Bulkley Timber Supply Area
Timber Supply Review

Data Package

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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. Bulkley Land and Resource Management Plans; Bulkley Landscape Unit Plans);
- legal objectives established under the *Forest and Range Practices Act* and the *Land Act* (e.g. Bulkley LRMP Objectives Set by Government).

The purpose of the timber supply review (TSR) 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 modelling 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 Analyses" identifies areas of uncertainty in the data and assumptions and outlines sensitivity analyses that are carried out.

2.2 Statement of major forest management considerations and issues

Table 1 lists 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 (AAC) 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 (HMM) 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.

(continued)

2. Current Forest Management Considerations and Issues

Table 1. Major forest management considerations

Consideration/issue	Description
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 TSR 2 modelling 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.
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 science.
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 restocked 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.

(continued)

2. Current Forest Management Considerations and Issues

Table 1. Major forest management considerations (concluded)

Consideration/issue	Description
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 TSR 2 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 Skeena Stikine and Morice TSAs. Timber supply implications of proposed zonations and new objectives shall be explored through sensitivity analyses. Visual quality – VQOs were established under the Forest Practices Code for all LUs except Bulkley Valley. Although not legally established, licensees manage Bulkley Valley VQOs as de facto, so those VQOs 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). A key implementation element of Bulkley strategic plans is the requirement to maintain a balanced timber supply "budget", in managing approved spatial or constraint changes to strategic planning zones. The 1996 Bulkley LRMP analysis was originally used in defining this budget. FSP results/strategies yield timber supply constraints that differ from the original LRMP analysis. Sensitivity analysis will test the timber supply impact of applying Bulkley LRMP analysis constraints.

Data source and comments:

In his Bulkley TSR 2 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.).

2. Current Forest Management Considerations and Issues

CF1. Continue to refine operability lines with the harvest method mapping (HMM) 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). FSP results and strategies have been selected to represent current management for the base case.

Despite this election, a key implementation element of the Bulkley LRMP and subsequent Bulkley strategic plans is the concept of maintaining an LRMP "budget" of maximum timber supply impacts associated with LRMP zonations. For example, parties proposing to lighten constraints or shift boundaries are required to identify offset areas where constraints are increased, or to provide suitable replacement areas, to ensure the balance is maintained.

Approved FSP results and strategies use different forest cover constraints than those used for the original Bulkley LRMP analysis (i.e. which defined the LRMP budget). A sensitivity analysis will test the timber supply impact of using TSR 2 constraints, which more closely match those of the original Bulkley LRMP analysis (see Section 7.0, "Sensitivity Analyses").

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.

Table 2. Inventory information

Data	Source	Vintage	Update
Agriculture development areas, wildlife habitat management areas	MoE Skeena[1]	2010	
Alluvial fans	MFR RNI[2]	2003	
Biogeoclimatic ecosystem classification	LRDW[3]		
Community watersheds	LRDW	1993	2010
Depletion layer	MFR District	2003	2010
Ecosystem network	MFR District	1997	2003
Environmentally sensitive area mapping	MFR District	1970's	
Fish sensitive watersheds	LRDW	2007	
Harvest method mapping	MFR District	2010	
Landscape units	LRDW	1997	2001
Objectives set by government - amalgamated special/resource management zones	MFR District	2010	
Ownership	MFR FAIB	2008	2010
Predictive ecosystem mapping/woodlands BEC subzones	MFR RNI	2010	
Provincial forest	LRDW	2001	
Provincial forest health overview survey	MFR Forest Practices Branch	2010	
Remote/accessible	MFR District	2004	
Research installations, growth and yield plots	LRDW	2009	
Riparian area	MFR District	2010	
Roads, trails, landings	MFR District	2010	
Recreation sites, trails, reserves	LRDW	2008	

(continued)

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

3. Inventories

Table 2. Inventory information (concluded)

Data	Source	Vintage	Update
Sensitive ecosystem inventory	MFR District	1998	
Soil erosion potential (class IV, V proxy)	MFR District	2010	
Terrain stability mapping (class IV, V)	MFR District	1996-2000	
Timber supply area	LRDW	2003	
Vegetation resources inventory	LRDW	2008	2009
Visual quality objectives	MFR District	1987-2008	2009
Watershed sub-basins	MFR District	1999	
Wildlife high-value habitat	MFR District	1997	
Wildlife – Grizzly Bear – moderate value habitat; Babine special management units	MFR District	1989	1997
Wildlife – Telkwa Caribou study area	MFR District	2004	2009

Data source and comments:

Agriculture Development Areas (ADAs), Wildlife Habitat Management Areas (WHMAs) – Proposed ADAs 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 ADAs 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) – 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 (CWs) 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.

3. Inventories

Ecosystem Network – The Ecosystem Network, comprised of Core Ecosystems (CE) and Landscape Riparian Corridors (LRC) is identified in Bulkley LRMP Objectives Set By Government (2006). CE provide ecosystem representation and interior forest conditions, and LRC 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 1970s-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 (MFLNRO). Linear features (i.e. trails) are converted to polygons with a 20-metre width.

Harvest Method Mapping (HMM) – HMM, 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 (LUs) – Bulkley LUs 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 Management 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 licences, 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 one kilometer to differentiate relatively accessible versus relatively remote land base. This file is used in setting harvest priority.

3. Inventories

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.

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 – MFLNRO 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 were made known during landscape 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 (VQO) 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 3 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 3. Objectives to be tracked

Objectives	Inventory definition
Early, mature + old, and old seral stage distributions	Crown forested land base (CFLB) by landscape unit and BEC variant
Patch size distribution	Number of THLB harvest passes by landscape unit and natural disturbance type (NDT)
Core ecosystems	Crown forested land base for each core ecosystem
Babine SMZ2	Crown forested land base within SMZ2
Harvesting in the Wetzink'wa Community Forest	THLB and volume harvested within Wetzink'wa Community Forest
Landscape riparian corridors	Crown forested land base by landscape corridor element
Wildlife habitat	Crown forested land base by habitat polygon by wildlife species
Visual quality objectives	Crown forested land base by visually sensitive area polygon
Harvest method mapping stand quality class	Volume harvested by stand quality class
Fish-sensitive watersheds (FSW)	THLB by FSW
Forest outside THLB	Crown forested land base by natural disturbance type (NDT)
Landscape units	Volume harvested by landscape unit
First Nations Houses	Volume harvested by First Nations House

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".

4. Division of the Area into Management Zones

"Crown forested land base" in Table 3 means the Crown forested area plus the forested area 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 6.1.3, "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, to support communications with First Nations.

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

Table 4. Definition of analysis units

Analysis unit identifier	Analysis unit (BEC variant – moisture class)	Site series
1	CWHws2 - Dry	02
2	CWHws2 - Fresh	01, 03, 05
3	CWHws2 - Moist	04, 06, 07, 08
4	CWHws2 – Very Moist	09, 11
5	CWHws2 – Wet	10
6	ESSFmc - Dry	02, 03
7	ESSFmc – Fresh	01, 04
8	ESSFmc – Moist	06, 07
9	ESSFmc - Wet	08, 09, 10
10	ESSFmk - Dry	02
11	ESSFmk – Fresh	01, 03
12	ESSFmk – Moist	04, 05
13	ESSFmk - Wet	07
14	ESSFwv - Dry	02, 03
15	ESSFwv – Fresh	01, 04
16	ESSFwv – Moist	05, 06
17	ESSFwv - Wet	07, 09
18	ICHmc1 - Dry	02
19	ICHmc1 - Fresh	01, 03, 04, 05
20	ICHmc1 - Wet	06
21	ICHmc2 - Dry	02
22	ICHmc2 - Fresh	01, 03, 04, 05, 06, 51, 52, 53, 54

(continued)

Table 4. Definition of analysis units (concluded)

Analysis unit identifier	Analysis unit (BEC variant – moisture class)	Site series
23	ICHmc2 - Moist	07
24	MHmm2 - Dry	02
25	MHmm2 – Fresh	01, 03, 05
26	MHmm2 – Moist	04, 06, 07
27	MHmm2 - Wet	09
28	SBSdk - Dry	02, 03
29	SBSdk - Fresh	01, 05, 06
30	SBSdk - Moist	07, 08
31	SBSdk - Wet	09, 10
32	SBSmc2 - Dry	02
33	SBSmc2 - Fresh	01, 03, 05, 06, 09
34	SBSmc2 - Moist	07, 10
35	SBSmc2 - 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*[4]) and similar stocking standard (re: November 2009 *Reference Guide for FDP Stocking Standards*[5]). Table 4 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).

[4] http://www.for.gov.bc.ca/hre/becweb/resources/classificationreports/subzones/index.html
[5] 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 Crown forested land base (CFLB) and the timber harvesting land base (THLB). The CFLB consists of provincial Crown land with forest cover that contributes to TSA objectives, such as landscape-level biodiversity.

The CFLB excludes:

- federal lands and reserves;
- long-term leases;
- woodlot licences
- private lands; and
- non-forested/non-productive lands.

The THLB is that portion of the Crown forested land base that is available for timber harvesting. The THLB excludes:

- parks and protected areas;
- areas that are not suitable for timber production; and
- areas 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 modelled in the timber supply analysis. The Crown forested land base outside of the THLB contributes to these other objectives.

Community Forest Agreements are usually excluded from the CFLB 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 CFLB because its large area makes significant contributions to landscape unit objectives. Section 6.4 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 Non-forest, non-productive forest and non-commercial cover

Table 5 shows the criteria used to remove non-forested areas, non-productive forest and non-commercial cover from the TLHB.

Table 5. Description of non-forest, non-productive forest and non-commercial cover areas

Attributes	Description
Non-forest	
Bulkley VRI BCLCS level 1 equal to 'N'	Non-vegetated
BCLCS level 2 = 'N' AND BCLCS level 4 not equal to 'ST or 'SL'	Non-treed, excluding shrub areas
BCLCS level 2 = 'N' AND BCLCS level 3 = 'W'	Non-treed wetlands
BCLCS level 3 = 'A'	Alpine
Non-productive forest	
FMLB indicator = "N"	Forested but not productive (low site productivity)
Non-commercial forest	
BCLCS level 2 = 'T' AND BCLCS level 3 = 'W'	Treed wetlands
BCLCS level 4 = 'ST or 'SL' AND no logging history	Shrub and not already logged

Data source and comments:

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

BC Land Classification System (BCLCS) attributes identify non-vegetated and various classes of vegetated areas. Non-forest areas include water, and non-vegetated land such as rock, ice and bare land. It is assumed that non-forested areas are not capable of growing forests. Non-commercial areas are generally covered by brush species and are also not considered suitable for timber production. All of these areas are excluded from both the Crown forested land base (CFLB) and the THLB; they do not contribute to objectives for wildlife habitat or biodiversity.

Non-productive forest is comprised of areas where the forest management land base (FMLB) indicator attribute is coded as "No". FMLB is coded "No" if the land base has no harvest history, and a site index < 5. These areas of low site productivity are considered non-productive, rather than sites with low timber growing potential (see Section 5.6), because they do not contribute to objectives for wildlife habitat or biodiversity. They are excluded from both the CFLB and THLB.

5. Timber Harvesting Land Base Definition

5.2 Land not administered for timber supply in the TSA

Land not administered for timber supply in the TSA includes private land, municipal land, federal land, Indian Reserves, and woodlot licences. These areas are all excluded from both the Crown forested land base (CFLB) and the THLB; they do not contribute to objectives for wildlife habitat or biodiversity.

The Bulkley file also includes Community Forest Licence, UREP/Recreation reserves, other miscellaneous reserves and leases, and parks and ecological reserves. The CFLB within these areas does not contribute to timber supply for the TSA; so is excluded from the THLB. However, the CFLB does contribute to objectives for wildlife habitat and biodiversity.

A spatial data set of land ownership was developed using information from the Crown Land Registry and the Integrated Cadastral Information Society. Table 6 shows the contribution of each ownership to the CFLB and the THLB.

Table 6. Ownership contributions

Ownership code	Crown forested land base	Timber 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 Use, Recreation and Enjoyment of the Public (UREP) Reserves	Yes	No
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:

- Ownership-schedule codes 62-C and 69-C indicate Crown land in a forest management unit and miscellaneous reserves, respectively. These are the only ownership codes that contribute to the THLB. Agricultural land reserve (ALR) area is included in ownership code 62C.

5. Timber Harvesting Land Base Definition

Ownership codes 77 and 79 indicate Crown land contained in a woodlot licence and Community Forest areas, respectively. The allowable annual cut for these areas is determined independently of the timber supply review process for the TSA. Their CFLB and THLB are normally excluded from the TSA for timber supply purposes.

However, the Wetzink'wa Community Forest makes significant contributions to landscape unit objectives in the TSA. Its' CFLB is removed from the TSA and tracked separately from the CFLB of the TSA. All subsequent land base removals to determine the THLB will also be applied to the community forest to determine its own THLB. This THLB is not included in the THLB for the TSA but it will be tracked as a separate zone (see Section 4.1, Management zones), to facilitate simulation of harvesting in the community forest (see Section 6.1.3, Harvest scheduling priorities).

Land base reductions identified in upcoming Sections 5.3 through 5.11 constitute removals from the THLB but not the CFLB. Their area is permitted to contribute to meeting objectives for wildlife habitat and biodiversity.

5.3 Environmentally sensitive areas

Table 7 shows the criteria and proportion of area considered to be unavailable for timber harvesting due to their environmental sensitivity.

Table 7. 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
Recreation	Recreational reserves (REC_TYPE = "RR" or "SIT" or "RTR")	100

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.

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 overestimated. District staff determined an appropriate reduction percent for Table 6 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 TSR 2 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 6 reduction percent 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 6 reduction percent 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 7 reduction percent for fans was determined using the same process as that employed for Class V terrain.

Reductions or forest cover constraints for other environmentally sensitive categories - wildlife, water, and fisheries - are addressed in Sections 5.2, "Land not administered for timber supply in the TSA", 5.11, "Riparian reserve and management areas", and 6.4.1, "Objectives with forest cover requirements".

5.4 Areas with high recreation values

In addition to Ownership Code 61 (Crown UREP reserves), other recreation reserves administered by the MFLNRO (i.e. commercial recreation areas, forest recreation sites and trails as identified in Table 8 are removed from the THLB. Linear features have been converted to polygons with a total width of 20 metres.

Visually sensitive areas (VSA) with a preservation visual quality objective (VQO) are removed from the THLB. Forest cover constraints associated with retention, partial retention, and modification VQO are described in Section 6.4.1, "Objectives with forest cover requirements".

Table 8. Recreational values

Category	Attributes	Reduction (%)
Visually sensitive areas	VQO = Preservation	100
Recreation	MTCA recreational reserves (REC_TYPE = "RR" or "SIT" or "RTR")	100

5.5 Areas considered inoperable

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 9 lists the operability classes that are excluded from the THLB.

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Table 9. Description of inoperable areas

Within "Woodlands" BEC subzone [6]	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.

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 modelled 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. Tables 10 and 11 describe HMM codes and their parameters[7].

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 10. Harvest method mapping "Harvest Method" and "Stand Quality" codes and descriptions

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

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

[7] These parameters have been revised from those used in the Bulkley TSR 2 process for better consistency with those used to originally define Bulkley's stand-quality based AAC partition, circa 1995.

Table 11. Parameters for harvest method mapping codes

Harvest method	Slope parameters	Stand quality	Description of parameters[8]
G	≤ 35%	S	(1) Pine and spruce-leading polygons (ITG 21-31) outside planning cell C7; (2) Fir-leading polygons (ITG 18-20) > 24 m height at 140 years, and site class medium or good; (3) All silviculture openings with a harvest history.
C	> 35 < 60%		
H	≥ 60 < 90%		
I	≥ 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
		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.

5.6 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 12.

[8] 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.

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Table 12. 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 prior to decadence. These can be categorized as "low" site class sites. The site index range by leading species in Table 12 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.

5.7 Problem forest types

Table 13 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 13. 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, 5.5, 5.6 and 5.7. Any remaining PFT stands are removed at this stage.

5.8 Wildlife habitat reductions

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 or WHA, 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 Section 7.0, "Sensitivity Analyses").
- 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), and indicates that the Ministry of Environment (MoE) may in future establish portions of WHMA as UWR. MoE (Skeena Region) staff advise that because the BVSRMP was established through a public process and mapped WHMA were included in the plan, UWR within WHMA areas may be established quickly without additional public process. UWR 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) 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; placement of WTP on or adjacent to south-facing slopes).

Forest cover constraints for mapped grizzly bear and caribou habitat are described in Section 6.4.1, "Objectives with 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. It is implicit that no harvest may occur within 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 14, 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 (WTP) and other reserves, or by avoidance during road and cutblock layout.

Table 14. Wildlife habitat exclusions

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

5.9 Cultural heritage resource reductions

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 First Nations information sharing, and to design, locate and time forest operations to protect CHR. 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.

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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 are anticipated to begin by November 2010. Proposed new management zone mapping is anticipated to be available at that time. A sensitivity analysis will test timber supply impacts within Bulkley TSA (see Section 7.0, "Sensitivity Analyses").

5.10 Exclusion of specific, geographically defined areas

Table 15 describes additional areas to be excluded from the timber harvesting land base to account for area exclusions not discussed in previous sections.

Table 15. Exclusion of specific, geographically defined areas

Description	Attributes	Reduction (%)
Special management zone 1 areas	RMZ_TYPE2 = 'SMZ1'	100
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 16	100
Blue-listed ecological communities in core ecosystems	FEN = 'CE' for blue-listed ecological communities listed in Table 16	100
Blue-listed ecological communities in Copper River SMZ2	RMZ_SUB = '12-2' for blue-listed ecological communities listed in Table 16	70

Data source and comments:

Special Management Zone 1 areas were established as no-harvest areas through the Bulkley LRMP Higher-Level Plan Order (2000). They are removed from the THLB.

A *Government Actions Regulation* (GAR) process was initiated then discontinued for the protection of research installations, growth and 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 licensee practice is to avoid research installations and not include in WTP or other reserves, because these are managed for research purposes so are not characteristic of the natural forest over a rotation. Because growth and yield plots and permanent sample plots could potentially be included in WTP or other reserves, they 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 15. 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 15. Table 16 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 15.

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Table 16. 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’)

(continued)

Table 16. Red- and blue-listed ecological communities (concluded)

Description	Red or Blue	Attributes
(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')

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.

5.11 Riparian reserve and management areas

Table 17 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 17. 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 17 criteria[9] 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.

[9] 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 17 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 modelled in the original GIS project: it is approximated by requiring a higher RMZ reduction percent 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.

5.12 Wildlife tree patches

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 18.

Table 18. Reductions for wildlife tree retention in cutblocks

Landscape unit or applicable area	BEC subzone	Reduction (%)
Telkwa Landscape Unit (LU)*	CWHws2	3
Copper LU	CWHws2	5
Copper, Deep Creek, Nilkitkwa, Reiseter LU	ESSFmc	1
Babine, Blunt, Harold Price, Telkwa, Torkelson LU	ESSFmc	3
Bulkley Valley*, Chapman LU	ESSFmc	5
Telkwa LU	ESSFmk	1
Corya, Harold Price, Telkwa, Trout Creek/ Kitseguecla LU	ESSFwv	1
Copper LU	ESSFwv	3
Harold Price LU	ICHmc1	1
Bulkley Valley, Corya LU	ICHmc1	3
Reiseter, Trout Creek/ Kitseguecla LU	ICHmc1	7
Harold Price LU	ICHmc2	1
Trout Creek/ Kitseguecla LU	ICHmc2	3
Bulkley Valley, Corya, Reiseter LU	ICHmc2	5
Copper LU	MHmm2	1
Deep Creek, Trout Creek/ Kitseguecla LU	SBSdk	1
Reiseter, Telkwa LU	SBSdk	3
Bulkley Valley LU	SBSdk	5
Trout Creek/ Kitseguecla LU	SBSmc2	1

(continued)

Table 18. Reductions for wildlife tree retention in cutblocks (concluded)

Landscape unit or applicable area	BEC subzone	Reduction (%)
Deep Creek LU	SBSmc2	3
Copper, Nilkitkwa, Reiseter LU	SBSmc2	5
Babine (outside Babine SMZ2 within PIR Forest Development Unit), Blunt, Bulkley Valley, Harold Price Telkwa, Torkelson LU	SBSmc2	7
Chapman LU	SBSmc2	11
Babine SMZ2 within PIR Forest Development Unit	SBSmc2	34
Telkwa Caribou Herd Recovery Area*	All ESSF	30
	All SBS	20

* Reduction % levels for Telkwa and Bulkley LU apply to portions of LU that are outside the Telkwa Caribou Herd Recovery Area. Different levels apply within.

Data source and comments:

The Table 18 reduction percent 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 strategy is addressed in this section. BCTS' strategy is addressed in Section 6.4.1, "Objectives with forest cover requirements".

PIR 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 19.

Table 19. 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 >15 cm DBH.

An average retention percent for all Babine SMZ2 cutblocks was calculated by converting target #trees/ha to a percent 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).

5. Timber Harvesting Land Base Definition

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 patches (WTP). In general, WTP are in patches two hectares or larger which are assumed to contribute toward old forest representation. WTP are assumed to persist for multiple rotations, so are removed from the THLB as a percentage reduction to harvested stand area.

5.13 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 20 shows the reductions made for existing and future RTL.

Table 20. 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 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 and landings will be converted to a buffer-area attribute of the adjacent polygons.

Since 1992, Pacific Inland Resources (PIR) has successfully reforested 202 decompacted landings (totalling 80.4 hectares) across Bulkley TSA[10]. These landings are now not visibly different from the productive forest, so were not included in the spatial landings file.

[10] 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.

5. Timber Harvesting Land Base Definition

Estimates for future roads, trails, and landings were derived using RESULTS and GENUS queries of total area of Permanent Access Structure (PAS), as percent 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 their operators primarily use low ground-pressure tracked forwarding equipment, most logging is done in winter versus summer, and roadside pile areas are usually burnt and replanted within a season of harvest.

6. Current Forest Management Assumptions

6.1 Harvesting

6.1.1 Merchantability limits

The merchantability limits in Table 21 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 21. Merchantability limits

	Utilization			
Analysis unit	**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 21 is reflective of current merchantability limits set in Bulkley TSA's forest licences. 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 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 22 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 22. 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) totalled to only 4060 cubic metres over the past 10 years in the Bulkley TSA. It was concluded that deciduous volumes in pure- and mixed-species stands can reasonably be excluded from consideration.

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 the 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 23 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 23. Minimum harvestable age criteria

Analysis unit	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.

"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 overriding 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. Current Forest Management Assumptions

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 licence requirements. Table 24 describes harvest scheduling priorities, and states the time period over which this priority applies.

Table 24. Priorities for scheduling the harvest

Description	Management zone or location	Decade	Priority 1 – 100 or harvest level
Wetzink'wa Community Forest	OWN_SCHED = '79B'	0.5	1 max 95,000 m3 annual harvest
		0.5 - 1.5	1 max 15,000 m3 annual harvest
		1.5 - 25	1 max 30,000 m3 annual harvest
All pine analysis units in accessible areas of MPB infestation	SEVERITY = 'T' or 'L' or 'M' or 'S' or 'V' **AND** IN_1KM = "YES"	1 - 2	1
M/P Partition; existing access	Harvest Method Mapping "GM" or "GP", **AND** IN_1KM = "YES"	1 - 9	2 minimum 41% of annual harvest
M/P Partition; no existing access	Harvest Method Mapping "M" or "P"	10 - 25	2 minimum 41% of annual harvest
Remaining stands	All	All	3
Babine Special Management Units	Boucher Creek	1, 6, 11, 16, 21	max 50% of area, each return
	Nichyeskwa North	2, 7, 12, 17, 22	max 50% of area, each return
	Nichyeskwa South	3, 8, 13, 18, 23	max 50% of area, each return

Data source and comments:

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 m^3, for five 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 m^3/year is applied in the community forest for the first five years, followed by a 10-year period during which harvest is decreased to 15 000 m^3/year prior to returning to the 30 000 m^3/year long-term level.

6. Current Forest Management Assumptions

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 m^3/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.

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.

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 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 nine decades to deplete at 41% of the 2001 analysis long-term annual harvest area rate (2000 hectares/year).

- "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.

The purpose of the Babine Special Management Units is to provide opportunity for grizzly movement with minimal human disturbance between important landscape features in the Boucher Creek Wetlands and Nichyeskwa Creek areas. Best management practice for these areas is a two-pass system: 5 year/50% first harvest, followed by a 50-year harvest deferral, followed by another 5 year/50% pass. Boucher Creek is of immediate harvest focus because it has a relatively higher component of MPB-infested pine.

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. Current Forest Management Assumptions

6.2 Unsalvaged Losses

6.2.1 Wildfire and windthrow

Table 25 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 25. 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 modelling MPB losses is taken as described in Section 6.2.2.

The following unsalvaged loss assumptions were developed for the 2001 analysis, and were found upon review by district staff to be appropriate for this analysis. Consistent with the Smithers Community Forest Timber Supply Assessment[11], unsalvaged losses attributable to the Wetzink'wa Community Forest account for 6.9% (i.e. the proportion of Community Forest THLB to Bulkley TSA THLB) of Table 25 values and impacts discussed in Section 6.2.2, "Mountain Pine Beetle", to a maximum of 3300 m^3/year.

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 2800 m^3. It is estimated that approximately 10% of this volume is salvaged, which leaves an annual unsalvaged loss of about 2600 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/hectare in the undisturbed forest, and determined that windthrow associated with cutblock edges accounts for 4.14 m^3 per hectare of harvested area. The net increase in windthrow due to harvesting is thus 4.14 - 0.718 = 3.422 m^3/ha. At the 2001 analysis long-term annual harvest area rate (2000 hectares/year) this equates to a net annual loss of about 6800 m^3 that is not accounted for by the inventory.

It is estimated that 20% of cutblock edge-induced windthrow is salvaged, leaving an annual unsalvaged loss of about 5500 m^3. Windthrow associated with catastrophic wind events is likely to be salvaged so was not included in this analysis.

[11] Industrial Forest Service Ltd. April 2006. Smithers Proposed Community Forest Sustainable Harvest Level Review, Version 1.3.

Balsam Bark Beetle

The last TSR contained an unsalvaged loss estimate for balsam bark beetle. Study results gathered and analysed 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 TSAs, 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 (OAF 2) applied to TIPSY yield curves (Section 6.3.1).

6.2.2 Mountain Pine Beetle (MPB)

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 two decades, with the exception of a few infestation pockets.

6. Current Forest Management Assumptions

It is assumed that major licensees will target all currently infested, red or dead sawlog potential Pli-leading stands for harvest over the next two 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 the following table.

Table 26. 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 five 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 will revert to their previous historic levels as defined for TSR 2 (3000 m^3/year).

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 TSAs (such as Bulkley) on the edges of the MPB epicentre 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 in the Interior Cedar-Hemlock (ICH) biogeoclimatic zone. 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 27.

Table 27. 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.	1851
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		3115

The stands in each management class will be modelled 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 28 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.

6. Current Forest Management Assumptions

Table 28. Regeneration assumptions by analysis unit

Managed stand analysis unit	Regen delay	OAFs		Regen method		Species		SIBEC mean site index	Stocking standard target density	Discounted actual density
		1	2	Type	%	Code	%			
CWHws2 – dry	1	15	5	Plant	100	Pl	40	12	600	(600)
						Hw	40	12		
						Cw	20	8		
CWHws2 - fresh	1	15	5	Plant	100	Sx	50	20	900	3200
						Ba	20	21.3		
						Hw	15	18.1		
						Pli	15	19.7		
CWHws2 - moist	1	15	5	Plant	100	Sx	40	24.8	900	3400
						Ba	20	24.8		
						Hw	20	24		
						Bl	20	24.8		
CWHws2 – very moist	1	15	5	Plant	100	Sx	70	12	800	800
						Cw	15	12		
						Ba	15	12		
CWHws2 – wet	1	15	5	Plant	100	Pli	80	12	400	400
						Cw	20	8		
ESSFmc – dry	1	15	5	Plant	100	Pli	80	13.5	1000	8900
						Bl	20	13.3		
ESSFmc - fresh	1	5	5	Plant	100	Sx	40	15.3	1200	2000
						Bl	40	13.7		
						Pli	20	16		
ESSFmc - moist	1	5	5	Plant	100	Sx	45	11.7	1200	1600
						Bl	35	14.9		
						Pli	20	18.3		
ESSFmc – wet	1	15	5	Plant	100	Sx	55	12.6	1000	2000
						Bl	45	10.8		
ESSFmk – dry	1	15	5	Plant	100	Pli	80	9	1000	1000
						Bl	20	9		
ESSFmk - fresh	1	15	5	Plant	100	Bl	50	11.4	1200	1200
						Sx	30	11.4		
						Hm	20	11.4		
ESSFmk - moist	1	15	5	Plant	100	Bl	50	12	1200	1200
						Sx	30	12.8		
						Hm	20	12		
ESSFmk – wet	1	15	5	Plant	100	Bl	60	9	1000	1000
						Sx	40	9		
ESSFwv – dry	1	15	5	Plant	100	Pli	80	9	1200	2500
						Bl	20	9		
ESSFwv - fresh	1	5	5	Plant	100	Sx	50	14.8	1200	2200
						Bl	30	11.4		
						Pli	20	15		

(continued)

6. Current Forest Management Assumptions

Table 28. Regeneration assumptions by analysis unit

Managed stand analysis unit	Regen delay	OAFs		Regen method		Species		SIBEC mean site index	Stocking standard target density	Discounted actual density
		1	2	Type	%	Code	%			
ESSFwv - moist	1	15	5	Plant	100	Sx	50	12.4	1200	2000
						Bl	30	12		
						Pli	20	12.4		
ESSFwv – wet	1	15	5	Plant	100	Bl	60	9	1000	3500
						Sx	40	9		
ICHmc1 – dry	1	15	5	Plant	100	Pli	80	19.6	1000	5300
						Hw	20	17.1		
ICHmc1 - fresh	1	15	5	Plant	100	Sx	50	23.3	1200	2200
						Hw	20	18.5		
						Bl	15	18.8		
						Pli	15	22.4		
ICHmc1 – wet	1	15	5	Plant	100	Sx	55	21	1000	1000
						Bl	25	15		
						Hw	20	15		
ICHmc2 – dry	1	15	5	Plant	100	Pli	80	15	1000	1000
						Hw	20	12		
ICHmc2 - fresh	1	15	5	Plant	100	Sx	65	22.3	1200	2600
						Pli	20	21.8		
						Hw	15	18.4		
ICHmc2 - moist	1	15	5	Plant	100	Sx	65	21	1000	3100
						Bl	20	15		
						Hw	15	15		
MHmm2 – dry	1	15	5	Plant	100	Hm	80	8	800	5800
						Ba	20	8		
MHmm2 - fresh	1	15	5	Plant	100	Ba	70	12.6	900	6800
						Hm	15	12.6		
						Bl	15	12.6		
MHmm2 - moist	1	15	5	Plant	100	Hm	50	8	900	900
						Ba	30	8		
						Bl	20	8		
MHmm2 - wet	1	15	5	Plant	100	Hm	80	8	800	800
						Yc	20	(8)		
SBSdk - dry	1	15	5	Plant	100	Pli	80	16.1	1200	3600
						Sx	20	14.9		
SBSdk - fresh	1	5	5	Plant	100	Pli	60	20.3	1200	2400
						Sx	20	18.8		
						At	20	(20)[12]		
SBSdk - moist	1	15	5	Plant	100	Sx	80	20	1000	1000
						Pli	20	21.7		
SBSdk - wet	1	15	5	Plant	100	Sb	60	14.6	400	400
						Sx	20	14.6		
						Pli	20	12		

(continued)

[12] 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.

Table 28. Regeneration assumptions by analysis unit (concluded)

Managed stand analysis unit	Regen delay	OAFs		Regen method		Species		SIBEC mean site index	Stocking standard target density	Discounted actual density
		1	2	Type	%	Code	%			
SBSmc2 - dry	1	15	5	Plant	100	Pli	80	16.2	1000	4300
						Bl	20	12		
SBSmc2 - fresh	1	5	5	Plant	100	Pli	50	19.3	1200	2200
						Sx	35	19.3		
						Bl	15	15.6		
SBSmc2 - moist	1	5	5	Plant	100	Sx	50	18.6	1000	1900
						Bl	30	19		
						Pli	20	18.8		
SBSmc2 - wet	1	15	5	Plant	100	Sx	50	(12)	400	400
						Sb	50	(12)		

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 one-year old seedling three years after the beginning of harvest signifies a two 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 one 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.

- OAF 1 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 OAF 1 study determined that an OAF 1 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[13]. Table 28 captures these recommendations.
- OAF 2 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 OAF 2 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 4, Definition of analysis units and the November 2009, *Reference Guide for FDP Stocking Standards*[14]) is captured in this column.

[13] Laing & McCulloch Forest Management Services. 2003. OAF1 Sampling in the Bulkley, Lakes and Morice Forest Districts.

[14] http://www.for.gov.bc.ca/his/results/fsp_sss.htm

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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, % - those MSAU's with high discounted actual density (e.g. greater than or equal to 2000 stems per hectare) are presumed to have a significant component of natural regeneration.

Stands with high discounted actual density will have a component of evenly-spaced planted stems (to target stocking levels), and a component of more clumpily-distributed natural regeneration. In an operational situation, the full volume potential of the stand is unlikely to be achieved because planted stems will be in direct competition for light, moisture, and nutrient supply with natural regeneration.

TIPSY provides both "Plant" and "Natural" yield curve options.

- "Plant" yield curves assume an idealized even stem distribution pattern, with no plantation gaps.
- "Natural" yield curves assume a clumped stem distribution pattern, with plantation gaps between clumps.
- For the same number of modelled regenerated stems and all other assumptions kept the same, "Plant" yield curves will tend to predict >= 20% higher volumes by minimum harvest age than "Natural" yield curves.
- The lower "Natural" volume prediction is mostly associated with incomplete stocking. The interaction behavior between individual stems within clumps, and implications to full achievement of volume potential, is not a consideration in TIPSY.

Because modelling of potential plantation gaps is already addressed by OAF 1 adjustments, the choice was made to use TIPSY "Plant" yield curves only (versus a hybridization of "Plant" and "Natural" curves).

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 28 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 where "Acceptable" species exceeded 20% of the WASC.

- 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).*

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 28.

- 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*[15]
- 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.

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.

The following process is used for MSAU yield curve generation. Table 28 inputs for the ICHmc2-fresh MSAU are used in the example:

- Assume the MSAU is 100% planted to the discounted actual density (e.g. 2600 stems/ha), using species composition per the species code and species percent figures shown (e.g. 65% Sx/ 20% Pli/ 15% Hw), and using the SIBEC mean site index for individual species (e.g. Site Index 22.3, 21.8, and 18.9 for Sx, Pli and Hw, respectively). Adjust the subsequent MSAU yield curves using the OAF 1 and OAF 2 percentages provided (e.g. 15% and 5%);
- Where species codes for a MSAU include Pli and/or Sx, apply genetic gain to just the Pli/Sx component of stocking standard target density in reference to Section 6.3.2, "Genetic gain from using Class A seed" assumptions (e.g. Sx genetic gain is applied to 65% of stocking standard target density = 65% x 1200 stems/ha; Pli genetic gain is applied to 20% x 1200 stems/ha).

6.3.2 Genetic gain from using class A seed

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.

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

6. Current Forest Management Assumptions

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 29 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.

Table 29. 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

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 modelled using the regeneration assumptions outlined in Table 28.

6.3.4 Not satisfactorily restocked (NSR) 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 30 shows assignment logic.

Table 30. Assignment of depletion status

OPEN_REC (Assigned Status)	STOCK_STATUS	STOCK_TYPE	OPEN_STAT
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

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 hectares 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 percent figures for MSAU, no additional special modelling measures are taken.

There are 157 UNK depletions. Following further investigation, all UNK openings will be reassigned to one of the other depletion categories.

6. Current Forest Management Assumptions

6.4 Integrated resource management

6.4.1 Objectives with 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 31 describes the forest cover requirements to be applied.

Table 31. Forest cover requirements

Resource objective	Area target	Condition target	Affected land base
Caribou – key forested Caribou Habitat	Minimum 90%	age > 50 yrs	Crown forested land base for each habitat unit
Grizzly high-value habitat	Minimum 80%	age > 50 yrs	Crown forested land base for each habitat unit
Grizzly mixed-forest habitat	Maximum 25%	ht < 3 m	Crown forested land base for each habitat unit
Babine SMZ2 within BCTS Forest Development Unit (FDU)	Minimum 30%	age > 140 yrs	Crown forested land base within BCTS FDU
Core ecosystems	Maximum 5%	age < 50 yrs	Crown forested land base for each core ecosystem
Landscape corridors	Minimum 70%	age > 80 yrs	Crown forested land base for each corridor element
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, community watersheds, core ecosystems, and landscape corridors
Seral stage distribution	See Table 33		Crown forested land base by landscape unit and BEC variant
Visual quality objectives	Maximum allowable disturbance in plan view for individual VSU	height ≤ mean visually effective green-up height for individual VSU	Crown forested land base for each visual sensitivity unit (VSU)

6. Current Forest Management Assumptions

Data source and comments:

Crown forested land base includes the forested land base of the Wetzink'wa Community Forest. THLB includes the THLB of the Community Forest. See Section 4.1, "Management zones" and Section 5.2, "Land not administered for timber supply in the TSA".

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.

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 modelling 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.

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 5.11), 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 31.

Table 32 lists Bulkley TSA's five established fisheries sensitive watersheds (FSW) and describes FSP commitments for their management.

6. Current Forest Management Assumptions

Table 32. Fisheries sensitive watersheds

FSW_NAME	FSP commitment		
	Equivalent clearcut area (ECA) 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 is for continued hydrologic stability. Resetting 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 modelled as such for the base case.

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

Table 33 describes legal seral stage distribution targets that will be directly modelled. They 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.

6. Current Forest Management Assumptions

Table 33. Seral-stage targets by landscape unit and BEC subzone

Landscape unit	BEC subzone	Natural disturbance type (NDT)	Minimum old[16] (%)	Minimum mature[17] + old (%)	Maximum young[18] (%)
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

(continued)

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

[17] 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

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

Table 33. Seral-stage targets by landscape unit and BEC subzone (concluded)

Landscape unit	BEC subzone	Natural disturbance type (NDT)	Minimum old[19] (%)	Minimum mature[20] + old (%)	Maximum young[21] (%)
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

Visual quality objectives

Scenic areas and their visual quality objectives (VQO) were established under the *Forest Practices Code Act* and grandparented under the *Forest and Range Practices Act*[22].

This section describes the approach used to determine the Table 31 forest cover constraints for allowable percent alteration of scenic areas from a planimetric or "plan" view, and minimum visually effective green-up (VEG[23]) heights. The approach is a mathematical approximation of the art of designing cutblocks within Bulkley TSA's scenic areas to address VQO 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.

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

[20] 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.

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

[22] On review it was determined that Bulkley scenic areas and VQO 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.

[23] 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 34 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) 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[24].

Table 34. Assignment of visual quality objectives

VQO	Maximum % alteration (perspective view)
Preservation	See Table 8
Retention	1.5
Partial retention	7
Modification	18

The percent alteration in perspective view from Table 34 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 32. 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 35. 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 that are at or below their mean VEG height.

[24] 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 VQOs. 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.

Table 35. 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.

Disturbance outside of the timber harvesting land base

Some forest cover requirements described in Table 31 apply to the Crown forested 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 Crown forested land base outside the THLB is comprised of mature and old seral age classes. Stands less than 20 years of age comprise less than one percent of this land base[25], 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 Crown forested land base outside the THLB shall be frozen. An alternative would be to allowing this land base to continue aging indefinitely, but an outcome of the alternative approach would be that the model would falsely allow more and more landscape-level mature and old-seral requirements to be achieved outside the THLB.

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

7. Sensitivity Analyses

Sensitivity analyses assess the timber supply impact of uncertainty in data and management assumptions. Table 36 lists the sensitivity analyses to be performed.

Table 36. Sensitivity issues

Issue to be tested	Sensitivity levels
Harvest flow	Various alternatives to the base case
Modelling disturbance to Crown forested land base outside the THLB	Assume that stands revert to age 0 upon reaching a maximum age of 350 years in NDT1, 200 years in NDT2, and 140 years in NDT3
New WHA for Telkwa Caribou Herd	Test timber supply implications of proposed new zonations and revised constraints
New Gitsegukla SRMP zones	Test timber supply implications of proposed new zonations and revised constraints
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
Alternate representation of “current management”	Apply the forest cover constraints used for the Bulkley LRMP Analysis/ Bulkley TSR 2 to all HLP zones
Visuals management	Test implication of full adherence to “Procedures for Factoring Visual Resources into Timber Supply Analyses”
Alternative approach to modelling 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
Volume estimates for existing stands	Test existing volumes (VDYP) +10%

7. Sensitivity Analyses

Data source and comments:

New WHA for Telkwa Caribou Herd – proposed changes include new and more limiting early and mature seral constraints (applicable to BEC variant by WHA area versus the broader BEC variant by landscape units) and a new and large no-harvest natal protection zone. These additional constraints may be partly offset by lightening of previous constraints for selected zones within the WHA area.

- 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 will not create new early seral. Present WHA Order does not enable increased flexibility to salvage harvest, thus higher level of NRL may occur.

Alternative approach to modelling 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[26].

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.

A general sensitivity analysis on existing stand volumes will be used in conjunction with estimates of dead potential to determine the impact of the log grade changes implemented in 2006.

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

- Moderate-value Grizzly Bear habitat;
- High-value Mule Deer habitat;
- Babine SMZ2;
- Reiseter SMZ2;
- Fish-sensitive watersheds;
- Retention, partial retention VQO;
- Riparian management zones.

[26] 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.