Lillooet Timber Supply Area
Timber Supply Review

Data Package

January 2021

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1. Introduction

Under Section 8 of the *Forest Act* the chief forester must review the timber supply and determine a new allowable annual cut (AAC) for each timber supply area (TSA) at least once every 10 years. The chief forester may also extend the current AAC an additional five years if the current timber supply is stable and recent developments are unlikely to change the AAC. The AAC of the Lillooet TSA was last determined in 2009 and the need for a new AAC determination has been identified.

The timber supply review (TSR) and AAC determination is a multistep process that involves:

1) The public release of a draft *Data Package* that describes known information and management;
2) Completion of a timber supply analysis based on the information presented in the *Data Package*;
3) Public release of a *Discussion Paper* that outlines the results of the timber supply analysis;
4) A presentation to the chief forester of the technical information, First Nations consultation information, and public review information; and,
5) The public release of a *Rationale* that describes the chief forester's AAC determination.

For more information about the TSR please visit the following website: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut

This draft *Data Package* summarizes the information and assumptions that are proposed to conduct a timber supply analysis for the Lillooet TSA. The information and assumptions represent current legal requirements and demonstrated management practices for the TSA and for the purpose of the TSR are defined by:

- current land base information for land ownership, topography, forest inventories, etc.;
- the current forest management regime — the productive forest land available for timber harvesting, the silviculture treatments, the harvesting systems and the integrated resource management practices used in the area;
- land-use plans approved by Cabinet and;
- legal objectives established under the *Forest and Range Practices Act* and the *Land Act* (e.g., visual quality objectives, wildlife habitat areas, and ungulate winter ranges).

The primary purpose of the timber supply review is to gather, and model information based on "what is" as opposed to "what if". The information in this draft *Data Package* represents the best available knowledge at the time of publication but is subject to change. Changes in forest management practices and data, when and if they occur, will be captured in future timber supply analyses.

The timber supply review process includes two, 60-day opportunities for review and comment by Indigenous Peoples, stakeholders, and the public. The first opportunity is following the release of the data package. All input received throughout the TSR process is summarized and presented to the chief forester for her consideration in making an AAC determination. Specific concerns that have timber supply implications, may be incorporated into the timber supply analysis to assist with understanding the timber supply in the Lillooet TSA. The second opportunity for input is following the analysis and release of the discussion paper. The chief forester will document how information received during the review periods has been considered within the AAC determination within a publicly released *AAC Determination Rationale*.

To support the AAC determination, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) (the "ministry") is committed to working collaboratively, in partnership with Indigenous peoples, throughout the TSR process. This collaboration, recognizes the values and interests of Indigenous Peoples, and aligns with the Province's broader commitment to implement the

United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). BC's Declaration on the Rights of Indigenous Peoples Act (the Declaration Act) provides for the ability of the government to enter into agreements with Indigenous governing bodies relating to one or both of the exercise of a statutory power of decision jointly by the Indigenous governing body and the government or another decision-maker; and the consent of the Indigenous governing body before the exercise of a statutory power of decision. Reaching such agreements is something that many Indigenous peoples support. Such agreements will, however, take time to negotiate and they must be enabled where necessary through changes in legislation, including the Forest Act. Collaborative processes are foundational to building trust between FLNRORD and Indigenous peoples and are often implemented more quickly without the requirement for legislative change or extensive negotiation.

2. Overview of the Lillooet Timber Supply Area

The Lillooet TSA covers approximately 1.125 million hectares in southwestern British Columbia, between the Coast Mountains and the Thompson-Okanagan Plateau. The TSA is administered by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) Cascades Natural Resource District (CNRD) in Merritt, BC, with a small field office in Lillooet.

Rugged topography and the dramatic climatic variations of mountainous terrain give rise to seven biogeoclimatic zones with 30 variants in the Lillooet TSA. The varied landscapes include dry grasslands, coniferous forests, and alpine tundra, at lower, middle, and higher elevations respectively. In the western portion of the TSA, temperate rainforest conditions predominate, while eastern areas are dominated by the semi-arid and dry grassland landscapes of the province's interior dry belt. These wide-ranging landscapes support diverse forest types dominated by lodgepole pine, Douglas-fir and spruce-leading stands, with other species including ponderosa pine, white bark pine, subalpine fir (balsam), western redcedar and hemlock.

The varied landscapes and the lakes and streams in the Lillooet TSA support a wide variety of wildlife, bird and fish species, some of which are at risk with declining populations across the province; 10 red-listed species (Endangered or Threatened), and 30 blue-listed species (Species of Concern) may be found in the TSA.

The several provincial parks and protected areas located in the TSA support significant recreation activities, including mountain biking, hiking, climbing, fishing, camping, wildlife viewing, whitewater boating, heli-skiing, snowmobiling, ski mountaineering, and cross-country skiing.

Archaeological evidence suggests that First Nations have inhabited the Lillooet region since the last glaciation over 10,000 years ago. A large First Nations population is present in the TSA and is comprised of four broad cultural groups: St'at'imc, Nlaka'pamux, Secwepemc and Tsilhqot'in. The TSA overlaps the traditional territory of these nations.

The St'at'imc, Nlaka'pamux, Secwepemc and Tsilhqot'in people are further subdivided into 28 First Nations communities, 12 of which reside within the TSA. The remaining 16 communities are located outside the Lillooet TSA but also use the area for sustenance, cultural and spiritual activities.

Both Traditional Use mapping and Archeology Overview Assessment mapping have been completed in the Lillooet TSA and are being used to help protect cultural resources. In addition, a number of Archaeological Impact Assessments have been completed to identify sites of archaeological significance and develop strategies to protect them.

The Nlaka'pamux, St'at'imc, Secwepemc, and Tsilhqot'in First Nations conduct strategic planning, economic development and coordination of information regarding the lands traditionally claimed by the First Nations through their respective tribal councils or independently within their communities. Forest Consultation and Revenue Sharing Agreements (FCRSA) are negotiated interim measure agreements between FLNRORD and a First Nation. Through these agreements, FLNRORD seeks to accommodate the economic aspect of First Nation's potential Aboriginal title Interests and to negotiate provisions to facilitate consultation on operational planning and administrative decisions.

The regional service centre in the TSA is the town of Lillooet which accounts for roughly 40% of the relatively small population of about 6,500 in the TSA. The village of Lytton is the only other incorporated settlement in the TSA, whose larger unincorporated communities include Bralorne, Gold Bridge, Spences Bridge and the First Nations communities of Tsal'alh, Xwisten, Sekw'el'was, T'it'q'et, Xaxli'p, Ts'kw'aylaxw, Kanaka Bar, Skuppah, Nicomen, Lytton, Cook's Ferry and Siska. A large portion—an estimated one-half—of the TSA's residents are First Nations' members.

The communities in the TSA have long based their economy on natural resources, with forestry continuing to be the largest industry. However, the only major timber processing facility in the TSA is Aspen Planer's veneer plant located in Lillooet. As there are currently no primary breakdown facilities

for sawlogs, volume must leave the TSA to be processed, typically in Merritt. Other contributors to the regional economy include tourism, agriculture and mining, with joint ventures between business, industry and First Nations being developed. Outdoor recreation opportunities in the TSA are exceptional. The area is well linked to the rest of BC by four highways and three rail lines.

The Lillooet TSA's current AAC is 570 000 cubic metres which was established on May 1, 2009, with a partition of non-pine volume at 350 000 cubic metres.

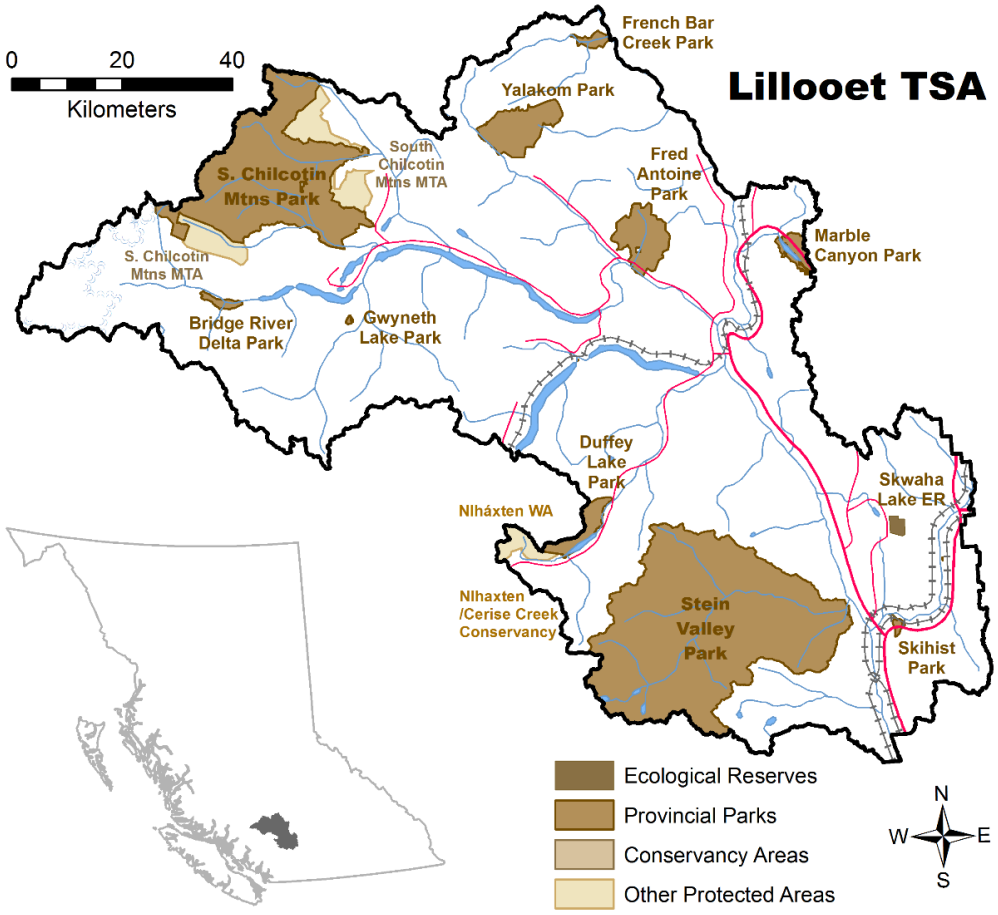

Figure 1. Lillooet Timber Supply Area map.

3. Current Forest Management Issues and Changes

3.1 Major forest management issues

The major forest management issues to be considered in this timber supply review are listed in Table 1 below. Where possible, the issues will be assessed directly in the timber supply analysis, however, in some cases, if there is uncertainty around an issue it may not be addressed directly in the analysis but will require other additional information to be presented separately to the chief forester for consideration.

Table 1. Major forest management issues

Issue	Description
Economic operability	Economic operability is a key concern in the Lillooet TSA. Economic concerns have been related to access and distance (i.e., cycle times), stand types (i.e., Douglas-fir *versus* lodgepole pine), and market accessibility.
Physical operability	The operability in the Lillooet TSA is limited by the rugged terrain (e.g., steep slopes) and large waterways (e.g., Fraser River). In 1995, the ministry and licensees identified operability mapping based primarily on physical limitations to access. For the purposes of this TSR, the 1995 physical operability mapping was compared to cutblock data from 2009 to 2019. The analysis confirmed that the physical operability mapping from 1995 was true to cutblock distribution on the land base.
Cultural heritage	Indigenous Cultural Heritage encompasses land, resources, Creation stories, histories, knowledge, practices, relations, and language. It also includes all of 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. All plants, animals and other natural resources necessary for survival are an integral part of cultural heritage. Indigenous Cultural Heritage is broader in its definition than has typically been considered within provincial government legislation or policy.
Water	Water is a resource value under the *Forest and Range Practices Act* (FRPA) that is impacted by forest harvesting and management. However, management for water resources is not always explicitly identified. The Lillooet TSA includes 24 formally designated community watersheds, for which consideration in the AAC determinations is necessary.
Wildlife	The Lillooet TSA has significant wildlife resources. Protection of certain wildlife species have been afforded through the Identified Wildlife Management Strategy. Extensive measures are in place for species such as spotted owl and further measures are in the proposal stage (e.g., general wildlife measures for grizzly bear).
Wildfire	Wildfire is a significant concern of communities within the Lillooet TSA. Communities are interested in pro-active forest management to ensure community safety, particularly within the Wildland Urban Interface (WUI). Interest also exists in prescribed burning for the management of some cultural heritage resources.
Silviculture systems	The predominant silviculture system used in the Lillooet TSA has been clearcutting with reserves. However, it is believed that in the Douglas-fir dry-belt stands a selection-harvest silvicultural regime could be used that would also protect other resource values.
Forest inventory	The forest inventory of the Lillooet TSA is primarily based on an older forest cover inventory. The ministry is currently re-inventorying the Lillooet TSA with an expected completion date in 2021. Initial timber supply analysis work is expected to be based on the older inventory and with a separate sensitivity analysis based on the re-inventory when it is completed.
Site productivity	Improved site productivity information within the Lillooet TSA is necessary to better understand the growth and yield of forests of the Lillooet TSA. Previous work around ecosystem mapping has not been completed, as such, limiting the information available.

3.2 Changes since previous AAC determination

Since the previous timber supply review was conducted, over a decade ago, some changes to the forest management regime have occurred. Table 2 outlines the major changes that have occurred.

Table 2. Major land base or forest management changes

Management change	Description
Tenure holders	There have been no significant changes with regards to tenure management since the last TSR. However, some minor changes have occurred in regard to area-based tenures. The previous TSR accounted for 16 Woodlot Licences comprising 8376 hectares. Since that time, Woodlot Licences have decreased to 14 licences and now comprise 7886 hectares.
Mountain pine beetle (MPB) infestation	In total, between 2005 and 2017, more than 4.5 million m^3 of Lodgepole Pine was killed within the timber harvesting land base (THLB). The kill of the MPB infestation has been incorporated into the forest cover inventory data.
Land use changes	Since the last Lillooet TSR determination, there have been 15 areas that have been officially protected in a variety of forms. Eight (8) have been established as Provincial Parks, three (3) as Mining and Tourism areas, one (1) as a Wildland Area, one (1) as a Conservancy Area, and two (2) as Culturally Significant Areas. Additional detail regarding these 15 areas and their contribution to the THLB are detailed in Table 6
Wildlife management changes	Wildlife habitat areas have been designated in the Lillooet TSA for, spotted owl, coastal tailed frog, western screech owl, and Lewis' woodpecker since the previous TSR determination. In addition, there is a pending Government Action Regulation (GAR) for grizzly bear that is expected to be approved in 2020.
Wildfire	Since the last Lillooet TSR determination, 44 450 hectares have been affected by wildfire within the Lillooet TSA. Most notable was the Cisco fire, K70122, that had 2173 hectares affected. Of this area, most of the THLB has been reforested through the Forest for Tomorrow Program and the small impact, there has not been significant impact to the land base due to wildfire.

4 Forest Estate Modelling

This data package identifies the data and the forest management that will be modelled in a timber supply analysis through forest estate modelling. The objective of forest estate modelling is to provide the chief forester an understanding of the timber supply in the Lillooet TSA given current forest management objectives and practices. This analysis is only one source of information that the chief forester considers in the AAC determination; other information includes non-modelled information around the land base and forest management and as well as information provided by input from First Nations and the public.

As with any modelling, the objective of forest estate modelling is to simplify complex information.

The first simplification step in forest estate modelling is to identify the land base upon which forest management and timber harvesting is or is not applicable.

Lands such as non-forested areas or area within an area-based tenure that has a separate AAC decision (e.g., a community forest) are not considered part of the TSA analysis land base. These lands have no impact on the timber supply associated with the TSA's AAC and thus are ignored within the forest estate modelling. Once areas that do not impact the AAC are excluded, the remaining area will be called the analysis forested land base (AFLB)[1].

Land upon which timber harvesting is likely to be excluded due to forest legislation or current forest practices is also specifically identified. In this step, some of the area excluded cannot be legally harvested (e.g., provincial parks) whereas in other areas, excluding harvesting is determined through operational choice (e.g., wildlife tree patches). In this latter case, this is simplified by establishing area equivalents to the legal requirements. Once identified, they may be excluded in the model (i.e., operationally the spatial location of the retention area may differ). After these exclusions, the remaining land base, upon which harvesting in the model may occur, is commonly called the THLB.

Further details about the first two steps are described in Section 6.1 below. These two steps are commonly referred to as the net down.

The second major simplification in the forest estate modelling is the identification of constraints associated with the forest management objectives for other resource values. The most common simplifications are the use of minimum retention or maximum disturbance constraints. A minimum retention constraint is simply maintaining a minimum percent of a defined land base over a specified age or height (e.g., for an old seral requirement 20% of a biogeoclimatic variant must be greater than 140 years). A maximum disturbance constraint is simply requiring a defined land base to have no more than a maximum percent less than a specified age or height (e.g., for a green-up constraint a maximum of 30% of the THLB can be below three metres in height).

Further simplifications made in the forest estate modelling relate to growth and yield estimates of forest stands, silviculture expectations, and harvest rules. These simplifications, which are not always simple, are described within this data package.

Forest estate modelling is not simply assembling data and letting the model run to provide a single answer. Forest estate modelling involves assessing the uncertainties around the available information and modelling simplifications. Forest estate modelling involves exploring different scenarios around forest management and the growth of forests. It is this understanding of the timber supply dynamics and associated uncertainties that is provided to the chief forester for their AAC determination.

[1] In previous timber supply reviews of the Lillooet TSA and other TSAs, the analysis forested land base was commonly called the crown forested land base (CFLB) or crown managed forested land base (CMFLB).

In this data package, we describe the various factors around the land base, growth and yield, and forest management. Much of this information will be used to develop a forest estate model that will describe the timber supply dynamics. Some of this information will be presented independently to the chief forester for consideration in the AAC determination.

5. Current Forest Management Information and Data

For the *Forest Act*, Section 8 allowable annual cut determination, the chief forester will desire to have knowledge of the current condition of the Lillooet TSA and its forest management. Information collected during the timber supply review supports analysis that further informs the chief forester about the timber supply of the TSA.

The following sections describe specific factors that the chief forester will consider, and which may be used to develop a timber supply analysis.

The information in this data package represents the best available knowledge at the time of publication but is subject to change. Comments about the data package are welcomed. See Section 7 below for further information on how to submit your comments.

5.1 Administrative boundaries

5.1.1 Timber Supply Area

Under Section 7 of the *Forest Act*, the minister may designate land as a timber supply area. The boundaries of TSAs were initially defined based on the pattern of wood flow to the existing (or expected) primary timber-using facilities. TSAs are a major management unit for which the chief forester determines an AAC. Within the outside boundary of a TSA, other area-based tenures with their own AAC may exist.

The spatial representation of timber supply areas is maintained within the BC Geographic Warehouse. The gross size of the Lillooet Timber Supply Area is 1.125 million hectares.

Data source and comments:

The Lillooet TSA boundaries were extracted from WHSE_ADMIN_BOUNDARIES.FADM_TSA within the BC Geographic Warehouse on December 18, 2018.

5.1.2 First Nation Territories

First Nations have provided the British Columbia government information on their territories for purposes outside of the timber supply review process. It is recognized that these maps, with solid boundaries, may not accurately reflect the boundaries of Indigenous Nations Territory or place. Where desired by a First Nation, an alternative boundary will be used.

The following table lists the First Nation territories that overlap with the Lillooet TSA given boundaries provided.

Table 3. First Nation's territories that overlap with the Lillooet TSA

Indigenous Nation	
Ashcroft Indian Band	N'Quatqua First Nation
Bonaparte Indian Band	Oregon Jack Creek Band
Boothroyd Indian Band	Samahquam First Nation
Boston Bar First Nation	Scw'exmx Tribal Council
Cayoose Creek Band	Sekw'el'was
Coldwater Indian Band	Shackan Indian Band
Cook's Ferry Indian Band	Siska First Nation
Esk'etemc First Nation	Skatin Nations
High Bar First Nation	Skuppah Indian Band
Kanaka Bar Indian Band	Spuzzum First Nation
Lillooet Tribal Council	St'at'imc Chiefs Council
Lil'wat First Nation	Stswecem'c Xgat'tem First Nation
Lower Nicola Indian Band	Tit'q'et First Nation
Lytton First Nation	Tsal'alh First Nation
Neskonlith Indian Band	Tsilhqot'in National Government
Nicomen Indian Band	Ts'kw'aylaxw First Nation
Nlaka'pamux Nation Tribal Council	Whispering Pines/Clinton Band
Nooaitch Indian band	Xaxli'p First Nation
Northern Secwepemc te Qelmucw (NStQ)	Xwisten
Northern Shuswap Tribal Council Society	Yunesit'in Government

Data source and comments:

Data is from the BC Geographic Warehouse
WHSE_ADMIN_BOUNDARIES.PIP_CONSULTATION_AREAS_SP

5.1.3 Excluded and constrained land

The Section 8, *Forest Act*, AAC applies only to the timber supply available from provincial crown lands. The forests and lands that have private, municipal, federal ownership are not considered within the determination as they are not provincially regulated for forest management.

As such, land with alternative ownership is excluded from the TSA analysis land base and do not contribute to the timber supply supporting the AAC determination.

These lands are identified within a variety of government maintained BC Geographic Warehouse (BCGW) files, as noted below under data source. For TSR purposes, a ministry compilation of ownership, that identifies land ownership is used to exclude these areas from the TSA analysis forested land base.

Ownership codes are generally used to identify whether the land can be considered to contribute to timber supply. Table 4 identifies the land ownership that contribute or do not contribute to the TSA analysis forested land base or the THLB.

Table 4. Constrained crown and alternatively owned land based on the FAIB ownership layer codes

Ownership code*	Description	% contribution to AFLB	% contribution to THLB
40-N	Private	0	0
52-N	Federal - Indian Reserve	0	0
54-N	Federal - Dominion government Block/Federal Parcels	0	0
60-N	Crown - Conservancy Area, Ecological Reserve, Protected Area, Provincial Park	100	0
61-C	Crown - UREP (Use, Recreation and Enjoyment of the Public Reserve)	100	100
62-C	Crown - Forest Management Unit	100	100
68-U	Crown - Forest Recreation Reserves	100	100
69-C	Crown - Community Watershed	100	100
69-U	Crown - Misc. Reserves	100	0
69-U	Crown - Watershed Reserve	100	100
80-N	Crown - Municipal Parcels	0	0

* Ownership codes found within ownership layer.

**The ownership layer has a sequential assignment of the ownership code to only a single category where overlap may occur (e.g., a crown tenure assign may override a recreation reserve).

Data source and comments:

Data is from the BC Geographic Warehouse. ownership coverage, WHSE_FOREST_VEGETATION.F_OWN

Data to derive the ownership coverage include BC Geographic Warehouse files:

WHSE_ADMIN_BOUNDARIES.CLAB_INDIAN_RESERVE

WHSE_ADMIN_BOUNDARIES.CLAB_NATIONAL_PARKS

WHSE_ADMIN_BOUNDARIES.FADM_SPECIAL_PROTECTION_AREA

WHSE_ADMIN_BOUNDARIES.FADM_TFL,
WHSE_ADMIN_BOUNDARIES.FADM_TFL_ADDITION,
WHSE_ADMIN_BOUNDARIES.FADM_TFL_DELETION,
WHSE_ADMIN_BOUNDARIES.FADM_TFL_SCHED_A

WHSE_CADASTRE.CBM_INTGD_CADASTRAL_FABRIC_SVW

WHSE_FOREST_TENURE.FTEN_Timber_Licence_poly_svw

WHSE_FOREST_TENURE.FTEN_TL_ELIMINATION_POLYGONS

WHSE_FOREST_TENURE.FTEN_MANAGED_LICENCE_POLY_SVW

WHSE_FOREST_TENURE.FTEN_RECREATION_POLY_SVW

WHSE_FOREST_TENURE.FTEN_TIMBER_USE_POLYGONS

WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW

WHSE_MINERAL_TENURE.MTA_SITE_POLY

WHSE_TANTALIS.TA_CROWN_TENURES_SVW

WHSE_TANTALIS.TA_LAND_CLAIM_STLMNT_AREAS_SVW

WHSE_TANTALIS.TA_PARK_ECORES_PA_SVW

WHSE_TANTALIS.TA_CONSERVANCY_AREAS_SVW

WHSE_TANTALIS.TA_SURFACE_OWNERSHIP_SVW

WHSE_TANTALIS.TA_WILDLIFE_MGMT_AREAS_SVW
WHSE_WATER_MANAGEMENT.WLS_COMMUNITY_WS_PUB_SVW

5.1.4 Area-based tenures

Area-based forest tenures such as Tree Farm Licences, Community Forest Agreements, First Nations Woodland Licences, and Woodlot Licences have their AAC determined independently of the AAC determination for the TSA. As such, area-based tenures are excluded from the TSA AFLB and the THLB of the timber supply analysis supporting the determination.

For TSR purposes, a ministry compilation of ownership that identifies area-based tenures is used to exclude these tenures from the TSA AFLB. Original BCGW sources will be used to capture any area-based tenures that have recently been established and are not included in the ownership layer. Table 5 identifies the specific Community Forest Agreement (CFA) and First Nations Woodland Licence (FNWL) in the Lillooet TSA. Woodlots are excluded from the AFLB and THLB as well.

Table 5. Area-based tenures in the Lillooet TSA

Name	% contribution to AFLB	% contribution to THLB
Xaxli'p Community Forest Corporation	0	0
Total 14 Woodlots	0	0

Data source and comments:

Data is from the ownership coverage and tenures coverage in the BC Geographic Warehouse.
WHSE_FOREST_VEGETATION.F_OWN
WHSE_FOREST_TENURE.FTEN_TIMBER_LICENCE_POLY_SVW

5.1.5 Protected areas

Numerous provincial parks and ecological reserves protect multiple values within the Lillooet TSA (Table 6). These protected areas are designated under various legislation and typically exclude harvesting. Therefore, areas such as parks and other protected areas are excluded from the THLB. Areas legally designated by the draft Land and Resource Management Plan (LRMP) as mining, tourism and wildland areas are also excluded from the THLB. Although the LRMP was never approved, the areas identified in Table 6 below were legally designated.

Table 6. Parks, ecological reserves, conservancy, mining, tourism and wildland areas

Name	Type	% contribution to AFLB	% contribution to THLB
Bridge River Delta Park	Provincial Park	100	0
Duffey Lake Park	Provincial Park	100	0
Fred Antoine Park	Provincial Park	100	0
French Bar Creek Park	Provincial Park	100	0
Goldpan Park	Provincial Park	100	0
Gwyneth Lake Park	Provincial Park	100	0
Marble Canyon Park	Provincial Park	100	0
Nlháxten	Wildland Area (Sec. 17)	100	0
Nlháxten /Cerise Creek	Conservancy Area	100	0
Pipi7iyekw Old Growth and Sensitive Area	OMGA	100	0
Seton Portage Historic Park	Provincial Park	100	0
Skihist Ecological Reserve	Ecological Reserve	100	0
Skihist Park	Provincial Park	100	0
Skwaha Lake Ecological Reserve	Ecological Reserve	100	0
South Chilcotin Mountains	Mining and Tourism Area	100	0
South Chilcotin Mountains Park	Provincial Park	100	0
Stein Valley Park	Provincial Park	100	0
Yalakom Park	Provincial Park	100	0

Data source and comments:

Data used from BC Geographic Warehouse:

WHSE_LAND_USE_PLANNING.RMP_PLAN_LEGAL_POLY_SVW – *Mining and Tourism Areas*

WHSE_TANTALIS.TA_PARK_ECORES_PA_SVW

WHSE_TANTALIS.TA_CONSERVANCY_AREAS_SVW – *Conservancy Area*

WHSE_TANTALIS.TA_CROWN_RSRV_NOTATIONS_SVW – *Nlhaxten WA & Cayoosh CMA*

5.2 Non-forest and non-productive lands

5.2.1 Land classified as non-forest

Non-forested areas such as alpine, lakes, rocks etc. and some non-productive forested lands do not impact the timber supply due to the lack of commercial timber or by not contributing to any land use objectives (e.g., old-seral objectives) that may impact timber supply. As such, these areas are removed from the TSA AFLB and the THLB.

The British Columbia land classification system (BCLCS) and site index (i.e., below 5 m) within the Vegetation Resources Inventory (VRI) will be used in conjunction with past logging to identify areas of non-forest. Table 7 shows the criteria used to remove non-forested areas from the THLB and the AFLB.

Table 7. Non-forest and non-productive area

Attributes	Description	% contribution to AFLB	% contribution to THLB
VRI BCLCS level 1 = 'N' and no logging history	Non-vegetated	0	0
BCLCS level 2 = 'N' and no logging history	Non-treed	0	0
BCLCS level 3 = 'A' and no logging history	Alpine	0	0
Projected height < 5 m and no logging history	Forested but does not contribute in context of TSR	0	0

Data source and comments:

Data is from BC Geographic Warehouse,
WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY

5.2.2 Roads, trails and landings

Roads, trails and landings are constructed to access and facilitate harvest operations and other purposes. If these structures are not reforested, productive forest land is lost.

For the current timber supply analysis, a strategic-level roads database will be used. This database contains line work from multiple sources that has been integrated from a hierarchical process into a single data source. This data, commonly called the regional cumulative effects road layer, was developed for strategic analysis purposes and not navigation purposes. The authoritative source for constructed roads is the Digital Road Atlas.

To determine the amount of productive forest lost to roads, trails and landings, the former Lillooet Forest District surveyed several drainages in 1997 to determine the extent of the impacted areas. This survey identified the width of the non-productive area along roads and trails and the area lost due to landings as shown in Table 8.

Table 8. Estimates for existing and future roads, trails, and landings

Road class	Slope	Effective road width (m)	% contribution to AFLB	% contribution to THLB
Highway	All	16	0	0
Regional paved roads	All	12	0	0
Logging roads	<10%	9.33	0	0
Logging roads	10-30%	11.76	0	0
Logging roads	>30%	15.27	0	0
Trail	<10%	4.49	0	0
Trail	10-30%	5.68	0	0
Trail	>30%	9.96	0	0

Roads and trails that currently exist do not contribute to either the THLB or other land use objectives (i.e., excluded from the TSA AFLB). The reduction associated with these roads will be based upon determining the buffered reduction.

Future roads and trails are modelled by first allowing a one-time timber harvest and then applying a 7.5% volume reduction to these stands to represent areas lost to future roads. Future roads and trails reduction are applied to stands without harvesting history.

Landings have been required to be rehabilitated since 1996. However, a 2% area-based reduction will be applied to all stands harvested prior to 1996.

Roads and trails that are rehabilitated would be part of the THLB. However, given the small area involved and the difficulty of identifying these areas, all existing roads and trails within the road data set will be excluded from the THLB. An estimate of rehabilitated roads and trails, if available, will be identified to the chief forester for the AAC determination.

In the previous timber supply review, it was identified that roads, trails, and landings impacted less than 1% the TSA AFLB.

Data source and comments:

Data to be used are from the Thompson-Okanagan Natural Resource Region geospatial data team. The file provided by Cumulative Effects and is named the Cumulative Effects Provincial Consolidated Disturbance Layer:

\\spatialfiles.bcgov\work\srm\bcce\shared\data_library\disturbance\human_disturbance\2019\inputs\Data\Disturbance_4_Dissolve.gdb

\\spatialfiles.bcgov\work\srm\bcce\shared\data_library\roads\2019\layerfiles

Alternative data, which was used in creation of the cumulative effects data set are from BC Geographic Warehouse:

WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW

WHSE_BASEMAPPING.DRA_DGTL_ROAD_ATLAS_MPAR_SP

WHSE_BASEMAPPING.TRIM_TRANSPORTATION_LINES

5.3 Forests

5.3.1 Vegetation resource inventory

The VRI is based upon aerial photo classification (which includes ground checks) that provides the inventory attributes (e.g., identifies polygons, land classes, tree species, heights, basal area) for forested stands. Following the aerial photo classification, a ground sample audit (or previously called Phase 2) may be conducted that provides a statistical comparison to the aerial photo interpretation.

The VRI classification information is maintained in a management system (commonly called the forest inventory). In this system, other attributes are derived (e.g., forest stand volume), harvesting and natural disturbances are added, and attributes are projected to the current year.

The current forest inventory for the Lillooet TSA was completed in four separate re-inventory aerial photo classification projects between 1988 and 1990 based on the older Forest Cover Inventory standards. The current forest inventory is a translation to VRI attributes of these older inventories. In 2003, a VRI phase 2 ground sample in the Lillooet TSA was completed by the Ministry of Sustainable Resource Management to assess the inventory.

For use in the TSR timber supply analysis, the current forest inventory, that is projected to January 1, 2019, will be used. Information on the Phase 2 assessment, including results of a sensitivity analysis that will explore the implication of Phase 2 results, as described in Section 6.7, will be presented to the chief forester for consideration in the AAC determination.

A new VRI aerial photo classification is to be completed by 2021. It is expected that this information will be available before the chief forester's AAC decision and that a sensitivity analysis will be completed that replaces the current inventory and natural yield tables based on the inventory attributes.

Data source and comments:

Data is from BC Geographic Warehouse:
WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY
MSRM, Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003.

5.3.2 Ecosystem mapping

In British Columbia, a biogeoclimatic (BGC) ecosystem classification (BEC) system and the associated BGC mapping form the cornerstone for many resource management activities. The BEC system classifies ecosystems at differing spatial and temporal levels.

At a regional level, the BEC system identifies biogeoclimatic units that have relatively uniform climate inferred from vegetation, soils, and topography. This zonal classification consists of a zone (a large geographic area with a broadly homogeneous macroclimate with characteristic climax vegetation), subzones that capture climatic variation within the zone, and variants that reflect slightly drier, wetter, warmer, or colder differences. This information is contained within the BGC mapping.

At a local level, the BEC system classifies landscape segments that have relatively uniform vegetation, soils and topography into site units. This site classification recognizes three units: site association, site series, and site type. Site series is the unit most commonly used by operational staff. Mapping of site series is typically accomplished either through Terrestrial Ecosystem Mapping or Predictive Ecosystem Mapping.

The current BGC mapping in the region was revised with the release of Version 6 in 2006. Further upgrades to the BGC mapping are occurring but the current focus by ministry ecologists is in the southern portion of the Thompson-Okanagan Region. Future expectations for the Lillooet TSA are that a separate field guide will be produced, given the uniqueness of the Lillooet TSA. It is expected that the current PPxh2 in the region will be split and treated as a separate unit in the Lillooet TSA.

In 2004, Predictive Ecosystem Mapping (PEM) was completed that covered the entire land base of the Lillooet TSA. However, the PEM project did not pass provincial standard quality checks and no further work has occurred or is currently planned to address the deficiencies.

BGC mapping supports both silviculture and non-timber objective activities. For the timber supply review, old-seral objectives are based upon BEC classes, and where necessary growth and yield predictions use analysis units based on BEC classes. The PEM has not been used (e.g., in the development of site productivity estimates) given its current status.

Data source and comments:

For a fuller description of the BEC program see
https://www.for.gov.bc.ca/hre/becweb/program/current/index.html

Data for the biogeoclimatic subzones are from the BC Geographic Warehouse file
WHSE_FOREST_VEGETATION.BEC_BIOGEOCLIMATIC_POLY

Shamaya Consulting and Silvatech Group Consulting Ltd. 2004. Lillooet TSA Predictive Ecosystem Map final report. BAPID # 4021 (MSRM registry number). FIA Service Agreement Activity #4219003-01. Lillooet, BC.

Braumandl, T. and P Dykstra. 2007. Accuracy assessment of a predictive ecosystem map – Lillooet Timber Supply Area. Prepared for Aninsworth Engineered Canada LP. March 15, 2007.

5.3.3 Site index

Site index is the most common measure of forest site productivity used in British Columbia. Site index may be used as a descriptor of existing forests or as a measure of the potential forest growth that is used as an input for certain growth and yield models.

In British Columbia, site index that is derived from height and age attributes of the forest inventory is recognized as likely underestimating the potential site productivity of younger and older stands. As such, the ministry has investigated other methods to determine the potential site productivity.

The ministry maintains a “provincial site productivity layer” that identifies estimates of potential site productivity based upon a ministry project, Site Index Estimates by BEC Site Series (SIBEC), that developed the relationship between site series and site index. Given these relationships and having site

series mapping based on either TEM or PEM, potential site index could be assigned to forest polygons within a TSA. These estimates form the majority of a "provincial site productivity layer" maintained by the ministry. Alternatively, where appropriate TEM or PEM is not available, site index estimates for the provincial site productivity layer for the TSA have been based upon a biophysical model.

In the Lillooet TSA, as the completed PEM did not meet accuracy standards, the site indices from the provincial site productivity layer are based on predictions from a biophysical model. These potential site indices are used as input to growth and yield projections for silviculturally treated stands based on the model Table Interpolation Program for Stand Yields (TIPSY).

As indicated in Section 6.7 *Model uncertainty and sensitivity analyses*, a sensitivity analysis will be conducted to evaluate the impact of applying site index estimates from the biophysical model vs the PEM.

Data source and comments:

The provincial site productivity layer is available through the BC Data Catalogue (https://catalogue.data.gov.bc.ca/dataset/site-productivity-site-index-by-tree-species).

Mah, S. and G. Nigh. 2003. SIBEC Site Index Estimates in Support of Forest Management in BC, Ministry of Forests, Science Program, 2003.

5.3.4 Forest growth

The forest inventory attributes for age, height, and volume is projected to January 1, 2019. For timber supply analysis, it is required to have estimates of future stand volumes and other attributes such as height. These attributes are projected, often more than 200 years into the future, from inventory and silviculture information using growth and yield models and tools. The growth and yield models and tools used to make forecasts of stand attributes are further described under Section 6.2.

5.4 Forest health

5.4.1 Forest health overview

In the Lillooet TSA, forest health issues continue to be an increasing concern. These agents include insects, pathogens, animals, and abiotic events, which have the potential to cause significant timber losses. The Forest Health Program of the FLNRORD evaluates the impact of forest health damaging agents on forest resource values and when necessary, prescribes and implements management practices to prevent damages.

In the Lillooet TSA, bark beetles continue to thrive (Table 9), with losses occurring in the high elevation ecosystems. Spruce bark beetle appears to be on the rise and has recently been a problem in the Duffy Lake Landscape Unit where almost all of the drainages have been affected. Mountain pine beetle continues to be significant, and in addition to lodgepole pine, white bark pine is now being affected. As some insects, such as the balsam bark beetle, have been increasing at historic records, most of these losses are not able to be recovered through harvest.

The levels of attack of the past three years, as shown in Table 9, are expected to continue into the foreseeable future.

Table 9. Number of hectares of impact for various bark beetles in the Lillooet TSA

Damaging agent	2016	2017	2018	2019
Spruce bark beetle	3 000	5 000	6 000	3 122
Mountain pine beetle	11 000	6 500	7 500	6 747
Douglas-fir beetle	1 600	1 350	600	188
Western Balsam bark beetle	24 000	20 000	11 000	15 697

Abnormal or catastrophic infestations and devastations are unpredictable and highly variable from year to year. The principle of regularly revisiting the AAC decision and the ability to revisit a decision earlier are important components of the AAC decision to address unpredictable events.

In the timber supply analysis, the empirical basis of the model Variable Density Yield Prediction Model (VDYP) and the use of operational adjustment factors or specific options (e.g., for root rots) in the model TIPSY are expected to capture volume loss due to endemic levels of pests. The capture of catastrophic losses (e.g., fire, epidemic infestations) is described below under non-recoverable losses.

Data source and comments:

2016, 2017, 2018, 2019 *Overview of Forest Health Conditions in Southern British Columbia* Lorraine Maclauchlan FLNRORD;

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/aerial-overview-surveys/summary-reports

5.4.2 Mountain pine beetle

Mountain pine beetle infestation in the interior of BC started in 1999 and peaked in 2005 resulting in the death of over 700 million cubic metres of merchantable pine volume in British Columbia. In the Lillooet TSA, the infestation reached its peak of 1.1 million cubic metres in 2007. Mountain pine beetle remains active in the Lillooet TSA, though at a lower level. Since 2012 annual impacts have been less than 100 000 cubic metres with a low of about 41 000 cubic metres in 2013. Recent MPB outbreaks have been observed in Slim Creek, Bridge River, Downton Creek, and Cadwallader Creek.

The 2019 projection of the VRI used in this timber supply analysis includes adjustments for the recent MPB infestation and provides separate live and dead layers. The dead layer was created based upon the provincial mountain pine beetle model that uses aerial survey information of the infestation. The live layer updates the attributes of the VRI to reflect the mortality contained in the dead layer.

Pine trees impacted by MPB start to degrade upon death. The loss of quality affects the value of the timber and the products that may be produced from the fiber. It is generally accepted that the quality of the wood from infested trees moves from dimension lumber quality through to pulp and secondary products, such as biofuels, in the years following death.

Shelf life is the length of time since death during which a specific merchantable product can be produced from the dead pine. It is dependent on several factors, including access, conditions, and available milling technology.

In the timber supply analysis, no shelf life considerations will be modelled. The model will report the amount of MPB killed (i.e., the dead layer) volume present within a harvested polygon. In addition, the sum of the dead volume harvested annually will be reported to the chief forester for consideration in the AAC determination (Table 10).

Table 10. Annual volume killed by mountain pine beetle and salvaged on the timber harvesting land base in the Lillooet TSA, 2009 to 2019

Year	Unsalvaged volume	Salvaged volume	Total volume killed
2009	599 846	23 665	623 511
2010	256 162	10 043	266 205
2011	103 834	7 038	110 872
2012	56 496	3 379	59 875
2013	40 144	1 319	41 463
2014	45 160	2 715	47 875
2015	67 405	1 865	69 270
2016	92 605	2 021	94 626
2017	61 902	1 209	63 111
2018	36 207	131	36 338
2019	15 597	0	15 597

Data source and comments:

Source: Forest Health Officer, Office of the Chief Forester; FLNRORD, Non-Recoverable Losses Survey Data: https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/NRLs/

For a description of Mountain pine beetle projections see: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/bark-beetles/mountain-pine-beetle/mpb-projections

5.4.3 Non-recoverable losses

Non-recoverable losses provide an estimate of the average annual volume of timber that will be damaged or killed on the forested land base and not salvaged or accounted for by other factors. These losses result from atypical events related to several factors that cause tree mortality, including insects, disease, blowdown, snow press, wildfires, etc. The values shown in the non-recoverable loss column of Table 11 below represent the estimated annual volume that will not be recovered or salvaged.

Managing the successive outbreaks of Mountain Pine Beetle (MPB), Spruce Bark Beetle (SBB) and Douglas-fir Beetle (DFB) in this TSA, has been operationally plagued by economic, social, and topographical challenges. These challenges are expected to continue for the Lillooet TSA.

Since the killed volume by the recent MPB infestation has been incorporated into the inventory layer (i.e., being excluded from the live volume), the following non-recoverable losses table (Table 11) does not include volume loss to MPB. Endemic pest losses are considered natural processes within stands and are accounted for within the growth and yield models. Therefore, non-salvaged dead pine will be placed on a VDYP yield curve.

The forecasted unsalvaged losses shown below in Table 11, are based on a 10-year average (2008-2018).

Table 11. Estimated average non-recoverable losses in the Lillooet TSA

Cause of loss	Annual unsalvaged loss (m^3/yr)
Insects	35 000*
Fire	74 000
Windthrow	8 000
Miscellaneous	1 000

*All insects except MPB.

Unquantified losses due to western spruce budworm have occurred in Douglas-fir stands. These losses are in understory regeneration and subdominant layers.

Annual miscellaneous losses relate to landslide areas and other minor factors such as mammals, flooding, drought, frost and winterkill. Of note were the losses due to the 2017 drought in young pine stands.

Non-recoverable loss will be deducted from the harvest flow in the base case.

Data source and comments:

Source: FLNRORD Provincial Aerial Overview Survey Data.

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/aerial-overview-surveys/summary-reports

5.4.4 Disturbance outside of THLB

Crown forest land outside of the THLB undergoes natural disturbance that affects age class distribution and its contribution to forest cover requirements (e.g., old seral requirements). This natural disturbance outside of the THLB should be accounted for to prevent this forest from aging continuously and contributing inappropriately to forest cover requirements.

To prevent stands from aging indefinitely, stands older than 300 years outside of the THLB will be set back to age 0 and regrown based on its natural volume table.

5.5 Cultural heritage

5.5.1 Cultural heritage resources and values

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 (discussed in a separate section), structural features, heritage landscape features and traditional use sites.

Indigenous Cultural Heritage, however, is broader in its definition. 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. All plants, animals and other natural resources necessary for survival are an integral part of cultural heritage. Cultural heritage also incorporates the intangible aspects such as history and identity, which combined constitutes intellectual property.

5.5.2 Archaeological

The *Heritage Conservation Act* provides for the protection of British Columbia's archaeological sites predating 1846. In accordance with the *Act* (Section 13(2)), archaeological sites may not be damaged, excavated or altered without a permit issued by the Minister or designate.

The Lillooet Timber Supply Area is operationally constrained by the high number of known archaeological sites as well as the unknown number of additional sites across the timber harvesting land base. Many of the known sites are situated along the river systems. There are three reasons for this: 1) these are areas where historic inhabitants were known to live and conduct activities, 2) these are the areas where archaeological studies have been undertaken, and 3) the upland sites are of a different type that are not as easily recognized. Archaeological sites located further from the river systems are usually found accidentally, often through operational activities. There are many examples of past incidences where harvesting has been delayed, amended or cancelled because of archaeological issues.

The BC Provincial Heritage Register database is the basis for records on archaeological sites and provides a polygon layer. For this timber supply review, all identified buffered archaeological sites within the provincial application Remote Access to Archaeological Data (RAAD) will be excluded from the timber harvesting land base.

Data source and comments:

Data is from BC Geographic Warehouse:

WHSE_ARCHAEOLOGY.RAAD_TFM_SITES_SVW. This is a restricted access dataset.

5.5.2.1 Other cultural heritage resources and values

Many cultural heritage resources and values, other than those formerly designated as archaeological sites, are present within the Lillooet Timber Supply Area. These resources and/or values may not have any legal designation and may or may not impact timber supply.

Through engagement with First Nations, First Nations may inform the ministry about specific cultural heritage resources that require operational considerations and additional forest estate modelling or analysis for inclusion in the information provided to the chief forester for consideration in the AAC determination.

Within government legal notations there are several reserves for cultural significance and Aboriginal Interest and use study areas (Table 12).

For example, a Section 17 *Land Act* designated use area has been established around a former First Nation village site. While harvesting is not excluded under this order, given the forest type and cultural values, these 600 hectares will be excluded from the THLB in the base case of the timber supply analysis.

Other areas of cultural significance have been designated under Section 17 of the *Land Act*. These areas are often designated as a Section 17 with the expectation that they may be transitioned into a conservancy area or ecological reserve that may be omitted from the THLB. In the Lillooet TSA, some of these are small areas that occur at the boundary of the TSA and contain no THLB. However, the Nlhaxten/Cayoosh Cultural Management Area (CMA) represents nearly 24 000 hectares. As the designation does not restrict timber harvesting, the base case will not model a reduction in timber supply, however, operationally licensees are expected to engage First Nations.

Table 12. Land Act, Section 17 legal notations identified with a cultural heritage related status

Name	% contribution to AFLB	% contribution to THLB
Ecological Area (Pavilion)	100	0
Nlhaxten/Cayoosh (CMA)	100	100
Twin One Headwaters	100	0
Twin Two Peak	100	0
Lizzie Headwaters	100	0

Data source and comments:

Data is from BC Geographic Warehouse:

WHSE_HUMAN_CULTURAL_ECONOMIC.FNSS_SENSITIVE_SITES_SP

This is a restricted access dataset.

5.6 Water

Water is recognized for its key ecological role and value as a resource used for many purposes. Forests play a key role in regulating the flow and quality of water. As such, various forest legislation identifies how forests are to be managed in order to address water concerns.

In the Lillooet TSA, water is an important resource. Forest management in the TSA can have significant impacts on the water resource given the high hazard level of sedimentation due to the steep terrain and the proximity of roads to streams.

The following sections describe several forest management considerations that relate to water. Section 5.16.4 '*Cumulative Effects'* also details information on the current state of water in the Lillooet TSA.

5.6.1 Community watersheds

Water in community watersheds is a value identified under the *Forest and Range Practices Act* (FRPA). Under FRPA, licensees are required to specify results and strategies in their forest stewardship plan that meet the objectives set by government for water quality. Objectives for water in community watersheds are established under Section 8.2 of the Forest Planning and Practices Regulation.

Operationally, these areas are managed as per licensees' commitments in their forest stewardship plans. This means that management constraints for community watersheds are not standardized but are typically based on the recommendations of a hydrological assessment by a qualified professional.

There are 24 officially designated community watersheds (continued under Section 180(e) of the FRPA) within the Lillooet TSA covering 40 947 hectares (Table 13). These will be modelled by restricting harvest within each community watershed to an equivalent clearcut area (ECA) of 30% using a recovery height of 15 m. This tree height is based on the updated hydrological recovery curves provided in Extension Note 116 where 90% hydrological recovery is attained at tree heights of greater than 15 m for pine-dominated forests (Winkler & Boon, 2015).

It is recognized that there are other non-designated watersheds within the TSA that have significant social concerns and within those there has been a higher level of management by licensees. These will not be modelled within the base case of the TSR. The watersheds identified in Table 14 will be modelled in a sensitivity analysis to determine the impact on timber supply.

Table 13. Designated community watersheds within the Lillooet TSA

Community watershed	Source
Blackbird Community Watershed	Blackbird Creek
Countless Community Watershed	Countless Creek
Dickey Community Watershed	Dickey Creek
Dicksam Community Watershed	Dicksam Brook
Fergusson Community Watershed	Fergusson Creek
Fountain Community Watershed	Fountain Creek
George Community Watershed	George Creek
Gladwin Community Watershed	Gladwin Creek
Inklyulnkinatko Community Watershed	Inklyuhkinatko Creek
Intlpam Community Watershed	Intlpam Creek
Lytton Community Watershed	Lytton Creek
Mcintyre Community Watershed	McIntyre Brook
Mellott Creek Community Watershed	Mellott Creek
Murray Community Watershed	Murray Creek
Nekliptum Creek (North Channel)	Nekliptum Creek (N. Channel)
Nepuchin Community Watershed	Nepuchin Creek
Nikaia Community Watershed	Nikaia Creek
Omin Community Watershed	Omin Brook
President Community Watershed	President Creek
Retasket Community Watershed	Retasket Brook
Six Mile Community Watershed	Six Mile Creek
Town Community Watershed	Town Creek

Table 14. Non-designated watersheds within the Lillooet TSA

Community watershed	Source
Gun Creek Watershed	Gun Creek
Twaal Watershed	Twaal Creek
Nicomen Watershed	Nicomen Creek
Buck Creek Watershed	Buck Creek
Della Creek Watershed	Della Creek
Botanie Creek Watershed	Botanie Creek
Hull Ardean Creek	Hull Ardean Creek

Community watershed assumptions will be modelled on a watershed level to better reflect the operational practices that occur within the Lillooet TSA (Table 15).

Table 15. Community watershed management assumptions

Management zone	Management requirement	Modelled constraint	Area to which it applies
Designated community watersheds	Max equivalent clearcut area of 30% using a hydrologic recovery height of 15 m	Max 30% < 15 m tall	AFLB portion of each watershed

Data source and comments:

Data is from BC Geographic Warehouse, WHSE_WATER_MANAGEMENT.WLS_COMMUNITY_WS_PUB_SVW

Extension Note 116: Revised Snow Recovery Estimates for Pine-dominated Forests in Interior British Columbia. R. Winkler and S. Boon. 2015. Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

5.6.2 Water intakes

Licensed waterworks within community watersheds are protected through FPPR Section 60. As per Section 60(2), authorized person must not harvest timber or construct road within 100 m radius upslope of a licensed waterworks where the water is diverted for human consumption unless the activity will not increase sediment delivery to the intake. There are currently 80 active domestic intakes in community watersheds. Domestic water intakes known in other watersheds include 113 active domestic intakes in Gun Creek, 7 in Twaal Creek, 7 in the Buck Creek, 2 in Dell Creek, 30 in Botanie Creek, 4 in Nicomen Creek, and 1 in Hull Ardean Creek.

For modelling purposes, an area of THLB equivalent to the 100 m upslope buffer will be removed from each watershed.

Table 16. Water intake management assumptions

Management zone	Management requirements	% contribution to AFLB	AFLB% contribution to AFLB
Points of diversion (water intakes for human consumption) in all watersheds	Reserve zone of 100 m applied upstream of CWS intake points (semi-circle)	100%	0%

Data source and comments:

Data is from BC Geographic Warehouse, WHSE_WATER_MANAGEMENT.WLS_WATER_RIGHTS_LICENCES_SP

5.6.3 Green-up and hydrologic recovery

The amount of recently harvested area within a watershed can have hydrological and biodiversity implications.

Under Section 64 of the Forest Planning and Practices Regulation, the size of a cutblock is not to exceed 40 hectares within the Lillooet TSA where more than 40% of the basal area of the stand is harvested.

Under Section 65 of the Forest Planning and Practices Regulation, requirements are set for harvesting in a cutblock that is adjacent to an existing cutblock. This section sets out specific conditions (i.e., average height of the regenerating forest reaching a specified target) that a logged block must achieve before adjacent areas can be logged. These requirements are commonly called green-up requirements.

Green-up requirements will be modelled using forest level objectives, as opposed to block specific spatial requirements. This is consistent with operational flexibility around cutblock location. The amount of THLB area less than three metres in height is limited to 33% within each watershed (Table 17).

Table 17. Green-up requirement by watershed

Management zone	Modelled green-up constraint	Area to which it applies
Integrated resource management zones	Max 33% < 3 metres	THLB within a watershed

Data source and comments:

First Look at Visually Effective Green-up in BC (MOF, 1994).

5.7 Biodiversity

5.7.1 Landscape-level biodiversity

Within the Lillooet TSA, landscape-level biodiversity is primarily managed through old-seral forest retention which is guided by the Order Establishing Provincial Non-Spatial Old Growth Objectives dated June 2004. This legislation specifies the required distribution and amount of old growth retention by ecosystem type and Biodiversity Emphasis Option (BEO). The retention is spread over the land base by requiring targets to be met in each landscape unit (LU) and BEC variant. Each LU is assigned as BEO (Low, Intermediate or High) that dictates the level of retention required in each BEC variant. Old stands in the AFLB of each unit were used to satisfy the old-growth seral stage requirement.

In the timber supply analysis, the old-seral requirements will not be directly modelled. Old-seral requirements will be modelled by the exclusion of non-legal OGMAs (see Section 5.7.2).

Table 18. Biodiversity emphasis options for landscape units in the Lillooet TSA

Landscape unit	Biodiversity emphasis option
Bridge	Low
Carpenter Lake North	Low
Carpenter Lake South	High
Carpenter Lake South	Low
Connell Creek	High
Connell Creek	Low
Duffey Lake	High
French Bar	Intermediate
Gun	Low
Hurley	Intermediate
Kwoiek	High
Kwoiek	Intermediate
Lost Creek	High
Murray	Low
Pavilion	Intermediate
Siska	Intermediate
Spruce Lake	Intermediate
Stein	NA
Texas Creek	Intermediate
Watson Bar	Low
Yalakom	Intermediate

Table 19. Old seral objective and requirement for biogeoclimatic zones in the Lillooet TSA

Biogeoclimatic zone	Natural disturbance type	Age of old forest	Percent old forest retention		
			Low BEO	Intermediate	High
MH	NDT1	>250 yrs	>19	>19	>28
CWH	NDT2	>250 yrs	>9	>9	>13
ESSF	NDT2	>250 yrs	>9	>9	>13
ESSF	NDT3	>140 yrs	>14	>14	>21
MS	NDT3	>140 yrs	>14	>14	>21
BG	NDT4	>250 yrs	>13	>13	>19
IDF	NDT4	>250 yrs	>13	>13	>19
PP	NDT4	>250 yrs	>13	>13	>19

Data source and comments:

Order Establishing Provincial Non-Spatial Old Growth Objectives, George Abbott, Minister of Sustainable Resource Management, June 2004.

5.7.2 Old-growth management areas

Old-growth forests are considered a key biodiversity component and a coarse filter for maintaining ecological diversity at the landscape level over time. OGMAs is one tool in maintaining biodiversity. Old-growth attributes are also managed across the landscape at a stand level and may be included via other fine filter tools such as wildlife tree patches, wildlife habitat areas, or other tools used to capture specific features important to old growth and biodiversity goals. OGMAs while usually comprising "old forests" may also capture younger forests or unusual/rare features that have importance, either to the integrity of the OGMA or within OGMAs.

OGMAs have been spatially located and mapped in the Lillooet TSA to address TSA landscape-biodiversity objectives for old-seral forest types that originate from the Order Establishing Provincial Non-Spatial Old Growth Objectives.

The draft OGMAs are not legally established but are being recognized by licensees through the *Managing OGMA Consolidation Mapping* Agreement that was jointly signed by the District Operational Implementation Team in 2013. Licensees have included provisions within their respective FSPs that allow for the replacement of the non-legal OGMA polygons. These changes are annually reported and consolidated with the Cascades Natural Resource District.

However, the aspatial old growth order will be modelled in a sensitivity analysis and compared with current practice.

In the timber supply analysis, the draft OGMAs will be excluded from the THLB and used as a surrogate for the old-seral requirements. Since TSR is a strategic process, the draft OGMAs indicate the magnitude of the area that is to be retained even if their size and location may be modified in the future.

Table 20. Old-growth management areas

Description	% contribution to AFLB	% contribution to THLB
OGMA's	100	0

A new OGMA from the Lil'wat Land Use Agreement with the Province has identified 864 hectares to be protected to help conserve biodiversity, support traditional Indigenous land-use activities and protect cultural landmarks. For the purposes of the Lillooet TSR base case, the Pipi7iyekw OGMA will be excluded from the THLB and treated as a Protected Area as described above in Table 6.

Data source and comments:

Data is from BC Geographic Warehouse, Cerise Creek Sensitive Area.

Lillooet TSA data updated as of December 18, 2018.

Agreement for Managing OGMA Consolidation Mapping. July 2013. https://www.for.gov.bc.ca/ftp/DCS/external/!publish/FSP_Local_Data/Licensee_Data/OGMA_Standards_DCS_July152013_FINAL.pdf

5.7.3 Stand-level biodiversity - wildlife tree retention

One of the primary methods of addressing stand-level biodiversity objectives is by means of wildlife tree and wildlife tree patches (WTP) retention. The retention requirements for wildlife trees and wildlife tree patches are set out in the Forest Planning and Practices Regulation as 7% of the total area of cutblocks harvested, and a minimum of 3.5% for each cutblock. Licensees have developed results and strategies in their Forest Stewardship Plans that set out wildlife tree retention targets by landscape unit and BEC variant.

Since WTPs often overlap with other forest values, such as riparian reserves zones, the effective percent of wildlife tree and WTP retention varies from the amount specified in the Forest Planning and Practices Regulation. Multiple resource value assessments show the results of stand- and landscape-level monitoring carried out under the Forest & Range Evaluation Program (FREP), but for the Lillooet TSA, the sample size is too small to draw a conclusion of the effective percent of the wildlife tree and wildlife tree patches.

In this timber supply analysis, the default requirement of 7% of FPPR will be modelled by applying a 7% reduction to the THLB.

5.8 Fish and riparian

As identified under the *Forest Planning and Practices Regulation*, the Province has set objectives for water, fish, wildlife and biodiversity within riparian areas. Without unduly reducing the supply of timber from British Columbia's forests, these objectives conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas.

5.8.1 Riparian

5.8.1.1 Streams

A stream reach is a relatively homogeneous section of a stream having a sequence of repeating structural characteristics (or processes) and fish habitat types. The key physical factors used to determine reaches in the field are channel pattern, channel confinement, gradient, and streambed and bank materials. Stream reaches generally show uniformity in these characteristics and in discharge.

5.8.1.2 Lakes

Properly functioning lakes store large amounts of water, are important in managing floods and droughts, replenish groundwater, positively influencing water quality downstream and provide habitat for fish, invertebrates and birds. Lakes may also provide important recreational and tourism opportunities in the Lillooet TSA. Lakes are well mapped in the province and spatial data is readily available on the BCGW. Lake classification is based on lake size and the biogeoclimatic unit in which they occur.

5.8.1.3 Wetlands

A wetland is a swamp, marsh, or similar area that supports natural vegetation that is distinct from the adjacent upland areas. More specifically, a wetland is an area where a water table is at, near, or above the surface or where soils are water-saturated for a sufficient length of time that excess water and resulting low oxygen levels are principal determinants of vegetation and soil development. Wetlands can also be transitions between dry land and water such as streams, rivers, lakes and coastline.

5.8.1.4 Modelling riparian areas

Riparian management areas (RMAs) along lakes, wetlands and streams provide key habitat for fish and wildlife and help conserve water quality and biodiversity. The FRPA provides for RMA widths which include both riparian reserve zones (RRZ) that exclude timber harvesting altogether, and riparian management zones (RMZ) where constraints are placed on timber harvesting.

Lakes and wetlands were identified using Terrain Resource Information Management (TRIM) information, consistent with the 1997 MFR *Riparian Management Guidebook*, and the appropriate effective buffers were then derived using current practices from forest stewardship plans and excluded from the THLB.

For streams, appropriate stream classifications from S1 to S6 were assigned through TRIM information using a classification algorithm intended to be consistent with the *Riparian Management Guidebook*. Updates to these classifications was completed by District staff comparing stream classification against current satellite imagery and fisheries survey information. Within designated community watersheds, riparian classes were limited to S1 to S4 streams.

Riparian reserve zones for lakes, wetlands and streams represent a 100% reduction of the THLB whereas RMZ retention requirements have been converted into an effective buffer width for modelling purposes. The average basal area retention percentage was pulled from licensee practices within the Lillooet TSA as stated in their Forest Stewardship Plans (Table 22 and Table 23).

For example, for an S6 riparian class, the RMZ has a width of 20 metres and a basal area retention requirement of 15%, the effective buffer width on one side would be three metres. This RMZ buffer is then added to the RRZ buffer to determine the effective buffer width to be excluded from harvest. Effective buffer widths for each riparian class are detailed in Table 21.

Table 21. Riparian reserve and management zones for streams

Riparian class	Riparian reserve zone (RRZ) (m)	Riparian management zone (RMZ) (m)	RMZ basal area retention average (%)	Effective buffer applied to both sides for modelling (m)*	% contribution to AFLB	% contribution to THLB
S1-A	0	100	35	35	100	0
S1-B	50	20	35	57	100	0
S2	30	20	22.5	35	100	0
S3	20	20	22.5	25	100	0
S4	0	30	25	8	100	0
S5	0	30	25	8	100	0
S6	0	20	15	3	100	0

Table 22. Riparian reserve and management zones for lakes

Riparian class	Riparian reserve zone (RRZ) (m)	Riparian management zone (RMZ) (m)	RMZ basal area retention average (%)	Effective buffer applied to both sides for modelling (m)*	% contribution to AFLB	% contribution to THLB
L1-A	0	0	15	0	100	0
L1-B	10	0	15	10	100	0
L2	10	20	22.5	15	100	0
L3	0	30	22.5	7	100	0
L4	0	30	22.5	7	100	0

Table 23. Riparian reserve and management zones for wetlands

Riparian class	Riparian reserve zone (RRZ) (m)	Riparian management zone (RMZ) (m)	RMZ basal area retention average (%)	Effective buffer applied to both sides for modelling (m)*	% contribution to AFLB	% contribution to THLB
W1	10	40	22.5	19	100	0
W2	10	20	22.5	15	100	0
W3	0	30	22.5	7	100	0
W4	0	30	18.75	6	100	0
W5	10	40	22.5	19	100	0

* = Effective buffer = RRZ + (RMZ*(basal area%/100)) measured in metres and applied to both sides of the stream.

Data source and comments:

Local Data provided by Cascades NRD, RiparianMgmtAreas_DCS_Nov2018.gdb (Lake/Wetland/Stream)

The Stream Classification data is a newly consolidated dataset that uses the original data from the LRMP and incorporates information from new data sources (e.g., MOE Draft Fish Passage Fish Habitat 2010) for fish passage/inventory/etc. and ortho photography to confirm widths where possible. The process of creating the consolidated dataset is described in detail in the following document: https://www.for.gov.bc.ca/ftp/dcs/external/!publish/FSP_Local_Data/FSP_Local_Data/Rip_StrCls_Nov2018_UpdateProject.pdf

Basal area % retention calculated using an average from approved forest stewardship plans (BC Timber Sales and Aspen Planers Ltd.).

5.9 Wildlife

The Lillooet TSA provides critical habitat for a variety of wildlife species, some of which are considered species at risk. A variety of legislative mechanisms are available to protect wildlife habitat.

Wildlife is identified as one of the 11 values that objectives may be prescribed under regulation of the *Forest and Range Practices Act* Section 149(1). Specific tools for wildlife habitat protection (e.g., wildlife habitat areas, ungulate winter range) are present under the FRPA Government Actions Regulation.

Wildlife habitat may be identified and managed through several processes including the Identified Wildlife Management Strategy (IWMS). For the IWMS wildlife habitat areas can be established under the Government Actions Regulation (GAR) or grandparented under the *Forest Practices Code Act*.

Since 2001, 31 wildlife habitat areas have been established in the Lillooet TSA for a variety of mammals, birds, reptiles, amphibians and plant communities (Tables 23 and 29). Most WHA range in size from one hectare to 250 hectares, but several larger WHAs are in place for spotted owl management.

In 2004, two Forest Planning and Practices Regulation Section 7 notices came into effect that applied to the Lillooet TSA.

A first notice for indicators of the amount, distribution and attributes of wildlife habitat required for the winter survival of ungulate species in the Lillooet timber supply area was established for mule deer, Bighorn sheep, elk, moose, and mountain goats.

A second notice for indicators of the amount, distribution and attributes of wildlife habitat required for the survival of species at risk in the Cascades Forest District. This notice for the Lillooet and Merritt TSAs applies to coastal tailed frog, "Great Basin" gopher snake, flammulated owl, Interior western screech-owl, spotted owl, spotted bat, and grizzly bear. Specific management and the considerations within the base case timber supply analysis are noted in the sections below.

5.9.1 Wildlife species of concern/identified wildlife

The BC Conservation Data Centre lists the conservation status of animals, plants, and plant communities. There are 33 animal species of concern whose distribution may extend into the Lillooet TSA which are detailed in Tables 24 and 30. In addition, a number of these species have been designated as "Identified Wildlife" under the 2004 Identified Wildlife Management Strategy.

The provincial *Identified Wildlife Management Strategy* provides for the creation of wildlife habitat areas (WHA) within the TSA, to protect key habitat features of listed wildlife species. Provincial policy states that WHAs can have a short-term AAC impact of up to 1%.

At the time of this analysis, WHAs have been designated in the TSA for grizzly bear, spotted owl, coastal tailed frog, Western screech owl, and Lewis' woodpecker. There are 12 proposed WHA for Western Screech Owl expected to become established after the Lillooet TSR determination.

In addition, a reduction of 1% to the THLB will be modelled to account for the eventual deployment and establishment of the additional WHA's as well as to consider the red- and blue-listed species not covered under WHAs as listed in Tables 24 and 30.

Data source and comments:

BC Conservation Data Centre: https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/species-and-ecosystems-explore

Identified Wildlife Management Strategy: http://www.env.gov.bc.ca/wld/frpa/iwms/iwms.html

Table 24. Red- and blue-listed wildlife in the Lillooet TSA

Scientific name	English name	BC status	Identified wildlife
Spea intermontana	Great Basin Spadefoot	Blue	Yes - May 2004
Ascaphus truei	Coastal Tailed Frog	Blue	
Botaurus lentiginosus	American Bittern	Blue	
Patagioenas fasciata	Band-tailed Pigeon	Blue	
Hirundo rustica	Barn Swallow	Blue	
Psiloscops flammeolus	Flammulated Owl	Blue	Yes - May 2004
Ardea herodias	Great Blue Heron, *herodias* subspecies	Blue	Yes - June 2006
Melanerpes lewis	Lewis's Woodpecker	Blue	Yes - May 2004
Numenius americanus	Long-billed Curlew	Blue	Yes - May 2004
Contopus cooperi	Olive-sided Flycatcher	Blue	
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	Red	
Falco mexicanus	Prairie Falcon	Red	Yes - June 2006
Oreoscoptes montanus	Sage Thrasher	Red	Yes - May 2004
Asio flammeus	Short-eared Owl	Blue	Yes - May 2004
Strix occidentalis	Spotted Owl	Red	Yes - May 2004
Buteo swainsoni	Swainson's Hawk	Red	
Megascops kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspecies	Blue	Yes - May 2004
Aeronautes saxatalis	White-throated Swift	Blue	
Taxidea taxus	American Badger	Red	Yes - May 2004
Ovis canadensis	Bighorn Sheep	Blue	Yes - June 2006
Pekania pennanti	Fisher	Blue	Yes - June 2006
Myotis thysanodes	Fringed Myotis	Blue	Yes - May 2004
Ursus arctos	Grizzly Bear	Blue	Yes - May 2004
Oreamnos americanus	Mountain Goat	Blue	
Euderma maculatum	Spotted Bat	Blue	Yes - May 2004
Myotis ciliolabrum	Western Small-footed Myotis	Blue	
Gulo luscus	Wolverine, *luscus* subspecies	Blue	Yes - May 2004
Salvelinus confluentus	Bull Trout	Blue	Y (Jun 2006)
Acipenser transmontanus pop. 4	White Sturgeon (Lower Fraser River population)	Red	
Pituophis catenifer deserticola	Gopher Snake, *deserticola* subspecies	Blue	Yes - May 2004
Coluber constrictor	North American Racer	Blue	Yes - June 2006
Crotalus oreganus	Western Rattlesnake	Blue	Yes - June 2006
Parnassius clodius pseudogallatinus	Clodius Parnassian, *pseudogallatinus* subspecies	Blue	
Pholisora catullus	Common Sootywing	Blue	
Euphyes vestris	Dun Skipper	Red	
Danaus plexippus	Monarch	Blue	
Apodemia mormo	Mormon Metalmark	Red	
Limenitis archippus	Viceroy	Red	
Argia vivida	Vivid Dancer	Blue	
Oncorhynchus clarkii	Cutthroat Trout, clarki subspp	Blue	

5.9.2 Grizzly bear

Grizzly bear is an important wildlife species, ecologically and culturally. Grizzly bears inhabit a wide variety of ecosystems in the Lillooet TSA from alpine meadows to the dryer forested areas.

On December 30, 2004, a Forest Planning and Practices Regulation Section 7 notice came into effect for the Cascades Forest District, specifying 8000 hectares of mature timber on the THLB as the allowed area impact from grizzly bear management in the Lillooet TSA.

To address grizzly bear needs, a proposal for GAR that specifies formal General Wildlife Measures (GWM) on specified areas in the Lillooet TSA is being developed but has not yet been established. The proposal, as described in August 2017, identified measures, some of them to be dealt with at the operational level, that included two measures that might impact timber supply: 1) the reduced stocking standard applies to stands with 10% or greater Vaccinium species, and, 2) no more than 25% of the area within 50 m of specifically identified polygons, could be less than 15 m in height.

A Forest Analysis and Inventory Branch (FAIB) Analyst examined the potential impact on timber supply of these two measures in August 2017 based on analysis consistent with the previous TSR in the Lillooet TSA and concluded that these two measures has no impact on short-term timber supply but decrease the long-term timber supply by 3%. Analyses in the previous TSR, that removed 7942 hectares of likely critical grizzly bear habitat identified that the impact would be 3.9% on the long-term timber supply.

As the GAR Order is expected to be approved prior to the upcoming AAC determination for the Lillooet TSA, it will be modelled in the base case. However, a sensitivity analysis will be conducted to assess the impact of excluding the GAR attributes from the base case while modelling the Section 7 Notice.

The base case will apply a 3.5% reduction to the long-term harvest level to reflect the impact on timber supply of the GWM for grizzly bear in the TSA. The reduction amount is derived from the analysis FAIB conducted for the grizzly bear GAR as an average reduction that can be seen from the GWM.

Grizzly bear wildlife habitat areas have been established in neighboring TSAs. However, given varying mapping standards, some of these WHAs are identified within the Lillooet TSA administrative boundary. Given that no harvesting is allowed within these WHAs, this area will be excluded from the THLB of the base case scenario.

Table 25. Wildlife habitat areas for grizzly bear that are partially mapped within the Lillooet TSA

WHA ID	Species	Timber harvest	% contribution to AFLB	% contribution to THLB
2-102	Grizzly bear	NO	100	0
2-173	Grizzly bear	NO	100	0
2-181	Grizzly bear	NO	100	0
2-263	Grizzly bear	NO	100	0
2-264	Grizzly bear	NO	100	0
2-265	Grizzly bear	NO	100	0
2-267	Grizzly bear	NO	100	0
2-268	Grizzly bear	NO	100	0
2-381	Grizzly bear	NO	100	0
2-390	Grizzly bear	NO	100	0
2-395	Grizzly bear	NO	100	0
2-443	Grizzly bear	NO	100	0

Data source and comments:

Data is from BC Geographic Warehouse,
WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POLY

Forsite Consultants Ltd., 2005. Lillooet Timber Supply Area Timber Supply Review #3 Analysis Report. Version 1.

Nienaber, G. 2017. Analysis support for Forestry General Wildlife Measures for Grizzly Bear Specified Areas in Lillooet TSA. Unpublished August 2017.

5.9.3 Northern Spotted Owl

The Northern Spotted Owl is one of Canada's most endangered species and whose northern range extends into the Lillooet TSA.

Recognizing that the 1997 cabinet approved Spotted Owl Management Plan did not address known locations and nesting sites within the Lillooet TSA, the draft LRMP and 2004 Section 7 notice identified the need for up to 5000 hectares of mature THLB was necessary for Northern Spotted Owl protection. Initially, short-term protection was provided through a memorandum of understanding and an operational plan was developed with licensees that managed seven long-term activity centers. Subsequently, wildlife habitat areas with specific general wildlife measures have been established to protect these areas.

Timber harvesting is not permitted within the established wildlife habitat areas for northern spotted owl, as such these areas will be excluded from the THLB of the base case.

*Table 26. Northern Spotted Owl wildlife habitat areas within the Lillooet TSA**

WHA ID	Species	Timber harvest	% contribution to AFLB	% contribution to THLB
3-034	Spotted Owl	NO	100	0
3-035	Spotted Owl	NO	100	0
3-036	Spotted Owl	NO	100	0
3-158	Spotted Owl	NO	100	0
3-159	Spotted Owl	NO	100	0
3-160	Spotted Owl	NO	100	0

*An insignificant area of WHA 2-508 is also identified within the Lillooet TSA administrative boundary.

5.9.4 Ungulates

The Lillooet TSA includes critical winter range for several ungulate species. Subsequently, ungulate winter ranges (UWR) and general wildlife measures are formally established within the Lillooet TSA under a Section 7 Notice for Mule Deer, Mountain Goat, Elk, Bighorn sheep, and Moose.

The draft Lillooet LRMP identified the need to consider the winter ranges for these species and identified the location of important habitat and measures to minimize adverse impact and to maintain or increase forage. The draft LRMP also identified the need for movement corridors, security cover, and reduction of conflict with recreational users. As the draft LRMP was never approved, these considerations were adopted into a Section 7 Notice.

Table 27. Ungulate winter range in the Lillooet TSA

Species	Modelled	AFLB	THLB
Mule Deer	Yes	Yes	Yes
Bighorn Sheep	Yes	Yes	Yes
Elk	Yes	Yes	Yes
Mountain Goat	No	Yes	Yes
Moose	No	Yes	Yes

Most habitat requirements for these species have been accommodated through operational planning without significant impacts to the THLB. Ungulate winter ranges include large areas of forest outside the THLB and often overlap extensively with areas already constrained in OGMAs, visually sensitive areas, and lake shore zones. However, to ensure that these operational considerations fully capture ungulate winter range impacts, the base case will model constraints as specified in the Section 7 Notice concerning snow interception cover and snowpack zones (Table 28).

Table 28. Snow interception cover attributes by snowpack zones

		Constraint			
Snowpack zone	Biogeoclimatic units	Dominant tree species	Minimum stand age (years)	Minimum canopy closure (%)	Minimum forested area (%)
Shallow	PP IDFxh2	Douglas-fir	140	46	15
Moderate	IDFdk1 IDFdk2 IDFdk3 IDFunk MS	Douglas-fir	140	46	33

5.9.5 Other wildlife

Under the 2004 Section 7 Notice for Species at Risk for the Cascades Forest District there are indicators also for coastal tailed frog, gopher snake, flammulated owl, western screech owl, and spotted bat. In the Lillooet TSA, some wildlife habitat areas have been established to address the needs of these species. Table 29 identifies the WHAs established to date and the implication for timber harvest.

The impact to timber supply varies among WHAs due to the associated general wildlife measures (GWM) and the forest composition. Some WHAs are expected to have no timber supply impact given that they contain no THLB or permit some conditional form of harvesting.

For timber analysis modelling, all WHAs will be excluded from the timber harvesting land base. The total area of the WHAs where conditional harvesting is present is 400 hectares.

Table 29. Wildlife habitat areas completely within the Lillooet TSA

WHA ID	Species	Timber harvest	% contribution to AFLB	% contribution to THLB
3-018	Coastal Tailed Frog	CONDITIONAL	100	0
	Coastal Tailed Frog	NO	100	0
3-019	Coastal Tailed Frog	CONDITIONAL	100	0
	Coastal Tailed Frog	NO	100	0
3-032	Western Screech Owl	NO	100	0
3-033	Western Screech Owl	NO	100	0
3-049	Data sensitive	NO	100	0
3-080	Lewis's Woodpecker	CONDITIONAL	100	0
3-081	Lewis's Woodpecker	CONDITIONAL	100	0
3-089	Lewis's Woodpecker	CONDITIONAL	100	0
3-138	Data sensitive	NO	100	0
3-164	Western Screech Owl	NO	100	0
3-165	Western Screech Owl	NO	100	0
3-166	Western Screech Owl	NO	100	0
3-182	Data sensitive	CONDITIONAL	100	0

5.10 Plant communities and range

5.10.1 Plant species of concern

In the Lillooet TSA, there are no WHAs established for the numerous blue- and red-listed plant species present (Table 30). No specific modelling consideration will be made within the timber supply analysis given the lack of specific operational management measures. However, any operational management measures that are conducted due to the plant species identified in Table 30 are addressed through the 1% THLB impact as identified in Section 5.9.1 above.

Table 30. Blue- and red-list plant species in the Lillooet TSA

Scientific name	English name	BC list
Boechera cascadensis / Boechera microphylla	littleleaf rockcress	Red
Boechera paupercula	tiny suncress	Red
Carex bicolor	two-coloured sedge	Blue
Carex hystericina	porcupine sedge	Blue
Castilleja cusickii	Cusick's paintbrush	Red
Chenopodium atrovirens	dark lamb's-quarters	Blue
Crepis modocensis ssp. rostrata	western low hawksbeard	Red
Crepis occidentalis ssp. conjucta	western hawksbeard	Blue
Delphinium bicolor ssp. bicolor	Montana larkspur	Blue
Descurainia sophioides	northern tansymustard	Blue
Hackelia diffusa var. diffusa	spreading stickseed	Red
Juncus triglumis ssp. albescens	whitish rush	Blue
Lupinus bingenensis var. subsaccatus	Suksdorf's lupine	Blue
Lupinus sulphureus	sulphur lupine	Blue
Pinus albicaulis	whitebark pine	Blue
Poa abbreviata ssp. pattersonii	abbreviated bluegrass	Blue
Poa fendleriana ssp. fendleriana	mutton grass	Red
Polemonium elegans	elegant Jacob's-ladder	Blue
Potentilla glaucophylla var. perdissecta	diverse-leaved cinquefoil	Blue
Potentilla supina ssp. Paradoxa	bushy cinquefoil	Blue
Pyrola elliptica	shinleaf wintergreen	Blue
Senecio integerrimus var. ochroleucus	white western groundsel	Red
Sporobolus compositus var. compositus	rough dropseed	Blue
Andreaea sinuosa	(moss)	Red
Bryoerythrophyllum columbianum	Columbian carpet moss	Blue
Entosthodon rubiginosus	rusty cord-moss	Blue
Plagiobryum demissum	(moss)	Red
Pterygoneurum kozlovii	alkaline wing-nerved moss	Blue
Draba glabella var. glabella	smooth draba	Blue
Atriplex argentea ssp. argentea	silvery orache	Blue
Carex vallicola var. vallicola	valley sedge	Blue
Sporobolus compositus var. compositus	rough dropseed	Blue

5.10.2 Whitebark pine

Whitebark pine is a long living high elevation species that was identified as endangered under the federal *Species at Risk Act* in 2012 and as blue-listed in British Columbia. Risks to whitebark pine include white pine blister rust, climate change, fire, and Mountain pine beetle. Natural whitebark pine reproduction is dependent on the Clark's Nutcracker for seed dispersal.

Whitebark pine is a keystone species on many alpine and subalpine sites, pioneering harsh sites and as established trees moderating snowmelt. The seeds are an important food source for grizzly bears and other wildlife.

In the timber supply analysis base case, no specific modelling considerations for whitebark pine are to be made. It is recognized that (1) much of the whitebark pine forest is likely excluded due to other netdown factors (e.g., non-productive), (2) whitebark pine is poorly represented within the forest inventory, and (3) at a TSA level whitebark pine would have a very small contribution to the timber supply.

Data source and comments:

Environment and Climate Change Canada. 2017. Recovery Strategy for the Whitebark Pine (Pinus albicaulis) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. viii + 54 pp.

5.10.3 Pine mushrooms

The pine mushroom (*Tricholoma magnivelare*) is considered the most economically significant mushroom species in the province and a valued resource by First Nations. Provincially, the pine mushroom habitat is associated with well drained, coarse textured and nutrient poor soils under mature forests (80-120+ years old) dominated by hemlock, Douglas-fir or lodgepole pine (Berch and Kranbetter 2010).

In the Lillooet TSA, there is no specific legislative protection or mapped location for important pine mushroom sites. However, the need to protect sites with known pine mushroom production are commonly identified by First Nations during the development of cutblock plans.

Given the lack of direct information on pine mushroom location and management in the Lillooet TSA, no specific modelling consideration for pine mushroom will be made within the base case of the timber supply analysis. However, information on the significance of pine mushrooms to First Nation communities and implications to timber supply will be presented to chief forester.

Data source and comments:

Berch, S.M. and J.M. Kranabetter. 2010. Compatible management of timber and pine mushrooms. B.C. Min. For. Range, For. Sci. Prog., and Cent. Non-Timber Resources, Royal Roads Univ., Victoria, B.C. Land Manag. Handb. 64.

5.10.4 Range

Summer range for livestock can be derived from forested areas. Sequential harvesting can provide either native forage and/or potential areas for seeding of domestic forages for summer range.

In the Lillooet, given the likely small impact of livestock management, no considerations for range management will be made in the base case.

5.11 Scenic management and recreation

Visual quality is one of the eleven resource values identified and protected under the *Forest and Range Practices Act*. The province has established a visual resource management program, that includes identifying and classifying scenic landscapes and by establishing visual quality objectives to guide forest management activities.

5.11.1 Scenic resource management

In the Lillooet TSA, the District Manager has established visual quality objective (VQO) areas.

Table 31 shows the maximum allowable percent alteration for each VQO in perspective view. Percentages are taken form the Timber Supply Analysis Bulletin, *Modelling Visuals in TSR III*.

Table 31. Assignment of visual quality objectives

	% alteration by visual absorption capacity (VAC), perspective view		
Established VQO	**Low VAC**	**Medium VAC**	**High VAC**
Retention	0.1	0.7	1.5
Partial retention	1.6	4.3	7.0
Modification	7.1	12.5	18.0

Data source and comments:

The percent alteration in 'perspective view' must be converted to a measure in 'plan view' for use in timber supply analysis. A Plan-to-Perspective (P2P) ratio is calculated for each visual unit by area weighting the P2P for each slope class within the visual unit, using the data in Table 32. The percent alteration in perspective view is multiplied by the area weighted P2P ratio to calculate the percent alteration in plan view.

An area weighted visually effective green-up (VEG) height is determined for each visual unit using the data in Table 32, Slope classes for calculating P2P ratio and VEG height, refers to top height (average height of tallest 10% of trees) but in current model use will refer to the stand age at which this height is reached based on height-age relationships for site index.

Table 32. Slope classes for calculating P2P ratio and VEG height

	Slope classes (%)														
	0-5	**5.1-10**	**10.1-15**	**15.1-20**	**20.1-25**	**25.1-30**	**30.1-35**	**35.1-40**	**40.1-45**	**45.4-50**	**50.1-55**	**55.1-60**	**60.1-65**	**65.1-70**	**70.1+**
P2P ratio	4.68	4.23	3.77	3.41	3.04	2.75	2.45	2.22	1.98	1.79	1.6	1.45	1.29	1.17	1.04
VEG height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.5	8.0	8.5	8.5	8.5

Data source and comments:

Slope classes adapted from *Procedures for Factoring Visual Resources in Timber Supply Analysis* (1998) and *Modelling Visuals in TSR III* (2003) by Luc Roberge, Visual Resource Specialist, NIFR – December 2007.

A recent study shows a first approximation of the predicted P2P ratios for absolute slope classes in 10% increments. Although P2P ratios and slope classes did not show a linear relationship, the median value were used in this table to determine the ratios for slope classes in 5% increments.

Information and documents on visual resource management is available at:

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/visual-resource-management

Data is from BC Geographic Warehouse,
WHSE_FOREST_VEGETATION.REC_VISUAL_LANDSCAPE_INVENTORY

Query used: REC_MADE_KNOWN_CODE = 'Y'

For Lillooet TSA, use REC_MADE_KNOWN_CODE = 'Y' polygons only with codes for Established Visual Quality Objectives in the REC_EVQO_CODE field, and where there are no EVQO codes, use Visual Sensitivity Class codes in the REC_VSC_FINAL_VALUE_CODE field.

5.11.2 Recreation sites and trails

Under the *Forest and Range Practices Act*, 65 recreation areas (29 reserves, 36 sites) containing 27 recreation sites, and 16 sets of trails have been established in the Lillooet TSA (Table 33).

The management strategy for recreation sites typically identifies the maintenance of a recreational feature such as a campsite or trail and the conservation of natural vegetation. This does not preclude industrial activity or harvesting; authorization by a recreation officer is required prior to any industrial activity or harvesting on an established site. However, while logging is possible, it is likely that harvesting activity will be limited.

Areas designated as Crown Use, Recreation and Enjoyment of the Public (UREPs) fall under *Land Act* reserves, without having designation under other legislation they are not reserved from harvest. However, some UREPs may be excluded from harvest due to other designations.

As recreation sites, trails and UREPs do not have legal protection from harvest they will be included in the THLB, unless otherwise excluded. A review of the contribution of recreation sites and trails to THLB and the harvest history will be completed to understand the impact of harvest on recreation resources. The chief forester will be presented information on the likely impact of current practices related to recreation trails and sites for consideration in making her AAC determination.

Table 33. Summary of recreation features within the Lillooet TSA

Category	% contribution to AFLB	% contribution to THLB
Active and pending recreation sites	100	100
Active and pending recreation reserves	100	100
Active recreation trails	100	100
UREPs	100	100

Within government legal notations there are several reserves for recreation related use. The notation status indicate that these areas do not restrict timber harvesting.

5.12 Soils

Soils is one of the eleven resource values identified and protected under the *Forest and Range Practices Act*. The province has established objectives to limit the extent of soil disturbance that causes negative impacts; to conduct forest practices that minimize detrimental soil disturbance, landslides, soil erosion, and sediment delivery to streams; and to limit the productive forest land occupied by permanent roads, trails, and landings.

5.12.1 Unstable terrain and environmentally sensitive areas

Environmentally sensitive areas (ESAs) are forested areas that are sensitive for a variety of reasons such as terrain stability, reforestation issues, hydrologic issues, or avalanche risk, or as being of value in meeting other resource objectives. ESAs are broad classifications that indicate sensitivity for unstable soils (E1s), forest regeneration problems (E1p), snow avalanche risk (E1a), and high-water values (E1h). ESA soils mapping has generally been replaced with level C and level D terrain stability mapping because it provides a better estimate of unstable terrain. In the Lillooet TSA, terrain stability mapping has been completed for 95% of the operable land base. Using this mapping—complemented by earlier ESA information from inventory files, sensitive areas are excluded from the THLB. Netdowns associated with these issues are as follows:

Table 34. ESA and unstable terrain netdown areas

ESA category	ESA description	% contribution to AFLB	% contribution to THLB
TSIL C class V	High likelihood of landslide initiation following harvesting or road construction	100	10
TSIL C class IV	Moderate likelihood of landslide initiation following harvesting or road construction	100	90
TSIL D class U	Unstable	100	10
TSIL D class P	Potentially unstable	100	75
E1s (where no terrain mapping exists)	Sensitive / unstable soils	100	0
E1a	Avalanche runout	100	0

Data source and comments:

Terrain Stability Data is from BC Geographic Warehouse, WHSE_TERRESTRIAL_ECOLOGY.STE_TER_STABILITY_POLYS_SVW

E1p and E1h areas are not excluded from the land base because FLNRORD District staff do not believe they result in a reduction to harvestable area once other net downs are considered. This assumption is consistent with TSR2 and TSR3.

The reductions identified for terrain stability are based on the expert opinion of Tim Giles, MOF SIFR geomorphologist (Tim Giles, pers. comm. 6 July 2004).

5.13 Timber

Timber is one of the eleven resource values identified and protected under the *Forest and Range Practices Act*. The province has identified general goals but has not established specific targets related to objectives.

5.14 Harvesting

5.14.1 Harvest / silviculture systems

Most harvesting in the Lillooet TSA involves a clearcut with reserves silvicultural system. Partial cut harvesting takes place within the dry-belt fir stands. Dry-belt fir stands will stay on VDYP curves after harvesting. However, through an analysis of partial harvesting throughout the Lillooet TSA, it was determined that less than 1% of the cutblocks harvested in the last 10 years utilized a partial harvest system.

Table 35. Partial cutting modelling parameters for dry-belt fir stands

	First entry	Second entry	Third entry
Volume removal	40%	30%	30%
Time between entry		30 years after first entry	30 years after second entry

5.14.2 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter (inside bark) and minimum diameter at breast height (DBH) by species and are used in the analysis to calculate merchantable volumes.

Table 36. Utilization levels

Analysis unit	Utilization		
	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Pine	12.5	30	10
All other species	17.5	30	10

Data source and comments:

The *Interior Timber Merchantability Specifications of the Provincial Logging Residue and Waste Measurement Procedures Manual* specifies a minimum diameter at dbh of 12.5 cm for pine and 17.5 for all other species in the interior.

5.14.3 Harvesting sequencing

For various reasons, it may be important to set priorities or harvest levels within certain management zones or types of stands to reflect insect infestations, salvage operations or other forest management objectives. Setting harvest levels on individual management zones will also facilitate the determination of an AAC that may be partitioned by these management zones.

The analysis will be conducted using REMSOFT's Woodstock model. The optimization function of Woodstock sequences stands in the way that is optimal for the harvest flow while following all rules the analyst has defined, e.g., meeting minimum harvest criteria. As such, no specific harvest sequence is specified.

Harvest profile by cycle time and species group (e.g., Douglas-fir vs. lodgepole pine) will be reported and checked against licensees' current performance and the information will be presented to the chief forester at the determination meeting.

5.14.4 Area considered inoperable

Inoperable areas are those areas that are not available for timber harvesting due to physical limitations or due to unsuitable economics related to steep slopes, road access or yarding distance. The Ministry of Forests (now FLNRORD), in coordination with licensees, delineated operability lines for the Lillooet TSA in 1995. The district recently conducted an operability assessment, finding all cutblocks were within operability lines with the exception of one cluster of blocks.

Table 37. Description of inoperable areas

Description	% contribution to AFLB	% contribution to THLB
Inoperable	100	0

Data source and comments:

Data is from BC Geographic Warehouse,
REG_LAND_AND_NATURAL_RESOURCE.OPERABILITY_AREAS_SIR_POLY

5.14.5 Minimum harvest criteria

Minimum harvestable ages are, as the term implies, the minimum age at which harvesting is expected to be feasible. While harvesting may occur in stands at the minimum requirements in order to meet forest level objectives (e.g., avoiding large inter-decadal changes to harvest levels), most stands will not be harvested until well past the minimum ages because other resource values take precedence (e.g., requirements for the retention of older timber).

To be eligible for harvesting a stand must meet both the age and volume requirements indicated in Table 38.

Table 38. Minimum harvestable criteria

Analysis unit	Minimum criteria			Minimum harvest age (years)
	Height class	Diameter cm	Volume m³	
Pine	All	12.5	150	60
Non-pine	All	17.5	150	80

Data source and comments:

The Electronic Commerce Appraisal System (ECAS) was used to determine harvested volume (m³/ha) for the years from 2002 to 2017 with the results shown below in Table 39. The table demonstrates that 99% of the stands harvested in the years 2002 to 2017, had greater than 147 m³/ha volume.

Table 39. Harvest volume (m³/ha) in Lillooet TSA (2002-2017) based on cruise information

	Harvest volume (m³)/ha by percentile									
Timber mark	1%	5%	10%	25%	50%	75%	90%	95%	99%	100%
Overall	147	215	221	287	369	444	530	542	641	659

The assumed minimum harvest ages were set by district staff based on field observations of when stands become economically merchantable for harvest. The minimum harvestable ages mainly impact the existing managed stands and future stands since existing natural stands are generally older than 60 years. A sensitivity analysis using 95% of the culmination of mean annual increment (CMAI) as the minimum harvestable age will be conducted.

The volume contribution to the harvest flow from the stands with harvest volume below 221 m³/ha will be reported and presented to the chief forester at the determination meeting.

5.14.6 Sites with low productivity

Sites may have low productivity either because of inherent limiting site factors (nutrient availability, exposure, excessive moisture, etc.) or because they are not fully occupied by commercial tree species. Typically, these stands are inter-mixed with other stands within the forested land base. As these stands are not considered economically harvestable, they are identified for removal from the THLB.

Data from the Electronic Commerce Appraisal System (ECAS) showed that between 2002 and 2017, approximately 99% of the harvest volume in Lillooet TSA was from stands with vol/ha above 147 cubic metres. In this analysis, stands that cannot reach 150 m³ within 160 years are excluded from the THLB as low sites (Table 40). However, areas with a logging history are included in the THLB.

Table 40. Minimum stand criteria for timber harvesting

Leading species	Minimum vol/ ha (m³/ha) at 160 yrs	At age	% contribution to AFLB	% contribution to THLB
All	150	160	100	0

5.14.7 Deciduous

Deciduous-leading stands are rarely harvested within the Lillooet TSA. As such, deciduous-leading stands without a logging history are excluded from the THLB (Table 41).

In mixed-species stands the deciduous component of the stand is not harvested. Thus, any deciduous volumes in coniferous-leading stands are removed from the volume tables used in the analysis.

Table 41. Deciduous stands

Description	% contribution to AFLB	% contribution to THLB
Deciduous leading	100	0

Data source and comments:

Data is from BC Geographic Warehouse, WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY

5.15 Silviculture

5.15.1 Regeneration

Reporting Silviculture Updates and Land status Tracking System (RESULTS) is a web-based application that provides clients and government staff direct on-line access to provincial spatially enabled silviculture information. Under legislation, a person who harvests a stand is required to establish a free-growing stand within 20 years but also at certain points along that time frame have to report forest cover information into RESULTS.

As per the FPPR, Section 86, before June 1st of each year, an agreement holder must report to the District through RESULTS of the amount of area harvested and provide an update of the forest cover inventory.

Recent plantations and future stands will be grown on silvicultural treated stand yield tables produced using TIPSY. The inputs required to produce the yield tables will be based upon forest cover information found within the silviculture survey database RESULTS.

Data source and comments:

RESULTS: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silviculture-reporting-results

5.15.2 Genetic gain

When reforesting Crown land, legislation requires the use of the best genetic quality seed available – also known as select seed. Planting trees grown from select seed increases the volume available for harvesting in the future. Using select seed can also affect timber supply by influencing timber supply factors such as reduced time to achieve green-up and minimum harvest age. These factors may increase mid- to long-term timber supply.

The Lillooet TSA receives planting stock derived from seed from nurseries by seed planning units by seed class (A – tree seed orchard, B+ - natural stands identified as superior provenances and B - natural stands). The following table show the average genetic gain for seed used for the TSA's growing stock by species, seed production unit and seed class. Areas left to regeneration naturally have no genetic gain.

Table 42. Average net genetic gain seedlings by species in the Lillooet TSA (average genetic gains from combined class A and B seed)

Species	Genetic gain (%)
Fdc	2.0
Fdi	0.3
Lw	16.7
Pl	1.7
Se	7.1
Ss	0.6
Sw	10.5

Data source and comments:

Genetic gain was calculated using density and genetic worth data from the RESULTS.

5.15.3 Forests for Tomorrow

The Forests for Tomorrow Program (FFT) was launched in 2005 to help reforest areas affected by wildfire and the mountain pine beetle. Under this program, approximately 4.4 million trees have been planted on nearly 2800 hectares in the Lillooet TSA. The Forests for Tomorrow Program contributes to a higher AAC as it allows for stands to grow on managed stand yield curves, reduces regeneration delay, and utilizes genetic stock where available.

Without the FFT program, stands impacted by wildfire and beetle kill would overwise grow on natural stand yield curves with a lengthened regeneration delay. The FFT enables stands to contribute increased volume over a shorter rotation and therefore contributes to a greater AAC.

Data source and comments:

Source: FLNRORD, 2018 RESULTS Database.

5.16 Other considerations

5.16.1 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 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.

However, 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.

Data source and comments:

None.

5.16.2 Community fire safety

Wildfire is a significant concern for the communities of the Lillooet TSA due to timber type, converging winds, and dry, hot seasonal conditions.

Seventeen (17) Community Wildfire Protection Plans (CWPP) have been developed for most communities within the Lillooet TSA. The plans identify general wildland urban interface zone (WUI) around communities and categorize the areas as “Extreme”, “High” or “Moderate” threat. The CWPPs often recommend reduced stocking of mature timber, thinning, pruning, understory burns, and aim to keep the forest around communities at a static state.

Given the variability of the detail and implementation among the CCWPs, the base case of the timber supply analysis will have no specific modelling considerations for the timber supply impacts of community wildfire safety.

The chief forester will be presented with information about existing interface management and generalizations about the timber supply impact based on a sensitivity analysis that removes all WUI in CWPPs from the timber harvesting land base.

Data source and comments:

WHSE_LAND_AND_NATURAL_RESOURCE.PROT_WUI_HMN_INTRFCE_BUFFR_SP

5.16.3 Land use planning

5.16.3.1 Draft Lillooet LRMP

The Lillooet Land and Resource Management Plan (LRMP) process was initiated in 1995 and entailed a planning table consisting of varied interest groups tasked with developing the LRMP. In March 2001, after five years of discussion and negotiation, the planning table submitted two land use options. The government at the time accepted one plan, however, with a change of government in 2001, the new government desired further social and economic assessment given the polarized nature of the planning table. On July 22, 2004 the Ministry of Sustainable Resource Management released an updated draft LRMP that reflects changes in land-use planning policy.

The draft LRMP was never approved in whole as a higher-level plan and remains as a recommendation. Since the release of the draft LRMP, components of the plan have been implemented under various legislation, as identified in other sections of this data package. These include parks and other protected areas, visual quality polygons, and significant wildlife habitat areas for spotted owl.

5.16.3.2 Land use planning agreement between the Lil'wat Nation and the Province of British Columbia

In 2008, the Lil'wat Nation and the Province of British Columbia signed a land-use planning agreement that attempts to harmonize the draft Sea-to-Sky LRMP and the draft Lillooet LRMP. While most of this agreement applies to the draft Sea-to-Sky LRMP, this agreement is also applicable to areas located at the most western tip and in the south-west portion of the TSA.

This agreement included the Nlháxten / Duffey Lake Park addition, Nlháxten / Cayoosh Cultural Management Area, Bridge River head waters and Stein Nahatlatch Provincial Park as described above in Table 6, Protected Areas.

Data source and comments:

Ministry of Sustainable Resource Management. 2004. Draft Lillooet Land and Resource Management Plan., 22 July 2004. Available at 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/thompsonokanagan-region/lillooet-lrmp/lillooet_lrmp.pdf

Lil'wat Nation and Province of British Columbia. 2008. Land use planning agreement between the Lil'wat Nation and the Province of British Columbia as represented by the Minister of Agriculture and Lands. Available at: 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/southcoast-region/seatosky-lrmp/agreement_lrmp_lilwat_bc.pdf

5.16.4 Cumulative effects

Cumulative effects are changes to environmental, social, and economic values caused by the combined effect of present, past, and reasonably foreseeable future actions or events on the land base. To address cumulative effects, a provincial Cumulative Effects Framework has been created. This framework is a set of policies, procedures and decision-support tools to assess and track the current condition and trend of values against government's existing objectives. More information about cumulative effects and existing assessments in the Thompson Okanagan Region can be found here (https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework/regional-assessments/thompson-okanagan).

Cumulative effects information will be provided to the chief forester and to First Nations as decision support for the Lillooet TSR (separate from this data package). The FLNRORD cumulative effects team will continue to collaborate with First Nations throughout the decision support process. Values that are expected to be addressed include: watersheds, grizzly bear, mule deer, and forest biodiversity. Following the development of a TSR base case scenario, the cumulative effects team plans to use spatial harvest output to infer future effects of harvest on the assessed values.

6. Timber Supply Analysis

For an overview of the modelling process see Section 4. In this section, further details around the methods used for the timber supply analysis are described.

6.1 Identification of the timber harvesting land base

An initial step in the modelling of timber supply is to identify the land base that does and does not contribute to the timber supply. This is commonly called the netdown. The netdown is a model simplification based on the strategic nature of the allowable annual cut determination.

The netdown items are summarized in Table 43. The steps seen within this table are to first identify a land base that is applicable to the AAC determination. In the table below this is called the AFLB. The AFLB in previous timber supply reviews was identified as the CFLB or CMFLB or CFMLB. Following identification of the AFLB, the netdown factors that are not included in the THLB are identified.

Land may be unavailable for timber harvesting for three principle reasons:

- it is not administered by the BC Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) for timber supply purposes (e.g., private land, parks, etc.);
- it is not suitable for timber production purposes (e.g. non-forested areas);
- it is unavailable for timber harvesting (e.g. recreation areas).

Table 43. Netdown items to identify analysis forest land base (AFLB) and timber harvesting land base (THLB) for the Lillooet TSA

Netdown factor	Excluded from AFLB	Excluded from THLB
Non-crown lands	Y	Y
Area based tenures	Y	Y
Non-forest and non-productive	Y	Y
Roads, trails, landings	Y	Y
Provincial parks & reserves	N	Y
Inoperable	N	Y
Terrain stability	N	Y
Sites with low growing potential	N	Y
Deciduous	N	Y
Landscape-level biodiversity – OGMA	N	Y
Wildlife habitat areas	N	Y
Ungulate winter range	N	Y
Riparian reserves & management areas	N	Y
Stand level biodiversity – WTP	N	Y
Archaeological	N	Y
Cultural heritage resources and values	N	Y

6.2 Modelling forest growth

6.2.1 Background

Knowledge of the volume available from a forest stand over time is a critical input for timber supply modelling. Growth and yield models are used to generate the volume estimates based on the characteristics of the forest stand.

British Columbia has a strong history in growth and yield modelling. The various models have been important to improving strategic decision making and understanding of the management of British Columbia's forest resources.

For the current analysis, two of the Ministry's growth and yield models will be used: the VDYP and TIPSY.

To enable modelling of the volume available from a forest stand over time, volume tables are created based on common forest stand inputs, growth characteristics, and the most suitable growth and yield model. Volume tables where sufficient input information is available will be based on information at a forest polygon or silvicultural opening level; however, where detailed information is not available (e.g., for future stands) a volume table may reflect an aggregation of stands. The current analysis will make greater use of existing silviculture survey information at a stand level than have been used in past timber supply reviews.

6.2.2 Variable density yield prediction model (VDYP7)

The VDYP7 model, developed by the FLNRORD, is an empirical growth model that has been parameterized based on a large temporary (52,000 plots) and permanent (9,300 plots) sample plot database collected from mature natural forests in British Columbia.

Input information for the VDYP7 model is based on VRI attributes, typically at the individual forest polygon level. Decay, waste and breakage estimates are incorporated within VDYP7 and are based on BEC loss factors using a decay sample tree database which consists of over 82,000 trees.

Information on VDYP is available at https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/growth-and-yield-modelling/variable-density-yield-projection-vdyp

6.2.3 Table interpolation program for stand yields (TIPSY)

The Table Interpolation Program for Stand Yields (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 yields and do not directly considered inter-species interactions.

Input information for TIPSY is based on stand initiation characteristics including species, initial density, regeneration method (planted or natural), genetic gains, and potential site index. TIPSY also enables considerations for various silviculture treatments, forest health, and general operational adjustment factors.

In the analysis, TIPSY version 4.4 is expected to be used. This version uses a database of TASS II generated yield tables.

Information on TIPSY is available at 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.

The Tree and Stand Simulator, version TASS II, developed by FLNRORD, is an individual tree level model for commercial species of British Columbia. TASS predicts the potential growth and yield of even-aged and single species stands by modelling individual tree crown dynamics and the crown relationship to bole growth and wood quality. The individual tree and crown focus make TASS well suited for predicting the response to many silviculture treatments and the exploration stand dynamics. TASS III is a recently released version, with limited species, that extends TASS into more complex stand structures and multiple-species and multi-age cohorts.

Information on TASS is available at https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/growth-and-yield-modelling/tree-and-stand-simulator-tass.

6.3 Volume table types

Volume table types are determined by (1) if and when a stand is harvested; and, (2) the source and the availability information for regeneration, forest inventory and management.

Volume tables for stands that have not been harvested are to be modelled with VDYP using input from VRI attributes for the stands. These volume tables are often referred to as existing natural stands.

All existing stands that have a history of harvesting or stands harvested in the future will be modelled with TIPSY where appropriate input information is available. The following descriptions provide a generalization of the derivation of different harvested stand volume table types; however, given the complexity of the information sources, the descriptions are unlikely to fully describe all volume table types.

For stands harvested prior to the 1987 legislated requirements for basic silviculture the TIPSY species composition will be based on the VRI species composition aggregated within an opening and a natural regeneration method.

For stands harvested between 1987 and 2019 with RESULTS information showing planting, the TIPSY species composition will be based on an aggregation of the RESULTS planting record within an opening and a TIPSY planted regeneration method will be used.

For stands harvested between 1987 and 2019 with RESULTS information showing natural regeneration, the TIPSY species composition will be based on an aggregation of the VRI species composition within an opening and a TIPSY.

For stands harvested between 1987 and 2019 where RESULT information is missing, the TIPSY species composition will be an aggregation from either VRI or RESULTS dependent on information identifying if regeneration method was natural or planted.

For stands harvested in the future, the TIPSY species composition for planted stands will be an aggregation of RESULTS planting records over the last seven years to the BEC subzone level and for natural stands the TIPSY species composition will be an aggregation of VRI information over the last 10 years to the BEC subzone level.

Data source and comments:

Input for stands modelled with VDYP are based upon data from the BCGW file WHSE_FOREST_VEGETATION.VEG_COMP_VDYP7_INPUT_POLY that is a subset of information from WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY in a format usable by the growth and yield model VDYP7.

Input for stands modelled with TIPSY will primarily be based upon silviculture data from the FLNRORD Reporting Silviculture Updates and Land Status Tracking System (RESULTS). For further information see https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silviculture-reporting-results.

6.3.1 Operational adjustments

The objective of this section is to describe what operational adjustment factors are, why they are needed, and how to determine operational adjustment factors (OAF) for planning purposes.

The yield tables generated by TASS[2] for use in TIPSY reflect the growth relationships observed in research plots established by FLNRORD and industry. Research plots were generally located in fully stocked, even-aged stands of uniform sites and in forests with little or no pest activity. As a result, TIPSY

[2] The Tree and Stand Simulator (TASS**)** is a three-dimensional growth simulator that generates growth and yield information for even-aged stands of pure coniferous species of commercial importance in coastal and interior forests of British Columbia. TASS generates the volume growth curves for use by TIPSY in managed stands.

yields reflect the potential yield of a specific site, species and management regime given full stocking. OAF is applied to these potential yields to adjust them to reflect an operational environment.

Two types of OAF are available in TIPSY to account for elements that reduce potential yields. The two OAF values are referred to as OAF1 and OAF2. OAF1 reflects uneven stocking or gaps and is a constant percentage reduction. OAF2 represents the impact of decay, waste and breakage and impacts the yield curve in an increasing percentage reduction. Changing both OAF values affects the magnitude and shape of the yield curve.

Standard OAFs were used to model managed stands. OAF1 was set to 0.85 (15% reduction) and OAF2 was set to 0.95 (5% reduction).

6.4 Modelling non-timber objectives

The concept of management zones is used to differentiate areas with different management objectives. For example, a zone may be based on a harvesting system, silviculture system, visual quality objectives, wildlife consideration or more than one management objective. In the timber supply analysis, each type of zone can be tracked separately, thereby allowing application of overlapping management objectives. Forest land that is unavailable for timber harvesting may contribute toward meeting objectives for other forest values.

The table below outlines the zones or objectives incorporated into the timber supply model. Further information on the forest cover requirements to be applied to these areas can be found in Section 6.

Table 44. Objectives to be tracked

Objective or zone	Inventory definition or source
Landscape-level biodiversity	Old growth management areas (OGMA) will be excluded from the THLB to meet objectives for old forest.
Stand-level biodiversity	Area reductions will be applied to the THLB as WTP.
Cutblock adjacency	Green-up requirement at the watershed level.
Community watersheds	*Forest and Range Practices Act*
Scenic areas/visual quality objectives (VQO)	*Forest and Range Practices Act*

Data source and comments:

Sources of information include both non-standard local map information in addition to provincial level GIS data stored in the corporate data warehouse. Origins of the data include higher-level plans, local resource management plans and ministerial orders.

6.5 Forest Estate Model

Woodstock was developed as a forest estate model in the 1990's by the Remsoft Inc. With over 20 years advancement Woodstock now is the core of the suite of Remsoft tools and widely used by many clients over 14 countries. Woodstock can perform both simulation and optimization, but the optimization function is much more widely used and will be used in this analysis.

6.6 Creation of a base case

As part of the TSR, a timber supply analysis is typically carried out using three categories of information: land base inventory, timber growth and yield, and management practices. Using this information and a computer model, a series of timber supply projections are produced to reflect different starting harvest levels, rates of increase or decrease, and potential trade-offs between short- and long-term harvest levels.

From a range of possible projections, one is chosen which attempts to avoid both excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This is known as the 'base case' projection and it provides a baseline harvest flow from

which the chief forester can understand the dynamics of timber supply in the TSA. The base case is designed to reflect current management practices and assumptions.

The base case is not an AAC recommendation because it represents only one of a number of possible projections and incorporates information and modelling assumptions about which there may be some uncertainty. The validity of the base case - as with all the other projections provided - depends on the validity of the data and assumptions incorporated into the computer model used to generate it.

Due to the existence of uncertainty in the timber supply analysis, additional projections are usually prepared to test the effect of changing some of the assumptions or data used in the base case. These harvest projections are referred to as 'sensitivity analyses'. Both the base case and sensitivity analyses are prepared using a computer model that projects the future availability of timber for harvesting based on the growth of the forest and the level of harvesting, while staying within the legal land use objectives established by the provincial government.

6.7 Model uncertainty and sensitivity analyses

Sensitivity analysis can provide a measure of the timber supply impact if uncertainty in management assumptions and/or data integrity exists. The magnitude of the increase or decrease in a particular variable should reflect the degree of uncertainty surrounding the assumption. Sensitivity analysis may indicate that a small reduction in these attributes may alleviate or exacerbate anticipated harvest level reductions in the future. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results. Table 45 presents the sensitivity analyses that will performed in the analysis. Additional sensitivities may be performed after the base case has been completed if new uncertainties are identified.

Table 45. Sensitivity issues

Issue to be tested	Sensitivity levels
Uncertainty in projected volumes based on VDYP	+/-10%
Uncertainty in projected volumes based on TIPSY	+/-10%
Uncertainty in THLB	+/- 5% change
Minimum harvest age	Using 95% CMAI for managed stands
Visual objectives	Increase % alteration to high-VAC level
Landscape biodiversity	Apply aspatial old-growth constraints
Proposed Grizzly Bear GAR order	Do not apply proposed GAR order constraint
Non-designated watersheds	Apply ECA constrains to non-designated watersheds
Wildland urban interface zone (WUI)	Excluding WUI area from the THLB
Phase 2 adjustments	Test the potential impact of yield adjustments based on Phase 2 results
PEM site index	Comparing the PEM site indices against the biophysical site indices to determine whether PEM site indices should be used in a sensitivity analysis

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8. Acronyms

AAC: Allowable Annual Cut

AFLB: Analysis Forested Land Base

BCGW: BC Geographic Warehouse

BCLCS: British Columbia Land Classification System

BEC: Biogeoclimatic Ecosystem Classification

BEO: Biodiversity Emphasis Option

BGC: Biogeoclimatic

CFA: Community Forest Agreements

CMA: Cultural Management Area

CMAI: Culmination of Mean Annual Increment

CNRD: Cascades Natural Resource District

CWPP: Community Wildfire Protection Plans

CWS: Community Watershed

Declaration Act: BC's Declaration on the Rights of Indigeneous Peoples Act

DBH or dbh: Diameter at Breast Height

DFB: Douglas-fir Beetle

ECAS: Electronic Commerce Appraisal System

ESA: Environmentally Sensitive Areas

FAIB: Forest Analysis and Inventory Branch

FCRSA: Forest Consultation and Revenue Sharing Agreement

FFT: Forests for Tomorrow Program

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

FNWL: First Nations Woodland Licence

FPPR: Forest Planning and Practices Regulation

FRA: Forest and Range Agreements

FREP: Forest and Range Evaluation Program

FRPA: *Forest and Range Practices Act*

GAR: Government Actions Regulation

GWM: General Wildlife Measures

IWMS: Identified Wildlife Management Strategy

LRMP: Land and Resource Management Plan

LU: Landscape Unit

MPB: Mountain Pine Beetle

OAF: Operational Adjustment Factor

OGMA: Old Growth Management Area

P2P: Plan-to-Perspective

PEM: Predictive Ecosystem Mapping

RAAD: Remote Access to Archaeological Data

RESULTS: Reporting Silviculture Updates and Land Status Tracking System

RMA: Riparian management areas

RMZ: Riparian Management Zones

RRZ: Riparian Reserve Zone

SBB: Spruce Bark Beetle

SIBEC: Site Index Estimates by BEC Site Series

TEM: Terrestrial Ecosystem Mapping

THLB: Timber Harvesting Land Base

TIPSY: Table Interpolation Program for Stand Yields

TRIM: Terrain Resource Information Management

TSA: Timber Supply Area

TSR: Timber Supply Review

UNDRIP: United Nations Declaration on the Rights of Indigeneous Peoples

UREP: Crown Use, Recreation and Enjoyment of the Public Reserve

VDYP: Variable Density Yield Projection

VEG: Visually Effective Green-Up

VQO: Visual Quality Objective

VRI: Vegetation Resources Inventories

WTP: Wildlife Tree Patch

WUI: Wildland Urban Interface

9. Your Input is Needed

Public input is a vital part of establishing the allowable annual cut. Feedback is welcomed on any aspect of this data package or any other issue related to the timber supply review for the Lillooet TSA. Ministry staff would be pleased to answer questions to help you prepare your response. Please send your comments to the resource district manager at the address below.

Your comments will be accepted until March 19, 2021 for consideration with respect to the data package. A further comment period will be made available following the release of a discussion paper that outlines the results of a timber supply analysis.

You may identify yourself on the response if you wish. If you do, you are reminded that responses will be subject to the *Freedom of Information and Protection of Privacy Act* and may be made public. If the responses are made public, personal identifiers will be removed before the responses are released.

For more information or to send your comments, contact:

Resource District Manager
Cascades Natural Resource District
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
PO Box 4400 Station Main
Merritt, BC V1K 1B8

Telephone: (250) 378-8400

Or contact:

Peter Stroes
Authorizations Officer
Cascades Natural Resource District
Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Telephone: (250) 378-8486
Electronic mail: Peter.Stroes@gov.bc.ca

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

To obtain further information about the AAC determination process, the Timber Supply Review and past Lillooet TSA timber supply review documents visit the BC government website at

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