APPENDIX B.

TFL 41 Timber Supply Analysis Information Package

TREE FARM LICENCE 41

TIMBER SUPPLY REVIEW

INFORMATION PACKAGE

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1.0 Introduction

The most recent timber supply review (TSR) and Allowable Annual Cut (AAC) rationale for Tree Farm Licence (TFL) 41 was completed in 1999, at which time the AAC was set at 400,000 m^3 on a gross land base area of 703,745 hectares. This AAC includes 220,000 m^3 partitioned to the offshore portion of the TFL, with the 180,000 m^3 balance partitioned to the inshore portion. Without specification to either portion, 34,000 m^3 of the total AAC is partitioned for non-conventional harvest methods.

Land is being deleted from TFL 41 as a result of volume re-allocation under the *Forest Revitalization Act*. The deletions have not been completed, but areas have been identified for deletion and the process should be completed in 2011. This analysis will consider the residual land base following the land deletions from the TFL that are required in order to accommodate the AAC apportionments to other parties, as well as the productive capacity of , and current management on, the residual land base. Skeena Sawmills will be operating on the residual land base following the proposed land deletions under its AAC apportionment of 122,926 m^3 annual harvest subject to the next AAC determination.

The purpose of this Information Package is to document the information sources and assumptions to be used in the base case timber supply analysis and to discuss potential sensitivity analysis scenarios. The base case will reflect current management, including management objectives, the land base available for timber harvesting, and harvesting and silviculture practices.

2.0 Inventory Information

2.1 Forest Cover

The TFL 41 inventory was completed in 1998 using aerial photography taken in 1996 and 1997 and was completed on a TRIM base to the forest inventory standard of the day. As such, the current inventory was not completed under the Vegetation Resources Inventory (VRI) program. It was conducted under terms of reference developed in consultation with the Ministry of Forests Resources Inventory Branch (RIB) with the sample design and methodology approved by RIB in 1996 as stated in the 1999 TFL 41 Management Plan 6 Information Package. The Deputy Chief Forester's Rationale for Allowable Annual Cut Determination in 1999 states that the 1998 inventory was developed to meet acceptable standards.

Inventory depletions that occurred after the date of the photography were updated to 1998 in the original inventory database. Subsequent harvest depletions have been mapped separately and incorporated into the GIS resultant dataset created for this project. The inventory has been updated for depletions and projected to January 1st, 2010. Stand age has been reset based on the year of harvest. Species composition for regenerated stands will be assigned based on biogeoclimatic subzone, variant and site series (see Table 31). Site productivity estimates for all stands are from the inventory database. For stands older than 30 years of age, site index (SI) is determined based on stand height and age using MFR-specified site index curves. SI for younger stands was estimated by the photointerpretter, and growth intercept data was used where available.

Inventory volumes for all unharvested stands have been projected to 2010 using VDYP (Batch Version 6.6d). For mature stands only (older than 140 years), these volumes have been adjusted using the localization factors shown in Table 1

Table 1: Mature Stand Volume Localization Factors

Species	Ratio
Hemlock	0.8057
Balsam	0.7170
Cedar	0.8446

The derivation of these factors is described in the '*Report of the Re-Inventory of Tree Farm Licence 41'*, a copy of which has been provided in Appendix I.

An Inventory audit (sample-based field audit) was completed in 1997 on the previous inventory. Neither an inventory audit nor a VRI Phase II program has been completed on the current inventory. Statements regarding the accuracy of the current inventory are made in the *Report on the Re-inventory of TFL 41 1996-98* (1999) as follows:

> "… The 1997 MoF inventory audit of mature timber on the operable area reported an average ground volume of 506 m^3/ha. The operability classification was revised in 1998. If it is assumed that the operable area sampled in the audit corresponds approximately to the 1998 conventional operability class then the localized VDYP average volume of 522 m^3/ha is comparable to the audit average. The localised volume is close to the mean and well within the audit confidence interval of 452 m^3/ha to 560 m^3/ha. The audit volumes quoted here are gross volume less DWB for tree classes 1 and 2, 17.5 cm+ DBH"

2.2 Data Sources

Table 2 provides a list of data sources used in this analysis.

Table 2: Data Sources

Description	Data Source / Custodian	Vintage of Data (Update)
TFL Boundary (Excluding all area proposed as deletions)	Timberline	2010
Parks and Protected Areas	LRDW	2008
TFL 41 PEM	LRDW	2004
Forest Cover	WFM	1996 / 1997
Riparian Classification Mapping	WFM	2010
Fish Stream Inventory Mapping	WFM	2000+
Water	WFM	1999
First Nations House And Territory Boundaries	MFR Northern Interior Forest Region and Skeena Stikine District	2009
Ownership	MFR Forest Analysis and Inventory Branch	2009
Forest Recreation Sites And Trails	LRDW	2009
Depletion Layer	WFM / RESULTS	2010
Environmentally Sensitive Areas (ESA)	WFM	1984 (1998)
Terrain Stability Mapping	WFM	1996+
Areas Without Terrain Stability Mapping	Timberline	2010
Operability Mapping	WFM	1998
Wildlife Habitat Areas – Tailed Frog	LRDW	2004-2006
Ungulate Winter Ranges – Mountain Goat	LRDW	2008
Kalum SRMP Special Resource Management Zones, Grizzly Bear Identified Watershed, Connectivity Corridors, Undeveloped Watershed	ILMB data warehouse	2006
Community Watersheds	LRDW	2006
Scenic Areas	LRDW	2000
Landscape Units	LRDW	2006
Biogeoclimatic Ecosystem Classification	LRDW	2009
Old Growth Management Areas	LRDW	2008
Archaeological Overview Inventory	WFM	1998
Watersheds	LRDW	2005

The TFL boundary was retrieved from the LRDW. Licencee data was used to exclude areas that will be deleted to account for Forest Revitalization Act (FRA) and pre-FRA BC Timber Sales volume and other minor discrepancies found in the LRDW version of the boundary. No parks and protected areas exist within the TFL boundary. Parks and protected areas that are peripheral and adjacent to the TFL boundary are identified. One polygon that is not part of the TFL falls within the TFL boundary. It is removed as the first step in the netdown.

Predictive ecosystem mapping (PEM) was completed for TFL 41 in 2004 as part of a larger project within the Kalum Forest District. An accuracy assessment conducted in 2007 found that scores were not

sufficiently high to permit its use for predicting site productivity in timber supply analysis. As described in the relevant sections of this document, the TFL 41 PEM is used in this project in order to:

- define silviculture regimes by site series to be applied post harvest;
- augment the identification of areas to be classified as non-forest and non- productive forest in addition to that provided by forest cover data; and
- provide the site series classification in order to model the forest cover constraints required to meet management objectives for the identified watersheds specified in the TFL 41 Forest Stewardship Plan (FSP).

Riparian classification mapping identifies known S1-B stream reaches (large fish bearing streams) based upon a combination of operational knowledge, existing fisheries inventories, and TRIM map features. Lakes and rivers are identified from the forest cover mapping, and are 100% consistent with TRIM map features. Wetlands were also extracted from the forest cover, but these do not match the TRIM data. TRIM wetlands were ignored.

Fish stream inventory mapping has been completed in several watersheds and identify all fish bearing stream reaches within the applicable watersheds. This information is used to assist in developing the netdowns necessary to account for riparian reserve zones and riparian management zone retention in areas outside the riparian management area of the classified S1-B stream reaches.

Harvest depletions were identified from licencee-maintained cutblock data. These were spot-checked against RESULTS information.

Forest Recreation Sites and Trails are administered by the Ministry of Tourism, Culture and Arts and have management objectives that have been established by government.

The soils portion of Environmentally Sensitive Areas (ESA) mapping was undertaken in 1984 which identified terrain that is unstable or potentially unstable. The mapping was completed under contract by the Land Use Planning Advisory Team (LUPAT) of MacMillan Bloedel Ltd. as described in their report (1985) and is a reliable source of information for use in timber supply analysis.

Terrain stability mapping (TSM) is an amalgamation of various projects starting from 1996 that focused on covering the operable land-base with more up to date terrain classification. The amalgamated map identifies areas that are outside of TSM boundaries where ESA mapping for sensitive soils will be used in this TSR.

Operability mapping defines the areas that are deemed to be physically accessible for timber harvesting. Areas mapped as operable are subject to all the various net-downs and constraints necessary to meet management objectives and requirements for various forest resources (e.g. riparian, sensitive soils). The projection of the operable area was revised for MP 6 based on the 1998 inventory and updates the previous operability mapping that was last done in 1982. The classification was completed under a terms of reference approved by the district manager on March 5, 1998. A report entitled Operability Report for TFL #41 (1998) was submitted to the district manager. The revised mapping recognizes use of helicopter yarding and improvements in cable yarding techniques. No new techniques or advance in methods have occurred since that time. Economic conditions have constrained access in portions of the operable land base; however the terms of reference remain appropriate in defining operability.

Wildlife habitat areas and ungulate winter ranges are mapped and established by the Ministry of Environment and are distributed on the LRDW.

As described in the Kalum TSA TSR Data Package (2010), 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 apply forest management requirements. These include the requirements for the McKay-Davies grizzly bear identified watershed, seral stage targets by landscape unit and biodiversity requirements for the Jesse and Emsley identified watersheds.

The Wathl Creek Community Watershed, within TFL 41 in the last TSR, is within the area to be deleted from the TFL area and not part of the area subject to this timber supply review.

The scenic areas map (2000) identifies scenic areas and visual quality objectives. Although more recent landscape inventories exist, the scenic areas mapped in 2000 were grand-parented under the *Forest and Range Practices Act* for which results and strategies are specified in the current TFL 41 FSP.

As stated in the Kalum Timber Supply Area Data Package (2010), old growth management areas (OGMA's) were established in 2006 through the Kalum SRMP, and subsequently amended in May 2007. The OGMA's represent "old" seral requirements put forward in the Kalum SRMP.

The Archaeological Overview Inventory identifies the location of archaeological sites that were known to exist in 1998. These sites are subject to conservation requirements under the *Heritage Conservation Act.*

Watershed data was retrieved from the LRDW, and has been used to help define riparian buffering, as described in Section 3.12.

3.0 Timber Harvesting Land Base Definition

The timber harvesting land base is determined by removing components of the land base that are not considered harvestable. Table 3 shows how the THLB was derived.

Table 3: Timber Harvesting Landbase Determination

Classification	Total Area (ha)	Net Area Removed (ha)	Net Volume Removed (m^3)
Gross Area Within TFL 41 Boundary (excludes all parks and protected areas)	**201,939**		
Landbase Reductions:			
Non-TFL	104	104	1
Non Productive	93,046	93,046	412,174
Old Growth Management Areas	10,366	10,071	3,670,370
Avalanche - ESA1	1,380	1,295	274,393
Soils-ESA1	4,533	3,303	1,077,687
Soils-ESA2	7,594	1,087	372,313
Terrain Class V	5,542	3,799	1,607,409
Terrain Class IV	13,782	1,222	499,482
Recreation Sites and Trails	74	43	9,099
Inoperable Stands	156,841	47,883	13,721,395
Non-Merchantable Mature Stands	13,865	619	159,298
Non-Merchantable Immature Stands	99,440	618	82,518
Problem Forest Types	4,882	1,215	569,039
Archaeological Sites	4	1	425
Wildlife Habitat – Tailed Frog	62	7	3,780
Wildlife Habitat – Goat	5,269	235	98,582
Riparian Reserve Zones - Spatial - S1	2,521	854	338,722
Riparian Reserve Zones - Spatial - Other Stream Classes	1,221	446	247,285
Riparian Reserve Zones - Unclassified Streams	148,994	2,107	475,044
Wildlife Tree Patch	154,707	103	19,518
Roads - Existing	19,050	999	15,887
Total Landbase Reductions		**169,058**	**23,654,423**
Current Timber Harvesting Landbase		**32,881**	**8,096,900**
Future Reductions			
Future Roads		1,324	
Long Term Timber Harvesting Landbase		**31,558**	

The following sections describe assumptions associated with each of these exclusions.

3.1 Non-TFL Area

The total residual area of TFL 41 is based on the original TFL area less deletions and therefore is substantially different from the land base in the 1999 analysis. All deletion areas are excluded from the data set, though not all were reflected in the LRDW version of the data. The boundary was assembled from the LRDW TFL boundary data (tfl boundary, tfl additions and tfl deletions layers) and updated for the takeback areas and other minor discrepancies, including one non-TFL polygon that is completely surrounded by the TFL. These areas and corrections were provided by the licensee and are excluded from the THLB, as presented in Table 4 below. Former Timber Licence T0991 has reverted to Schedule B status, thus there are no Schedule A lands included within the TFL. The gross TFL area in the 1999 analysis was 703,745 hectares; for this analysis it has fallen to 201,939 hectares.

Table 4: Non-TFL Area

Description	Data Source	Reduction %
Excluded Area	TFL Boundary	100

Data Source and Comments:

- The TFL boundary file from the LRDW was downloaded in April 2010 and was updated with deletion areas provided by the MFR. The revised boundary file was reviewed and approved by WFM.
- One non-TFL polygon that is shown as TFL area in the LRDW version of the data is the only area netted out at this step.
- No salt water falls within the TFL boundary.
- A License of Occupation, held by the District of Kitimat, overlaps a small portion of the TFL near Claque Mountain. This licence does not confer any rights to timber, and would not limit harvesting in the area. Consequently, it has been disregarded for the purpose of this timber supply analysis

3.2 Non-Forest and Non-Productive Forest

Non-forest and non-productive areas are defined using both the forest cover and the PEM. Table 5 summarizes the forest cover criteria for non-forest and non-productive classifications. Areas with a logging history are assumed to be forested and / or capable of supporting a forest stand and are therefore not removed from the THLB. Table 6 shows the site series from the PEM that are classed as non-forest and non-productive and are removed from the THLB, with these exclusions occurring regardless of logging history.

Table 5: Non-Forest and Non-Productive – Forest Cover

Logging History	Projected Type ID	Description	Reduction (%)	Reduction Category
No	0	No projected type ID	100	Non-Forest
	5	Non-commercial	100	Non-commercial
	6	Non-productive	100	Non-Productive
	8	No-typing available	100	Non-Forest

Table 6: Non-Forest and Non-Productive – PEM

BGC Label	Site Series Code	Site Series Description	Reduction (%)
All Variants	AW	Alder Willow	100
	DV	Urban Development	100
	ET	Estuary	100
	GL	Glacier	100
	HG	Heath / Grassland	100
	HM	Herbaceous Meadow	100
	LA	Lake	100
	ME	Wet Meadow	100
	MN	Moraine	100
	MU	Mudflat	100
	OC	Ocean	100
	PF|KR	Parkland or Krummholz	100
	RI	River	100
	RO	Rock	100
	RS	Riparian shrub	100
	RS|09	complex of Riparian Shrub and 09	100
	SA	Slide/Avalanche	100
	SB	Sand Bar	100
	TA	Talus	100
	WL	Undifferentiated Wetland	100

Data Source and Comments:

- Site series are defined from the 2004 TFL 41 PEM
- Water bodies are excluded based on where the site series is coded as Lake, River or Wetland, and also based on forest cover mapping.

3.3 Old Growth Management Areas

Areas identified as old growth management areas (OGMA) are removed from the THLB.

3.4 Terrain Stability

Certain categories of ESA-rated lands, listed below in Table 7, are removed from the THLB. Further, terrain stability mapping (TSM) is used where available in place of ESA ratings as TSM is a more current assessment of terrain stability. Terrain stability mapping (TSM) covers the majority of the THLB. Notwithstanding, the original soil sensitive area (ES) inventory, conducted under contract by the Land Use Planning Advisory Team (LUPAT 1985) of MacMillan Bloedel Ltd., is still a reliable source of data that can be used in similar fashion as TSM.

Table 7: Environmentally Sensitive Areas and Terrain Stability Classes

Logging History	ESA Category	Reduction (%)
No	Ea	100
	Es1	90
	Es2	20
	TSM Class V	80
	TSM Class IV	10

Data Source and Comments:

- The reduction values for the ESA categories are consistent with the Management Plan (MP) 6 analysis. These reduction values were found to be reasonable based on an analysis considered in the Chief Forester AAC Postponement Order for TFL 41 dated March 20, 2003 which reviewed the ESA categories of areas that were subject to on-the-ground terrain stability field assessments and subsequently harvested based on actual prescriptions. The reduction values for the TSM categories are based on the analysis outlined above which also compared the TSM and ESA categories of areas that were subject to on-the-ground terrain stability field assessments and subsequently harvested based on actual prescriptions.

3.5 Areas With High Recreation Values

The TFL 41 FSP specifies that certain recreation sites and trails be designated for protection. Recreation sites are wholly excluded from the THLB. Similarly, recreation trails will be buffered and removed from the THLB. Table 8 details the exclusions required for the recreation sites and trails within TFL 41.

Table 8: Areas with High Recreation Value

Feature	Description	Excluded Area	Reason For Exclusion
Forest Recreation Sites	Enso Recreation Site Kitimat River Recreation Site Onion Lake Recreation Site	All areas within the site	No harvest or salvage
Forest Recreation Trails	Claque Mountain Recreation Trail Robinson Ridge Recreation Trail	All portions of the trail and 10m buffer	No harvest or salvage

Data Source and Comments:

- Area exclusion parameters are consistent with the TFL 41 FSP

- The TFL 41 recreation inventory completed in 1998 identified recreation sites and trails and was used in the 1999 TFL TSR. This inventory has been superseded by the designation of recreation sites and trails and management objectives under the *Forest Practices Code of BC Act* which were grand-parented under the *Forest and Range Practices Act*.

3.6 Inoperable Areas

Table 9 below lists and defines the operability classes that continue from MP 6, along with the proportions that are removed from the THLB.

Table 9: Inoperable Areas

Logging History	Operability	Definition	Reduction (%)
No	Conventional	Ground-based, cable, A-frame.	0%
	Non-conventional	Helicopter and skyline, where SI < 10m or height < 28.5m or Hemlock > 50%	100%
	Inoperable	Physically and economically inaccessible	100%

Data Source and Comments:

- The projection of the operable area was revised for MP 6 based on the 1998 inventory and updates the previous operability mapping that was last done in 1982.
- Consistent with the 1999 TFL TSR, a portion of the area identified as operable for non-conventional harvesting methods is excluded. Areas that have site index 10 or below, height class below 4 and species composition of greater than 50% hemlock are excluded.
- The proportion of operable area that is classified as non-conventional is considerably less significant than the case in the 1999 TFL TSR where 7.6% of the initial THLB was identified as non-conventional area. These areas were predominantly in the "offshore" partition portion of land base that will be deleted from the TFL and not considered in this TSR.
- Although helicopter harvesting performance has been largely in the "offshore" partition areas where the non-conventional areas predominant, limited helicopter yarding has been performed within (or in conditions similar to) the current TSR land-base (Table 10).

Table 10: Recent Helicopter Logging

Year	Licence Area	Location	Block	Area (ha)	Volume (m^3)	Comments
1995	TFL 41 (Onshore)	Hirsch Cr	6-200-6	3	1,500	Onshore AAC partition, in deleted area
		Kitimat R	5-1000-30	15	7,577	Onshore AAC partition, residual area
	FL A16885	Minette Bay	75-3	2	1,000	Forest Licence similar timber
1996	TO955	Lakelse	36-5 / 36-5A	51	25,559	Timber Licence similar timber
	TFL 41 (Onshore)	Kitimat R	5-200-3A	15	8,694	Onshore AAC partition, residual area
2000	FL A16885	Bish Creek	M-M-10	2	1,000	Forest Licence similar timber
			M-A-1	16	8,000	Forest Licence similar timber

Year	Licence Area	Location	Block	Area (ha)	Volume (m^3)	Comments
2002	TFL 41 (Onshore)	Kildala Arm	41-10-1/2	76	38,397	Onshore AAC partition, in deleted area
2008	TFL 41 (Onshore)	Miskatla Inlet	41-40-X	78	39,000	Onshore AAC partition, residual area
	FL A16885	Miskatla Inlet	41-40-X	18	9,000	Forest Licence similar timber
Total				**276**	**139,727**	

3.7 Non-Merchantable Mature Stands

Table 11 below defines the criteria used to identify sites with non-merchantable mature stands older than 200 years of age with low volumes and low timber growing potential that are excluded from the THLB.

Table 11: Non-Merchantable Mature Stands

Logging History	Leading Species	Age (yrs)	Volume (m^3/ha)	Height (m)	Reduction (%)
No	All	>= 200	<300	< 19.5	100

Data Source and Comments:

- Inventory age, heights and volumes are projected to 2010
- These criteria are consistent with the Kalum TSR used to identify sites that have low timber growing potential. The residual TFL area that will be subject to this TSR is located within the same general locale as the FIZ A portion of the Kalum TSA The merchantability criteria used here correspond to similar criteria that are described in the Terms of Reference for TFL 41 Operability (1998).

3.8 Non-Merchantable Immature Stands

The criteria used to identify mature stands with low volumes and low timber growing potential are also applied to younger stands. Volumes and heights for unharvested stands younger than 200 years are projected to age 200. Stands in which the merchantability criteria are not achieved by age 200 are excluded from the THLB.

Table 12: Non-Merchantable Immature Stands

Logging History	Leading Species	Age (yrs)	Volume (m^3/ha)	Height (m)	Reduction (%)
No	All	< 200	<300	< 19.5	100

Data Source and Comments:

- Inventory age, heights and volumes are projected to a stand age of 200 years.

3.9 Problem Forest Types

Problem forest types (PFT) are stands that are not currently utilized or have marginal merchantability, but are physically operable and exceed low site criteria. As per the criteria in Table 13 below, these stands are excluded from the THLB.

Table 13: Problem Forest Types

Logging History	Description	Current Age (yrs)	Crown Closure (%)	Reduction (%)
No	Deciduous leading			100
	Low crown closure	> 60	0-25	100
	Spatially identified mature timber patches less than 25 ha isolated by previous harvesting	>250		100

Data Source and Comments:

- The distribution of the current mature conventional operable area was reviewed. There exists certain small patches of mature timber that is surrounded and isolated by previous harvesting, but shown as operable based upon classification as per the 1999 TSR. Some of these patches are located in areas such as within gullies or at cut-block edges appearing to be out of cable yarding reach from the established road locations. Such timber is not likely to be operable in the future. Other small patches evident may have been isolated at the time of harvesting due to merchantability constraints or other operational aspects and are also not likely to be operable in the future. A GIS exercise was conducted to estimate the extent of these areas which are then removed from the THLB for this TSR. The patch size was limited to less than 25 ha and a review of the map verified the reasonableness of the parameters used.

3.10 Archaeological Sites

Table 14 below defines and describes the specific, geographically defined areas that are excluded from the THLB.

Table 14: Archaeological Sites

Feature	Description	Excluded Area	Reason For Exclusion
Archaeological Site	Buffered archaeological sites	All	No harvest

Data Source and Comments:

- An archaeological overview inventory of TFL 41 has been completed. Management zones have been defined for sites that were identified in the inventory. Management zones were created for all sites using a 50 metre circular buffer.
- Within the residual TFL 41 area subject to this TSR, seven sites have been buffered. Information on these sites can be requested from Archaeology Branch subject to an access to archaeological site information policy.
- In addition to the above archaeological sites, there are culturally modified tree (CMT's) sites that have been identified within the land-base and future sites that will likely be encountered. Many of these sites are left unaltered within riparian reserves, riparian retention areas or within wildlife tree patches. Other CMT sites have been harvested under permits issued by the Archaeology Branch subsequent to archaeological impact assessments. As also indicated in the Kalum TSA TSR Data Package, management of CMT sites has not impacted timber harvesting landbase to any significant extent and it would be reasonable that this would continue to be the case.

3.11 Wildlife Habitat Areas

Wildlife habitat areas will be removed from the THLB as per the criteria listed in Table 15 below.

Table 15: Wildlife Habitat Exclusions

Wildlife Species	Inventory Description	Reduction (%)
Tailed frog	Wildlife habitat area 6-067 core area	100
	Wildlife habitat areas 6-067 special management zone	70
Mountain goat	Mountain goat ungulate winter ranges	100

Data Source and Comments:

- As stated in the Kalum TSA TSR Data Package, ungulate winter range for mountain goat and wildlife habitat areas for tailed frog have been legally established under the Forest and Range Practices Act and are in effect within TFL 41 as well. Management requirements are specified within the legal orders.
- The special management zone for WHA #6-067 requires the maintenance of 70% residual stand volume evenly dispersed. Consistent with the rationale stated in the Kalum Data Package, the area is small and would be uneconomic to implement harvest return subsequent to initial entry, therefore a 70% land-base reduction is applied instead.

3.12 Riparian Management Areas

Table 16 defines the riparian reserve zone (RRZ) and riparian management zone (RMZ) requirements for each type of riparian feature. The reserve zone and management zone together make up the riparian management area for riparian features within which a netdown of the land base is required. For this analysis, riparian reserve zone netdown areas are extended to account for additional retention in the RMZ. These buffer widths, shown in Table 16, are calculated as follows:

$$Netdown\ Width = RRZ\ Width + (RMZ\ Width * RMZ\ Retention\ \%)$$

All buffered areas are excluded from the THLB.

Table 16: Riparian Reserve and Management Areas

Stream, Wetland or Lake Class	Reserve Zone Width (m)	Reserve Zone Reduction (%)	Management Zone Width (m)	Management Zone Retention (%)	Netdown Width (RRZ + RMZ * RMZ Retention)
Streams					
S1-A	0	n/a	100	20	20
S1-B	50	100	20	20	54
S2	30	100	20	20	34
S3	20	100	20	20	24
S4	0	n/a	30	10	3
S5	0	n/a	30	10	3
S6	0	n/a	20	0	0
Lakes					
L1-A	0	n/a	0	n/a	0
L1-B	10	100	0	n/a	10
L3	0	n/a	30	10	3
Wetlands					
W1	10	100	40	10	14
W3	0	n/a	30	10	3
W5	10	100	40	10	14

Data Source and Comments:

- RRZ and RMZ widths are consistent with the *Forest Practice and Planning Regulations*
- The RMZ retention percentages indicated in Table 16 are as per the Kalum TSR and meet the requirements as specified in the TFL 41 FSP. In specific areas where assessments justify the variation in accordance to the FSP, the actual riparian management zone retention percentage required in practice may be lower than specified above
- Lakes and rivers are classified on the basis of forest cover data, and are consistent with TRIM mapping.
- Wetlands are classified on the basis of forest cover data, and are **not** consistent with TRIM mapping.
- In TFL 41, with the exception of the S1-B reaches stream classification is incomplete. However, for certain watersheds there are data identifying fish presence and absence for all streams within the applicable watersheds. Based upon the available information, the netdown for stream riparian management area is derived as follows:
    - In general, the locations of all fish bearing streams with reaches classified as S1-B are known through existing inventories or operational knowledge. Where the upper extent of the S1 reach has not been confirmed, the extent is estimated based on where TRIM maps identify the stream as a “double-line/bank” feature. For the riparian management area (riparian reserve zone plus riparian management zone) of all S1-B streams, a spatial netdown width of 54 m is applied in accordance to Table 16.

Fish stream inventories conducted within the Jesse Creek, and Upper Kitimat-Hoult-Davies watersheds, and a tributary watershed of Chist Creek, have categorized all stream reaches in accordance to the presence or absence of fish. In the foregoing watersheds, in addition to areas surrounding the S1-B reaches, a spatial netdown is also applied to the riparian management area of these remaining streams. As shown in Table 17, the estimate of the distribution of stream classes combined with the buffer information from Table 16 is used to estimate average riparian netdown widths to be applied to those streams that are located outside the riparian management area of the S1-B reaches. The estimated distribution of stream classes outside of S1-B reaches within the aforementioned watersheds is based upon professional judgement.

The result is that the required riparian netdown for the area within these watersheds is accomplished entirely through a spatial netdown.

Table 17: Netdown Width for Unclassified Streams – Watersheds with Known Fish Presence / Absence

Fish Presence	Estimated Distribution (%)	Netdown Width (RRZ + RMZ * RMZ Retention)	Weighted Netdown Width (m)
Fish present (no width info)			
	S2:30	34	10.2
	S3:40	24	9.6
	S4:30	3	0.9
Total			**20.7**
Fish not present (no width info)			
	S5:50	3	1.5
	S6:50	0	0.0
Total			**1.5**

- For areas outside of the watersheds identified above, an aspatial reduction factor is applied to each polygon for area that is outside of that associated with the riparian management area (RMA) of S1-B reaches. This reduction factor is based on an assessment of the percentage of the operable forest land base removed, outside of the RMA of S1-B reaches, within the Upper Kitimat-Hoult –Davies watershed where netdowns required have been applied spatially. The Upper Kitimat-Hoult –Davies is the largest watershed based area where fish stream inventory information is complete.

3.13 Wildlife Tree Patches

Table 18 describes the wildlife tree retention criteria required for each landscape unit and BEC variant. These criteria ensure the maintenance of structural diversity in managed stands so that objectives established under the Kalum SRMP are met.

Table 18: Wildlife Tree Patch Requirements

Landscape Unit	BEC Subzone	Target WTP Retention (% of cut-block area)
Hirsch	CWHvm	5
	CWHws	11
	MHmm	0
Lakelse	CWHws	7
	MHmm	0
Wedeene	CWHvm	3
	CWHvh	2
	CWHws	10
	MHmm	3
Hot Springs	CWHws	7
	MHmm	0.5
Jesse Bish	CWHvm	1
	MHmm	0
Kitimat	CWHvm	5
	CWHws	7
	MHmm	0

Operationally, there is significant overlap between WTP retention and other retention areas such as riparian reserve zones, terrain stability zones, OGMA's and inoperable areas. To take two examples, approximately 5000 hectares of productive forest within the area defined as operable are netted out to account for potential slope stability issues, and an additional 8500 hectares falls within riparian reserve zones. These areas are distributed throughout the operable area of TFL, and taken together amount to an effective retention level of almost 20%. These levels of retention well exceed the requirements listed in Table 18 above. In order to take advantage of these areas when allowing for future WTP retention, they will be buffered and the portion of the THLB that falls within this buffer will be noted. The full WTP requirements listed above will be applied to areas outside of this buffer (after allowing for partial, non-spatial netdowns for Terrain Class IV, sensitive soils [Es2] and aspatial riparian netdowns).

The Kalum SRMP provides guidance that distances between WTP (or to other suitable habitat leave areas outside of cut-blocks) should not normally exceed 500m. Consistent with the Kalum SRMP, the TFL 41 FSP provides details on wildlife tree patch requirements which afford flexibility in terms of spatial distribution as follows:

1. a wildlife tree patch can contain a single tree or a group reserve;

2. retention is by cut-block, but the target can be shifted or varied within a cut-block aggregate, subject to risks to biodiversity, where a cut-block aggregate are a group of cut-blocks within 10 km radius of each other; and

3. WTP can be internal or external to a cut-block.

Areas deemed suitable as wildlife tree habitat, and predominantly reserved from harvest in the analysis model, are buffered by a 250 metre radius. Areas within the 250 metre radius are deemed to have wildlife tree retention requirements fully met by the adjacent suitable habitat. Areas outside of this buffered area would be defined as areas that would require additional net-down to meet wildlife tree retention requirements. Partial net-downs that already apply, including the aspatial riparian requirements, ES2 and Terrain class IV, will be taken into account, and additional net-down applied to meet the requirements in Table 18.

Areas that are deemed suitable to contribute to wildlife tree requirements and predominantly reserved from harvest within the analysis model are defined as follows:

1. mature productive coniferous forest older than 80 years of age;

2. outside of the THLB including inoperable areas as well as areas that have 80% plus netdown (e.g. ES1 Terrain Class V, riparian reserves, OGMA's); and

3. at least 2 hectares contiguous area in size.

3.14 Roads, Trails and Landings

Loss of productive forest land due to existing and future road, trails and landings (RTL) are estimated separately. The 1999 TFL 41 AAC Rationale accepted existing RTL reductions (as of 1998) as 6% and future RTL reductions (post-1998) is 7.8%. The age break of 35-years as of 1999 has been updated to 46 years for this analysis. Existing RTL estimates are removed from the THLB. Two different netdowns, based on stand age, have been applied to estimate the area covered by existing roads. Future RTL reductions are applied in the timber supply model after stands have been harvested for the first time. Existing and future RTL reductions are shown in Table 19.

Table 19: Roads, Trails and Landings

Road, Trails and Landings	Stand Age (years)	Operability	Logged	Reduction (%)
Existing	0 - 11	All	Yes	8.0
	12 - 46	All		6.0
Future	> 46	Conventional	-	8.0

Data Source and Comments:

- The reduction values continue from the 1999 TFL 41 AAC Rationale.
- No future road reduction has been applied to non-conventional areas

- As stated in the 1999 TFL 41 AAC Rationale: "…A 1996 BCFS report on measured site disturbance showed that roads, trails and landings on TFL 41 reduced the productive forest by 7.8 percent. District staff indicated that, while 6% may be appropriate for existing roads, trails and landings, 7.8 % is more likely indicative of the road area that will be required in the terrain types where the licencee will be operating in the future…." The foregoing report indicated that offshore areas, which are now excluded from the area subject to the TSR, have higher amount of area occupied by roads than inshore areas. Although based upon a limited sample size, this would support the statement in the 1999 TFL 41 AAC Rationale that it is likely that the actual percent of area occupied by roads in the future will fall between six and eight percent, as the area defined as the offshore portion of TFL 41 will be deleted and not subject to this TSR.

4.0 Current Forest Management Assumptions

4.1 Management Objectives

The area to which a particular management objective applies must be defined in order to address the objective in the forest estate model. Table 20 identifies the management objectives addressed through this analysis and provides a summary of how these are defined. The productive and THLB areas within each zone are also provided.

Table 20: Management Objectives

Objective	Land Base Definition
Grizzly Bear Habitat	CFLB within McKay-Davies grizzly bear identified watershed
Seral Stage Targets	CFLB within each LU-BEC
Visual Quality Objectives (VQO)	CFLB within each LU / VQO class
Identified Watersheds	CFLB within the identified BEC site series within the Jesse and Emsley watersheds
Patch Size Distribution / Integrated Resource Management (IRM)	THLB without VQO targets within each LU

Grizzly bear habitat, seral stage targets and identified watersheds management objectives are as specified in the Kalum SRMP and defined in the TFL 41 FSP. Visual quality objectives are as defined in the TFL 41 FSP.

The patch size distribution requirement is modelled using a proxy for cutblock adjacency. This is applied to the integrated resource management (IRM) area outside of special management zones, community watersheds and areas with VQO's. 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.

Table 21 shows the amount of area that falls within each Management Zone. Only those zones that contain some THLB area listed in the table. For modelling purposes, zones that have less than 25 hectares of THLB will be combined with larger, similar zones.

Table 21: Management Zone Areas

Management Zone	Productive Area (ha)	THLB Area (ha)
Grizzly Bear Habitat		
McKay – Davies	26,262	9,607
Seral Stage Targets		
Hirsch – CWH vm 1	2,812	2,011
Hirsch – CWH vm 2	3	2
Hirsch – CWH ws 1	2	1
Hirsch – CWH ws 2	3,731	1,232
Hirsch – MH mm 1	3,545	14
Hot Springs – CWH ws 1	1,308	921
Hot Springs – CWH ws 2	549	92
Jesse – Bish – CWH vm 1	6,528	2,436
Jesse – Bish – CWH vm 2	6,487	479
Jesse – Bish – MH mm 1	999	0
Kitimat – CWH vm 1	316	266
Kitimat – CWH vm 2	97	75
Kitimat – CWH ws 1	19,139	12,607
Kitimat – CWH ws 2	18,332	3,903
Kitimat – MH mm 2	11,779	81
Lakelse – CWH ws 1	1,015	640
Lakelse – CWH ws 2	1,008	32
Wedeene – CWH vm 1	4,102	1,657
Wedeene – CWH vm 2	8,272	672
Wedeene – CWH ws 1	9,562	5,524
Wedeene – CWH ws 2	4,065	131
Visual Quality Objectives		
Hirsch – PR	689	129
Hot Springs – M	229	86
Hot Springs – PR	446	99
Jesse – Bish – M	8	–
Jesse – Bish – PR	1,219	449
Kitimat – M	3,645	963
Kitimat – PR	2,019	878
Lakelse – M	801	201
Wedeene – M	3,392	417
Wedeene – PR	1,101	150
Identified Watersheds		
Emsley – CWHvm2 – 01	69	1
Emsley – CWHvm2 – 05	28	4
Emsley – CWHvm2 – 06	83	10
Jesse – CWHvm1 – 01	1,237	380
Jesse – CWHvm1 – 03	153	14
Jesse – CWHvm1 – 05	68	11
Jesse – CWHvm1 – 06	830	254

Management Zone	Productive Area (ha)	THLB Area (ha)
Jesse – CWHvm1 – 08	306	64
Jesse – CWHvm1 – 12	33	1
Jesse – CWHvm1 – 14	25	13
Jesse – CWHvm2 – 01	1,230	32
Jesse – CWHvm2 – 03	462	4
Jesse – CWHvm2 – 05	199	2
Jesse – CWHvm2 – 06	603	25
Jesse – CWHvm2 – 08	149	17
Jesse – CWHvm2 – 09	70	3
IRM		
Hirsch	10,096	3,263
Hot Springs	2,057	1,013
Jesse – Bish	14,022	2,919
Kitimat	49,666	16,933
Lakelse	2,886	672
Wedeene	30,061	7,984

4.2 Utilization Levels

The utilization specifications define the minimum diameter breast height (DBH), the maximum stump height and the minimum top diameter inside bark (DIB). Table 22 lists the utilization levels used to calculate merchantable volume.

Table 22: Utilization Standards

Analysis Unit	Maximum 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

4.3 Volume Exclusions For Mixed-Species Stands

The amount of THLB containing a significant component of deciduous species is limited. All deciduous species are considered non-merchantable and are not harvested. As such, the deciduous volume from natural stands will be excluded from the merchantable volume portion of natural stand yield curves.

Table 23: Volume Exclusions For Mixed Species Stands

Species	Volume Exclusion (%)
All deciduous species	100

4.4 Minimum Harvest Ages

The minimum harvest age (MHA) is the earliest age at which a stand is considered merchantable. The criteria for the determination of MHA are presented in Table 24 below.

Table 24: Minimum Harvest Ages

Analysis Unit	Height (m)	Volume (m^3/ha)	Mean Diameter (All Stems) (cm)
All species	19.5	250	25

Data Source and Comments:

- Height is the inventory leading species projected height
- Volume is the VDYP derived merchantable stand volume
- The criteria used in the 1999 TFL 41 TSR used a minimum mean stand diameter (all stems) of 30 cm and a minimum stand volume of 300 m^3 / ha . The 1999 TFL 41 AAC Rationale commented that the foregoing criteria may too conservative. The 1999 TSR included land base from more remote offshore areas which may justify a conservative approach considering the increased handling costs associated with smaller piece sizes. However, these same offshore areas are not subject to the current TSR.
- The criteria used in the current TSR is as per the Kalum TSA Data Package as follows:
    - the 19.5 m top height is based upon the requirement to produce an adequate log length of 7-10 m; and
    - the minimum average diameter criterion of 25 cm dbh is based upon the report *Potential financial returns from alternate silvicultural prescriptions in second-growth stands of coastal British Columbia* (Howard and Temesgen, 1997) where marginal tree size for harvesting was determined to be between 22 and 28 cm.

4.5 Silviculture Systems

The base case and sensitivity analyses will assume clear cut harvesting with reserves (for WTP and riparian areas only) in all stands.

4.6 Unsalvaged Losses

Unsalvaged losses account for merchantable volume that is lost due to wind, fire, disease, insects, and other events that are not otherwise captured through this analysis. Unsalvaged losses are removed from the harvest volume from each timber supply forecast.

Table 25: Unsalvaged Losses

Cause of Loss	Annual Unsalvaged Loss for the Kalum TSA (m^3/yr)	Relative Size of THLB in TFL 41 to the Kalum TSA	TFL 41 Unsalvaged Losses (m^3/yr)
All sources	5,000	35.8%	1795

Data Source and Comments:

- Unsalvaged loss estimates as per the Kalum TSA TSR Data Package are applied pro-rata to the TFL as described in Table 25.
- Kalum Forest District staff reviewed the unsalvaged loss estimate and found it to compare favourably to the results of Forest Health overview surveys conducted in the Kalum District from 2004-2009.

4.7 Natural Disturbances

Forest ecosystems on TFL 41 fall within Natural Disturbance Types (NDT) 1 and 2. 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. In both of these types, stand initiating events occur seldomly and are of limited extent. However, in is not reasonable to assume that – for modeling purposes – stands outside of the THLB will continue to age indefinitely and thereby fulfill an increasing portion of the biodiversity requirements that were previously met by THLB stands.

The impacts of natural disturbances outside of the THLB will be assessed based on stand disturbance information from the *Biodiversity Guidebook* using the guidance provided in the MFR document, *Modelling Options for Disturbance of Areas Outside of the Timber Harvesting Land Base.* Option #2 from that document – 'Static Contribution from the Non-Timber Harvesting Landbase' – will be applied. For each zone listed in Table 21, the current contribution (to the seral stage targets) of the non-contributing landbase will be calculated. The difference between that and the target is the amount (i.e. the number of hectares) that will be required from the THLB throughout the entire planning horizon in order to satisfy the constraint. This is the simplest option available and, because disturbance in the non-THLB area are historically infrequent, it will provide acceptable results for this analysis.

4.8 Not Satisfactorily Restocked (NSR) Areas

There is no backlog NSR on the TFL. If forest cover attributes are missing as a result of harvesting updates to the spatial data, they will be populated based on regeneration assumptions in Table 31. If site index is missing, the stand will be assigned an average SI based on BEC zone/subzone/variant and leading site series.

4.9 Forest Cover Requirements

Modelling integrated resource management (IRM) objectives will be accomplished through the use of forest cover constraints. These constraints are summarized in Table 26 and are described in greater detail in the sections below.

Table 26: Summary of Forest Cover Requirements

Resource Objective	Area Target (%)	Condition Target	Affected Land Base
Seral Stage Targets	As specified in Table 28	As specified in Table 27	CFLB
VQO	As specified in Table 29		CFLB
Grizzly Bear	Maximum 30%	Between 25 and 100 years old	CFLB within McKay-Davies Watershed
Identified watersheds	As specified in Table 30	Age >=250 years	CFLB within identified watersheds
IRM / Patch Size	Maximum 35%	Height <=3m	THLB by LU.

4.9.1 Seral Stage Targets

The seral stage requirements established by the Kalum SRMP, and as specified in the TFL 41 FSP, are duplicated below in Table 27 and Table 28. Table 27 defines the age ranges of seral stages. Table 28 defines the seral stage distribution for early, mature plus old, and old forest as well as the allowable deviation from target for the early seral stage.

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Table 27: Seral Stage Definition By Biogeoclimatic Unit

BEC Unit	NDT (%)	Forest Stand Age (years)		
		Early	Mature	Old
CWH vm, vm1, vm2	1	< 40	> 80	> 250
MH mm1, mm2	2	< 40	> 120	> 250
CWHws1, ws2	2	< 40	> 80	> 250

Table 28: Seral Stage Distribution Targets

Landscape Unit	Biodiversity Emphasis Option	BEC Variant	Seral Stage Distribution (% of forested land base)			
			Early	Maximum Early	Mature + Old	Old
Hirsch	Intermediate	CWHvm	<30	<40	>36	>13
		CWHws1	<36	<51	>34	>9
		CWHws2	<36	<46	>34	>9
		MHmm1	<22	<32	>36	>19
Lakelse	Intermediate	CWHws1	<36	<51	>34	>9
		CWHws2	<36	<46	>34	>9
		MHmm2	<22	<32	>36	>19
Wedeene	Intermediate	CWHvh2/vm	<30	<40	>36	>13
		CWHws1	<36	<51	>34	>9
		CWHws2	<36	<46	>34	>9
		MHmm1/mm2	<22	<32	>36	>19
Hot Springs	Low	CWHws1/ws2	n/a	n/a	>17	>9
		MHmm2	n/a		>19	>19
Jesse Bish	Low	CWHvm	n/a	n/a	>18	>13
		MHmm1	n/a		>19	19
Kitimat	Low	CWHvm	n/a	n/a	>18	>13
		CWHws1/ws2	n/a		>17	>9
		MHmm1/mm2	n/a		>19	>19

Data Source and Comments:

- As stated in the Kalum TSA TSR Data Package old seral stage requirements established by the Kalum SRMP have been fully implemented by legally established old growth management areas (OGMA's) and these are removed from the THLB as per Section 3.3. These OGMA's are used instead of the old seral stage requirements.
- The Kalum SRMP specifies transition measures for implementation of seral stage targets intended to minimize impacts on timber supply as follows:
    - the early and mature plus old seral stage targets will be achieved in the shortest time possible;
    - the early seral stage proportion of the forested land-base may exceed the target up to the maximum specified in Table 28; and
    - where the above transitional measures are used, the time frame to achieve target will be stated in the Analysis Report

- All seral requirements will be met from the TFL 41 landbase. No credit will be taken for existing old seral stands in adjacent parks and protected areas.

4.9.2 Visual Quality Objectives

Visually effective green-up (VEG) heights and plan-to-perspective (P2P) ratios will be used to model scenic areas and visual quality objectives (VQO), as per the *Procedures for Factoring Visual Resources into Timber Supply Analyses*, and the update bulletin, *Modelling Visuals in TSR III*.

A digital elevation model was used to derive average slope for each VQO polygon. The predicted P2P ratios and VEG heights are based on Table 26 of the *Kalum Timber Supply Area Timber Supply Review Updated Data Package (March 2010).* According to the data package P2P ratios were calculated from *Predictive Models for Plan-to-Perspective (P2P) Ratios* and VEG tree heights were derived based on Table 6 of *Procedures for Factoring Visual Resources into Timber Supply Analyses*. Table 29 shows the P2P ratios and the VEG tree heights calculated for this analysis.

Consistent with the *Kalum TSA Data Package*, maximum percent visible disturbance for each VQO is calculated based on the approach detailed in *Modelling Visuals in TSR III*. To determine maximum permissible disturbance in plan view, the perspective number was converted to an area weighted average slope for each VQO category and the corresponding P2P ratio for that slope class is applied. This number is then multiplied by the percent alteration, to derive a planimetric number for modelling purposes. Finally, an area-weighted average VEG tree height was determined for each VQO as well. These values are also displayed in Table 29.

Visual quality objective targets will be modelled for each landscape unit / VQO class combination using the maximum percent alteration percentages (plan view) and VEG heights from Table 29.

Table 29: VQO Assumptions

VQO Class	Average Slope (%)	Max. Percent Alteration (Perspective View)	P2P Ratio	Max. Percent Alteration (Plan View)	VEG Height (m)
PR	47	7.0	1.6	11.2	7.0
M	50	18.0	1.6	28.4	7.0

Data Source and Comments:

- Maximum alteration percentages have been calculated based on average slope information in the resultant database.
- VEG heights are based on average slope using the lookup table in the Kalum TSA Data Package. Height will be modelled on a stand-by-stand basis using the height curves for the managed stands analysis units.
- The upper end of the permissible alteration range has been used, but other limits will be tested in sensitivity analyses.

4.9.3 Identified Watersheds

Table 30 below identifies the old seral stage forest targets within each identified watershed as specified in the Kalum SRMP.

Table 30: Target Old Seral Stage Forest within Identified Watersheds

Identified Watershed	BEC Variant	Site Series	Old Forest Predicted By Natural Disturbance (%)	Old Seral Forest Target (% forested land base within each site series)
Jesse, Emsley	CWHvm	01	89	27
		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

Data Source and Comments:

- The target values are as per the TFL 41 FSP and are consistent with the Kalum SRMP
- TFL 41 PEM is used to identify the site series to ensure the TSR model accounts for this management objective.

4.9.4 Grizzly Bear Habitat

As identified in the FSP and consistent with the Kalum SRMP, within the McKay-Davies grizzly bear identified watershed unit no more than 30% of the forested land base, excluding hardwood, will be between 25 and 100 years old.

4.9.5 Integrated Resource Management / Patch Size Objectives

The Kalum SRMP sets objectives for the temporal and spatial distribution of cutblocks. This element of biodiversity is often referred to as "patch size distribution". The goal of this objective is to create and maintain a pattern of forest seral stages distributed across the landscape that reflect the natural disturbance regime. For this analysis, the rate of harvesting in each landscape unit will be limited using a maximum disturbance constraint of 35%. No more than 35% of the THLB that is not being managed for visual quality can be less than 3 metres in height (consistent with the approach taken in the Kalum TSA). Height will be modelled on a stand-by-stand basis using the height curves for the managed stands analysis units. This is the same approach that was used for the Kalum TSA timber supply analysis.

5.0 Growth and Yield

5.1 Natural Stand Yield Tables

All stands without logging history information will be assumed to follow natural stand yield curves. Logging history was taken from historical cutblock mapping maintained by the licencee. All previous harvest blocks now support managed stands – they are modelled as described in the next section.

Projected height, projected age, stocking class, crown closure, PSYU and species composition from the inventory database are used to generate natural stand yield tables for each polygon using the Variable Density Yield Prediction (VDYP) model version 6.6d. These polygon-level yield tables are then incorporated into the timber supply model. Default decay, waste and breakage (DWB) values from VDYP 6 will be utilized. As no Phase II or NVAF programs have been completed on the TFL, this is still the best available DWB information.

Yield curves for hemlock, balsam and cedar-leading stands older than 140 years will be adjusted using the localization factors shown in Table 1.

5.2 Managed Stand Yield Tables

Stands with logging history information will be considered as managed stands and will follow managed stand yield curves. Growth and yield for all managed stands will be modelled with the Table Interpretation Program for Stand Yields (TIPSY) 4.1d.

Managed stand analysis units (AU) are defined using PEM site series as defined in the regeneration assumptions from Table 31. Regeneration delay reflects the amount of time required to regenerate a stand after logging such that the stand is at the zero age point on the yield curve. Under this definition a stand planted with two year old stock two years after harvesting would have a regeneration delay of zero.

A review of historical silviculture practices on the TFL suggests that the regeneration assumptions listed in Table 31 accurately reflects the growth and yield on both existing and future managed stands and is therefore used for both stands. The exception to this is the past application of spacing treatments on the TFL which will be addressed through adjusted managed stand yield curves as described in Section 5.2.1 below.

Table 31: Regeneration Assumptions

BGC Variant	Leading Site Series	SP1	SP1 %	SP2	SP2 %	SP3	SP3 %	Initial Density	Regen Delay	Method Type	%
CWHvm1	01	Ba	50	Hw	40	Cw	10	2500	1	Planted	5
CWHvm1	01	Hw	60	Ba	35	Cw	5	5000	0	Natural	95
CWHvm1	02	Hw	60	Ss	10	Cw	10	1500	1	Planted	50
CWHvm1	02	Hw	60	Ba	35	Cw	5	2000	2	Natural	50
CWHvm1	03	Ba	50	Hw	40	Cw	10	2000	1	Planted	10
CWHvm1	03	Hw	60	Ba	35	Cw	5	4500	2	Natural	90
CWHvm1	04	Ba	50	Hw	40	Cw	10	2000	1	Planted	20
CWHvm1	04	Hw	60	Ba	35	Cw	5	4000	2	Natural	80
CWHvm1	05	Ba	50	Hw	40	Cw	10	2000	1	Planted	70
CWHvm1	05	Hw	60	Ba	35	Cw	5	2000	2	Natural	30
CWHvm1	06	Ba	50	Hw	40	Cw	10	1500	1	Planted	70
CWHvm1	06	Hw	60	Ba	35	Cw	5	2000	2	Natural	30
CWHvm1	08	Ba	50	Hw	40	Ss	10	1500	1	Planted	30
CWHvm1	08	Hw	60	Ba	35	Ss	5	2000	2	Natural	70
CWHvm1	09	Ba	50	Hw	40	Ss	10	1500	1	Planted	90
CWHvm1	09	Hw	60	Ba	35	Ss	5	2000	2	Natural	10
CWHvm1	10	Cw	60	Ba	20	Hw	20	1500	1	Planted	90
CWHvm1	10	Cw	60	Ba	20	Hw	20	2000	2	Natural	10
CWHvm1	12	Cw	60	Ba	20	Hw	20	1500	1	Natural	50
CWHvm1	12	Cw	60	Ba	20	Hw	20	1500	2	Planted	50
CWHvm1	13	Cw	60	Ba	20	Hw	20	1500	1	Natural	50
CWHvm1	13	Cw	60	Ba	20	Hw	20	1500	1	Planted	50
CWHvm1	14	Cw	60	Ba	20	Hw	20	1500	1	Natural	50
CWHvm1	14	Cw	60	Ba	20	Hw	20	1500	1	Planted	50
CWHvm2	01	Ba	50	Hw	40	Cw	10	2500	1	Planted	5
CWHvm2	01	Hw	60	Ba	35	Cw	5	5000	0	Natural	95
CWHvm2	02	Cw	40	Hw	30	Pl	30	1000	1	Planted	50
CWHvm2	02	Pl	40	Cw	40	Hw	20	1500	2	Natural	50
CWHvm2	03	Hw	60	Cw	40			2000	1	Planted	10
CWHvm2	03	Hw	60	Cw	40			4500	2	Natural	90
CWHvm2	05	Ba	60	Hw	35	Ss	5	2000	1	Planted	30
CWHvm2	05	Hw	60	Ba	35	Ss	5	4000	2	Natural	70
CWHvm2	06	Ba	60	Hw	35	Ss	5	1500	1	Planted	40
CWHvm2	06	Hw	60	Ba	35	Ss	5	2000	2	Natural	60
CWHvm2	08	Ba	60	Hw	35	Ss	5	1500	1	Planted	80
CWHvm2	08	Hw	60	Ba	35	Ss	5	2000	2	Natural	20
CWHvm2	09	Hw	70	Cw	30			1500	1	Planted	70
CWHvm2	09	Hw	70	Cw	30			2000	2	Natural	30
CWHvm2	10	Pl	60	Hm	20	Yc	20	1000	1	Planted	50
CWHvm2	10	Pl	60	Hm	20	Yc	20	1500	2	Natural	50
CWHvm2	11	Cw	60	Hm	20	Yc	20	1500	1	Planted	50
CWHvm2	11	Cw	60	Hm	20	Yc	20	2000	2	Natural	50
CWHws1	01	Ba	50	Hw	40	Cw	10	2000	1	Planted	30
CWHws1	01	Hw	65	Ba	30	Cw	5	5000	2	Natural	70
CWHws1	02	Hw	80	Cw	10	Ss	10	1000	1	Planted	50
CWHws1	02	Hw	75	Ba	20	Cw	5	1500	2	Natural	50
CWHws1	03	Ba	50	Hw	40	Cw	10	2000	1	Planted	70
CWHws1	03	Hw	60	Ba	35	Cw	5	4000	2	Natural	30
CWHws1	04	Ba	50	Hw	40	Cw	10	2000	1	Planted	40
CWHws1	04	Hw	60	Ba	35	Cw	5	3500	2	Natural	60
CWHws1	05	Ba	50	Hw	40	Cw	10	1500	1	Planted	60
CWHws1	05	Hw	60	Ba	35	Cw	5	3000	2	Natural	40
CWHws1	06	Ba	50	Hw	40	Cw	10	1500	1	Planted	70
CWHws1	06	Hw	60	Ba	35	Ss	5	2500	2	Natural	30
CWHws1	07	Ba	40	Hw	40	Ss	20	1500	1	Planted	90
CWHws1	07	Hw	60	Ba	35	Ss	5	2500	2	Natural	10
CWHws1	08	Ba	40	Cw	30	Hw	30	1400	1	Planted	90
CWHws1	08	Ba	50	Hw	30	Ba	20	1600	2	Natural	10
CWHws1	10	Pl	60	Hw	40			800	1	Planted	50

BGC Variant	Leading Site Series	SP1	SP1 %	SP2	SP2 %	SP3	SP3 %	Initial Density	Regen Delay	Method Type	%
CWHws1	10	Pl	50	Hw	50			1000	2	Natural	50
CWHws1	11	Cw	50	Ss	30	Hw	20	1400	1	Planted	50
CWHws1	11	Cw	40	Hw	30	Ss	30	1600	2	Natural	50
CWHws2	01	Ba	50	Hw	40	Ss	10	2500	1	Planted	30
CWHws2	01	Hw	65	Ba	30	Ss	5	5000	2	Natural	70
CWHws2	02	Hw	80	Pl	20			1000	1	Planted	50
CWHws2	02	Hw	60	Pl	30	Cw	10	1500	2	Natural	50
CWHws2	03	Hw	80	Pl	10	Hm	10	2000	1	Planted	70
CWHws2	03	Hw	70	Pl	20	Hm	10	4000	2	Natural	30
CWHws2	04	Ba	50	Hw	40	Ss	10	2000	1	Planted	40
CWHws2	04	Hw	60	Ba	35	Ss	5	3500	2	Natural	60
CWHws2	05	Ba	50	Hw	40	Ss	10	1500	1	Planted	70
CWHws2	05	Hw	60	Ba	35	Ss	5	3000	2	Natural	30
CWHws2	06	Ba	50	Hw	30	Ss	20	1500	1	Planted	90
CWHws2	06	Hw	60	Ba	35	Ss	5	2000	2	Natural	10
CWHws2	07	Ba	50	Hw	40	Ss	10	1500	1	Planted	90
CWHws2	07	Hw	60	Ba	35	Ss	5	2000	2	Natural	10
CWHws2	08	Ba	50	Hw	40	Ss	10	1500	1	Planted	90
CWHws2	08	Hw	60	Ba	35	Ss	5	2000	2	Natural	10
CWHws2	10	Pl	60	Cw	30	Hm	10	1000	1	Planted	50
CWHws2	10	Pl	50	Hm	30	Cw	20	2000	2	Natural	50
CWHws2	11	Cw	40	Ss	30	Hw	30	1000	1	Planted	90
CWHws2	11	Cw	40	Ss	30	Hw	30	2000	2	Natural	10

BGC Variant	Leading Site Series	SP1	SP1 %	SP2	SP2 %	SP3	SP3 %	Initial Density	Regen Delay	Method Type	%
MHmm1	01	Ba	60	Hm	40			2000	1	Planted	40
MHmm1	01	Hm	60	Ba	40			4500	2	Natural	60
MHmm1	02	Hm	70	Ba	30			2000	1	Planted	50
MHmm1	02	Hm	40	Ba	30	Yc	20	2000	2	Natural	50
MHmm1	03	Ba	60	Hm	30	Yc	10	2000	1	Planted	30
MHmm1	03	Hm	60	Ba	30	Yc	10	3000	2	Natural	70
MHmm1	04	Ba	60	Hm	30	Yc	10	2000	1	Planted	30
MHmm1	04	Hm	60	Ba	30	Yc	10	3500	2	Natural	70
MHmm1	05	Ba	60	Hm	30	Yc	10	1100	1	Planted	30
MHmm1	05	Hm	60	Ba	30	Yc	10	1400	2	Natural	70
MHmm1	06	Hm	90	Yc	10			900	1	Planted	70
MHmm1	06	Hm	70	Yc	30			1100	2	Natural	30
MHmm1	07	Ba	60	Hm	30	Yc	10	1100	1	Planted	50
MHmm1	07	Hm	60	Ba	30	Yc	10	1400	2	Natural	50
MHmm1	08	Hm	60	Hw	30	Yc	10	800	1	Planted	50
MHmm1	08	Hm	60	Yc	30	Hw	10	900	2	Natural	50
MHmm1	09	Hm	70	Ba	20	Yc	10	1000	1	Planted	50
MHmm1	09	Hm	60	Yc	30	Ba	10	1100	2	Natural	50
MHmm2	01	Ba	60	Hm	40			1100	1	Planted	30
MHmm2	01	Hm	60	Hm	40			1600	2	Natural	70
MHmm2	02	Hm	60	Ba	40			1000	1	Planted	40
MHmm2	02	Hm	80	Ba	20	Yc	10	1100	2	Natural	60
MHmm2	03	Ba	60	Hm	40			1100	1	Planted	30
MHmm2	03	Hm	60	Ba	40			1600	2	Natural	70
MHmm2	04	Ba	60	Hm	40			1100	1	Planted	30
MHmm2	04	Hm	60	Ba	40			1600	2	Natural	70
MHmm2	05	Ba	60	Hm	40			1100	1	Planted	30
MHmm2	05	Hm	60	Ba	40			1400	2	Natural	70
MHmm2	06	Hm	80	Yc	20			900	1	Planted	70
MHmm2	06	Hm	60	Yc	40			1100	2	Natural	30
MHmm2	07	Ba	70	Hm	20	Yc	10	1000	1	Planted	50
MHmm2	07	Ba	60	Hm	20	Yc	20	1100	2	Natural	50
MHmm2	08	Hm	70	Ba	30			800	1	Planted	50
MHmm2	08	Hm	80	Ba	20			900	2	Natural	50
MHmm2	09	Hm	70	Ba	30			800	1	Planted	50
MHmm2	09	Hm	80	Ba	20			900	2	Natural	50

Data Source and Comments:

- The proportion of regeneration method specified is based upon the historic performance of natural regeneration in different biogeoclimatic zones and site series. Where there has been little harvesting history, professional judgment has been applied.
- The regeneration delay for naturally regenerated stands reflects the presence of advanced regeneration and rate of ingress. On zonal (01) sites within the CWHvm1/vm2, experience has shown that adequate advanced regeneration is present at time of harvest hence the regeneration delay is 0.
- The regeneration delay for planted stands generally reflects normal practice where most areas identified as requiring planting are planted within 2 years of harvest with one-year old stock. This is notwithstanding that planting is often completed within one year following harvest and in some cases fill-planting is conducted beyond 2 years due to failure of natural or planted regeneration.
- Species composition is based upon management towards meeting the FSP stocking standards by site series while taking into account the natural rate of ingress of hemlock.

- For forest estate modelling, a single yield curve will be compiled for each AU. To do this, two TIPSY curves will be generated – one managed and one natural. These will be combined using the weighting shown in the last column of the table.
- Site index for each AU will be the area-weighted average inventory (adjusted) site index of all stands that fall within the AU.
- TIPSY default site index curves will be used
- A site index adjustment of plus 10 metres has been applied to all Hw-leading stands in the CWH with an inventory SI of between 8 and 18 metres. This factor is based on the report OGSI site index study completed in the Kalum District.

5.2.1 Juvenile Spacing History

A review of silviculture history on the TFL indicates that juvenile spacing has been applied to approximately 1,452 ha between 1998 and 2009 whereby stands were treated at an average age of 18 years to a post-treatment density of approximately 1,000 stems per hectare. Spacing treatment applied prior to 1998 would be captured in the existing TFL inventory where stocking treatment is spatially defined. The post 1997 treatments were predominantly applied to the CWHws-01 and CWHvm1-01 site series according to the area figures in Table 32. This will be captured in the analysis by modelling the growth and yield of this spacing treatment using TIPSY and applying it *pro rata* to the yield curves for existing managed stands within these site series based on the relative proportion within each of these analysis units (site series).

Table 32: Spaced Stands

BGC Variant	Leading Site Series	Area Treated (ha)
CWHvm1	01	461
CWHws1	01	991
Total		1,452

Data Source and Comments:

- Historical spacing is based on licencee records and maps.
- RESULTS data is not available for areas treated prior to 2005

5.2.2 Operational Adjustment Factors

Standard operational adjustment factor (OAF) values of 0.85 and 0.95 will be used to reflect OAF 1 and 2 respectively.

5.2.3 Site Productivity Estimates

A Predictive Ecosystem Mapping (PEM) project was completed for the TFL in 2004 however this PEM did not meet the provincial minimum accuracy assessment percentages to include SIBEC site productivity estimates in the Base Case.

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 153 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 2010, so the 140-year age boundary is interpreted to mean 140 + 13 = 153 years of current inventory age in 2010).

This adjustment was applied to western-hemlock leading stands with an inventory SI between 8 and 18. Stands of all other leading species – including mountain hemlock – were left unadjusted and the inventory site index was used to generate yield curves.

5.2.4 Genetic Gains

The Chief Forester's stocking standards require the use of Class A seed when available. Class A seed has been used on the TFL since 2005 in the following percentages: Hw 11%, Cw 65% and Ss 53%. By 2020 it is expected that 100% of the planted Cw will be Class A with a 12% gain and 70% of the Hw will be class A with a 15 % gain. Although Ss has Class A status, breeding has been for forest health reasons which may result in growth gains, but this benefit has not been quantified to date. No Ba Class A seed is expected for the foreseeable future. Due to very limited use and supply, no Class A Yc or Pl will be utilized.

Based on this, genetic gains will be applied to all future, planted Cw and Hw stems using 11.5% and 14.4%. These percentages are based on the phase in of the full genetic gains over the first 10 years of the planning horizon.

6.0 Forest Estate Model

This timber supply analysis will be conducted using the Patchworks spatial optimization model. Patchworks is a spatially explicit harvest scheduling optimization model developed by Spatial Planning Systems in Ontario. It is capable of developing harvest allocations and exploring trade-offs between a broad range of conflicting management and harvest goals. Modelling will use 10-year periods for cut control purposes, but forest growth and harvest volumes will be compiled annually.

Patchworks will be formulated to maximize harvest volume while meeting all the management objectives listed in this document. Harvest scheduling decisions are based on maximizing the value of an objective function that incorporates volume harvested and the achievement of other management objectives on the land base. As such, there are no explicit harvest rules, other than minimum merchantability limits, applied to the model. Merchantability limits are set up such that no stands may be harvested before they have achieved the minimum harvest age (MHA) criteria set out in Section 4.4 above. Maps of scheduled harvesting and harvest statistical summaries will be produced and reviewed by the licencee to ensure that model results are realistic.

The current available mature timber, consisting almost exclusively of old-growth, is distributed throughout the entire land-base with many operating areas having experienced extensive past harvesting. In order to reflect operationally feasible harvest scheduling practices for the first 50 years of harvest, before second growth is anticipated to be abundantly available, a constraint will be placed on the model to limit harvesting to only discrete contiguous portions of the land-base at a time. This will simulate an operating area concept which is concentrated on a portion of the land base commensurate with the current AAC level of harvest. In this way the model cannot unrealistically maximize harvest by being able to select harvesting units from across the entire land-base during any one harvest period to get around adjacency and seral stage requirements during a stage when these issues may well be most constraining on the availability of mature timber.

The forest estate model will be used to find a long-term harvest level that meets all resource objectives and results in a stable forest growing stock over the final 50 years of the 250-year planning horizon.

Based on the substantial deletions from the TFL that have occurred since the last analysis, the initial harvest level will have to be determined through preliminary analysis. A logical starting point for analysis would be the existing AAC apportionment of 122,926 m^3 that Skeena Sawmills will be operating under within the residual land base subject to the next AAC determination. In determining the base case harvest forecast the following principles will be applied:

- the long term harvest level is not compromised to meet short-term needs (by ensuring that growing stock levels do no fall below a minimum value after the THLB age class distribution has become balanced), and

- any reduction in harvest levels should not exceed 10% per decade

Due to the small proportion of non-conventional operable area within the residual land-base, these areas will be lumped with the conventional land-base and no separate flow constraints will be applied.

Patchworks is approved for use in Timber Supply Review and Management Plan analysis by the Ministry of Forest and Range Forest Analysis and Inventory Branch.

7.0 Sensitivity Analysis

Sensitivity analysis provides a measure of the upper and lower bounds of the base case harvest forecast that reflects the uncertainty in the data and/or the management assumptions made in the base case. The magnitude of the increase and decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that specific variable. Table 33 summarizes the sensitivity analyses that will be performed for this analysis. Examination of the base case analysis results will determine the nature of any sensitivity analysis that are required.

Table 33: Potential Sensitivity Analysis Scenarios

Issue To Be Tested	Description
Harvest flow alternatives	Various alternatives to the base case, including maximum even flow and maximum initial harvest level.
SIBEC site productivity estimates	PEM SIBEC values will used to assess site productivity on managed stands.
Operability	Remove all of the non-conventional area (skyline and heli) from the timber harvesting land-base
Minimum merchantability criteria	Reduce volume, height and diameter criteria by 20%, alone.
Management for visual quality	Visually effective green-up height of five metres and nine metres

Modelling alternative harvest flows will give the licencee and Chief Forest valuable information about timber supply dynamics – in particular the timing and duration of timber supply shortfalls. Second growth will comprise an increasing portion of the harvest as time progresses. The timber supply and resource implications of accelerating the move of harvesting into second growth may also be examined.

Although SIBEC site index estimate are not being used for the base case (because the underlying PEM did not meet the required accuracy standards), it may in fact be a better estimate of the true long-term productivity of the TFL. Managed stand yield tables will be recompiled using these SI estimates, and the resulting change in timber supply will be examined.

Since the base case will not generate separate harvest rates by operability class, a sensitivity analysis on removing the non-conventional timber harvesting land-base should determine the level of effect that may result if the non-conventional THLB is not accessed on proportionate basis.

If minimum merchantability criteria are reduced, existing second growth stands will become available earlier in the planning horizon. For this sensitivity test, the minimum merchantability applied for the corresponding Kalum TSA TSR sensitivity run will be applied. The minimum volume, height and diameter criteria will be reduced by 20%.

Management for visual quality is important along the highway corridor and in cases where harvesting is visible from recreational areas commonly used by the public. VEG height for the base case is 7 metres. This will be relaxed to 5 metres, and increased to 9 metres.

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