Invermere Timber Supply Area
Timber Supply Review

Updated Data Package

May 2016

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1. Introduction

Under Section 8 of the *Forest Act* the chief forester must review the timber supply for each timber supply area (TSA) at least once every 10 years. Under the same section the chief forester may extend the current allowable annual cut (AAC) up to 15 years if the current timber supply is stable and any new developments would unlikely change the AAC. For more information about the AAC process please visit the following internet site:
https://www.for.gov.bc.ca/hts/pubs/tsr/Timber%20Supply%20Review%20Backgrounder_April_28_2016.pdf

The completed data package contains those inputs that represent current performance for the TSA. For the purpose of the timber supply review (TSR), "current performance" can be defined by:

- 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;
- fully implemented land-use plans;
- land-use decisions approved by Cabinet;
- orders issued through the *Government Actions Regulation* (GAR) of the *Forest and Range Practices Act* (FRPA);
- the order establishing provincial non-spatial old growth objectives and landscape units pursuant to the *Forest Practices Code of British Columbia Act;* and,
- approved higher level plans under the *Forest Practices Code of British Columbia Act*.

The primary purpose of the timber supply review (TSR) program is to model "what is" not "what if". Changes in forest management objectives and data, when and if they occur, will be captured in future timber supply analyses.

Each section of this data package is generally organized in the following way:

1) A short explanation of the data used in the data table;
2) Data table or lists of modelling assumptions;
3) Description of data sources and other comments.

The information in this data package represents the best available knowledge at the time of publication, but is subject to change. A First Nations consultation and public review period has been established to allow submission of comments and concerns about the data package to the Ministry of Forests, Lands and Natural Resource Operations (FLNRO). The information and assumptions in the data package that have been revised to incorporate First Nations and public input will be used to determine the timber harvesting land base (THLB) - the productive Crown forest land in the TSA available for timber harvesting. Until the THLB is determined, it is not possible to finalize the values shown in some of the tables in this document. In addition, should any major changes in management practices occur during the next few months, the timber supply analysis will attempt to capture them.

2. Background Information

2.1 Overview of the Invermere Timber Supply Area

The Invermere Timber Supply Area (TSA) is within the Kootenay-Boundary Natural Resource Region - Rocky Mountain Natural Resource District and is administered out of the district office in Cranbrook. The Rocky Mountain Natural Resource District is situated in the southeastern corner of British Columbia and was created in 2003 by amalgamating the old Invermere and Cranbrook Forest Districts. The district contains approximately 2.63 million hectares, of which 1.15 million hectares falls within the Invermere TSA.

The Invermere TSA is bounded by the Cranbrook TSA to the south, the Golden TSA and Tree Farm Licence (TFL) 14 to the north, the Rocky Mountains / Alberta border to the east, and the Purcell Mountains to the west. Between these two mountain ranges lies the Rocky Mountain Trench, a broad, flat valley with numerous rivers and wetlands. The Columbia River flows north through the trench from Columbia Lake, creating a large, complex wetland ecosystem called the Columbia Wetlands.

The TSA includes one national park (Kootenay) and eleven provincial parks: Mount Assiniboine, Height of the Rockies, Top of the World, Purcell Wilderness Conservancy, Bugaboo Glacier, Windermere Lake, Whiteswan Lake, Premier Lake, Canal Flats, James Chabot, and Dry Gultch.

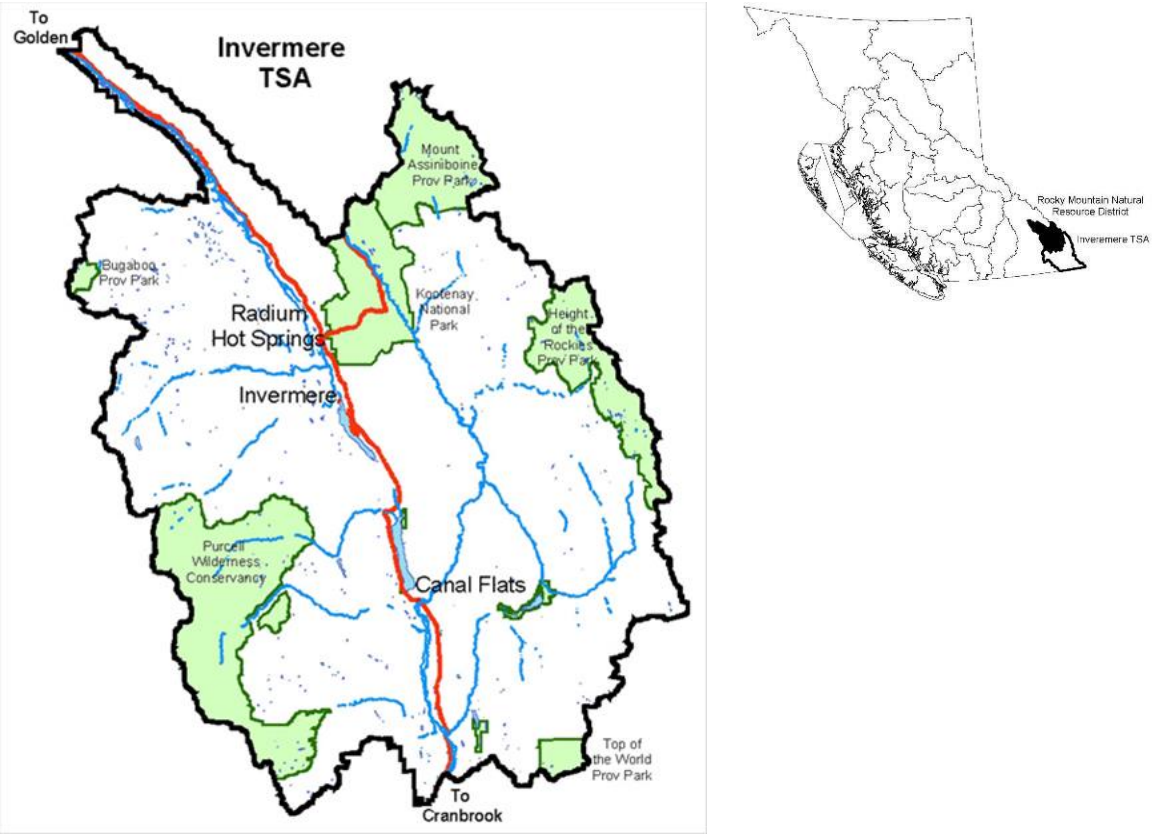

Figure 1. Invermere Timber Supply Area map.

The major population centers in the TSA are Invermere, Windermere, Canal Flats, and Edgewater, while smaller communities include Wilmer, Radium, Fairmont Hot Springs, and Parsons.

The Invermere TSA offers many and varied opportunities for recreation and tourism, due to its lakes, parks and spectacular mountains. The area provides a wide range of front- and back-country recreational opportunities including mountain biking, hiking, climbing, fishing, camping, wildlife viewing, whitewater boating, heli-skiing, snowmobiling, ski mountaineering, cross country skiing, and downhill skiing. The TSA also contains significant water resources. Numerous watersheds are classified as either domestic or community watersheds.

The current allowable annual cut (AAC) is 581 570 cubic metres plus 5000 cubic metres for ecosystem restoration and 12 000 cubic metres for small scale salvage.

2.2 First Nations

There are two First Nation Councils whose asserted traditional territories are located within the Invermere TSA, the Ktunaxa Nation Council and Shuswap Nation Tribal Council.

Archaeological evidence suggests the Ktunaxa have inhabited the East Kootenay region, adjacent to the Columbia and Kootenay Rivers, since the last glaciation over 10,000 years ago. The Ktunaxa engaged in subsistence activities throughout their traditional territory and beyond.

The Ktunaxa Nation Council is represented in treaty negotiations by the Ktunaxa Kinbasket Treaty Council (KKTC), and is nearing completion of Stage 4 – Agreement-in-Principle negotiations.

Two First Nations communities exist within the Invermere TSA, the ?Akisq'nuk First Nation (Columbia Lake Indian Band) and the Shuswap Indian Band.

The ?Akisq'nuk First Nation is located at Windermere, is a member band of the Ktunaxa and has a population of approximately 270. ?Akisq'nuk First Nation is the Ktunaxa Community in closest proximity to the Jumbo Creek valley. The Ktunaxa Nation established Jumbo (Qat'muk) as a Ktunaxa protected area through the Qat'muk Declaration in 2010 and has developed a management plan for the area. Ktunaxa Nation is requesting that the Province establish a legislative conservancy over the area.

?Akisq'nuk First Nation is the Ktunaxa Community in closest proximity to Columbia Lake and has been actively engaged in activities to protect the archaeological, cultural, historical and environmental values on the east side of Columbia Lake. The Ktunaxa connection to Columbia Lake is established in its creation. The Spirit Trail traverses the east side of Columbia Lake and numerous pictographs are recorded in this area.

?Akisq'nuk First Nation has expressed interest in title (and in the interim, a partnership with the Province for stewardship) over the Madias Tatley area adjacent to Reserve. A significant portion of the Madias-Tatley is within a Ktunaxa Treaty Land and Cash Offer land parcel.

Following is a list of negotiated agreements and memorandum of understanding between the province and the Ktunaxa Nation.

Completed Negotiations

- Ktunaxa Nation Strategic Engagement Agreement (2010); (2013);
- Ktunaxa Nation Economic and Community Development Agreement (2013);
    - Amendment (2013);
    - Forest Revenue Sharing Project Appendix (2014);
    - Elk Valley Coal Mining Revenue Sharing Project Appendix (2013);
- Incremental Treaty Agreement (Wensley Bench) (2013);
- Ktunaxa Nation Incremental Treaty Agreement (Creston) (2014);
- Forest Tenure Opportunity Agreement (2013-2028);
- Replaceable Forest Licence (2013);
- Ktunaxa Nation Community Forest Agreement (2009);
- BC, Montana, Ktunaxa Nation Council, Confederated Salish and Kootenay Tribes Memorandum of Understanding and Cooperation (MOU) on Environmental Protection, Climate Action and Energy (2010);
- BC, Regional District of East Kootenay (RDEK) and Ktunaxa Nation Engagement Agreement on the Lake Koocanusa Area (2008).

The Shuswap Nation Tribal Council is a political organization comprised of most of the Southern Secwepemc bands. Shuswap Nation Tribal Council (SNTC) member bands are not involved in the BC treaty process. As an organization, it works on matters of common concern, including the development of self-government and the settlement of the aboriginal land title question. SNTC is involved in resource management within the Secwepemc Nation territory and also provides technical support to member communities to improve services in health, child welfare, employment and training, research on traditional territories and community development.

The Shuswap Indian Band is located two kilometers northeast of Invermere, is a member of the Shuswap Nation Tribal Council and has a population of approximately 230. The Shuswap Band is very interested in forestry opportunities and currently holds Forest Consultation and Revenue Sharing and Forest Tenure Opportunity Agreements with the province. The Band is working with the Selkirk and Rocky Mountain Natural Resource Districts toward increased access to fiber volumes. The Shuswap Band is involved in discussions with resource districts related to access to increased timber supply in the Arrow, Boundary and Invermere Timber Supply Areas. Following is a list of negotiated agreements and memorandum of understanding between the province and the Shuswap Indian Band.

Completed Negotiations

- Secwepemc Reconciliation Agreement - Amendment 2014;
- Shuswap Forest Consultation and Revenue Sharing Agreement – 2011-2014;
- Shuswap Forest Consultation and Revenue Sharing Agreement – 2014-2017.

The Adams Lake Indian Band and Neskonlith Indian Band are members of the Shuswap Nation Tribal Council. Although their reserves are not located within the Invermere TSA, their asserted traditional territories encompass approximately the northern half of the Invermere TSA. Following is a list of negotiated agreements and memorandum of understanding between the province and the Adams Lake Indian Band.

Completed Negotiations

- Adams Lake Indian Band Forestry Consultation and Revenue Sharing Agreement (2012);
- Recreation Sites and Trails Partnership Agreement (2013) – 12 sites near Adams Lake;
- Secwepemc Reconciliation Framework Agreement (2013).

The SRFA expires in April 2016. Regional staff are currently working with the signatory bands to conduct a review of the current SRFA in preparations for the potential renegotiation of the agreement. Signatory bands have expressed a desire to revisit the mandate for the next agreement and are seeking more fulsome commitments around shared-decision making, recognition and reconciliation.

Following is a list of negotiated agreements and memorandum of understanding between the province and the Neskonlith Indian Band.

Completed Negotiations

- Neskonlith Indian Band Forest Consultation and Revenue Sharing Agreement (2013).

2.3 Archaeological assessments

Archaeological overview assessments (AOAs) have been completed for the TSA. AOAs are the basis for determining areas and sites that may require further assessment in the form of an archaeological impact assessment (AIA). AIAs are carried out as part of operational planning. The timber supply modelling assumptions for known archaeological and other First Nations' cultural heritage resources are discussed in more detail in the Section 5.14, "Cultural heritage resource reductions".

3. Current Forest Management Considerations and Issues

3.1 Base case management assumptions

The timber supply analysis base case assumptions reflect current performance with respect to the status of forest land, forest management practices, and knowledge of timber growth and yield. The harvest forecast developed from these assumptions is termed the base case harvest forecast and will be used as a reference to which other development scenarios are compared. Uncertain assumptions will be quantitatively examined through sensitivity analysis which assesses the potential timber supply implications of different assumptions (see Section 7, "Sensitivity Analyses to be Performed").

3.2 Major forest management considerations and issues

The major forest management issues to be considered in this timber supply review are listed in the table below. Where possible, the issues will be assessed directly in the timber supply analysis. If an issue does not fall within the definition of current management the related timber supply impacts will be considered during the AAC determination.

Table 1. Major forest management considerations

Consideration/issue	Description
Kootenay-Boundary Land Use Plan	Government has accepted the Kootenay-Boundary Land Use Plan (KBLUP) and the objectives are reflected in a higher-level plan order. Strategies and practice requirements to meet the KBLUP objectives are provided in approved operational plans.
Landscape-level biodiversity	The KBLUP requires that landscape-level biodiversity be maintained by meeting or exceeding mature-plus-old and old forest objectives for each landscape unit (LU). These units are defined by the natural disturbance type (NDT) and biogeoclimatic ecosystem classification (BEC) subunit. It should be noted that disturbance in stands outside of the THLB contribute to the achievement of forest cover requirements and thereby affect the timber supply availability of stands within the THLB.
Stand-level biodiversity	Stand-level biodiversity requirements, which are achieved by wildlife tree retention, are described in the Forest Stewardship Plans of major licensees and British Columbia Timber Sales (BCTS). Wildlife tree retention represents a downward pressure on timber supply in those cases where there is no plan for a subsequent harvest entry. The residual wildlife trees also have an impact on the growth and yield of the next crop.
Green-up	The KBLUP has set green-up requirements for harvested areas, except in community watershed, scenic areas, Enhanced Resource Development Zones – Timber and in fire-maintained ecosystems.
Grizzly bear habitat and connectivity corridors	The KBLUP provides for maintaining mature and/or old forests adjacent to important grizzly bear habitat, and within connectivity corridors for the purposes of regional forest ecosystem connectivity.
Consumptive use streams	The KBLUP provides for stream-side management provisions for S5 and S6 streams.
Fire-maintained ecosystems	The KBLUP provides for the restorations and maintenance of fire-maintained ecosystems, and provides for treatments that contribute to the creation of a complex, ecologically-appropriate mosaic of habitats over the long term, and treatments in open range and open forest that will remove excessive immature and understory trees and emphasize the retention of the oldest and largest trees.

(continued)

Table 1. Major forest management considerations (concluded)

Consideration/issue	Description
Fire-maintained ecosystems stand inventories	District staff have identified that operational cruise volumes from the fire maintained ecosystems are only half that shown in inventory.
Scenic areas	The District Manager of the Rocky Mountain Natural Resource District established visual quality objectives (VQO's) that also required consideration of *Front-Country Visual Management Guidelines* outlined in the KBLUP implementation strategy.
Site productivity	A large potential impact on timber supply exists from the use of ecologically based managed stand indices using predictive ecosystem mapping (PEM) and site index biogeoclimatic classification (SIBEC).
Caribou	An ungulate winter range (UWR) order (U-4-013) that restricts harvesting in recognized caribou habitat has been established.
Ungulate winter range (UWR)	The KBLUP Implementation Strategy outlines forest cover requirements for moose, elk, whitetail deer and mule deer. In February 2005, PEM-derived UWR in the Invermere TSA were formerly approved under Ungulate Winter Range Order U-4-008. This order specifies mature forest cover, snow interception cover and early seral stage limits.
Wildlife habitat areas	Wildlife habitat areas (WHA) have been declared in the Rocky Mountain Natural Resource District through orders under the authority of the GAR. The following species have identified habitat, which have general wildlife measures (GWM): Rocky Mountain Tailed Frog, Long Billed Curlew, Flammulated Owl, Lewis's Woodpecker, Badger, Williamson's Sapsucker, Western Screech Owl, Antelope Brush/Bluebunch Wheatgrass, Douglas-fir/Snowberry/Balsam Root and Gillette's Checkerspot. There are also unidentified species which have data sensitive measures.
Operability	In the 2005 determination, the chief forester requested that licensees report on their harvesting performance on cable ground.
Silviculture systems	TSR3 assumed that the predominant silviculture system used has been clearcutting with reserves and also a small area of shelterwood. Open forest are typically selectively logged. The chief forester has requested that licensees monitor the actual practices and the associated growth and yield implications.
Roads, trails and landings (RTLs)	Roads, trails and landings represent a netdown of the THLB.
Certification	Various forest certification schemes are in use by licensees in the Invermere TSA, and these have potential timber supply impacts, particularly where the certification standard calls for measure incremental to legislated requirements.
Watersheds	A total of 10 community watersheds are present in the Invermere TSA. These watersheds are those that have been continued under Section 180(e) of the *Forest and Range Practices Act* (FRPA).
Mountain pine beetle (MPB) infestation	A comprehensive monitoring program for mountain pine beetle has been developed and included as a part of the Invermere TSA forest health strategy. Beetle populations have showed a steady decline since their peak in 2012. A forest health program aimed primarily at managing beetle populations in suppression units with significant non-timber values is in place. In holding units, licensees continue to manage MPB as part of their normal planning operations and in concert with information provided by the district.

4. Inventories

4.1 Background information

Table 2 is a list of the inventories that will be used to determine the THLB and the associated management themes to be used in defining forest management activities.

Table 2. Inventory information

Data	Source	Factor
WHSE_FOREST_VEGETATION.F_OWN	BCGW	Ownership
WHSE_BASEMAPPING.DRA_DIGITAL_ROAD_ATLAS_LINE_SP	BCGW	Roads
WHSE_BASEMAPPING.TRIM_TRANSPORTATION LINES	BCGW	Transportation lines
WHSE_WATER_MANAGEMENT.WLS_COMMUNITY_WS_PUB_SVW	BCGW	Community watersheds
WHSE_TANTALIS.TA_PARK_ECORES_PA_SVW	BCGW	Protected areas
WHSE_LAND_AND_NATURAL_RESOURCE.PROT_CURRENT_FIRE_POLYS_SP	BCGW	Current fire polygons
WHSE_LAND_AND_NATURAL_RESOURCE_PROT_HISTORICAL_FIRE_POLYS_SP	BCGW	Historical fire polygons
WHSE_FOREST_TENURE.FTEN_RECREATION_POLY_SVW	BCGW	Recreation polygons
WHSE_FOREST_TENURE.FTEN_RECREATION_LINES_SVW	BCGW	Recreation lines
WHSE_WILDLIFE_MANAGEMENT.WCP_UNGULATE_WINTER_RANGE_SP	BCGW	Ungulate winter range
WHSE_WILDLIFE_MANAGEMENT.WCP_WILDLIFE_HABITAT_AREA_POLY	BCGW	Wildlife habitat areas
WHSE_FOREST_VEGETATION.VEG_COMP_LYR_R1_POLY	BCGW	Vegetation cover
WHSE_LAND_USE_PLANNING.RMP_OGMA_NON_ALL_SVW	BCGW	Non-legal OGMA
BEC_BIOGEOCLIMATIC_POLY	BCGW	Biogeoclimatic polygons
TERRAIN_STABILITY_CAR_POLY	BCGW	Terrain stability polygons
WHSE_FOREST_TENURE.FTEN_CUT_BLOCK_POLY_SVW	BCGW	Cutblock polygons
WHSE_ADMIN_BOUNDARIES.FADM_TSA	BCGW	TSA boundary
WHSE_LAND_USE_PLANNING RMP_PLAN_LEGAL_POLY_SVW	BCGW	Resource management zones
WHSE_LAND_USE_PLANNING RMP_LANDSCAPE_UNIT_SVW	BCGW	Landscape units
Operability Layer	DRM	Operability lines
WHSE_BASEMAPPING.TRIM_CONTOUR_LINES	BCGW	Contour lines

(continued)

Table 2. Inventory information (concluded)

Data	Source	Factor
BCMPB 2014 (Year 12)	FAIB	Mountain Pine Beetle infestation
ESA mapping – TSR3 coverage	FAIB	Environmentally sensitive areas
ER_2013.gdb (geodatabase)	DRM	Ecosystem restoration
Predictive ecosystem mapping	FAIB	Local data
REG_LAND_AND_NATURAL_RESOURCE_OPERABILITY_DCB_POLY	DRM	Local data
Lakeshore management zones riparian management	DRM	Local data

Data source and comments:

There are generally three sources of data for the analysis; corporate level data that resides in the provincial geographic data warehouse (BCGW), data maintained by the Forest Analysis and Inventory Branch (FAIB) and local data that is stored at the Rocky Mountain Natural Resource District (DRM). Two notable exceptions are RESULTS[1] information which is maintained by Resource Practices Branch and SIBEC which is also maintained by FLNRO.

4.2 Forest cover inventory

The forest cover inventory for the Invermere TSA was completed in 1995 based on air-photo interpretation using 1988 photos. The Forest Inventory Planning (FIP) lines and attributes were rolled over to the VRI format in 2000. The inventory is missing the vegetation resource inventory (VRI) attributes that were not a part of the FIP database.

Forest cover updates have taken place from RESULTS and the inventory adjusted to 2009. The inventory has been further adjusted for denudation to 2013 utilizing satellite imagery. For the analysis the forest inventory has been projected to January 1, 2014 for growth and yield.

An audit of the inventory was undertaken in 1996 and indicated that the natural stand volumes in the TSA were overestimated by the inventory by 5%, though this difference was not statistically significant.

The volumes associated with partially harvested stands within the inventory have been adjusted manually to account for over-prediction of volumes by VDYP.

4.3 Site index biogeoclimate inventory (SIBEC)

An extensive field program to collect and derive Site Index by BEC (SIBEC[2]) was also initiated as a parallel project to the Predictive Ecosystem Mapping[2] (PEM). The SIBEC sampling did not meet all provincial stands (63% *versus* the minimum provincial standard of 65%). Nonetheless, FLNRO regional ecologist recommended its use in the base case. For more information see Section 6.8, "Site productivity".

The Site Index Estimates by BEC Site Series (SIBEC) and PEM were completed in 2004 and reviewed again in 2015 for use in the current analysis.

[1] Reporting Silviculture Updates and Landstatus Tracking System.

[2] Acceptance letter from Deb Mackillop, Regional Ecologist to Albert Nussbaum, Director FAIB, June 3, 2015.

4.4 Management zones and tracking of multiple 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 3. Objectives to be tracked

Objective or zone	Inventory definition or source
Landscape-level biodiversity	As per the Kootenay-Boundary Land Use Plan Order (KBLUPO) - old growth management areas (OGMA) will be excluded from the THLB to meet objectives for old forest. In addition, the recommended seral stage distribution for old-plus-mature forest in each biogeoclimatic unit will be modelled.
Stand-level biodiversity	As per the KBLUPO - reductions will be applied the THLB as the location of these have not been entered into the VRI.
Cutblock adjacency	As per the KBLUPO.
Community watersheds	*Forest Practices Code of BC Act.*
Domestic watersheds	As per the KBLUPO.
Ungulate winter ranges (UWR)	As per the KBLUPO.
Scenic areas/visual quality objectives (VQO)	As per the District Manager's Letter, March 14, 2003. *Front Country Visual Resource Management Guidelines.*

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.

4.5 Analysis units

An analysis unit (AU) represents a combination of stands with a specific timber growing capability that will be managed under a silviculture regime — as indicated by the leading species and site index. Each analysis unit is assigned its own timber volume projection (yield table).

i) Yield tables for existing naturally established stands are derived using the variable density yield projection (VDYP7) growth and yield model.

ii) Existing managed stands will be modelled as already growing on the managed growth curve of the analysis unit. After a stand is harvested within the model forecast, it will be projected to grow following the managed growth curves assigned by table interpolation program for stand yields (TIPSY).

iii) Yield tables for recent plantations and future stands are also derived using TIPSY.

Three sets of analysis units were created to reflect the level of forest management associated with various time frames.

Existing natural stands

These are the stands where forest management (planting/spacing) has been generally absent. These are stands that have never been harvested or harvested prior to 1982 with no record of planting or spacing in RESULTS.

Existing managed stands

These are the stands where forest management (planting/spacing) has had a positive impact on the regeneration/growth of the stand. These are stands that were harvested prior to 1982, that have records of planting or spacing in RESULTS, as well as all stands harvested from 1982 to the present.

Future managed stands

Stands harvested from today forward. Once existing stands are harvested, they are assigned to one of these analysis units.

Table 4. Definition of analysis units - existing natural stands

Analysis unit (existing natural stand)	Analysis unit (future managed stand)	Analysis unit description	Site index class	Rationale/comments
101	201	Fd Others - Poor	10 <= SI < 15	Clearcut (CC) with reserves
102	202	Fd Others - Med	15 <= SI < 20	CC with reserves
103	203	Fd Others - Good	20 <= SI	CC with reserves
104	204	SB - Poor	10 <= SI < 15	CC with reserves
105	205	SB - Med	15 <= SI < 20	CC with reserves
106	206	SB - Good	20 <= SI	CC with reserves
107	207	CH	All	CC with reserves
108	208	Pl - Poor	10 <= SI < 15	CC with reserves
109	209	Pl – Med	15 <= SI < 20	CC with reserves
110	210	Pl – Good	20 <= SI	CC with Reserves
111	211	Pl - Ext Rotation	All	Problem forest type (PFT) in AU 108-110
112	212	Lw – Poor	10 <= SI < 15	CC with reserves
113	213	Lw – Med	15 <= SI < 20	CC with reserves
114	214	Lw – Good	20 <= SI	CC with reserves
115	N/A	Open range	All	Fire maintained ecosystem Restoration (FMER) open range single entry
116	216	Open Forest, FdPy, Py	All	FMER open forest partial cutting regime

Data source and comments:

For existing natural stands, the inventory site index were used in the analysis.

For existing and future managed stands, site indices were assigned in the analysis using SIBEC PEM values.

The extended rotation AU's contain problem forest type (PFT) stands in AU's 108-110.

Fire Maintained Ecosytem Restoration (FMER) Open Range and Open Forest area is estimated to be 109 457 hectares in the Rocky Mountain Natural Resource District, of which 62 050 hectares is open range and 47 406 hectares is open forest. These areas were established under the authority of the Kootenay-Boundary Higher Level Plan for grass-growing areas.

AU 115 (open range) represents a one-time volume removal.

AU 116 represents a regime with multiple harvest entries to retain open-forest conditions. The first entry into these stands results in retention of a minimum of 76 stems per hectare, the desired management condition. Silviculture values are low and this regime is assumed to be natural regeneration of stands (7 to10 years to establish) with a harvest age of 80.

Naturally regenerated future stands on open forest (AU 116) were modelled at 66% of the VDYP yields, less factors for overstorey shading and losses for roads. Shading reductions were calculated as 0.5% for each percentage of volume retained (33% @ 5% for 16.5%). Road loss of 5.5% was applied. This resulted in a 49.5% total reduction from the regular VDYP curve for these sites.

For AU 116 and AU 216 existing yields and harvest ages were calculated from three sources:

- From 1984 to present 417 blocks in the extended rotation (ER) operating area were harvested at an average age class of 4.4 (88 years in age). Range was age class 1 to 8; information based on forest cover stand ages.
- From 2010 to 2014, 35 cutting authorities with existing cruise data showed an average harvest age of 87 years (range of 70 to 200) and an average cruise volume of 111 m³/hectare (range of 41 to 207 m^3/hectare). No scale volume is available.
- Five cutting authorities (non–renewable forest licences) in the ER area, where the district directed harvesting to occur, have an average cruise volume of 76 m^3/hectare (range of 30 to 106) at an average age of 76.7 years (range 50 to 90 years).

Table 5. Partial cutting modelling parameters

	Open range restoration	Open forest initial entries	Open forest successive entries
Analysis unit #	115	116	216
Minimum harvest age (years)	90	90	90
Retention volume	10 m^3/ha	25 m^3/ha	
Yield model	VDYP	VDYP	VDYP
Yield reduction modelled			49.50%

Table 6. Definition of analysis units - existing managed stands

Analysis unit (existing managed stand)	Analysis unit (future managed stand)	Label	Site index class	Rationale/comments
501	201	FdOthers - Poor	10 <= SI < 15	CC with reserves
502	202	FdOthers - Med	15 <= SI < 20	CC with reserves
503	203	FdOthers - Good	20 <= SI	CC with reserves
504	204	SB - Poor	10 <= SI < 15	CC with reserves
505	205	SB - Med	15 <= SI < 20	CC with reserves
506	206	SB - Good	20 <= SI	CC with reserves
507	207	CH	All	CC with reserves
508	208	Pl - Poor	10 <= SI < 15	CC with reserves
509	209	Pl - Med	15 <= SI < 20	CC with reserves
510	210	Pl - Good	20 <= SI	CC with reserves
511	211	Pl - Ext Rotation	0 < SI < 10	PFT's in AU 508-510
512	212	Lw - Poor	10 <= SI < 15	CC with reserves
513	213	Lw - Med	15 <= SI < 20	CC with reserves
514	214	Lw - Good	20 <= SI	CC with reserves
516	N/A	OF, FdPy, Py	All	CC with reserves

Data source and comments:

Site index is a measure of forest site productivity and is defined as the height of the tree in metres at age 50 years.

5. Timber Harvesting Land Base Definition

5.1 Identification of the timber harvesting land base

This section outlines the steps used to identify the timber harvesting land base (THLB) which is the productive forest expected to support timber harvesting within the Invermere TSA. Land may be unavailable for timber harvesting for three principle reasons:

- it is not administered by the BC Forests, Lands and Natural Resource Operations (FLNRO) 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).

Land may also be added to the THLB:

- by management activities which improve productivity or operability (e.g., the stocking of land currently classified as non-commercial brush);
- by the acquisition of productive forest land (e.g., timber license reversions).

The THLB for the Invermere TSA will be determined by a process of delineating the categories of land (described in subsections below) that are not expected to contribute to timber harvesting in the TSA. Land will be considered outside the THLB only where no harvesting is expected. Any area in which some timber harvesting will occur will remain in the THLB, even if the area is subject to other management objectives such as wildlife habitat and biodiversity objectives. The management objectives will be modelled in the timber supply analysis. In most cases the Crown forested land base (CFLB) outside of the THLB will also contribute to management objectives.

It is not uncommon for specific areas to be identified by more than one land category; for example, deciduous stands within riparian reserve zones. These areas will be classified as deciduous, prior to the riparian classification. Therefore, in most cases the net area reduction for a particular category will be less than its gross area due to overlap with areas previously excluded from the THLB.

5.2 Land not administered by FLNRO for timber supply purposes

Ownership codes are generally used to identify whether the land can be considered to contribute to timber supply. Only those lands coded for timber management (coded as "C") may contribute to the timber harvesting land base. Lands with a code of "-N" are non-contributing to the THLB, but provincial crown ownership lands (60-N, 61-N, 62-N, 63-N, 65-N, 67-N and 69-N) do contribute to the CFLB. These lands can contribute to meeting such landscape-level objectives as landscape-level biodiversity.

Table 7. Ownership codes and application in TSR4

Ownership code	Description	% contribution to CFLB	% contribution to THLB
51-N	National Parks	0	0
60-N	Ecological Reserves	100	0
61-C	Use, recreation and enjoyment of public (UREP) Reserves – Contributing	100	100
61-N	UREP Reserves – Non-contributing	100	0
62-C	Forest Management Unit	100	100
62-N	Timber Agreement Lands	100	0
63-N	Provincial Park Class A	100	0
65-N	Provincial Park Class C	100	0
67-N	Provincial Park	100	0
69-C	Misc. Reserves - Contributing	100	100
69-N	Misc. Reserves – Non-contributing	100	0
72-B	Schedule B land in a TFL	100	100
75-N	Christmas Tree Permits	0	0
77-N	Woodlot Licences	0	0
99-N	Misc. Leases	0	0
7890	Federal Lands, Private Land, First Nations Reserves, Dominion Gov't Lands	0	0

Data source and comments:

Data is from the ownership coverage, BC Geographic Warehouse.

5.3 Land classified as non-forest

Non-forest areas such as alpine, lakes, rocks etc. are removed from the THLB as well as the Crown forest land base. Forest areas with projected site index below 5 are also excluded in this step. The British Columbia land classification system (BCLCS) and site index within the VRI will be used in conjunction with past logging to identify areas of non-forest. Table 8 shows the criteria used to remove non-forested areas from the THLB and the CFLB.

Table 8. Non-forest area

Attributes	Description
VRI BCLCS level 1 = 'N' and no logging history	Non-vegetated
BCLCS level 2 = 'N' and no logging history	Non-treed
BCLCS level 3 = 'A' and no logging history	Alpine
Projected Height < 5 m and no logging history	Forested but does not contribute to biodiversity and habitat objectives

Data is from the VEG_COMP_POLY layer, BC Geographic Warehouse

5.4 Roads, trails and landings lines

The purpose of this section is to identify that portion of the land base that will be occupied by roads, trails and landings constructed to access and facilitate harvest operations.

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates are applied as reductions to the current productive forest considered available for harvesting and future RTL reductions are applied after stands are harvested for the first time in the timber supply model.

In 2008, Timberline Natural Resource Group produced the report, "Roads, Trails and Landings Inventory Project within the Invermere Timber Supply Area". The report provides estimates of current and future roads, trails and landings reductions to the THLB which are presented in the following table.

Table 9. Estimates for existing and future roads, trails, and landings

Era	Road class	Reduction percent (%) to THLB
Existing RTLs		
	Secondary roads	0.42
	Logging roads	4.24
	Trails	0.01
	Internal landings	0.63
	Total	5.30
Future RTLs		
	Roads	1.2
	Trails	1.3
	Landings	1.3
	Total	3.8

Reductions for existing RTL are applied to stands less than 60 years old. Future reductions are applied to the remaining stands by the timber supply model.

Data source and comments:

The estimate of the future RTL recognizes that much of the road infrastructure in the TSA already exists.

"Roads, Trails and Landings Inventory Project within the Invermere Timber Supply Area", FIA Project 06-RIP-FIA-705, prepared for Tembec Enterprises Inc. by Timberline Natural Resource Group.

5.5 Non-commercial cover

Non-commercial cover is productive forest land that is otherwise occupied by non-commercial tree or shrub species. This area of land does not currently grow commercial tree species, and is not expected to do so without intervention. This area is thus excluded from the THLB and the CFLB.

Table 10. Non-commercial cover

Description	Percent (%) reduction
Non-commercial brush (NF Descr = NCBr)	100%

5.6 Old growth management area

The KBLUPO specifies the amount of mature-plus-old and old forest that must be maintained within each BEC variant for each landscape unit. Although statutory old growth management areas (OGMA) do not exist in the Invermere TSA, non-statutory spatially explicit OGMA's are in place, and are being recognized by licensees and BCTS in order to meet KBLUPO targets. These OGMA's are thus treated as a 100% reduction in the THLB.

Table 11. Old growth management areas

Description	Percent (%) reduction
OGMA's	100%

Data source and comments:

Data was clipped from the non-legal OGMA provincial layer, BC Geographic Warehouse.

5.7 Areas 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. Operability thresholds were derived using the mapping of the harvest history for the last 10 years.

Table 12. Description of inoperable areas

Description	Class	Reduction (%)
Slope <= 40% (ground skidding)	1	0
Slope > 40% and <= 70% (cable yarding)	2	50
Slope > 70% inoperable	3	100
Operability	I,N	100

Data source and comments:

Sensitivity analyses (Section 7) will examine the impact of assuming 100% and 0% reduction applied to Class 2.

5.8 Sites with low timber growing potential

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.

In the Invermere TSA, timber extraction is completed using different harvesting systems depending on the steepness of the site. On slopes >= 40%, more expensive ground-based systems or cable harvesting are typically used. On slopes < 40%, conventional harvesting methods are used. In general, steeper slopes require a higher threshold of timber volume and piece size to be considered economic and this is reflected in a higher minimum site index threshold. Table 13 shows the minimum criteria that stands need to achieve in order to be considered part of the THLB. It assumes that pine-leading stands have a lower threshold for piece size and are more sensitive to increases in piece size with slope. Other species are not differentiated based on slope in the analysis but the values used reflect a weighted average of all conditions.

Table 13. Minimum stand criteria for timber harvesting

Leading species	Slope	Minimum vol/ ha (m^3/ha)	At age
Pl Leading	< 40%	150	120
Pl Leading	>= 40%	200	120
Fd Leading	< 40%	100	150
Fd Leading	>=40%	150	150
Other	All	150	120

District reviewed Table13 and VDYP model output. The results were generalized reduction criteria based on leading species, site index and slope. The reduction criteria applied to existing natural stands are shown in Table 14. Previously harvested stands are not removed in the low-site netdown since it is assumed that if an existing stand was harvested once it will be harvested again under managed conditions.

Table 14. Low site netdowns

Leading species	Site index	Slope (%)	Percent (%) reduction
Pl Leading	< 10.0	< 40	100%
Pl Leading	< 12.0	>= 40	100%
F leading except FS	< 10.0	< 40	100%
F leading except FS	< 13.0	>= 40	100%
FS, S, Pw	< 8	All	100%
All others	<10	All	100%

5.9 Wildlife habitat reductions

Wildlife habitat reductions may be identified and managed through several processes including the Identified Wildlife Management Strategy (IWMS), identification and approval of ungulate winter range (UWR), and management practices specified in plans such as the KBLUPO.

5.10 Ungulate winter range (UWR)

Ungulate Winter Range U-4-008, established for the protection of habitat for white-tailed deer, mule deer, moose, elk, bighorn sheep and mountain goat. The prescribed General Wildlife Measures (GWM) do not exclude timber harvesting. Therefore, this UWR is not removed from the THLB and the GWM's are modelled as forest cover constraints in Section 6.18, "Ungulate winter range (UWR) forest cover objectives".

Ungulate Winter Range U-4-013 was established for the protection of woodland caribou range, and restricts harvesting. This area is excluded from the THLB.

5.11 Wildlife habitat areas (WHAs)

A number of approved wildlife habitat areas (WHA) are found within the Invermere TSA for the protection of identified wildlife. The associated general wildlife measures (GWM) established by ministerial order under the *Government Actions Regulation* (GAR) guide harvest practices in WHA. The WHA's are listed in Appendix I.

Data source and comments:

It is expected that many of the no harvest areas will overlap with OGMA, WTRA and other ecological and environmental management areas with harvest constraints. No harvest areas are excluded from the THLB but will contribute towards landscape–level biodiversity and scenic objectives.

Modified harvesting is allowed in some wildlife habitat areas with the objective of enhancing or restoring habitat values. These areas are accounted for and discussed under Section 6.4, "Silviculture systems".

Upon review of the areas and management prescriptions (retention and high levels of retention) for WHA's, Forest Analysis and Inventory Branch staff, have for analysis purposes only, removed the entire area of the WHA's from the THLB. The prescriptions shown in Appendix I will be applied during harvest operations.

5.12 Environmentally sensitive areas

Environmentally sensitive areas (ESA) are areas of significant value for other resource delineated within the VRI. ESA are a broad classification of land that are sensitive for the following reasons: unstable soils (E1s), forest regeneration problems (E1p), avalanche risk (E1a), and high water levels (E1h). Netdowns associated with these issues are as follows:

Table 15. Environmentally sensitive areas

ESA category	ESA description	Percent (%) reduction
E1a	Severe snow avalanching	100%
E1h	High water values	100%
E1p (outside of FMER OR and OF)	Severe regeneration problems caused by biotic factors	100%
E1s (where no terrain mapping exists)	Sensitive / unstable soils	100%

5.13 Terrain stability

Licensees and BCTS have completed terrain stability mapping for areas of concern in the Invermere TSA. Mapping was completed in a variety of projects to various intensities of mapping (Level B and D) to support operational and legislative requirements. As this data is considered to be more accurate than ESA mapping, it will be used instead of the ESA soils mapping. Area reductions for unstable terrain are summarized in Table 16.

Table 16. Description of terrain stability reductions

Description	Area reduction (%)
Class P or IV in community watersheds	95
Class U or V in community watersheds	100
Class P or IV outside of community watersheds	5
Class U or V outside of community watersheds	95

Data source and comments:

Areas classified as P (potentially unstable) or Class IV (moderate instability) terrain are generally suitable for timber harvest. Class U (unstable) or Class V (high instability) areas are generally unsuitable for harvesting.

Input from licensees and BCTS shows that 90 to 100% of areas in U/V are unsuitable for harvesting, while 0 to 10% of P/IV are unsuitable for harvesting. Licensees and BCTS indicate that within community watersheds, 0 to 10% of P/IV are suitable for harvesting, while 0% of U/V is suitable for harvesting. The figures in the table above are based on the mid-point of this input by category.

5.14 Cultural heritage resource reductions

An Archaeological Overview Assessment (AOA) and band specific Traditional Use Studies (TUS) have been completed within the Invermere TSA. Landscape or forest development unit First Nation consultation occurs through the Forest Stewardship Plan application processes while site specific consultation occurs during the cutting permit adjudication process.

Most known archeological sites are small and many are found in areas with additional ecological or environmental constraints. These sensitive lands are typically removed from the THLB through the placement of reserve or no harvest zones. Discussion with district staff indicates that additional area over and above that already excluded is anticipated to be minimal (see Section 6.12, “Integrated resource management”). Therefore, no specific additional land base reduction will be applied for cultural heritage resources.

5.15 Riparian management areas

Streams in the Invermere TSA have been mapped through several initiatives. In 2000, the Ministry of Sustainable Resource management (MSRM) created a riparian reserve zone coverage from TRIM streams (some of which had been classified by CANFOR), MWLA (Watershed Atlas data), and MWLAP Fish Presence data. The resultant geodatabase identified riparian reserve zones associated with S1-S3 streams. The geodatabase was then combined with a complete TRIM stream dataset for the TSA. Any known stream classifications from Tembec Enterprises Inc. were utilized and where no information was available, the MSRM coverage was used to assign a general S1 to S3 classification. Any remaining streams not classified were identified as fish streams (S4) or non-fish streams (S5, S6) based on gradient. This methodology was utilized for TSR3, and will also be adopted for TSR4.

Lakes and wetlands in the Invermere TSA were mapped through forest cover and TRIM data, and classified on an area basis.

Riparian reserve zones and management zones by stream, wetland and lake class are set out in the *Forest Planning and Practices Regulation.* Reserve zones represent a 100% reduction of the THLB. Management zone tree retention is guided by results and strategies within Forest Stewardship Plans formulated by licensees and BCTS.

Table 17. Riparian reserve and management zones - streams

Riparian class	Stream length	Reserve width (m)	Management zone width (m)	Management zone retention (%)	Effective buffer width (m) (each side)	Reduction percent (%)
S1	293	50	20	50	60	100
S2	285	30	20	50	40	100
S3	355	20	20	50	30	100
FISH[1]	9,097				31.4	100
S4	445	0	30	25	8	100
S5	247	0	30	25	8	100
NON-FISH[2]	14,753				1.6	100
S6	2,929	0	20	5	1	100

1. FISH – Effective width is an area weighted average of the S1-S4 stream class lengths.
2. NON-FISH – Effective width is an area weighted average of S5-S6 stream class lengths.

Data source and comments:

Effective width is calculated as Reserve Width (m) + (Management Zone Width X Management Zone Retention).

Table 18. Riparian reserve and management zones - wetlands and lakes

Riparian class	Waterbody area (ha)	Reserve width (m)	Management zone width (m)	Management zone retention (%)	Effective buffer width (m) (each side)	Reduction percent (%)
L1 > 1000 ha	4,092	0	200	15	30	100
L1 <= 1000 ha	4,460	10	190	15	39.5	100
L2	17	10	20	50	20	100
L3	860	0	30	50	15	100
L4	29	0	30	50	15	100
W1	12,239	10	40	50	30	100
W2	10	10	20	50	20	
W3	1,173	0	30	50	15	100
W4	2	0	30	50	15	100
W5	0	10	40	50	30	100
Flooded[1]	4				15	
Wetland[1]	203				15	

1. Flooded and wetland where given a buffer width on 15 metres.

Data source and comments:

Effective width is calculated as Reserve Width (m) + (Management Zone Width x Management Zone Retention).

5.16 Problem forest types

Problem forest types (PFT) are those stands that occupy sites that have the potential to produce merchantable timber, but are currently not utilized due to marginal merchantability. These sites are partially removed from the THLB. In the Invermere TSA, a PFT partition has been created to encourage opportunities for the rehabilitation of these moderately dense pine stands and to provide harvest opportunities for post- and rail-licensees.

Table 19. Problem forest types

Description	Age	Height (m)	Reduction percent (%)	Percent (%) extended rotation
Pl leading	>40	< 10.5	80%	0
Pl leading	41-60	16	35%	10
Pl leading	61-80	16	18%	24
Pl leading	>80	16	29%	57

Stands with extended rotation have an additional 20 years to meet the minimum harvesting age criteria above regular stands.

5.17 Non-merchantable forest types

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume. These types are excluded from the THLB. In the Invermere TSA, deciduous stands and whitebark pine stands are not considered economically viable. Decadent timber types (western red cedar, western hemlock and subalpine fir stands > 200 years old) were also removed from the THLB due to economic uncertainty.

Table 20. Non-merchantable forest types

Description	Age	Volume exclusion (%)
Deciduous leading	All	100
Whitebark pine leading	All	100
Cedar or hemlock leading	>200 years old	100
Subalpine fir leading	> 200 years old	100

6. Current Forest Management Assumptions

6.1 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 21. Utilization levels

Analysis unit	Utilization		
	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Pine	12.5	30	10
Cedar	17.5	30	15
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 the utilization levels for billing of timber and are also utilized for assessing cut control for licensee annual allowable cuts.

For yield table projections in the timber supply analysis, the specifications for minimum stump diameter are converted to a corresponding breast height diameter. The specification for minimum top diameter is assumed to be 10 cm for all species due to the limitations of the growth and yield models. Previous analyses show this has a negligible impact on overall stand volume.

6.2 Minimum harvestable age criteria

Minimum harvestable ages are the youngest ages at which timber harvesting is expected to be feasible for a particular forest type. 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 requirements shown in Table 22 and volume requirements shown in Table 13.

Table 22. Minimum harvestable age criteria[1]

Analysis unit	Minimum harvest age criteria		
	Height class	Diameter cm	Age (years)
Pine	All	12.5	60
Douglas-fir	All	17.5	80
Non-pine	All	17.5	80

1. Specifications for open range, open forest and problem forest analysis units have been discussed in Section 4.5, "Analysis units".

Data source and comments:

The assumed minimum harvest ages were set by district staff based on field observations of when stands become economically merchantable for harvest.

6.3 Harvest sequencing

For various reasons, it may be important to set priorities or harvest levels within certain management zones or analysis units 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. Table 23 describes suggested harvest scheduling priorities and limitations within the Invermere TSA for use in the analysis.

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. Woodstock usually sequences the oldest stands which grow slowly which is optimal for harvest flow.

Harvest profile from the base case will be checked against licensees' current performance and these sequencing rules may be modified in order for the base case to reflect current practice.

Table 23. Priorities for scheduling the harvest

Priority	Location or analysis unit	Description or objective
1	>50% lodgepole pine	Pine-leading stands have been under attack by mountain pine beetle and have been targeted by licensees and BCTS for harvest and salvage.
2	Open Range and Open Forest restoration	Open Range and Open Forest stands within the THLB.
3	Oldest first	Oldest stands first after ensuring all forest cover requirements met.

6.4 Silviculture systems

Most harvesting in the Invermere TSA involves a clearcut with reserves silvicultural system. Some partial cut harvesting takes place within NDT4 areas that are being managed for Open Forest or Open Range. The timber supply analysis assumes clearcut with retention will apply to all stands except for Open Forest where partial cutting is assumed.

A certain portion of the TSA has been partial harvested in the past (estimated 6500 hectares since 1987). The stands were typically partial cut removing only lodgepole pine, to meet objectives for UWR, visual concerns and other integrated resource management issues. These stands are growing more slowly and will provide less volume at the next harvest entry.

6.5 Unsalvaged losses

Unsalvaged 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 a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. The values shown in the unsalvaged loss column of the table below represent estimated annual volume that will not be recovered or salvaged.

The impacts from MPB mortality are discussed separately. Endemic pest losses are considered natural processes within stands and are accounted for within the growth and yield models.

Table 24. Annual unsalvaged losses

Analysis unit	Species	Cause of loss	Annual unsalvaged loss (m³/year)
All	F	Douglas-fir beetle	1387
All	F	Fir engraver beetle	44
All	All	Fire	2341
All	All	Flooding	801
All	Sx/Se	Spruce bark beetle	7781
All	Pl	Western pine beetle	5
All	All	Windthrow/snowpress	32
All	Bl	Western balsam bark beetle	2420
Total annual loss (m³/year)			**14811**

Data source and comments:

Windthrow/snowpress estimates have not been updated since 2005.

All other NRL estimates are based on 10–year average loss derived from data provided by FAIB.

6.6 Operational adjustment factors

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

The yield tables generated by TASS[3] for use in TIPSY reflect the growth relationships observed in research plots established by FLNRO 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 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.

The OAF1 value used in this analysis was the provincial default of 15%.

The OAF2 value used in this analysis was the default of 5% plus an amount to reflect losses from root disease (Armillaria), as was done in TSR3. Biogeoclimatic variants and leading species were used to identify hazard rating for root rot. A final OAF value was calculated for each AU by determining the amount of area in each of the three risk categories and calculating a weighted average. These values are shown for each analysis unit in Table 25. The additional OAF2 used to address root rot in TSR3 was developed from informed opinion of the Regional Pedologist, using information from research conducted in the Salmon Arm area, and assumptions used in previous TSR's. The percentages reflect the proactive management occurring in the TSA to minimize losses. These consist of higher establishment densities, planting of mixed species and planting of lower risk species.

[3] 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.

Table 25. Operational adjustment factors (OAF) values

Leading species	BEC variants	Hazard category	Additional OAF2 for Root Rot	Total OAF2 (%)
Fd leading	Non-ESSF	High	5.8%	10.8%
Pl leading	Non-ESSF	Moderate	3.7%	8.7%
Non-Fd or Pl	Non-ESSF	Low	0%	5.0%
All	ESSF	Low	0%	5.0%

6.7 Mountain Pine Beetle (MPB)

The mountain pine beetle has been active in the Invermere TSA since 1978. Infestation levels peaked in 2008, and have been progressively declining since then.

District staff note that MPB infestation has basically run its course within the TSA. Further, the licensees have proactively logged infested stands. As such, no additional analysis of the MPB infestation will be undertaken since residual impacts have been accounted for in the VDYP yield curves for existing stands.

6.8 Site productivity

Site index (SI) is a relative measure of forest site quality based on the height (in metres) of the dominant trees at a specific age (50 years). In British Columbia, studies have shown that inventory based site indices may underestimate potential site indices within younger and older stands.

Changes to site index have important implications for estimating the potential yield of regenerated stands since site index is a required input for the TIPSY model that is used for managed stands in timber supply analysis.

Improved site productivity estimates for young and future managed stands can be derived from SIBEC information provided by the PEM[4]. The FLNRO project, Site Index Estimates by BEC Site Series (SIBEC[4]), relates site index to biogeoclimatic site series for the primary tree species in different areas of BC. A major advantage of the SIBEC approach is that it provides consistent site index estimates across the province. The SIBEC project was initiated in the mid-1990's and the first approximation SIBEC estimates provided site index values in three metre classes; a relatively low precision for the estimates.

As sampling standards were revised and more data were collected, second approximation SIBEC estimates were developed by FLNRO to provide improved accuracy and precision. This included the review of previously collected data and data found to be inadequate were removed from the database.

A report by Mah and Nigh[5] indicated the SIBEC site index estimates would be appropriate for supporting AAC determination and other timber management decisions.

Second generation SIBEC tables were released by FLNRO in 2011 and will be used in conjunction with PEM (see Section 4.3) to estimate site productivity for the TIPSY growth model.

Increases[6] in site index that accrue from the implementation of SIBEC can:

- potentially increase the area of THLB base by reducing the amount of low productivity area;
- redistribute area from lower site classes into higher site classes;

[4] Acceptance letter from Deb Mackillop, Regional Ecologist to Albert Nussbaum, Director, FAIB, June 3, 2015.

[5] SIBEC Site Index Estimates in Support of Forest Management in BC, Shirley Mah and Gordon Nigh, Ministry of Forests, Science Program, 2003.

[6] Increasing the precision of the site index estimate may also produce lower productivity estimates with a reverse effect from those stated.

- lower the age to green-up (i.e., reduce the time before adjacent areas may be harvested);
- reduce the time it takes for stands to reach minimum merchantable volume (i.e., reduce the minimum harvest age).

New PEM estimates have been available since 2004. As noted earlier in the report the PEM scored 63%, two percentage points below the provincial standard. Notwithstanding the regional ecologist has recommended their use in the base case. Also of note, only 88% land base was surveyed. The result is some BEC zones, subzones and variants are not represented in the PEM.

In the last TSR a sensitivity analysis was performed using the provincial SIBEC where there were missing values. This resulted in a 0.1% change to the base case. Given the negligible impact, inventory site indices will be used in the base case.

6.9 Regeneration activities in managed stands

Recent plantations and future stands will be grown on managed stand yield tables (MSYT) produced using TIPSY. The inputs required to produce MSYT shown in Table 26 were summarized from RESULTS free-growing survey data for 8000 hectares recorded since 1993. Regeneration delay, the elapsed time between harvesting and onset of stand growth, incorporate the time needed to establish a stand and the age of seedling stock planted, where applicable.

Table 26. Regeneration assumptions for existing and future managed stands

Analysis unit	Label	Stand regen delay (years)	Regeneration method and weighting (%)	Regenerating species and weighting (%)	Initial density (sph)
501/201	Fd - P	2	Planted (75%) Natural (25%)	Fd45Pl30Lw15Sx10 Fd60Pl20Lw20	1300 2500
502/202	Fd - M	2	Planted (75%) Natural (25%)	Fd45Pl30Lw15Sx10 Fd60Pl20Lw20	1300 2500
503/203	Fd - G	2	Planted (85%) Natural (15%)	Fd35Pl35Lw15Sx15 Fd45Lw20Pl20Sx15	1300 2500
504/204	SB - Poor	2	Planted (100%)	Sx40Bl35Pl25	1300
505/205	SB - Med	2	Planted (100%)	Sx35Pl35Bl30	1300
506/206	SB - Good	2	Planted (100%)	Sx35Pl35Bl30	1300
507/207	Cw/Hw - All	2	Planted (100%)	Sx50Fd30Cw10Bl10	1300
508/208	Pl - Poor	3	Planted (100%)	Pl50Sx35Bl15	1300
509/209	Pl - Med	2	Planted (80%) Natural (20%)	Pl55Bl15Sx15 Lw10Fd10 Pl60Sx20Fd10Lw10	1300 3000
510/210	Pl - Good	2	Planted (90%) Natural (10%)	Pl50Sx20Lw10Fd10Bl5 Pl70Lw15Fd10Sx5	1300 3000
512/212	Lw - Poor	2	Planted (100%)	Pl40Lw30Fd15Sx15	1300
513/213	Lw - Med	2	Planted (100%)	Pl40Lw30Fd15Sx15	1300
514/214	Lw - Good	2	Planted (90%)	Pl45Lw35Fd15Sx5	1300

Data source and comments:

For regeneration delay all area weighted averages were rounded up to whole years. Regenerating species components were discussed with licensees and the actual data was modified slightly; minor species were not included.

Initial densities were estimated after reviewing uncapped well spaced free-growing densities from RESULTS.

It should be noted that differences in merchantable volume at 100 years are small when comparing planting densities of 1200-1600 sph and natural establishment of 2500-4000 sph (i.e., <10m^3/ha).

6.10 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 Invermere 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 the amount of 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 27. Estimated use of genetic class A and class B+ seed

Era	Percent (%) use by species[1]			
	Fdi	Lw	Pli	Sx
1998-2003	0	53	31	71
2003-2014	9	82	26	51
Future	10	95	50	90

(1) Rounded to the nearest integer. The estimates are the area weighted usage of Class A, B+ and B seed.

Table 28. Net genetic gain seedlings by species to be applied to yield curves[1]

Era	Net genetic gain by species to be applied to the yield curves			
	Fdi	Lw	Pli	Sx
1982-2003	0	2	3	15
2004-2014	0	19	1	13
Future stands	3	27	5	27

(1) These are the average genetic gains from combined class A and B seed.

Data source and comments:

For this analysis it is assumed that the planted genetic stock will survive to be part of the well-spaced stems measured at the free-growing survey.

The 1982-2003 data was taken from the TSR3 reports.

The 2003-2014 and future data for genetic gain was provided by Tree Improvement Branch, FLNRO.

6.11 Not satisfactorily restocked (NSR) areas

Lands classified in the VRI as not satisfactorily restocked (NSR) are included in the current timber harvesting and base. The purpose of this section is to identify the total area of NSR currently existing in the THLB, and the estimated rate at which the NSR area will be restocked.

At the present time, all backlog NSR (pre-1987) in the Invermere TSA previously identified has been addressed, and the resultant balance is zero.

The recently and future harvested stands are expected to regenerate as per the assumptions presented in Table 26, "Regeneration assumptions for existing and future managed stands".

Data source and comments:

The current NSR is based on the RESULTS "Milestone Declaration Report" and is a reflection of current harvesting.

6.12 Integrated resource management

Non-timber forest management objectives such as biodiversity, UWR, visual quality areas and watershed typically require management of forest cover. The forest cover requirements associated with these factors are discussed below.

Forest cover requirements may be examined at a number of different levels, including landscape units, UWR and visual quality areas.

6.13 Green-up and adjacency - Integrated Resource Management Zones

The Kootenay-Boundary Higher Level Plan Order (KBLUPO) specifies different green-up requirements to be applied within the Invermere TSA. Green-up requirements can often be waived if licensees manage for patch size distributions specified in the HLPO and detailed in the "Landscape Unit Planning Guide" (MoF/MoE 1999).

Modelling of green-up requirements will be done using forest level objectives, as opposed to block specific objectives, because this is consistent with the operational flexibility afforded by patch size management. Green-up requirements and how they will be modelled are provided in the following table.

Table 29. Green-up requirement by management zones

Management zone	Green-up requirement	Modelled green-up constraint	Area to which it applies
KBHLUPO Enhanced Resource Developed Zone (ERDZ) Timber Zone	Successful regeneration (stocked)	Max 33% < 2 year within each landscape unit/ERDZ	THLB area inside the KBHLUPO mapped ERDZ timber zone
Fire Maintained Ecosystems - Open Forest and Open Range	None	None	Open Range and Open Forest areas (FMER mapping)
Integrated Resource Management Zones	2.5 m tall trees	Max 33% < 12 years within each LU/IRM	THLB area not included in the above two zones

Data source and comments:

Age to green-up is determined by calculating the area weighted stand type for each of the zones and then evaluating the age/height relationship for the stand in site tools.

6.14 Visual quality objectives

The District Manager established visual quality objectives (VQO) with a letter to licensees dated March 14, 2003. These established VQO's were grandparented into *FRPA* via Section 180 and 181.

Table 30 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 30. 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 31. 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 31. 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 31. 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 on the FLNRO Resource Practices Branch website at https://www.for.gov.bc.ca/hfp/values/visual/

6.15 Seral stage distribution

Landscape-level biodiversity is managed through the retention of 'mature plus old' and 'old' seral forest. Stand-level biodiversity is managed through the retention of wildlife trees and wildlife patches.

Section 1 and 2 of the KBLUPO specifies the amount of mature plus old and old forest that must be maintained within each biogeoclimatic (BEC) variant for each landscape unit (LU). Landscape units have been legally established along with biodiversity emphasis option (BEO) assignments. The KBLUPO targets for the Invermere TSA are shown in the following table.

Table 32. Mature plus old and old forest cover requirements for landscape-level biodiversity objectives

BEC sub–zone	NDT	Mature age (years)	Old age (years)	Mature + old seral requirements			BEC sub–zone				
				Low	Inter	High	Low* 1st Rot	Low* 2nd Rot	Low * 3rd Rot	Inter	High
ESSF wm/wmu	1	>120	>250	19%	36%	54%	6.3%	12.6%	19%	19%	28%
ESSF dk1/dk2/dku	3	>120	>140	14%	23%	34%	4.7%	9.3%	14%	14%	21%
ICH mk1	3	>100	>140	14%	23%	34%	4.7%	9.3%	14%	14%	21%
IDF dm2/dm2n/xk	4	>100	>250	17%	34%	51%	4.3%	8.7%	13%	13%	19%
MS dk	3	>100	>140	14%	26%	39%	4.7%	9.3%	14%	14%	21%
PP dh2	4	>100	>250	17%	34%	51%	4.3%	8.7%	13%	13%	19%

The KBHLPO allows for 'old' requirements to be reduced to one-third low biodiversity emphasis areas. The full target for old forests must be met by the end of the third rotation.

Old growth management areas (OGMAs) have been spatially located and mapped in the Invermere TSA. Although not all of the OGMAs are legally established, the non-legal OGMAs will be used in the analysis. Since TSR is a strategic process the non-legal OGMAs indicated the magnitude of the area that is to be retained even if their size and location is modified in the future.

Data source and comments:

The analysis will use the provincial SIBEC mapping as the new SIBEC has zones, subzones and variants not covered by the KBHLPO.

6.16 Stand-level biodiversity

One of the primary methods of addressing stand-level biodiversity objectives is by means of wildlife tree retention. The retention requirements for wildlife trees is 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 and BCTS have developed results and strategies that set out wildlife tree retention targets by landscape unit and BEC variant.

An analysis of wildlife tree retention provided through the Forest and Range Evaluation Program (FREP) shows that a total of 6% of area harvested is in unconstrained wildlife tree patches or dispersed retention. Wildlife tree retention will be modelled by reducing the stand yield curves by 6%.

6.17 Community and domestic watersheds

There are a total of 10 community watersheds present in the Invermere TSA. These watersheds are managed under Section 180(e) of the *Forest and Range Practices Act*. The base case will use the equivalent clearcut area (ECA) within these watersheds to no more than 30% of the area being less than six metres height.

There are also domestic watersheds in the Invermere TSA. Based on advice from the Regional Hydrologist domestic watershed should be modelled as per community watersheds.

Table 33. Community and domestic watersheds – forest cover requirements

Watershed type	Forest cover objectives	Area of application
Community watershed	Max 30% < 6m	CFLB within each watershed type
Domestic watershed	Max 30% < 6m	CFLB within each watershed type

6.18 Ungulate winter range (UWR) forest cover objectives

Ungulate winter range U-4-006, established for the protection of habitat for white-tailed deer, mule deer, moose, elk, bighorn sheep and mountain goat, has prescribed (GWM's that are modelled as forest cover constraints), as per Table 34.

Ungulate Winter Range order U-4-013 was established for the protection of woodland caribou range, and restricts harvesting. This area represents a 100% deduction to the THLB.

Table 34. Modelled forest cover constraints for UWR U-4-006

Habitat type	Area of application forest cover requirements	Qualification
Managed forest (dry)	Mature cover	10% > 100 years and evergreen crown closure >=20%, or layer 1 age >100 years
Managed forest (transitional)	Snow interception cover	10% > 60 years and evergreen crown closure >=40%
Managed forest (transitional)	Mature cover	10% > 100 years, Fd or Sx leading and evergreen crown closure >=40%
Managed forest (mesic)	Snow interception cover	10% > 60 years and evergreen crown closure >=40%
Managed forest (mesic)	Mature cover	20% > 100 years, Fd or Sx leading and evergreen crown closure >=40%
Managed forest (moist)	Snow interception cover	20% > 60 years and evergreen crown closure >=40%
Managed forest (wet)	Snow interception cover	30% > 60 years and evergreen crown closure >=40%

Data source and comments:

For habitat types that have snow interception cover and mature cover requirements, both constraints will be applied.

6.19 Grizzly bear habitat and connectivity corridors

The KBHLPO provides for the maintenance of mature and old cover requirements adjacent to important grizzly bear habitat, and within mapped connectivity corridors. Where applicable, these areas must be used first to address 'mature and old' targets in these areas. There will be no explicit modelling of the bear habitat as this managed through ground operations.

6.20 Disturbance outside the THLB

Crown forest land outside of the THLB undergoes natural disturbance that affects age class distribution and its contribution to forest cover 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.

The proposed timber supply model does not yet have the ability to directly model disturbances in forest outside of the THLB. Since OGMA's are being accounted for in the base case there is no need to explicitly model disturbance outside of the THLB.

7. Sensitivity Analyses to be Performed

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 35 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 35. Sensitivity issues

Issue to be tested	Sensitivity levels
Operability class 2 - slopes greater than 40% and less than 71%.	Include and exclude all available area
Lack of harvesting in the problem forest types	Remove PFT's from THLB
TIPSY potential overestimations of managed stands	Decrease yields 10%
Cumulative effects	Currently being discussed
Difficult to regenerate stands	Remove PFT's from THLB
Alternative harvest rates	Highest initial harvest for 5 and 10 years. Set initial harvest to half way between the base case and current AAC for 5 and 10 years. To be determined after the establishment of the base case

8. Appendix I

Following a review of the mapped wildlife habitat areas, staff concluded that due to the relatively small areas subject to the forest cover constraints listed below, and to reduce the complexity of the timber supply analysis, the areas would be either fully excluded or included in the THLB.

Table 36. Estimates for wildlife habitat areas, Invermere TSA

WHA	Species	Species/habitat under consideration	Analysis Assumption
4-002	Lewis' Woodpecker	100	No harvesting
4-065	Long-billed curlew	Seasonal harvesting, some retention	Harvesting permitted
4-066	Long-billed curlew	Seasonal harvesting, some retention	Harvesting permitted
4-067	Long-billed curlew	Seasonal harvesting, some retention	Harvesting permitted
4-068	Long-billed curlew	Seasonal harvesting, some retention	Harvesting permitted
4-069	Long-billed curlew	Seasonal harvesting, some retention	Harvesting permitted
4-070	Long-billed curlew	Seasonal harvesting, some retention	Harvesting permitted
4-081	Flammulated owl	No harvesting in core area. No harvest in xeric sites. 50% cut in management zone.	No harvesting
4-082	Flammulated owl	No harvesting in core area. No harvest in xeric sites. 50% cut in management zone.	No harvesting
4-083	Flammulated owl	No harvesting in core area. No harvest in xeric sites. 50% cut in management zone.	No harvesting
4-084	Flammulated owl	No harvesting in core area. No harvest in xeric sites. 50% cut in management zone.	No harvesting
4-085	Flammulated Owl	No harvesting in core area. No harvest in xeric sites. 50% cut in management zone.	No harvesting
4-102	Badger	Extended rotation	Harvesting permitted
4-103	Badger	Extended rotation	Harvesting permitted
4-106	Badger	Extended rotation	Harvesting permitted
4-117	Antelope-brush/ Bluebunch wheatgrass	Seasonal harvesting, some retention	Harvesting permitted