# Kalum Timber Supply Area
# Timber Supply Review

## Updated Data Package following completion of the timber supply analysis

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BRITISH COLUMBIA
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Ministry of
Forests and Range

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# 1. Introduction

This data package summarizes the information and assumptions that were used to conduct timber supply analysis for the Kalum 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 (i.e., Kalum Land and Resource Management Plan);
- legal objectives established under the *Forest and Range Practices Act* and the *Land Act* (i.e., Kalum Sustainable Resource Management Plan, wildlife habitat areas, and ungulate winter ranges).

The purpose of the timber supply review program is to model "what is", as opposed to "what if." Changes in forest management objectives and data, when and if they occur, will be captured in future timber supply analyses.

Each section of this data package contains:

1) a short explanation of the data required;
2) a data table or list of modelling assumptions;
3) a description of data sources and other comments.

A draft of this data package was released for public review in May 2009. A number of developments have since occurred that change some of the assumptions used in the timber supply analysis. Any changes are noted in the appropriate section of this version of the data package.

# 2. Current Forest Management Considerations and Issues

## 2.1 Base case management assumptions

The assumptions described in this data package reflect current performance with respect to the status of forest land, forest management practices and knowledge of timber growth and yield. The harvest forecast developed from these assumptions is the base case harvest forecast and is used as a baseline for assessing the impacts of uncertainties. Section 7, "Sensitivity Analysis" identifies areas of uncertainty in the data and assumptions and outlines sensitivity analyses that are carried out.

## 2.2 Major forest management considerations and issues

Table 1 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 |
|---|---|
| Land use zones | The Kalum Land and Resource Management Plan (LRMP) received final approval in May 2002. It recommends the establishment of new protected areas, which were legally established in May 2004. The Kalum LRMP also recommends land use zones that were legally established in the Kalum Sustainable Resource Management Plan (SRMP) in April 2006 as orders under the *Land Act* or the *Forest and Range Practices Act*. These include special resource management zones and community watersheds. |
| Biodiversity | The Kalum SRMP was approved on April 28, 2006. It establishes legal objectives and targets for: seral stage distribution; old forest retention; wildlife tree retention; species composition; temporal and spatial distribution of cutblocks; landscape connectivity; and rare ecosystems on the Skeena Islands. |
| Wildlife habitat | The Kalum SRMP establishes an objective and targets for grizzly bear habitat in specific watersheds. Ungulate Winter Ranges (UWR) for mountain goat and Wildlife Habitat Areas (WHA) for tailed frog have been established under the *Forest and Range Practices Act*. These are included as appendices of the Kalum SRMP. |
| Visual resources | The Kalum SRMP describes the goal and summarizes the guidelines for managing visual resources. |
| Operability | A new operability study classifies areas by harvest method and stand quality. |
| Riparian areas | Riparian reserve and management zones have management requirements under the *Forest and Range Practices Act*. |
| Insects and diseases | Dothistroma needle blight is causing mortality in young pine stands in the Kalum TSA. The analysis addresses the changes in species composition and stand ages that are predicted to occur.<br>Mountain pine beetle is significantly impacting older pine stands in the TSA. The analysis addresses the impact of this damaging agent. |

| Consideration/issue | Description |
|---|---|
| Site productivity | The site productivity of old-growth stands has been shown to underestimate the productivity of regenerated stands. Site index adjustments are applied to existing old-growth hemlock stands following harvest in the timber supply model. |
| Wood quality | Forests in the Kalum TSA contain a high proportion of pulplog-quality timber, but pulplog markets have been poor in recent years. This can lead to sustainability issues when harvesting activities focus on sawlogs. Although the original data package proposed exploring a potential partition of the AAC into sawlog stands and non-sawlog stands, subsequent analysis determined that this is not warranted. |
| Transition to second growth | In response to current economic conditions and difficulty accessing high-value stands, there is considerable interest in harvesting second-growth timber. This affects the stands targeted for harvest in the model. This issue is explored in sensitivity analysis. |
| Harvest availability | The availability of harvest volumes within landscape units is reported. |
| Cedar | There are concerns about the sustainability of cedar harvesting and the amount of cedar being regenerated. Cedar standing and harvested volumes are tracked in the timber supply model. |

# 3. Inventories

Table 2 lists the inventories that are used to determine the timber harvesting land base (THLB) and to model forest management activities. These inventories are listed in the order in which they are first used in this document.

*Table 2. Inventory information*

| Data | Source | Vintage | Update |
|---|---|---|---|
| Timber supply area boundary | LRDW[a] | 2009 | |
| Nisga'a final agreement boundaries | MFR[b], Kalum District | 2000 | |
| First Nations house and territory boundaries | MFR Northern Interior Forest Region and Skeena Stikine District | 2009 | |
| Ownership | MFR, Forest Analysis and Inventory Branch | 2009 | |
| Research installations and growth & yield plots | MFR Research Branch | 2009 | |
| Forest recreation sites and trails | LRDW and Haisla | 2009 | |
| Vegetation resource inventory | LRDW | 1992/99 | 2008 |
| Depletion layer | LRDW/RESULTS and MFR Forest Analysis and Inventory Branch | 2007 | |
| Environmentally sensitive areas | MFR Kalum District | 1976 | 1989 |
| Terrain stability mapping | MFR Kalum District | 2000's | |
| Areas without terrain stability mapping | MFR Kalum District | 2006 | |
| Harvest method mapping (HMM) | MFR Kalum District | 2006 | |
| Inaccessible areas | MFR Kalum District | 2006 | |
| Wildlife habitat areas – tailed frog | LRDW | 2004-6 | |
| Ungulate winter ranges – mountain goat | LRDW | 2008 | |
| Kalum SRMP special resource management zones, grizzly bear identified watershed, connectivity corridors, undeveloped watershed | ILMB[c] data warehouse | 2006 | |
| Riparian stream classification mapping | MFR Kalum District | 2000's | |
| Areas with no stream classification | MFR Kalum District | 2009 | |
| Riparian buffers | MFR Northern Interior Forest Region | | |

[a] LRDW – Land and Resource Data Warehouse
[b] MFR – Ministry of Forests and Range
[c] ILMB – Integrated Land Management Bureau

| Data | Source | Vintage | Update |
|---|---|---|---|
| Community watersheds – existing and new | LRDW | 2006 | |
| Visual landscape inventory | MFR Northern Interior Forest Region | 2008 | |
| Landscape units | LRDW | 2006 | |
| Biogeoclimatic ecosystem classification | LRDW | 2009 | |
| Old growth management areas | LRDW | 2008 | |
| Skeena Islands rare ecosystems | MOE[d] Skeena Region | 2004 | |
| Dothistroma risk mapping | MFR Kalum District | 2006 | 2008 |

**Data source and comments:**

Ownership is a custom layer created by Forest Analysis and Inventory Branch using information from the Crown Land Registry and the Integrated Cadastral Information Society. It includes woodlot licences and community forest licences (which have their AACs set outside of the timber supply review process for TSAs), UREP/recreation reserves, private lands, federal lands, Indian Reserves, and parks and protected areas, including 22 new protected areas created since the last timber supply review as a result of the Kalum LRMP. The ownership data are adjusted to ensure that certain reserves are still available for forest management (e.g., community watersheds).

Volumes and heights in the Vegetation Resources Inventory have been statistically adjusted using the results of *Penner, M. 2009. The Implementation of the Inventory Adjustment Strategy – Kalum TSA*. In addition, yield tables for adjusted and unadjusted stands were calculated for each stand and attached to the VRI file.

A forest cover depletion layer is used to update the forest cover for recent harvesting and other depletions. It is created from RESULTS openings and harvest history and a remote sensing change detection layer.

ESA mapping was generated as part of forest cover in 1976 and updated in 1989.

Terrain Stability Mapping is an amalgamation of projects completed in Arc/Info or similar format. Other projects completed in earlier formats (such as Pamap or Microstation) are not included in the amalgamation. The amalgamated map is used to identify areas with no TSM, where ESA mapping for sensitive soils is used.

Forest Recreation Sites and Trails are administered by the Ministry of Tourism, Culture and the Arts. Linear features are converted to polygons with a width of 20 metres.

Harvest Method Mapping (HMM) is used to identify which areas are operable. Associated with this data set is the buffered stream data used to determine riparian land base reductions. A separate data layer identifies areas that are inaccessible due to isolation, distance, physical barriers or the scattered nature of operable timber.

Wildlife habitat areas and ungulate winter ranges are mapped and established by Ministry of Environment.

The Kalum Sustainable Resource Management Plan (SRMP) was approved on April 28, 2006. It legally implements some of the recommendations from the Kalum Land and Resource Management Plan (LRMP). Its mapping products and objectives are used to determine the timber harvesting land base or to apply forest management requirements.

Riparian stream classification mapping is an amalgamation of all of the stream classifications produced to date by licensees as part of their operational planning under the *Forest Practices Code Act* and the *Forest and Range Practices Act*. An additional map was created from this data to identify those areas which do not have stream classifications.

[d] MoE – Ministry of Environment

Community watersheds are established to protect licensed water works.

Visual landscape inventory identifies areas to be managed using visual quality objectives. A slope map is used to determine the maximum allowable disturbance for each area.

Old growth management areas (OGMAs) established in 2006 through the Kalum SRMP, and subsequently amended in May, 2007 are accounted for in the analysis. The OGMA's represent 'old seral' requirements put forward in the Kalum SRMP.

Skeena Islands rare ecosystems mapping classifies stands into stand types and conservation ranks.

First Nations boundaries are used for reporting harvest levels.

Dothistroma needle blight risk mapping, completed in 2006 and updated in 2008 is utilized in the analysis.

# 4. Division of the Area into Management Zones

## 4.1 Management zones and objectives

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

Table 3 outlines the zones or objectives incorporated into the timber supply model. Further information on the forest cover requirements to be applied to these areas can be found in Section 6.6, "Integrated resource management."

*Table 3. Objectives to be tracked*

| Objectives | Inventory definition |
|---|---|
| Grizzly bear habitat | Forested land base by Grizzly Bear Identified Watershed mapping from Kalum SRMP. |
| Patch size distribution | Number of harvest passes by landscape unit in the timber harvesting land base. |
| Community watersheds | Forested land base of community watersheds. |
| Lakelse River Special Resource Management Zone | Forested land base of the Lakelse River SRMZ. |
| Visual quality objectives | Forested land base in each visual unit. |
| Old forest retention in undeveloped watersheds | Forested area by BEC variant. In the Jesse-Emsley watershed. |
| Mature+old and early seral stage distributions | Forested area by landscape unit and BEC variant. |
| Rare ecosystems around the Skeena Islands | Mapped zones from Skeena Islands Project. |
| Harvest by stand quality class | Stand quality classes from harvest method mapping. |
| Harvest by age class | Age classes: 1-140, 141-250, 250+ |
| Harvest by landscape unit | Landscape units. |

**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 6.6, "Integrated resource management".

The Kalum SRMP specifies old forest requirements by ecological site series for undeveloped watersheds, specifically the Jesse-Emsley watershed in the Kalum TSA. The original data package proposed to apply the requirement to the forested area of each BEC variant. Subsequent analysis showed that the old forest requirements could be met entirely outside of the timber harvesting land base, so the requirements are not applied. See "Seral Stage Requirements" in Section 6.6.1 "Forest Cover Requirements" for additional detail.

Harvest by age class and landscape unit is used to track the availability of timber. The original data package proposed the use of 20-year age classes, but this has been simplified to the age classes shown.

## 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 stands are derived using the Variable Density Yield Prediction (VDYP) model. Yield tables for recent plantations and future stands are derived using the Table Interpolation Program for Stand Yields (TIPSY).

Table 4Table 4 shows the criteria for defining the analysis units for existing natural stands. Site index ranges for analysis units have been determined for the full timber harvesting land base.

*Table 4. Definition of analysis units for existing natural stands*

| Analysis unit (leading species and site class) | | Site index range (m @ 50 years) | Analysis unit (leading species and site class) | | Site index range (m @ 50 years) |
|---|---|---|---|---|---|
| A1 | Cottonwood – good | ≥ 32.0 | M1 | Mountain Hemlock – good | ≥ 21.0 |
| A2 | Cottonwood – medium | 22.0 – 31.9 | M2 | Mountain Hemlock – medium | 16.0 – 20.9 |
| A3 | Cottonwood – poor | 11.0 – 21.9 | M3 | Mountain Hemlock – poor | 9.0 – 15.9 |
| A4 | Cottonwood – low | < 11.0 | M4 | Mountain Hemlock – low | < 9.0 |
| B1 | Balsam – good | ≥ 25.0 | P1 | Pine – good | ≥ 23.0 |
| B2 | Balsam – medium | 17.0 – 24.9 | P2 | Pine – medium | 17.0 – 22.9 |
| B3 | Balsam – poor | 11.0 – 16.9 | P3 | Pine – poor | 11.0 – 16.9 |
| B4 | Balsam – low | < 11.0 | P4 | Pine – low | < 11.0 |
| C1 | Cedar – medium | ≥ 22.0 | S1 | Spruce – good | ≥ 24.0 |
| C2 | Cedar – medium | 17.0 – 21.9 | S2 | Spruce – medium | 17.0 – 23.9 |
| C3 | Cedar – medium | 10.0 – 16.9 | S3 | Spruce – poor | 11.0 – 16.9 |
| C4 | Cedar – low | < 10.0 | S4 | Spruce – low | < 11.0 |
| H1 | Western Hemlock – good | ≥ 21.0 | | | |
| H2 | Western Hemlock – medium | 16.0 – 20.9 | | | |
| H3 | Western Hemlock – poor | 9.0 – 15.9 | | | |
| H4 | Western Hemlock – low | < 9.0 | | | |

**Data source and comments:**

Hemlock-leading stands account for most of the area. Stands with other leading species occupy small proportions of the timber harvesting land base (i.e., less than 10% for each species). The original data package proposed combining cedar and spruce, but these species have been separated in the analysis. Western Hemlock has also been separated from mountain hemlock. In addition, separate analysis units have been created for low site class stands that exceed the criteria described in Section 5.7, "Stands with low timber growing potential".

Analysis units have been created for both 'natural stands', and 'managed stands. It has been assumed that existing 'natural stands' will regenerate as 'managed stands', as described in Section 6.5.1, "Silviculture and regeneration activities in managed stands".

Existing managed stands that have been spaced have been identified from the RESULTS database. These stands have been assigned to separate analysis units.

Site index ranges have been based on the distribution of site index values for the timber harvesting land base for each leading species.

Coniferous analysis units are subdivided into three categories to facilitate the application of site index adjustments for existing old-growth stands following harvest:

a) hemlock-leading stands in the CWH biogeoclimatic zone older than 140 years;

b) all other coniferous-leading stands older than 140 years;

c) 140 years and younger.

The inventory site index is considered to be reliable for stands 140 years and younger. Old-growth site index studies show that site index is underestimated in old stands. In the base case, the site index of existing natural stands of western hemlock is adjusted following harvest in the model according to the findings of the publication "Site index adjustment for old-growth coastal western hemlock stands in the Kalum Forest District" by G.D. Nigh and B. Love, 1997. Because the study was done in 1997 and the inventory from that time has been projected in age to 2008, the 140-year age boundary was interpreted to mean 140 + 11 = 151 years of current inventory age in 2008. See Section 6.5.1, "Silviculture and regeneration activities in managed stands", for further details. Sensitivity analysis addresses site index adjustments to other components of the forest.

# 5. Timber Harvesting Land Base Definition

This part of the data package outlines the steps used to identify the Crown forested land base and the timber harvesting land base (THLB). The Crown forested land base consists of provincial Crown land with forest cover that is managed by the BC Forest Service for TSA timber supply. The Crown forested land base excludes community forests;

- tree farm licences;
- woodlot licences; and
- private 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.

Land may be added to the THLB 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).

After identifying all areas that are not part of the THLB, any additional lands are added to the THLB. The result defines the current timber harvesting land base.

The forest inventory for the Kalum TSA contains a mix of old Forest Inventory Planning (FIP) files and new Vegetation Resource Inventory (VRI) files. The original data package contained descriptions of land removals using only FIP attributes. New procedures have been developed to identify the land using VRI attributes as much as possible.

## 5.1 Land outside the core TSA

The legal boundary of the Kalum TSA contains several large areas along the perimeter of the TSA that do not contribute to TSA timber supply and do not contribute to other objectives for the Kalum TSA when assessing timber supply. These areas are: Tree Farm Licences (TFL) 1 and 41, Nisga'a lands, Kitlope Heritage Conservancy Protected Area, Foch-Gilttoyees Park, Gitnadoix River Park, Nisga'a Memorial Lava Bed Park and a sliver of the Atna River Park on the eastern boundary of the TSA (adjacent to TFL 41). The removal of these areas leaves an area referred to in the analysis as the "core TSA". The core TSA includes some private lands and tenures that exist within the large areas removed by this section. These private lands are removed in Section 0, "Land not administered by the BC Forest Service for TSA timber supply".

## 5.2 Non-forest, non-productive forest and non-commercial cover

Table 5Table 5 shows that 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 areas*

| Attributes | Description |
|---|---|
| **Non-forest** | |
| VRI: BCLCS level 1 equal 'N' or 'U' or missing | non-vegetated |
| VRI: BCLCS level 2 = 'N' AND BCLCS level 4 not equal to 'ST' or 'SL' | vegetated but non-treed, excluding shrub areas |
| VRI: BCLCS level 2 = 'N' AND BCLCS level 3 = 'W' | non-treed wetlands |
| **Non-productive forest** | |
| VRI: BCLCS level 3 = 'A' | alpine |
| VRI: Site index is missing or less than 5 | not productive |
| FIP: non-productive code with any value | FIP not productive |
| **Non-commercial** | |
| VRI: BCLCS level 2 = 'T' AND BCLCS level 3 = 'W' | treed wetlands |
| VRI: BCLCS level 4 = 'ST or 'SL'<br>AND FIP: non-forest descriptor is not 'NSR' (where FIP attributes exist)<br>AND no logging history | shrub but not FIP NSR , and not already logged |
| VRI: BCLCS level 4 = 'ST or 'SL'<br>AND FIP: non-forest descriptor = 'NSR' (where FIP attributes exist)<br>AND species code 1 is missing<br>AND no logging history | shrub and FIP NSR but no species information, and not already logged |
| FIP: non-forest descriptor = 'NC' or 'NCBR' (where FIP attributes exist)<br>AND no logging history | FIP non-commercial, and not already logged |

**Data source and comments:**

The Kalum forest inventory consists of Forest Inventory Planning (FIP) data converted to Vegetation Resource Inventory (VRI) format plus some original VRI data that lacks FIP attributes. The criteria shown in Table 5Table 5 use VRI attributes as much as possible, with FIP attributes being used last in each part of the classification scheme. B.C. land classification system (BCLCS) attributes identify non-vegetated and various classes of vegetated areas. Non-forested areas include water, and non-vegetated land such as rock, ice and bare land. It is assumed that non-productive 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 and the THLB; they do not contribute to objectives for wildlife habitat or biodiversity.

Logged areas (excluded from the THLB reductions) are identified using the depletion layer described in Section 3, "Inventories".

Treed areas with a site index less than five metres are considered non-productive, rather than being sites with low timber growing potential (see Section 5.7) because they are not considered to contribute to objectives for wildlife habitat or biodiversity.

Non-productive area removed using the FIP non-productive attribute accounted for 13 954 hectares out of 70 792 hectares (or 20%) of the non-productive area. This indicates that VRI attributes alone do not effectively identify non-productive areas. The FIP non-forest descriptor of Not Satisfactorily Restocked (NSR) was critical in identifying non-commercial areas. They cannot be identified using VRI attributes only.

## 5.3 Land not administered by the BC Forest Service for TSA timber supply

Land not administered by the BC Forest Service for timber supply in the TSA includes private land (including Nisga'a private land), municipal land, federal land, Indian Reserves, Tree Farm Licences, Community Forest Agreements, and Woodlot Licences. Some of these areas, which occur on the perimeter of the TSA, have already been excluded from the core TSA in Section 5.1. 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. Timber licences are normally also removed, but all timber licences in the Kalum TSA have been harvested and have reverted to the TSA.

Parks and protected areas within the core TSA are part of the Crown forested land base and contribute to objectives for biodiversity and wildlife. However, they are not administered by the BC Forest Service for timber supply, so they are excluded from the THLB. New parks and protected areas were created as a result of the Kalum LRMP, including: Brim River, Coste Rocks, Dala/Kildala River Estuary, Eagle Bay, Exchamsiks River Park Expansion, Foch-Giltoyees, Gitnadoiks, Hai Lake – Mount Herman, Jesse Falls, Kitimat River Ecological Reserve Proposal, Kitsumkalum Lake North, Lakelse Lake Welands, Lower Skeena River – Exstew, Lower Skeena River – Kasiks, Lundmark Bog, Nalbeelah Creek Wetlands, Owyacumish River, Sleeping Beauty Mountain, Sue Channel / Hawkesbury Island, Sue Channel / Loretta Island, Swan Creek, and Weewanie Hotsprings.

A spatial data set of land ownership has been developed using information from the Crown land Registry and the Integrated Cadastral Information Society. Table 6Table 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 |
| 51 National Park | Yes | No |
| 52 Indian Reserve | No | No |
| 53 Military Reserve | No | No |
| 54 Dominion Crown Block | 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) or Crown Timber Agreement Lands | Yes | Schedule C: Yes<br>Schedule N: No |
| 63 Crown Provincial Park Class A | Yes | No |
| 67 Crown Provincial Park equivalent or Reserve | Yes | No |
| 69 Crown Miscellaneous Reserves | Yes | Schedule C: Yes<br>Schedule N: No |

| Ownership code | Crown forested land base | Timber harvesting land base |
|---|---|---|
| 70 Crown Active Timber Licence in a TSA or TFL | Yes | Schedule N: Yes<br>Schedule C: No |
| 72 Crown and Private Schedule “A” and “B” Lands in a TFL | No | No |
| 74 Crown and Private timber alienated in watershed | No | No |
| 75 Crown Christmas tree permit | Yes | No |
| 77 Crown and Private Woodlot Licence | No | No |
| 79 Community Forest | No | No |
| 99 Crown Misc. lease (Fairground, R&G Club site, recreation cottage site) | No | No |

The Nisga’a private lands surround several areas with ownership code 62C that were removed from the THLB because they are isolated:

- mapsheet 103P014 – polygons 27, 57 and 68;
- mapsheet 103P025 – polygon 447;
- mapsheet 103P035 – polygon 433.

Similarly, polygon 12 in mapsheet 103P006 has been removed from the THLB because it is an isolated polygon within the boundary of TFL 1.

## 5.4 Environmentally sensitive areas

Some forest lands are environmentally sensitive or significantly valuable for other resources. These areas, previously identified and delineated during the Kalum forest inventory, are called environmentally sensitive areas (ESAs). The ESA system uses the following classification: sensitive or unstable soil (S), forest regeneration problems (P), snow avalanche (A), recreation I, wildlife (W) and watersheds (H). With the exception of snow avalanche (A), two sensitivity categories are used: 1-high and 2-moderate.

Terrain stability mapping (TSM) provides a more accurate assessment of slope stability than ESA mapping for sensitive soils (Es), so TSM was used in place of Es mapping where available.

Environmental sensitivity may reduce or preclude harvesting on identified sites. This can be accounted for through area reductions, or specific evaluations of individual ESA polygons for harvesting opportunity. Table 7Table 7 shows the proportion of ESAs in various categories that are excluded from the THLB.

*Table 7. Description of environmentally sensitive areas*

| ESA category | ESA description | Reduction (%) |
|---|---|---|
| A | Avalanche — highly sensitive | 100 |
| S1 | Soil — highly sensitive | 50 |
| S2 | Soil — moderate sensitive | 30 |
| TSM class V | Unstable slopes – high likelihood of landslide initiation following timber harvesting or road construction | 90 |
| TSM class IV | Potentially unstable slopes – moderate likelihood of landslide initiation following timber harvesting or road construction | 10 |

**Data source and comments:**

Land base exclusions for regeneration ESAs (P) are not used because the classifications are outdated. These areas overlap almost completely with inoperable areas or areas with low timber growing potential.

Land base exclusions for ESAs for watersheds (H), recreation (R), and wildlife (W) are not used because they are also outdated. They are replaced by mapping for community watersheds, recreation reserve mapping, and specific habitat mapping for mountain goat, grizzly bear and tailed frog. They are addressed in later sections.

Watersheds where TSM exists have been delineated. TSM replaces ESAs for sensitive soils (S) in these watersheds. ESAs for sensitive soils are used in watersheds where TSM has not been completed.

Areas classified in TSM as class V terrain (unstable slopes) are generally unsuitable for harvest. However, TSM tends to overestimate the amount of class V terrain because of limited field sampling for some levels of survey intensity, and because TSM is inherently conservative to ensure that all unstable areas are identified and subjected to field assessment. Forest licensees, BC Timber Sales Staff and district staff estimate that 90 percent of mapped class V terrain is considered unavailable for harvest.

Areas classified in TSM as class IV terrain (potentially unstable slopes) are generally suitable for harvesting, although these areas often require more expensive road construction techniques to mitigate the potential for subsequent landslides. Where construction costs are prohibitive and alternative road locations are not available (i.e., either above or below the Class IV terrain), areas may become unavailable for harvesting due to access limitations. In the Kalum TSA, the impact of Class IV terrain on the THLB cannot be accurately quantified at this time because harvesting has not occurred in all areas where TSM exists. BC Timber Sales staff experience in the adjacent Kispiox TSA suggests a reduction of five percent in areas planned for harvest is appropriate. This estimate was derived from first pass harvest development, which may have occurred on somewhat easier terrain, and subsequent passes may be more limited by Class IV terrain. Based on this, 10 percent of class IV terrain in the Kalum TSA is considered unavailable for harvest due to cost-prohibitive mitigating measures for access.

Operational findings from the previous timber supply review indicate that ESA mapping overestimates the amount of area with sensitive soils (S1 and S2). In the previous TSR the typical land base removal of 100 percent for S1 is reduced to 50 percent to account for this overestimate, and the typical land base removal of 50 percent for S2 is reduced to 30%. No new information is available currently so this analysis also uses these lower reductions for ESAs with sensitive soils.

## 5.5 Areas with high recreation values

Some areas with high recreation value have been designated for protection as recommended by the Kalum LRMP. These areas are addressed in Section 0, “Land not administered by the BC Forest Service for TSA timber supply”. Areas designated as Use, Recreation and Enjoyment of the Public (UREP/recreation reserves) are excluded from the THLB. Other recreation reserves administered by the Ministry of Tourism, Culture and the Arts as forest recreation sites and trails are also removed from the THLB. Any linear features are converted to polygons with a total width of 20 metres.

Areas with preservation visual quality objectives are excluded from the THLB.

## 5.6 Inoperable areas

Areas are considered inoperable where there are physical barriers or limitations to harvesting, where appropriate logging methods (e.g. cable) are not available or 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 8Table 8 lists the operability classes that are excluded from the THLB.

*Table 8. Description of inoperable areas*

| Accessible | Harvest method | Stand quality | Reduction (%) |
|---|---|---|---|
| No | All | All | 100 |
| Yes | I – inoperable | All | 100 |
| Yes | A – aerial | P | 100 |

**Data source and comments:**

A harvest method mapping (HMM) project was undertaken in 2006 to re-define operability in the Kalum TSA. Operability is defined based on physical accessibility and economic feasibility of harvest. The methods, parameters and results of the project are documented in a report entitled "*Kalum TSA and Nass TSA Operability Study*" produced by Magellan Digital Mapping. A digital elevation model was classified by slope classes to produce harvest method polygons. Forest stands were classified by stand attributes to produce stand quality classes. The following codes were used:

Harvest Method: G – ground, C – cable, A – aerial, I – inoperable

Stand Quality: S – sawlog, M – marginal sawlog, P – pulplog, D – deciduous, L – low site, T – density problems

The HMM does not identify isolated or inaccessible areas that would be uneconomic to harvest. Additional mapping identifies the following areas that are considered to be inaccessible:

- Exchamsiks landscape unit isolated by the Exchamsiks River Park Expansion;
- area in the upper Clore River that is not economic to harvest;
- area north of the Nisga'a private land that was transferred from the North Coast TSA;
- scattered sawlog and marginal sawlog stands at the heads of various drainages.

An additional inaccessible sliver of land was identified along the eastern TSA boundary near the Burney River. This is polygon 12 in mapsheet 093L011, and is removed from the THLB.

The original data package proposed that if an area has already been logged (i.e., if it has a logging history according to the depletion layer described in Section 3, "Inventories") then it would be considered operable regardless of the HMM classification, as long as the area is accessible. This criteria was dropped because it only affected eight hectares of land.

Licensees and district staff indicate that pulplog stands (as defined by the HMM study) have insufficient value to permit aerial harvesting. Therefore, only sawlog and marginal sawlog stands remain in the THLB for the aerial harvest method in the base case.

The original data package stated that there is uncertainty about the economic viability of marginal sawlog and pulplog stands and that here has been very little harvesting in these low quality stands in the past five years. Subsequent analysis of harvest history for the past 10 years shows that there has in fact been considerable harvest within these stands. Furthermore, the classification of sawlog and pulplog areas was a poor predictor of the volume of sawlogs and pulplogs harvested. The original data package also proposed assessing the impact of removing all or part of the marginal sawlog and pulplog areas in sensitivity analyses. Based on the fact that considerable harvest has occurred in these areas within the past 10 years, sensitivity analysis is focussed on specific areas (see Section 7, "Sensitivity Analyses").

## 5.7 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. Typically, these stands are intermixed with other stands within the forested land base. As these stands are not considered to be harvestable, they are removed from the timber harvesting land base using the criteria listed in Table 9.

*Table 9. Description of sites with low timber growing potential*

| Leading species | Characteristics | | | | | |
|---|---|---|---|---|---|---|
| | Current age (years) | Current volume ($m^3$/ha) | Current height (m) | Height at age 200 years (m) | Volume at age 200 years ($m^3$/ha) | Reduction (%) |
| All | > 200 | FIZ A: < 300<br>FIZ J: < 250 | < 19.5 | | | 100 |
| All Coniferous | ≤ 200 | | | < 19.5 | FIZ A: < 300<br>FIZ J: < 250 | 100 |
| Cottonwood | ≤ 200 | | | < 19.5 | < 250 | 100 |

**Data source and comments:**

The previous timber supply review used site index limits based on a minimum mean annual increment of one cubic metre per hectare per year. The 1999 allowable annual cut (AAC) rationale recognized that those site index limits may have been too low.

Current practice indicates that stands that do not meet minimum volume or height criteria are not suitable for harvest. These criteria are applied in two different ways.

a) Stands currently older than 200 years that do not meet both the minimum volume and minimum height criteria are removed from the THLB. Ages and heights are adjusted in the inventory file according to: *Penner, M. 2009. The Implementation of the Inventory Adjustment Strategy – Kalum TSA.*

b) Stands currently 200 years old or younger that do not meet the minimum volume and height criteria in the future are removed from the THLB, except that stands that have previously been harvested are not removed. The original data package proposed calculating the minimum site index that produces both the minimum volume and height criteria by age 200 for each entry in Table 9Table 9. Since each stand had a yield table for volume and height attached to the inventory file, these young stands were identified by a yield table lookup instead of calculating the minimum site index.

The criteria described here are consistent with to the criteria for minimum harvestable ages described in Section 6.1.3. They are also similar to those used to assign the stand quality code of L – Low Site in the harvest method mapping (HMM). The volume criteria vary by Forest Inventory Zone (FIZ) as a result of iterative testing of the HMM to produce mapped results using forest cover inventory attributes that agree with local knowledge from licensees. The HMM differs from this data package in the following ways:

- HMM assesses volume at age 140 years instead of at 200 years. Age 140 is judged in HMM to be too young to remove stands from the THLB due to low volume or height. Using 200 years allows time for existing natural stands to reach these minimum criteria.
- HMM sets a minimum site index of 10 for all stands, instead of a minimum site index for stands age 61 to 200 years old based on meeting producing minimum volume and height. Using site index for younger stands based on achieving minimum height and volume is less arbitrary than using site index 10 for all stands.

Because a minimum site index is not calculated when identifying stands of low timber growing potential, some stands with low site index remain in the THLB. They are assigned to a low site class analysis unit.

## 5.8 Problem forest types

Problem forest types are stands that are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. These types are wholly or partially excluded from the timber harvesting land base according to the criteria listed in Table 10Table 10.

*Table 10. Problem forest types criteria*

| Description | Age | Crown closure (%) | Stocking Class | Reduction (%) |
|---|---|---|---|---|
| Deciduous-leading stands other than cottonwood-leading | | | | 100 |
| Low crown closure (open-grown) | > 60 | 0-25 | | 100 |
| Stocking problems | | | 2, 3, 4 | 100 |

**Data source and comments:**

Currently, deciduous-leading stands other than cottonwood-leading stands, open-grown stands, stands with low volume, and stands with stocking problems (low or high) are not targeted for harvest.

The criteria for deciduous stands corresponds approximately with stand quality code D – Deciduous in the harvest method mapping. However code D in HMM does not differentiate between cottonwood-leading stands and other deciduous-leading stands. Code D in HMM also only includes deciduous-leading stands with less than 30 percent coniferous content. Interest has been expressed in harvesting cottonwood stands, so these stands are not excluded from the THLB, regardless of coniferous content.

Stocking class 2 represents mature stands with low stocking. Stocking classes 3 and 4 represent lodgepole pine-leading stands that are stagnant. There may be overlap between open-grown, low volume and low stocking criteria. These correspond with stand quality code T – Density Problems in the harvest method mapping.

Not satisfactorily restocked (NSR) areas are not excluded using these problem forest type criteria because of uncertain species composition information.

## 5.9 Wildlife habitat reductions

Wildlife habitat may be identified and managed through several processes including the *Identified Wildlife Management Strategy*, identification and approval of ungulate winter range (UWR), and management practices specified in plans that establish legal objectives, such as the Kalum SRMP. Management may include "no harvesting" in core areas around nesting sites or other valuable habitats for endangered species, as well as modified harvesting in management areas outside of the core areas. Table 11Table 11 describes the areas to be removed from the timber harvesting land base for wildlife.

*Table 11. Wildlife habitat exclusions*

| Wildlife species | Inventory description | Reduction (%) |
|---|---|---|
| Tailed frog | Wildlife habitat areas #6-058 and 6-059 – core area and special management zone | 100 |
| Tailed frog | Wildlife habitat areas #6-060 to 6-067 – core area | 100 |
| Tailed frog | Wildlife habitat areas #6-060 to 6-067 – special management zone | 70 |
| Mountain goat | Mountain goat ungulate winter ranges | 100 |

**Data source and comments:**

Ungulate Winter Ranges for mountain goat and Wildlife Habitat Areas for tailed frog have been legally established under the *Forest and Range Practices Act*. They are also documented in the Kalum SRMP. Harvest requirements are specified in the legal orders. The management requirement for the special management zone of tailed frog WHAs #6-060 to #6-067 specifies a silviculture system that maintains 70 percent residual stand volume and attributes of the natural stand structure profile, evenly dispersed. The areas involved are small and the requirement has been converted to a 70 percent land base reduction because it is likely uneconomic for harvesting returns in these small areas.

There are currently no habitat exclusions for grizzly bear. Management requirements for grizzly bear are described in Section 6.6.1, "Forest Cover Requirements". Wildlife habitat areas for grizzly bear will be established in the near future. A sensitivity analysis tests their impact on timber supply.

Licensees are also required to manage for other red- and blue-listed species and plant communities. In most cases these are being addressed at an operational level using wildlife tree patches (WTP) and other reserves, or by managing access construction. Where additional reserves are required, they are generally small and have insignificant impacts.

## 5.10 Cultural heritage resources

Archaeological overview and cultural heritage inventories for the entire Kalum TSA have been completed. Within the Kalum TSA, there are 2512 hectares which are identified as having high archaeological potential. Some cultural heritage resources are very close to lakes, rivers and streams and lie within riparian reserve zones and riparian management areas. Some features can be incorporated into wildlife tree patches. Current practice by licensees to address any cultural heritage resources that fall outside of riparian areas and wildlife tree patches is to assess the areas and acquire site alteration permits under the *Heritage Conservation Act*. This generally affects the timing of logging but does not prevent it.

One old-growth area of approximately 132 hectares has been identified with an abundance of culturally modified trees (CMT) that likely results in only half of the area being available for harvest. Therefore, 50 percent of this area is removed from the THLB. This area is located in the vicinity of the mouth of the Lakelse River, outside of the Lakelse River Special Resource Management Zone. It is identified as forest cover polygon 360 in mapsheet 103I047.

## 5.11 Exclusion of specific, geographically defined areas

Table 12Table 12 describes additional areas to be excluded from the timber harvesting land base to account for area exclusions not discussed in previous sections.

*Table 12. Exclusion of specific, geographically defined areas*

| Inventory source | Area description | Excluded area | Reason for exclusion |
|---|---|---|---|
| Kalum SRMP | Lakelse River Special Resource Management Zone – Subzone 1 | All | No harvest or salvage |
| Kalum SRMP | Kiteen-Cedar landscape connectivity corridor – polygon A | All | No harvest |
| Kalum SRMP | Old growth management areas | All | No harvest |
| Research Installations | Research installations and growth & yield plots | All | No harvest |
| Skeena Islands rare ecosystem mapping | All old-mature coniferous stands, all secondary deciduous stands in conservation rank, 700 hectares of secondary deciduous stands in conservation rank B2 | All | No harvest |

**Data source and comments:**

The Kalum SRMP establishes the Lakelse River Special Resource Management Zone and polygon A of the Kiteen-Cedar landscape connectivity corridor. They are to be removed from the THLB. The Kalum SRMP also establishes two additional landscape connectivity corridors; polygon B of the Kiteen-Cedar corridor and the Williams – Thomas/Clore corridor. These areas require partial harvesting or maintenance of stand structure and function. These requirements do not preclude timber harvesting so they are not removed from the THLB.

The Kalum SRMP further designates old-growth management areas, which are removed from the THLB.

A process is underway to identify and designate research installations and growth and yield plots under the *Government Actions Regulation*. These areas are removed from the THLB.

The Kalum SRMP requires conservation of rare plant communities on the Skeena Islands. Rare plant communities include: high bench Sitka Spruce – Salmonberry (CWHws1/07, CWHvm1/09) and middle bench Black Cottonwood – Red-osier Dogwood (CWHws1/08, CWHvm1/10). The Kalum SRMP does not specify how to achieve this objective. A draft refinement of the Kalum SRMP objective proposes targets to retain or recruit 70% of the amount of each plant community that existed prior to logging in 1947.

Table 13 shows the existing condition of the Skeena Islands in terms of the area in each stand type by conservation rank. It also shows the priorities for conservation and the conservation targets.

To model the effect of the conservation targets in Table 13, it is assumed that the target of retaining 2950 hectares of old-mature coniferous stands for the red-listed plant community requires removal from the THLB of all of the old-mature coniferous stands, and 700 hectares of the secondary deciduous stands in conservation rank B1. The stand types and conservation ranks are mapped by the Skeena Islands rare ecosystems project and the terms are defined below the area summary in Table 13. However, this table and the targets apply to the entire Skeena Islands study area, not just the portion that lies within the core Kalum TSA. Meeting the targets for the core Kalum TSA was achieved by removing from the THLB all of the old-mature coniferous stands (no change) and all of the secondary deciduous stands in conservation rank B1 (slightly different).

It is assumed that recruitment and retention for the blue-listed plant community permits harvesting using best management practices being developed by the Skeena Islands rare ecosystems project. No removals from the THLB are made for the blue-listed plant community.

*Table 13. Skeena Islands area summary and priority for conservation*

| Conservation rank | Stand type (hectares) | | | |
|---|---|---|---|---|
| | Primary deciduous | Secondary deciduous | Old-mature coniferous | Total |
| A Excellent Condition | 342 | 0 | 1009 | 1351 |
| B1 Good Condition | 1051 | 1241 | 0 | 2292 |
| B2 Good Condition | 1549 | 847 | 0 | 2396 |
| B3 Good Condition | 1350 | 262 | 0 | 1612 |
| B4 Good Condition | 427 | 84 | 0 | 511 |
| C Marginal Condition | 121 | 157 | 0 | 278 |
| D Non forested | 131 | 151 | 0 | 282 |
| **Total forested area** | **4840** | **2591** | **1009** | **8440** |
| **Minimum conservation area** | | **2819** | **2950** | |

Highest priority for conservation and recruitment, and at or near future desired condition.

Mid priority for conservation and recruitment, and focus area for management decisions and best-management plan development.

Lowest priority for conservation and recruitment, and longest time and potential for recruitment.

Conservation Rank Definitions:

| | | |
|---|---|---|
| A (natural and managed) | Excellent condition | No previous harvest history, or < 25% selective cut, with old-growth conifers and few exotic species. |
| B1 | Good condition | Similar to original stand, with conifers in understory and previous harvest history >25%. |
| B2 – B4 | Good condition | Decreasing value based on ranking criteria (size, amount of conifers and/or old-growth structure remnants). |
| C | Marginal condition | Previously harvested. Forested state but where original stand characteristics not maintained. Understory conifer not visible on air photo, or high number of exotic species. |
| D | Poor condition | Being maintained in non-forested state. |

Stand Class Definitions

| | |
|---|---|
| Primary deciduous | Deciduous cover on young islands |
| Secondary deciduous | Deciduous cover as a successional stage on mid- or high-bench where original conifer stands have been previously harvested. |
| Mature conifer | Original or mature stands. |

Source: *Landscape and Stand Scale Structure and Dynamics, and Conservation Ranking of Skeena River Floodplain Forests* (de Groot, A, S. Haeussler, D.Yole 2005). Areas from Table 21, page 45. Definitions from Appendix 5, page 74.

## 5.12 Riparian reserve and management areas

Table 14Table 14 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 14. Riparian management areas*

| Stream, wetland or lake class | Reserve zone width (metres) | RRZ reduction (%) | Management zone width (metres) | RMZ reduction (%) |
|---|---|---|---|---|
| S1-A (width ≥ 100 m) | 0 | n/a | 100 | 20 |
| S1-B (width < 100 m) | 50 | 100 | 20 | 20 |
| S2 | 30 | 100 | 20 | 20 |
| S3 | 20 | 100 | 20 | 20 |
| S4 | 0 | N/A | 30 | 10 |
| S5 | 0 | N/A | 30 | 10 |
| S6 | 0 | N/A | 20 | 0 |
| W1 | 10 | 100 | 40 | 10 |
| W3 | 0 | N/A | 30 | 10 |
| W5 | 10 | 100 | 40 | 10 |
| L1-A (area ≥ 1,000 ha) | 0 | N/A | 0 | n/a |
| L1-B (area < 1,000 ha) | 10 | 100 | 0 | n/a |
| L3 | 0 | N/A | 30 | 10 |

**Data source and comments:**

All of the available stream classifications produced to date by licensees is included in the analysis. Mapped streams are buffered with the appropriate riparian reserve and management zone for their stream class. An additional map is created from this data to identify areas that do not have classified and mapped streams. The explicit buffers are converted to a buffer-area attribute of the adjacent polygons. This allowed the actual buffers to be removed from the data set, thereby reducing the size of the data set.

The buffer-area attribute is used explicitly to remove land from the THLB for areas with stream class mapping. The proportion of THLB (thus far) in riparian buffers is calculated for the area with stream class mapping. This proportion is applied as the riparian reduction in the area without stream class mapping.

Full retention of riparian reserves is required under the *Forest Planning and Practices Regulation*. Current practice for retention in riparian management zones is defined by Forest Stewardship Plans in the Kalum TSA. There is a slight variation among Forest Stewardship Plans; Table 14Table 14 reflects the common elements.

## 5.13 Wildlife tree patches

The Kalum SRMP establishes an objective to maintain structural diversity in managed stands by retaining wildlife tree patches in each cutblock. Retention amounts are specified by landscape unit and BEC variant. Table 15Table 15 shows the reductions for wildlife tree retention.

*Table 15. Reductions for wildlife tree retention in cutblocks*

| Landscape unit | Biogeoclimatic subzone | Residual area or volume estimate on the timber harvesting land base (%) |
|---|---|---|
| Beaver | CWHws | 8 |
| | MHmm | 0.5 |
| Clore | CWHws | 6 |
| | ESSFmk | 3 |
| | ESSFwv | 1 |
| | MHmm | 3 |
| Exchamsiks | CWHvm | 0 |
| | MHmm | 0 |
| Exstew | CWHws | 6 |
| | MHmm | 3 |
| Falls | CWHvm | 1 |
| | MHmm | 0 |
| Hirsch | CWHvm | 5 |
| | CWHws | 11 |
| | MHmm | 0 |
| Hot Springs | CWHws | 7 |
| | MHmm | 0.5 |
| Jesse Bish | CWHvm | 1 |
| | MHmm | 0 |
| Kalum | CWHws | 10 |
| | MHmm | 5 |
| Kasiks | CWHvm | 0 |
| | MHmm | 0 |
| Kiteen (Ksi Gahlt'in) | CWHws | 3 |
| | ESSFwv | 1 |
| | ICHmc | 7 |
| | MHmm | 1 |
| Kitimat | CWHvm | 5 |
| | CWHws | 7 |
| | MHmm | 0 |
| Kleanza Treasure | CWHws | 7 |
| | ICHmc | 6 |
| | MHmm | 2 |
| Lakelse | CWHws | 7 |
| | MHmm | 0 |
| Nelson Fiddler | CWHws | 8 |
| | ICHmc | 5 |
| | MHmm | 2 |

| Landscape unit | Biogeoclimatic subzone | Residual area or volume estimate on the timber harvesting land base (%) |
|---|---|---|
| Skeena River Kalum | CWHvm | 5 |
| | CWHws | 5 |
| | ICHmc | 4 |
| | MHmm | 0 |
| Wedeene | CWHvm | 3 |
| | CWHvh | 2 |
| | CWHws | 10 |
| | MHmm | 3 |

**Data source and comments:**

The values in Table 15Table 15 are the result of detailed calculations for each combination of landscape unit and biogeoclimatic subzone according to the 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. The Kalum SRMP states that wildlife tree patches may be internal or external to a cutblock. Retention outside of cutblocks may overlap with riparian reserves or other areas outside of the THLB. Most current operations occur in higher elevation areas where streams do not require riparian reserves.

The predominant biogeoclimatic subzone in the Kalum TSA is CWHws, which has an average required retention of 6.8 percent. In comparison, the RESULTS database for the period 2001 – 2006 shows that licensees left an average of 8.1 percent of each cutblock for wildlife tree retention. This is higher than the required level of retention because it includes some riparian reserves that are reported as wildlife tree patches. This indicates that the retention levels specified in Table 15Table 15 can be used without double-counting for riparian reserves.

Most wildlife tree retention is left in the form of wildlife tree patches (WTP). Most of the area in WTPs is in patches two hectares or larger, which are assumed to contribute toward old forest representation. WTPs are assumed to be persistent and will not be economic to harvest in the future. WTPs are removed from the THLB.

## 5.14 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 after stands are harvested for the first time in the timber supply model. Table 16Table 16 shows the reductions made for existing and future RTL.

*Table 16. Estimates for existing and future roads, trails and landings*

| Roads, trails and landings | Age (years) | Logged | Total reduction (%) |
|---|---|---|---|
| Existing | ≤ 45 | Yes | 8.8 |
| Future | > 45 | – | 8.8 |

**Data source and comments:**

Studies from 1992 associated with timber supply reviews for Tree Farm Licences (TFLs) 1 and 41, and the Kalum TSA indicate a weighted average of 8.8 percent of cutblock area is lost to roads, trails, landings and major debris piles. More recent information for the Kalum TSA from the RESULTS database, based on harvesting from 1997 to present, indicates that an average of 6.3 percent of the gross cutblock area is occupied

by non-productive roads. Significant additional area is lost as a result of the continued practice of retaining large debris piles in roadside work areas that are not burned or otherwise removed. In the absence of more detailed estimates of the area lost to these debris piles, the previous estimate of 8.8 percent is used in this analysis for the total area lost to roads, trails, landings and debris piles.

The reduction for existing roads is only applied to areas 45 years and younger (consistent with immature plantation history criteria in Section 0, "Immature Plantation History" that have been logged. Logged areas are identified by the depletion layer described in Section 3, "Inventories".

The same reduction is applied in the timber supply model to stands harvested in the future.

## 5.15 Timber licence reversions

Timber licences are a form of timber tenure that gives the holder exclusive right to harvest merchantable timber from defined areas of Crown land. After the area is harvested and reaches a free-growing condition the land reverts to Forest Service jurisdiction. The timber cut from timber licences is not part of the allowable annual cut of a TSA. All timber licences in the Kalum TSA expired on March 4, 2002 and have reverted to Forest Service jurisdiction. There is no need to account for any further timber licences reversions.

# 6. Current Forest Management Assumptions

## 6.1 Harvesting

### 6.1.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter inside bark (inside bark) and minimum diameter at breast height by species. Table 17Table 17 shows the utilization levels used in the analysis to calculate merchantable volume.

*Table 17. Utilization levels*

| | | Utilization | | |
|---|---|---|---|---|
| Analysis unit | Minimum stump diameter (cm) | Corresponding minimum DBH (cm) | Maximum stump height (cm) | Minimum top dib (cm) |
| Pine | 15 | 12.5 | 30 | 10 |
| Cedar | 20 | 17.5 | 30 | 15 |
| All other | 20 | 17.5 | 30 | 10 |

**Data source and comments:**

Table 1-2 Interior Timber Merchantability Specifications of the *Provincial Logging Residue and Waste Measurement Procedures Manual* specifies the utilization levels for billing of harvested timber. These levels are also used in assessing cut control for licence AACs.

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.

### 6.1.2 Volume exclusions for mixed-species stands

Table 18Table 18 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 18. Volume exclusions for mixed-species types*

| Species | Volume exclusion (%) |
|---|---|
| All deciduous except cottonwood | 100 |

**Data source and comments:**

Forest district staff reviewed the harvest levels of deciduous tree species. The small contribution made by such components is negligible, except for cottonwood. For example, a small amount of alder (approximately 500 cubic metres) has been harvested in the past five 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 19Table 19 shows the criteria to determine minimum harvestable ages.

*Table 19. Minimum harvestable age criteria*

| Analysis unit | Minimum criteria | | |
|---|---|---|---|
| | Height (metres) | Volume ($m^3$/hectare) | Average diameter – all stems (cm) |
| All except Cottonwood | 19.5 | 250 | 25 |
| Cottonwood | | 250 | |

**Data source and comments:**

All stands except cottonwood are expected to meet all three criteria before being eligible for harvest. The minimum height criterion refers to top height (i.e., average of the tallest tree in each $1/100^{th}$ hectare plot in a survey), not average height. It is required to produce an adequate log length of 7 to 10 metres. The minimum average diameter is a critical element and is based on all trees, not just the largest 250 trees per hectare. The minimum average diameter criterion is based on *Potential financial returns from alternative silvicultural prescriptions in second-growth stands of coastal British Columbia* by A.F. Howard and H. Temesgen, 1997, Canadian Journal of Forest Research, 27: 1483-1495. Cottonwood only uses the minimum volume criteria.

The original data package proposed that minimum harvestable ages may be adjusted if large differences result from the height and volume criteria. However, it was unnecessary to calculate minimum harvestable ages because the timber supply model as able to track height, volume and diameter individually for each analysis unit. Sensitivity analysis examines the impact of changing the criteria.

### 6.1.4 Harvest scheduling priorities

Records on harvesting from 2000 to 2006 indicate that approximately 90% of blocks harvested were older than 250 years, and 8% were between 141 and 250 years old. A small number of blocks were between 101 and 140 years old. This pattern has changed recently as a result of poor economic conditions and mill closures. Licensees are now targeting the most valuable stands for harvest to maintain the viability of their operations, although they still appear to be harvesting old stands because they have high volume and a high proportion of high value timber. There is also a strong desire to harvest stands younger than 140 years, including any second growth stands that are available because they occur on favourable terrain and have ready access.

The base case sets harvest priorities by assigning weights to the volume tables of analysis units. Table 20Table 20 describes the harvest priorities and weights used to implement the priorities.

*Table 20. Harvest priorities*

| Priority | Stand types (natural/regenerated, quality class, leading species, age) | Weight |
|---|---|---|
| 1 | natural, sawlog, non-hemlock coniferous, all ages | 2.0 |
| 1 | natural, sawlog, hemlock, ≤ 140 years | 2.0 |
| 2 | natural, sawlog, hemlock, > 140 years | 1.5 |
| 2 | natural, sawlog, cottonwood, all ages | 1.5 |
| 3 | regenerated, all quality classes, all species, all ages | 1.0 |
| 4 | natural, marginal sawlog, all species, all ages | 0.5 |
| 5 | natural, pulplog, all species, all ages | 0.1 |

The original data package proposed using a set of group priorities for use in a simulation model. The model built using Woodstock could not effectively address the myriad of management requirements in simulation mode. The system of weights described in Table 20Table 20 implement the harvest priorities in an optimization model.

### 6.1.5 Silvicultural systems

Most harvesting within the Kalum TSA involves a clearcut silviculture system. Although forest district staff anticipate some increased use of partial or selection harvest systems in the future, there is currently little partial cutting occurring, and accounting for these approaches in the Kalum TSA timber supply is not warranted at this time.

The Kalum SRMP requires special harvesting in several specific areas. At least 50% of the volume harvested in any five year planning cycle in subzone 2 of the Lakelse River Special Resource Management Zone must be selection harvested. Partial harvesting is also required in part of the Kiteen-Cedar landscape connectivity corridor. Stand structure and function must be maintained in the Williams – Thomas/Clore landscape connectivity corridor. All of these areas are relatively small and only the timing of the timber harvest volume is affected, so they are all modelled using clearcut methods.

No commercial thinning has been carried out within the Kalum TSA in the past five years and none is forecast to be carried out based on licensee information. Limited commercial thinning has been carried out within the Kalum Forest District, but mostly within Tree Farm Licence 1. Considering the poor local market for small wood, the cost of commercial thinning, and the supply of larger mature wood for conventional harvesting, it is unlikely that the application of this harvest method will increase significantly in the near future.

## 6.2 Unsalvaged losses

Table 21Table 21 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 21. Unsalvaged losses*

| Cause of loss | Annual total loss ($m^3$/year) | Annual unsalvaged loss ($m^3$/year) |
|---|---|---|
| Fire | 2 500 | 2 500 |
| Wind | 7 000 | 2 500 |
| **Total** | 9 500 | 5 000 |

**Data source and comments:**

Estimated annual loss due to wind from the last timber supply review has been reduced from 14 000 cubic metres to 7000 cubic metres. The estimated annual loss from wildfire is the same as for the last timber supply review. The popularity of the salvage program has reduced the total unsalvaged loss to 1500 to 3500 cubic metres (average of 2500 $m^3$). There is currently no other information available.

The unsalvaged loss for Mountain Pine Beetle is explained in the next section. The original data package included them in this section.

## 6.3 Mountain pine beetle

The Mountain Pine Beetle entered the Kalum TSA in 2007. Surveys in 2008 identified over 13,000 red-attack trees and a spread ratio of red-attack to green-attack of 1:1.57. Assuming an average of 800 trees per hectare with an average yield of 250 cubic metres per hectare, the volume of red-attack trees amounts to approximately

4000 cubic metres. Applying the estimated spread rate of 1.57 to the next four years produces a total attacked volume of approximately 61 000 cubic metres, or an average of 12 200 cubic metres per year for the first five-year period. Similarly, the estimated volume of attacked timber in the second five-year period is 116 500 cubic metres per year. It is assumed that the small area of mature pine (i.e., older than 60 years) in the TSA will be completely attacked in 10 years. Under current market conditions, which are not expected to change, all of this volume will be an unsalvaged loss.

Mountain Pine Beetle damage has been simulated by targeting all mature pine stands to be "harvested" by the beetle in the first decade. This amounts to 1793 hectares. Pine stands are converted to the corresponding natural hemlock analysis unit (i.e., same site productivity class) with an age of 20 years. This reflects the existence of younger conifers below the main pine canopy that will form new stands after the pine dies.

The original data package included volume estimates for the unsalvaged loss due to Mountain Pine Beetle in Section 6.2, "Unsalvaged losses". Since this is a one-time loss (i.e., all within the first decade), the area conversion approach does not require an estimate of the volume lost.

## 6.4 Dothistroma needle blight

Dothistroma needle blight (Dothistroma septosporum) has been significantly impacting lodgepole pine plantations in the Kalum TSA within the last decade. This disease causes pine trees to lose their needles, which can reduce growth and cause mortality. Spread of the disease has been facilitated by a series of wet summers. There is a risk that some of these stands will die completely and be replaced by naturally regenerated, younger stands.

Surveys in 2006 and 2008 classified the condition of stands according to the level of Dothistroma infection and stocking level of pine and other species. Stands were then assigned to management classes according to their condition. In 2008, 1090 hectares of regenerated pine stands were surveyed. The results by management class are summarized in Table 22Table 22.

*Table 22. Dothistroma management summary of surveyed pine stands*

| Management class | Description | Area (hectares) |
|---|---|---|
| Stocking likely without pine | Adequate stocking of conifers other than pine, no planting required. | 304 |
| Wait and see | Marginal stocking of conifers other than pine or located at higher elevation, and low to moderate risk. | 703 |
| Action imperative | Insufficient stocking of conifers and high risk, requires planting. | 79 |
| Total | | 1086 |

The surveyed stands in each management class are modelled as follows:

- "Stocking likely without pine" is assigned to the corresponding natural hemlock analysis unit (i.e., same site productivity class) but with their age 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" maintain their current analysis unit and age. This represents normal growth.
- "Action imperative" areas are assigned to the corresponding planted hemlock analysis unit but with age reduced by 20 years to a minimum age of 0 years. This represents immediate fill planting to boost stocking of existing understocked conifers in these stands.

## 6.5 Silviculture

### 6.5.1 Silviculture and regeneration activities in managed stands

Recent plantations and future stands are projected using managed stand yield tables produced using the B.C. Forest Service TIPSY growth and yield model. Table 23Table 23 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) are then aggregated into one table.

*Table 23. Regeneration assumptions by analysis unit*

| Analysis unit | Regen delay[a] (years) | OAFs[b] (%) | | Method | | Species | | Density (sph) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | Type | % | Code | % | Initial | Spaced[c] |
| A1, A2, A3 Cottonwood – all | 1 | 15 | 5 | Natural | 100 | Ac | 100 | 800 | |
| B1 Balsam – good site | 1 | 15 | 5 | Plant | 100 | Ba | 100 | 4500 | |
| B2 Balsam – medium site | 2 | 15 | 5 | Natural | 100 | Ba | 100 | 4500 | |
| B3 Balsam – poor site | 2 | 15 | 5 | Natural | 100 | Ba | 100 | 4500 | |
| B4 Balsam – low site | 2 | 15 | 5 | Natural | 100 | Ba | 100 | 4500 | |
| C1 Cedar – good site | 1 | 15 | 5 | Plant | 100 | Cw | 100 | 2000 | |
| C2 Cedar – medium site | 1 | 15 | 5 | Plant | 100 | Cw | 100 | 2000 | |
| C3 Cedar – poor site | 2 | 15 | 5 | Natural | 100 | Cw | 100 | 2000 | |
| C4 Cedar – low site | 2 | 15 | 5 | Natural | 100 | Cw | 100 | 2000 | |
| H1 Western hemlock – good site | 1 | 15 | 5 | Plant | 100 | Hw | 100 | 4500 | |
| H2 Western hemlock – medium site | 2 | 15 | 5 | Natural | 100 | Hw | 100 | 4500 | |
| H3 Western hemlock – poor site | 2 | 15 | 5 | Natural | 100 | 100 | 100 | 4500 | |
| H4 Western hemlock – low site | 2 | 15 | 5 | Natural | 100 | 100 | 100 | 4500 | |
| M1 Mountain hemlock – good site | 1 | 15 | 5 | Plant | 100 | Hw | 100 | 4500 | |
| M2 Mountain hemlock – medium site | 2 | 15 | 5 | Natural | 100 | Hw | 100 | 4500 | |
| M3 Mountain hemlock – poor site | 2 | 15 | 5 | Natural | 100 | 100 | 100 | 4500 | |
| M4 Mountain hemlock – low site | 2 | 15 | 5 | Natural | 100 | 100 | 100 | 4500 | |
| P1 Pine – good site | 1 | 15 | 5 | Plant | 100 | Pl | 100 | 1400 | |
| P2 Pine – medium site | 1 | 15 | 5 | Plant | 100 | Pl | 100 | 1400 | |
| P3 Pine – poor site | 1 | 15 | 5 | Plant | 100 | Pl | 100 | 1400 | |
| P3 Pine – low site | 1 | 15 | 5 | Plant | 100 | Pl | 100 | 1400 | |

a) Regeneration delay reflects current operational practice and is defined as the time after harvest but before planting or seed germination occurs. Regeneration delays will be applied in the TIPSY yield model.

b) Operational adjustment factors (OAFs) are used to adjust timber yield estimates to account for operational factors. OAF1 is a constant percentage reduction to account for small non-productive areas within stands, uneven stem distribution and endemic losses that do not increase with age. OAF2 accounts for losses that increase with stand age, such as decay due to disease. In this case OAF2 increases from 0 at stand establishment and passes through 5% at 100 years of age.

c) Existing spaced stands have a spaced density of 800 trees per hectare. No future spacing is planned.

| Analysis unit | Regen delay[a] (years) | OAFs[b] (%) | | Method | | Species | | Density (sph) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | Type | % | Code | % | Initial | Spaced[c] |
| S1 Spruce – good site | 1 | 15 | 5 | Plant | 100 | Sx | 100 | 2000 | |
| S2 Spruce – medium site | 1 | 15 | 5 | Plant | 100 | Sx | 100 | 2000 | |
| S3 Spruce – poor site | 2 | 15 | 5 | Natural | 100 | Sx | 100 | 2000 | |
| S4 Spruce – low site | 2 | 15 | 5 | Natural | 100 | Sx | 100 | 2000 | |

a) Regeneration delay reflects current operational practice and is defined as the time after harvest but before planting or seed germination occurs. Regeneration delays will be applied in the TIPSY yield model.

b) Operational adjustment factors (OAFs) are used to adjust timber yield estimates to account for operational factors. OAF1 is a constant percentage reduction to account for small non-productive areas within stands, uneven stem distribution and endemic losses that do not increase with age. OAF2 accounts for losses that increase with stand age, such as decay due to disease. In this case OAF2 increases from 0 at stand establishment and passes through 5% at 100 years of age.

c) Existing spaced stands have a spaced density of 800 trees per hectare. No future spacing is planned.

**Data source and comments:**

Although mixed planting and natural regeneration does occur, analysis units are assumed to regenerate to the leading species of the analysis unit. Records show that, traditionally, 63% of good sites are planted, 65% of medium sites are planted, and 80% of low sites were planted. However, practices have changed to rely more on natural regeneration. Planting is generally focused on good sites while medium and poor sites regenerate naturally and are fill-planted when necessary. Regeneration delay is assumed to be one year for planted sites and naturally regenerated cottonwood sites, and two years for other naturally regenerated sites.

Density at regeneration delay is about 4500 stems/hectare (range is 4300 to 5600). Spruce/cedar sites have lower densities. The densities at the lower end of the range also account for lower stocking requirements specified by the Kalum SRMP for specific sites within identified grizzly bear watersheds. Pine stands are assumed to have lower densities (1400 stems per hectare at initiation) because of lower natural ingress. Juvenile spacing has been carried out historically within the district, to a limited degree, and area associated with this treatment has been assigned a separate analysis unit. Some spacing is ongoing through the Northwest Strategy and the Forest Investment Account.

Limited "Class A" seed is available for use within the Kalum Forest District, and so tree improvement has not been factored into yield curves.

The timber yield for coniferous analysis units with a low site class cannot be modelled in TIPSY, which requires a minimum site index of 10. These stands and all cottonwood analysis units will be regenerated in the model using the corresponding existing stand yield tables.

A "paired plot" old-growth site index study – *Site index adjustment for old-growth coastal western hemlock stands in the Kalum Forest District* by G.D. Nigh and B. Love, 1997 – confirmed that site index is underestimated by 10 metres when hemlock-leading stands currently greater than 140 years of age are harvested and replaced with managed hemlock stands. A site index adjustment of 10 metres is applied in the base case to hemlock-leading stands currently older than 151 years in the CWH biogeoclimatic zone after they are harvested in the model (this study was done in 1997 and the inventory from that time has been projected in age to 2008, so the 140-year age boundary is interpreted to mean 140 + 11 = 151 years of current inventory age in 2008). Information from Site Index by Biogeoclimatic Ecosystem Classification (SIBEC) cannot be used because doing so requires an acceptable Predictive Ecosystem Mapping (PEM) which does not exist for the Kalum TSA.

### 6.5.2 Immature plantation history

Areas of immature forest where the density (stems per hectare) has been reduced through spacing 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.

The original data package proposed that the following areas be treated as plantations with managed stand yield tables: all stands 30 years and younger, 70% of stands between 31 and 40 years, and 30% of stands between 41 and 50 years. Since plantations are established following harvest, the criteria used in the analysis have been changed to all coniferous-leading stands 45 years or younger with a logging history (identified using the depletion layer described in Section 3, "Inventories"). These criteria are consistent with the criteria for identifying areas with existing roads, trails and landings in Section 5.14.

Stands identified in recent Dothistroma surveys (see Section 6.4) as 'stocking likely without pine' are not assigned to managed stand yield tables because of the understory natural regeneration. Stands identified as 'STP' (i.e., action imperative) are assigned to managed stand yield tables.

A report from the RESULTS silviculture database shows that 14 632 hectares of stands have been spaced in the Kalum TSA. The coniferous-leading stands identified in this report are assigned to managed stand yield tables with spacing.

### 6.5.3 Not satisfactorily restocked (NSR) areas

The original data package proposed that not satisfactorily restocked (NSR) land would remain in the timber harvesting land base unless they are inoperable. NSR land would be identified using the FIP attribute type identity. This attribute was only available for the portion of the forest inventory based on FIP data, so another approach was developed to address NSR land, which addressed all of the depletions identified in the depletion layer (see Section 3, "Inventories").

Two kinds of depletions are identified in the depletion layer:

a) recent depletions from RESULTS and satellite change detection;

b) VRI harvest_date history.

For each of these two types of depletions, there are three conditions that are handled as follows:

1. All required attributes exist – Species, age and site index. For recent depletions, they are the pre-harvest values. For VRI depletions, they are the existing stand values.
   - Recent depletions in this condition retain their original leading species, to reflect data package assumptions. Age is set to the harvest age (i.e., years since harvest). Site index is retained and adjusted (+10) for hemlock-leading stands in the CWH biogeoclimatic zone, as described in Section 6.5.1, "Silviculture and regeneration activities in managed stands".
   - VRI depletions in this condition retain all existing values with no changes.
2. Species and age values are missing, but site index values exist. These areas are classified as NSR or NCBR (non-commercial brush) in the FIP inventory.
   - Recent and VRI depletions are assigned a leading species based on the dominant leading species within their BEC variant. Age is set to the harvest age. Site index is the area-weighted average site index for stands with the same leading species by BEC variant having an age of 140 years or younger. The age criteria avoids underestimating site index as a result of including old stands in the calculation. Although site index values exist for these areas, the associated species is unknown, so the site index is considered to be unreliable.
3. No required attributes exist – species, age and site index values are all missing. These areas are classified as non-productive or non-commercial types in the FIP inventory.
   - These areas are assumed to be non-productive and are removed from the THLB, with no adjustments made to species, age, or site index.

## 6.6 Integrated resource management

### 6.6.1 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 24Table 24 describes the forest cover requirements to be applied.

*Table 24. Forest cover requirements*

| Resource objective | Area target (%) | Condition target | Affected land base |
|---|---|---|---|
| Patch size distribution | Maximum 35% | Height ≤ 3 m | THLB by landscape unit outside community watersheds, special management zones and visual areas |
| Community watersheds | Maximum 30% | Height ≤ 5 m | Crown forested land base by community watershed for watersheds > 250 ha |
| Lakelse River SRMZ – subzone 2 | Maximum 27% | Age ≤ 40 years | Crown forested land base |
| Grizzly Bear | Maximum 30% | Age between 25 and 100 years | Coniferous Crown forested land base in each of the McKay-Davies and Copper identified grizzly bear watersheds |
| Visual quality objectives | Maximum allowable disturbance in plan view by VQO in Table 25Table 25 and Table 26 | Height ≤ visually effective green-up height in Table 26Table 26 | Crown forested land base for each visual unit |
| Seral stage distributions | Area targets in Table 28 and Table 29Table 29 | Age targets in Table 27Table 27 | Crown forested land base by landscape unit and BEC variant |
| Old forest in undeveloped watersheds | See Table 30Table 30 | | Crown forested land base by watershed and BEC variant |

**Data source and comments:**

Note: The original data package proposed that minimum height requirements for patch size distribution and visual quality objectives be converted to ages. The Woodstock timber supply model can track several yield components, including height curves, so height requirements are modelled directly instead of being converted to ages.

Patch size distribution

The patch size distribution requirement is modelled using a proxy for cutblock adjacency. This is applied to the integrated resource management area outside of special management zones, community watersheds and areas with VQOs. IRM areas are generally large contiguous patches of harvestable forest and the maximum disturbance of 35 percent adequately describes the cutting pattern used at this time.

Community watersheds

All or part of five existing community watersheds (Deep Creek, Wathl Creek, Drake Creek, Eneeksgilaguaw Creek, Virginia Creek) are located within the Kalum TSA. Only the first two of these are larger than 250 hectares. The Kalum SRMP establishes an additional five community watersheds Rosswood (Clear Creek), Kleanza (Singlehurst Creek), Hatchery Creek, Usk (Skovens Brook) and Gossen (Gossen Creek). All of these new community watersheds lie within the Kalum TSA but only the first three are larger than 250 hectares. The

Kalum SRMP requires a clearcut equivalency of less than 20 percent of the total area for each watershed larger than 250 hectares. The forest cover requirements shown in Table 24Table 24 for community watersheds are interpreted from the *Forest Practices Code Community Watershed Guidebook*.

Lakelse River SRMZ

The previous timber supply review accounted for the management requirements of the Thunderbird Integrated Resource Management Plan (IRMP). That plan has since been incorporated into the Kalum LRMP and Kalum SRMP. The old forest requirements of the Thunderbird IRMP are now part of the old seral stage requirements represented by old growth management areas, which are removed from the timber harvesting land base (see Section 5.11, "Exclusion of specific, geographically defined areas"). The early seral stage requirement is now the requirement for the Lakelse River SRMZ in Table 24Table 24.

Grizzly Bear

The Kalum SRMP specifies mid-seral requirements for grizzly bear habitat in the McKay-Davies and Copper watersheds.

Visual Quality Objectives

Scenic areas and visual quality objectives (VQO) have been legally established or grand-parented under the *Forest and Range Practices Act*. The original data package proposed that each visual polygon would be modelled individually. This created a model that is too large to run with the computer resources available, so visual polygons are aggregated by VQO and landscape unit. Table 25Table 25 shows the maximum allowable percent alteration for each VQO in perspective view.

*Table 25. Assignment of visual quality objectives*

| Recommended VQO | % alteration by VAC[a] (perspective view) | | |
|---|---|---|---|
| | Low | Medium | High |
| Retention | 0.1 | 0.7 | 1.5 |
| Partial retention | 1.6 | 4.3 | 7.0 |
| Modification | 7.1 | 12.5 | 18.0 |

[a]VAC = visual absorption capacity.

The percent alteration in perspective view from Table 25Table 25 must be converted to a measure in plan view for use in a timber supply model. A Plan to Perspective (P2P) ratio is calculated for each visual unit by area-weighting the P2P for each slope class within the visual unit, using the data in Table 26. The percent alteration in perspective view is multiplied by the area-weighted P2P ratio to calculate the percent alteration in plan view.

An area-weighted Visually Effective Green-up (VEG) height is determined for each visual unit using the data in Table 26. VEG heights refer to top height (average height of tallest 10% of trees).

*Table 26. 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.

Seral stage requirements

The Kalum LRMP incorporates the management requirements from the 1992 Thunderbird Integrated Resource Management Plan (IRMP), including the seral stage requirements. These requirements are established as legal objectives in the Kalum Sustainable Resource Management Plan (SRMP).

The Fiddler Creek Total Resource Plan (approved by the Kalum Forest District Manager in December 1995) also specifies some management requirements. This plan has not been legally established under the *Forest Practices Code Act* or the *Forest and Range Practices Act*. However, all but two requirements from this plan are accounted for by management requirements of the Kalum SRMP. These are forest cover requirements for the Critical Habitat Zone (Zone 1) and the Fish/Wildlife Special Management Zone (Zone 2). Zone 1 requirements are largely met by the current riparian management practices for the Skeena River and Fiddler Creek, which are accounted for in this data package. Zone 2 lies almost entirely outside of the area that is operable for timber harvesting, so its requirements are met automatically. Therefore, the requirements of this plan are not explicitly addressed in this data package.

The seral stage requirements established by the Kalum SRMP are duplicated here in Table 27Table 27 through Table 30Table 30 for the landscape units that cover the Kalum TSA. Table 27Table 27 defines the age ranges for each seral stage, based on the *Biodiversity Guidebook*. Table 28 defines the seral stage distribution for early, mature plus old, and old forest. Old seral stage requirements have been fully implemented by legally established Old Growth Management Areas (OGMAs). These OGMAs are used instead of the old-seral stage requirements. They are removed from the THLB as described in Section 5.11, "Exclusion of specific, geographically defined areas". The effect of forest aging in OGMAs is discussed in Section 6.6.2, "Disturbance outside of the timber harvesting land base".

The Kalum SRMP contains a transition strategy for meeting early and mature plus old seral stage targets. It does not specify a time frame other than "as soon as possible", so it is assumed to be within 20 years. Table 29 identifies the Kalum SRMP's adjusted early seral stage targets for the transition strategy.

Footnotes to the tables in the Kalum SRMP that correspond with Table 28**Error! Reference source not found.** and Table 29 indicate that:

- the early seral requirements of the Lakelse landscape unit do not apply to subzone 2 of the Lakelse River Special Resource Management Zone. This area is addressed in Table 24Table 24.
- the old seral stage requirements for the Hirsch landscape unit do not apply to the Jesse and Emsley watersheds. This area is addressed in Table 30.

This is interpreted to mean that the special requirements for these two areas apply in addition to the requirements specified for each landscape unit in Table 28**Error! Reference source not found.**. The Kalum SRMP confirms this for the Jesse and Emsley watersheds.

The Kalum SRMP identifies several undeveloped watersheds, one of which is located in the Kalum TSA – the Jesse Emsley watershed in the Jesse Bish landscape unit. Table 30Table 30 shows the old forest retention targets for this watershed. These targets are specified by site series, but there is no accurate mapping of site series for the Kalum TSA. The most recent Predictive Ecosystem Mapping did not meet the accuracy standards set by the chief forester. OGMAs have not been established in this undeveloped watershed. The equivalent amount of old-seral forest is estimated using the following procedure:

1. Implement THLB reductions for all other factors listed in this data package.
2. Calculate the CFLB area, THLB area and minimum old-seral area for each analysis unit (a surrogate for site series) by biogeoclimatic variant (only CWH vm exists in the THLB) in each of the Jesse and Emsley watersheds.
3. Calculate the area required to meet the old-seral target for each analysis unit, variant and watershed, using 25% to represent the average old-seral target for each site series shown in Table 30Table 30.

Most of the area outside the THLB is old or near-old (200 years or older). Near-old areas serve as recruitment area for old growth. The only area requiring THLB to contribute to the old-seral target is the hemlock poor site class analysis unit in the Jesse watershed. Approximately 20 hectares is required to meet the target of 272 hectares. Since this is a small amount relative to the size of both the target and the watershed, it is assumed that the shortfall is insignificant. This confirms the assumption in the Kalum SRMP (page 10) that the entire old-seral target for undeveloped watersheds can be met outside the THLB. Therefore, these requirements are not applied in the timber supply model.

*Table 27. Seral stage definitions*

| BEC unit | NDT[a] | Forest stand age (years) | | |
|---|---|---|---|---|
| | | Early | Mature | Old |
| CWHvh2, vm, vm1, vm2 | 1 | ≤ 40 | > 80 | > 250 |
| ESSFwv, MHmm1, mm2 | 1 | ≤ 40 | > 120 | > 250 |
| CWHws1, ws2 | 2 | ≤ 40 | > 80 | > 250 |
| ESSFmk | 2 | ≤ 40 | > 120 | > 250 |
| ICHmc1, mc2 | 2 | ≤ 40 | > 100 | > 250 |

(a) Natural disturbance type.

*Table 28. Target seral-stage distribution*

| Landscape unit | BEO[5] | BEC variant | Seral stage distribution (% of forested land base) | | |
|---|---|---|---|---|---|
| | | | Early | Mature + old | Old |
| Beaver | I | CWHws1/ws2 | <36 | >34 | >9 |
| | | MHmm2 | <22 | >36 | >19 |
| Clore | I | CWHws1/ws2 | <36 | >34 | >9 |
| | | ESSFmk | <36 | >28 | >9 |
| | | ESSFwv, MHmm2 | <22 | >36 | >19 |
| Exchamsiks | L | CWHvm | n/a | >18 | >13 |
| | | MHmm1 | n/a | >19 | >19 |
| Exstew | I | CWHws1/ws2 | <36 | >34 | >9 |
| | | MHmm2 | <22 | >36 | >19 |
| Falls | L | CWHvm/vm1 | n/a | >18 | >13 |
| | | MHmm1 | n/a | >19 | >19 |
| Hirsch | I | CWHvm | <30 | >36 | >13 |
| | | CWHws1/ws2, | <36 | >34 | >9 |
| | | MHmm1 | <22 | >36 | >19 |
| Hot Springs | L | CWHws1/ws2 | n/a | >17 | >9 |
| | | MHmm2 | n/a | >19 | >19 |
| Ishkheenickh (Ksi Hlginx) | I | CWHvm, | <30 | >36 | >13 |
| | | CWHws1/ws2 | <36 | >34 | >9 |
| | | MHmm1 | <22 | >36 | >19 |
| Jesse Bish | L | CWHvm | n/a | >18 | >13 |
| | | MHmm1 | n/a | >19 | >19 |
| Kalum | I | CWHws1/ws2 | <36 | >34 | >9 |
| | | MHmm2 | <22 | >36 | >19 |
| Kasiks | I | CWHvm | <30 | >36 | >13 |
| | | MHmm1 | <22 | >36 | >19 |
| Kiteen (Ksi Gahlt'in) | L | CWHws2 | n/a | >17 | >9 |
| | | ICHmc1/mc2 | n/a | >15 | >9 |
| | | MHmm2 | n/a | >19 | >19 |
| Kitimat | L | CWHvm | n/a | >18 | >13 |
| | | CWHws1/ws2 | n/a | >17 | >9 |
| | | MHmm1/mm2 | n/a | >19 | >19 |
| Kleanza Treasure | L | CWHws1/ws2 | n/a | >17 | >9 |
| | | ICHmc2 | n/a | >15 | >9 |
| | | MHmm2 | n/a | >19 | >19 |

[5] Biodiversity emphasis option: H – higher; I – intermediate; L – lower.

| Landscape unit | BEO[5] | BEC variant | Seral stage distribution (% of forested land base) | | |
|---|---|---|---|---|---|
| | | | Early | Mature + old | Old |
| Lakelse | I | CWHws1/ws2 | <36 | >34 | >9 |
| | | MHmm2 | <22 | >36 | >19 |
| Nelson Fiddler | L | CWHws1/ws2 | n/a | >17 | >9 |
| | | ICHmc2 | n/a | >15 | >9 |
| | | MHmm2 | n/a | >19 | >19 |
| Skeena River Kalum | H | CWHvm | <23 | >54 | >19 |
| | | CWHws1/ws2 | <27 | >51 | >13 |
| | | ICHmc2 | <27 | >46 | >13 |
| | | MHmm1/mm2 | <17 | >54 | >28 |
| Tseax (Ksi Sii Aks) | I | CWHws1/ws2 | <36 | >34 | >9 |
| | | ICHmc1/mc2 | <36 | >31 | >9 |
| | | MHmm2 | <22 | >36 | >19 |
| Wedeene | I | CWHvh2/vm | <30 | >36 | >13 |
| | | CWHws1/ws2 | <36 | >34 | >9 |
| | | MHmm1/mm2 | <22 | >36 | >19 |

[5]Biodiversity emphasis option: H – higher; I – intermediate; L – lower.

*Table 29. Allowable deviations from the early seral-stage targets*

| Landscape unit | BEC variant | Maximum early seral forest (% of forested land base) |
|---|---|---|
| Beaver | CWHws1 | <51 |
| | CWHws2 | <46 |
| | MHmm2 | <32 |
| Clore | CWHws1 | <51 |
| | CWHws2, ESSFmk | <46 |
| | ESSFwv, MHmm2 | <32 |
| Exstew | CWHws1 | <51 |
| | CWHws2 | <46 |
| | MHmm2 | <32 |
| Hirsch | CWHvm | <40 |
| | CWHws1 | <51 |
| | CWHws2 | <46 |
| | MHmm1 | <32 |
| Kalum | CWHws1 | <51 |
| | CWHws2 | <46 |
| | MHmm2 | <32 |
| Kasiks | CWHvm | <30 |
| | MHmm1 | <32 |
| Lakelse | CWHws1 | <51 |
| | CWHws2 | <46 |
| | MHmm2 | <32 |
| Skeena River Kalum | CWHvm | <33 |
| | CWHws1 | <42 |
| | CWHws2, ICHmc2 | <37 |
| | MHmm1, MHmm2 | <27 |
| Wedeene | CWHvh2, CWHvm | <40 |
| | CWHws1 | <51 |
| | CWHws2 | <46 |
| | MHmm1, MHmm2 | <32 |

*Table 30. Target old seral stage forest within undeveloped watersheds*

| Undeveloped watershed | BEC variant | Site series | % of old forest predicted by natural disturbance | Old seral forest target (% of forested land base) |
|---|---|---|---|---|
| Jesse | CWHvm1 | 01 | 89 | 27 |
| Emsley | | 03 | 93 | 28 |
| | | 05 | 73 | 22 |
| | | 06 | 88 | 26 |
| | | 08 | 73 | 22 |
| | | 09 | 70 | 21 |
| | | 12 | 93 | 28 |
| | | 13 | 93 | 28 |
| | | 14 | 78 | 23 |
| | CWHvm2 | 01 | 89 | 27 |
| | | 03 | 93 | 28 |
| | | 05 | 73 | 22 |
| | | 06 | 88 | 26 |
| | | 08 | 73 | 22 |
| | | 09 | 70 | 21 |
| | | 10 | 70 | 21 |
| | MHmm1 | 01 | 86 | 26 |
| | | 02 | 93 | 28 |
| | | 03 | 86 | 26 |
| | | 04 | 93 | 28 |
| | | 06 | 93 | 28 |

### 6.6.2 Disturbance outside of the timber harvesting land base

Some forest cover requirements described in Table 24Table 24 apply to the Crown productive forest, which includes forest outside of the THLB. Forest outside of the THLB undergoes 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 aging continuously and contributing inappropriately to forest cover requirements.

Forest ecosystems in the Kalum TSA lie within Natural Disturbance Types (NDT) 1 and 2 (Table 27Table 27). In NDT 1, small gap disturbances are created by the death of individual trees or small patches of trees. When disturbances such as wind, fire, and landslides occur, they are generally small and result in irregular edge configurations and landscape patterns. In NDT 2, infrequent fires disturb areas ranging in size from 20 hectares to 1000 hectares.

The forest ecosystems in the Kalum TSA experience relatively low levels of natural disturbance and are dominated by old forest. Therefore, the age of the forest stands outside the THLB are frozen in the timber supply model, i.e., these stands are not permitted to age further. This means that the current age distribution of these stands represents the average distribution over time. An alternative approach, particularly in NDT 2 where natural disturbance is larger in scale, would be to calculate the amount of disturbance required to produce the natural amount of forest older than 250 years in each NDT. However, this would result in an even age distribution outside of the THLB, which is less realistic than the frozen age distribution implemented for this analysis.

# 7. Sensitivity Analysis

Sensitivity analysis can assess the timber supply impact of uncertainty in data and management assumptions. It can also help determine which variables have the greatest influence on harvest forecasts. Table 31Table 31 lists the sensitivity analyses to be performed.

*Table 31. Sensitivity analysis*

| Issue to be tested | Sensitivity levels |
|---|---|
| Harvest flow alternatives | Various alternatives to the base case, including immediate harvesting of second growth. |
| Harvest priorities | Two priorities: a) lowest priority for hemlock-leading age class 9 stands; b) top priority for second growth. |
| Site productivity for older stands | Adjust site index of old stands following harvest using the results of the provincial *Old Growth Site Index* (OGSI) studies using paired plots and veteran trees, other than those already adjusted in the base case. |
| Operability | Test removal of specific areas that may be uneconomic. |
| Minimum harvestable age | Reduce volume, height and diameter criteria by 20%, alone and in conjunction with harvest priority on second growth. |
| Management for visual quality | Visually effective green-up height of five metres. |
| Management for patch size distribution | Find the threshold for maximum disturbed area that disrupts timber supply when using the proxy for cutblock adjacency. |

**Data source and comments:**

The tests for harvest priority explore the effect of potential licensee behaviour to maximize value under market-logging conditions.

The original package proposed a sensitivity analysis for operability to test the partition of the harvest forecast into sawlog and pulplog components. Analysis of harvest history for the past 10 years shows that there has been little change in the proportion of sawlog and pulplog stands harvested, or in the proportion of sawlog and pulplog volumes harvested. Furthermore, the classification of sawlog and pulplog areas was a poor predictor of the volume of sawlogs and pulplogs harvested. The proposed sensitivity analysis was changed to test the removal of specific geographic areas.