf)
- Province of British Columbia. (2017). Climate-Based Seed Transfer. Retrieved March 28, 2021, from Province of British Columbia: <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/tree-seed/seed-planning-use/climate-based-seed-transfer>.
- Province of British Columbia. (2018). Vegetation Resources Inventory – British Columbia Ground Sampling Procedures. Victoria: Province of British Columbia. Retrieved April 11, 2021, from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/vri_ground_sampling_procedures_2018.pdf.
- Province of British Columbia. (2019, July 17). Government takes action on old growth, protects 54 groves with iconic trees. Retrieved August 30, 2021, from Province of British Columbia: <https://news.gov.bc.ca/releases/2019FLNR0189-001452>.
- Province of British Columbia. (2019). LiDAR Enhanced Forest Inventory - Product Delivery Specifications. Victoria: Province of British Columbia.
- Province of British Columbia. (2019). Provincial Logging Residue and Waste Measurements Procedure Manual - Coast, Woodlot Licenses and Community Forest Agreements. Victoria, BC: Province of British Columbia. Retrieved April 16, 2021, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-pricing/residue-and-waste/res_waste_coast_master_2b.pdf.

- Puettmann, M., & Lippke, B. (2020). The role of wood products and biomass energy in carbon stores and emissions. M. Cloughesy, & E. S. Hall, Carbon in Oregon's Managed Forests (pp. 63-90). Portland: Oregon Forest Resources Institute. Retrieved May 6, 2021, from <https://oregonforests.org/pub/carbon-oregons-managed-forests-science-review>.
- Robinson, C. (2020, June 8). LiDAR Height Assignment to Polygon. (S. Boyd, Interviewer).
- Technical Working Group. (2019). Haida Gwaii Timber Supply Review Draft Data Package, Report for the Haida Gwaii Management Council. Old Massett, Haida Gwaii, BC: Province of British Columbia.
- The Intergovernmental Panel on Climate Change. (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry. Hayama, Japan: Institute for Global Environmental Strategies. Retrieved May 6, 2021, from https://www.ipcc-nggip.iges.or.jp/public/gpplulucf/gpplulucf_files/GPG_LULUCF_FULL.pdf.
- The Intergovernmental Panel on Climate Change. (2007). AR4 Climate Change 2007: The Physical Science Basis. Cambridge, United Kingdom: Cambridge University Press. Retrieved May 6, 2020, from <https://www.ipcc.ch/report/ar4/wg1/>
- Wang, T. (2020, July 20). ClimateBC. Retrieved March 28, 2021, from ClimateBC: <https://climatebc.ca/>
- Wang T, Hamann A, Spittlehouse D, Carroll C. (2016). Locally Downscaled and Spatially Customizable Climate Data for Historical and Future Periods for North America. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0156720>
- Western Forest Products Inc. (2017). TFL 37 Management Plan 10. Campbell River, BC: Western Forest Products Inc.
- Western Forest Products Inc. (2020). TFL 44 Economic Analysis for Partition Recommendation. Campbell River: Western Forest Products Inc.
- Western Forest Products Inc. (2021, March). Big Tree Retention. Retrieved August 30, 2021, from Western Forest Products Inc.: <https://www.westernforest.com/responsibility/environment/big-tree-retention/>.
- Western Forest Products Inc. (2021). Evaluation of Inventory Estimates Using Cruise Plots In TFL 44. Campbell River, BC: Western Forest Products Inc.

Licence Holder Plans and Timber Supply Analysis Documents

- Canadian Forest Products Ltd. (2004). TFL 37 Information Package for Sustainable Forest Management Plan 9. Campbell River: Canadian Forest Products Ltd. Retrieved February 25, 2022, from <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-tenures/tree-farm-licence/management-plans/tfl-37-03-mnngment-plan-9-appendix-3-timber-supply-analysis-information-package.pdf>.
- Pienaar, L. V., & Rheney, J. W. (1995). Modeling Stand Level Growth and Yield Response to Silvicultural Treatments. Forest Science, 41(3), 629–638.
- Province of British Columbia. (2016). Arrowsmith Timber Supply Area Timber Supply Review Updated Data Package. Victoria: Province of British Columbia. Retrieved April 1, 2022, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/arrowsmith_tsa_data_package_updated.pdf.

Province of British Columbia. (2016). Great Bear Rainforest Order. Victoria: Province of British Columbia. Retrieved January 6, 2022, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/westcoast-region/great-bear-rainforest/gbr_land_use_order.pdf.

Province of British Columbia. (2020). North Island Timber Supply Area Timber Supply Review Data Package. Victoria: Province of British Columbia. Retrieved April 1, 2022, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/48tsdp_2020.pdf.

Province of British Columbia. (2021). Order for the Recovery of Marbled Murrelet (*Brachyramphus marmoratus*). Victoria: Province of British Columbia. Retrieved January 6, 2022, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/biodiv-hab-mngt/mamu/mamu_luor_2dec2021.pdf.

Province of British Columbia. (2021). Sunshine Coast Timber Supply Area Timber Supply Review Data Package. Victoria: Province of British Columbia. Retrieved April 1, 2022, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/39ts_dpkg_2021.pdf.

Sparks, A. M., & Smith, A. M. (2022). Accuracy of a LiDAR-Based Individual Tree Detection and Attribute Measurement Algorithm Developed to Inform Forest Products Supply Chain and Resource Management. (O. Viedma, Ed.) *Forests*, 13(1), 3. Retrieved February 25, 2022, from <https://www.mdpi.com/1999-4907/13/1/3/pdf>.

Western Forest Products Inc. (2010). Tree Farm Licence 44 Timber Supply Analysis Management Plan 5. Campbell River: Western Forest Products Inc.

Western Forest Products Inc. (2019, April). Big Tree Retention. Retrieved August 30, 2021, from Western Forest Products Inc. <https://www.westernforest.com/responsibility/environment/big-tree-retention/>.

Western Forest Products Inc. (2020). TFL 44 Economic Analysis For Partition Recommendation. Campbell River: Western Forest Products Inc.

Western Forest Products Inc. (2021). Evaluation of Inventory Estimates Using Cruise Plots In TFL 44. Campbell River, BC: Western Forest Products Inc.