

**BRITISH COLUMBIA  
MINISTRY OF FORESTS**

**Rationale for  
Allowable Annual Cut (AAC)  
Determination for  
Mackenzie  
Timber Supply Area**

**Effective May 4, 2023**

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## **Objective of this document**

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

## **Acknowledgement**

For preparation of the information I considered in this determination, I am indebted to staff of the BC Ministry of Forests, (the “Ministry”) in the Mackenzie Natural Resource District, the Omineca Natural Resource Region, and the Forest Analysis and Inventory Branch (FAIB). I am also grateful to the First Nations, forest industry representatives, local residents, individuals and other stakeholders who contributed to this process.

## **Statutory framework**

Section 8 of the *Forest Act* requires the chief forester to determine AACs for TSAs and Tree Farm Licences (TFL) after considering certain specified factors. Section 8 of the *Forest Act* is reproduced in full as Appendix 1 of this document.

## **Description of the Mackenzie Timber Supply Area**

The Mackenzie TSA, located in the north-east interior of the province, is the fourth largest TSA in the province and covers approximately 6.41 million hectares. The Rocky Mountain Trench, with flat to gentle terrain, runs north-south through the center of the TSA, with the rugged Rocky Mountains on the east side and the more rounded Omineca Mountains to the west. The Williston Reservoir is within the central portion of the TSA and within the Rocky Mountain Trench. The Williston Reservoir is the largest reservoir in BC.

In the TSA the largest community is Mackenzie (3700 residents). Mackenzie was built in the 1960's during the construction of the W.A.C. Bennett Dam. Other smaller communities within the TSA include Kwadacha, Tsay Keh, Germansen Landing, and Manson Creek.

The traditional territories of 16 First Nations overlap the Mackenzie TSA. The First Nations are: Binche Whut'en, Blueberry River First Nations, Doig River First Nation, Fort Nelson First Nation, Gitksan, Halfway River First Nations, Horse Lake First Nation, Kwadacha, Nak'azdli Whut'en, McLeod Lake Indian Band, Prophet River First Nation, Sauteau First Nation, Tahltan First Nation, Takla Nation, Tsay Keh Dene Nation and, West Moberly First Nations.

Since time immemorial, First Nations have resided on the lands of the Mackenzie TSA. The two Indigenous communities that exist today (Kwadacha and Tsay Keh) were formed as a result of the historically acknowledged forced relocation of the First Nations following the flooding of a large part of their lands and resources that once flourished along the historic sections of the Finlay and Peace Rivers, now known as the Williston Reservoir. The community of Kwadacha is located north of Mackenzie at the confluence of the Fox, Kwadacha, and Finlay rivers in the Rocky Mountain Trench. The community of Tsay Keh is located near the northern terminus of the Williston Reservoir. Just outside the TSA, the McLeod Lake Indian Band is located at the northern tip of McLeod Lake. First Nations extensively utilize the lands and resources within the TSA for sustenance and maintenance of cultural well-being through cultural practices including hunting, trapping, fishing, gathering and spiritual uses.

The TSA is one of three in the Omineca Region and is administered by the Mackenzie Natural Resource District located in Mackenzie.

## **History of the AAC**

The AAC for the Mackenzie TSA was determined six times since 1981. Prior to the mountain pine beetle (MPB) outbreak in 2010, the AAC was approximately 3.0 million cubic metres. In 2014, the chief forester increased the AAC to encourage salvage of dead pine resulting from the MPB outbreak. The AAC for the Mackenzie TSA was set at 4.5 million cubic metres. No more than 950 000 cubic metres of the AAC could be non-pine of which no more than 300 000 could originate from the southwest (SW) partition zone – the area that is west of Williston Reservoir and south of Omineca Provincial Park and Omineca Arm.

In February 2019 the AAC partition was amended to be no more than 2.0 million cubic metres of live, uninfested coniferous timber of which a maximum of 500 000 cubic metres per year could be harvested from the SW partition zone. In the 2019 AAC partition amendment, the chief forester also specified that harvest should focus on dead, dying and damaged timber throughout the TSA. The limit on live, uninfested timber in the SW portion of the TSA was set to reduce the rate of harvesting in this area where most of the harvesting historically occurred.

## **New AAC determinations**

Effective May 4, 2023, the new AAC for the Mackenzie TSA will be 2.39 million cubic metres of which a maximum of 1.17 million cubic metres may be harvested in the southwestern partition zone. This new AAC is 46.9 percent below the current AAC and 19.5 percent below the base case harvest projection. This AAC will remain in effect until a new AAC determination is made, which must take place within 10 years of this determination.

## **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 AAC determinations is in the form of a timber supply analysis and its inputs related to forest inventory, growth and yield and management practices. 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.

Computer models cannot incorporate all of 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 decisions such as AAC determinations. Such information does provide valuable insight into potential impacts of different resource-use assumptions and actions, and thus forms an important component of the information I must consider in AAC determinations.

In determining the AAC for the Mackenzie TSA I have considered known limitations of the technical information provided. I am satisfied that the information provides a suitable basis for my determination.

## **Guiding principles for AAC determinations**

Given the large number of periodic AAC determinations required for British Columbia'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 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 *Forester's 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 wood supply.

These guiding principles focus on responding to uncertainties; incorporating information related to First Nations' rights, titles, and interests; and considering information related to integrated decision making, cumulative effects, and climate change.

#### *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.

Two important ways of dealing with this uncertainty are:

- (i) managing risks by evaluating the significance of specific uncertainties associated with the current information and assessing the potential current and future social, economic, and environmental risks associated with a range of possible AACs; 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 various 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, as closely as possible, that 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 any 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.

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 government land use decisions must be followed by detailed implementation decisions requiring, for instance, further detailed planning or legislated designations such as those provided for under the *Land Act* and 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 decision 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.

Where appropriate, information will be considered 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 alternate strategies for dealing with information uncertainty may be to delay AAC determinations or to generally reduce AACs in the interest of caution.

However, given that there will always be uncertainty in information, and due to the significant impacts that AAC determinations can have on communities, I believe that no responsible AAC determination can be made solely on the basis of a precautionary response to uncertainty with respect to a single value.

Nevertheless, 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 in evaluating this uncertainty.

#### *First Nations*

The BC government has committed to true, lasting reconciliation with Indigenous peoples, including fully adopting and implementing the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Reconciliation and implementation of UNDRIP will likely require changes to policies, programs, and legislation, which will take time and involve engagement with Indigenous peoples. While this work is undertaken, BC is committed to fulfilling its legal obligations to consult and accommodate Aboriginal Interests consistent with the Constitution, case law, and relevant agreements between First Nations and the government of BC.

Where First Nations and the Province are engaged in collaborative land and resource planning, the Province may make general commitments regarding stewardship and other aspects of resource management. Where such commitments have been made, I will consider them when determining AACs, within the scope of my statutory authority.

As is the case for land use and management planning in general, where land use zones or management objectives resulting from collaborative planning between First Nations and the Province have not been finalized, it is beyond the statutory authority of the chief forester to speculate on final outcomes. 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.

Where the nature, scope and geographic extent of Aboriginal rights and title have not been established, the Crown has a constitutional obligation to consult with First Nations regarding their Aboriginal Interests in a manner proportional to the strength of those Interests and the degree to which they may be affected by the decision. The manner of consultation must also be consistent with commitments made in any agreements between First Nations and the Province.

In this regard, full consideration will be given to:

- (i) the information provided to First Nations to explain the timber supply review process and analysis results;
- (ii) any information brought forward through consultation or engagement processes or generated during collaboration with First Nations with respect to Treaty rights or Aboriginal Interests, including how these rights or interests may be impacted;
- (iii) any operational plans and/or other information that describe how First Nations' Treaty rights or Aboriginal Interests are addressed through specific actions and forest practices; and
- (iv) existing relevant agreements and policies between First Nations and the BC Government.

Treaty rights or 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*. 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.

Established Aboriginal title lands (meaning declared by a court or defined under an agreement) and other areas, such as Treaty Settlement Lands or Indian Reserves, are not provincial Crown land.

Consequently, the timber on these lands does not contribute to the AAC of the timber supply area or tree farm license with which they overlap. 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, either by court declaration or by agreement, could affect timber supply, given uncertainties about the scope, nature, and geographic extent of title. Until land has been established as Aboriginal title land, it remains as provincial land managed by the province, and will contribute to timber supply.

#### *Integrated decision making and cumulative effects*

One of the responsibilities of the Ministry is to plan the use of forest and range resources such that the various natural resource values are coordinated and integrated. 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 timber supply.

With respect to cumulative effects, I must interpret related information according to my statutory authority. As emphasized above, the chief forester is authorized only 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 pass to those responsible for such planning. Information on cumulative effect can also support considerations related to Aboriginal Interests.

#### *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. Nevertheless, 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 more definitive information 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 appear to be 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 could provide buffers against uncertainty. The appropriate mix of timber supply management approaches is ultimately a social decision.

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. Analysis will be useful for exploring options and trade-offs. Any management decisions about the appropriate approach and associated practices will be incorporated into future AAC determinations. In general, the requirement for regular AAC reviews will allow for the incorporation of new information on climate change, on its effects on forests and timber supply, and on social decisions about appropriate responses as it emerges.

### **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 projections 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 a data 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 model, a series of timber supply projections can be produced to reflect 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 harvest projection, 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, demonstrated performance and established management requirements.

Because it represents only one of several theoretical timber supply 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 projection of timber supply, whose validity, as with all the other projections provided, depends on the validity of the data and assumptions incorporated into the computer model used to generate it.

Therefore, much of what follows in the considerations outlined below is an examination of the degree to which the assumptions made in generating the base case are realistic and current, and the degree to which resulting projections of timber supply must be adjusted to more properly reflect the current and foreseeable situation.

These adjustments are made based on informed judgment using currently available information about forest management, and that information may well have changed since the original data 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 analyses I am provided are 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, particularly in cases characterized by a large degree of unquantified

uncertainty, 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 the Mackenzie TSA**

The base case for Mackenzie TSA was prepared by FAIB staff using the Ministry's spatial timber supply model (STSM2020) which was developed using the Spatially Explicit Landscape Event Simulator (SELES) modelling framework. STSM2020 was used to project harvesting and growth over an analysis horizon of 250 years.

The data and assumptions used in the base case are intended to provide a reasonable representation of current forest management practices based on evidence of actual practices, using the best available information. The base case is used as reference point to assess the timber supply in Mackenzie TSA, including exploration of the potential impacts of uncertainties through sensitivity analyses.

The timber supply projections are not predictions, because many unforeseeable events will certainly occur, and practices and knowledge will change and evolve. Given this change and uncertainty, the projections may change in the future. Changes in practices and information will be incorporated into future AAC determinations. However, the harvest projections developed to support this AAC determination were designed to provide a rigorous and reasonable basis for the AAC decision and be consistent with the guiding principles for AAC determinations.

Much of what follows in the considerations outlined below is an examination of the degree to which the assumptions made in generating the base case harvest projection are accurate, realistic and current, and of the degree to which resulting projections of timber supply must be adjusted to more properly reflect the current situation. These adjustments are made on the basis of informed judgment, using currently available information about forest management some of which may have changed since the original *Data Package* was assembled.

A *Discussion Paper*, which contained the results of the timber supply analysis, was published in July 2022. The published base case shows that an initial harvest level of 2.97 million cubic metres per year is maintained for 10 years before declining to 2.47 million cubic metres per year by the end of the third decade. The mid-term harvest level is sustained for 60 years before increasing to the long-term harvest level of 3.13 million cubic metres per year in the 20th decade.

As discussed under '*History of the AAC*', in 2019, the chief forester established AAC partitions intended to limit the harvesting of timber in the southwest portion of the TSA (the area that is west of Williston Reservoir and south of Omineca Provincial Park and Omineca Arm) and to encourage the salvage of dead timber. The Ministry's data indicates that licensees have not complied with either the partition limiting the amount of harvesting in the southwest or the partition limiting the harvest of green trees. In this timber supply review, the harvest projected in the base case is from live trees only, and it also assumes that the current geographic partition does not apply. For this determination, I was also provided harvest projection scenarios showing compliance with the existing geographic partition, an alternate geographic partition, and a scenario showing a 25 percent reduction of timber volume from all stands within the TSA. These scenarios all assume that there will not be any salvage of dead timber.

I was also provided with scenarios showing the amount of dead volume that could be salvaged during the normal course of harvesting the live volume. This dead volume is the "bycatch" generated from normal harvesting operations.

The base case was used only as a point of reference for the consideration of many factors that affect timber supply and the determination of the AAC. I reviewed all inputs to the base case, including how the environmental objectives in the Mackenzie Land and Resource Management Plan (LRMP) were incorporated into the analysis. I also reviewed in detail the assumptions and methodology incorporated in the base cases, as well as the model output, including species distribution over time; growing stock

projections by age class over time; average age, area, and volume harvested annually; and other factors as described in my considerations below. For this determination I am satisfied that the base case harvest projection, the sensitivity analyses, and the alternate scenarios have provided a suitable basis for my assessment of the timber supply for the Mackenzie TSA.

## **Alternative scenarios conducted for the TSA**

### *Compliance with existing geographic partition*

In this scenario the southwest partition zone contributes 1.27 million cubic metres per year for the first 10 years before decreasing to the mid-term harvest level of 1.17 million cubic metres per year in the third decade. The harvest projection from the rest of the TSA is 1.53 million cubic metres per year for the first 10 years before declining to the mid-term harvest level of 1.22 million cubic metres per year in the fourth decade. The combined initial harvest level from the geographic partitions is 2.8 million cubic metres per year (six percent lower than the base case).

### *Alternate geographic partition*

Given the low volume being harvested in the northern portion of the TSA where water transport is required, staff proposed a southern partition zone which encompasses the entire “winter roaded” portion of the TSA. This is the area that is south of the Peace Arm in the east and south of the Omineca Provincial Park in the west. In this scenario the southern partition zone can support an initial harvest level of 1.51 million cubic metres per year for 20 years before transitioning to a mid-term harvest level of 1.4 million cubic metres per year in the third decade. The harvest projection from the rest of the TSA is 1.41 million cubic metres per year for 20 years before transitioning to the long-term harvest level of 1.01 million cubic metres per year in the third decade. The combined initial harvest level of 2.93 million cubic metres is almost the same as the base case harvest.

### *Reduced timber volume yields from all stands in the TSA (the south partition yield 75 percent scenario)*

As described under ‘*First Nations engagement*’, Ministry staff and some First Nations formed a Collaborative Technical Working Group (CTWG) which worked collaboratively to share information and review all inputs to the timber supply model used in the analysis. First Nations participating in the CTWG wanted to evaluate a timber supply projection that exercises caution by lowering the volume yield estimates, thereby lowering the short-term harvest level, to reduce the risk of overharvest and potential adverse impacts to other resource values. While there is no substantive data to support the assumption that yield estimates applied in the base case should be lower, volume yields for all stands in this scenario were reduced by 25 percent and compliance with the southern partition zone described above were modelled in this scenario.

Under this scenario the harvest projected from the southern partition zone is 1.0 million cubic metres per year. The harvest from the rest of the TSA is 600 000 cubic metres per year. The total projected harvest of 1.6 million cubic metres per year is 46 percent below the base case harvest in the first decade. This level is maintained for 90 years before the harvest is projected to increase to the long-term level of 2.08 million cubic metres 190 years from now.

### *Salvage alternative 1*

The three salvage scenarios all assume that the dead trees harvested are the bycatch resulting from harvesting stands predominantly composed of live trees; salvage is not focussed on dead trees. This scenario assumes that the harvest of merchantable-dead volume could occur anywhere in the TSA for 10 years following mortality. A starting harvest level of 3.0 million cubic metres per year is maintained for 10 years before declining to the mid-term harvest level in the fourth decade. During the first decade, an average of approximately 370 000 cubic metres per year of dead volume is harvested.

*Salvage alternative 2*

Under this scenario it is assumed that the harvest of merchantable-dead volume could occur only in the southern portion of the TSA (the area bounded by the Peace Arm in the east and Omineca Provincial Park in the west) for the 10 years following mortality. A starting harvest level of 3.1 million cubic metres per year is maintained for 10 years before declining to the mid-term harvest level in the third decade. During the first decade an average of approximately 320 000 cubic metres per year of dead volume is harvested.

*Salvage alternative 3*

This scenario assumes that the harvest of merchantable-dead volume could occur only in the southern portion of the TSA for the five years following mortality. A starting harvest level of 2.98 million cubic metres per year is maintained for 10 years before declining to the mid-term harvest level in the third decade. During the first five years an average of approximately 320 000 cubic metres per year of dead volume is harvested.

**First Nations engagement**

The traditional territories of 16 First Nations overlap the Mackenzie TSA. The First Nations are: Binche Whut'en, Blueberry River First Nations, Doig River First Nation, Fort Nelson First Nation, Gitksan, Halfway River First Nations, Horse Lake First Nation, Kwadacha, Nak'azdli Whut'en, McLeod Lake Indian Band, Prophet River First Nation, Saulteau First Nation, Tahltan First Nation, Takla Nation, Tsay Keh Dene Nation and, West Moberly First Nations.

Five of the First Nations communities in the TSA currently have Forest Consultation and Revenue Sharing Agreements with the Ministry. A number of Nations are working with the Province to build relationships and address concerns associated with land and resource use. The Ministry and First Nations have collaborated on this timber supply review to minimize and accommodate potential impacts to First Nations interests. The Province of British Columbia and Tsay Keh Dene Nation, Kwadacha and Gitksan First Nations have signed collaboration agreements. The agreements provide a framework for the Province and the First Nations to increase and deepen collaboration on TSR.

In addition to the collaboration agreements, representatives from Kwadacha Nation, Tsay Keh Dene Nation, Takla Nation, Gitksan, Nak'azdli Whut'en and McLeod Lake Indian Band and Ministry staff formed a Collaborative Technical Working Group. The CTWG shared information and transferred knowledge about the base case timber supply analysis and related sensitivity analyses that reflect current management practices. The CTWG also collaboratively developed information requests and additional sensitivity analyses to assess (i) the past, present, and potential future effects of forest management practices, and (ii) the effects of First Nation's proposed changes to the timber harvesting land base and management practices, on timber supply and on First Nations' S.35 Rights as well as First Nations' interests related to stewardship/cultural resources and socio-economics (First Nations' interests). For some factors, the review by the CTWG resulted in changes to the inputs to the base case. For other factors, the CTWG review informed the sensitivity analyses performed to test the effect of those proposed changes to the base case timber supply.

The First Nations participating in the CTWG provided comments on the analysis results and those comments were included in the *Discussion Paper* which was published in July 2022. The CTWG comments in the *Discussion Paper* and for the factors I considered in making this decision were informed by a *Technical Report* which was prepared by the First Nations participating in the CTWG. These comments were presented to me as I reviewed each of the factors I considered when making this AAC determination.

In my considerations for the Mackenzie TSA, I am mindful of the significant interest shown by First Nations in the harvest level and the effect of past and present harvesting on their interests and ability to meaningfully practice their rights. I am also aware of the government's desire for reconciliation with First Nations and the government's intention to change the way forests are managed in this province as described in the June 2021 document titled *Modernizing Forest Policy in British Columbia: Setting The Intention and Leading the Forest Sector Transition* (Intentions Paper).

On October 18 and 19, 2022, I was in Prince George where I met separately with representatives from Takla Nation, Gitksan, Tsay Keh Dene, Nak'azdli Whut'en, McLeod Lake Indian Band and Kwadacha. At these meetings I listened to the concerns and issues raised by the representatives, and I will reflect on what I heard when making the AAC decision. Concerns included the need for further wildlife habitat and stream protection to ensure First Nations can continue to practice their Aboriginal rights, the need to protect cultural heritage resources for cultural survival, and the need to safeguard water quality and quantity.

Concerns and recommendations from Takla were:

- *They are concerned about the effects of timber harvesting on their ability to meaningfully exercise their rights.*
- *They are concerned that they are being blamed for the reductions in AAC.*
- *They would like an area-based tenure, First Nations Woodland Licence (FNWL), so they could manage the area for values important to them.*
- *They are having trouble finding areas suitable for salvage operations.*

Concerns and recommendations from Gitksan were:

- *The consultation process is flawed.*
- *They would like to be part of the decision and so influence what occurs on the land.*

Concerns and recommendations from Tsay Keh Dene (TKD) were:

- *They recommend to the Province that it accelerates discussions on TKD forestry-related interests including greater access to forestry tenures and equitable revenue sharing for TKD as accommodations for impacts to TKD rights and title from forestry activity in TKD territory.*
- *If a north-south partition is established, resort to a soft partition (i.e., not enforced by the Minister) first to encourage Indigenous groups and stakeholders to collaborate in implementing the partition.*
- *They recommend to the Province that as an accommodation for impacts to TKD rights and title from forestry activity in TKD territory, the Province initiate formal discussions with TKD on the status of the Ingenika Protected and Conserved Area and the Chuyaza (Helicopter Lakes) Conservancy.*
- *They would like a bioenergy partition established for the Mackenzie TSA that focuses on dead and deciduous volume to support the development of the bioenergy industry in the Mackenzie region including the Sekani Biofuels LP project.*

Concerns and recommendations from Nak'azdli Whut'en were:

- *They want more cooperative/collaborative management in their area.*
- *They are concerned about whether their Immediate Measures proposals will be respected. Need to reduce the impact of logging on other resources.*

- *They would like to continue harvesting dead wood to supply the biofuel plant which they jointly own.*

Concerns and recommendations from Kwadacha were:

- *No forestry activities should occur north of the community of Kwadacha.*
- *Need to work with licensees to control operations in their territory.*
- *They would like their existing First Nations Woodland Licence to be expanded to include all the THLB in their traditional territory.*

Concerns and recommendations from McLeod Lake Indian Band were:

- *The rate of harvest in their territory in the southwest of the TSA is too high.*
- *They do not support the old-growth deferrals proposed by the Technical Advisory Panel. Instead, the nation proposes the creation of a park in the Callizone area.*
- *They would like a First Nations Woodland Licence covering the southwest portion of the TSA.*

Concerns from First Nations who were not able to meet with me were presented to me at the AAC determination meeting by Ministry staff as documented throughout this rationale and in the First Nations consultation record which I reviewed. On October 20, 2022, I had the opportunity to take a helicopter tour over parts of the TSA to observe the condition of the forest and discuss concerns raised by First Nations with District staff.

A representative for Tsay Keh Dene and a representative for the CTWG First Nations participants were present at the AAC determination meeting held on December 7 and 8, 2022. These representatives presented their comments and contributed insights as each factor was discussed during these two days. These factors were considered priority factors for the CTWG. The representatives were not present for the following two days when staff continued presenting the remaining factors for my consideration, and I rendered my preliminary decision on the new AAC for the Mackenzie TSA.

## **Licensee engagement**

The previous chief forester of the province toured the TSA on July 25, 2018, with the chief forester and operations manager of Canadian Forest Products Ltd. (Canfor). During that tour, Canfor's representatives requested that the provincial chief forester not force them to harvest dead timber in the north of the TSA outside the southwest partition zone. On October 17, 2022, I also held separate meetings with representatives from Canfor, Conifex Timber Inc., Dunkley Lumber Ltd., and BC Timber Sales to discuss their concerns and recommendations.

Conifex Timber stated there is little to no economic value remaining in the dead profile. Conifex does not believe that a stand-type or species partition will be effective but will support a geographic (north/south) partition. Conifex stated that they are abiding by the current partition and would like any future partitions strictly enforced. Conifex is committed to being good partners and are working collaboratively with Tsay Keh Dene and Kwadacha.

Dunkley Lumber believes in maintaining good working relationships and informed me that they have formed partnerships with First Nations and other licensees and are operating throughout the TSA. They stated that they are following the current partition rules and would prefer any future partitions I set to not be rigidly enforced. They find it increasingly difficult to harvest dead wood.

BC Timber Sales informed me that they are operating throughout the TSA and are working cooperatively with Kwadacha, Tsay Keh Dene and McLeod Lake Indian Band. They support a geographic (north/south) partition and would like the AAC to be based on a sustainable green timber supply. BCTS is willing to employ partial harvesting where required for protection of non-timber values but since they

auction timber sales licences and do not actually harvest any timber, they are not able to enforce this practice.

Canfor stated there is little to no economic value remaining in the dead profile. Canfor does not believe that a stand-type or species partition will be effective but will support a geographic (north/south) partition.

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

I have reviewed the information for 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.

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 issues raised and the reasoning that led to my conclusions.

Table 1. List of factors accepted as modelled in the base case.

<i>Forest Act section and description</i>	<b>Factors accepted as modelled and not discussed further in the rationale</b>
8(8)(a)(i) the composition of the forest and its expected rate of growth on the area	<ul style="list-style-type: none"> <li>• Non-forest and non-productive forest</li> <li>• Existing roads, trails, and linear corridors</li> <li>• Future roads</li> <li>• Provincial parks, protected areas and ecological reserves</li> <li>• Areas excluded for ungulate winter range</li> <li>• Areas excluded for wildlife habitat areas</li> <li>• Mugaha marsh sensitive area</li> <li>• Low productivity sites</li> <li>• Stand-level retention</li> <li>• Economic and physical inoperability</li> </ul>
8(8)(a)(ii) the expected time that it will take the forest to become re-established following denudation	<ul style="list-style-type: none"> <li>• Regeneration delay</li> </ul>
8(8)(a)(iii) silviculture treatments to be applied to the area	<ul style="list-style-type: none"> <li>• Forests for Tomorrow</li> </ul>
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	<ul style="list-style-type: none"> <li>• Utilization standards and compliance</li> <li>• Decay, waste and breakage</li> <li>• Minimum harvestable ages and volume</li> </ul>
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	<ul style="list-style-type: none"> <li>• Scenic resources and visual quality objectives</li> <li>• Recreation resources</li> <li>• Crown land plan</li> <li>• Wildlife, ungulate winter ranges, wildlife habitat areas</li> </ul>
8(8)(a)(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber	<ul style="list-style-type: none"> <li>• Harvest assumptions</li> <li>• Operating areas</li> <li>• Carbon modelling</li> </ul>
8(8)(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area	<ul style="list-style-type: none"> <li>• Alternative harvest flows</li> </ul>
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	<ul style="list-style-type: none"> <li>• Economic and social objectives of the Crown</li> </ul>
Section 8(8)(e) Abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area	<ul style="list-style-type: none"> <li>• Mountain pine beetle</li> <li>• Balsam bark beetle and decline</li> </ul>



**Forest Act Section 8 (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**

*- general comments*

The total land area of the Mackenzie TSA is 6.41 million hectares. After removing areas not managed by the Province, non-forest and non-productive areas, and areas managed by area-based tenure holders the remaining forested area is 3.0 million hectares (47 percent of the TSA area). This area is referred to as the analysis forest land base (AFLB) and contributes to timber and non-timber objectives.

The timber harvesting land base (THLB) is an estimate of the land where timber harvesting is considered both legally available and economically feasible, given the objectives for all relevant forest values, 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.

As part of the process used to define the THLB, a series of deductions were made from the AFLB. These deductions account for biophysical, economic or ecological factors that reduce the forested area available for harvesting. For the Mackenzie TSA, the THLB that is available after deductions are applied is 1 228 612 hectares. The THLB represents about 19 percent of the total area and about 41 percent of the AFLB.

In reviewing these deductions, I am aware that some areas may have more than one classification. To ensure accuracy in defining the THLB, the FAIB analysts took care to not double-count the area associated with overlapping objectives. Hence, a specific deduction for a given factor reported in the analysis or the AAC rationale does not necessarily reflect the total area with that classification; some portion of it may have been deducted earlier under another classification.

For this determination, I accept that the approach used to determine the THLB for the Mackenzie TSA base case was appropriate.

*- excluded and private lands*

Excluded and private lands are types of land not contributing to the AAC set for a TSA. First Nations woodland licences, community forests, woodlot licences and federal parcels are examples of the types of land excluded from my AAC consideration. I am pleased to see that the Kwadacha First Nation have obtained a woodland licence totalling about 234 000 hectares in their traditional territory. Kwadacha are able to manage this land for timber and non-timber values that are important to the nation.

*- areas excluded for old growth management*

Old growth management areas (OGMA) are spatially-defined areas of old growth forest that are established by a Ministerial Order under Section 93.4 of the *Land Act*. OGMA's were established for landscape units (LU) in the southern portion of the TSA in October 2010. The spatial OGMA's are assumed to reserve a sufficient area of old forest to meet the old-seral biodiversity requirements for the LU.

The gross area of OGMA's in the Mackenzie TSA is 62 192 hectares while the net area excluded from the THLB is 46 293 hectares. In October 2021, government's Old Growth Technical Advisory Panel (TAP) identified additional priority areas to be deferred from harvesting but to date there has not been a final decision on whether, and how much of these areas will become OGMA's.

The CTWG First Nations stated that deferring harvesting in old-growth areas identified by the TAP for 10 years and then making them available for harvesting puts Indigenous Rights at extreme risk.

I do not have the authority to make land use decisions attributable to the amount of area deferred for old growth management considerations in any areas of the province. Therefore, for this determination, I will not make any adjustments to the base case harvest projection to account for additional old growth management areas. When the government makes a final decision on the amount of OGMA's in the TSA, the AAC may be adjusted to account for that decision if necessary, and it will be reflected in future AAC decisions. The requirement for regular AAC reviews will ensure that future determinations address ongoing plan implementation decisions.

*- forest inventory: general comments*

The Vegetation Resources Inventory (VRI) is the standard for forest cover inventories in the province of British Columbia. The VRI is a photo-based, two-phase program. Phase 1 delineates polygons of homogeneous land cover types through photo interpretation and provides estimates of the vegetation attributes for each polygon. Phase 2 is ground sampling to verify the accuracy of volumes and some key phase 1 vegetation attributes. The Phase I VRI program for the Mackenzie TSA was completed in 2012 and covers the southern two-thirds of the TSA. Most of the southern portion of the TSA (67 percent) is based on aerial photography acquired between 1999 and 2010. The Phase 2 ground sampling was not done for this TSA, therefore there were no adjustments made to the Phase 1 attributes. Instead, ground sample data from the change monitoring inventory (CMI) and young stand monitoring (YSM) programs are used to describe the accuracy of the inventory. Data from the CMI indicate that the Phase 1 volume estimates are a reasonable approximation of the ground volume. The YSM data indicate that the volume projections for those young stands are less than the ground sampled volumes. The inventory data have been updated to 2021 for recent harvesting activities and major disturbances such as fires.

The Mackenzie TSA was severely affected by mountain pine beetle (MPB) epidemic that peaked between 2009 and 2010. In 2015, the Ministry used estimates of dead pine volume projected by the BC Mountain Pine Beetle (BCMPB) model to account for this loss, and adjust stand volumes in the inventory. CMI data indicate that the actual dead volume is less than the estimated dead volume used to adjust the inventory. Since the yield tables developed for the base case include live volume only, it is likely that the volume projections used in this analysis underestimate the actual live volume.

The CTWG First Nations questioned the accuracy of mortality estimates from the BCMPB model. They pointed out that it was poorly calibrated for the Mackenzie TSA due to a lack of aerial overview surveys to estimate pine mortality from 2007 to 2009.

I recognize the difficulty in obtaining accurate estimates of live and dead volumes when a major disturbance has occurred and a new Phase I inventory is not possible. Since this determination includes live volume only, and this component is likely underestimated, I will not make any adjustments to the base case harvest projection to account for dead volume in the forest inventory.

*- natural stand yield estimates*

Existing natural stands are those that have not been logged or have not received silviculture treatments such as planting or spacing. Natural stand volumes were projected using the Variable Density Yield Projection (VDYP7) model. VDYP7 is an empirical growth and yield model for natural stands, based on data from temporary inventory sample plots and permanent growth and yield sample plots.

As discussed above under '*Forest inventory: general comments*' the inventory attributes were already adjusted for mortality caused by the MPB epidemic. VDYP7 used the attributes from each individual forest stand to project the live volume for that stand. The live volume estimates were then adjusted in the timber supply model to account for losses due to natural disturbance not captured in the inventory such as spruce bark beetle and balsam bark beetle.

In areas affected by MPB, it is expected that the remaining live trees and seedlings will grow quickly and occupy the space created by the dead trees. In stands affected by MPB, there is little data on how these complex unmanaged stands are regenerating. Further, the future growth dynamics of these stands and their ability to contribute to timber supply is largely unknown. In the base case, it was assumed that after 40 years the seedlings growing in the mortality spaces will start contributing to the merchantable volume of the stand and the resulting stand will then grow to a volume similar to the original stand before the MPB outbreak.

The CTWG First Nations are concerned that the data used to calibrate the VDYP7 growth functions was not as described on the VDYP7 website, was missing a significant number of sample plot re-measurements, contained compilation errors for stems per hectare, basal area and stand volume, and was missing most of the breast height ages collected throughout the 1990s.

The CTWG First Nations are also concerned that the methodology used to develop yield tables for stands affected by the MPB epidemic does not account for the different stand types and their associated secondary stand structure. They believe that yield estimates produced by the SORTIE model, which is designed to model damaged stands, indicate that the method used in the base case overestimates future volume for unharvested MPB affected stands.

As discussed above under ‘*Forest inventory: general comments*’ data from the CMI indicate that the Phase 1 volume estimates in the VRI are a reasonable approximation of the ground volume. The CTWG First Nations questioned the statistical validity of this conclusion and stated that they will conduct their own analysis, using the live and dead volumes used in the TSR process, and include the results in the next version of the *CTWG First Nations Technical Report*.

The Ministry biometrician who conducted the analyses stated that “statistical analysis suggests that the ratio of CMI ground sample yield to phase 1 yield estimates likely falls within a region of practical equivalence and as such the phase 1 should be considered a reasonable approximation of the ground condition”.

I have complete confidence in the advice of the Ministry’s biometrician. I have not seen any evidence that the volumes projected for natural stands are overestimated in the base case. The data I saw indicated that the volumes may be underestimated. At this time, I will not make any adjustments to the base case harvest projection to account for natural stand volumes used in this analysis.

*- site productivity estimates*

The measure of forest site productivity used in British Columbia is site index. For a particular species, site index is the height of the largest diameter site tree at a breast-height age of 50 years. The growth and yield models used by the Ministry require potential site index as a necessary input to develop projected volume yield tables.

In the base case, volume estimates for natural stands used site index estimates provided in the VRI, while volume estimates for managed stands used site index estimates from the Provincial Site Productivity Layer (PSPL) version 7. The PSPL is a database of site index values for commercial species, which can be linked to the ecological, biophysical, and/or climatic conditions of sites across the province.

There are two sources of site index estimates in the PSPL. The first source uses the site index by biogeoclimatic ecosystem classification (SIBEC) model, which provides site index estimates based on ecosystem classifications from predictive ecosystem mapping (PEM) or terrestrial ecosystem mapping (TEM). The other source is the biophysical model developed by FAIB, which is a regression equation that predicts site index based on biogeoclimatic ecosystem classification (BEC) and biophysical variables, such as slope, aspect, elevation, and climate variables. The biophysical model is applied where the PEM or TEM data required for SIBEC are not available or are not reliable. There is very little area covered by

approved PEM/TEM mapping in the Mackenzie TSA, so most of the TSA (> 90 percent) has PSPL site index values produced by the biophysical model.

YSM data indicate that the PSPL tends to underestimate the site index for young spruce stands by an average of 18 percent in the Mackenzie TSA. Sensitivity analysis explored the effect on timber supply of increasing the average site index for managed spruce stands by 18 percent. This change increased short-term timber supply by about three percent and long-term timber supply by about 14 percent.

The CTWG First Nations are concerned that the uncertainty in PSPL estimates of managed stand site productivity is not being properly accounted. They stated that a) most of the TSA is not covered by PEM/TEM and therefore estimates are based on the biophysical model, and b) there are no PSPL estimates for the Spruce-Willow-Birch (SWB) BEC zone and estimates for the Boreal White and Black Spruce (BWBS) zone are used as a surrogate.

The Ministry acknowledges that it is preferable to use SIBEC estimates of site index but since the necessary PEM/TEM mapping is not available for this TSA, it is appropriate to use the biophysical model. Staff informed me that the SWB zone comprises only 1.6 percent of the THLB, therefore using the BWBS as a surrogate represents a minimal risk to timber supply. I account for the underestimation of spruce site productivity in my determination as discussed under '**Reasons for Decision**'.

*- managed stand yield estimates*

Managed stands are those stands that have already been harvested and reforested. To produce yield tables for managed stands FAIB used the Reporting Silviculture Updates and Land Tracking System (RESULTS) data to incorporate both planting data as well as free-growing survey data, thus accounting for species changes after planting due to ingress or mortality. A managed stand yield table (MSYT) is developed for every existing managed stand. Where data was insufficient to generate a yield table, stands were assigned an aggregate yield table. These tables were produced using a species composition and stem density derived from an average of the BEC zone and subzone based on recent planting history in the TSA.

In this analysis, managed stand yield projections were produced using Table Interpolation Program for Stand Yields (TIPSY). TIPSY provides yield tables for single-species and even-aged stands based upon the interpolation of yield tables generated by the individual tree growth model Tree and Stand Simulator (TASS). Mixed species yield tables generated by TIPSY are weighted averages of single-species yield projections and do not directly consider inter-species interactions. BatchTopsy Composer version 2019.10.28 was used for this analysis. This version uses a database of TASS III generated yield tables for lodgepole pine and white spruce and TASS II generated yield tables for all other species.

Existing managed stands regenerated prior to 1987 were assumed to have regenerated naturally because stands regenerated prior to 1987 have limited planting records and were frequently regenerated without stocking standards.

To verify that managed stand growth aligns with the TIPSY volume projections FAIB initiated a Young Stand Monitoring (YSM) sampling program across the province. In 2018, FAIB established 51 YSM plots in 15- to 50-year-old stands across the Mackenzie TSA. The data collected indicate that:

- the MSYT underestimated stand volume;
- the PSPL underestimated spruce site index by an average of 18 percent;
- the deciduous proportion in the YSM samples was 20 percent; and,
- there was 75 percent agreement between the species composition from YSM ground samples and the MSYT inputs (derived from RESULTS and the VRI).

The CTWG First Nations are concerned that: a) the YSM sample plots have not yet been re-measured to provide localized growth increment data to validate TIPSYS growth projections; and b) the statistical analysis of the YSM data is inappropriate and an analysis of equivalence should have been used instead.

I was informed that the YSM samples established in 2018 in the Mackenzie TSA are scheduled for five-year remeasurement in 2023. In neighbouring TSAs where the five-year remeasurements were completed, the data show that actual ground measured growth rates are consistent with, or greater than TASS/TIPSYS projected growth rates. FAIB staff also informed me that traditional analysis methods using paired t-tests with 95 percent confidence limits were appropriate for this analysis.

I note that YSM sample data suggest that the MSYT are conservative in their yield estimates. I conclude that the volume projections for managed stands followed a reviewed and accepted procedure and the yield tables used were appropriate. I will not make any adjustments to the base case to account for managed stand yields.

*- genetic worth*

Genetic worth is an indication of the quality of genetically improved seed, as represented by a percentage volume increase expected near rotation age. Licensees are obliged by regulation to use the best available seed source when regenerating sites with planted stock. Information on the use of select seed and the associated genetic gains are available from the Seed Planning and Registry (SPAR) application of the Forest Improvement and Research Management Branch.

The total area-weighted average of genetic worth of select seed sown over the past decade in the TSA was 19 percent. The weighted average genetic worth for select pine seed was nine percent while the weighted average genetic worth for select spruce seed was 24 percent. The base case used genetic worth values obtained from RESULTS which showed an average genetic worth of 1.5 percent for pine seedlings and 19 percent for spruce. No sensitivity analyses were done to test the effect of using the corrected values for genetic worth, but staff informed me that there would be an increase in long-term timber supply.

The CTWG First Nations stated that there are no realized gain trials to substantiate increased yields due to the genetic worth of select seed for the Mackenzie TSA. They believe that the genetic worth of select seed should be assessed as a sensitivity analysis and not used in the base case.

I consider that the science of tree improvement is sufficiently advanced to warrant the use of genetic worth when producing managed stand yield tables. Under '**Reasons for Decision**', I will account for the underestimation of genetic worth in the base case harvest projection.

*- silvicultural systems*

A silviculture system is a planned program of silvicultural treatments (harvesting, regeneration and stand tending) intended to achieve a predictable yield of benefits from a forest stand over time. In the Mackenzie TSA, the most frequent silviculture system used is clearcut with reserves. Clearcut patches range in size from one hectare to several hundred hectares with a median size of 47 hectares. The retained areas, or 'reserves' are intended to function as wildlife tree patches, protection of cultural heritage resources, riparian reserve and management areas, and forest patches to conserve old-growth forest characteristics. In the base case, all harvesting is modelled as a clearcut with reserve silviculture system.

One member of the public commented that clearcutting is leading us to societal collapse through biodiversity loss and global warming. Clearcutting and removing large amounts of biomass results in a loss of ecosystem services such as moisture absorption and regulation, and clearcutting has negative impacts on wildlife and other biotic species.

The CTWG First Nations stated the following: *Current silvicultural systems put ecosystems and Indigenous Rights at high to extreme risk over the short to long term. Areas reserved do not have old growth characteristics and are often represented by low productivity/non-merchantable forest characteristics (i.e., no large structure, low volume). At the landscape scale, the fundamental issue of current silvicultural systems is the replacement of more resilient multi-age productive old-growth forests with less-resilient even-aged coniferous monocultures.*

I was informed that data from RESULTS show that clearcuts are consistently regenerated with mixed species planting and 24 percent of existing managed stands have a deciduous component resulting from deciduous ingress. I am also aware that under forest landscape planning, which is underway in some TSAs, the participants will consider a broad range of silvicultural systems to be practiced in the TSA. For this determination, I will not make any adjustments to the base case to account for silvicultural systems.

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

*- grade 4 credit*

Grade 4 logs are low-quality, green, or dead logs that could be used in both sawmills and secondary processing facilities depending on log quality and market demand. Grade 4 volume is charged to the AAC whether it is taken to a mill or left on site. The base case does not account for log grades, therefore live grade 4 logs are included in the harvest projection.

To incent harvesting of MPB-damaged pine, the Ministry created a grade 4 crediting system whereby grade 4 logs delivered to a non-sawlog facility are not charged to the AAC. Licensees were allowed to harvest an equivalent volume of higher-grade timber which was charged towards their AAC. Grade 4 crediting is recognized as a mechanism to facilitate delivery of grade 4 logs to secondary manufacturing facilities.

Grade 4 credit approvals are managed by regional tenures staff. If not actively managed, grade 4 crediting could result in overharvesting the AAC. In 2014, the *Forest Act* and the Cut Control Regulation were amended to allow the minister to limit the volume of grade 4 timber that may be credited in a TFL or TSA if sustainability of the timber supply is a concern.

The CTWG First Nations stated that given the increase in wood pellet production throughout BC, the grade 4 credit system has the potential to increase the harvest level above the AAC. Tsay Keh Dene Nation has signed an agreement with Provectus Biofuels Inc. to develop, build, and operate a biofuel plant in Mackenzie. I am aware that Kwadacha and Conifex already operate bioenergy facilities in the TSA. I would like to encourage the use of lower quality timber in this and every other management unit in BC. I encourage First Nations to work with regional tenures and district staff for opportunities to obtain harvest volume that do not put the sustainability of this AAC at risk. For this determination, I will not make any adjustments to the base case to account for grade 4 credits.

*- undercut and unused AAC disposition plans*

In January 2018, the Ministry introduced a *Policy Regarding the Administration of Unharvested Volumes, Uncommitted Volumes and Unused BCTS Volumes* (collectively referred to as accumulated volume). Accumulated volume in the Mackenzie TSA is currently 14 million cubic metres. The base case is predicated on the condition of the forest, including the amount of timber growing stock, as of the date of the timber supply analysis. The timber growing stock was not depleted to account for potential harvesting of any accumulated ('undercut') volume in the Mackenzie TSA. Therefore, any volume harvested (including accumulated volume) that is above the AAC in this determination, constitutes use of the growing stock at a greater rate than projected in the base case, if the AAC were fully utilized.

First Nations within the Mackenzie TSA have requested forest tenures that are sourced from the unharvested, uncommitted, and unused volumes. This request is beyond the scope of my authority.

The Regional Executive Director and the Executive Director of BC Timber Sales have informed me that, in accordance with the policy, there are no plans to issue licences to harvest any portion of the accumulated volume. I will therefore not make any adjustments to the base case harvest projection based on accumulated volume.

**(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**

*- land and resource management plans*

The Mackenzie Land and Resource Management Plan (LRMP) has objectives for resource management zones, landscape biodiversity and patch size. The LRMP objectives have not been established as objectives set by government, however, some of the LRMP objectives have been established under the *Land Act* or are demonstrated as current practice through commitments by licensees in approved Forest Stewardship Plans.

The management intent for the special resource management (SRM) zone for wildlands precludes timber harvest within the zone and licensees are currently not harvesting in this area. Since there is no legal order preventing harvesting in this area, it was included in the THLB in the base case. Sensitivity analysis shows that removing the SRM zone for wildlands from the THLB reduces the harvest level in the first decade by 9.3 percent.

Although the LRMP does not preclude timber harvesting from the Muskwa-Kechika management area (M-KMA), any harvesting must be conducted consistent with the access management plans and landscape unit objectives set for this area. The base case includes harvest contribution from the M-KMA. Currently, there is no harvesting in the M-KMA, and sensitivity analysis shows that removing the M-KMA from the THLB reduces short-term timber supply by 8.3 percent.

The CTWG First Nations stated the following comments: *Land use planning for the Mackenzie TSA in the past has not been balanced in its approach to development, inclusive or respectful of Indigenous Rights. The land use planning processes were dominated by provincial and private interests (including, in some respects, accelerated and unsustainable development) and did not reflect Indigenous values or priorities and strategies for development and conservation. The land use planning process was premised on BC ownership of and primary stewardship over the lands and resources in the Mackenzie TSA. This may be slowly changing.*

As discussed under ‘*Areas excluded for old growth management*’, I do not have the authority to make land use decisions. As the CTWG First Nations noted, First Nations are participating in current land use planning, and I expect those plans will reflect First Nations values. When government makes a final decision on land use in the Mackenzie TSA, there is a process to account for that decision where necessary, and it will be reflected in future AAC decisions. For this determination, and in accordance with my guiding principles, I will not make any adjustments to the base case harvest projection to account for land use decisions yet to be made.

*- First Nations cultural heritage resources*

A cultural heritage resource is defined in 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. Cultural heritage resources include archaeological sites, structural features, heritage landscape features, and traditional use sites. The base case mistakenly included archaeological sites in the THLB. Excluding these sites will reduce the THLB by 265 hectares or 0.02 percent.

Indigenous cultural heritage, however, is broader in its definition. Indigenous cultural heritage encompasses land, resources, creation stories, histories, knowledge, practices, relations, and language. It also includes all the places, spiritual areas, and objects that are linked to Indigenous history and traditions: transformer places, archaeological sites, trails, hunting grounds, gathering areas, burial grounds, artifacts, and cultural objects and materials.

Indigenous Protected and Conserved Areas (IPCA) are a component of the federal government's Nature Fund Target 1 Challenge initiative led by Environment and Climate Change Canada. Tsay Keh Dene Nation has provisionally established the Chuyaza conservancy and an IPCA in the Ingenika watershed. The Ingenika watershed is of crucial importance to Tsay Keh Dene historically, ecologically, culturally, and spiritually. Tsay Keh Dene stated that they have agreements in place with two major licensees to avoid harvesting in the Ingenika core area and are in the process of purchasing the third major licence.

Sensitivity analysis explored the effect on timber supply of removing the proposed Ingenika IPCA from the THLB. Removing the IPCA from the THLB reduces the short-term harvest by 10 percent in the first decade.

As part of the Tsay Keh Dene collaboration agreement, FAIB staff conducted a sensitivity analysis to assess the effect on timber supply of deferring harvest for 10 years in biodiversity management areas (BMA) that were developed through the Nation's Environment Stewardship initiative covering the Mackenzie TSA. Deferring harvest in the BMAs for 10 years reduces the short-term harvest level by 1.5 percent in the first decade.

Tsay Keh Dene informed me that they have established relationships with international companies that obtain forest products in BC through their supply chains. These companies have expressed strong support for Tsay Keh Dene's decision to establish the Ingenika IPCA and are supporting Tsay Keh Dene's decision through management of their supply chains and responsible sourcing policies.

Tsay Keh Dene informed me that they will not permit logging in these areas and will use all means available to prevent logging in the Ingenika and Chuyaza protected areas. The Nation recommends that as an accommodation for impacts to Tsay Keh Dene rights and title from forestry activity in Tsay Keh Dene territory, the Province initiate formal discussions with Tsay Keh Dene on the status of the Ingenika IPCA and the Chuyaza (Helicopter Lakes) Conservancy.

It is beyond the scope of my authority to protect the Ingenika IPCA or the Chuyaza conservancy. I note that Tsay Keh Dene has agreements with licensees to avoid logging in the Ingenika IPCA. I recognize that if the full AAC is harvested, avoiding harvesting in this area increases the pressure to harvest at unsustainable levels elsewhere. I support the recommendation by Tsay Keh Dene that formal discussions with the Province on the status of the Ingenika IPCA and the Chuyaza (Helicopter Lakes) Conservancy should be initiated. For this determination I will not make any adjustments to the base case to account for proposed protected areas.

**(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber**

*- harvest performance*

Data from the Ministry's harvest billing system (HBS) indicate that during the period 2011 to 2021 an average of 78 percent of the AAC was harvested annually and that the total AAC was fully harvested in 2018. The mean annual harvest over the past two decades has been approximately 2.5 million cubic metres and the mean annual harvest since 2011 was approximately 3.04 million cubic metres.



Historically, harvest was concentrated in the southern portion of the Mackenzie TSA, due to physical and economic constraints. Over the past decade, 72 percent of scaled volume harvested was from the southwestern partition zone.

During the past decade harvesting targeted pine-leading stands to expedite the salvage of MPB damaged timber. Since 2011, the mean annual percentage of scaled pine volume was 53 percent. A review of recently issued cutting permits, yet to be harvested, indicate that the proportion of pine volume will decrease to 36 percent.

Harvesting only 78 percent of the AAC during the past decade does not concern me. The AAC is the maximum harvest allowed, and it was increased by about 1.5 million cubic metres to encourage salvage of MPB-killed timber. The actual average harvest of 3.04 million cubic metres per year is very close to the AAC before the outbreak of the MPB epidemic. I expect the pine harvest to decline after the beetle salvage effort, however, I am most concerned about the concentration of harvest in the SW partition zone. I will discuss this further under '*partition performance*'.

*- partition performance*

In November 2014, the AAC in the TSA was set at 4.5 million cubic metres, an increase of 1.5 million cubic metres to enable salvage of mortality caused by the MPB epidemic. The 2014 AAC determination included a partition that set the maximum harvest of non-pine at 950 000 cubic metres, of which no more than 300 000 cubic metres was to be harvested from the south-west partition zone of the TSA – the area that is west of Williston Reservoir and south of Omineca Provincial Park and Omineca Arm.

Harvest monitoring data for the period November 2014 to January 2019 indicated that licensees were not abiding by the partition limiting the harvest of non-pine, especially in the south-west partition zone. In response to the spruce beetle outbreak and the economic viability of dead pine, the chief forester amended the partition in February 2019 to allow for a maximum harvest of 2.0 million cubic metres of live uninfested coniferous timber from the entire TSA, of which no more than 500 000 cubic metres was to be harvested from the southwest partition zone. For the 3.5-year period since the amendment (February 2019 to July 2022), the green coniferous volume harvested in the partition zone was approximately 65 percent greater than the partition limit. If all the volume for which licensees have permits to harvest is harvested by February 2023, it is estimated that the total green harvest within the partition zone will be approximately 2.5 times greater than the partition level for the four-year period (February 2019 to February 2023).

For this timber supply review, staff reviewed 12 781 openings (openings are cutblocks or aggregation of cutblocks) in the TSA to determine the distance from the opening to the milling complex in the town of Mackenzie. The furthest opening from Mackenzie was 292 kilometres. Eighty-one percent of the openings occurred within 150 kilometres, 65 percent within 100 kilometres, and 37 percent within 50 kilometres of the milling complex. Since 2009, 75 percent of the openings were within 100 km and 43 percent were within 50 kilometres of the Mackenzie milling complex.

I note that the most northerly point of the TSA is 434 kilometres from the milling complex and the most northerly point of the current partition boundary is 138 kilometres from the milling complex.

One licensee pointed out that achieving the Ministry's partition goals hinged on whether the assumptions that underpin the partition were accurate, realistic, and current. They stated that "Regrettably, it appears that Ministry failed to carefully and adequately consider any major developments that were undermining the economic viability of processing timber from salvage stands." They further stated that "the current AAC partition amendment was applied without consideration for the economics of harvesting and processing dead fibre in this region. This has resulted in significant negative consequences to industry operations and has been extremely detrimental to the forest industry in Mackenzie."

In response, I wish to reiterate that the chief forester does not prescribe where harvesting occurs. The AAC decision is a sustainability decision. In the interest of sustainability, the partition clearly stated the maximum amount of harvesting that could occur in the southwest partition zone. Less economic timber outside the partition zone does not mean that licensees should ignore the partition. It is the licensee's decision whether, and how much, harvesting occurs outside the partition zone (up to the maximum limit of the AAC). The partition set by the chief forester was intended to limit the damage to forest values caused by overharvesting in the southwest. If licensees continue harvest at levels inconsistent with the levels I set and there is no order enforcing the partition, I will expedite a review of this AAC.

The CTWG First Nations provided the following comments: *The combination of forest operators' unwillingness to adhere to both the chief forester's partition and guidance documents during recent and current mountain pine beetle and spruce beetle salvage periods, highlights the ineffectiveness of non-legally binding partitions and guidance measures recommended by the chief forester's office to maintain both socio-economic and ecological objectives. Furthermore, the lack of effectiveness to essentially control salvage harvesting activities in the TSA, has led to severe impacts in the southwest partition zone resulting in First Nations' highly constrained ability to meaningfully exercise their Rights.*

I agree with the CTWG First Nations' comments regarding the the implications of licensees disregarding the partition limiting harvesting in the southwestern partition zone. As discussed under '**Reasons for Decision**', I will consider partition performance in this AAC determination.

*- problem timber profiles*

Problem timber profiles are stands that are physically operable and/or exceed the merchantability thresholds but have a limited harvest history or are considered marginally economic.

The base case included the harvest contribution from aspen-leading stands, however, there has been very limited harvesting in these stand types. Cottonwood-, birch-, and willow-leading stands were excluded from the THLB.

Sensitivity analyses were conducted to explore the effect on timber supply of restricting the harvest contribution of aspen-leading stands. If all aspen-leading stands were excluded from the THLB, the initial harvest level is 12 percent lower than the base case, and by the third decade the harvest level is six percent lower than the base case. If aspen-leading stands with greater than 75 percent deciduous species were considered as a separate timber type, a harvest of 63 000 cubic metres per year can be maintained from this timber type throughout the planning horizon.

Historically, the volume harvested from areas that are only accessible using cable and mixed systems has not been proportional to the relative area of the THLB. Cable and mixed system areas comprise 25 percent of the THLB, but their contribution to the historic harvest was about 11 percent. In the TSR analysis about 25 percent of the THLB in the TSA is designated as accessible through cable or mixed systems. About 35 percent of the THLB in the more northern portion of the TSA is designated as cable or mixed system. The higher harvest costs associated with cable systems, along with the high cost associated with waterborne log transport, suggests this portion of the timber profile may constitute a problem timber type and inclusion in the THLB should be considered an uncertainty in the base case.

Sensitivity analysis explored the harvest contribution from stands accessible through cable harvest systems. If all cable-only areas are removed from the THLB, the initial harvest level is three percent lower than the base case. If both cable and mixed (cable and ground) systems are excluded from the THLB in the northern part of the TSA where waterborne log transport is required, the initial harvest level is 18 percent lower than the base case. Excluding just the cable-only areas from the northern part of the TSA and establishing a southern partition reduces the initial harvest level by six percent.

Before the MPB epidemic, an average of 11 percent of the harvest volume was balsam. Examining cutting permits issued over the past 20 years shows that there is little or no harvest activity in stands composed of more than 75 percent balsam. Sensitivity analysis showed that excluding stands with greater than 75 percent balsam from the THLB reduces the initial harvest level by 4.7 percent.

District staff informed me that they issued one licence for the harvest of deciduous-leading stands that allowed for 100 000 cubic metres per year but there was no harvesting under this tenure. I was also informed by Tsay Keh Dene that the proposed biofuel plant in Mackenzie could utilize deciduous fibre.

The CTWG First Nations stated that including balsam and deciduous volume in the base case does not represent current management. They are concerned that inclusion of these species in the base case could lead to overharvesting of pine and spruce.

One member of the public provided reasons why he was opposed to any deciduous harvesting in the TSA.

One licensee who operates a power plant in Mackenzie stated that sometimes they have difficulty securing appropriate feedstock for the power plant. Their view is that despite lack of use of these species in the past, both birch and cottonwood near Mackenzie should be considered merchantable as power plant feedstock in times of need.

One licensee commented that they have invested in state-of-the-art cable equipment and will therefore be increasing their operations in cable-accessible terrain. A second licensee pointed out that they were harvesting on flat terrain because they were focussing on salvaging dead pine. Now that the salvage of the MPB epidemic is over, they will shift to harvesting spruce and balsam growing on steeper terrain.

I can see evidence that the harvest of deciduous and balsam may increase. I can also see that cable harvesting will likely increase. However, there is some uncertainty that harvesting of deciduous- and balsam-leading stands and in cable areas will comprise as much of the volume as projected in the base case. I will not make any adjustments to the base case to account for problem timber profiles in this determination, but under '**Implementation**' I will ask staff to monitor the use of cable systems in the TSA to provide more certainty for future determinations.

*- adjacency, maximum cutblock size and green-up*

The Forest Practices and Planning Regulation (FPPR) specifies that cutblocks cannot be larger than 60 hectares in the Omineca Forest Region. However, cutblocks may be larger if timber harvesting is being carried out to recover timber damaged by fire, insect infestation, wind, or other similar events, for sanitation treatments, or the holder ensures, to the extent practicable, that the structural characteristics of the cutblock after timber harvesting has been substantially completed resemble an opening that would result from a natural disturbance. The FPPR also stipulates that cutblocks cannot be immediately adjacent to one another unless certain minimum green-up requirements are met.

For the base case, the projected future cutblocks were simulated in the timber supply model and ranged in size from a minimum of five hectares and a maximum of 100 hectares. This is consistent with current practice since the last determination. Since harvesting to recover dead volume is ongoing in the TSA and will likely persist at varying degrees following future natural disturbances for the foreseeable future, adjacency was not modelled in the base case.

Sensitivity analysis explored the effect on timber supply of implementing spatial adjacency rules. If the minimum distance between cutblocks was 100 metres and this was strictly observed, the short-term timber supply would be 19 percent lower than the base case.

The CTWG First Nations stated that adjacency and maximum cutblock size limits are meant to protect biodiversity, a key indicator of Indigenous Rights, and green-up limits are meant to protect hydrological function, a key interest to First Nations. Since salvage is no longer a priority, the CTWG First Nations feel adjacency, maximum cutblock size, and green-up limits should have been applied in the base case.

During my helicopter tour of the TSA on October 20, 2022, I was struck by the size of the openings, particularly in the SW partition zone. Since current practice in the TSA does not contravene the FPPR, I have not adjusted the base case. However, under ‘**Implementation**’, I wish to remind licensees to ensure they continue to apply the necessary management strategies to ensure that operational practices are aligned with the intent of the FPPR regarding cutblock size and adjacency.

- *harvest risk assessment (geographic tranche)*

In timber supply analyses the effect of uncertainty in data or management practices is examined using sensitivity analyses, in which one parameter is changed to test the effect of that change on timber supply. These provide useful information to understand the stability of the base case harvest projection. However, quite often the parameters are related and therefore the impacts cannot be considered additive. For the Mackenzie TSA timber supply review, a method of structured analysis based on the financial concept of risk tranches was developed.

A low-risk tranche represents the portion of timber supply with high certainty of being achievable, while a high-risk tranche represents the portion of timber supply with lower certainty of being achievable. By defining a set of risk classes in which higher risk categories embed lower risk categories, the resulting nested timber supply assessments can be expressed in terms of the contribution of each risk class to timber supply (i.e., identifying the timber supply tranche associated with the risk class).

As discussed under ‘*partition performance*’ and ‘*problem timber profiles*’, a unique aspect of the Mackenzie TSA is the relatively large area served by water-based transport (barge and boom) of logs across Williston Reservoir. Some water transport areas consist of valleys in rugged terrain with disconnected road networks.

For the geographic tranche sensitivity analysis, the TSA was subdivided into zones based on the remoteness of the road network and whether the network within the zone was connected to the winter-road portion of the TSA or was dependent upon the water transportation system to move timber to either the milling complex in Mackenzie or to other milling centers in the region.

Four risk classes were defined based on access and transport geography. Risk class 1: areas accessible by non-remote roads in the south-west partition, which comprise 33 percent of the THLB. Risk class 2: areas accessible by roads outside the southwest partition zone or from areas with “remote” road access which comprise 16 percent of the THLB. Risk class 3: areas that involve water transport on Williston Reservoir and access via non-remote roads, which comprise 35 percent of the THLB. Risk class 4: areas that involve water transport and access via remote road access areas which comprise 16 percent of the THLB.

The results from the geographic area risk class analysis indicate about 40 percent of the total timber supply for the TSA over the mid- to long-term is supported by areas with good road access in the south-west partition zone (risk class 1); an additional 12 percent is supported by other areas not involving water transport (risk class 2); approximately 33 percent is supported by areas that involve barge access, but with reasonably short road access (risk class 3); and approximately 15 percent is supported by areas that involve barge and as well as relatively remote road access (risk class 4).

The District of Mackenzie commented that the BC stumpage system does not appropriately account for the increased costs of towing logs via the reservoir. A single AAC for the entire TSA with "soft partitions" and lack of enforcement has resulted in overharvesting in the southern half of the TSA where timber harvesting is more economically feasible. This will put the long-term viability of the community at risk and the District of Mackenzie supports the establishment of a "hard" partition of the AAC into a northern and southern component.

The CTWG First Nations stated the following: *Given the susceptibility of realizing the harvest of areas classified as risk class 3 or 4 on market conditions, the CTWG First Nations feel the harvest risk assessment should be accompanied by a market condition assessment to define the risk of how much of the AAC may not be realized due to economic constraints. Until such a risk can be assigned to the susceptibility of harvesting areas classified as 3 or 4, the CTWG First Nations request that the chief forester take a precautionary approach when determining the AAC.*

I commend the staff for completing this tranche analysis which I believe was done for the first time supporting TSR in BC. Under ‘**Reasons for Decision**’, I will consider the insight provided by this analysis when deciding whether to partition this AAC.

- caribou

Woodland caribou have significant cultural and ecological value for residents of BC. Once abundant, many caribou subpopulations have declined steeply over the past several decades. Caribou recovery is a key priority of the Government of BC, and a wide range of recovery actions have been implemented in caribou ranges.

Even though the province has legal jurisdiction over wildlife, the federal government can assert itself through a *Species at Risk Act* (SARA) emergency protection order. In 2020, the Province entered into two agreements that reduced the risk of a SARA emergency protection order for southern mountain caribou. Although these two agreements better align the Province’s interests with the federal interests, they are no guarantee against a SARA emergency protection order.

Caribou are adapted to live in mature coniferous forests, mountainous terrain, peatlands, and areas with deep, persistent snowpack. When forests are harvested, the vegetation regrowth is initially dominated by leafy shrubs, herbs, and grasses. This vegetation supports more moose, elk, and deer, the primary prey for wolves. In addition, industrial roads and other linear features facilitate the efficient movement of wolves in caribou habitat. Ultimately, these factors lead to more caribou being killed by wolves.

Since harvesting was historically concentrated in the southwestern portion of the TSA, the herds most affected were the Wolverine and Scott herds.

A habitat supply analysis was completed that assessed the influence of current and simulated future forestry and wildfire activities on caribou habitat in the Mackenzie TSA. The patterns of harvest, road network development and wildfires projected in the base case were used as the basis for the habitat supply analysis. A second analysis used the scenario requested by CTWG First Nations where the yield projections were reduced by 25 percent (south partition yield 75 percent).

In the base case, forestry and wildfire disturbance increased between 2020 to 2090, suggesting increased loss of habitat and risk to caribou herds. The Kennedy Siding, Graham, Chase, Moberly, and Finlay herds appeared to be at greatest risk to simulated future forestry development. The south partition yield 75 percent scenario resulted in less disturbance in caribou range compared to the base case, suggesting this scenario would result in less loss of habitat and risk of caribou population decline in the region.

It is important to note that this analysis only simulated forestry disturbance in those portions of the caribou habitat areas that overlapped the Mackenzie TSA. Most of the caribou herds habitat areas only partially overlapped the Mackenzie TSA, and thus hypothetical future disturbance trends across the whole habitat range may be different than what is described in the habitat analysis.

One guide/outfitter commented that “the limiting factor for northern caribou is low elevation pine lichen winter range, yet the current AAC is directing licensees to harvest the last remaining intact stands of this crucial habitat for the Chase and Wolverine herds. The UWR that has been created was mostly high elevation and not the habitat that was under direct threat. We cannot realistically expect a good outcome for caribou if we continue down this path.”

Tsay Keh Dene reported that they have a moratorium on caribou hunting due to the high level of impact on caribou herds.

The CTWG First Nations informed me of a three-year project (2017-2019) which was undertaken by the province to assess habitat use and population demographics in the Wolverine herd. Results from this work suggested that the herd has declined by 27 percent since 2016. The author cautioned that “*While much of the high elevation habitats in the Wolverine range currently fall under existing ungulate winter range protection, low-mid elevation forests, such as critical pine-lichen stands remain at risk.*”

I am concerned about the decline of caribou populations across BC. I note that the analysis indicates that a lower rate of harvest could reduce the risk to caribou populations. Since I do not decide where harvesting occurs, a lower AAC is not sufficient to reduce the risk to caribou. However, I can establish partitions which limit the harvest in certain areas and under ‘**Reasons for Decision**’ I will consider limiting the harvest in the southwestern portion of the TSA. Tsay Keh Dene informed me that a partition allows them to work with licensees to direct where harvesting occurs. Under ‘**Implementation**’, I will ask that licensees reduce their harvesting activities in low-elevation pine stands where caribou forage for lichen. I will also ask that licensees reforest promptly after harvesting to reduce the incidence of moose and deer, and therefore wolves which prey on caribou.

- *fisher*

Fishers are medium-sized carnivores that have the long thin body characteristic of the weasel family. Several aspects of their ecology require the use of structural features found in late-successional forests, such as, large, dead, or dying trees that provide the cavities needed for denning and raising kits.

Although moderate levels of forest modification can increase the capacity of some landscapes for fishers by providing a diverse mosaic of habitat types, forest modifications that occur too quickly and cover too large of an area will greatly reduce the ability of fishers to occupy an area.

The Mackenzie TSA overlaps the boreal and sub-boreal fisher habitat zones. The fisher population in the sub-boreal habitat zone is part of the Columbian population of fisher, which the BC Conservation Data Centre (CDC) currently catalogues as red-listed (i.e., extirpated, endangered, or threatened). The fisher population in the boreal zone is currently catalogued as blue-listed (i.e., special concern) by the CDC.

Fisher harvest (trapping) is regulated under the *Wildlife Act*. Trapping of fisher in the sub-boreal zone was closed in 2021 due to concern over loss of habitat and low population numbers. The boreal population remained open for harvest.

Fishers are of concern to First Nations in the TSA who requested an analysis to assess the potential influence of future forest harvesting on fisher population. This analysis estimated the relative probability of fisher territory being occupied. Fisher-equivalent territory areas (FETA) of 3000 hectares each, which represent the amount of area and habitat that could theoretically support a female fisher, were distributed across the TSA. Fisher territory relative probability of occupancy was estimated using the percentage of a fisher territory that is wetlands or less than 12-year-old logged forest (i.e., open area). Territories with more wetland or logged forest were less likely to be occupied. An important limitation on the use of this model as an indicator of fisher occurrence is that it does not consider the quality of habitat within territories. For example, this approach does not evaluate the presence of large trees with cavities that are necessary for fisher denning. Therefore, even though the relative probability of occupancy for a given territory may be high, it does not mean that all the habitat features necessary for fisher survival and reproduction are provided.

Currently, the relative probability of fisher occupancy of FETAs was considered low in the southwest portion of the Mackenzie TSA and considered high in the east-central and northern portions of the TSA. In the scenario using the base case projection of future development, the relative probability of occupancy values of all FETAs decreased across the simulation period. Under the scenario using the south partition

yield 75 percent scenario, the relative probability of occupancy was essentially flat across the simulation period (about five percent greater than the base case scenario).

The CTWG First Nations commented that the FETAs probability of occupancy of less than 20 percent are in the SW partition zone where most of the base case harvest for first 10 years will take place. They state that deferring harvest in these areas for 20 years will unlikely influence the AAC level but will influence the spatial distribution of the harvest. Given the significant impact to First Nations' Rights, further discussion on potential partition areas and limits of harvesting in these partition areas is warranted.

As discussed under 'caribou', I do not decide where harvesting occurs, but I can establish partitions which limit the harvest in certain areas and under '**Reasons for Decision**' I will consider limiting the harvest in the southwestern portion of the TSA.

- *grizzly bear*

Grizzly bears are ecologically significant and important to British Columbians. They are federally listed as a species of special concern under SARA and are blue-listed by the BC Conservation Data Centre. Grizzly bears are found throughout the Mackenzie TSA with their densities varying based on habitat quality, habitat fragmentation, and human activity.

To assess risk to grizzly bear habitat, core security areas were defined as areas that have adequate habitat with a minimum of human use. They are large enough to accommodate a female grizzly bear's daily foraging requirements. The integrity of a security area is sensitive to the extent and spatial arrangement of developments including roads, settlements, recreation areas and industrial areas.

The grizzly bear indicator analysis completed for this TSR focused on two indicators of risk to grizzly bear habitat: core security and road density. The analysis is based on processes described in the *Interim Assessment Protocol for Grizzly Bear in British Columbia* (October 2020).

For core security, the analysis found that by the year 2120 of the base case projection, approximately 60 percent of the grizzly bear assessment units (landscape units) were below the 60 percent core habitat threshold recommended for recovery of grizzly bear populations. This is a 29 percent increase over the starting condition in 2020. Under the south partition-yield 75 percent scenario, 53 percent of the assessment units were below the threshold by 2120.

For road density the analysis found that by the year 2120 under the base case projection approximately 21 percent of the assessment units were above the 60 percent high-density ( $> 0.6 \text{ km/km}^2$ ) threshold recommended for recovery of grizzly bear populations. Under the south partition yield 75 percent scenario, 16 percent of grizzly bear assessment units were above the 60 percent threshold for high road density at the end of 2120.

The CTWG First Nations generally agreed with the disturbance methodology used to assess core security for grizzly bears applied in this study. However, they noted that the projected spatial distribution of the cutblocks and associated roads produced in the base case do not align with what is currently been observed in recently harvested, permitted, and planned forest harvesting activities. This made it challenging for them to assess the potential impacts to Indigenous Rights over the next 10 years from changing grizzly bear core habitat.

I acknowledge the information presented showing an increasing risk to grizzly bear habitat. As indicated in my considerations for caribou and fisher, I intend to establish a partition which will limit the allowable annual harvest in certain geographic areas to help reduce the pressure on habitat. I believe such a partition would potentially benefit grizzly bear as well, and as discussed under '**Reasons for Decision**', I will consider limiting the allowable annual harvest in the southwestern portion of the TSA.

- *aquatic ecosystem health*

The current condition of watershed hazards was assessed using the Watershed Health Project Omineca Region (WHPOR) protocol. The findings of this assessment were based on a Geographic Information System (GIS) spatial evaluation that has not been field verified for the area.

Regarding streamflow, WHPOR indicates the Mackenzie TSA has more than 20 percent of the assessment unit watersheds (AUW) in moderate or higher streamflow hazard. These areas of the TSA have either been influenced by forest disturbance and/or their watershed characteristics are such that the units may be more responsive than others to increased peak flow with forest canopy disturbance.

Regarding sediment accumulation, WHPOR indicates that the TSA has close to 20 percent of AUWs with a moderate or higher sediment hazard. This suggests that sediment erosion and control are important considerations when planning road development and other sediment generating activities.

The Provincial Cumulative Effects Framework Interim Assessment Protocol for Aquatic Ecosystems was used to assess future potential impacts resulting from two harvest scenarios: the base case and the south partition yield 75 percent scenario.

The analysis focused on trends in core indicator hazards over time. Six core indicators: road density, stream crossing density, peak flow, road density less than 100 metres from streams, road density on unstable slopes, and riparian disturbance were assessed at three time-steps in the timber supply projection: 2030, 2070 and 2120.

For the base case there are trends of increasing hazard for all indicators over the first 50 years (to 2070) of the projection due to forest cover disturbance or removal. After the first decade of the projection, 57 percent of the AUWs had at least one of the six core indicators ranked as ‘high’, while approximately 26 percent of the units had three or more ‘high’ ranks.

Under the south partition yield 75 percent scenario, there are also trends of increasing hazard for all indicators across the first 50 years of the projection. After the first decade of the projection 57 percent of the units had at least one of the six core indicators ranked as ‘high’, while approximately 40 percent of the units had two or more ‘high’ ranks.

Under the south partition yield 75 percent scenario, there is increased roading necessary to achieve the harvest targets since the scenario assumed less volume per hectare and therefore more road developed per cubic metre harvested. Most of the core disturbance indicators are influenced by roads so the overall impacts of both scenarios were similar.

Supplemental analysis completed for the CTWG applied the H60 concept to six watersheds within the TSA (these watersheds are not the same as AUWs). The H60 is the elevation line above which 60 percent of the watershed area exists. This area generally has snow cover in the spring when water flows begin to increase and can therefore contribute meltwater to spring floods. Timber harvesting in this “snow zone” has the potential to have a greater influence on peak flows because of changes in snow accumulation and snowmelt when the forest canopy is removed. When applying H60, the equivalent clearcut area (ECA) indicator of disturbance is usually higher than when H60 is not used. In this analysis, all six of the watersheds showed higher ECA levels. The higher ECA level indicated a higher streamflow hazard (from low to moderate) for one of the watersheds.

The CTWG First Nations provided the following comments: *Watershed health, particularly in fisheries sensitive watersheds, is important to Indigenous Section 35 rights. Given the uncertainty with GIS-based aquatic ecosystem health analyses, the CTWG First Nations request the chief forester recommend a hydrological assessment of any watershed prior to harvesting activities. Hydrological assessments should adhere to the professional practice guidelines developed by the ABCFP and EGBC for watershed assessment and management of hydrological and geomorphic risk.*



I agree with the CTWG First Nations' comments, and I want to remind licensees that it is their obligation to have a designated professional complete watershed assessments before any harvesting occurs. For this determination, I will not make any adjustments to the base case to account for aquatic ecosystem health.

*- fisheries sensitive watersheds*

Watersheds must meet two criteria to qualify as a fishery sensitive watershed (FSW): they must have significant fisheries values, and those values are sensitive to changes in the watershed. Forty-four watersheds have been identified in the Mackenzie TSA as possible FSWs. These draft FSWs are in the initial stages of development and provide a starting point for discussion among government agencies, collaboration with First Nations and discussions with licensees.

Draft FSWs, which encompass approximately 25 percent of the THLB within the TSA, were not modelled in the base case. Sensitivity analyses were conducted to assess the potential impacts to timber supply of establishing fisheries sensitive watersheds in the TSA. Two management objectives were applied to each draft FSW: enhanced retention along small streams, and ECA thresholds.

Increasing the retention along small streams in the draft FSWs reduces the THLB by 10 158 hectares or 0.83 percent, and the harvest level is 2.5 percent lower than the base case.

Forest cover disturbances are caused by harvesting activities as well as by natural events (fires, insects). The ECA of a watershed, which results from both human and natural causes affects stream flow. As discussed under 'wild fire', the incidence of future fires was modelled explicitly in the base case. Applying the ECA thresholds in draft FSWs in conjunction with an explicit fire natural disturbance regime reduces the harvest level by 18 percent in the first decade and 10 percent in the second decade. Conversely implementing the ECA thresholds in draft FSWs while modelling natural disturbance implicitly (as a standard non-recoverable loss) reduces the harvest level by 1.5 percent in the first decade.

The Gitksan First Nation stated that fish habitat has changed due to natural resource development in Gitksan's Territory. They believe that protecting streams, lakes and rivers is important with current climate changes and one cannot just take the trees and leave all the damages incurred behind.

Given the combined risk of harvesting and fire on FSWs, the CTWG First Nations believe that harvesting should be restricted in FSWs since harvesting is the only variable that can be controlled.

Since FSWs are not legally established, and it is beyond the scope of my authority to restrict harvesting in draft FSWs, I will not make any adjustments to the base case to account for draft FSWs. Under '**Implementation**' I ask staff to complete the process of legally establishing FSWs so that they could be considered in future AAC determinations.

*- climate change*

Data from Environment and Climate Change Canada weather stations within the Mackenzie TSA show that over the last 70 years mean annual temperature has increased by 1.7°C, extreme maximum temperature by 1.3°C, and extreme minimum temperature by 5.5°C. The most significant changes have occurred during the winter and summer seasons. The winters have fewer cold extremes and less precipitation (-26 percent), whereas the summers have hotter temperatures and no increase in precipitation which likely results in greater moisture stress on vegetation.

Using a mid-range greenhouse gas emission scenario and an average of climate model output, an additional 3.2°C increase in mean annual temperatures is projected for the Mackenzie TSA during the period 2041-2070. These temperature increases will be highly variable and wide ranging; however, it is likely that there will be further increases in extreme maximum temperatures and decreases in extreme minimum temperatures.

Precipitation is projected to increase in the TSA, potentially the most in the fall and least in the summer. It is likely that such increases could be from short-term storm events, or there could be prolonged periods of wet conditions as well as prolonged periods of dry conditions.

Growing degree days and the number of frost-free days are projected to increase, which may lead to more favourable conditions for tree growth, but will also favour conditions for some pests and invasive species.

Given the uncertainty about the rate and specific characteristics of climate change, and the uncertainty around the impact to the forest and how forest managers will respond, it is not possible to quantify climate change impacts on timber supply with confidence. For this review, two sensitivity analyses (wildfire risk assessment and drought risk assessment) were conducted to assess climate change-related natural disturbance impacts to timber supply.

Some of the adaptation and mitigation measures recommended by staff include: plant species suitable for future climates; use genetically improved seed (e.g., pest resistance, drought tolerance); promote diversity of species and age classes; manage for beetle by reducing dead and downed or moisture stressed timber, and restricting hauling during beetle flight weather; manage for drought risk using the stand-level drought risk assessment tool; increase riparian buffers and avoid degradation of stream bank stability.

I agree with these recommendations, and I expect that most will be considered during forest landscape planning for the TSA. I will consider the information provided by the sensitivity analyses (wildfire risk assessment and drought risk assessment) when making this AAC determination.

- *wildfire risk assessment*

The tranche method described under ‘*harvest risk assessment*’ was used to assess and visualize the risk to the base case resulting from a changing wildfire regime associated with a warming climate.

Information about historic and current wildfires was obtained from the Provincial historic wildfire database. Estimated changes in key fire regime factors were obtained from a study conducted by Wotton et al. (2017) for an area of boreal forest in central Alberta. These researchers estimated the factors at years 2030 and 2090 under moderate climate change (Representative Concentration Pathway, RCP 4.5) and under more severe climate change (RCP 8.5). While the forest in Mackenzie TSA is different from the boreal forest of central Alberta, the expected changes were considered suitable to demonstrate fire risk in this sensitivity analysis.

Six risk classes were defined based on a gradient from a pessimistic outlook on climate change and management response to a more optimistic outlook: Risk class 1 assumes a “worst case” fire regime under RCP 8.5 climate change (increasing fires), no salvage, and no fire suppression. Risk class 2 assumes timber recovery from salvage operations under RCP 8.5. Risk class 3 assumes a less severe fire regime under RCP 4.5 climate change without salvage. Risk class 4 assumes a less severe fire regime under RCP 4.5 climate change with salvage of dead timber. Risk class 5 assumes no climate change (historic fire regime and fire suppression, with salvage). Risk class 6 assumes no fires in the TSA.

Risk class 5 approximates the base case.

Under the RCP 4.5 scenario the area burnt in the THLB increases from an average 1000 hectares per year to 1500 hectares per year while the average number of fires per year is 13. Under the RCP 8.5 scenario the area burnt in the THLB increases from an average 1000 hectares per year to 2800 hectares per year while the average number of fires per year is 23.

Future fires caused only minor differences in short- and mid-term timber supply under risk classes 2, 3, and 4. However, under risk class 1 (worst case scenario), short-term timber supply is reduced to 66 percent of the base case harvest level and long-term timber supply is reduced to 59 percent of the base case harvest level. Under risk class 2, long-term timber supply is 94 percent of the base case harvest level. Under risk class 3, long-term timber supply is 80 percent of the base case harvest level. Under risk

class 4, long-term timber supply is 96 percent of the base case harvest level. Under risk class 5, which is the base case, there is no change to the harvest level.

Salvage harvest plays a significant role in mitigating the most severe impacts of increased frequency of wildfire in the TSA. Salvage accounts for 35 percent of the long-term timber supply under RCP 8.5 climate change (risk class 2). The higher operating costs associated with the northern portion of the TSA significantly limit the ability to salvage timber, and future fire damage in the northern portion of the TSA poses a significant risk to long-term timber supply.

While the fire regime factors used in this analysis could certainly be refined, it is reasonable to expect increased fires due to a combination of increased fire season length, increased chance of fires crowning and increased fire intensity.

The CTWG First Nations commented as follows: *Under “Guiding Principles” regarding the contemplation of setting an AAC by the chief forester “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”. Therefore, salvage factors should largely be ignored, and the chief forester needs to contemplate current scientific literature that is more reflective of the “more severe” climate change scenario as described above – particularly if the chief forester identifies the requirement to exercise caution given the results of this factor that has an approximate 34 percent short-term downward pressure and a 41 percent long-term pressure on the AAC (risk class 1).*

In response, I note that the section of the guiding principles referenced by the CTWG First Nations’ is appropriate. However, the guiding principles also state that “the chief forester acknowledges there will always be uncertainty in information, but due to the significant impacts that AAC determinations can have on communities, I believe that no responsible AAC determination can be made solely on the basis of a precautionary response to uncertainty”. I am aware that there are only minor differences in short- and mid-term timber supply under tranches 2, 3, 4, and 5. This sensitivity analysis, which used data obtained from Alberta, was intended to illustrate the uncertainty associated with future fire regimes. I agree that the climate is changing and that this introduces uncertainty to the harvest projections presented to me. Under ‘**Reasons for Decision**’, I will consider the uncertainty posed by future fires when making my AAC determination.

*- drought risk assessment*

Drought threatens forests by limiting the available water that trees need to survive. When water is limited, trees become weakened and cannot grow at a normal rate and may die. Subsequent regeneration is also likely to be impeded. It is also difficult for stressed and weakened trees to defend themselves against insects and diseases. Similarly, during wildfires, weakened trees are at higher risk of being burned. These issues directly affect the available timber supply.

Areas that have not previously experienced frequent drought are expected to become drier in the future.

Projected climate change is expected to shift many ecosystems toward warmer and drier conditions, which would result in reduced soil moisture over the long term. Increases in drought could have far-reaching impacts on forests, both directly, through impacts on tree growth and survival, and indirectly, through drought-related increases in the frequency of disturbances such as fire and insect outbreaks.

For this timber supply review, sensitivity analysis explored the implications of increased drought-related mortality on timber supply. The Stand-Level Drought Risk Assessment Tool was used to classify stands based on current and future risk of drought-induced mortality. Stands were classified as either low, moderate, high, or very high risk of drought-induced mortality. These classifications were projected for the years 2020, 2050 and 2080. The timber supply model generated a report under the base case showing the amount of harvest occurring in each risk category for each classification period.

The projection of the first 100 years shows timber harvest activity becoming more dependent upon stands with a high to very high risk for drought-induced mortality. This suggests that current and future timber supply may be increasingly vulnerable to natural disturbance, leading to increased salvage and lower than projected harvest levels.

Additional sensitivity analysis explored the implications of a management response targeting high-risk stands early in the projection. This sensitivity analysis also assumed that once a stand has been harvested its drought risk is reduced by two risk categories due to adaptive management and stocking with more drought tolerant species.

The results show that a re-focused harvest can achieve the base case harvest level. However, the outcome is likely less achievable given the broad spatial distribution of target stands and the costs associated with access and road development in the northern portion of the TSA.

I was informed that the results of the Stand-Level Drought Risk Assessment Tool are field checked in different locations every year and changes are made to the tool where necessary. I am aware of the risk drought poses to the forest and in 2021 I established a Chief Forester's Provincial Drought Working Group, comprised of Ministry staff and licensees, to improve our understanding of drought impacts to forests and to create guidance on risk reduction to drought. Under '**Reasons for Decision**', I will consider the uncertainty to timber supply posed by drought when making this AAC determination.

*- valued ecosystem components*

The CTWG provided analyses that assessed the effect on timber supply of maintaining a range of valued ecosystem components (VEC) below defined thresholds of risk. The VECs assessed were selected by the CTWG First Nations which included biodiversity, caribou, grizzly bear, and fisher. The risk thresholds of extreme and high were designed by a representative of the CTWG First Nations based on their understanding of current research. Working collaboratively with FAIB analysts, the values required to sustain the VECs below the extreme and high risk thresholds were approximated in the timber supply model as objectives for old forest retention, disturbance limits, deferral of harvesting and limits on road development. Modelling limitations prevented some VEC values linked to Indigenous Rights, such as limits on stream crossings, from being included in these analyses.

The combination of the model objectives required to stay below, or recover to, the extreme risk thresholds were projected in one scenario. The starting harvest level of approximately 1.6 million cubic metres per year (54 percent of the base case) is sustained for 90 years before climbing to a long-term harvest level of approximately 2.03 million cubic metres per year by 2200 (66 percent of the base case).

The model objectives required to stay below, or recover to, the high-risk thresholds were combined in another scenario. The starting harvest level of approximately 1.06 million cubic metres per year (36 percent of the base case) is sustained for 60 years before climbing to a long-term harvest level of approximately 1.73 million cubic metres per year by 2090 (58 percent of the base case).

In both scenarios the harvest contribution attributed to the southwest portion of the TSA decreases to approximately 150 000 cubic metres per year and approximately 50 000 cubic metres per year in the southeast for the first two decades as harvesting is largely deferred in these areas to allow fisher habitat to recover.

As evidenced by my considerations provided under '*areas excluded for old growth management*', '*caribou*', '*grizzly bear*', and '*fisher*', I share a concern for all these valued ecosystem components. The analysis provided by the CTWG demonstrates that there are significant challenges in planning patterns of harvest that balance the requirements of all these components concurrently. I will discuss my considerations further under '**Reasons for Decision**'.

**8(8)(b) The short-and long-term implications to British Columbia of alternative rates of harvesting from the area**

*- alternative harvest flows*

I considered the implications of alternative rates of harvesting by reviewing a series of alternative scenarios prepared for this timber supply review. These scenarios were previously discussed in comparison to the base case under ‘*Alternative scenarios conducted for the TSA*’.

**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**

*- socio-economic information for Mackenzie TSA*

Changes in the timber supply can have serious consequences for local communities which are highly dependent on the forest industry. It is recognized that the forest sector plays a significant role in local economies and employment and supports additional employment through businesses purchasing goods and services (indirect impact) and through employees spending their income on local goods and services (induced impact). A report titled *Mackenzie Community Economic Development Strategy: Community Profile*, indicates that in 2021, agriculture, forestry, fishing, hunting, and manufacturing (milling) account for approximately 44 percent of the total basic employment in the community of Mackenzie.

Using information on the local economy provided by the District of Mackenzie, along with other sources, including the *Canadian 2016 Census of Population*, a socio-economic analysis was completed by the Economics and Trade Branch of the Ministry. This analysis considered harvest volume, stumpage value, and direct impacts to gross revenue, gross domestic product (GDP), employment and government revenue. The Statistics Canada Input-Output Model (IOM) was used to generate the estimates. Economic multipliers were applied to potential harvest scenarios to estimate the impact to employment, provincial government revenue, output (gross sales), and GDP.

Based on the average harvest level for the past seven years, three different scenarios were generated to examine the effect of a change in timber supply on employment: the base case, the maximum even-flow, and the south partition yield 75 percent scenario. The analysis assumed that the entire volume projected for the first decade in each scenario is harvested.

The base case shows that a harvest level of 2.97 million cubic metres per year could potentially sustain 1416 direct jobs provincially. Under the maximum even-flow scenario a harvest level of 2.46 million cubic metres per year could sustain 1174 direct jobs (17 percent lower than the base case). Under the southern partition yield 75 percent scenario, a harvest of 1.6 million cubic metres per year could sustain 766 direct jobs (46 percent lower than the base case).

The District of Mackenzie commented that one of the dominant factors influencing management and harvesting in the Mackenzie TSA over the past 15 years is:

Government’s 2018 harvest partition that was based on a flawed assumption that dead pine trees do not lose merchantable volume for 15 years – and the continuation of this partition which subsequently forced sawmills to close (and thus failed in addressing the Minister’s October 30, 2017, letter to the Provincial Chief Forester to “support forest dependent communities .... [and] consider the environmental, social, and economic needs of local communities”. The partition directed forest companies to include a large component of dead pine and then dead wood in their log profile for dimensional lumber production. The imposition of these constraints on the harvest were undoubtedly key factors that led to the closure of the Duz Cho cant mill in 2019, the Canfor sawmill in mid-2019, and the Paper Excellence pulp mill in 2021.

In response, I wish to reiterate that the chief forester does not prescribe where harvesting occurs. The AAC decision is a sustainability decision. In the interest of sustainability, the partitions set in 2014 and in 2019 limited the amount of harvesting in the SW portion of the TSA. Licensees were not directed to harvest dead trees. Those dead trees were included in the AAC to allow licensees an opportunity to harvest that volume if they chose to do so. If the accelerated rate of harvest continues in the SW, the analysis shows that within 20 years, almost 80 percent of the harvest will have to come from the north of the TSA. This northern harvest is highly unlikely since licensees have stated that they need to offset the higher wood cost in the north with more economical wood in the south. If I do not limit the harvest in the SW portion of the TSA, as indicated by the harvest performance to date, there will be a much-reduced forest industry in Mackenzie after 20 years.

I will not make any adjustments to the base case on account of the socio-economic information provided here, however, I will be mindful of the economic and social objectives of government regarding the impact of any AAC reductions on forest-dependent communities.

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

*- wildfire*

For the Mackenzie TSA the dominant disturbance agent historically has been wildfire. In the base case, fires were modelled through natural disturbance simulation generating both salvage volume and non-recoverable losses. Other disturbance agents were modelled as conventional non-recoverable losses through an addition to the harvest request.

The timber supply model used in this analysis, STSM2020, can be used to explicitly model stand-replacing natural disturbance agents (e.g., wildfire, insects). Explicit modelling of natural disturbance allows modelling of natural disturbance processes that apply equally in the THLB and in the non-THLB; explicit modelling of potential salvage volume depending on harvest preferences and priorities; and unsalvaged volume to be recorded as NRL after the shelf life of the timber expires.

Two data sources were used to describe the fire regime used in the base case: the historic fire parameters spatial file and the 2017 BC Wildfire Provincial Strategic Threat Analysis (PSTA) dataset. In this analysis, fire is initiated randomly, and spread was controlled by the PSTA layer with the highest hazard areas having the greatest probability of being burned.

For the base case 6164 hectares are burnt annually of which 12 percent occurs within the THLB. The average volume affected by fires on the THLB is 97 000 cubic metres per year of which approximately 28 percent (27 000 cubic metres per year) is salvaged as bycatch. NRLs from fires were 70 000 cubic metres per year.

I note that the fire modelling applied in the base case is a significant advancement in the ability to explore the uncertainty in future natural disturbance regimes and I wish to commend staff for this initiative. I will not make any adjustments to the base case to account for fires losses.

*- spruce beetle*

The spruce beetle is a native insect in the spruce forests of western North America. In BC, the spruce beetle typically has a two-year life cycle, but a one-year life cycle can also occur after early, warm spring weather. Spruce beetle (IBS) outbreaks occur regularly in BC and historically have lasted up to seven or eight years. The current outbreak in the Mackenzie TSA started in 2013 in the south-east portion of the TSA. As of 2019 it is estimated that about 220 000 hectares were affected and the cumulative mortality in the THLB is approximately 2.4 million cubic metres.

In the base case the inventory volume estimates were adjusted in the timber supply model to account for losses due to natural disturbance not captured in the inventory such as spruce bark beetle and balsam bark beetle. It was assumed that dead spruce trees would be harvestable for up to five years after death.

In affected spruce stands not harvested, it is expected that the remaining live trees and seedlings will grow quickly and occupy the space created by the dead trees. In the base case, it was assumed that after 50 years the live seedlings will start contributing to the merchantable volume of the stand and the resulting stand will have a similar volume to the original stand before the IBS outbreak.

Sensitivity analyses were conducted to assess the resilience of the timber supply to disturbances resulting from an ongoing IBS epidemic in the TSA. The reason for conducting the sensitivity analyses was that a warming climate may improve beetle survival, potentially altering its life cycle and extending the duration of outbreaks over longer periods than have been experienced historically. The IBS sensitivity analyses were developed in collaboration with the Provincial Director of Bark Beetle Response who provided or approved all IBS parameters including target population size and type, and progression assumptions.

Two harvest projections were developed to explore worst-case scenarios. In the first scenario it was assumed that there will be complete loss of spruce in the north and there is no AAC partition. The resulting initial harvest level is 2.4 million cubic metres per year (18 percent less than the base case) and is maintained for 10 years then decreases immediately to the mid-term harvest level of 2.2 million cubic metres (11 percent less than the base case) in the second decade. In the second scenario it was assumed that there will be complete loss of spruce in the north and there is a southern partition. The initial harvest level in this scenario is 2.55 million cubic metres per year (14 percent less than the base case) and is maintained for 10 years before decreasing to the mid-term harvest level of 2.26 million cubic metres (10 percent less than the base case) in the third decade.

I am satisfied that current losses due to IBS were appropriately accounted for in the base case. Considering the warming trend in BC it is likely that IBS will continue to affect spruce forests in Mackenzie TSA where susceptible host trees remain. Under '**Implementation**' I will ask staff to monitor the spread of the IBS and I also ask licensees to focus salvage on IBS-infected stands where feasible. I will not make any adjustments to the base case to account for spruce beetle.

- *blister rust and gall rust*

Comandra blister rust (DSC, *Cronartium comandrae*), stalactiform blister rust (DSS, *Cronartium coleosporioides*) and western gall rust (DSG, *Cronartium harknessii*) are native pathogens of lodgepole pine. Factors affecting incidence and severity of infection by these pathogens include the age of trees, distribution and proportion of lodgepole pine within a stand and across the landscape, the presence of the alternate host (for DSC and DSS), and the occurrence of favourable weather conditions.

Each pathogen has a unique lifecycle and affects trees and stands differently. DSC stem infections rapidly girdle and kill young pine trees resulting in a clumped distribution of living trees. Although not quantified, the potential for natural ingress to compensate for losses before rotation is assumed to vary by ecosystem and generally decrease as incidence increases. The primary assumption at the stand-level for DSC is that cumulative mortality levels off and becomes stable by stand age 15 years.

On the other hand, DSS stem infections can girdle young pine trees but most often mortality occurs when multiple infections merge into larger cankers. This pathogen causes deformation and degradation of infected trees which may persist in stands for decades after initial infection.

For DSG, the tree-level impacts of stem infections vary greatly depending on tree age and location of infection. When infection occurs in young pine trees, galls on the main stem are generally lethal with mortality typically levelling off somewhat by age 20 to 25 years. However, when stem infections occur on older trees, both galls and the infected trees commonly persist into late rotation. This can result in

stem breakage at the location of the gall and associated volume losses depending on the severity of the infection.

FAIB models the impact of rusts using the Gall Rust Impact Module (GRIM) and Comandra Rust Impact Module & Evaluator (CRIME) in the Tree and Stand Simulator (TASS). Rust incidence at age 15 years is used to initiate the modules.

Based on silviculture survey data in RESULTS and DSC and/or DSG records between 1956 to mid-2018, the historical average incidence of these rusts across all BEC zones in the TSA is 12 percent for DSC and seven percent for DSG.

The regional forest pathologist pointed out that the stand age associated with the historical survey data in RESULTS varies and thus the surveys do not reflect the full expression of rust incidence at age 15 years. The pathologist also identified challenges and uncertainties related to the modules, GRIM and CRIME, and recommended that these modules not be used to model the effect of rusts in the base case.

Since the base case does not account for the effect of rusts, two sensitivity analyses were conducted to explore the potential effect of rusts in the Mackenzie TSA. The first sensitivity analysis used incidence values from RESULTS corrected for age. GRIM and CRIME were used to derive rust factors which were used to reduce volume tables supplied to the timber supply model.

The second sensitivity analysis used BEC-based incidence values for DSC and DSS combined provided by the regional forest pathologist. The values were derived from historical RESULTS data to estimate the full expression of blister rust incidence at stand age 15 years. GRIM and CRIME were then used to generate rust factors by BEC zone which were used to reduce volume tables supplied to the timber supply model.

Applying the RESULTS-based incidence values to the GRIM and CRIME modules reduces mid-term timber supply by one percent, whereas applying the BEC-based incidence values reduces mid-term timber supply by 3.5 percent.

The CTWG First Nations stated that the Mackenzie TSA has one of the highest incidences of blister rust in the province. The CTWG First Nations feel that rusts should have been included in the base case so that the VEC analysis properly accounts for the impact to values that affect Indigenous Rights.

For this AAC determination, the regional pathologist stated that the second sensitivity analysis is the preferred approach for estimating rust impacts to timber supply as it was derived from the best available information.

I concur with the regional pathologist and under '**Reasons for Decision**' I will account for a 3.5 percent reduction in mid-term timber supply. Staff informed me that a Rust Working Group was initiated to address how rust impacts are modelled in future TSRs. I support this collaboration and I request that subject matter experts from FAIB and Forest Health work together to improve transparency, communications, and provide the best available information for my consideration in future TSRs.

## **Reasons for Decision**

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

The base case showed an initial harvest level of 2.97 million cubic metres per year for the first decade. The harvest then decreases to 2.47 million cubic metres per year by the third decade and remains at this level for a further six decades before increasing to the long-term harvest level of 3.13 million cubic metres per year. The actual harvest over the past 20 years averaged 2.5 million cubic metres per year.

I am satisfied that the assumptions applied in the base case for many of the factors applicable to the Mackenzie TSA were appropriate, as detailed in Table 1 or as described elsewhere in this rationale.



However, I have identified factors which, considered separately, indicate that the timber supply may be either greater or less than projected in the base case. Some of these factors can be readily quantified and their impact on the harvest level assessed with reliability. Others may influence timber supply by adding an element of risk or uncertainty to the decision but cannot be readily quantified at this time.

I have identified the following factors in my considerations as indicating that the timber supply projected in the base case may have been underestimated, to a degree that can be quantified:

- *Site productivity estimates* – Data obtained from the young stand monitoring project indicate that the site productivity of regenerating spruce stands is underestimated. Correcting the site productivity for these stands increases short-term timber supply by three percent. Long-term timber supply is increased by up to 14 percent.

I have identified the following factors in my considerations as indicating that the timber supply projected in the base case may have been underestimated, but are not quantifiable at this time:

- *Genetic worth* – staff indicated that the genetic worth of select tree seed used in the Mackenzie TSA is greater than what was modelled in the base case. Applying the correct values will lead to an increased timber supply in the long term.

I have also identified the following factors in my considerations as indicating that the timber supply projected in the base case may have been overestimated, to a degree that can be quantified:

- *Blister rust and gall rust* – staff indicated that the values used to account for losses due to tree rust in the base case were underestimated. Applying the improved estimates for tree rust reduced the mid-term timber supply by about 3.5 percent.

In considering the above-mentioned influences, I find that the combined effect of accounting for the quantifiable factors represents a net underestimation of short-term timber supply by about three percent. However, there were some factors I considered where the impacts to timber supply were unquantified. These factors, which are related to climate change, concentration of harvest, and cost of harvesting were discussed earlier under ‘wildfire risk assessment (fire tranche)’, ‘drought risk assessment’, ‘spruce beetle’, ‘caribou’, ‘fisher’, ‘grizzly bear’, and ‘harvest risk assessment’. I reviewed and discussed the analyses and recommendations provided by ministry staff on these factors and the VEC analyses provided by the CTWG. While it is beyond the scope of my authority to prescribe remedies to maintain these values and to mitigate the risks to timber supply posed by wildfire and drought, I conclude that, taken together, these uncertainties pose a significant risk to timber supply.

As stated under ‘Guiding principles for AAC determinations’, one way of dealing with uncertainty is to manage risks by evaluating the significance of specific uncertainties associated with the current information and assessing the potential current and future social, economic, and environmental risks associated with a range of possible AACs. Consequently, the AAC I determine will account for these unquantified risks and give staff the opportunity to adopt forest practices to mitigate the risk to these values and to timber supply.

As discussed under ‘partition performance’ and ‘harvest risk assessment (geographic tranche)’, I am aware of the difficulties and high cost of operating in the Mackenzie TSA. The most northerly point of the TSA is 434 kilometres from the milling centre in Mackenzie. Beyond the southern “winter-roaded” area, logs have to be transported by boom and barge along the Williston reservoir which is frozen for parts of the year. Since 2009, 75 percent of the harvesting in the TSA has occurred within 100 kilometres of the Mackenzie milling centre and 43 percent within 50 kilometres of the Mackenzie milling centre. I note that the most northern point of the current partition zone is 138 kilometres from the Mackenzie milling centre. One consequence of the high cost of operating in the north is the concentration of harvest in the south and particularly in the southwestern portion of the TSA.

I am aware that for any harvesting to occur in the north, there must be some harvesting in the south to offset the higher costs in the north. However, this concentration of harvest in the southwest has adverse consequences for First Nations rights and many ecological values such as: wildlife habitat, riparian areas, and stream flow. The base case shows that if the partitions set by the chief forester in 2014 and 2019 continue to not be abided by, approximately 75 percent of the harvesting will need to come from the remainder of the TSA (north and southeast) 20 years from now. This effectively means that, due to the high cost of operating in the north, there may well not be any timber harvesting in the TSA after that period. It also means there will be further adverse impacts to First Nations rights and ecological values. I will therefore consider setting a geographic partition limiting the rate of harvest in the southwestern portion of the TSA and I expect licensees to abide by the partition.

Tsay Keh Dene Nation has signed an agreement with Provectus Biofuels Inc. to develop, build, and operate a biofuel plant in Mackenzie. Tsay Keh Dene Nation requested me to establish a bioenergy partition for the Mackenzie TSA that focuses on salvage and deciduous volume in order to encourage the development of the bioenergy industry and to obtain the necessary financing for this project. Alternative harvest scenarios show that the dead bycatch ranges from 320 000 to 370 000 cubic metres per year. If harvesting targets dead trees, then I expect that the dead volume available would be significantly higher. Since the Tsay Keh Dene Nation wishes to explore the possibility of constructing a biofuel plant, I encourage ministry staff to work with the Tsay Keh Dene Nation so they can acquire the bioenergy licence they request.

Two of the major licensees in the TSA, Canfor and Conifex, have stated that there is little to no economic value remaining in the dead timber especially the dead timber in the northern portion of the TSA.

Given the harvesting practices described under '*partition performance*', I do not anticipate a shift in the economic potential of salvaging dead standing timber and therefore will not impose a timber type (live/dead) partition in addition to the geographic partition I am considering.

I was provided with a harvest projection scenario which considered the southwestern portion of the TSA and the remainder of the TSA as two discreet management units within the TSA. It shows that if the southwestern portion of the TSA is treated as a separate discreet unit, the harvest projection from this zone is 1.27 million cubic metres per year for the first decade. The harvest in this portion then decreases to 1.17 million cubic metres per year by the third decade and remains at this level for a further eight decades before increasing to the long-term harvest level. The harvest from the remainder of the TSA is 1.53 million cubic metres per year for the first decade before declining to the mid-term level of 1.22 million cubic metres per year by the fourth decade.

Following the comprehensive public review of the analysis results for the Mackenzie TSA, I have considered the many comments and concerns regarding harvest levels expressed by First Nations, licensees, and residents of the TSA. Given the current concentration of harvest in the southwestern portion of the TSA, I conclude that a partition limiting the amount of harvest in this zone is necessary to address First Nations' concerns and to protect non-timber values. The base case demonstrated that the initial harvest level may be maintained above the sustainable mid-term level for 10 years and factors where the impact to timber supply were quantifiable indicate that this short-term harvest level could be further increased by three percent. However, after considering the risk to timber supply posed by future fires, drought, insects and disease, I decided that the harvest levels in both the southwestern zone and the rest of the TSA should not exceed the sustainable mid-term harvest projections for those separate parts of the TSA (1.17 million cubic metres in the southwest and 1.22 million cubic metres in the remainder of the TSA). I expect that the reductions I made to the base case harvest projection will address the concerns raised.

At this time, it is my expectation that Ministry staff will work with licence holders to monitor and assess harvest performance within the SW partition zone and report back to me if adjustments are necessary. If voluntary compliance with the partition proves to be a concern, Ministry staff will consider

recommending implementation of a Minister's partition order under Section 75.02 of the *Forest Act*. As stated in my '*Guiding Principles for AAC determinations*', where the cumulative effect of timber harvesting and other land-based activities indicate a risk to natural resource values, my AAC determination for the Mackenzie TSA has identified those risks for consideration in Forest Landscape Planning. With this AAC determination I have made a decision that encourages actions and practices that mitigate risks to the natural resources values mentioned previously and secure a sustainable forest industry in the future.

## Determination

I have considered and reviewed 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 and that reflects current management practices as well as the socio-economic objectives of the Crown, can be best achieved in Mackenzie TSA by establishing an AAC of 2.39 million cubic metres. This new AAC is 46.9 percent below the current AAC and 19.5 percent below the base case.

Further, I specify under Section 8(5)(a) of the *Forest Act*, that a maximum of 1.17 million cubic metres of the AAC is attributable to the SW partition zone (the area that is west of Williston Reservoir and south of Omineca Provincial Park and Omineca Arm).

This determination becomes effective on May 4, 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 I have predicated this decision, then I am prepared to revisit this determination or partitions sooner than the 10 years required by legislation.

## Implementation

In the period following this decision and leading to the subsequent determination, I encourage Ministry staff, other agencies, and licensees (as appropriate) to undertake or support the tasks noted below, the particular benefits of which are described in greater detail in appropriate sections of this rationale.

I recognize that the ability of staff and licensees to undertake projects is dependent on available resources, including funding. However, I have highlighted here what I view to be the most critical needs to help reduce the risk and uncertainty associated with key factors that affect the timber supply in the Mackenzie TSA.

1. *Partition performance* – Successful implementation of this AAC and the partitions set require licensees, district staff and First Nations to develop a credible plan for collaborative management and strategies and measures for avoidance and meaningful mitigation of adverse impacts to Indigenous Rights. I strongly recommend that the parties work cooperatively to implement the AAC for this TSA. I expect that Ministry staff work with First Nations and licence holders to monitor and assess harvest performance within the SW partition zone and report back to me if adjustments are necessary.
2. *Blister rust and gall rust* – I request that subject matter experts from FAIB and forest health work together to improve transparency, communications, and provide the best available information on the incidence and effect of rusts on timber supply in all management units in BC.
3. *Species at risk* – I ask that Ministry of Forests staff work with First Nations, licensees and Ministry of Water, Land and Resource Stewardship staff (Wildlife, Habitat and Species Recovery Branch) to reduce the impact of forest harvesting on habitat for species-at-risk (e.g., caribou, fisher, grizzly bears) and support ecosystem health. This includes supporting collaborative spatial planning of harvest that maintains sufficient forest habitat for species-at-risk and improves habitat, through

restorative silvicultural practices and removing roads. Specifically, for caribou I ask licensees to reduce their harvesting activities in low-elevation pine stands where caribou forage for lichen. I also ask licensees to reforest promptly after harvesting to reduce the incidence of moose and deer, and therefore wolves which prey on caribou.

4. *Problem timber profiles* – I ask staff to monitor the use of cable harvest systems in the TSA to provide more certainty for future AAC determinations.
5. *Spruce beetle* – I ask staff to monitor and report the spread of the spruce beetle and I also ask licensees to focus salvage on spruce beetle-infected stands where feasible.
6. *Adjacency, maximum cutblock size and green-up* – I expect licensees to ensure that operational practices align with the intent of the FPPR regarding cutblock size and adjacency when harvesting in the TSA.
7. *Fisheries sensitive watersheds* – I ask staff from the Ministry of Water, Land and Resource Stewardship to complete the collaborative process with First Nations to identify watersheds to be proposed as fisheries sensitive watersheds in the Mackenzie TSA and to legally establish those that meet the requirements.



Shane Berg, RPF  
Chief Forester



May 4, 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 April 26, 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 April 26, 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

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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

## Appendix 4: Information sources used in the AAC determination

The information sources considered in determining the AAC for the Mackenzie TSA include the following:

- A New Future for Old Forests: A Strategic Review of How British Columbia Manages for Old Forests Within Its Ancient Ecosystems. Gorley, A. Merkel, G. (2020). <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/old-growth-forests/strategic-review-20200430.pdf>;
- Adjusting the Forest Cover to Reflect Mountain Pine Beetle Impacts Fires and LiDAR Data Acquisition. (2016). [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/data-management/mpb\\_changes\\_to\\_veg\\_2015.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/data-management/mpb_changes_to_veg_2015.pdf);
- Aerial Overview Mapping Spatial Data. (2019);
- Amendment No. 29 to the Provincial Logging Residue and Waste Measurement Procedures Manual. (2019). [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-pricing/residue-and-waste/rwp\\_amend\\_29.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-pricing/residue-and-waste/rwp_amend_29.pdf);
- Amendment Order for the Non-Spatial Landscape Biodiversity Objectives in the Mackenzie Forest District. (2010). [https://www.for.gov.bc.ca/ftp/TPG/external/!publish/Forest\\_Stewardship\\_Plans/PG-FSP/Approved%20FSP/Support%20Documents/5.1.1.1.4/signed\\_mackenzie\\_non\\_spatial\\_amend\\_20100923.pdf](https://www.for.gov.bc.ca/ftp/TPG/external/!publish/Forest_Stewardship_Plans/PG-FSP/Approved%20FSP/Support%20Documents/5.1.1.1.4/signed_mackenzie_non_spatial_amend_20100923.pdf);
- Approved Wildlife Habitat Order (Meslinka 7-012, Muscovite 7-013, Eklund 7-014, & Mason 7-015)). (2021). [https://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=wlap\\_region&wlap=Omineca](https://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=wlap_region&wlap=Omineca);
- Approved Wildlife Habitat Orders Caribou (7-062 through 7-074). (2021). [https://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=wlap\\_region&wlap=Omineca](https://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=wlap_region&wlap=Omineca);
- Approved Wildlife Habitat Orders Caribou (7-076 through 7-084). (2021). [https://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=wlap\\_region&wlap=Omineca](https://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=wlap_region&wlap=Omineca);
- Approved Ungulate Winter Range for U-7004, U-7005, U-7006, U-7007, U-7008, U-7009, U-7017, U-7025, U-7026, U-7027, U-7028, U-7029 & U-7030. [https://www.env.gov.bc.ca/wld/frpa/uwr/approved\\_uwr.html](https://www.env.gov.bc.ca/wld/frpa/uwr/approved_uwr.html);
- Aquatic Ecosystem Health in the Mackenzie TSA. (2022);
- Archeological Overview Assessments Spatial Data. (2018);
- Base Mapping Spatial Data. (2018);
- BC Cumulative Effects Integrated Roads Dataset. (2018);
- BCMPB v14 Cumulative Kill Grids Spatial Data. (2017);
- Biodiversity Guidebook. (1995). <https://www.for.gov.bc.ca/hfd/library/documents/bib19715.pdf>;
- Biodiversity Management Areas Carrier Sekani. (2021);
- Biodiversity Management Areas Tsay Keh Dene. (2021);
- Biogeoclimatic Ecosystem Mapping. (2018);
- Carbon Modelling Guidance. (2022);
- Caribou Habitat Disturbance Analysis of the Mackenzie Timber Supply Review Base Case. (2021);

- Carrier Sekani First Nations Biodiversity Risk Assessment. (2017);
- Chief Forester Expectations For Prioritization to Spruce Beetle Outbreaks. (2020).  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles/cf\\_expectationsforprioritization\\_response\\_to\\_spruce\\_beetle\\_outbreaks\\_30june2020.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles/cf_expectationsforprioritization_response_to_spruce_beetle_outbreaks_30june2020.pdf);
- Chief Forester Expectations: Harvest Prioritization in Response to Spruce Beetle Outbreaks. (2018).  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/harvest\\_prioritization\\_in\\_response\\_to\\_spruce\\_beetle\\_outbreaks.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/harvest_prioritization_in_response_to_spruce_beetle_outbreaks.pdf);
- Climate Change in the Mackenzie TSA Presentation. (2021);
- CSFN Biodiversity Risk Assessment. Daust and Price 2017;
- CTWG Nations Technical Report. (2022).  
[https://portal.taklafa.ca/document\\_downloads/MackenzieTSR\\_2022.pdf](https://portal.taklafa.ca/document_downloads/MackenzieTSR_2022.pdf);
- Community Watersheds Spatial Data. (2018);
- Conservancies Spatial Data. (2018);
- Conservation Lands Spatial Data. (2018);
- Consolidated Cutblock Layer. (2019);
- Crown Tenures Spatial Data. (2019);
- Cumulative Effects Framework Interim Policy for Natural Resource Sector. (2016).  
[https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/cef-interimpolicy-oct\\_14\\_-2\\_2016\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/cef-interimpolicy-oct_14_-2_2016_signed.pdf);
- Current Fires Spatial Data. (2019);
- *Declaration on the Rights of Indigenous Peoples Act*. (2019).  
<https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/19044>;
- Deriving Rust Impacts from RESULTS Data FAIB Process Overview. (2021);
- Designated Areas Spatial Data. (2018);
- Digital Road Atlas Spatial Data. (2019);
- District Boundaries Spatial Data. (2018);
- Discussion and Analysis with the Collaborative Technical Working Group Nations. (2019-2022);
- Draft Caribou Mortarium and Recovery Zones Spatial Data. (2019);
- Draft Fisher WHA Spatial Data. (2019);
- Draft Northern Caribou WHA Spatial Data. (2019);
- Draft TSA 16 Partition Monitoring Report. (2021);
- Draft Wolverine WHA Spatial Data. (2019);
- Electronic Commerce Appraisal System (ECAS). (2021).  
<https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/electronic-commerce-appraisal-system>;
- External Partition Monitoring Report. July 14, 2022. (2022);

- Factors Affecting Landscape Occupancy by Fisher in North-Central British Columbia. (2010). Weir, Richard D. Corbould, Fraser B. <https://wildlife.onlinelibrary.wiley.com/doi/abs/10.2193/2008-579>;
- First Nations Agreements Spatial Data. (2018);
- First Nations Reserves Spatial Data. (2018);
- First Nations Treaty Boundaries Spatial Data. (2018);
- First Severity Mapping Spatial Data. (2019);
- Fisheries Sensitive Watersheds Spatial Data. (2018);
- FLNR Provincial Site Productivity Layer. PEM/TEM-SIBEC and Biophysical Analysis Version 5.0. 2016. [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/site-productivity/flnr\\_provincial\\_site\\_productivity\\_layer\\_v5\\_final\\_2016.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/site-productivity/flnr_provincial_site_productivity_layer_v5_final_2016.pdf);
- *Forest Act*. Current to March 8, 2023. [https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96157\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96157_01);
- *Forest and Range Practices Act* (2004). Current to March 8, 2023. [https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/02069\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/02069_01);
- *Forest and Range Practices Act* Forest Planning and Practices Regulation (2004). Current to March 7, 2023. [https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14\\_2004](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14_2004);
- Forest Carbon Strategy 2016-2020. (2016);
- *Forest Practices Code of British Columbia Act*. Current to March 8, 2023. [https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96159\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96159_01);
- Grizzly Bear Indicator Analysis in the Mackenzie TSA. (2022);
- Harvested Wood Product Calculator. (2022). <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/natural-resources-climate-change/natural-resources-climate-change-mitigation/tools-resources>;
- Health of Young Stands: The Challenge, the science, the future Science to Policy Forum Part 2. (2020). [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/news/hoys\\_symposium\\_proceedings\\_feb\\_12\\_final\\_edits.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/news/hoys_symposium_proceedings_feb_12_final_edits.pdf);
- *Heritage Conservation Act* (1996). Current to March 8, 2023. [https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96187\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96187_01);
- Historical Fires Spatial Data. (2018);
- Hydrology, riparian, and watershed management recommendations for spruce beetle affected systems available as part of the Chief Forester's guidance. <https://www.for.gov.bc.ca/ftp/DMK/external!/publish/SpruceBeetle/Documents/Omineca%20Region%20Spruce%20Beetle%20Document%20Series/v3%20SB%20Document%20Series%20Omineca%20Region%20June%202017.pdf>;

- Impacts and Susceptibility of Young Pine Stands to the Mountain Pine Beetle, *Dendroctonus Ponderosae* in British Columbia. (2015).  
[https://www.researchgate.net/publication/283514771\\_Impacts\\_and\\_Susceptibility\\_of\\_Young\\_Pine\\_Stands\\_to\\_the\\_Mountain\\_Pine\\_Beetle\\_Dendroctonus\\_ponderosae\\_in\\_British\\_Columbia#:~:text=The%20mountain%20pine%20beetle%2C%20Dendroctonus%20ponderosae%20Hopkins%20%28Coleoptera%3A,in%20young%20pine%20stands%20in%20central%20British%20Columbia;](https://www.researchgate.net/publication/283514771_Impacts_and_Susceptibility_of_Young_Pine_Stands_to_the_Mountain_Pine_Beetle_Dendroctonus_ponderosae_in_British_Columbia#:~:text=The%20mountain%20pine%20beetle%2C%20Dendroctonus%20ponderosae%20Hopkins%20%28Coleoptera%3A,in%20young%20pine%20stands%20in%20central%20British%20Columbia;)
- Integrated Cadastral Fabric Spatial Data. (2018);
- Interim Assessment Protocol for Aquatic Ecosystems in British Columbia: Standards for Assessing Condition of Aquatic Ecosystem under British Columbia's Cumulative Effects Framework. (2020).  
<https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/protocols/cef-aquatic-ecosystems-protocol-dec2020.pdf>;
- Interim Assessment Protocol for Forest Biodiversity in British Columbia: standards for assessing the condition of forest biodiversity under British Columbias cumulative effects framework. (2020).  
[https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/protocols/cef\\_forest\\_biodiversity\\_protocol\\_sept2020\\_final.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/protocols/cef_forest_biodiversity_protocol_sept2020_final.pdf);
- Interim Assessment Protocol for Grizzly Bear in British Columbia. (2020).  
[https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/protocols/cef\\_grizzly\\_bear\\_protocol\\_oct2020\\_final.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/protocols/cef_grizzly_bear_protocol_oct2020_final.pdf);
- Interim Assessment Protocol for Moose in British Columbia: Standards for British Columbias Cumulative Effects Framework Values. (2018).  
[https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/cef\\_assessment\\_protocol\\_moose\\_draft\\_v10.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/cef_assessment_protocol_moose_draft_v10.pdf);
- Interior Appraisal Manual. <https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/interior-timber-pricing/interior-appraisal-manual>;
- Kwadacha FNWL Spatial Data. (2018);
- Kwadacha Nation Land Use Framework. (2010).  
[https://kaskadenacouncil.com/kwadacha-nation-land-use-plan/#:~:text=The%20Kwadacha%20Nation%20Land%20Use%20Plan%20addresses%20the,Use%20should%20be%20considered%20for%20all%20resource%20development](https://kaskadenacouncil.com/kwadacha-nation-land-use-plan/#:~:text=The%20Kwadacha%20Nation%20Land%20Use%20Plan%20addresses%20the,Use%20should%20be%20considered%20for%20all%20resource%20development;);
- *Land Act* (1996). Current to March 29, 2023.  
[https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96245\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96245_01);
- Landscape Units Spatial Data. (2018);
- Legal OGMAs (Spatial Data 2018);
- Mackenzie Land and Resource Management Plan (LRMP). (2000).  
[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/omineca-region/mackenzie-lrmp/land\\_resource\\_management\\_plan.pdf](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/omineca-region/mackenzie-lrmp/land_resource_management_plan.pdf);
- Mackenzie Old Growth Order Reporting Units Spatial Data. (2019);
- Mackenzie Timber Supply Archaeological Overview Assessment Final Report-Archaeological Field Reconnaissance and Heritage Potential Modelling. (1997). T.H. Gibson, C. Ramsay, and B. Low  
[https://www.for.gov.bc.ca/ftp/archaeology/external!/publish/web/raad/Mackenzie%20TSA/the\\_mackenzie\\_timber\\_supply\\_area\\_AOA\\_final\\_report\\_archaeolical\\_field\\_reconnaissance.pdf](https://www.for.gov.bc.ca/ftp/archaeology/external!/publish/web/raad/Mackenzie%20TSA/the_mackenzie_timber_supply_area_AOA_final_report_archaeolical_field_reconnaissance.pdf);

- Mackenzie Timber Supply Archaeological Overview Assessment Final Report - Heritage Potential Modelling. (1997). T.H. Gibson, J. Finnigan, C. Ramsay, and B. Low  
[https://www.for.gov.bc.ca/ftp/archaeology/external!/publish/web/raad/Mackenzie%20TSA/the\\_mackenzie\\_timber\\_supply\\_area\\_AOA\\_final\\_report\\_heritage\\_potential\\_modeling.pdf](https://www.for.gov.bc.ca/ftp/archaeology/external!/publish/web/raad/Mackenzie%20TSA/the_mackenzie_timber_supply_area_AOA_final_report_heritage_potential_modeling.pdf);
- Mackenzie Timber Supply Area (TSA) Timber Supply Review (TSR) Data Package. (2012).  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/mackenzie\\_tsa\\_data\\_package.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/mackenzie_tsa_data_package.pdf);
- Mackenzie TSA Archaeological Inventory Assessment. (1998);
- Mackenzie TSA Fisher Indicator. (2022);
- Mackenzie TSA Rationale for AAC Partition Amendment. (2019).  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/16tsra\\_2019\\_partition\\_amendment.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/16tsra_2019_partition_amendment.pdf);
- Mackenzie TSA Rationale for Allowable Annual Cut (AAC) Determination. (2014).  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/mackenzie\\_tsa\\_rationale.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/mackenzie_tsa_rationale.pdf);
- Mackenzie TSA Timber Supply Analysis Public Discussion Paper. (2013).  
<https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/16tsdp13.pdf>;
- Mackenzie TSA Timber Supply Review Data Package. (2020).  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/16ts\\_dp\\_2020\\_november.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/16ts_dp_2020_november.pdf);
- Mackenzie TSA Timber Supply Review Process Description: Apply Secondary Stand Structure to Mountain Pine Beetle Killed stands as a Natural Stand Volume Adjustment. (2022);
- Mackenzie TSA Young Stand Monitoring Program. (2021);
- Managed Licences Spatial Data. (2018);
- Mapping and Assessing Terrain Stability Guidebook. (1999).  
<https://www.for.gov.bc.ca/ftp/hfp/external!/publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/terrain/zipped/terrain.pdf>;
- Mature Inventory Audit for Management Unit: TSA16 Mackenzie. (2021);
- Methodology for accounting for ingress or mortality. (2021);
- Mineral Reserves Spatial Data. (2018);
- Mountain Pine Beetle Forest Pest Leaflet. (2001);
- Mountain Pine Beetle Hazard Rating Documentation Version 1.2. (2013).  
<https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles>;
- *Muskwa-Kechika Management Area Act*. Current to April 26, 2023.  
[https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/98038\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/98038_01);

- Muskwa-Kechika Management Plan Regulation. Current to April 25, 2023. <https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/1347673393>;
- Nak'azdli Whut'en Planning Report A Companion Document to the Nak'azdli Land Stewardship Plan. (2021);
- National Parks Spatial Data. (2018);
- Old Growth Management Areas-Legal-Current. (2018). <https://catalogue.data.gov.bc.ca/dataset/old-growth-management-areas-legal-current>;
- Order Establishing Non-Spatial Landscape Biodiversity Objectives in the Mackenzie Forest District. (2008). [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/omineca-region/mackenzie-lrmp/mackenzie-srmp/non-spatial\\_landscape\\_biodiversity\\_obj\\_mackenzie\\_forest\\_district.pdf](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/omineca-region/mackenzie-lrmp/mackenzie-srmp/non-spatial_landscape_biodiversity_obj_mackenzie_forest_district.pdf);
- Order Establishing Provincial Non-Spatial Old Growth Objectives. (2004). [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/bc\\_non-spatial\\_old\\_growth\\_fpc\\_30jun2004.pdf](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/bc_non-spatial_old_growth_fpc_30jun2004.pdf);
- Order Establishing Spatial Land Use Objectives for the Southern Portion of the Mackenzie Forest District. (2011);
- Order to Establish a Sensitive Area and Objectives for Mugaha Marsh. (2001). [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/omineca-region/mackenzie-lrmp/mackenzie-srmp/mugahamarsh\\_order.pdf](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/omineca-region/mackenzie-lrmp/mackenzie-srmp/mugahamarsh_order.pdf);
- Order to Establish Land Use Objectives for Agricultural Development Areas and Settlement Reserves. (2006). [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/omineca-region/mackenzie-lrmp/mackenzie-srmp/order\\_min\\_agriculture\\_lands.pdf](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/omineca-region/mackenzie-lrmp/mackenzie-srmp/order_min_agriculture_lands.pdf);
- Order to Establish the Obo River and Fox Landscape Units and Objectives. (2002). [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/omineca-region/mackenzie-lrmp/mackenzie-srmp/order\\_obo\\_river\\_fox\\_landscape\\_units\\_objectives.pdf](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/omineca-region/mackenzie-lrmp/mackenzie-srmp/order_obo_river_fox_landscape_units_objectives.pdf);
- Ownership Spatial Data. (2018);
- Parks and Ecological Reserves Spatial Data. (2018);
- Permanent Sample Plots Spatial Data. (2018);
- Pine Stem Rusts in the Mackenzie TSA. (2021);
- Planned OGMAs Spatial Data. (2018);
- Population Assessment of the Wolverine caribou (*Rangifer tarandus*) Subpopulation. Year 3 (2018/2019) Final Report on Activities. Peace Region Fish and Wildlife Compensation Program. Klaczek, M. 67pp.;
- Potential Climate Change Impacts on Fire Intensity and Key Wildfire Suppression Thresholds in Canada. Wotton, Flannigan, and Marshall. (2017). <https://iopscience.iop.org/article/10.1088/1748-9326/aa7e6e>;
- Priority Deferrals: An Ecological Approach. (2021);



- Procedures for Factoring Visual Resources into Timber Supply Analyses. 1998.  
[https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vrm\\_procedures\\_for\\_factoring\\_timber\\_supply\\_analyses.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vrm_procedures_for_factoring_timber_supply_analyses.pdf);
- Provincial Change Monitoring Inventory (CMI) and Young Stand Monitoring (YSM) Sampling Framework. (2018). [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/ground-sample-inventories/provincial-monitoring/provincial\\_cmi\\_and\\_ysm\\_sampling\\_framework\\_20180616.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/ground-sample-inventories/provincial-monitoring/provincial_cmi_and_ysm_sampling_framework_20180616.pdf);
- Provincial Logging Residue and Waste Measurement Procedures Manual. (2019).  
<https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/forest-residue-waste/provincial-logging-residue-and-waste-measurements-procedure-manual>;
- Provincial Site Productivity Layer. (2020). [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vrm\\_procedures\\_for\\_factoring\\_timber\\_supply\\_analyses.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vrm_procedures_for_factoring_timber_supply_analyses.pdf);
- Provincial Strategic Threat Analysis: 2017 Update BC Wildfire Service. (2017).  
<https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/vegetation-and-fuel-management/fire-fuel-management>;
- Provincial Strategic Threat Analysis: 2019 Update. (2019).  
<https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/vegetation-and-fuel-management/fire-fuel-management>;
- Recreation Spatial Data. (2018);
- Regional Boundaries Spatial Data. (2018);
- Research Installations Spatial Data. (2018);
- Resource Management Plans Spatial Data (Legal). (2018);
- Resource Management Plans Spatial Data (Planned). (2018);
- RESULTS Forest Cover, Opening and Reserves Spatial Data. (2018);
- Reporting Silviculture Updates and Land Status Tracking System (RESULTS) Application. (2020).  
<https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silviculture-reporting-results>;
- Revised Snow Recovery Estimates for Pine-dominated Forests in Interior British Columbia. (2015).  
Winkler, R. and Boon, S.  
[https://www.for.gov.bc.ca/hfd/pubs/docs/en/EN116.htm#:~:text=Data%20collected%20in%20pine%20dominated,trees%20are%2025%20m%20tall](https://www.for.gov.bc.ca/hfd/pubs/docs/en/EN116.htm#:~:text=Data%20collected%20in%20pine%20dominated,trees%20are%2025%20m%20tall;);
- Riparian Management Area Guidebook. (1995).  
<https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silvicultural-systems/silviculture-guidebooks/riparian-management-area-guidebook>;
- Risk Assessment of Forest Harvesting In the PG TSA on Carrier Sekani First Nations Values. 2017;

- Section 35 of the *Constitution Act*. (1982). [https://laws-lois.justice.gc.ca/eng/const/page-13.html#:~:text=35%20\(1\)%20The%20existing%20aboriginal,are%20hereby%20recognized%20and%20affirmed.&text=\(2\)%20In%20this%20Act%2C,and%20M%C3%A9tis%20peoples%20of%20Canada](https://laws-lois.justice.gc.ca/eng/const/page-13.html#:~:text=35%20(1)%20The%20existing%20aboriginal,are%20hereby%20recognized%20and%20affirmed.&text=(2)%20In%20this%20Act%2C,and%20M%C3%A9tis%20peoples%20of%20Canada;);
- SELES Spatial Timber Supply Model (STSM) Assessing Potential Effects of Climate Change on Natural Disturbance and Timber Supply an Experiment in Morice Timber Supply Area. (2019);
- Spatial Land Use Objectives for part of the Mackenzie Forest District Area. (2010). [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/omineca-region/mackenzie-lrmp/mackenzie-srmp/spatial\\_land\\_use\\_obj\\_ogma.pdf](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/omineca-region/mackenzie-lrmp/mackenzie-srmp/spatial_land_use_obj_ogma.pdf);
- Spruce Beetle Hazard Rating Documentation Version 1.2. (2014). [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles/sb\\_hazard\\_rating\\_documentation\\_version12.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles/sb_hazard_rating_documentation_version12.pdf);
- Strategic Land and Resources Plans Spatial Data. (2018);
- Statistical Review of the Mackenzie VRI, CMI and YSM Assessments for TSR. (2021);
- Stream Networks Spatial Data. (2018);
- Stump and Breast Height Diameter Tables for British Columbia Tree Species. (1989). <https://www.for.gov.bc.ca/hfd/pubs/docs/Frr/Frr062.pdf>;
- Survey of Selected British Columbia Logging and Forest Management Costs. Price Waterhouse Coopers. (2017);
- Susceptibility of lodgepole pine stands to the mountain pine beetle: testing of a rating system. (2000). Shore, T.L.; Safranyik, L.; Lemieux, J.P. Canadian Journal of Forest Research 30: 44-49. <https://cfs.nrcan.gc.ca/publications?id=5414>;
- Table Interpolation Program for Stand Yields (TIPSY). (2020). <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/growth-and-yield-modelling/table-interpolation-program-for-stand-yields-tipsy>;
- Takla Forestry Stewardship Framework Best Management Practices. (2019). Takla Nation Lands and Stewardship Department. <http://taklafn.ca/wp-content/uploads/2019/10/BMP-Documents-1.0.pdf>;
- The B.C. Geographic Warehouse. (2020). <https://www2.gov.bc.ca/gov/content/data/geographic-data-services/bc-spatial-data-infrastructure/bc-geographic-warehouse>;
- Terrain Stability Spatial Data. (2018);
- Terrestrial & Predictive Ecosystem Mapping. (2008). <https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/known-locations-of-species-and-ecosystems-at-risk/mapping-methods/ecosystems>;
- TFL Boundaries Spatial Data. (2018);
- Timber Supply Analysis as Risk Assessment: A Risk Tranche Pilot Assessment in the Mackenzie Timber Supply Area. (2020);
- Timber Supply Review: Mackenzie Timber Supply Area Socio Economic Assessment. (2022);
- Tranche Analysis Draft. (2021);

- TSA 16 TSR Forest Health Technical Summary. (2021);
- TSA Boundaries Spatial Data. (2018);
- TSA Fire Modelling Methodology. (2021);
- Ungulate Winter Range Spatial Data. (2018);
- Vegetation Resources Inventory Analysis – Volume Audit (Mature). (2021);
- Visual Resource Inventory. (2019);
- Visual Quality Inventory Spatial Data. (2018);
- Watershed Health Project Omineca Region (WHPOR). (2021);
- Watersheds Spatial Data. (2018);
- Wetlands Spatial Data. (2018);
- *Wildlife Act* (1996). Current to March 29, 2023.  
[https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96488\\_01](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96488_01);
- Wildlife and Timber: Mackenzie Timber Supply Review. (2021); Presentation by Tyler Muhly for the Collaborative Technical Working Group (CTWG) with 6 Nations;
- Wildlife Habitat Area Spatial Data. (2018).