Bulkley Timber Supply Area
Timber Supply Review

Updated Data Package following completion of the timber supply analysis

December 2012

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1. Introduction

This data package summarizes the information and assumptions that are used to conduct timber supply analysis for the Bulkley Timber Supply Area (TSA). The information and assumptions represent current performance, which is 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, including objectives and practice requirements contained in the *Forest and Range Practices Act*;
- land-use plans approved by Cabinet (e.g. 1996 Bulkley Land and Resource Management Plan);
- legal objectives established under the *Forest and Range Practices Act* and the *Land Act* (e.g. 2006 Bulkley LRMP Objectives Set by Government).

The purpose of the timber supply review program is to model "what is", as opposed to "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 contains:

1) a short explanation of the data required;

2) a data table or list of modeling assumptions;

3) a description of data sources and other comments.

2 Current Forest Management Considerations and Issues

2.1 Base Case Management Assumptions

The assumptions described in this data package 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 the base case harvest forecast and is used as a baseline for assessing the impacts of uncertainties. Section 7, "Sensitivity Analysis" identifies areas of uncertainty in the data and assumptions and outlines sensitivity analyses that are carried out.

2.2 Major Forest Management Considerations and Issues

Table 1 major forest management issues and considerations. Where possible, the issues are assessed directly in the timber supply analysis. If the issue does not fall within the definition of current management as described in Section 1, "Introduction", the related timber supply impacts are assessed in a sensitivity analysis. There may be significant uncertainties in defining some current management issues. In such cases, sensitivity analysis can assist in assessing the timber supply implications and assigning degrees of risk to timber supply during allowable annual cut determination.

Table 1. Major forest management considerations

Consideration/Issue	Description
Improved definition of operability (CF1)	The operable land base is defined using a refined Harvest Method Mapping approach. Amongst other changes, the upper extent of the operable land base is now set to the lower elevational edge of recently mapped low productivity "woodlands" biogeoclimatic subzones.
Improved inventories (CF2 and CF3)	1970's Environmentally Sensitive Area soils mapping (Es1 and Es2) is replaced with Terrain Stability Mapping (TSM) where available, and with a new sensitive soils proxy in areas where TSM is unavailable. Roads, Trails, Landings – complete, geospatially correct digital files have been compiled to improve estimates of THLB losses to existing roads, trails and landings.
Site Productivity (CF4)	The site productivity of existing stands has been shown to underestimate the true productivity of regenerated stands. Site index adjustments are applied to existing stands following harvest in the timber supply model using new site index estimates from Site Index by Biogeoclimatic Ecosystem Classification (SIBEC).
Understorey Retention (CF5)	Licensees retain understorey stems to extent possible for numerous reasons (e.g. faster green-up, stand-level biodiversity). This retention has a potentially unrealized timber supply benefit. District silviculture records were reviewed to determine which BEC variants have naturally high levels of secondary stand structure. Regeneration assumptions have been structured to better recognize contribution of understorey in those variants.
Landscape level biodiversity (CF6)	Bulkley TSA objectives set by government (OSBG) set legal targets for landscape-level seral stage and patch size distribution. Refinements to the TSR2 modeling approach were considered necessary. The refined approach models legal seral stage distribution targets. Adherence to patch size distribution targets is approximated using a multiple harvest pass concept.

Consideration/Issue	Description
Unsalvaged Losses (CF7 and CF8)	There is uncertainty regarding the degree to which volume losses attributable to spruce bark beetle (SBB), balsam bark beetle (BBB), spruce root rot, and windthrow are accounted for as “natural” endemic losses in VDYP yield curves. Unsalvaged loss estimates have been revisited with current knowledge..
Major Forest Health Issues	Mountain pine beetle (MPB) infestation levels range from nil to significant across Bulkley TSA. Provincial forest health overview mapping is used to identify areas of infestation. Higher harvest priority is placed on accessible pine stands within areas of infestation. Dothistroma needle blight is affecting lodgepole pine plantations in Interior Cedar-Hemlock biogeoclimatic variants. This disease reduces growth and causes plantation failure. It is expected that affected stands will be re-stocked through either natural or artificial regeneration. Regeneration assumptions have been developed for three Dothistroma management classes: “stocking likely without pine”, “wait and see”; and “action imperative”.
Inclusion of area from Area-Based Tenures	A probationary community forest tenure was awarded in 2008. The area does not contribute to TSA timber supply but does contribute significantly to landscape-level objectives set by government (OSBG) in several landscape units.
Partition	To ensure harvest of the full stand quality profile in Bulkley TSA, the Chief Forester established a stand quality-based partition requiring that at least 41% of harvest occurs in “marginal sawlog” or “pulp” quality stands. The partition is considered in setting harvest priority in the model.
Land Use Planning	Strategic planning processes completed since TSR2 include the Bulkley Resource Management Zone Higher-Level Plan Order (2000), the Bulkley Valley Sustainable Resource Management Plan (2005), and Bulkley LRMP Objectives Set by Government. (2006). Legal objectives for landscape and stand-level biodiversity, wildlife habitat, visual quality, fish-sensitive areas, and special management zones are considered in the analysis. Strategic processes presently underway include the Gitsegukla SRMP, and Wildlife Habitat Area Order #6-333 for Northern Caribou in Bulkley and Morice TSA’s. Timber supply implications of proposed zonations and new objectives shall be explored through sensitivity analyses. Visual Quality - VQO’s were established under the Forest Practices Code for all LU’s except Bulkley Valley. Although not legally established, licensees manage Bulkley Valley VQO’s as de facto, so those VQO’s are considered in the base case.
Current Management	Legal government objectives and current management, as established by standard licensee operational practices, are both considered in generation of the base case harvest forecast. For the base case, “current management“ is defined by licensee results and strategies from approved Forest Stewardship Plans (FSP’s). A key implementation element of Bulkley strategic plans is the requirement to maintain a balanced timber supply “budget”, in managing future changes to spatial boundaries or constraints for strategic planning zones. An analysis supporting the Bulkley Higher Level Plan Order (HLPO 2006) re-set this “budget”. Certain FSP results/strategies yield timber supply constraints that differ from those considered in the HLPO 2006 analysis. Sensitivity analysis will test the timber supply impact of applying constraints more comparable to those used for the HLPO 2006 analysis.

Data source and comments:

In his Bulkley TSR2 AAC Rationale (2001), the Chief Forester provided the following implementation recommendations to District staff intended to reduce risk and uncertainty around key timber supply factors. The considerations/issues in Table 1 that relate to these recommendations are identified by recommendation number (CF1, CF2, etc.).

CF1. Continue to refine operability lines with the harvest method mapping approach

CF2. Replace environmentally sensitive soils (Es description) mapping with terrain stability mapping Further refine methodologies for future roads, trails, and landings to account for rehabilitation and better forestry practices

CF3. Improve site index information for the OASIS approach to estimating site index

CF4. Continue to study and assess the modelling techniques for understorey retention, and to continue to collect data and monitor advanced balsam growth

CF5. Further refine and model the HLP objectives for seral stage and patch size distribution targets for future TSRs

CF6. Do a comprehensive review of the methods and results for accounting for unsalvaged losses

CF7. Consider developing utilization standards specific to harvest in stands with epidemic levels of Balsam Bark Beetle infestation.

The Wetzink'wa Community Forest Agreement (CFA) would normally be excluded from the TSA land base because it has its AAC set by a separate process. However, this CFA occupies significant area in four landscape units, thereby contributing significantly to landscape level biodiversity. In addition, the holders of the CFA are cooperating with other forest licensees in the Bulkley TSA to undertake coordinated analysis of silvicultural investments and other issues in the TSA. The TSR base case model will be used as the base case for these analyses, so it is important for the TSR analysis to account for the CFA.

The definition of "current management" in Bulkley TSA was discussed internally and with licensees. At debate is whether "current management" is better represented by LRMP implementation elements, or licensee practices as defined within Forest Stewardship Plans (FSP's). Major licensee FSP results and strategies (R/S) have been used to represent "current" management for the base case1.

Despite this election, a key implementation element of Bulkley Higher Level Plan Order (2006) is the concept of maintaining a balanced "budget" of timber supply impacts associated with LRMP zonations. For example, proponents seeking to lighten constraints or shift boundaries are expected to identify offset areas where constraints are increased, or to provide suitable replacement areas, to ensure the balance is maintained.

Bulkley HLPO (2006) was intended to be consistent with all previous Bulkley strategic plans, and historic agreements on forest management practices that were negotiated between government and licensees - as captured in Landscape Unit Plan (LUP) strategies. The analysis supporting Bulkley HLPO, that establishes the current "budget" balance, considered LUP strategies.

Certain of the FSP results and strategies differ from LUP strategies. A sensitivity analysis will test the timber supply impact of using constraints that more closely match those intended (see Section 7.0, "Sensitivity Analysis").

[1] Where the sets of R/S are essentially consistent between licensees, constraints have been blended. Where they are significantly different (e.g. Babine SMZ2 management), a split by traditional licensee operating area has been provided.

3. Inventories

Table 2 lists the inventories and themes that will be used to determine the timber harvesting land base (THLB), and to model forest management activities.

Data	Source	Vintage	Update
Agriculture Development Areas, Wildlife Habitat Management Areas	MoE Skeena[2]	2010	
Alluvial Fans	MoFR RNI[3]	2003	
Biogeoclimatic Ecosystem Classification	LRDW[4]		
Community Watersheds	LRDW	1993	2010
Depletion layer	MoFR District	2003	2010
Ecosystem Network	MoFR District	1997	2003
Environmentally Sensitive Area mapping	MoFR District	1970's	
Fish Sensitive Watersheds	LRDW	2007	
Harvest Method Mapping	MoFR District	2010	
Landscape Units	LRDW	1997	2001
Objectives Set by Government - Amalgamated Special/Resource Mgt Zones	MoFR District	2010	
Ownership	MoFR FAIB	2008	2010
Predictive Ecosystem Mapping/ Woodlands BEC Subzones	MoFR RNI	2010	
Provincial Forest	LRDW	2001	
Provincial Forest Health Overview Survey	MoFR Forest Practices Branch	2010	
Remote/Accessible	MoFR District	2004	
Research Installations, Growth and Yield Plots	LRDW	2009	
Riparian Area	MoFR District	2010	
Roads, Trails, Landings	MoFR District	2010	
Recreation Sites, Trails, Reserves	LRDW	2008	
Sensitive Ecosystem Inventory	MoFR District	1998	
Soil Erosion Potential (Class IV, V proxy)	MoFR District	2010	
Terrain Stability Mapping (Class IV, V)	MoFR District	1996-2000	
Timber Supply Area	LRDW	2003	
Vegetation Resources Inventory	LRDW	2008	2009
Visual Quality Objectives	MoFR District	1987-	2009

[2] MoE Skeena – Ministry of Environment, Skeena Region
[3] MOFR – Ministry of Forests and Range; RNI – Northern Interior Region;
[4] LRDW – Land and Resource Data Warehouse

3. Inventories

Data	Source	Vintage	Update
		2008	
Watershed Sub-Basins	MoFR District	1999	
Wildlife High-Value Habitat	MoFR District	1997	
Wildlife - Grizzly Bear - Moderate Value Habitat; Babine Special Mgmt Units	MoFR District	1989	1997
Wildlife - Telkwa Caribou Study Area	MoFR District	2004	2009

Data source and comments:

Agriculture Development Areas (ADA's), Wildlife Habitat Management Areas (WHMA's): Proposed ADA's may be established in near future as land reserves under the Lands Act – the necessary public review process occurred during completion of Bulkley Valley SRMP (2005). ADA management is not compatible with long-term forest management: eligible parties may apply to develop for agricultural purposes. However, because ADA's are not presently established, their area will be retained in the THLB and modelled with underlying zonations and constraints. To be consistent with the approach used to model any future land use that is uncertain, the removal of land resulting from future agricultural development will be reflected in future TSR.

Alluvial Fans – an alluvial fan spatial file was derived from amalgamated digital Terrain Maps and field-verified by the Regional Geomorphologist.

Biogeoclimatic Ecosystem Classification: BEC information is current to 2007. New codes have been developed since the last TSR. The current data is described as version 7 (abec_v7).

Community Watersheds: forest management constraints associated with established Community Watersheds (CW's) will be included in the analysis.

Depletion layer: A forest cover depletion layer is used to update the forest cover for recent harvesting and other depletions. District Geomatics staff created a depletion layer from LRDW RESULTS spatial view files, the Vegetation Resources Inventory (VRI) (FIP rollover – pre-2008), forest tenure harvesting information spatial layers (FTEN), and satellite change detection mapping. Spatial data pieces were merged and overlaid with 2006 orthophotography and 2009 satellite imagery. Any depletions not captured in the preliminary spatial file were digitized. Attribute information missing in the spatial views of RESULTS or other datasets was reviewed against a tabular RESULTS file to determine block status. Statuses are classed by one of the three following labels; FG – free growing, SR – sufficiently restocked, NSR – not sufficiently restocked. If a status was not derivable, a value of unknown (UNK) was assigned.

Ecosystem Network: the Ecosystem Network, comprised of Core Ecosystems (CE's) and Landscape Riparian Corridors (LRC's) is identified in Bulkley LRMP Objectives Set By Government (2006). CE's provide ecosystem representation and interior forest conditions, and LRC's provide habitat connectivity. Minor modifications have been made to the original version created for the Bulkley LRMP in 1997 to track small areas that were harvested and replacement areas that were added.

Environmentally Sensitive Area (ESA) mapping: mapping from the 1970's-era to identify areas such as avalanche areas, sensitive soils, wildlife habitat, reforestation concern and others. Most of this mapping has been replaced by more recent mapping, but the areas of reforestation concern are used in this analysis..

Fish Sensitive Watersheds: five Bulkley watershed sub-basins were designated fish-sensitive through a December 2005 Ministry of Environment (Skeena Region) Order.

Forest Recreation Sites, Trails, Reserves: these areas administered by the Ministry of Forests, Lands and Natural Resource Operations. Linear features (i.e. trails) are converted to polygons with a 20 metre width.

3. Inventories

Harvest Method Mapping: Harvest Method Mapping, originally completed in 1998, is used to identify operable areas. An update completed in 2010 considers an upper operability line defined by the lower elevational edge of newly mapped "woodlands" BEC subzones. Forest types are assigned a harvest method and stand quality code; types deemed economically feasible for harvest are included in the operable land base.

Landscape Units (LU's): Bulkley LU's were established in 1999 as legal Objectives Set by Government via section 4(1) of the *Forest Practices Code of BC Act.*

Objectives Set by Government - Amalgamated Special/Resource Mgt Zones: these areas of constrained land base are identified in the Bulkley Resource Management Zone Higher-Level Plan Order (2000).

Ownership: a customized data layer was produced for the province of BC in 2008 by Forest Analysis and Inventory Branch. Ownership coding is reflective of that used for the previous Forest Cover Inventory "f_own" file. District staff reviewed to verify accuracy and presence of current 2009/2010 information. File includes woodlots (Crown land portion), Community Forest Licenses, UREP/Recreation reserves, private lands, federal reserves, Indian Reserves, other miscellaneous reserves and leases, and parks and ecological reserves.

Woodlots were corrected in the Ownership file to ensure full consistency with their spatial representation within the forest tenure management database.

Predictive Ecosystem Mapping (PEM)/ Woodlands BEC Subzones – Bulkley PEM (2009) meets the 65% accuracy standard permitting its consideration in TSR. PEM polygons - grouped into biogeoclimatic variant/moisture classes - are used to define the existing natural stand and managed stand analysis units.

The lower elevational edge of Woodlands BEC subzones define the upper operability line. Woodlands BEC subzones were recently mapped and have yet to be incorporated into the LRDW BEC layer. They are incorporated into the PEM file.

Provincial Forest Health Overview Survey – this survey, conducted annually for the province, provides delineation of forest health agent infestation areas and a relative severity code (trace, light, moderate, severe, very severe). Survey products are used to identify current areas of mountain pine beetle infestation, and to help quantify short-term pine mortality rates.

Remote/Accessible: the existing Bulkley road network was buffered by 1kilometer to differentiate relatively accessible versus relatively remote land base. This file is used in setting harvest priority.

Research Installations, Growth and Yield Plots: forest within growth and yield plots is representative of the natural or managed forest. Because forested area of plots could potentially be included in WTP or other reserve, it is retained in the THLB. Research installations are managed for research purposes so may or may not be characteristic of the natural forest over a rotation. Their area is removed from the THLB; protective buffer areas around installations contribute to THLB.

Riparian Area: District staff derived a spatial riparian management area file, using provincial Corporate Watershed Base (CWB) aquatic features mapping as a primary reference layer. Riparian classification was performed in accordance with coastal fish/forestry guidelines.

Roads, Trails, Landings – roads and trails were aggregated from all known digital sources including Provincial Land and Resource Data Warehouse (LRDW) road layers and licensee spatial road data. Landings were spatially identified from 2006 orthophotography.

Sensitive Ecosystem Inventory – COSEWIC red- and blue- listed ecosystems occurring within Bulkley Valley were mapped by an ecological consultant in 1998, or are identifiable using new Bulkley PEM. Sensitive ecosystems falling within Copper River SMZ2 and Core Ecosystem areas are excluded from THLB.

3. Inventories

Soil Erosion Potential (TSM Class IV,V proxy) – District staff derived soil erosion potential mapping for all Bulkley TSA, using terrain classification mapping projects and soil/landform mapping of the 1970's and 1980's as reference layers. High/very high surface erosion potential is used as a TSM Class IV/V proxy in those parts of the TSA where detailed TSM projects are not completed.

Terrain Stability Mapping (Class IV, V): Class IV and V stability classes from Terrain Stability Mapping (TSM) projects were amalgamated into a single file.

Vegetation Resources Inventory: A new VRI was completed in 2008. Inventory attributes (including species composition, age class, stocking class, and density) were adjusted according to VRI Phase II ground sampling. New Net Volume Adjustment Factors (for timber decay and stem taper) from the VRI project were used in assigning net merchantable volumes. Species, volume, and inventory-based information is projected to 2009.

Visual Quality Objectives: MOFR Landscape Inventory Specialists are in the process of updating and finalizing Bulkley's visual landscape inventory file. The LRDW-stored version is an interim file.

Because Bulkley's visually sensitive areas and VQO's were made known during landcape unit planning and grandparented to legal status via *Forest and Range Practices Act* (FRPA) section 180 and 181, the District elected to make corrections to the LRDW-stored version to ensure full spatial consistency with landscape unit plans.

Wildlife - High-Value Habitat – these areas of high-value habitat for caribou, deer, moose, goat, and grizzly were identified in Bulkley LRMP Objectives Set By Government (2006).

Wildlife – Grizzly Bear - Moderate Value Habitat; Babine Special Mgmt Units – these areas of significant grizzly value identified in Bulkley LRMP Objectives Set By Government (2006) have access constraints that will be considered in the analysis.

Wildlife - Telkwa Caribou - Study Area – the Telkwa Caribou Herd Recovery Area and associated forest management constraints are identified in Bulkley LRMP Objectives Set By Government (2006).

4. Division of the Area into Management Zones

4.1 Management Zones

Management zones are used to differentiate areas with distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective or wildlife consideration. An area of forest may be subject to more than one management objective. Each objective can be tracked separately in the timber supply model. Land considered unavailable for timber harvesting can contribute to the achievement of other forest management objectives.

Table 1 outlines the zones or objectives incorporated in the timber supply model. Further information on the forest cover requirements to be applied to these areas can be found in Section 6.4, "Integrated Resource Management".

Table 1. Objectives to be tracked

Objectives	Inventory Definition
Early, Mature + Old, and Old Seral stage distributions	Forest management land base by landscape unit and BEC variant
Patch size distribution	Number of THLB harvest passes by landscape unit and natural disturbance type
Core Ecosystems	Forest management land base for each landscape unit, inside and outside of the Telkwa Caribou Recovery Area,
Babine SMZ2	Forest management land base within SMZ2
Harvesting in the Wetzink'wa Community Forest	Forest management land base, THLB and volume harvested within Wetzink'wa Community Forest
Landscape Riparian Corridors	Forest management land base by landscape unit, , inside and outside of the Telkwa Caribou Recovery Area
Wildlife Habitat	Forest management land base by landscape unit by wildlife species
Visual Quality Objectives	Forest management land base by landscape unit
Harvest Method Mapping Stand Quality Class	Volume harvested by Stand Quality Class
Fish-Sensitive Watersheds (FSW)	THLB by FSW
Forest Outside THLB	Forest management land base by Natural Disturbance Type (NDT)
Landscape Units	Volume harvested by Landscape Unit

Data source and comments:

See Section 3, "Inventories", for the sources of mapping and zones referenced above. Information on the forest cover requirements to be applied to these areas can be found in Section 6.4, "Integrated Resource Management".

"Forest Management Land Base" in Table 1 includes the Forest Management Land Base of the Wetzink'wa Community Forest. The Wetzink'wa Community Forest does not contribute to TSA timber supply, but the Community Forest does make significant contribution to achievement of landscape-level objectives. Harvesting within the Community Forest will be simulated as described in section 6.1.4, "Harvest scheduling priorities".

Volume harvested will be tracked by Landscape Unit to support a coincident Bulkley TSA Type 2 Silviculture Analysis. Volume harvested will additionally be tracked by First Nations House (for Gitxsan and Wet'suwet'en First Nations) or traditional territory (for Lake Babine and Kitselas First Nations), to support communications.

4. Division of the Area into Management Zones

4.2 Analysis Units

An analysis unit is composed of forest stands with similar tree species composition, timber growing potential and treatment regimes. Each analysis unit is assigned its own timber volume projection (yield table) for existing and future stands. Yield tables for existing "natural stand" analysis units are derived using the Variable Density Yield Prediction (VDYP) model. Yield tables for "managed stand" analysis units (i.e. recent plantations and future stands) are derived using the Table Interpolation Program for Stand Yields (TIPSY).

Table 2 shows the criteria used for defining analysis units for existing natural stands.

Table 2 . Definition of Analysis Units

Analysis Unit	BEC variant	moisture class	Site Series
1	CWHws2	Dry	02
2		Fresh	01, 03, 05
3		Moist	04, 06, 07, 08
4		Very Moist	09, 11
5		Wet	10
6	ESSFmc	Dry	02, 03
7		Fresh	01, 04
8		Moist	06, 07
9		Wet	08, 09, 10
10	ESSFmk	Dry	02
11		Fresh	01, 03
12		Moist	04, 05
13		Wet	07
14	ESSFwv	Dry	02, 03
15		Fresh	01, 04
16		Moist	05, 06
17		Wet	07, 09
18	ICHmc1	Dry	02
19		Fresh	01, 03, 04, 05
20		Wet	06
21	ICHmc2	Dry	02
22		Fresh	01, 03, 04, 05, 06, 51, 52, 53, 54
23		Moist	07
24	MHmm2	Dry	02
25		Fresh	01, 03, 05
26		Moist	04, 06, 07
27		Wet	09
28	SBSdk	Dry	02, 03
29		Fresh	01, 05, 06
30		Moist	07, 08
31		Wet	09, 10

4. Division of the Area into Management Zones

Analysis Unit	BEC variant	moisture class	Site Series
32	SBSmc2	Dry	02
33		Fresh	01, 03, 05, 06, 09
34		Moist	07, 10
35		Wet	12

Data source and comments:

Each combination of BEC variant/moisture class defines a single analysis unit.

Moisture classes for each BEC variant were derived by grouping site series with similar edatopic grid relative moisture condition (re: *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region*[5]*)* and similar stocking standard (re: November 2009 *Reference Guide for FDP Stocking Standards*[6]). Table 2 shows which site series have been selected to represent the moisture class.

For existing natural stand analysis units, a mean yield table is calculated from the individual polygon yield tables in the analysis unit, weighted by the THLB area of each polygon. Yield tables for natural stands will use the default decay, waste and breakage factors contained in VDYP. Once harvested by the model, each analysis unit is assigned to a TIPSY yield table which uses a mean site index calculated for the regenerated species (see section 6.3.1 "Regeneration activities in managed stands" for a complete description of methodology).

[5] http://www.for.gov.bc.ca/hre/becweb/resources/classificationreports/subzones/index.html
[6] http://www.for.gov.bc.ca/his/results/fsp_sss.htm

5. Timber Harvesting Land Base Definition

This part of the data package outlines the steps used to identify the forest management land base, gross harvesting land base and timber harvesting land base.

The forest management land base (FMLB) is the portion of the total area with forest cover that contributes to Crown forest management objectives in the context of TSA timber supply, such as landscape-level biodiversity or visual quality objectives. The FMLB excludes:

- private land
- federal reserves
- long-term leases
- area-based forest tenures
- non-forested lands.

The gross harvesting land base (GHLB) is the portion of the FMLB where timber harvesting is permitted, subject to forest management objectives and constraints. The GHLB excludes:

- miscellaneous provincial crown land not contributing to timber supply
- federal and provincial protected areas
- areas with legally established boundaries where timber harvesting is incompatible with management objectives for other resource values.

The timber harvesting land base (THLB) is the portion of the GHLB where timber harvesting is projected to occur over the long term. The THLB excludes:

- areas that are not suitable or uneconomic for timber production; and
- areas without legally established boundaries where timber harvesting is incompatible with management objectives for other resource values.

Land is considered outside the THLB only where harvesting is not expected to occur. Any area in which some timber harvesting will occur remains in the THLB, even if the area is subject to other management objectives, such as wildlife habitat and biodiversity. These objectives are modeled in the timber supply analysis. The FMLB outside of the THLB contributes to these other objectives.

Community Forest Agreements are usually excluded from the FMLB and the THLB because they have their AAC set by a separate process. However, this analysis will consider the Wetzink'wa Community Forest Agreement to be part of the FMLB because its large area makes significant contributions to landscape unit objectives. Section 6.4.1, "Summary of forest cover requirements", describes how the Wetzink'wa Community Forest Agreement contributes to these objectives.

The current timber harvesting land base may increase in size over time in the following situations:

- where management activities improve productivity or operability (e.g., the stocking of land currently classified as non-commercial brush with commercial tree species);
- through the acquisition of productive forest land (e.g., timber licence reversions).

or decrease in size where:

- where management activities prevent the reestablishment of a productive forest (e.g.,future permanent roads).

5. Timber Harvesting Land Base Definition

5.1 Forest Management Land Base Exclusions

5.1.1 Private and alienated Crown land

Land is excluded from the forest management land base when it does contribute to TSA objectives for wildlife habitat, biodiversity or visual quality in the context of timber supply. Such land includes private land, municipal land, federal land and Indian Reserves.

A spatial data set of land ownership was developed using information from the Crown Land Registry and the Integrated Cadastral Information Society. Table 3 shows the contribution of each ownership to the forest management land base and the gross harvesting land base..

Table 3. Ownership contributions

Ownership Code	Forest Management Land Base	Gross Harvesting Land Base
40 Private – Crown Grant	No	No
50 Federal Reserve	No	No
52 Indian Reserve	No	No
60 Crown Ecological Reserve	Yes	No
61 Crown UREP (Use, Recreation and Enjoyment of the Public) Reserves	Yes	Yes
62 Crown Forest Management Unit (TSA)	Yes	Schedule C: Yes Schedule N: No
63 Crown Provincial Park Class A	Yes	No
69 Crown Miscellaneous Reserves	Yes	Schedule C: Yes Schedule N: No
77 Crown and Private Woodlot Licence	No	No
79 Community Forest	Yes	No
99 Crown Misc. lease	No	No

Data source and comments:

Table 3 shows information used in section 5.1.2, "Area-based forest tenures", and section 5.2, "Gross Harvesting Land Base Exclusions".

5.1.2 Area-based forest tenures

Area-based forest tenures such as Community Forest Agreements and Woodlot Licences are removed from the forest management land base because they have their AAC determined independently of the timber supply review process for the TSA. These areas are listed in Table 3.

The Wetzink'wa Community Forest makes significant contributions to landscape unit objectives in the TSA. It is removed from the forest management land base, but it is included in the timber supply model to ensure that that these contributions are recognized. Harvesting in the community forest is tracked separately from harvesting in the rest of the TSA. This is accomplished by determining the THLB for the community forest according to land base removal criteria described in subsequent sections. Harvesting of this area is tracked separately from harvesting in the rest of the TSA. See Section 4.1, "Management Zones" and Section 6.1.4 "Harvest scheduling priorities".

5. Timber Harvesting Land Base Definition

5.1.3 Non-forest areas

Table 4 shows the criteria used to remove non-forested areas, non-productive forest and non-commercial cover from the THLB.

Table 4. Description of non-forest areas

Attributes	Description
Bulkley VRI BCLCS level 1 equal to '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 OR Crown Closure Layer 1+2 < 20% and no logging history	forested but does not contribute to biodiversity and habitat objectives
Existing roads, trails and landings	See section 5.3.11 "Roads, trails and landings"

Data source and comments:

The Bulkley forest inventory consists of original Vegetation Resource Inventory (VRI) data.

B.C. land classification system (BCLCS) attributes identify non-vegetated and various classes of vegetated areas. Non-vegetated, non-treed and alpine areas are removed from the FMLB unless they have been logged. They do not contribute to objectives for wildlife habitat or biodiversity.

Some area is comprised of forest with no harvest history, and very low height or crown closure attributes. These areas are excluded from both the FMLB and THLB, because their poor height and crown closure attributes were determined to be unsuitable for achievement of landscape-level biodiversity and wildlife habitat objectives[7].

As Table 4 indicates, "logging history" is a key factor in FMLB definition. To address Bulkley VRI data gaps and anomalies around silviculture openings, a combination of VRI attributes and a specially created "depletion layer" (see section 6.3.4 "Not satisfactorily restocked areas") was used to identify these areas:

- OPENING_IN (Opening Indicator) = "Y"
- HARVEST_DA (Harvest Date) is not null
- LINE_7B_DI (Disturbance portion of History Symbol) is like "L"
- OPENING_ID (Opening Identifier) > 0
- NON_FOREST = "NSR"
- OPEN_REC (Assigned Status, from depletion layer) is not null

[7] These CFLB cutoff values are consistent with a 2011 Bulkley Higher Level Plan Order Analysis project which involved (amongst other deliverables) defining a CFLB suitable for achieving landscape-level biodiversity objectives. To serve this project, licensees consolidated [areas of past logging disturbance not appearing in VRI], and [areas of proposed harvest] into a CFLB "validation file". They ran CFLB iterations, exploring attributes including projected height, crown closure, basal area, BCLCS levels and stand density. The "validation file" was used to check CFLB iterations for anomalies (i.e. areas that were not picked up as CFLB).

Height and crown closure VRI attribute data were determined to be the most consistently collected in the VRI file – parameters for these attributes were adjusted to the highest levels that permitted inclusion of all anomalies in CFLB."

5. Timber Harvesting Land Base Definition

5.2 Gross Harvesting Land Base Exclusions

Areas are removed from the gross harvesting land base where harvesting is not permitted. These include Crown parcels with ownership codes 62N and 69N and protected areas (Table 3). Also excluded are the Special Management Zone 1 areas established by the Bulkley LRMP Higher-Level Plan Order (2000) (RMZ_TYPE2 = 'SMZ1') .

Harvesting is permitted in Crown UREP areas (ownership code 61) (Table 3). The portions of these areas captured within recreation reserves are subject to partial netdown (see section 5.3.2 "Areas with high recreational values"). Harvesting is also permitted in agricultural land reserve (ALR) areas, which have ownership code 62C.

5.3 Timber Harvesting Land Base Exclusions

5.3.1 Environmentally sensitive areas

Table 5 shows the criteria and proportion of area considered to be unavailable for timber harvesting due to their environmental sensitivity.

Table 5. Description of Environmentally Sensitive Areas

Category	Description and Criteria	Reduction (%)
Regeneration issues	Ep1 and Ep2 from ESA mapping (ESA_1 = "P" or ESA_2 = "P")	100
Avalanche tracks	PEM site series 51 (SITE_S1 = "51")	100
Highly unstable soils	Terrain Stability Mapping (TSM) Class V: Unstable terrain (SLPSTB_CLS = "Class 5") and no logging history	94
Moderately unstable soils	TSM Class IV: Potentially unstable terrain (SLPSTB_CLS = "Class 4") and no logging history	89
Unstable soils where TSM does not exist	"HIGH" and "VERY HIGH" Soil Erosion Potential (ERO_PROXY = "H" or "VH") and no logging history	97
Telkwa Bulbous Toe	OWN_NAME = "Telkwa Bulbous Toe"	100
Alluvial Fans	FAN = "FAN" and no logging history	40

Data source and comments:

Most environmentally sensitive area categories from the 1970's-era Environmentally Sensitive Areas (ESA) inventory - snow avalanche, sensitive soils, regeneration issues, recreation, wildlife, water, and fisheries - can now be better represented spatially using more current and detailed inventories.

The exception is areas with **regeneration issues** (Ep1 and Ep2). District staff spatially overlaid Ep polygons from ESA mapping over RESULTS openings and determined there was virtually no overlap, signaling that these areas are possibly avoided during cutblock layout. District staff then verified that Ep areas are predominately within the FLMB – i.e. are not excluded as non-forest, non-productive forest or non-commercial forest – and consequently elected to exclude 100% of Ep area from THLB.

Snow avalanche tracks, identifiable as site series 51 from Bulkley Predictive Ecosystem Mapping (PEM), have significant stability and regeneration concerns. They are 100% excluded from THLB.

5. Timber Harvesting Land Base Definition

Unstable soils: areas of highly unstable soils are generally unsuitable for harvesting or road construction, due to high likelihood of landslide initiation. Class V polygons from Terrain Stability Mapping (TSM) are used to represent areas of highly unstable soils. A portion of Class V polygons was previously harvested and successfully reforested, indicating that the extent of Class V terrain is likely over-estimated. District staff determined an appropriate reduction % for Table 5 using the following technique:

- the proportion of Class V area in operable land base that was harvested within last 30 years was determined;
- the proportion of Class V area in operable land base that may be harvested over next 100 years (i.e. from TSR2 base case, the future time by which the THLB will be fully comprised of managed stands) if current Class V depletion rates hold steady was then calculated using a ratio i.e. (% harvested over next 100 years) = (% harvested last 30 years x 100 years) / 30 years);
- the reduction % is set to {100% - (proportion estimated to be harvested next 100 years)}
- the reduction % is treated as a non-spatial percent reduction to the area of each Class V polygon

Areas of moderately unstable soils may be at least partially unsuitable for harvesting, due to a moderate likelihood of landslide initiation. Class IV (potentially unstable terrain) polygons from TSM are used to represent moderately unstable soils. The Table 5 reduction % for Class IV terrain was determined using the same process as that employed for Class V.

For areas without TSM, the extent of areas of unstable soils was approximated. District staff completed a GIS-based soil erosion potential mapping project, using a process documented by Madrone Consultants Ltd. which interprets terrain and soil mapping, landform mapping, and slope class attributes into soil erosion potential classes. Areas of VERY HIGH and HIGH soil erosion potential were used to represent unstable soils in areas where TSM has not been completed.

- **HIGH:** all fluvial, colluvial and morainal surface material on slope codes 4, 5 or 6. If gullying present, a HIGH rating was given for slopes codes 4, 5 or 6 regardless of surface material. The same was generated for avalanche areas.
- **VERY HIGH:** all fluvial surface material on slope codes greater than 7; all morainal and colluvial surface materials on slope codes greater than 8. If gullying present, a VERY HIGH rating was given for slope codes greater than 7 regardless of surface material. The same was generated for avalanche areas.

The Table 5 reduction % for HIGH and VERY HIGH soil erosion potential areas was determined using the same process as that employed for Class V terrain.

The Telkwa Bulbous Toe is a known and mapped area of highly unstable soils on shallow slopes that is not completely picked up through TSM, alluvial fan, or unstable soil proxy mapping. Current management practice is to avoid this area for primary development activities; it is fully excluded from THLB.

Fans have issues including inherent instability and potential for debris torrents that can affect road integrity and reforestation success. Fans are treated sensitively, but not avoided during primary forest development activities. The Table 5 reduction % for fans was determined using the same process as that employed for Class V terrain.

Reductions for other environmentally sensitive categories - wildlife, water, and fisheries - are addressed in section 5.3.6 “Wildlife habitat” and section 5.3.9 “Riparian reserve and management areas”.

5. Timber Harvesting Land Base Definition

5.3.2 Areas with high recreation values

Recreation reserves administered by the Ministry of Forests, Lands and Natural Resource Operations (i.e. commercial and other designated recreation reserve areas, and forest recreation sites, as identified in Table 6) are partially removed from the THLB. These large area-based sites and reserves are managed in an integrated fashion that permit a certain level of harvest: it was determined that a partial netdown of 25%, applicable by individual recreation polygon, reasonably approximates harvest practice in these areas.

Trail corridors (REC_TYPE = "RTR") are permitted to contribute to THLB. Licensees may harvest in trail corridors, subject to practices including moving the trailhead to the edge of mature timber and ensuring trail beds are maintained or restored post-harvest.

Visually Sensitive Areas (VSA's) with a Preservation Visual Quality Objective (VQO) are recreationally important – consistent with the definition of "Preservation VQO" they are removed from the THLB. Forest cover constraints associated with Retention, Partial Retention, and Modification VQO's are described in section 6.4.7 "Visual quality objectives".

Table 6. Recreational Values

Category	Attributes	Reduction (%)
Visually Sensitive Areas	VQO = Preservation	100
Recreation	recreational reserves (REC_TYPE = "RR" or "SIT")	25

5.3.3 Inoperable areas

Areas are considered inoperable where there are physical barriers or limitations to harvesting, where appropriate logging methods (e.g. cable) are not available or are deemed to be too costly, or where stands are not merchantable (low value or high cost). The first factor listed is an example of physical operability or accessibility. The last two factors listed are examples of economic operability. Changing technology and economic conditions can affect both physical and economic operability. Table 7 lists the operability classes that are excluded from the THLB.

Table 7. Description of inoperable areas

Within "Woodlands" BEC Subzone [8]	Harvest Method	Stand Quality	Reduction (%)
Yes	All	All	100
No	I	All	100
No	C, H	M, P	100

Data source and comments:

A new "woodlands" biogeoclimatic subzone has been spatially mapped for Bulkley TSA. Local climate conditions and soil moisture levels in this area are considered too harsh to permit successful reforestation following harvest. The lower elevational edge of this subzone is used to represent the maximum upper ecological extent of the THLB.

[8] Where BECLABEL from (nonstd_pem) = ESSFmcw or ESSFmkw or ESSFwvw or MHmm2w

5. Timber Harvesting Land Base Definition

A GIS-based Harvest Method Mapping (HMM) approach is employed for spatially grouping the Bulkley Timber Supply Area forested land base into combinations of Harvest Method and Stand Quality types. These types are essentially a modeled proxy for licensee Total Chance Plan harvest "chances", and aid in defining the extent of the physically operable and economically feasible land base below the maximum upper ecological extent. Table 8 and Table 9 describe HMM codes and their parameters[9].

Harvest Method type "I" is excluded from THLB for reasons of physical inoperability. Combinations 'CM', 'CP', 'HM' and 'HP' are excluded from THLB for reasons of economic inoperability – these areas account for less than 0.7% of total historic TSA harvest.

Table 8. Harvest Method Mapping "Harvest Method" and "Stand Quality" Codes and Descriptions

'Harvest Method' codes	'Stand Quality' codes
G - ground systems	**S** – "sawlog" (sawlog-quality grades predominate)
C - cable systems	**M** – "marginal sawlog" (small piece size, primarily high elevation stands; sawlog-quality grades predominate)
H - cable/helicopter systems	**P** – "pulp" (pulp-quality grades predominate)
I - inaccessible, forested	**PFT –** problem forest types

Table 9. Parameters for Harvest Method Mapping Codes

Harvest Method	Slope Parameters	Stand Quality	Description of Parameters[10]
G	≤ 35%	S	(1) Pine and spruce-leading polygons (ITG 21-31) outside planning cell C7; (2) Fir-leading polygons (ITG 18-20) > 24m height at 140 years, and site class medium or good; (3) All silviculture openings with a harvest history.
C	> 35 < 60%		
H	≥ 60 < 90%	M	(1) All sawlog quality timber in planning cell C7; (2) Fir-leading or fir-spruce polygons (ITG 18, 20) that are: - 19.5 to 24 metres in height at 140 years, OR - site class poor, height class 3, OR - site class medium < 24 metres
I	≥ 90%		
		P	(1) All mature hemlock-leading polygons (ITG 12, 14-17); (2) All mature fir or spruce-leading polygons (ITG 19, 23) with >40% hemlock component; (3) All amabilis fir-leading polygons within the CWH
		PFT	(1) Deciduous-leading stands; (2) Coniferous stands on low productivity sites (site class low); (3) Coniferous stands with density problems that prevent achievement of minimum harvest criteria.

5.3.4 Sites with low timber growing potential

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. As these stands are not considered to be harvestable, unless there is previous harvest history they are removed from the THLB using the criteria listed in Table 10.

[9] These parameters have been revised from those used in the Bulkley TSR2 process for better consistency with those used to originally define Bulkley's stand-quality based AAC partition, circa 1995.

[10] Coding is reliant on attributes of Inventory Type Group (ITG) and Site Class. These attributes were carried in the previous Forest Cover Inventory but not the new Vegetation Resources Inventory, so were recreated for this analysis.

5. Timber Harvesting Land Base Definition

Table 10. Description of Sites with Low Timber Growing Potential

Description	Leading Species	Characteristics			
		BCLCS Level 4	BCLCS Level 5	Site Index	Reduction (%)
Low Site Class	Fir			< 8	100
	Hemlock			< 8	100
	Pine			< 7.5	100
	Spruce			< 7.5	100
Stocking problems	All	TC (treed-coniferous), TM (treed-mixed)	SP (sparse)	All	100

Data source and comments:

Sites with low timber growing potential include existing forested stands that are unlikely to achieve minimum stand volume criteria as described in section 6.1.3 “Minimum harvestable ages” prior to decadence. These can be categorized as “low” site class sites. The site index range by leading species in Table 10 was selected to define “low” site class for HMM coding, and is consistent with the low to poor site class split by species from the VDYP Batch Users Guide.

- Based on an analysis completed in support of the AAC Determination process associated with the 2001 analysis, historical harvest in ‘low’ site class stands accounted for only 1.3% of all historic harvest. This minimal harvest occurred in the site index 7-8 range.

Mature treed sites with low levels of stocking are also unlikely to achieve minimum stand volume criteria. These were previously identified using Stocking Class Codes. Because these codes are not carried by the new Vegetation Resources Inventory, BCLCS Level 4 and 5 criteria for treed, coniferous sites with sparse (i.e. less than 25%) cover are used as a proxy.

5.3.5 Problem forest types

Table 11 describes types that are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. They are wholly excluded from the THLB.

Table 11. Problem Forest Types Criteria

Description	Reduction (%)
Deciduous-leading stands	100
Black Spruce-leading stands	100
Remaining HMM Stand Quality = “PFT”	100

Data source and comments:

Currently, neither deciduous-leading nor black spruce-leading stands are targeted for harvest in Bulkley TSA.

The HMM “PFT” Stand Quality category includes deciduous-leading stands, coniferous stands on low productivity sites, and coniferous stands with density problems that prevent achievement of minimum harvest criteria. These stands should already be excluded from THLB as the result of exclusions described in sections 5.3.1 “Environmentally sensitive areas”, 5.3.3 “Inoperable areas”, 5.3.4 “Sites with low timber growing potential”, and 5.3.5 “Problem forest types”. Any remaining PFT stands are removed at this stage.

5. Timber Harvesting Land Base Definition

5.3.6 Wildlife habitat

Wildlife habitat may be identified and managed through several processes including the *Identified Wildlife Management Strategy (IWMS),* identification and approval of ungulate winter range (UWR) and wildlife habitat areas (WHA), and management practices specified in plans that establish legal objectives.

Bulkley TSA has no legally established UWR's or WHA's, so there are no land base reduction for wildlife habitat except for mountain goat as described below. However, public processes that are either recently completed or currently underway may lead to establishment of both WHA and UWR in the near future.

- A public process around establishment of "Wildlife Habitat Area #6-333: Northern Caribou – Skeena Stikine, Morice TSA's" is nearing completion. When legalized, the Order will establish a new core no-harvest area, impose new seral constraints, and require modified harvesting practices within an expanded Telkwa Caribou Herd Recovery Area. A sensitivity analysis tests timber supply impacts (see 7.0, Sensitivity Analysis).
- The Bulkley Valley Sustainable Resource Management Plan (BVSRMP) was approved as government policy in 2005. This plan identifies objectives for mapped Wildlife Habitat Management Areas (WHMA's), and indicates that the Ministry of Environment (MoE) may in future establish portions of WHMA's as UWR. MoE (Skeena Region) staff advise that because the BVSRMP was established through a public process and mapped WHMA's were included in the plan, UWR within WHMA areas may be established quickly without additional public process. UWR's will be considered in a future analysis if and when established.

Bulkley TSA has mapped areas of high-value wildlife habitat with legal objectives set by government (OSBG) for grizzly bear, moose, mountain goat, mule deer and caribou.

With respect to moose and mule deer habitat, Forest Stewardship Plans (FSP's) commit to actions that do not result in additional land base exclusions or increased forest cover constraint (e.g. retention of non-merchantable stems as visual screening for cutblocks; access control; maintenance of deciduous in WTP's; placement of WTP's on or adjacent to south-facing slopes).

Forest cover constraints for mapped grizzly bear and caribou habitat are described in section 6.4.1, "Summary of forest cover requirements".

High-value mountain goat habitat was mapped in areas that were outside the THLB when strategic planning occurred. The THLB has since expanded and now overlaps mapped habitat.

- These mapped areas represent core mountain goat winter range. Harvest within mapped areas has been incidental (representing 0.2% of all historic harvest). Per Table 12, these areas can reasonably be excluded from THLB for reasons of current management practice.

Northern goshawk is an IWMS species that was once provincially blue-listed (of special concern) but is presently yellow-listed (not at risk). There are mapped nesting locations within the TSA. No wildlife habitat reductions are made for goshawks - licensees protect nesting locations by ceasing operations during critical life cycle periods, protecting within wildlife tree patches and other reserves, or by avoidance during road and cutblock layout.

Table 12. Wildlife Habitat Exclusions

Description	Reduction (%)
Mountain goat habitat (SPECIES = "G")	100

5. Timber Harvesting Land Base Definition

5.3.7 Cultural heritage resources

Cultural heritage features in the Bulkley TSA include traditional use sites and archaeological features. Known features (e.g. major grease trail networks; significant clusters of culturally modified trees), and areas with cultural heritage resource (CHR) potential, have been compiled into a local Cultural Heritage and Archaeological Resources Inventory (CHARI). This inventory is updated as new information becomes available.

Pre-1846 archaeological features are protected under the *Heritage Conservation Act*. Licensee practice around pre-1846 features is to have areas assessed by a professional archaeologist, and where possible and appropriate to proceed with harvest under provisions of site alteration permits obtained through authority of *Heritage Conservation Act*. This generally affects the timing of harvest but does not prevent it.

Additionally, licensees use CHARI to advise intensity of CHR reconnaissance and 1st Nations information sharing, and to design, locate and time forest operations to protect CHR's. Modifications to operations include incorporating features into riparian and wildlife tree reserves, excluding areas from block boundaries, stubbing culturally modified trees above markings, and deferring or ceasing harvesting.

In summary, CHR values are generally accommodated without additional THLB reductions.

Local First Nations emphasize that their interests go well beyond individual CHR features. They include maintaining the productive capacity of the land and its resources, including biodiversity, wildlife, fish, water, timber and plants.

The Province and the Gitxsan First Nations are presently engaged in land use planning in the Gitsegukla Watershed, which overlaps the Copper Landscape Unit. Negotiations for the Gitsegukla SRMP began in late 2010, but they have not concluded. The timber supply impact of proposed management zone mapping will be assessed in a sensitivity analysis (see section 7.0, "Sensitivity Analysis").

5.3.8 Exclusion of specific, geographically defined areas

Table 13 describes additional areas to be excluded from the timber harvesting land base to account for area exclusions not discussed in previous sections.

Table 13. Exclusion of specific, geographically defined areas

Description	Attributes	Reduction (%)
Research Installations	PROJ_KEY = not <null>	100
Red-Listed Ecological Communities in Core Ecosystems, and in Copper River SMZ2	FEN = 'CE' or RMZ_SUB = '12-2' for red-listed ecological communities listed in Table 14	100
Blue-Listed Ecological Communities in Core Ecosystems	FEN = 'CE' for blue-listed ecological communities listed in Table 14	100
Blue-Listed Ecological Communities in Copper River SMZ2	RMZ_SUB = '12-2' for blue-listed ecological communities listed in Table 14	70

Data source and comments:

A Government Actions Regulation (GAR) process was initiated then discontinued for the protection of research installations, growth & yield plots, and permanent sample plots. These areas and their forested buffers have instead been established as map notations which flag electronically during government and industry conflict checks.

Current management practice is to avoid research installations and not include in WTP or other reserves, because they are managed for research purposes so are not "representative" of the natural forest over a

rotation. Growth and yield plots and permanent sample plots are intended to be "representative" thus are retained in the THLB.

Bulkley TSA has objectives set by government to manage for red- and blue-listed ecological communities in areas identified in Table 14. Licensees manage at an operational level by avoiding, incorporating into wildlife tree patches and other reserves, or by partial harvesting. Specific exclusions are described in Table 13. Table 14 lists the red- and blue-listed ecological communities that are known to occur in Bulkley TSA, and provides identifying criteria where available. Those with identifying criteria will have reduction criteria applied per Table 13.

Table 14. Red- and blue-listed ecological communities

Description	Red or Blue	Attributes
(a, b) CWHws2/02	Red	Moist_Cls = 'CWH-dry'
(a) CWHws2/03	Blue	
(a, b) CWHws2/04	Blue	
(b) CWHws2/06	(Blue)	
(a, b) CWHws2/07	Blue (Red)	CLASS = 'FP' and R_E_CODE = '22'
(a, b) CWHws2/08	Blue	CLASS = 'FP' and R_E_CODE = '9'
(b) CWHws2/10	(Blue)	Moist_Cls ='CWH-wet'
(b) ESSFmc/02	(Blue)	
(a, b) ESSFmk/02	Blue	Moist_Cls = 'ESSFmk-dry'
(a, b) ESSFmk/03	Blue	
(b) ESSFwv/02	(Blue)	
(a, b) ICHmc1/02	Blue	Moist_Cls = 'ICHmc1-dry'
(b) ICHmc1/05	(Recommend Blue)	
(b) ICHmc1/06	Blue	Moist_Cls = 'ICHmc1-wet'
(a, b) ICHmc2/02	Blue	Moist_Cls = 'ICHmc2-dry'
(b) ICHmc2/05	(Recommend Blue)	
(b) ICHmc2/06	(Recommend Blue)	
(b) ICHmc2/07	Blue	Moist_Cls = 'ICHmc2-moist'
(b) ICHmc2/08	(Recommend Blue)	Moist_Cls = 'ICHmc2-wet'
(b) ICHmc2/53	(Recommend Blue)	
(a, b) ICHmc2/54	Blue	
(a, b) SBSdk/02	Blue	
(b) SBSdk/07	(Recommend Red)	Moist_Cls = 'SBSdk-moist' or (CLASS = 'M' and R_E_CODE = '14')
(b) SBSdk/08	(Red)	Moist_Cls = 'SBSdk-moist' or (CLASS = 'FP' and R_E_CODE = '8')
(a) SBSdk/09	Blue	
(a, b) SBSdk/81	Red	CLASS = 'NF' and R_E_CODE = '21'
(a, b) SBSdk/82	Red	CLASS = 'NF' and R_E_CODE = '6'
(b) SBSmc2/03	(Blue)	
(b) Miscellaneous noteworthy communities	(Recommend Blue)	(CLASS = 'M' and R_E_CODE = '0') or (CLASS = 'NF' and R_E_CODE = '0' or '18' or '29') or (CLASS = 'W' and R_E_CODE = '31')

5. Timber Harvesting Land Base Definition

Data source and comments:

(a) Source: Ministry of Environment "BC Species and Ecosystems Explorer" (http://a100.gov.bc.ca/pub/eswp/)

(b) Source: Haeussler, Sybille. 1998. Rare Plant Communities and Plant Species within the Bulkley portion of the Bulkley-Cassiar Forest District. 32 pp.

5.3.9 Riparian areas

Table 15 lists the area reductions to be applied to account for riparian reserve zones and riparian management zones along streams and around lakes and wetlands.

Table 15. Riparian Management Areas

Description	Class	Reserve Zone Width (metres)	Management Zone Width (metres)	RMZ Reduction (%), BCTS Operating Areas	RMZ Reduction (%), PIR and CanFor Operating Areas
Streams	S1-A	0	100	20	5
	S1-B	50	20	20	25
	S2	30	20	20	25
	S3	20	20	20	25
	S4/S5	0	30	10	5 (70% in Reiseter SMZ2)
	S6	0	20	0	5 (100% in Reiseter SMZ2)
Wetlands	W1/W5	10	40	10	25
	W3/W4	0	30	10	5
Lakes	L1	10	20	10	25
	L3/L4	0	30	10	5

Data source and comments:

A GIS project was conducted to approximate riparian reserve zones and riparian management zones for streams, lakes, and wetlands. Each stream, lake, and wetland class was spatially identified, then buffered in accordance with Table 15 criteria[11] to create a reserve zone and management zone.

Corporate Watershed Base (CWB) files from the Land and Data Warehouse (LRDW) were used as source files for Bulkley stream, lake and wetland spatial features. CWB stream files are identical to TRIM 1. CWB lake and wetland files are more comprehensive than TRIM 1; this linework is largely although not fully reflective of lakes and wetlands linework carried in the new Vegetation Resources Inventory.

S1-A rivers were manually selected from the CWB stream file. They include Babine River, Bulkley River, Canyon Creek, Harold Price Creek, Nichyeskwa Creek, Nilkitkwa River, Telkwa River, and Zymoetz (Copper) River. S1-B, S2-S6 waterways, and lakes and wetlands were selected using appropriate feature codes (e.g. S2 - WA24111120; S3 - GA24850000; S4/S5 - GA24850150; S6 - GA24850140).

Full exclusion of riparian reserve area from THLB is required under the *Forest Planning and Practices Regulation*. Riparian management zone area is partially excluded: RMZ Reduction (%) refers to the percentage of basal area that is removed from THLB within those areas.

[11] The logic for grouping S4/S5 streams is based on feature coding, management zones as they are identified in *"Riparian Management in BC; An Important Step Towards Maintaining Biodiversity, Working Paper 13, 1995 – MOF Research Program"*.

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The reduction percentages in Table 15 are extracted or interpreted from major licensee (BC Timber Sales, Pacific Inland Resources, and Canadian Forest Products Ltd.) commitments within current Forest Stewardship Plans. Within Reiseter SMZ2, PIR committed to a 20 metre RRZ for all S4, S5, and S6 streams. This commitment was not modeled in the original GIS project: it is approximated by requiring a higher RMZ reduction % for S4, S5, and S6 streams within Reiseter SMZ2.

Because riparian buffers will be converted to a buffer-area attribute of the affected polygons (versus being treated as spatial entities), discrepancies of CWB water feature linework from VRI linework is not viewed as a concern.

5.3.10 Wildlife tree retention

Bulkley LRMP Objectives Set by Government. (2006) provides legal targets for wildlife tree retention by landscape unit and BEC subzone, and for certain management zones, as a percent of cutblock area. Those targets are shown in Table 16.

Table 16. Reductions for wildlife tree retention in cutblocks

Landscape Unit or Applicable Area	BEC Variant	Reduction (%)
Telkwa Landscape Unit (LU)*	CWHws2	3
Copper LU	CWHws2	5
Copper, Deep Creek, Nilkitkwa, Reiseter LU's	ESSFmc	1
Babine, Blunt, Harold Price, Telkwa, Torkelson LU's	ESSFmc	3
Bulkley Valley*, Chapman LU's	ESSFmc	5
Telkwa LU	ESSFmk	1
Corya, Harold Price, Telkwa, Trout Creek/ Kitseguecla LU's	ESSFwv	1
Copper LU	ESSFwv	3
Harold Price LU	ICHmc1	1
Bulkley Valley, Corya LU's	ICHmc1	3
Reiseter, Trout Creek/ Kitseguecla LU's	ICHmc1	7
Harold Price LU	ICHmc2	1
Trout Creek/ Kitseguecla LU	ICHmc2	3
Bulkley Valley, Corya, Reiseter LU's	ICHmc2	5
Copper LU	MHmm2	1
Deep Creek, Trout Creek/ Kitseguecla LU's	SBSdk	1
Reiseter, Telkwa LU's	SBSdk	3
Bulkley Valley LU	SBSdk	5
Trout Creek/ Kitseguecla LU	SBSmc2	1
Deep Creek LU	SBSmc2	3
Copper, Nilkitkwa, Reiseter LU's	SBSmc2	5
Babine (outside Babine SMZ2 within PIR Forest Development Unit), Blunt, Bulkley Valley, Harold Price Telkwa, Torkelson LU's	SBSmc2	7
Chapman LU	SBSmc2	11
Babine SMZ2 within PIR Forest Development Unit	SBSmc2	34

* Telkwa and Bulkley LU's have additional retention requirements which amount to harvest deferrals. See Table 36 in Section 7 "Sensitivity Analysis" for details.

Data source and comments:

5. Timber Harvesting Land Base Definition

The Table 16 reduction % values for Landscape Units are the result of detailed calculations for each combination of landscape unit and biogeoclimatic subzone, conducted in accordance with procedures set out in the *Landscape Unit Planning Guide*. These values account for the proportion of each landscape unit and subzone that is in the THLB, and the proportion of this THLB that has been harvested without any wildlife tree retention.

BCTS and PIR Forest Development Units include separate and distinct portions of the Babine Special Management Zone (SMZ2). The licensees are committed to different Forest Stewardship Plan (FSP) strategies for achieving SMZ objectives. PIR's strategy is addressed in this section. BCTS' strategy is addressed in section 6.4.1 "Summary of forest cover requirements".

PIR's FSP strategy for Babine SMZ2 is to increase wildlife tree retention on a sliding scale based on cutblock size. A simplified statement of their strategy is captured in the first two columns of Table 17.

Table 17. Wildlife tree retention in cutblocks within certain portions of Babine SMZ2

Cutblock size (ha)	Target #trees/ha >15cm dbh	Corresponding target % retention[1]	Patch size distribution for SBSmc2	Average Babine SMZ2 % retention
Maximum 40	112.5	15	20%	34
Maximum 80	225	29	80%	
Greater than 80	375	49		

[1] Based on TSA average of 770 stems/ha for stands with >15cm DBH

An average retention % for all Babine SMZ2 cutblocks was calculated by converting target #trees/ha to a % retention value, then weighting by the target patch-size distribution for the landscape unit/BEC subzone (Babine SMZ2 is fully within Babine LU and the SBSmc2 BEC subzone).

Within the Telkwa Caribou Herd Recovery Area, licensees have committed to retaining 30% of cutblock area in ESSF BEC subzones, and 20% of cutblock area in SBS subzones.

Most wildlife tree retention is left in the form of wildlife tree retention (WTR) areas. In general, WTR's are in patches 2 ha or larger which are assumed to contribute toward old forest representation. The WTR area reduction is assumed to remain the same from one harvest rotation to the next (although the actual spatial location of WTR's may change after each harvest rotation), so WTR area is removed from the THLB as a permanent percentage reduction to harvested stand area.

5.3.11 Roads, trails and landings

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 THLB. Future RTL reductions are applied to stand area when harvested for the first time by the timber supply model. Table 18 shows the reductions made for existing and future RTL's.

Table 18. Estimates for existing and future roads, trails, and landings

Roads, trails and landings	Spatially Identified	Reduction (%)
Existing	Yes	100
Future	No	3.9

Data source and comments:

Existing roads, trails and landings are removed from the forest management land base as described in section 5.1.3 "Non-forest areas".

5. Timber Harvesting Land Base Definition

Existing roads and trails were aggregated from all known digital sources, merged into one spatial file, and coded by road type (paved, unimproved, etc.). Additional roads showing on 2006 orthophoto imagery were digitized and added. Roads on the spatial file that did not show on the orthophoto were reviewed with District and licensee engineering staff, and non-existing segments were removed.

A polygonal file of realistic road and trail right-of-ways (ROW) was then generated, using the following (GIS-derived average) ROW buffer width by road class:

- Paved roads – 40 metres
- 2 Lane Gravel roads – 30 metres
- 1 Lane Gravel roads – 20 metres
- Unimproved roads – 10 metres
- Trails – 10 metres

A GIS project was also undertaken to generate a spatial file of existing landings. A digital point was placed at the centre of all landings discernible from 2006 orthophoto imagery. These points were expanded to 20 metre width "virtual" landings, where the 20 metres is reflective of the (GIS-derived average) landing width. Areas of overlap with the spatial road ROW file were removed. Spatial road ROW's and landings will be converted to a buffer-area attribute of the adjacent polygons.

Since 1992, Pacific Inland Resources (PIR) has successfully reforested 202 de-compacted landings (totaling 80.4 hectares) across Bulkley TSA[12]. These landings are now not visibly different from the productive forest, so were not included in the spatial landings file.

Estimates for future roads, trails, and landings were derived using RESULTS and GENUS queries of total area of Permanent Access Structure (PAS), as % of gross block area, for all cutblocks harvested in Bulkley TSA from 2000 to 2009.

The result (3.9%) is much lower than the 7% permitted under the *Forest Planning and Practices Regulation*, but on review with major licensees was determined to be realistic and consistent with recent stronger reliance on roadside harvest (i.e. no or few landings).

Licensees submit that the practice of roadside harvest may result in significantly less NP than is reported because most logging is done in winter versus summer, and roadside pile areas are usually burnt and replanted within a season of harvest.

[12] Baxter, Alan. 2002. The Effectiveness of Soil Decompaction on Medium Textured Soils in Northern Interior British Columbia: A Case Study in the Telkwa Watershed. ABCPF Professional Report. 55 p.

6. Current Forest Management Assumptions

6.1 Harvesting

6.1.1 Merchantability limits

The merchantability limits in Table 19 specify the maximum stump height, minimum top diameter (inside bark) and minimum diameter at breast height of harvested tree species. They are used in the analysis to calculate merchantable volume.

Table 19. Merchantability Limits

Species	Minimum stump diameter (cm)	Corresponding minimum DBH (cm)	Maximum stump height (cm)	Minimum top dib (cm)
All Pine	15	12.5	30	10
All other	20	17.5	30	10

Data source and comments:

Table 19 is reflective of current merchantability limits set in Bulkley TSA's forest licenses. These limits are consistent with Interior Timber Merchantability Specifications of the *Provincial Logging Residue and Waste Measurement Procedures Manual*.

The specifications for minimum stump diameter are converted to the nearest corresponding breast height diameter for use with yield models. The specification for minimum top diameter inside bark is ignored because the yield models do not address it.

On April 1, 2006 new log grades were implemented in the BC interior to include all scaled logs in the AAC, regardless of whether they were dead or alive when harvested. The model used to estimate existing stand volume (VDYP) does not account for the dead trees that could potentially be used as sawlogs (dead potential). At this time, the 1997 inventory audit is considered the best source of data regarding dead potential timber in the Bulkley TSA. This information will be presented to the Chief Forester when he makes his AAC determination.

6.1.2 Volume exclusions for mixed species stands

Table 20 identifies any species in mixed species stands that are unmerchantable and are not harvested. The unharvested portion of a stand does not contribute to estimated stand volumes (timber yield curves).

Table 20. Volume Exclusions for Mixed Species Types

Species	Volume Exclusion (%)
Whitebark Pine	100%
Deciduous	100%

Data source and comments

Provincial Harvest Billings System (HBS) records indicate that trembling aspen, cottonwood, and birch billed volumes (including waste) totaled to only 4,060 cubic metres over the past 10 years in Bulkley TSA. It was concluded that deciduous volumes in pure and mixed-species stands can reasonably be excluded from consideration.

6. Current Forest Management Assumptions

Because whitebark pine is most often present in open-grown high-elevation stands, it generally has undesirable piece size and stem characteristics (i.e. branchiness, severe stem taper), so volumes are excluded from consideration. HBS revealed no billings for whitebark pine in past 10 years.

6.1.3 Minimum harvestable ages

The minimum harvestable age is the earliest age at which a stand is considered to be harvestable. While harvesting may occur in stands at the minimum age in order to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decadal changes in harvest levels), most stands are not harvested until well beyond the minimum harvestable ages because of management objectives for other resource values (e.g., requirements for the retention of older forest).

Table 21 shows the criteria used to determine minimum harvestable ages. The timber supply model calculates minimum harvestable ages using height, volume and diameter yield tables for each analysis unit, so minimum harvestable ages are not calculated here.

Table 21. Minimum Harvestable Age Criteria

Leading Species	HMM Stand Quality	Minimum Criteria		
		Height (m)	Diameter (cm)	Volume (m^3/ha)
All	P	21	21	150
All Pine	S, M	18	18	150
All Non-Pine	S, M	-	25	150

Data source and comments:

Minimum harvestable age criteria are consistent with discussions with licensees on desirable average piece size attributes of stands being targeted for a particular grade profile – i.e. stands composed primarily of pulp-quality grades versus stands composed primarily of sawlog-quality grades.

Stand quality refers to the stand quality at the time of harvest in the model. Stand quality may change for stands containing dead pine that becomes pulp quality after 5 years, See section 6.2.6 "Mountain pine beetle" for a description of the HMM+5 stand quality.

"Pulp" stands have not historically been targeted for a particular piece size. Pulp-grade logs are whole-log chipped so piece size is a contributing but not over-riding factor. Licensees advise that were they to target a stand for its average piece size, it would be reasonable to target for 0.3 m^3/piece with an average stem length of 21 metres and a 21 cm stem diameter at breast height (DBH).

Pine-leading stands impacted by mountain-pine beetle are a priority for harvest. Stands with an average piece size of 0.21 m^3 and an average DBH of 18 cm are targeted. Coincidentally piece sizes down to merchantability limits (i.e. down to 12.5 cm DBH for pine) are utilized, scaled and billed.

In absence of new information, criteria from the 2001 TSR analysis were used for "Sawlog" or "Marginal Sawlog" stands of other leading species.

6.1.4 Harvest scheduling priorities

Harvest priorities or minimum harvest levels are set for certain management zones or analysis units to reflect current licensee practices in response to forest health issues, operational pressures and/or license requirements. Table 22 describes harvest scheduling priorities, and states the time period over which this priority applies.

6. Current Forest Management Assumptions

Table 22. Priorities for Scheduling the Harvest

Description	Management Zone or location	Decade	Priority or Harvest Target
All pine-leading stands in accessible areas of MPB infestation	SEVERITY = 'T' or 'L' or 'M' or 'S' or 'V' **AND** IN_1KM = "YES"	1 - 2	Priority 1
All other stands	All	All	Priority 2
Wetzink'wa Community Forest	OWN_SCHED = '79B'	0.5 0.5 - 1.5 1.5 - 25	95,000 m3/year 15,000 m3/year 30,000 m3/year
M/P Partition	Harvest Method Mapping "GM" or "GP", **AND** IN_1KM = "YES"	1 - 6	minimum 41% of annual harvest
	Stand quality "M" or "P"	7 - 25	as much as possible

Data source and comments:

Short-term harvest focus by all licensees is on accessible pine-leading stands that are currently either significantly infested or are already killed by mountain pine beetle (MPB). Licensees advise these stands will be targeted for harvest during the next two decades, to maximum levels permitted by landscape-level biodiversity and other constraints.

The AAC for the Wetzink'wa Community Forest is 30,000 m^3/year, which is consistent with the long-term harvest level determined for the community forest area in a 2006 timber supply analysis. A temporary uplift approved in September 2010 increases the AAC to 95,000 m3, for 5 years starting in 2010. To account for the effect of harvesting in the community forest on landscape-level objectives in the TSA, harvest of 95,000 m3/year is applied in the community forest for the first 5 years, followed by a ten year period during which harvest is decreased to 15,000 m3/year prior to returning to the 30,000 m3/year long-term level. These targets are prorated to create appropriate targets by decade in the timber supply model.

The AAC for the Bulkley TSA is 882,000 m^3/year, with partitions of 520,000 m^3/year for sawlog stands and 362,000 m^3/year for marginal sawlog/pulpwood stands. The current AAC in the base case timber supply model is 852,000 m3/year, which is the TSA AAC minus the Community Forest AAC. The harvest flow objectives used in the analysis are:

- maximize a steady long-term harvest level with stable long-term growing stock
- maintain current AAC as long as possible
- any decline in harvest levels does not exceed 10% per decade.

Bulkley's quality-based partition requires that licensees target 41% of annual harvest to "Marginal Sawlog" and "Pulp" quality (M/P Partition) stands. Although main harvest priority is on MPB-infested stands, licensee intent is still to meet M/P Partition targets over the short-term.

- 2006-2009 partition performance tracking indicates that PIR targeted 39% of total harvest to M/P Partition stands, due primarily to a 2006-2008 increase in pulp prices;
- Review of past 10 years of HBS records for BC Timber Sales shows that with exception of 2001, BCTS had 81+% sawlog in their harvest profile. However, BCTS affirms their intent to achieve the M/S Partition within next two years as they deplete their inventory of MPB-infested stands.

Licensees advise that M/P Partition stands adjacent to existing access will be targeted (defined for this analysis as Harvest Method Mapping "GM" and "GP" within one kilometer of existing roads). There are 72,000 hectares of this type, which would take approximately 9 decades to deplete at 41% of the 2001 analysis long-term annual harvest area rate (2000 hectares/year).

6. Current Forest Management Assumptions

- "Pulp" stands are laid out as Standing Timber Inventory (STI) primarily based on an attempt to achieve a good geographic distribution. These stands remain in STI until pulp commodity prices rise to a level that enables profitable harvest. Because licensees are required to achieve the quality-based partition, when pulp commodity prices are low the stands that are closest to mill and adjacent to existing access are targeted for harvest.

6.1.6 Silvicultural systems

Most harvesting within the Bulkley TSA has employed a "clearcut" or "clearcut with reserves" silvicultural system. There is currently minimal partial cutting occurring, and accounting for these approaches is not warranted at this time.

6.2 Unsalvaged Losses

6.2.1 Wildfire and windthrow

Table 23 shows the estimated average annual unsalvaged volume loss to insect and disease epidemics, fires, wind damage or other agents on the timber harvesting land base. The unsalvaged loss column only reflects those areas in which the volume is not recovered or salvaged.

Table 23. Unsalvaged losses

Cause of loss	Annual total loss (m^3/year)	Annual unsalvaged loss (m^3/year)
Wildfire	2 800	2 600
Windthrow	6 800	5 500
Total	9 600	8 100

Data source and comments:

The last TSR contained unsalvaged loss estimates for mountain pine beetle (MPB). Because of a recent MPB outbreak, a different approach to modeling MPB losses is taken as described in section 6.2.2 "Mountain pine beetle".

The unsalvaged loss assumptions described below were developed for the 2001 analysis, and were found upon review by District staff to be appropriate for this analysis. These unsalvaged losses include losses in the Wetzink'wa Community Forest, which is excluded from the THLB. When the community forest is not excluded from the THLB, it accounts for 4.8% of the total THLB. Therefore, 95.2% of the unsalvaged losses identified in Table 23 (i.e., 7700 cubic metres) will be attributed to the THLB outside of the community forest.

Annual wildfire losses were determined from 1977-1996 Northwest Fire Centre wildfire records. Records indicated a total lost volume of 56,818 m^3, which corresponds to an annual loss of about 2,800 m^3. It is estimated that approximately 10% of this volume is salvaged, which leaves an annual unsalvaged loss of about 2,600 m^3.

Annual windthrow losses were approximated using results of a study conducted by SYMBIOS Research in the 1990's. SYMBIOS assessed data from 51 transects associated with logged blocks, and 56 transects associated with undisturbed forest. They calculated an average background windthrow level of 0.718 m^3/ha in the undisturbed forest, and determined that windthrow associated with cutblock edges accounts for 4.14 m3 per hectare of harvested area. The net increase in windthrow due to harvesting is thus 4.14 - 0.718 = 3.422 m3/ha. At the 2001 analysis long-term annual harvest area rate (2000 hectares/year) this equates to a net annual loss of about 6,800 m3 that is not accounted for by the inventory.

6. Current Forest Management Assumptions

It is estimated that 20% of cutblock edge-induced windthrow is salvaged, leaving an annual unsalvaged loss of about 5,500 m3. Windthrow associated with catastrophic wind events is likely to be salvaged so was not included in this analysis.

Balsam Bark Beetle

The last TSR contained an unsalvaged loss estimate for balsam bark beetle. Study results gathered and analyzed to date indicate that VDYP yield curves accurately address losses, and therefore no additional volume reductions are required. The regional entomologist is currently conducting a study to determine the degree to which this is true. Although study areas are located in Kispiox, Morice and Lakes TSA's, results are applicable to Bulkley TSA.

Pests of Young Stands (POYS); *Tomentosus* Root Rot

The last TSR contained an unsalvaged loss estimate for *Tomentosus* root rot. However, POYS (e.g. hard stem rusts, leader weevils) and *Tomentosus* occur sporadically in Bulkley plantations. In the absence of localized loss data, losses towards maturity due to POYS, and decreased growth attributable to *Tomentosus*, are assumed to be accounted for through a 5% Operational Adjustment Factor (OAF2) applied to TIPSY yield curves (section 6.3.1 "Regeneration activities in managed stands").

6.2.2 Mountain pine beetle

Pine volumes comprise approximately 25% of the Bulkley inventory. Pine-leading stands are unevenly distributed in the TSA. Extensive concentrations occur in certain landscape units (Babine, Torkelson, Deep Creek, Chapman , Reiseter, Harold Price, Nilkitkwa, Telkwa, Copper, Kitseguecla/Trout), but concentrations are scattered in remaining units (Bulkley Valley, Corya, Blunt). Mountain Pine Beetle (MPB) has historically been present in the TSA at endemic levels.

Until 2003, MPB infestation areas were localized and treatable. Detailed aerial overview surveys were conducted annually and infestation centres were marked by GPS waypoint. Waypoints were coded and successfully treated as "fall and burn", "small-scale salvage", "harvest" or "no treatment".

Since 2003, a major MPB epidemic centred in the BC interior has been occurring. Fortunately, strong westerly prevailing winds slowed spread into Bulkley TSA. Provincial Forest Health Overview Survey flights reveal that spread of the epidemic did occur from 2003-2008 in south and east central Bulkley landscape units, resulting in significant pine mortality.

However, since 2008 the spread of the epidemic through Bulkley TSA has slowed considerably. It is also understood that the MPB epicentre has started to collapse.

- 2009 detailed aerial overview surveys with follow-up transect and waypoint-based ground probing revealed that concentrations of Babine, Torkelson, Harold Price, and Blunt LU pine-leading stands are being affected by pockets of infestation as opposed to a continuous wave of attack.
- beetle management unit designation flights conducted in 2009 and 2010 over the entire TSA revealed very few units with extensive new spread, with exception of certain concentrations within Nilkitkwa, Harold Price, Trout Creek, and Telkwa.

For the base case, it is assumed that Bulkley TSA current infestation levels will stay static – i.e. Bulkley will not experience future waves of attack from the MPB epicentre. Infestation levels will revert to previous endemic status within next 2 decades, with the exception of a few infestation pockets.

It is assumed that major licensees will target all currently infested, red or dead sawlog potential Pli-leading stands for harvest over the next 2 decades to maximum levels permitted by land base constraints. 2010 Provincial overview survey results are used as the basis for defining the extent of the current infestation. Provincial overview spatials are used to group pine-leading types; the overview survey call on degree of infestation is then applied to the pine component of the grouped types per Table 24.

6. Current Forest Management Assumptions

Table 24. Provincial overview survey severity codes and stand mortality assumptions

Severity	% trees in polygon with red attack	% assumed for TSR
Trace (T)	<1	1
Light (L)	1-10	5
Moderate (M)	11-30	20
Severe (S)	31-50	40
Very Severe (V)	>50	75

It is assumed that sawlog potential of the pine component of pine-leading stands will persist for 5 years (with the year of analysis set as year 0), after which if not already harvested by the model it will revert to pulp. An (HMM + 5 year) stand quality code shall be developed for currently infested stands using this assumption.

It is assumed that dead pine will persist as standing inventory for 15 years, after which if not already harvested by the model it will fall down. Thus after 15 years this volume will be removed from the inventory to be counted as NRL (pro-rated over a 5-year period). An (HMM + 15 years) stand quality code shall be developed for currently infested stands using this assumption.

After 20 years, it is assumed that MPB NRL's will revert to their previous historic levels as defined for TSR2 (3,000 m^3/year). As described above for unsalvaged losses, 95.2% of this amount (i.e., 2,850 m^3/year) will be attributed to the THLB outside of the Wetzink'wa Community Forest.

Results from the BC Provincial Scale Mountain Pine Beetle Model (BCMPB) project depict a different near-future condition for Bulkley forests. BCMPB predicts that the beetle infestation is expected to overrun Bulkley TSA by 2016, and that cumulative pine mortality is expected to rise from 19% in 2010 to 71% in 2016 before tapering off to a 2% or less increase in following years.

Although BCMPB has been found to be fairly accurate in its predictions for pure pine stands, it is considered less reliable in predicting losses and spread in those TSA's (such as Bulkley) on the edges of the MPB epicenter with primarily mixed stands. BCMPB results thus define a conservative "worst case scenario" that will be considered through sensitivity analysis.

6.2.3 Dothistroma needle blight

Dothistroma needle blight (*Dothistroma septosporum*) is affecting Bulkley TSA pine plantations, to a significant degree in the Interior Cedar-Hemlock (ICH) biogeoclimatic zone although it is also known to be present at more trace levels in the SBS and ESSF. This disease causes premature loss of needles, and if it recurs in successive years can significantly reduce pine growth or even cause complete pine mortality.

Surveys in 2006 and 2008 classified the condition of plantations (with pine component exceeding 50%) in the Bulkley ICH according to their level of Dothistroma infection, and stocking levels of pine and other species. Stands were then assigned to management classes according to their condition. Management class descriptions, and current area by class, are provided in Table 25.

6. Current Forest Management Assumptions

Table 25. Dothistroma management summary of surveyed pine stands

Management Class	Description	Area (ha)
Stocking likely without pine	Adequate stocking of conifers other than pine, no planting required.	1 851
Wait and see	Marginal stocking of conifers other than pine or located at higher elevation, and low to moderate risk of Dothistroma	946
Action Imperative	Insufficient stocking of conifers and high risk, requires planting	318
Total		3 115

The stands in each management class will be modeled as follows:

- "Stocking likely without pine" will be assigned to an appropriate managed stand yield table based on BEC variant-moisture class, with stand ages reduced by 10 years. This reflects the existence of younger conifers below the main pine canopy that will form new stands after the pine dies.
- "Wait and See" will be similarly assigned, and will maintain their current age. This represents normal growth.
- "Action Imperative" will be assigned to a managed stand analysis unit, based on BEC variant and moisture class, with age reduced by 20 years to a minimum age of 0 years. This represents immediate fill planting to increase stocking of existing understocked conifers in these stands.

6.3 Silviculture

6.3.1 Regeneration activities in managed stands

Yields for all managed stands, and stands harvested in the future, are projected using managed stand yield tables produced by the Tree Interpolation Program for Stand Yields (TIPSY) model. Table 26 shows the inputs required to produce managed stand yield tables for the analysis. A managed stand yield table may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables are produced for the different regeneration methods (each method x species combination) and then aggregated into one table.

Table 26. Regeneration assumptions by Analysis Unit

Managed Stand Analysis Unit	Regen delay	OAFs 1	OAFs 2	Regen Method Type	Regen Method %	Species code	Species %	SIBEC Mean Site Index	Stocking Standard Target Density	Discounted Actual Density
CWHws2 – dry	1	15	5	Plant	100	Pl Hw Cw	40 40 20	12 12 8	600	(600)
CWHws2 - fresh	1	15	5	Plant Natural	30 70	Sx Ba Hw Pli	50 20 15 15	20 21.3 18.1 19.7	900	3200
CWHws2 - moist	1	15	5	Plant Natural	30 70	Sx Ba Hw Bl	40 20 20 20	24.8 24.8 24 24.8	900	3400
CWHws2 – very moist	1	15	5	Plant	100	Sx Cw Ba	70 15 15	12 12 12	800	800
CWHws2 – wet	1	15	5	Plant	100	Pli Cw	80 20	12 8	400	400

6. Current Forest Management Assumptions

Managed Stand Analysis Unit	Regen delay	OAFs 1	OAFs 2	Regen Method Type	Regen Method %	Species code	Species %	SIBEC Mean Site Index	Stocking Standard Target Density	Discounted Actual Density
ESSFmc – dry	1	15	5	Plant Natural	10 90	Pli Bl	80 20	13.5 13.3	1000	8900
ESSFmc - fresh	1	5	5	Plant	100	Sx Bl Pli	40 40 20	15.3 13.7 16	1200	2000
ESSFmc - moist	1	5	5	Plant	100	Sx Bl Pli	45 35 20	11.7 14.9 18.3	1200	1600
ESSFmc – wet	1	15	5	Plant	100	Sx Bl	55 45	12.6 10.8	1000	2000
ESSFmk – dry	1	15	5	Plant	100	Pli Bl	80 20	9 9	1000	1000
ESSFmk - fresh	1	15	5	Plant	100	Bl Sx Hm	50 30 20	11.4 11.4 11.4	1200	1200
ESSFmk - moist	1	15	5	Plant	100	Bl Sx Hm	50 30 20	12 12.8 12	1200	1200
ESSFmk – wet	1	15	5	Plant	100	Bl Sx	60 40	9 9	1000	1000
ESSFwv – dry	1	15	5	Plant Natural	50 50	Pli Bl	80 20	9 9	1200	2500
ESSFwv - fresh	1	5	5	Plant Natural	50 50	Sx Bl Pli	50 30 20	14.8 11.4 15	1200	2200
ESSFwv - moist	1	15	5	Plant	100	Sx Bl Pli	50 30 20	12.4 12 12.4	1200	2000
ESSFwv – wet	1	15	5	Plant Natural	30 70	Bl Sx	60 40	9 9	1000	3500
ICHmc1 – dry	1	15	5	Plant Natural	20 80	Pli Hw	80 20	19.6 17.1	1000	5300
ICHmc1 - fresh	1	15	5	Plant Natural	50 50	Sx Hw Bl Pli	50 20 15 15	23.3 18.5 18.8 22.4	1200	2200
ICHmc1 – wet	1	15	5	Plant	100	Sx Bl Hw	55 25 20	21 15 15	1000	1000
ICHmc2 – dry	1	15	5	Plant	100	Pli Hw	80 20	15 12	1000	1000
ICHmc2 - fresh	1	15	5	Plant Natural	40 60	Sx Pli Hw	65 20 15	22.3 21.8 18.4	1200	2600
ICHmc2 - moist	1	15	5	Plant Natural	30 70	Sx Bl Hw	65 20 15	21 15 15	1000	3100

6. Current Forest Management Assumptions

Managed Stand Analysis Unit	Regen delay	OAFs 1	OAFs 2	Regen Method Type	Regen Method %	Species code	Species %	SIBEC Mean Site Index	Stocking Standard Target Density	Discounted Actual Density
MHmm2 – dry	1	15	5	Plant Natural	15 85	Hm Ba	80 20	8 8	800	5800
MHmm2 - fresh	1	15	5	Plant Natural	15 85	Ba Hm Bl	70 15 15	12.6 12.6 12.6	900	6800
MHmm2 - moist	1	15	5	Plant	100	Hm Ba Bl	50 30 20	8 8 8	900	900
MHmm2 - wet	1	15	5	Plant	100	Hm Yc	80 20	8 (8)	800	800
SBSdk - dry	1	15	5	Plant Natural	30 70	Pli Sx	80 20	16.1 14.9	1200	3600
SBSdk - fresh	1	5	5	Plant Natural	50 50	Pli Sx At	60 20 20	20.3 18.8 (20)[13]	1200	2400
SBSdk - moist	1	15	5	Plant	100	Sx Pli	80 20	20 21.7	1000	1000
SBSdk - wet	1	15	5	Plant	100	Sb Sx Pli	60 20 20	14.6 14.6 12	400	400
SBSmc2 - dry	1	15	5	Plant Natural	20 80	Pli Bl	80 20	16.2 12	1000	4300
SBSmc2 - fresh	1	5	5	Plant Natural	50 50	Pli Sx Bl	50 35 15	19.3 19.3 15.6	1200	2200
SBSmc2 - moist	1	5	5	Plant	100	Sx Bl Pli	50 30 20	18.6 19 18.8	1000	1900
SBSmc2 - wet	1	15	5	Plant	100	Sx Sb	50 50	(12) (12)	400	400

Data source and comments:

Regen Delay column - Regeneration Delay (RD) is the time period between the beginning of harvest and the initiation of tree growth. The age of planted seedlings is included in the RD figure. For example, planting a 1 year old seedling 3 years after the beginning of harvest signifies a 2 year RD. Current licensee practice is to reforest harvested areas by planting as soon as possible, generally resulting in a RD of between one and two years. An operational RD of 1 year was chosen for this analysis. Regeneration delay is applied in the TIPSY yield model.

Operational Adjustment Factors (**OAFs 1 and 2**) are used to adjust TIPSY yield curves to account for factors that affect achievement of optimal growth.

[13] Values in parentheses indicate circumstances where a SIBEC value is not available for the selected species. A SIBEC call has been made on the basis of reasonableness.

6. Current Forest Management Assumptions

- OAF1 is a constant percentage reduction to account for small, unproductive areas within stands, uneven stem distribution, and endemic losses that do not increase with age. A provincial average default of 15% is generally used. However, a localized OAF1 study determined that an OAF1 of 5% is appropriate for SBSdk/01, 05, 06; SBSmc2/01, 01c, 05, 06, 09, 10; ESSFmc/01, 04, 05, 06, and ESSFwv/01 site series[14]. Table 26 captures these recommendations.
- OAF2 accounts for losses that increase with stand age due to pests, disease, decay, waste and breakage. In the absence of localized studies, the provincial default OAF2 of 5% is used for this analysis.

Stocking Standard Target Density - planting is the preferred regeneration method in Bulkley TSA. The stocking standard density for the site series associated with the Managed Stand Analysis Unit or MSAU (in reference to Table 2 Definition of Analysis Units and the November 2009 Reference Guide for FDP *Stocking Standards*[15]*)* is captured in this column.

Discounted Actual Density - although planting is the norm, significant levels of natural ingress occur on many site series. Also, within operational limitations licensee practice is to leave advanced regeneration and non-merchantable stems in clumps, for numerous reasons including maintenance of stand-level biodiversity and visual screening. Although practice is to plant through these clumps, a portion of this advanced regeneration (estimated <= 10%) is of acceptable stem form and quality and contributes to the inventory label.

The figures in this column are the weighted average total stems per hectare for each MSAU, as derived from the inventory layer of existing RESULTS openings, with a 20% discount applied. The 20% discount is to account for the approximate contribution of small, non-competing stems to the inventory label. Although these stems deplete available site moisture and soil nutrients thus affect crop tree growth, their effect is assumed to be much less than that of large competing stems. For analysis units that had no data in RESULTS, density numbers are set to the "Stocking Standard Target Density".

Regen Method Type, % - because TIPSY assumes that planted seedlings will grow more quickly and produce higher yields than natural regeneration, there is a need to determine the proportion of planted to natural seedlings.

For those MSAU's where Discounted Actual Density is greater than or equal to 2000 stems per hectare, there is strong likelihood that a significant component is of natural regeneration. A proportion of planted versus naturally regenerated stems is provided, using Stocking Standard Target Density as reference. Those MSAU's with less than 2000 stems per hectare Discounted Actual Density are assumed to be 100% planted.

Species Code, % - this column shows the species composition selected for each MSAU. Selected species were limited to a maximum of four per MSAU. Those selected are either "Preferred" or "Acceptable" species for those BEC site series associated with the MSAU (re: November 2009 *Reference Guide for FDP Stocking Standards*) and in virtually all cases have a SIBEC site index.

The Table 26 species proportions are for the most part reflective of the weighted average inventory label species composition (WASC) for the RESULTS polygons associated with the MSAU. Exceptions were as follows:

- Because "Acceptable" species should (in sum total) not comprise more than 20% of the inventory label, proportional adjustment occurred for MSAU's where "Acceptable" species exceeded 20% of the WASC.

[14] Laing & McCulloch Forest Management Services. 2003. OAF1 Sampling in the Bulkley, Lakes and Morice Forest Districts.
[15] http://www.for.gov.bc.ca/his/results/fsp_sss.htm

- In situations where no RESULTS data exists for the MSAU, species proportion was selected using relative tree species prominence in the Vegetation Table for BEC site series associated with the MSAU (re: *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region)*.

The TIPSY yield model does not accept black spruce, so Sx is substituted for Sb.

SIBEC Mean Site Index - Bulkley Predictive Ecosystem Mapping (PEM) and Site Index-BEC site series (SIBEC) correlation work has been completed and meets the accuracy standard required to permit use in timber supply review for adjustments to file-based site productivity estimates. The following method was used to determine mean site index values by species for Table 26.

- Generate a table of site index by site series by leading species for each BEC variant, in reference to *Site Index Estimates by Site Series: Report by Biogeoclimatic Unit; 2008 Approximation*[16]
- Group PEM site series polygons into broad moisture classes within each BEC variant, in reference to edatopic grid position
- Calculate the regenerated mean site index by leading species for each combination of BEC variant/moisture class, weighted by the proportion of forested area of each site series in the BEC variant.

A site index of 10 is used where the SIBEC site index is less than 10, because the TIPSY yield model does not accept site index less than 10.

According to RESULTS, in the past 10 years juvenile spacing has occurred on only 13 units, totaling 317 hectares. Of this area, only 56.5 hectares were on licensee obligation blocks. Because spacing is not a standard operational practice, thinned densities are not specified for MSAU's.

The following process is used for MSAU yield curve generation. Table 26 inputs for the MHmm2-dry MSAU are used in the example:

- For MSAU's where the Regen Method Type is "Plant" only, generate one yield curve that assumes the MSAU is 100% planted to the Discounted Actual Density (e.g. 5800 stems/ha), using species composition per the Species Code and Species % figures shown (e.g. 80% Hm/ 20% Ba), using the SIBEC Mean Site Index for individual species (e.g. Site Index 8 for both species), and adjusted per the OAF1 and OAF2 percentages provided (e.g. 15% and 5%);
- For MSAU's where Regen Method Type includes a 'Natural' category, generate a second TIPSY yield curve with all assumptions the same as the "Plant" curve, except model 100% natural regeneration. Generate a weighted planted/natural yield curve using the Regen Method Type and % proportions (e.g. 15% weighting to "Plant" curve, 85% weighting to "Natural" curve).

6.3.2 Genetic gain

Where permittable under the Chief Forester's Standards for Seed Use and where production is available, licensees are required to use provincial seed orchard Class A seed for reforestation purposes. Class A seed provides "genetic worth" (GW) to seedlings in comparison to seed from natural wild stand collections (Class B), including an expected gain in volume at rotation. As an example, a GW of 10 indicates that a tree generated from Class A seed is expected to gain 10% more volume at rotation than a tree generated from Class B seed.

[16] http://www.for.gov.bc.ca/hre/sibec/reports/sisubyBgcUnit2008.pdf

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Table 27. Net genetic worth of species planted over last 8 years

Year	Pli GW (a)	% Select Seed Use – Pli (b)	Net GW Pli (c)	Sx GW (a)	% Select Seed Use – Sx (b)	Net GW Sx (c)
2002	10	9	1	6	95	6
2003	8	54	4	7	100	7
2004	12	10	1	5	100	5
2005	11	12	1	6	100	6
2006	12	100	12	15	100	15
2007	12	100	12	0	0	0
2008	12	100	12	8	34	3
2009	13	72	9	19	100	19
8 Year Average (d)			**7**			**8**

Data source and comments:

Interior Lodgepole Pine (Pli) and Spruce Hybrid (Sx) are presently the only species for which Class A seed is available in Bulkley TSA. Seed Planning and Registry System (SPAR) GW reports were run for Pli and Sx for the years 2002-2009 (management unit-level reports are not available prior to 2002). Table 27 shows, by species, the (a) Tree Seed Centre's calculated GW for the Class A seed that year, (b) the proportion of seedlings sown that year for which Class A seed was used, (c) the calculated net GW by species for that year, factoring in a GW of 0 for the Class B seed that was used, and (d) an 8-year average GW.

The 8-year average GW is applied to the planted pine and spruce components of all TIPSY yield curves for stands harvested since 2001 and all future harvest, e.g. planted pine yields are immediately increased by 7% throughout all ages along the yield curve.

The Forest Genetic Council forecasts that for Bulkley Valley Pli and Sx Seed Planning Zones (which cover most of the TSA), seed orchard production will likely meet 100% of Pli seedling needs by 2013 with an average GW of 10%, and 100% of Sx seedling needs by 2014 with a GW of 23%: significantly higher than the present 8-year average GW. However, because these are forecast versus experienced gains they are not used for the base case.

6.3.3 Immature plantation history

Areas of immature forest where the density (stems per hectare) has been controlled are assigned to a managed stand yield table. All not satisfactorily restocked (NSR) areas and future harvested stands are also assumed to regenerate under managed stand yield tables.

All areas harvested in the Bulkley TSA are scheduled for some kind of management. Since there is approximately 40 years of logging history in the TSA, any stand under 40 years of age with a logging history are modeled using the regeneration assumptions outlined in Table 26.

6.3.4 Not satisfactorily restocked areas

The depletion layer produced for this analysis captures recent depletions (from RESULTS, satellite change detection, FTEN spatial layers, and as digitized off recent orthophotos and satellite imagery), and historic depletions (from FIP rollover).

In reference to tabular RESULTS attribute information, depletions are assigned a "status" of FG – free growing, SR – sufficiently restocked, NSR – not sufficiently restocked, MAT – mature, NCPF – non-commercial, non-productive, or non-forest, or UNK – unknown (i.e. insufficient attributes to make a status assignment). Table 28 shows assignment logic.

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Table 28. Assignment of Depletion Status

OPEN_REC (Assigned Status)	STOCK_STATUS[17]	STOCK_TYPE[18]	OPEN_STAT[19]
FG	<null>, IMM	<null>, NAT, PL, ART	FG
SR	IMM	<null>, ART, NAT, PL	<null>, AMD, APP, DFT
NSR	NSR	<null>, PL	<null>, APP
MAT	MAT, RES	NAT	<null>, APP, FG
NCPF	C, L, NC, NP, NSR, S	UNN, NAT, BR, RD	<null>, APP
UNK	<null>	<null>	<null>, APP

Data source and comments:

MAT and NCPF status areas are within the depletion file but are not depletions. They are not assigned to a managed stand analysis unit (MSAU).

FG, SR, NSR, and UNK depletions are all assigned to a managed stand analysis unit (MSAU) based on BEC variant and moisture class. MSAU regeneration assumptions for species composition and site index supersede existing attribute information. Stand age is set to age of leading species where present, or to (final year of harvest + 1) where species information is not present.

The depletion file indicates 570 hectares of "backlog" NSR (i.e. NSR associated with pre-October 31, 1987 harvest), and 1743 ha of "current" NSR (i.e. post-1987 harvest). It is assumed that "current" NSR stands will be promptly restocked. For "backlog" NSR, because area is small and because RESULTS attributes for NSR depletions already contribute to the weighted mean average Discounted Actual Density, Species Code and Species % figures for MSAU's, no additional special modeling measures are taken.

There are 157 UNK depletions. Nine are depleted since 2006 (i.e. show up on recent satellite imagery). The remainder (summing to 2434 ha) are from RESULTS spatial files and were apparently denuded in 1899. Following further investigation, UNK openings will be reassigned to one of the other categories.

6.4 Integrated Resource Management

6.4.1 Summary of forest cover requirements

Forest cover requirements may be examined at a number of different levels, including landscape units, wildlife areas, and visual quality areas. With the requirement to retain different forest characteristics across the landscape, it is important to identify how forest outside of the THLB may be considered in the forest cover requirements (i.e., maximum allowable disturbance or minimum area retention). Table 29 describes the forest cover requirements to be applied.

[17] Stocking Status Codes: IMM (immature), RES (wildlife tree reserve), C (cultivated), L (lake), NC (non-commercial), NP (non-productive), S (swamp)
[18] Stocking Types Codes: NAT (natural), PL (plantable), ART (artificial), UNN (unnatural or man-made), BR (brush), RD (road)
[19] Opening Status Codes: AMD (amended), APP (approved), DFT (draft)

6. Current Forest Management Assumptions

Table 29. Forest cover requirements

Resource Objective	Area Target	Condition Target	Affected Land Base
Caribou – Key Forested Caribou Habitat	maximum 50%	age < 90 yrs	Forest management land base
Grizzly high-value habitat	minimum 80%	age > 50 yrs	Forest management land base by Landscape Unit
Grizzly mixed-forest habitat	maximum 25%	ht < 3 m	Forest management land base by Landscape Unit
Babine SMZ2 within BCTS Forest Development Unit	minimum 30%	age > 140 yrs	Forest management land base within BCTS FDU
Core ecosystems	maximum 5%	age < 50 yrs	Forest management land base by Landscape Unit, separated by areas inside and outside the Telkwa Caribou Recovery Area
Landscape corridors	minimum 70%	age > 80 yrs	Forest management land base for each Landscape Unit, separated by areas inside and outside the Telkwa Caribou Recovery Area
Fisheries Sensitive Watersheds	maximum 33%	ht < 3 m	THLB for each Fisheries Sensitive Watershed
Patch size distribution	maximum 33%	ht < 3 m	THLB by landscape unit and natural disturbance type (NDT), outside of all habitat areas, special management zones, areas with VQOs, fish-sensitive watersheds, core ecosystems, and landscape corridors
Seral stage distribution, Landscape Units	See Table 31		Forest management land base by landscape unit and BEC variant
Seral stage distribution, Telkwa Caribou Herd Recovery Area	See Table 32		Forest management land base by BEC variant, by landscape unit portion of Telkwa Caribou Herd area
Visual Quality Objectives	maximum allowable disturbance in plan view	height ≤ mean Visually Effective Green-up height	Forest management land base for each visual quality objective by landscape unit.

Data source and comments:

Forest management land base includes the forest management land base of the Wetzink'wa Community Forest. THLB includes the THLB of the Community Forest. See Section 4.1 "Management Zones" and Section 5.1.2 "Area-based forest tenures".

Any condition target related to "ht < 3 m" uses the results of the report "B.C. Ministry of Forests. 2000. Age to green-up height: using regeneration survey data by region, species and site index. B.C. Min. For. and Forest Renewal BC". Other height requirements use normal height curves directly, without being converted to ages.

6.4.2 Wildlife

Forest cover requirements for caribou and grizzly habitat, Babine SMZ2 and landscape corridors are consistent with government objectives and licensee Forest Stewardship Plan (FSP) commitments.

Requirements for core ecosystems are a modeling proxy chosen by District staff. They are consistent with FSP commitments to ensure that only small scale low-intensity harvest occurs in these areas, and strictly for purpose of forest health control.

6. Current Forest Management Assumptions

6.4.3 Community watersheds

Objectives Set by Government (OSBG) for Community Watersheds requires that cumulative hydrological effects of primary forest activities do not adversely impact water quantity, quality and timing of flow. In addition to riparian management (see section 5.3.9 "Riparian areas"), Forest Stewardship Plans commit to plan and locate operations such that no harmful material will enter water used by licensed waterworks. Because these actions do not impose an additional forest cover constraint, Community Watersheds are not included in Table 29.

6.4.4 Fisheries sensitive watersheds

Table 30 lists Bulkley TSA's five established fisheries sensitive watersheds (FSW's) and describes FSP commitments for their management.

Table 30. Fisheries Sensitive Watersheds

FSW_NAME	FSP Commitment		
	Equivalent Clearcut Area threshold (% of FSW area)	Peak Flow Index threshold	Other
Cumming Creek	30	35	Road density <= 1.4 km/km2; Stream crossing density <= 0.5/km2
Gramophone Creek	25	35	Road density <= 1.6 km/km2; Stream crossing density <= 0.5/km2
5 Mile Creek	35	45	Road density <= 1.3 km/km2; Stream crossing density <= 0.5/km2
Jonas Creek	n/a	n/a	No harvest >1 ha until watershed assessment completed and indicator thresholds set
Toboggan Creek	n/a	n/a	No harvest until watershed assessment completed and indicator thresholds set

Operationally if ECA, Peak Flow Index or other indicator thresholds are encountered, licensees cease further development until completion of another detailed watershed assessment that confirms or sets new thresholds, or recommends remedial actions.

However, the intent in FSW's is for continued hydrologic stability. Re-setting of thresholds cannot proceed indefinitely - there is a threshold where further harvest must cease until sufficient hydrologic green-up occurs, once indicators of instability (e.g. gross channel morphology changes) start to occur. Because present ECA thresholds are roughly comparable to a 3 harvest pass system, they are modeled as such for the base case.

6.4.5 Landscape-level biodiversity

Adherence to legal patch size distribution targets involves temporal considerations, and will be approximated using a 3 harvest pass concept.

Table 31 describes legal seral stage distribution targets that are applicable by landscape unit and BEC subzone. Because Bulkley TSA does not have spatial Old Growth Management Areas (OGMA), old seral targets are applied in the timber supply model.

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Table 31. Seral-stage targets by landscape unit and BEC Subzone

Landscape Unit	BEC Subzone	Natural Disturbance Type (NDT)	Minimum Old[20] (%)	Minimum Mature[21] + Old (%)	Maximum Young[22] (%)
Babine	ESSFmc	2	9	28	36
	SBSmc2	3	11	23	54
Blunt	ESSFmc	2	9	14	n/a
	SBSmc2	3	11	11	n/a
Bulkley Valley	SBSdk, SBSmc2	3	10	n/a	n/a
Chapman	ESSFmc	2	9	14	n/a
	SBSmc2	3	11	11	n/a
Copper	ESSFwv, MHmm2	1	19	36	22
	CWHws2	2	9	34	36
	ESSFmc	2	9	28	36
	SBSmc2	3	11	23	54
Corya	ESSFwv	1	28	54	17
	ICHmc1, ICHmc2	2	13	46	27
Deep Creek	ESSFmc	2	9	14	n/a
	SBSdk, SBSmc2	3	11	11	n/a
Harold Price	ESSFwv	1	19	36	22
	ESSFmc	2	9	28	36
	ICHmc1	2	9	31	36
	SBSmc2	3	11	23	54
Nilkitkwa	ESSFmc	2	13	42	27
	SBSmc2	3	16	34	40
Reiseter	ESSFmc	2	9	28	36
	ICHmc1, ICHmc2	2	9	31	36
	SBSdk. SBSmc2	3	11	23	54
Telkwa	ESSFmk	2	19	36	22
	ESSFwv	1	19	36	22
	CWHws2	2	9	34	36
	ESSFmc	2	9	28	36
	SBSdk, SBSmc2	3	11	23	54
Torkelson	ESSFmc	2	9	14	n/a
	SBSmc2	3	11	11	n/a
Trout Creek/ Kitseguecla	ESSFwv	1	19	36	22
	ICHmc1, ICHmc2	2	9	31	36
	SBSdk, SBSmc2	3	11	23	54

[20] Old is defined as > 250 yr in all subzones except SBSdk/mc2; and as > 140 yr in the SBSdk/mc2

[21] Mature is defined as > 120 yr in the MHmm2 and ESSFmc/mk/wv; as > 100 yr in the ICHmc1/mc2 and SBSdk/mc2; and as > 80 yr in the CWHws2

[22] Young is defined as <= 40 yr in all subzones.

6. Current Forest Management Assumptions

6.4.6 Telkwa caribou herd

Table 32 describes legal seral stage distribution targets that are specific to the Telkwa Caribou Herd area. They are applicable by Forest management land base by BEC variant, to the landscape unit portions of the Telkwa Caribou Herd area.

Table 32. Seral-stage targets for Telkwa Caribou Herd Recovery Area

Landscape Unit	Study Area (STUD_AREA)	BEC Subzone	Natural Disturbance Type (NDT)	Minimum Old[23] (%)	Minimum Mature[24] + Old (%)	Maximum Young[25] (%)
Telkwa	"yes"	ESSFmc	2	9	28	36
		ESSFmk	2	19	36	22
		SBSmc2	3	11	23	54
		SBSdk	3	11	23	54
Bulkley Valley	"yes"	SBSdk	3	10	n/a	n/a
		SBSmc2	3	10	n/a	n/a

6.4.7 Visual quality objectives

Scenic areas and their visual quality objectives (VQO) were established under the *Forest Practices Code Act* and grand-parented under the *Forest and Range Practices Act*[26].

This section describes the approach used to determine the Table 29 forest cover constraints for allowable percent alteration of scenic areas from a planimetric or "plan" view, and minimum visually effective green-up (VEG[27]) heights. The approach is a mathematical approximation of the art of designing cutblocks within Bulkley TSA's scenic areas to address VQO's that have a legally worded description versus legally defined alteration targets. The approach is possibly more constraining than what can be accomplished operationally through actions including creative adjustment of boundaries and WTP placement, but is consistent with provincially-accepted VQO management practices.

[23] Old is defined as > 250 yr in all subzones except SBSdk/mc2; and as > 140 yr in the SBSdk/mc2

[24] Mature is defined as > 120 yr in the MHmm2 and ESSFmc/mk/wv; as > 100 yr in the ICHmc1/mc2 and SBSdk/mc2; and as > 80 yr in the CWHws2

[25] Young is defined as <= 40 yr in all subzones.

[26] On review it was determined that Bulkley scenic areas and VQO's are legally established with the possible exception of those in the Bulkley Valley landscape unit. Because licensees commit to their management within Forest Stewardship Plans, Bulkley Valley visuals are included in the base case for reasons of current management.

[27] VEG is the stage at which regeneration is seen by the public as newly established forest. Research has found that tree height is the best biophysical variable for predicting VEG and that it is very dependent on the slope of the land: the steeper the ground, the higher must the trees be to achieve VEG.

6. Current Forest Management Assumptions

Table 33 shows a maximum permittable percent alteration from a perspective view for each VQO. The alteration percentage is applicable to the vegetated portion of individual visual sensitivity units (VSU's) within a scenic area. Targets are consistent with the December 2003 Forest Service "Bulletin - Modelling Visuals in TSR III", and also essentially consistent with commitments made in the BC Timber Sales Forest Stewardship Plan[28].

Table 33. Assignment of Visual Quality Objectives

VQO	Maximum % alteration (perspective view)
Preservation	See Table 6
Retention	1.5
Partial retention	7
Modification	18

The percent alteration in perspective view from Table 33 must be converted to a measure in plan view for use in a timber supply model. A Plan to Perspective (P2P) ratio is determined for each VSU by area-weighting the P2P across all slope classes within that VSU, using data from Table 34. The percent alteration in perspective view is then multiplied by the area-weighted P2P ratio to calculate the maximum allowable plan view percent alteration for each VSU.

A mean Visually Effective Green-up (VEG) height was also determined for each VSU by area-weighting the VEG across all slope classes within the unit, using data from Table 34. This mean VEG is used as a forest cover height constraint for individual VSU's – i.e. the model only permits harvest to occur in VSU's that are at or below their mean VEG height.

Table 34. Slope classes for calculating P2P ratio and VEG height

	Slope Classes[1] (%)														
	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	45.1 - 50	50.1 - 55	55.1 - 60	60.1 - 65	65.1 - 70	70.1+
P2P Ratios[2]	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

[1] Adapted from *Procedures for Factoring Visual Resources into Timber Supply Analysis* (1998) and *Modelling Visuals in TSR III* (2003) by Luc Roberge, Visual Resource Specialist, NIFR - December 2007.

[2] 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 was used in this table to determine the ratios for slope classes in 5% increments.

[28] The BCTS Forest Stewardship Plan committed to maximum perspective view alteration thresholds of 0% for Preservation, 5% for Retention, 15% for Partial Retention, and 18% for Modification VQO's. However, these alteration targets are stated as applicable to areas "in a visibly non-vegetated state", which would include non-vegetated areas such as rock and ice in addition to any new clearings. The % alteration thresholds in Table 31 are lower but comparable since they are applicable to just the vegetated portion of VSU's.

6. Current Forest Management Assumptions

6.4.8 Disturbance outside of the timber harvesting land base

Some forest cover requirements described in Table 29 apply to the Forest management land base, which includes forest outside of the THLB. Forest outside of the THLB can undergo natural disturbance that affects its age class distribution and its contribution to forest cover requirements. This natural disturbance outside the THLB must be accounted for, to prevent this forest from contributing inappropriately to forest cover requirements.

Approximately 79% of Forest management land base outside the THLB is comprised of mature and old seral age classes. Stands less than 20 years of age comprise less than 1% of this land base[29], even though the TSA is dominated by forest ecosystems that naturally have a frequent fire return interval. This skew to mature and old stands is likely attributable to successful fire suppression efforts.

For the base case, the current age class of Forest management land base outside the THLB shall be frozen.

An alternative would be to allowing this land base to continue aging indefinitely. The problem with this approach is that while all the THLB will eventually be disturbed by harvesting, only natural disturbance occurs outside the THLB. Continual aging outside the THLB is unrealistic because it allows progressively more of the old-seral targets to be met outside of the THLB over time without accounting for the natural disturbance that occurs there. Even though less than 1% is currently younger than 20 years, that only affects the early seral stage. The proportion younger than 80 or 100 years affects the mature+old seral stage.

Modelers tend to model disturbance outside the THLB by setting a maximum age and forcing stands that reach this age to cycle back to 0. However, the rate of disturbance outside the Bulkley THLB is low (as reflected by the age class distribution), so another approach is required to mimic the level of natural disturbance. Freezing the age class distribution outside the THLB assumes that what is there now is representative of the age class distribution over time. This is a reasonable assumption, since there currently is area in all age classes. Assuming continuous aging is not reasonable.

The "freezing" approach is a simplification of reality, but it is appropriate in a modeling context for TSR. Other choices are available that are more complicated to model. Given the low level of natural disturbance, a more complicated modeling approach is not warranted. Freezing the age class distribution has the added benefit of simplifying a model, because all seral stage targets can be prorated to the THLB using the current condition, so the model only needs to address the THLB, not the entire FMLB.

[29] Source: Timber Supply Branch. April 2001. Timber Supply Review: Bulkley Timber Supply Area Analysis Report.

7. Sensitivity Analysis

Sensitivity analyses assess the timber supply impact of uncertainty in data and management assumptions. Table 35 lists the sensitivity analyses to be performed.

Table 35. Sensitivity issues

Issue to be Tested	Sensitivity Levels
Harvest flow	Various alternatives to the base case
Adjacency and green-up	Find the threshold for maximum disturbed area that disrupts timber supply when using the proxy for cutblock adjacency
Patch size distribution	Use a harvest blocking tool to assess base case patch size distribution
Alternative approach to modeling MPB non-recoverable losses	Model base case approach substituting pine losses predicted by BCMPB model
Unconstrained pine harvest	Relax zone-specific forest cover constraints to allow relatively unconstrained harvest of pine profile over next two decades
Alternate representation of "current management"	Apply the forest cover constraints used for the Bulkley LRMP Analysis/ Bulkley TSR2 to all HLP zones
Volume estimates for existing stands	Test existing volumes (VDYP): apply Phase II inventory adjustments
Managed stand yield estimates	Test use of standard OAF1 for all managed stands
Modeling disturbance to Forest management land base outside the THLB	Assume that stands revert to age 0 upon reaching a maximum age of 350 years in NDT1, 300 years in NDT2, and 250 years in NDT3
New WHA for Telkwa Caribou Herd	Test timber supply implications of proposed new zonations and revised constraints

Data source and comments:

Alternative approach to modeling MPB non-recoverable losses – the BC Provincial Scale Mountain Pine Beetle (BCMPB) model uses inputs including BEC variant, forest cover attributes, IBM attack severity by Provincial Overview Survey polygon, THLB, proximity to roads, and Beetle Management Unit strategy (monitor, suppression, holding, salvage) to predict at a provincial scale the (1) spread and severity of main MPB population; (2) volume and area of pine-leading stands affected or killed, and (3) volume and area likely to be harvested as green or salvage[30].

The 2010 BCMPB projection indicates that the beetle infestation is expected to overrun Bulkley TSA by 2016, and that cumulative pine mortality is expected to rise from 19% in 2010 to 71% in 2016 before tapering off to a 2% or less increase in following years. The 2012 BCMPB projects a lower level of mortality, with annual mortality peaking in 2012 and 65% of pine killed by 2022.

Alternative representation of "current" management – for the sensitivity, modeling constraints will be altered for consistency with the 1996 Bulkley LRMP analysis for the following zones:

[30] Walton, Adrian. May 2010. Provincial Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the 2009 Provincial Aerial Overview of Forest Health and the BCMPB model (year 7). BC Forest Service Research Branch.

7. Sensitivity Analysis

- High-value Grizzly Bear habitat – minimum 50% older than 80 years
- Moderate-value Grizzly Bear habitat – a 2-pass system, maximum 50% harvest each pass with harvest only in decades 1, 6, 11, 16, 21
- Boucher Creek Special Management Unit – a 2-pass system, maximum 50% harvest each pass with harvest only in decades 1, 6, 11, 16, 21. Boucher Creek is of immediate harvest focus because it has a relatively higher component of MPB-infested pine.
- High-value Mule Deer habitat – maximum 20% < 20 years, applies to FMLB within each landscape unit (includes mule deer and moose/mule deer habitat).
- Babine SMZ2 – minimum 30% older than 105 years; applies to FMLB
- Reiseter SMZ2 – Remove all area with TSM class 4 and 5 and all area with high or very high soil erosion potential from the THLB. Limit harvesting to 10% of THLB every decade.

Volume estimates for existing stands – Pacific Inland Resources (PIR) recently conducted a comparison of [new VRI prediction of merchantable stand volumes, adjusted for a 12.5 cm utilization for pine and 17.5 cm utilization for all other species, with decay waste and breakage factored out] to [actual cruise volumes], using data compiled from 12 cutting permits located in SBS and ESSF biogeoclimatic zones and representing 800,000 m3 of harvest volume.

The comparison was made to cruise volumes, because their experience is that cruise volumes are very close to actual delivered volumes. The comparison revealed that the new VRI (with Phase II adjustments, new decay waste and breakage factors, and mixed utilization levels) overestimated volume by: 12% for pine, 36% for Sx, and 8% for Bl. Comparisons with unadjusted VRI were more favourable so the base case did not apply these adjustments when developing existing stand yield tables.

The base case did not apply the Phase II adjustments to VRI. Sensitivity analysis will test the application of the Phase II adjustments on existing stand yields.

Managed Stand yield estimates – the base case included reductions in OAF1 for some managed stand yield tables. It is uncertain that this approach is warranted, so sensitivity analysis will test the use of standard OAF1 of 15% for all managed stand yield tables.

New WHA for Telkwa Caribou Herd – the new WHA Order will introduce several forest management changes in the Telkwa Caribou Herd area including more limiting early and mature seral constraints, and a new and large no-harvest area.

Table 36 summarizes present draft WHA Order direction (column 1), explores the extent to which direction is already accommodated in "status quo" management (column 2), then recommends a modeling approach that more fully addresses WHA Order direction (column 3).

Table 37 describes content and modelling criteria for a "spatial offset" layer that was co-developed by MoF/MoE as part of the effort to keep the LRMP budget "balanced". This layer depicts zones within the WHA area where usual constraints will be lightened or removed to partially mitigate new WHA timber supply impacts.

- The sensitivity should consider implications of new early seral requirements on short-term pine availability. When pine dies, pine-leading stands will in essence (and short-term) revert to an early seral condition. Licensees could be given flexibility to salvage-harvest this volume, since their actions won't create new early seral. Present WHA Order does not enable increased flexibility to salvage harvest, thus higher level of NRL may occur.

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Table 36. Constraint and modelling differences between Status Quo versus WHA Order

WHA Direction	Status Quo constraint and modelling criteria (from Bulkley TSR3 Data Package)	WHA constraint and suggested modelling criteria
Legal management direction for Bulkley HLPO (2006) management zones continues to apply following Order enactment	Key Forested Caribou Habitat: maintain FMLB in each habitat unit at maximum50% FMLB <90 years old	Key Forested Caribou Habitat polygons cease to exist – remove constraint.
	SMZ1: no harvest	Same
	Core Ecosystems: maintain each CE at <=5% FMLB < 50 years old	Same
	Landscape Riparian Corridors: maintain each corridor element at minimum70% FMLB >80 years old	Same
	Areas with VQO's: per Data Package approach	Same
	Other Wildlife Habitat Areas: Goat: no harvest	Same
GWM's - CFLB within LRMP zones contributes to achieving GWM's	n/a – statement provided for context on what landbase contributes to GWM achievement	n/a
GWM 1 Telkwa Caribou No Harvest Zone: no timber extraction permitted	None, over and above usual LRMP zone management	No harvest
GWM 2 ESSF		
Maintain >60% >80 years Maintain <28% <40 years	Apply "LUP ESSF Seral Stage Objectives", to FMLB, by BEC variant, within LU portion of WHA area Telkwa LU - ESSFmc: Early seral: maximum 36% <40 years Mature+Old seral: minimum 28% >120 years Old seral: minimum 9% >250 years Telkwa LU – ESSFmk: Early seral: maximum 22% <40 years Mature+Old seral: minimum 36% >120 years Old seral: minimum 19% >250 years	Apply the following mature+old and early seral targetsto FMLB in ESSF zone as a whole outside of the new No Harvest Zone, within Bulkley TSA portion of WHA area minimum 60% >80 years maximum 28% <40 years
Design wildlife tree patches or within-block retention to focus on key caribou features. Maintain retention areas with terrestrial, arboreal lichen	(Area and distribution needs are covered off by a combination of WTP management, aspatial seral stage management plus Key Forested Caribou Habitat management). TCHRPA ESSF WTP% requirement: 30% (applied as a % of individual cutblock area) Operational practice is to apply normal WTP reserves within cutblocks (3% for ESSFmc in Telkwa LU; 1% for ESSFmk in Telkwa LU), and defer the harvest of a nearby area equivalent to 30% of the gross cutblock area until the middle of the next rotation (approximately 40 years).	(Non-legal) direction from Schedule 1 recommends applying the Landscape Unit WTP% targets (as a % of individual cutblock area Telkwa LU ESSFmc: 3% Telkwa LU ESSFmk: 1%

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WHA Direction	Status Quo constraint and modelling criteria (from Bulkley TSR3 Data Package)	WHA constraint and suggested modelling criteria
Provide (special unroaded) visual screening buffers around wetland and meadow complexes greater than 5 ha in size	A portion are protected within CE's; the remainder get screened by retained stems within riparian management areas (RRZ's/RMZ's): W1 or W5 wetland RRZ: 10m no-harvest W1 or W5 wetland RMZ: additional 40m with 25% basal area retention	Same, since RRZ/RMZ management should result in sufficient visual buffering of wetland areas
Establish treed reserves between roads, cut blocks and easily accessible subalpine habitat	Was not modelled.	Confirmed with MoE that an additional ESSF buffer to protect key areas of Caribou No Harvest Zone will not be required.
GWM 3 SBSmc		
Maintain >60% > 80 years Maintain < 28% 40 years	Apply "LUP SBS Seral Stage Objectives" to FMLB, by BEC variant, within LU portions of WHA area Telkwa LU – SBSmc2: Early seral: maximum 54% <40 years Mature+Old seral: minimum 23% >100 years Old seral: minimum11% >140 years Bulkley LU – SBSmc2: Early seral: n/a Mature+Old seral: n/a Old seral: minimum 10% >140 years	(lump CWH variants with SBSmc2). Apply the following mature+old and early seral targets to FMLB in SBSmc2 as a whole outside of the new No Harvest Zone, within Bulkley TSA portion of WHA area minimum 60% >80 years maximum 28% <40 years
Maintain large areas as inactive but still harvestable (non-legal direction from Appendix 1 recommends a "get in and get out" approach where harvest activity is concentrated within 1/3 to 1/2 of the operating area and completed over a two year interval, followed by > 15 years of no activity.	(landscape-level patch-size distribution management) Patch-size Distribution management: <33% <3m, applicable to THLB by NDT by LU (outside of wildlife habitat areas, FSW's, SMZ1's, areas with VQO's, CE's and LRC's).	A new multiple pass concept that replaces the status quo patch size distribution modelling approach: - set as a "Priority 1" harvest priority - harvest periodicity starts the 1st decade that constraints permit harvest, then every 2nd decade afterwards - maximum 20% harvest of THLB in SBSmc2 in WHA area permitted each return - harvest restricted to the half-decade
Design wildlife tree patches or within-block retention to focus on key caribou features. Maintain retention areas with terrestrial, arboreal lichen	(Area and distribution needs are covered off by a combination of WTP management, aspatial seral stage management plus Key Forested Caribou Habitat management). TCHRPA SBS WTP% requirement: 20% (applied as a % of individual cutblock area) Operational practice is to apply normal WTP reserves within cutblocks (7% for SBSmc2 in Telkwa LU; 7% forSBSmc2 in Bulkley LU), and defer the harvest of a nearby area equivalent to 20% of the gross cutblock area until the middle of the next rotation (approximately 40 years).	(Non-legal direction from Schedule 1 recommends applying the Landscape Unit WTP% targets (as a % of individual cutblock area) Telkwa LU SBSmc2: 7% Bulkley LU SBSmc2: 7%

7. Sensitivity Analysis

WHA Direction	Status Quo constraint and modelling criteria (from Bulkley TSR3 Data Package)	WHA constraint and suggested modelling criteria
Provide (special unroaded) visual screening buffers around wetland and meadow complexes greater than 5 ha in size	See ESSF write-up for this same constraint	See ESSF write-up for this same constraint
GWM 4 SBSdk		
Maintain >45% > 80 years Maintain < 39% > 40 years	Apply "LUP SBS Seral Stage Objectives" to FMLB, by BEC variant, within LU portions of WHA area Telkwa LU – SBSdk: Early seral: maximum54% <40 years Mature+Old seral: minimum 23% >100 years Old seral: minimum 11% >140 years Bulkley LU – SBSdk: Early seral: n/a Mature+Old seral: n/a Old seral: minimum 10% >140 years	(No CWH or ICH are in close proximity, so nothing to lump with SBSdk). Apply the following mature+old and early seral targets to FMLB in SBSdk as a whole outside the new No Harvest Zone, within Bulkley TSA portion of WHA area minimum 45% >80 years maximum 39% <40 years Note: there is no SBSdk in the No Harvest Zone.
Maintain large areas as inactive but still harvestable (non-legal direction from Appendix 1 recommends a "get in and get out" approach where harvest activities are concentrated within 1/3 to 1/2 of the operating area and completed over a two year interval, followed by > 15 years of no activity.	See SBSmc2 write-up for same constraint	A new multiple pass concept that would replace the status quo patch size distribution modelling approach: - set as a "Priority 1" harvest priority - harvest periodicity starts the 1st decade that constraints permit harvest, then every 2nd decade afterwards - maximum 20% harvest of THLB in SBSdk in WHA area permitted each return - harvest restricted to the half-decade
Design wildlife tree patches or within-block retention to focus on key caribou features. Maintain retention areas with terrestrial, arboreal lichen	Area and distribution needs are covered off by a combination of WTP management, aspatial seral stage management plus Key Forested Caribou Habitat management. TCHRPA SBS WTP% requirement: 20% (applied as a % of individual cutblock area) Operational practice is to apply normal WTP reserves within cutblocks (3% for SBSdk in Telkwa LU; 5% for SBSdk in Bulkley LU), and defer the harvest of a nearby area equivalent to 20% of the gross cutblock area until the middle of the next rotation (approximately 40 years).	(Non-legal direction from Schedule 1 recommends applying the Landscape Unit WTP% targets (as a % of individual cutblock area) Telkwa LU SBSdk: 3% Bulkley LU SBSdk: 5%
Provide (special unroaded) visual screening buffers around wetland and meadow complexes greater than 5 ha in size	See ESSF write-up for this same constraint	See ESSF write-up for this same constraint

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Table 37. Modelling Concept for Spatial Offset layer

Description	Modelling concept
LRC's along Telkwa and Bulkley Rivers within WHA area (Status = "open")	Remove LRC constraint (underlying riparian management constraints continue)
LRC's (11 corridor elements) providing landscape connectivity between Telkwa River and SMZ1's/ alpine/ highland CE's (Status = "open")	Remove LRC constraint (underlying riparian management constraints continue). Note that the key and most heavily used connective corridors from Telkwa and Bulkley Rivers to subalpine and alpine are retained in west and east extents of WHA area.
CE's (2) along Telkwa and Bulkley Rivers (Status = "open")	Remove CE constraint (underlying riparian management constraints continue; underlying red- and blue-listed ecosystems still continued as no-harvest areas)
LRC's, CE's, KFCH's within new Telkwa Caribou no-harvest zone (Status = "constrain")	Over-write previous constraints with "no harvest"
LRC's and CE's outside new Telkwa Caribou no-harvest zone but within WHA area (Status = "constrain")	Retain CE and LRC constraints