Integrated Stewardship Strategy for the Mackenzie TSA

Data Package

Version 1.4

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Project 419-35

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List of Acronyms

AD	Anthropogenic Disturbance
ATC	Access Timing Constraints
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Option
CFLB	Contributing Forest Land Base
ECA	Equivalent Clearcut Area
GIS	Geographic Information System
IBS	Insect Beetle Spruce
ISS	Integrated Stewardship Strategy
LU	Landscape Units
MPB	Mountain Pine Beetle
NRL	Non-Recoverable Losses
OGMA	Old Growth Management Area
PEM	Predictive Ecosystem Mapping
RMZ	Resource Management Zone
THLB	Timber Harvesting Land Base
TSA	Timber Supply Area
TSR	Timber Supply Review
UWR	Ungulate Winter Range
VRI	Vegetation Resource Inventory
WHA	Wildlife Habitat Area

Document Revision History

Version	Date	Notes/Revisions
1.0	Sep 2017	First version distributed to project team for review and comment. Only included assumptions for Base Case and Reserve Scenarios.
1.0 (not changed)	Sep 20, 2017	Updated section 4, (Harvest Scenario).
1.2	Dec 12, 2017	Updated section 5 (Silviculture Scenario).
1.3	March 19, 2018	Updated section 6 (Combined Scenario)
1.4	August 02, 2018	Updated Appendix 1 with correct targets

1 Introduction

The British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development initiated an Integrated Stewardship Strategy – sustainable forest management analysis – in the Mackenzie Timber Supply Area (TSA). The data package describes the information that is material to the analysis including the model used, data inputs, and assumptions.

1.1 Study Area

The Mackenzie TSA is located around the Williston Reservoir in the North-Central part of the province in the Omineca Region. The TSA includes the communities of Mackenzie, Germansen Landing, Tsay Keh, and Kwadacha. The Mackenzie TSA is administered by the Mackenzie Natural Resource District.

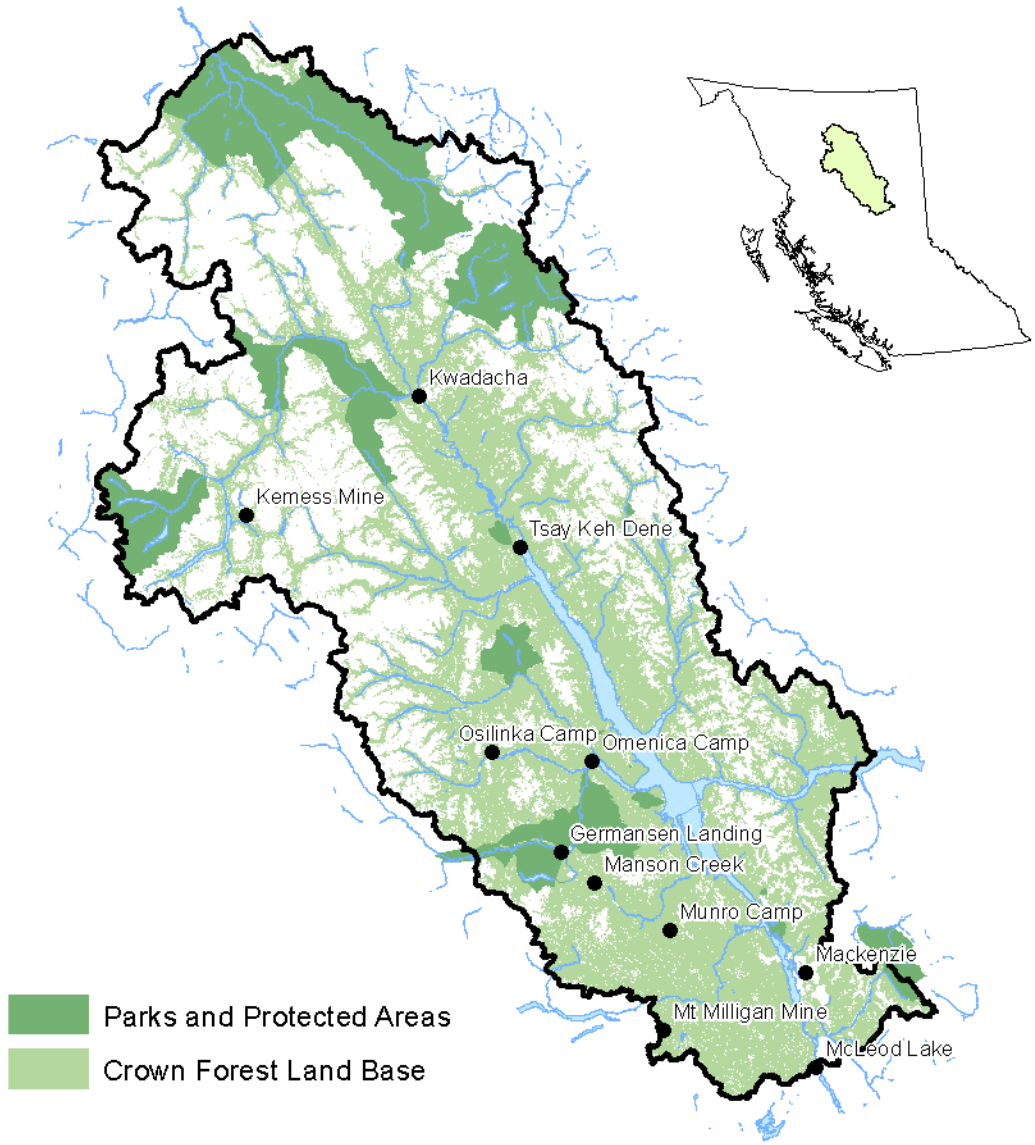


Figure 1 Mackenzie TSA and Communities

The Mackenzie TSA covers approximately 6.4 million ha of land where approximately 3.26 million ha (51%) is considered productive Crown forest (excludes First Nations reserves, private lands, non-forest, woodlots, and community forests). This area contains 1.3 million ha of timber harvesting land base forest with the balance specifically set aside for non-timber resources such as biodiversity, fish or wildlife or because the site is too poor to grow trees economically.

Considerations in this analysis include:

- The Mackenzie Land and Resource Management Plan (MLRMP) finalized on November 14, 2000.
- The Mukswa-Kechika Management Area Plan which covers the North-Eastern corner of the TSA. This management plan area houses four different resource management zones: Protected Areas, Special Wildland Resource management Zones, Special Resource Management Zones, and Enhanced Resource Management zones.
- Mugaha Marsh Sensitive Area – 2002.
- Agriculture Development and Settlement Areas (2006).
- Obo River and Fox landscape unit (LU) management objectives (2002).
- Old Growth Areas in southern portion of TSA (2010) and Non-Spatial Biodiversity management objectives elsewhere (2010).

1.2 CONTEXT

This document is the third in a series of documents developed through the ISS process.

1. Situation Analysis – describes in general terms the situation for the unit.
2. Scenario Development – describes the development of a combined scenario to be explored through forest-level modelling and analysis. This is first developed and explored as three separate scenarios:
    a) Base Case Scenario – provides a baseline for comparison against other scenarios. It is a more flexible test that takes into account non-legal 'status quo management' compared with TSR that can only consider legally-established objectives.
    b) Reserve Scenario – review and analyze existing and proposed management zonation and develop strategy options that provide for the sustainable management of non-timber values.
    c) Harvest Scenario – review and analyze current and planned timber harvesting plans, infrastructure, and capabilities in the context of the distribution of MPB-killed pine salvage opportunities and the landscape reserve scenario. This must consider the current salvage period and the transition into the mid-term timber supply.
    d) Silviculture Scenario –provides treatment options, associated targets, timeframes and benefits to minimize the impact of the MPB infestation over the mid-term timber supply.
    e) Combined Scenario – provides an integrated strategy for the first iteration of the ISS process by combining key elements from all previous 4 scenarios and guiding the development and implementation of tactical plans for the first 20 years of the planning horizon.
3. **Data Package** - describes the information that is key to the analysis including the model used, data inputs and assumptions.
4. Analysis Report –provides modeling outputs and rationale for choosing a combined scenario.
5. Tactical Plan – direction for the implementation of the combined scenario.
6. Final Report – summary of all project work completed.

7. Monitoring Recommendations – direction on monitoring the implementation of the ISS; establishing a list appropriate performance indicators, recommending monitoring responsibilities and timeframe, and a reporting format and schedule.

1.3 MODEL

The PATCHWORKS ™ modeling software was used for forecasting and analysis. This suite of tools is sold and maintained by Spatial Planning Systems Inc. of Deep River, Ontario (Tom Moore - www.spatial.ca).

PATCHWORKS is a fully spatial forest estate model that can incorporate real world operational considerations into a strategic planning framework. It utilizes a goal seeking approach and an optimization heuristic to schedule activities across time and space in order to find a solution that best balances the targets/goals defined by the user. Targets can be applied to any aspect of the problem formulation. For example, the solution can be influenced by issues such as mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, snag densities, CWD levels, ECAs, specific mill volumes by species, road building/hauling costs, delivered wood costs, net present values, etc. The PATCHWORKS model continually generates alternative solutions until the user decides a stable solution has been found. Solutions with attributes that fall outside of specified ranges (targets) are penalized and the goal seeking algorithm works to minimize these penalties – resulting in a solution that reflects the user objectives and priorities. Patchworks' flexible interactive approach is unique in several respects:

- PATCHWORKS' interface allows for highly interactive analysis of trade-offs between competing sustainability goals.
- PATCHWORKS software integrates operational-scale decision-making within a strategic-analysis environment: realistic spatial harvest allocations can be optimized over long-term planning horizons. Patchworks can simultaneously evaluate forest operations and log transportation problems using a multiple-product to multiple-destination formulation. The model can identify in precise detail how wood flows to mills over a complex set of road construction and transportation alternatives.
- Allocation decisions can be made considering one or many objectives simultaneously and objectives can be weighted for importance relative to each other. (softer vs. harder constraints)
- Allocation decisions can include choices between stand treatment types (Clearcut vs. partial cut, fertilization, rehabilitation, etc.).
- Unlimited capacity to represent a problem – only solution times limit model size.
- Fully customizable reporting on economic, social, and environmental conditions over time.

Reports are built web-ready to share analysis results easily – even comparisons of multiple indicators across multiple scenarios.

1.4 DATA SOURCES

Table 1 Spatial data sources

Spatial Data	Source	Feature Name	Effective
Administrative Layers			
TSA Boundary	WHSE_ADMIN_BOUNDARIES	FADM_TSA	2010
Indian Reserves	WHSE_ADMIN_BOUNDARIES	CLAB_INDIAN_RESERVES	2012
Managed Licence	WHSE_FOREST_TENURE	FTEN_MANAGED_LICENCE_POLY_SVW	2012

Spatial Data	Source	Feature Name	Effective
Ownership	WHSE_FOREST_VEGETATION	F_OWN	2012
Utility Corridors, Gas, Hydro	WHSE_TANTALIS	TA_RESERVE_NOTATIONS_SVW	2015
Slope Class	Forsite	Operability	2016
Road Buffers	DMK/Forsite	Buffered_roads	2016
Pipeline Routes	DMK	power_pipe	2016
Kwadacha FNWL	FLNRO/Secure	Kwadacha_FNWL_Proposed	2017
Management Guidance Layers			
Parks and Protected Areas	WHSE_TANTALIS	TA_PARK_ECORES_PA_SVW	2012
Landscape Units (LU)	WHSE_LAND_USE_PLANNING	RMP_LANDSCAPE_UNIT_SVW	2011
Legal Planning Objectives	WHSE_LAND_USE_PLANNING	RMP_PLAN_LEGAL_POLY_SVW	2011
Cultural Area	WHSE_LAND_USE_PLANNING	RMP_PLAN_NON_LEGAL_POLY_SVW	2011
Heritage Trail	WHSE_LAND_USE_PLANNING	RMP_PLAN_NON_LEGAL_POLY_SVW	2011
RMZ	WHSE_LAND_USE_PLANNING	RMP_PLAN_NON_LEGAL_POLY_SVW	2011
Agriculture and Settlement Lands	WHSE_LAND_USE_PLANNING	RMP_PLAN_LEGAL_POLY_SVW	2011
Mugaha Marsh Sensitive Area	WHSE_LAND_USE_PLANNING	RMP_PLAN_LEGAL_POLY_SVW	2011
Muskwa Kechika Management Area	WHSE_TANTALIS	TA_MGMT_AREAS_SPATIAL_SVW	2011
Weissener Buffer	Fox and Obo River LU order	weisner_Buffer	2008
Old Growth Management Areas (OGMA)	WHSE_LAND_USE_PLANNING	RMP_OGMA_LEGAL_CURRENT_SVW	2011
Watersheds	WHSE_BASEMAPPING	FWA_ASSESSMENT_WATERSHEDS_POLY	2011
Fish sensitive watersheds	DMK	Export_For_Forsite	2016
Draft Fisheries Sensitive Watershed	RNI	FSW_Draft	2016
Visual Landscape Inventory	WHSE_FOREST_VEGETATION	REC_VISUAL_LANDSCAPE_INVENTORY	2009
Riparian Buffers	FWA/Forsite	water_dissolve	2012
Terrain Stability Assessment	DMK	TSM	2015
Haul Cycle Times	DMK/Forsite	Haul_Time_Half_Hour_Poly	2016
Seed planning units	WHSE_FOREST_VEGETATION	SEED_PLAN_UNIT_POLY_SVW	2015
Dump Allocation	DMK	Dump_Allocation	2016
TSR Excessive Haul Distance	Forsite/digitized from TSR	DISTANCE_TSR	2016
Consolidated Wildlife Features (combines draft, proposed, approved datasets)	Forsite	Wildlife_Consolidate_v2	2016
Wildlife Habitat Area - APPROVED	WHSE_WILDLIFE_MANAGEMENT	WCP_WILDLIFE_HABITAT_AREA_POLY	2015
Wildlife Habitat Area - PROPOSED	RNI		2016
Wildlife Habitat Area - PROPOSED	REG_LAND_AND_NATURAL_RESOURCE	WLD_WHA_PROPOSED_SP	2015
Wildlife Habitat Area - DRAFT Bull Trout	DMK	WHA_DRAFT_Bull_Trout	2015
Wildlife Habitat Area - DRAFT Caribou	DMK	WHA_DRAFT_Caribou	2015
Wildlife Habitat Area - DRAFT Fisher	DMK	WHA_DRAFT_Fisher_v2	2017
Ungulate Winter Ranges - APPROVED	WHSE_WILDLIFE_MANAGEMENT	WCP_UNGULATE_WINTER_RANGE_SP	2011
Ungulate Winter Range - PROPOSED (Peace)	REG_LAND_AND_NATURAL_RESOURCE	WLD_UWR_PROPOSED_PEACE_SP	2011
Ungulate Winter Range - APPROVED Mountain Goat	DMK	tuwra_u-7-029 tuwra_u-7-030	2017
Ungulate Winter Range - APPROVED Northern Caribou	DMK	tuwra_u-7-025	2017
Ungulate Winter Range - APPROVED Stone's Sheep	DMK	tuwra_u-7-028	2017
Northern Caribou High Elevation Winter Range	DMK/Secure	ALL_HEWR_2013	2013
Northern Caribou High Elevation Summer Range	DMK/Secure	ALL_HEWR_2015	2015
Northern Caribou Low Elevation Winter Range (Kennedy Siding)	DMK/Secure	Ken_Win_LE_2015	2015
Inventory Layers			
Forest Inventory –VRI	WHSE_FOREST_VEGETATION	VEG_COMP_LYR_R1_POLY	2014
Forest Inventory – Reserves	WHSE_FOREST_VEGETATION	RSLT_FOREST_COVER_RESERVE_SVW	2015
Forest Inventory – Managed Site Index	FAIB	Site_Prod_with_All_PEM_TEM_v3_20130630	2013
Biogeoclimatic Ecosystem Mapping	WHSE_FOREST_VEGETATION	BEC_BIOGEOCLIMATIC_POLY	2015
Wildfires – Historic (to 2014)	WHSE_LAND_AND_NATURAL_RESOURCE	PROT_HISTORICAL_FIRE_POLYS_SP	2011
Wildfires – Current (2015)	WHSE_LAND_AND_NATURAL_RESOURCE	PROT_CURRENT_FIRE_POLYS_SP	2012
Forest Inventory – Depletions	FAIB	CONSOLIDATED_CUTBLOCKS_2012	2015
Forest Inventory – Cut Blocks	WHSE_FOREST_TENURE	FTEN_CUT_BLOCK_POLY_SVW	2015
Forest Inventory – Results Openings	WHSE_FOREST_VEGETATION	RSLT_OPENINGS_SVW	2015
Forest Inventory – Reserves	WHSE_FOREST_VEGETATION	RSLT_FOREST_COVER_RESERVE_SVW	2015
Forest Inventory – Results Forest Cover	WHSE_FOREST_VEGETATION	RSLT_FOREST_COVER_INV_SVW	2015
Forest Inventory – Results SU	WHSE_FOREST_VEGETATION	RSLT_STANDARDS_UNIT_SVW	2012
Spaced/Fertilized	WHSE_FOREST_VEGETATION	RSLT_ACTIVITY_TREATMENT_UNIT_SVW	2015

Spatial Data	Source	Feature Name	Effective
Consolidated Wildfires	Forsite	Union_Fire	2015
Consolidated Forest Cover (VRI,LVI, Depletions, Fire, SIA)	Forsite	veg_harv_bec_buffer	2015
Spruce beetle aerial surveys	FLNRO	Spruce_Beetle_consolidated_2017	2017
PSTA Wildfire Threat Rating	FLNRO	PSTA_FireThreat_HighExtreme	2015
No Salvage Line	DMK, Canfor, Forsite	NoSalvageLine	2017

1.5 FOREST INVENTORY UPDATES

The current forest inventory of the Mackenzie TSA is based on photographs dating as far back as 1956. However, most of the southern portion of the TSA (67%) is based on aerial photography acquired between 1999 and 2010.

The forest inventory was initially acquired from the provincial data distribution service which is updated for specific aspects and attributes and projected for growth to 2013. Further updates to these data were required to prepare the inventory for this analysis.

Disturbance

The forest inventory is updated for logging disturbance to 2016 and detailed attributes from RESULTS are brought into the inventory for logged blocks. This process aims to retain opening identifiers to link with RESULTS in the next step. Stand level reserves identified in RESULTS are not treated as disturbance data.

Various attributes are updated using the most current survey data from RESULTS. Where appropriate, area-weighted average values are calculated and used to replace existing inventory attributes for these openings (VRIMs uses dominant SU attributes and does not use density information out of RESULTS). Forest attributes are not updated where RESULTS data identifies openings logged using partial harvest systems (e.g., selection, shelterwood, patch cut).

Managed stand site indices

Managed stand site indices were calculated for each forest polygon using the provincial site productivity layer which provides SIBEC estimates for site series identified in the predictive ecosystem mapping for Mackenzie TSA. Values were assigned to forest cover polygons using area-weighted averages from the raster dataset for multiple species per polygon.

Mountain Pine Beetle

The 2015 update to the Provincial Forest Cover incorporates changes to account for current MPB losses:

- For inventories captured before MPB, stand density and volume estimates were adjusted / prorated based on the BCMPB Model (cumkill2010) and a Year-of-Death data layer. For inventories captured after the peak MPB attack period of 2009, volumes did not need to be adjusted because the MPB impact was already reflected in the typing.
- Growth and yield projections utilized the dead stand percentage available in the inventory and no additional future mortality from MPB was implemented. The dead stand percentage attributes reflect percentages for the entire stand – factored according to the pine component within the stand.

Wildfires

The fire boundaries have been included in the resultant. No other analysis was conducted in regards to fires.

Volume Adjustments

No volume adjustments were applied to the forest inventory. Past VRI ground sampling and adjustment projects undertaken in the Mackenzie TSA were deemed inconclusive for this analysis because of the uncertainty around how they applied to the current inventory conditions.

2 Base Case Scenario

This section describes the assumptions used to model the base case scenario (status quo management). This scenario provides the base from which to compare various silviculture treatment scenarios.

2.1 LAND BASE ASSUMPTIONS

Land base assumptions are used to define the contributing forest land base (CFLB) and timber harvesting land base (THLB) in the TSA. The THLB is designated to support timber harvesting while the CFLB is identified as the broader productive forest that can contribute toward meeting non-timber objectives (e.g., biodiversity).

Table 2 Mackenzie TSA Land Base Area Summary

Factor		Gross Area (ha)	Effective Area (ha)	% of Total Area	% of CFLB
Total Area		**6,410,665**	**6,410,665**	**100.0%**	
Less:					
	Non TSA (Private, Woodlots, CFA, Federal/Military/Misc. Reserves)	41,738	41,738	0.7%	
	FN Reserves	838	286	0.0%	
Total TSA			**6,368,641**	**99.3%**	
Less:					
	Water	225,384	221,552	3.5%	
	Wetland and Alpine	1,438,756	1,213,071	18.9%	
	BEC Alpine	1,075,980	227,528	3.5%	
	Snow, Ice, Rock	795,397	18,524	0.3%	
	Shrubs, Herbs	1,176,344	591,994	9.2%	
	Glacier, Bedrock	790,376	0	0.0%	
	Exposed Soil	2,767	0	0.0%	
	Low Site Index (<5m)	2,831,783	777,169	12.1%	
	Roads and Utility	66,744	55,708	0.9%	
	Logged Agricultural and Settlement Areas	535	535	0.0%	
Crown Forest Land Base (CFLB)			**3,262,561**	**50.9%**	**100.0%**
Less:		#in CFLB			
	Inoperable				
	Excessive Haul Distance	280,501	280,501	4.4%	8.6%
	Unstable Terrain (U,V, 5)	14,953	14,953	0.2%	0.5%
	Slope >=46% and Vol <250m³	497,000	453,933	7.1%	13.9%
	Non Commercial Species (W,EP, Z)	15,962	13,459	0.2%	0.4%
	Slope <=35 and Vol<150m³ (incl PL)	694,814	565,938	8.8%	17.3%
	Slope 35-46 and Vol<150m³	226,383	204,769	3.2%	6.3%
	Reserves				
	Provincial Parks	375,051	124,850	1.9%	3.8%
	Crown Reserves	377,637	442	0.0%	0.0%
	Misc. Reserves	110	91	0.0%	0.0%
	UWR No Harvest	398,443	108,202	1.7%	3.3%
	WHA No Harvest	107,073	61,899	1.0%	1.9%
	OGMA	55,112	28,218	0.4%	0.9%

Factor		Gross Area (ha)	Effective Area (ha)	% of Total Area	% of CFLB
	Mugaha Marsh Sensitive Area	0	0	0.0%	0.0%
	Muskwa-Kechika Management Area	397,811	33,894	0.5%	1.0%
	Weissener Buffer	473	162	0.0%	0.0%
	Riparian	248,190	106,930	1.7%	3.3%
	Isolated	3,469	2,450	0.0%	0.1%
Current THLB			**1,261,869**	**19.7%**	**38.7%**
	Less:				
	Agriculture/Settlement areas		611	0.0%	0.0%
	Retention (In-block + MPB Salvage Zones)*		66,331	1.0%	2.0%
	Future Roads (4% of THLB>300m from roads)**		24,914	0.4%	0.8%
Long Term THLB			**1,170,013**	**18.3%**	**35.9%**

** Various in-block retention depending on the patch size within MPB salvage zone (section 2.2.1.1).*

*** Yield reduction of 1.97% applied to future stands regenerated after clearcut of existing natural stands (section 2.1.16).*

More detailed descriptions of these land base assumptions are provided in the following sections of this document. After applying these assumptions, the land base was summarized below according to BEC zones (Figure 2).

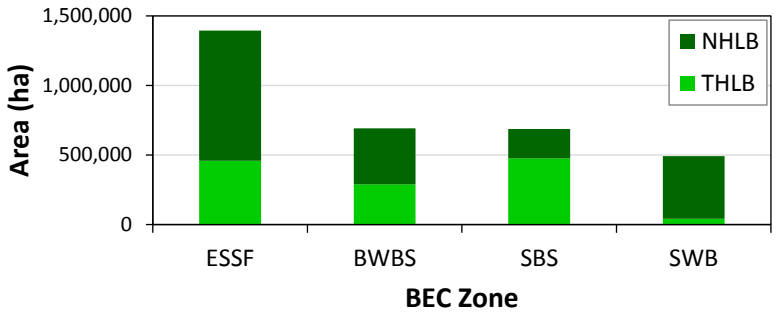


Figure 2 BEC zone distribution across the forest management land base

Considering the magnitude of area affected by the MPB and fire across the spectrum of age classes, we can expect a large shift of future stands into a narrow age class range. Once mature, these stands will become available for harvest again in a common period. It will be necessary to find ways to break up this age class cohort and minimize the risk of future MPB outbreaks. After applying assumptions to reflect changes in stand age from disturbances (i.e., fire, insects and harvesting) the current age class distribution on both the THLB and Non-THLB are shown in Figure 3.

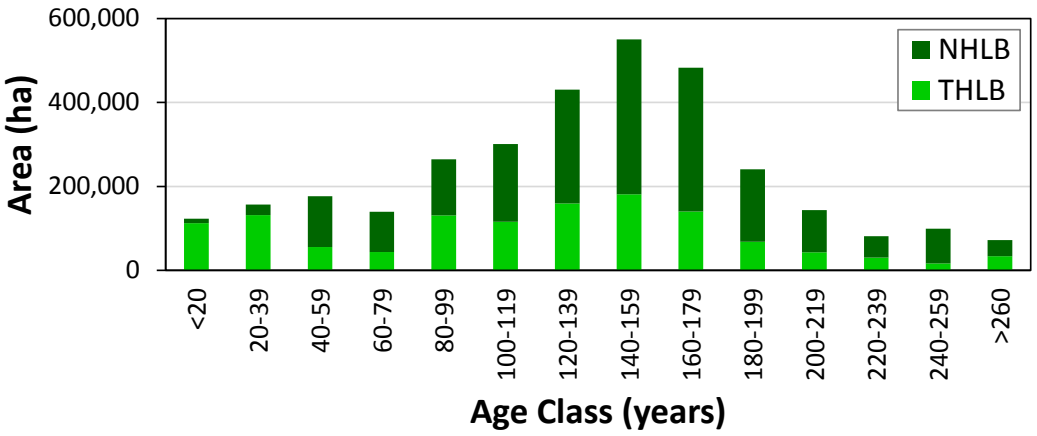


Figure 3 Age class distribution across the forest management land base

Differences from the TSR

Forsite's attempt to replicate the land base definition used in the TSR resulted in an approximately 156,452 ha below the TSR long term THLB. The key factors that contributed to the difference were the slope and non-forest area. Statistics for each netdown factor are detailed in the sections below.

2.1.1 Non-TSA Ownership

For this analysis, the CFLB was spatially reduced for all areas identified as private land (40N), federal reserve (50N), Indian reserve (52N), military reserve (53N), woodlots (77A, 77B), community forests (79B), and miscellaneous leases (99N).

Table 3 Ownership

Ownership code and land type	Gross Area (ha)	CFLB Area (ha)	THLB Area (ha)
40 Private – Crown Grant	8,625	Excluded	Excluded
50 Federal Reserve	1,399	Excluded	Excluded
52 Indian Reserve	285	Excluded	Excluded
53 Military Reserve	0	Excluded	Excluded
54 Dominion Crown block	0	Excluded	Excluded
60 Crown Ecological Reserve	899,488	375,046	Excluded
62-N Crown Forest Management Unit (TSA) or Crown Timber Agreement Lands	295	259	Excluded
62-C Crown Forest Management Unit (TSA) or Crown Timber Agreement Lands	5,453,125	2,875,916	1,259,283
69-N Crown Miscellaneous Reserves	136	110	Excluded
69-C Crown Miscellaneous Reserves	15,598	11,230	2,586
70-N Crown Active Timber Licence in a TSA or TFL	0	0	0
70-C Crown Active Timber Licence in a TSA or TFL	0	0	Excluded
72 Crown and private Schedule “A” and “B” Lands in a TFL	0	0	Excluded
75 Crown Christmas tree permit	0	0	Excluded
77 Crown and private woodlot licence	7,831	Excluded	Excluded
79 Community Forest	23,882	Excluded	Excluded
99 Crown misc. lease (fairground, club site, cottage site)	1	Excluded	Excluded
Total	**6,410,665**	**3,262,561**	**1,261,869**

Differences from TSR

Only TSR assumptions were applied. However, the ownership layer might have been different from the one used by Forsite. The TSR netted out approximately 1,910 ha (gross area difference) or 697 ha (net area difference) less than Forsite TSR Benchmark scenario (i.e., the scenario developed by Forsite to emulate the latest TSR).

2.1.2 Non-Forest and Non-Productive

Non-forest and non-productive areas were identified using the logic provided in Table 4. Blocks that had previously been harvested were automatically considered productive.

Table 4 Non Productive Classification

Attributes	Description	Gross Area (ha)	Net Area (ha)
BCLCS_LEVEL_2== "W" or BCLCS_LEVEL_3 in ("LA", "RE", "RI", "OC")	Water	225,384	221,552
BCLCS_LEVEL_3 in ("W", "A")	Wetland or Alpine	2,514,736	1,440,598
BCLCS_LEVEL_4 in ("SI", "RO") or (BCLCS_LEVEL_2 =="EL" and not Previously Harvested)	Snow ice Rock and rubble (Or Exposed never been harvested land)	795,397	18,524
BCLCS_LEVEL_4 in ("ST","SL", "HE","HF","HG","BY","BM","BL")	Herbs and Shrubs	1,176,344	591,994
BCLCS_LEVEL_5 in ("GL", "PN","BR","TA","BI","MZ","LB")	Glacier, Snow Cover, Bedrock	790,376	0
BCLCS_LEVEL_5 in ("RS", "LS", "RM", "BE", "LL", "RZ", "MU", "CB", "MN", "GP", "TZ", "RN", "UR", "AP","MI%") or BCLCS_LEVEL_5 == "ES%" (and not harvested)	Sediments, beach, landing, Road surface, urban (or exposed soil, never been harvested)	2,767	0
Total		**5,505,004**	**2,272,668**

Differences from TSR

Only TSR assumptions were applied. However, TSR netted down approximately 14,629 ha (net area difference) less than Forsite TSR Benchmark scenario. Gross area statistics were not available in the TSR.

2.1.3 Low Productivity Stands

Low productivity stands cannot grow sufficient merchantable volume to make a cost-effective harvest entry within a reasonable timeframe. In this case, these are stands whose merchantable volumes never reach the minimum harvest volume thresholds. A site index (SI) (i.e., top height in metres at age 50) cut off of 5m was used to exclude area from the CFLB.

Table 5 Low Productivity Stands

Attributes	Description	Gross Area (ha)	Net Area (ha)
SI <5 m	Low Site Index (<5m)	2,831,783	777,169

Differences from TSR

Only TSR assumptions were applied. Low sites were included in the non-forest and non-productive category.

2.1.4 Roads and Utility

A current road network was compiled using road_segments and road_atlas data layers. These roads are given classes based on usage (Table 6). Roads were given the Mainline classification if Client name is District Manager and they are not classified as local or highway. All other dirt roads are either classified as operational or in-block. Roads within cut block boundaries are considered in-block roads. Power and rail lines were classified the same as in the TSR following the buffer widths listed in Table 10.

The roads and utility account for 55,708 ha net area (66,745 ha gross).

Table 6 Existing Roads and Buffers

Class	Buffer Width
-1 Highways	45 m
1 Local Roads	45 m
2 Mainlines	25 m
3 Operational Roads	20 m
4 In-block roads	10 m

Table 7 Power and Rail line with Buffers

Class	Buffer Width
Rail lines	45 m
Kemess and Mt Milligan (Above Parsnip River)	70 m
Below Parsnip river to merger with Town Power Lines	120 m
Connection to Main Power line	170 m
Main Power Line	200 m
Pipelines	18 m

Differences from TSR

Only TSR assumptions were applied. However, the area excluded was approximately 34,596 ha (net area difference) less than Forsite TSR Benchmark scenario. Gross area statistics were not available in the TSR. The difference might be due to different classification of uncertain line features.

2.1.5 Excessive haul distance

In the case of the ISS scenarios, Forsite developed a haul distance profile based on cycle hours (section 2.3.4). In this analysis, excessive haul distance is considered all CFLB area with a harvest profile cycle greater than 5 hours. This assumption is closest to the TSR excessive haul distance map.

Differences from TSR

TSR 3 defined excessive haul distance as 293 km away from Mackenzie. The actual layer was not available for this analysis. In the case of the TSR Benchmark scenario, a rough boundary was drawn using the excessive haul distance map in Figure 11 from the Technical Record document (June 10, 2014).

Forsite attempted to match TSR assumptions and a spatially explicit data set was developed from the aforementioned map. Forsite dataset was approximately 246,724 ha (gross area difference) or 3,090 ha less than TSR.

2.1.6 Non-Commercial and Physically and Economically Inoperable

In this analysis, non-commercial stands were defined by stands whose leading species in the VRI is Willow (W), Birch (Ep), or Unknown (Z). Such stands were 100% excluded from the THLB.

Physically and economically inoperable areas are 100% excluded from the THLB. Such areas were assumed to be any forested area that has not been logged and is currently subject to operational constraints. The operational constraints are defined by 2 criteria:

- Terrain classification. Using Level C and D terrain mapping where it was available in the TSA, any unstable (V, U, or 5) ground was 100 % removed.
- Slopes and site productivity criteria. VDYP natural stand yield curves were derived for the entire land base spanning from 10 to 300 years. The pine beetle assumptions were that 75% of the pine in all stands greater than 60 years old was dead. Each VRI polygon was assessed as to whether it achieved greater than 150 m^3/ha and 250 m^3/ha.
    - Polygons on slopes less than 46% that achieved less than 150 m^3/ha were removed from the THLB.
    - Polygons on slopes greater than or equal to 46% that achieved less than 250 m^3/ha were removed from the THLB.
    - Pine leading stands impacted by MPB will not be salvaged on slopes greater than 35%.

Table 8 Non-Commercial and Physically and Economically Inoperable

Category	Logic	CFLB Area (ha)	THLB Area (ha)
Unstable Terrain	SLPSTB_CLS in ('U','V','5')	14,953	14,953
Low Volume Steep	(All Volume – 75%PL)<250m^3, Slope ≤ 46%	497,000	453,933
Non-commercial Species	SPECIES_CD_1 in (W,EP,Z)	15,962	13,459
Low volume Ground	All vol < 150m^3 , slope < 35%	694,814	565,938
Low volume Cable	(All Volume – 75%PL)<150m^3, 35%≤Slope<46%	226,383	204,769
Total		**1,449,111**	**1,253,051**

Differences from TSR

No difference in the assumptions. However, the quality check indicated that TSR slope classes did not align well with the contour lines. Because slope class was used to define other inoperable areas, the cumulative impact was that TSR netted out approximately 2,431,858 ha (gross area difference) or 201,257 ha (net area difference) less than Forsite TSR Benchmark scenario.

The slope stability classes used in TSR to exclude area from the THLB included U and V. However, slope stability class 5 should also have been excluded. Thus, TSR netted out approximately 13,112 ha (gross area difference) or 3,599 ha (net area difference) less than Forsite TSR Benchmark scenario.

Overall, the TSR Benchmark Scenario identified approximately 207,945 ha (net area difference) more area as inoperable (including excessive haul distance).

2.1.7 Parks and Reserves

Parks and reserves within the TSA boundary are considered part of the CFLB and partially contribute to objectives for biodiversity and wildlife (e.g., old seral requirements). Other reserves (Crown and Miscellaneous) were identified using ownership codes (i.e., Schedule N and Own code = 60 to 69 or 75)

Table 9 Parks and Reserves

Park	CFLB Area (ha)	Net Area (ha)
BIJOUX FALLS PARK	30	26
BLACKWATER CREEK ECOLOGICAL RESERVE	245	241
CARP LAKE PARK	27	27
CHASE PARK	28,102	11,106
CHUKACHIDA PROTECTED AREA	8	0
CHUNAMON CREEK ECOLOGICAL RESERVE	343	226
DENETIAH PARK	19	0
DUNE ZA KEYIH PARK [A.K.A. FROG-GATAGA PARK]	125,500	6,033
DUNE ZA KEYIH PROTECTED AREA	9,402	2,322
ED BIRD - ESTELLA LAKES PARK	4,693	4,083
FINLAY - RUSSEL PROTECTED AREA	10,821	6,635
FINLAY RUSSEL PARK	52,868	23,203
GRAHAM - LAURIER PARK	69	37
HEATHER - DINA LAKES PARK	4,779	4,269
HEATHER LAKE ECOLOGICAL RESERVE	266	229
KWADACHA WILDERNESS PARK	14,201	4,304
MUSCOVITE LAKES PARK	4,988	4,243
OMINECA PARK	93,390	52,751
OMINECA PROTECTED AREA	1,906	1,499
OSPIKA CONES ECOLOGICAL RESERVE	722	227
PATSUK CREEK ECOLOGICAL RESERVE	532	375
PINE LE MORAY PARK	5,106	2,950
PITMAN RIVER PROTECTED AREA	16	0
RASPBERRY HARBOUR ECOLOGICAL RESERVE	64	32
SPATSIZI PLATEAU WILDERNESS PARK	387	0
TATLATUI PARK	16,517	0
TUDYAH LAKE PARK	48	34
Crown Reserves	377,637	442
Misc. Reserves	110	91
Total	**752,798**	**125,384**

Differences from TSR

TSR netted out approximately 39,465 ha (gross area difference) or 1,351 ha (net area difference) less than Forsite TSR Benchmark scenario. The differences are assumed to be due to ownership layers used, and combining the Parks dataset with ownership codes (e.g., Schedule N).

2.1.8 Ungulate Winter Ranges and Wildlife Habitat Areas

Various legal orders exist for ungulate winter range (UWR) and wildlife habitat areas (WHA). In addition to the approved orders, this analysis also included draft and proposed orders as detailed in Table 10 and Table 11.

Table 10 Spatial reductions for Ungulate Winter Ranges

UWR Tag	UWR Name	Status	TSR Assumption	CFLB Area (ha)	Net Area (ha)
u-7-001	Kennedy Siding - Low Elevation Northern Caribou	Draft Amendment	Log 50% every 50 years	8,248	7,292
u-7-004	Peace Arm (Brewster) Mountain Goat	Approved	No harvest	535	29
u-7-006	Peace Arm Stone Sheep	Approved	No harvest	2,170	518
u-7-009	Pine Pass Northern Caribou (PP-001)	Approved	No harvest	1,258	185
u-7-009	Pine Pass Northern Caribou (PP-002)	Approved	No harvest	11,032	4,387
u-7-009	Pine Pass Northern Caribou (PP-004)	Approved	No harvest	6,830	2,957
u-7-017	Akie-Pesika (mountain goat) (AP3)	Approved	No harvest	507	70
u-7-017	Akie-Pesika (mountain goat) (AP4)	Approved	No harvest	474	31
u-7-017	Akie-Pesika (mountain goat) (AP5)	Approved	No harvest	1,667	197
u-7-017	Akie-Pesika (mountain goat) (AP6)	Approved	No harvest	1,830	131
u-7-025	Caribou (Northern Pop), Core Area	Approved	Not included	222,930	47,956
u-7-028	Stone's Sheep, Core Area	Approved	Not included	21,193	4,065
u-7-029	Mountain Goat, Core Area	Approved	Not included	9,157	3,130
u-7-030	Mountain Goat, Core Area	Approved	Not included	33,128	3,235
u-9-002	Northern Caribou and Stone's Sheep	Draft Amendment	Not included	65,367	27,071
u-9-004	Northern Caribou and Stone's Sheep	Draft Amendment	Not included	17,066	6,950
Total				**403,393**	**108,202**

Table 11 Spatial Reductions for Wildlife Habitat Areas

WHA Tag	WHA Name	Status	TSR Assumption	CFLB Area (ha)	Net Area (ha)
9-001	Brewster Salt Lick (Mountain Goat)	Approved	No Harvest	40	31
9-035	Graham Laurier (Northern Caribou)	Approved	No Harvest	1,865	626
9-036	W. Nabesche (Northern Caribou)	Approved	No Harvest	3,118	1,283
9-037	Emerslund Cr. E. (Northern Caribou)	Approved	No Harvest	791	0
9-038	Upper Schooler Cr N. N. (Northern Caribou)	Approved	No Harvest	1,412	40
9-039	Upper Schooler Cr S. S. (Northern Caribou)	Approved	No Harvest	4,351	1,740
9-040	Schooler Cr W. (Northern Caribou)	Approved	No Harvest	759	339
9-102	Meadow Creek N. (Northern Caribou)	Approved	No Harvest	488	1
9-103	Meadow Creek S. (Northern Caribou)	Approved	No Harvest	708	84
9-146	Northern Caribou	Proposed	Not included	260	0
9-999	Peace Northern Caribou Plan	Draft	Not included	6,000	2,406
7-012	Fisher Core Area	Draft	Not included	52	52
7-013	Fisher Core Area	Draft	Not included	118	97
7-014	Fisher Core Area	Draft	Not included	95	88
7-015	Fisher Core Area	Draft	Not included	54	54
7-016	Fisher Core Area	Draft	Not included	98	62
7-012	Fisher Management Area	Draft	Not included	3,509	2,851
7-013	Fisher Management Area	Draft	Not included	4,114	3,765
7-014	Fisher Management Area	Draft	Not included	1,159	986
7-015	Fisher Management Area	Draft	Not included	1,999	1,532
7-016	Fisher Management Area	Draft	Not included	5,577	4,382
	Bull Trout Davis River	Draft	Not included	177	166
	Bull Trout Lower Scott Creek	Draft	Not included	134	88
	Bull Trout Missinchinka River	Draft	Not included	213	186
	Bull Trout Point Creek	Draft	Not included	148	142
	Bull Trout Upper Scott Creek	Draft	Not included	93	83
	Calving - Chase and Wolverine Caribou Herds (Units 1-4, 6, 13)	Draft	Not included	2,439	600
7-233	PostRut - Chase and Wolverine Caribou Herds	Draft	Not included	35,379	25,850
7-234	PostRut - Chase and Wolverine Caribou Herds	Draft	Not included	8,069	3,489
7-237	PostRut - Chase and Wolverine Caribou Herds	Draft	Not included	15,597	7,122

WHA Tag	WHA Name	Status	TSR Assumption	CFLB Area (ha)	Net Area (ha)
7-238	PostRut - Chase and Wolverine Caribou Herds	Draft	Not included	2,592	699
7-239	PostRut - Chase and Wolverine Caribou Herds	Draft	Not included	4,020	1,169
999	PostRut - Chase and Wolverine Caribou Herds	Draft	Not included	2,161	1,886
Total				**107,588**	**61,899**

*Gross Area. At the time the resultant file was developed, this layer was not available. The quality check indicated that 100% of the gross area is excluded from the THLB by other netdown factors. The gross area shown is not included in the total values.

Differences from TSR

Forsite TSR Benchmark scenario resulted in similar gross areas to the TSR. However, TSR included as no-harvest area only the legally established orders at the time of TSR analysis – UWR tag# u-7-004 through u-7-017 (Table 10) and WHA tag# 9-001 through 9-103 (Table 11). The ISS base cases included draft amended, draft, and proposed UWRs and WHAs as indicated above.

2.1.9 Old Growth Management Areas

Old Growth Management Areas (OGMA) were established for the Southern portion of the TSA in October 2010 (Table 12). Within these LU all of the old seral requirements are fulfilled through these spatial OGMAS. According to the order, Spatial Land Use Objectives for part of the Mackenzie Forest District Area, minor forestry activities are allowed within the OGMAs (10% in OGMAs less than 50 hectares, or, 5% or 40 hectares whichever is less in OGMAs of 50 hectares or greater). In this analysis, OGMAs were considered part of the NHLB and were not available for harvest.

Table 12 Old Growth Management Area by LU

LU	CFLB Area (ha)	Net Area (ha)
Connaghan Creek	403	158
Eklund	2,713	1,009
Gaffney	11,144	8,798
Gillis	2,106	1,006
Jackfish	2,524	1,850
Kennedy	4,090	1,172
Klawli	5,695	906
Manson River	3,335	1,949
Misinchinka	10,216	6,565
Parsnip	10,588	3,570
South Germansen - Upper Manson	786	651
Tudyah B	336	273
Twenty Mile	1,178	312
Total	**55,112**	**28,218**

Differences from TSR

No differences.

2.1.10 Mugaha Marsh Sensitive Area

The Mugaha Marsh Sensitive Area was established under section 5 of the Forest Practices Code for British Columbia (2001). The order states that only 10% of the commercial forest may be disturbed at one time, and a 100m wide reserve zone adjacent to all lakes and wetlands within the area should be established. For simplicity, the TSR treated this area as 100% removal from the THLB. The same strategy was adopted for this analysis.

Differences from TSR

No differences.

2.1.11 Muskwa-Kechika Management Area

The Muskwa-Kechika Management Area was established in 1998 by the The Muskwa-Kechika Management Area Act because its unique wilderness in northeastern BC is endowed with a globally significant abundance and diversity of life. The Act affords additional protection to the wilderness characteristics, wildlife, and habitat by providing restrictions to natural resource extractions within the Management Area. In this analysis, the entire area was excluded from THLB.

Differences from TSR

In the TSR, the Muskwa-Kechika Management Area was not explicitly excluded from THLB. However, other netdown factors (e.g., excessive haul distance) excluded all but 1 ha from the THLB.

2.1.12 Weissener Buffer

In October of 2002, an order for the Fox and Obo River LUs was established. This order contained old seral and patch size requirements (section 2.2.6) that are handled though non-timber management objectives.

Furthermore, this order identified a 200m exclusion buffer around Weissener Lake in the Fox LU, and a further 50m 50% harvest zone. For modelling purposes, this buffer had 225 m (200m + 50% of 50m) excluded from the THLB.

Differences from TSR

In the TSR, the Weissener Buffer was not explicitly removed from the THLB because it was located beyond the bounds of the assumed THLB (probably was netted out due to excessive haul distance).

2.1.13 Riparian Zones

Riparian netdowns were calculated based on the buffers applied to each riparian class (Table 13). Except for small streams, these areas are removed from the THLB, but do partially contribute to non-timber management objectives. Small stream areas are calculated and removed aspatially from the THLB (see section 2.2.2).

Table 13 Stream zone buffer widths

Riparian Class	Definition	Buffer Width (m)	CFLB Area (ha)	Net Area (ha)
Stream Large	Where FWA stream centreline overlaps an FWA "two line" river. Buffer on "two line" river. Stream Order ≥ 6.	70	47,050	24,335
Stream Medium	For remaining FWA line work where the FWA feature code of GA24850000 ("definite"). Stream Order 3, 4, 5.	50	119,188	49,489
Lake Large	Greater than 5 ha	50	15,660	8,211
Lake Medium	Greater than 1 ha, less than 5ha	30	3,581	1,574
Lake Small	Less than 1 ha	30	6,804	2,646
Wetland Large	Greater than 5 ha	50	34,170	11,742
Wetland Medium	Greater than 1 ha, less than 5ha	30	14,918	5,742
Wetland Small	Less than 1 ha	30	6,819	3,192
Total			**248,190**	**106,930**

Differences from TSR

In the TSR, aspatial retention of 4.7% was used for both, riparian and in-block retention.

2.1.14 Isolated

Stands that are still considered part of the THLB after all other netdown factors were considered, but <4ha in size and greater than 75m away from any THLB neighbours > 4ha, are considered isolated and removed from the THLB.

Differences from TSR

In the TSR, isolated stands were assumed to be all disjointed patches from main THLB or non-adjacent to an existing road or Williston Lake. The main THLB was loosely defined, as the contiguous THLB area. The TSR netted out approximately 81,686 ha (net area difference) more than Forsite TSR Benchmark scenario.

2.1.15 Agricultural Development Areas and Settlement Reserve Areas

Agricultural development and settlement reserve areas have been established within the Mackenzie TSA under a ministerial order. These areas are excluded after the first pass. If these areas would be considered NHLB, or if they have been previously harvested, they were automatically excluded.

Table 14 Agricultural Development Areas and Settlement Reserve Areas

Status	Gross Area (ha)	CFLB Area (ha)	Net Area (ha)
Logged	535	0	535
Not-Logged	611	611	611
Total	**1,146**	**611**	**1,146**

Differences from TSR

In the TSR, the area reported for this factor was 2,281 ha (gross) and 980 ha (net). It is unclear why the two datasets resulted in different results.

2.1.16 Future Roads

The TSR future road reduction is 4% of the volume harvested further than 300m from a current road. In this analysis, a percentage of THLB needed to be calculated as:

$$\%\ of\ THLB\ as\ Future\ Road = \frac{(\text{Area of THLB} > 300\text{m from road}) * 0.04}{Area\ of\ THLB} * 100$$

The THLB area >300m from existing roads was estimated to be 622,861 ha. Given the estimated THLB area of 1,261,869 ha, the percentage of THLB as future roads was estimated to 1.97%. This percentage was applied in the model as a yield reduction for all future managed stands following clearcut of existing natural stands.

Differences from TSR

No difference in assumptions.

2.2 NON-TIMBER MANAGEMENT ASSUMPTIONS

This section describes the criteria and considerations used to model non-timber resources.

2.2.1 Landscape-Level Biodiversity

To address landscape-level biodiversity, the established spatially-defined OGMAs are netted out for the southern LUs (section 2.1.9). In the north, forest cover requirements established under the Non-Spatial Landscape Biodiversity Objectives are applied.

The definition of old for each seral group is described in Table 15. An 'x' in Table 15 indicates that this level of categorization is not used for this BEC Grouping. Thresholds for all LU and BEC Groups are listed in Appendix 1.

Table 15 Old Seral Definitions and Groupings

Zone	Subzone	Variant	SPP	BEC Grouping	Old Definition (years)
ESSF	mcp	x	x	1	140
ESSF	mvp	2	x	1	140
ESSF	mvp	3	x	1	140
ESSF	mvp	4	x	1	140
ESSF	wcp	3	x	1	140
SWB	mks	x	x	1	140
ESSF	mc	x	x	2	140
ESSF	mv	2	x	2	140
ESSF	mv	3	x	2	140
ESSF	mv	4	x	2	140
SWB	mk	x	x	2	140
ESSF	wc	3	x	3	140
ESSF	wk	2	x	3	140
SBS	mk	1	x	4	120
SBS	mk	2	x	4	120
SBS	wk	1	x	4	120
SBS	vk	x	x	5	140
SBS	wk	2	x	5	140
BWBS	mw	1	x	6	140
BWBS	wk	2	con	6	140
BWBS	dk	1	con	7	140
BWBS	x	x	dec	6&7	100

Source: Order for the Non-Spatial Landscape Biodiversity Objectives in the Mackenzie Forest District.

Differences from TSR

No difference in assumptions.

2.2.1.1 Fox and Obo River Landscape Units

The Fox and Obo River LUs have a specific order with objectives. The biodiversity objectives for this order are managed as non-timber management constraints.

Firstly, there is a patch size distribution constraint to maintain the size and distribution of openings/cut blocks, and to minimize fragmentation. Legal requirements are summarized in Table 15. These are maintained in the model by ensuring that patches of stands less than 20 years old adhere to the targets in Table 16.

Table 16 Patch Size Distribution % by NDT and Size

Natural Disturbance Type	Patch Size (ha)	Target (%)
NDT 2	<40	30-40

Natural Disturbance Type	Patch Size (ha)	Target (%)
	40-80	30-40
	80-250	30-40
NDT 3	<40	10-20
	40-80	10-20
	80-250	60-80

Secondly, these LUs also have their own seral stage requirements based on Natural Disturbance Type (NDT) and BEC zone (Table 17). These will be maintained through harvesting constraints in the model. The age definitions for the seral stage requirements in the Fox and Obo River LUs come from the definitions in the biodiversity guidebook (Table 18).

Table 17 Seral Stage Requirements in Fox and Obo River LUs

LU	NDT	BEC	THLB Area (ha)			NHLB Area (ha)			Current (%)		Min Target (%)	
			Total	MatOld	Old	Total	MatOld	Old	MatOld	Old	MatOld	Old
Fox	NDT2	ESSF	10,833	6,131	67	37,621	23,476	39	61%	0%	42%	13%
		SWB	4,686	3,128	77	18,425	12,583	105	68%	1%	42%	13%
	NDT3	BWBS	44,865	38,124	24,169	32,451	27,795	21,170	85%	59%	34%	16%
Obo River	NDT2	SWB	8,023	6,844	68	22,094	20,021	159	89%	1%	42%	13%
	NDT3	BWBS	4,143	4,002	1,015	3,767	2,623	1,438	84%	31%	34%	16%
Total			**72,549**	**58,229**	**25,396**	**114,359**	**86,499**	**22,910**	**77%**	**26%**		

Table 18 Definition of Mature and old (From Land Use Guide)

NDT	BEC ZONE	Mature Age	Old Age
NDT 2	ESSF	>120 years	>250 years
NDT 2	SWB	>120 years	>250 years
NDT 3	BWBS (Conifer leading)	>100 years	>140 years
NDT 3	BWBS (Deciduous leading)	>80 years	>100 years
NDT 3	ESSF	>120 years	>140 years

Differences from TSR

The Fox and Obo River LUs were not modelled in TSR because these units are beyond the harvesting distance threshold defined in TSR3.

2.2.2 Stand-Level Biodiversity

To address the potential negative impacts of large openings created by MPB salvage operation, the Chief Forester, in 2005, developed guidance for adjusting the retention levels relative to opening size (i.e., conservation uplift). Based on this guidance, opening sizes were determined for the MPB salvage zone.

The MPB salvage zone is defined by: i) areas harvested since 1986 (last 30 years), ii) mature stands that become non-merchantable by the end of MPB salvage period (MPB disturbance since 2003), and iii) stands disturbed by fires in the last 30 years (all fire records from the VRI since 1986 plus the fire history records since 1998 where fire size >50ha). To prevent opening splitting by narrow linear features (e.g., roads), openings that are within 20 m of one another are grouped together.

For each of the opening sizes within the salvage zone, and the non-salvage zone (Table 19), a retention percentage was determined using the following approach:

- Determine the ISS base in-block retention.

$$TSR\ Retention - \frac{Effective\ Riparian\ Reserves\ (ha)}{Effective\ Riparian\ Reserves + THLB\ (ha)} = ISS\ base\ in - block\ Retention\ (\%)$$

  - TSR Retention = 4.7% (includes in-block and all riparian).
  - Effective Riparian Reserves does not include small streams = 105,761 ha.
  - THLB = 1,261,861.
  - ISS base in-block retention = 4.7%-7.8% = -3.1%. Assumed to be 0%.
- Determine the modelled retention as the highest value between the target retention set by Chief Forester (mid-point value) and the ISS base in-block retention. Because the ISS base in-block retention is 0%, the mid-point target retention set by the Chief Forester is the modelled retention.
  - The modelled retention percentage is applied as an area reduction to each polygon according to the salvage zone designation.
  - The effective impact of the MPB retention = Modelled Retention – ISS base in-block Retention.

Table 19 Modelled Retention

Salvage Zone	Opening Size (ha)	Target Retention* (% of opening size)	Modelled Retention (%)
Small	<50	10%	10%
Medium	50-250	10-15%	12.5%
Large	50-1,000	15-25%	20%
Very Large	>=1,000	>25%	30%
Non-Salvage	N/A	N/A	0% (ISS base in-block Retention)

* Taken from 2005 Chief Forester Guidance

Differences from TSR

In the TSR, aspatial retention of 4.7% was used for both, riparian and in-block retention. No salvage zones assumptions were considered.

2.2.3 Scenic Areas

There are 658 legally established visual polygons that require a range of visual quality objectives (VQO) to be achieved by limiting the amount of disturbance. In the previous TSR analysis it was estimated that the VQOs impact on harvest level would be minor. Given the effort to model such objectives and the estimated minor impacts, the VQOs were not modelled in this analysis.

Differences from TSR

The TSR reported that only 4.6% of the THLB is covered by VQOs (61% modification, 39% partial retention), and estimated the impact of meeting VQOs objectives on the harvest level would be <1%. Therefore, the VQOs were not modelled in the previous TSR.

2.2.4 Watersheds

There are various watersheds throughout the TSA that were identified as sensitive (i.e, community watersheds, Draft Fish Sensitive Watersheds (FSW), and watersheds identified by the district manager). Within the sensitive watersheds, harvest is restricted via maximum disturbance thresholds defined by equivalent clearcut area (ECA).

The ECA is an index that measures the impact stand replacing disturbances (e.g., clearcuts) have on the hydrology of an area. It is assumed that clearcut of a forested area is the maximum impact a disturbance can have on a hydrology of the affected area. Consequently, the ECA of newly clearcut area is assumed to be 100% of the affected area. As a new stand emerges, a hydrological recovery process begins and the impact a clearcut has on the hydrology of the area decreases. The emergence of the new stand is measured by the tree height. For example, when the newly established stand reaches heights over 3 m, it is considered that 25% of the area is hydrologically recovered, or, 75% of the area still has an equivalent clearcut impact on the hydrology of the affected area (i.e., ECA is 75% of the affected area). The definition of a fully hydrological recovered stand is up to debate, but in general, stands with tree heights over 12 m are considered fully recovered. At this stage, the ECA is 0% of the affected area. Note that natural disturbances are also assumed to have an impact on the hydrological processes.

In this analysis, the ECAs were determined based on the general guidance provided for FSWs in the Omineca Region (November 2, 2016 - Sandra Sulyma) (Table 20 and Table 21). Given the separate accounts for private and permanent anthropogenic disturbances (AD), new ECA targets had to be developed (Appendix 2):

- Determine the area for private lands, AD, natural non-forest, and CFLB.
- Determine the maximum area allowed to be disturbed.
    - Max Area ECA (ha) = Watershed Area (ha) * ECA target (%).
- Determine the Area ECA generated from AD and private lands.
    - Area ECA AD+Private = Max Area ECA (ha) – (Area AD (ha) x ECA (100%) – Area Private (ha) x ECA (75%)).
- Determine the new max ECA.
    - New Max ECA (%) = (Max Area ECA (ha) – Area ECA AD+Private(ha)) /CFLB area (ha).

Table 20 ECA estimates by stand height and land use

Criteria	ECA%
Private Land	75
Anthropogenic Disturbance*	100
Stand height <3m	100
Stand height ≥3m and <5m	75
Stand height ≥5m and <7m	50
Stand height ≥7m and <9m	25
Stand height ≥9m and <12m	10
Stand height ≥12m	0
Natural Non-Forest	0
Wildfires**	100

*Anthropogenic disturbance examples: roads (Digital Road Atlas), gravel pits, mines, railway, pipelines, utility corridors.
**Not modelled here.

Table 21 ECA estimates for MPB and IBS-affected stands

Years Since Attack*	ECA% by Dead Percentage Class**		
	≥30 and <50%	≥50 and <70%	≥70%
0 to 5	5	5	10
6 to 10	10	15	30
11 to 15	15	20	40
16 to 20	20	30	45

Years Since Attack*	ECA% by Dead Percentage Class**		
	≥30 and <50%	≥50 and <70%	≥70%
21 to 25	20	30	45
26 to 30	15	20	40
31 to 35	10	15	30
36 to 40	5	10	25
41 to 45	0	5	20
46 to 50	0	0	15
51 to 55	0	0	10
56 to 60	0	0	5
>60	0	0	0

* Years since attack derived from VRI (N_LOG_DIST, N_LOG_DATE)
** Dead Percentage Class derived from VRI (DEAD_PCT)

Three sets of ECA curves were then developed, one set for existing and future managed stands based on tree heights (Table 20), one set for all stands impacted by MPB (i.e., age 2016 >=28 yrs, stand percentage dead >=30%, non-logging disturbance = IBM, " and non-logging disturbance year >=2003) (Table 21), and another set for all stands impacted by IBS (i.e., age 2016 >=10 and IBS severity >=30) with identical ECA curves as for MPB (Table 21). The ECA height curves were developed during the yield generation using TIPSY and the specifications in Table 20. The ECA height curves were then used to develop a feature account in Patchworks which tracked the ECA based on height for each watershed. For the ECA-MPB curves, a feature account was developed in Patchworks to track in each watershed, all stands impacted by MPB and assigned corresponding curve from Table 21. For ECA-IBS stands, a similar approach to ECA-MPB was followed. Finally, for each watershed, the three accounts (ECA based on heights, ECA-MPB, and ECA-IBS) were summed, a ratio account was developed by dividing with the total CFLB area, and the New Max ECA targets (Appendix 2) applied to the ratio accounts.

Differences from TSR

No watershed assumptions were made in TSR.

2.2.5 Wildlife Habitat Areas and Ungulate Winter Ranges

A variety of WHAs and UWRs have been established within the study area. All no-harvest WHAs and UWRs (draft, proposed, and approved) were removed in the netdown process in section 2.1.8. General wildlife measures and appropriate modelling assumptions for spatially-defined UWR areas are summarized in Table 22.

Table 22 General Wildlife Measures

UWR/ WHA Tag	UWR Name	Legal Requirement	Modelling
u-7-001	Caribou (Northern Pop)	Harvest max. 50% of entire area at a time on 100-yr rotation so 45-55% is 0-50 years old and 45-55% is 50-100 years old. Harvest patches 250 to 1,400 ha. Maintain visual screen between roads and adjacent cutblocks (so caribou within that cutblock are not visible from road). No silv activity to increase site productivity for trees (i.e. no fertilization). Avoid harvesting between Oct 1 – Feb 28, and ensure adequate snow cover when winter harvesting. Do not	Harvest max. 50% of area at one time (100-yr rotation) so that 45-55% is 0-50 years and 45-55% is 50-100 years. Harvest patches 250 to 1,400 ha.

UWR/ WHA Tag	UWR Name	Legal Requirement	Modelling
		increase current road density, and future roads built to lowest class practicable.	
u-7-005	Peace Arm (Elk)	Maintain a minimum of 40% of the forested portion of the UWR greater than 100 years old with a crown closure greater than 40%	Maintain a minimum of 40% of the CFLB within UWR older than 100 years.
u-7-007	Caribou (Northern Pop: low elevation)	Manage Terrestrial Lichen Habitat area within the UWR on a two pass system over a 140 year rotation	Max 50% of the THLB area younger than 70 years.
u-7-008	Ingenika (Elk)	Maintain a minimum of 40% of the forested portion of the UWR greater than 100 years old with a crown closure greater than 40%	Maintain a minimum of 40% of the CFLB within UWR older than 100 years.
u-7-009	Pine Pass Caribou (Northern Pop: PP-003)	a) Maintain 20% CFLB greater than 100 years old. B) no more than 20% being less than 3m in height	a) Maintain 20% CFLB greater than 100 years old. b) no more than 20% being less than 3m in height (area-weighted average of age 20)
u-7-017	Akie-Pesika (mountain goat) (AP1, AP2)	a) Maintain 20% of the forested stands greater than or equal to 100 years old with a crown closure greater than or equal to 40% b) Maintain 25% of the forested stands greater than 80 years old with a crown closure greater than or equal to 40% c) A maximum of 20% of the forested stands can be less than 20 years old	a) Maintain 20% of the forested stands greater than or equal to 100 years old b) Maintain 25% of the forested stands greater than or equal to 80 years old c) A maximum of 20% of the forested stands can be less than 20 years old
u-7-025	Caribou (High Elevation)	Specified area – Range use restrictions; timber harvest and roads permitted.	None
u-7-028	Stone's Sheep	Specified area (SA1, SA2, SA3, and SA4). Range use restrictions; timber harvest and roads permitted.	None
u-7-029	Mountain Goat	No removal of forest cover within mountain goat winter range. All heli-logging within 2,000 m line-of-sight to UWR must take place July 15 – Oct 31. Within 500 m of core UWR harvesting must take place July 15 – Oct 31 (unless goat not present). All roads constructed within 500m must be decommissioned within 3 years following harvest.	No harvest
u-7-030	Mountain Goat	No removal of forest cover within mountain goat winter range. All heli-logging within 2,000 m line-of-sight to UWR must take place July 15 – Oct 31. Within 500 m of core UWR harvesting must take place July 15 – Oct 31 (unless goat not present). All roads constructed within 500m must be decommissioned within 3 years following harvest.	No harvest
WHAs	Caribou Migration Corridor	Finlay Herd (7-318), Wolverine Herd (7-244-7-248, 7-252), and Chase Herd (7-292-7-295, 7-313). For each migration corridor,	Max 35% on all CFLB area that is under 40 years (existing natural stands and NTHLB) or under 70 years

UWR/ WHA Tag	UWR Name	Legal Requirement	Modelling
		maintain max 35% of the CFLB under 40 years, if disturbed by natural events, and under 70 years if disturbed by logging.	(existing and future managed THLB)

Differences from TSR

In TSR, for UWRs u-7-001 and u-7-007, harvesting of 50% of the area was permitted only in decades 1, 6, 11, 16, 21, and 26, and 30, and decades 1, 8, 15, 22, and 29, respectively. In ISS, UWRs u-7-005, u-7-008, u-7-009, and u-7-017 are modelled identical in TSR and ISS. TSR did not include: u-7-025, u-7-028, u-7-029, u-7-030, or the Caribou Migration Corridor WHAs described at the bottom of Table 22.

2.2.6 First Nations cultural heritage and aboriginal interests

Within the Mackenzie TSA there are 10 First Nations. Many First Nations territories overlap, many of the First Nations have members within other communities, and a number of First Nations have partnerships with one another.

No modelling assumptions were made.

Differences from TSR

No differences.

2.3 HARVESTING ASSUMPTIONS

This section describes the criteria and considerations used to model timber harvesting activities.

2.3.1 Utilization Levels

The minimum merchantable timber specifications for all species and analysis units (natural and managed) are shown in Table 23.

Table 23 Utilization Levels

Leading Species	Minimum Stump diameter	Minimum Diameter at Breast Height	Maximum Stump Height	Minimum Top Diameter Inside Bark
Pine	15.0 cm	12.5 cm	30.0 cm	10.0 cm
All other	20.0 cm	17.5 cm	30.0 cm	10.0 cm

Differences from TSR

No differences.

2.3.2 Minimum Harvest Criteria

Stands need to meet certain criteria to be eligible for harvest within the model. Some stands that will never meet these requirements are removed from the timber harvesting land base (section 2.1).

All stands must have at least 151m³/ha to be harvested. On slopes <= 35%, dead pine is included in this 151m³/ha. On slopes > 35%, dead pine is not included in the volume calculations. Stands on slopes >=

46% need at least 250m³/ha to be eligible for harvest. Recall, MPB salvage does not occur on slopes >35% (pine-leading stands only).

Furthermore, the average harvest per ha of all stands over the entire land base is required to be at least 200 m³/ha per five year period. The model only harvests stands whose merchantable volumes meet these minimum thresholds.

Differences from TSR

No differences.

2.3.3 Harvest Priority

The harvest priorities refer to a range of reasons for which the harvest level should be controlled in the model. For example, certain units or areas need to be harvested first for salvage purposes or not harvested in order to achieve one (or more) non-timber objective. The Patchworks model uses a heuristic algorithm to balance the timber and non-timber objectives where the user can influence the weight of these objectives on the final solution. Typically, once the non-timber objectives are met, the oldest and poorest existing natural stands are harvested first because these stands have relatively low MAI and transition sooner to more productive managed stands. Thus, more will be available for harvesting sooner which increases the long term sustained yield. Moreover, harvesting oldest stands first reduces the time the THLB transitions to relatively regular state (i.e. equal areas/volumes in each age class).

In this analysis, harvest priorities were set as harvest partitions to address the MPB salvage for the duration of the salvage period (first 15 years of the planning horizon (year 2017-2032)). The assumption was that year 2011 was the last year of MPB significant disturbance level with a 22-year shelf-life (see section 2.4.3). Thus, by year 2032, all MPB killed volume on the land base becomes unsalvageable.

The harvest partitions during the MPB salvage period (year 2017-2032) were set as follows:

- At least 67% of the harvest must come from pine leading stands.
- The harvest generated by the non-pine leading coniferous stands does not exceed 950,000 m³/year, and 300,000 m³/year from the southwest portion of the TSA (i.e., west of Williston Reservoir and south of Omineca Park and Omineca Arm).

Other harvest partitions for the entire planning horizon were set as follows:

- Maximum 100,000 m³/year from deciduous-leading stands.
- Volume from Balsam-leading stands managed as an even-flow of 92,000 m³/year.

Once the salvage period is over, the model is allowed to explore as many options as possible to find the best possible solution while meeting all non-timber objectives. The harvest flow is developed so it does not decline below the pre-established even flow, it does not exceed ±10% per decade, and the long term harvest equals growth (i.e., in the last 100 years of the 300-year planning horizon, the THLB growing stock is flat or slightly increasing while the harvest flow is flat).

Differences from TSR

No differences for pine leading stands partition.

The volume from non-pine leading coniferous stands does not exceed 905,000 m³/year. No harvest partition for the southwest portion of the TSA.

No differences for other harvest partitions set for entire planning horizon.

2.3.4 Haul Distance Profile

Haul distance is assigned using a road network generated by combining road_segments and road_atlas. Each segment of road is given a speed based on its classification (Table 24). Potential future roads are created that follow major drainages and assigned a speed of 60km/hour. Finally, non-roaded land travel is assigned a speed of 10km/hour, and Williston Lake is considered unavailable for travel.

Table 24 Assumed speeds based on road class for a haul distance profile.

Road Class	Speed
-1 Highways	80 km/hr
1 Local Roads	40 km/hr
2 Mainlines	50 km/hr
3 Operational Roads	30 km/hr
4 In-block roads	10 km/hr

These roads were then segmented and a time to travel is assigned to each segment.

$$time = \frac{metres \cdot 3.6}{speed}$$

The cost data was converted to a raster dataset (20x20m pixel) and used as the input surface to the *cost distance tool* in ArcGIS[1] which provided the number of seconds to travel the fastest route between each pixel and the closest of 5 log dump locations or the Mackenzie mill site. To preferentially travel via road to Mackenzie rather than barge from a log dump, a 2.5 km buffer with a speed of 5km/hour is put around each dump site north of Mackenzie.

Cost allocation is run using the same inputs; this identifies which dump any given pixel was routed to. The end result is shown in Figure 4. Recall, in this analysis, the excessive haul distance was considered the forested area where haul cycle >5 hours.

[1] http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/how-the-cost-distance-tools-work.htm

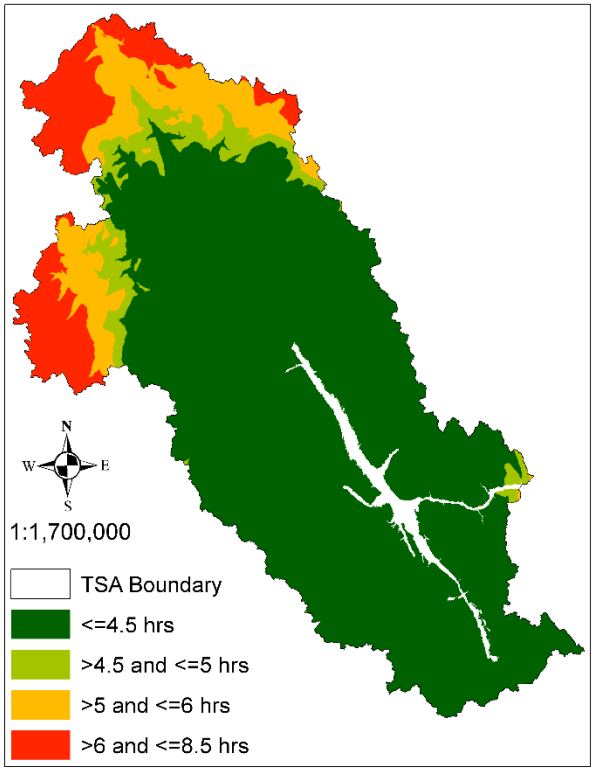


Figure 4 Haul cycle time zones

Differences from TSR

Excessive haul distance was defined in TSR as beyond 293 km away from Mackenzie (section 2.1.5).

2.3.5 Silvicultural Systems

Clearcut with reserves is assumed to be the silvicultural system used for all stand types within the Mackenzie TSA. The reserves are determined based on the retention levels determined in section 2.2.2.

Differences from TSR

No differences, except retention levels.

2.3.6 Patch Size Distribution

No patch sizes defined by logged stands younger than 20 years were modelled, except for Fox and Obo River LUs (section 2.2.1.1).

Differences from TSR

No differences

2.4 Growth and Yield Assumptions

Growth and yield assumptions describe how net volumes for natural and managed stands are developed and incorporated in the model. They also describe changes in other tree and stand attributes over time (e.g., height, tree diameters, presence of dead trees, etc.).

2.4.1 Analysis Unit Characteristics

Stands are grouped into analysis units (AU) to reduce the complexity and volume of information in the model and for assigning potential treatments and transitions to yield curves following harvest. Analysis units are based on state (existing natural, existing managed, and future managed), leading species, site index (based on current VRI site index distribution by THLB area), BEC zone, genetic gain era, and slope (Figure 5).

For stands impacted by the MPB, in addition to the previous criteria, current age of stand, MPB attack year, and stand percentage dead are also considered. The assumptions are as follows:

- MPB stands were considered all stands =>28 years, grouped by young MPB stands (age 28-64 years) and mature MPB stands (age =>65 years). Here, the age refers to the age in current year (2016) after all inventory updates were conducted (e.g., depletions).
- MPB attack year for mature stands was taken from VRI. There were no MPB records for attack year 2009. The MPB attack year for young stands was adopted from the TSR as being 2011.Using the attack year, an age of attack on the yield curve of each AU was determined (i.e., current age – (2016-attack year)). The age of attack was then used to reconstruct yield curves (section 2.4.3).
- Stand percentage dead was also taken from VRI. For each of the 9 levels of classification, an area weighted average was determined and used to reconstruct the yield curves.
- In the case of young stands, the MPB assumptions were adopted from the TSR. Young stands with ages between 28 and 32 had the stand percentage dead of 1.4% (applied to entire yield). The rest of the MPB young stands had 55% (age 33-42) and 70% (age 43-64) pine component mortalities. The pine component mortalities were applied only to the pine component of the stands.

Stands impacted by spruce beetle (IBS), were identified from aerial overview surveys conducted by BC Forest Health between 2014 and 2017. The assumptions are as follows:

- Three severity classes (i.e., percentage of trees killed by IBS in each polygon) were used in this analysis: Medium (M) 20% IBS mortality, Severe (S) 40% mortality, and Very Severe (VS) 60% mortality.
- Non-MPB existing natural stands were grouped in 5-year age classes (10-325 years).
- Non-MPB existing managed stands (pre-2000) were grouped into two age classes (17-23 and 24-29 yrs)
- MPB stands (existing natural and existing managed pre-2000) were not stratified any further, just a different AU series added.

The NHLB stands are grouped into AU 9,000 series by adding 9,000 to the existing natural or managed stands in the 100, 300, or 400 series. There are no MPB assumptions for the NHLB portion of the land base.

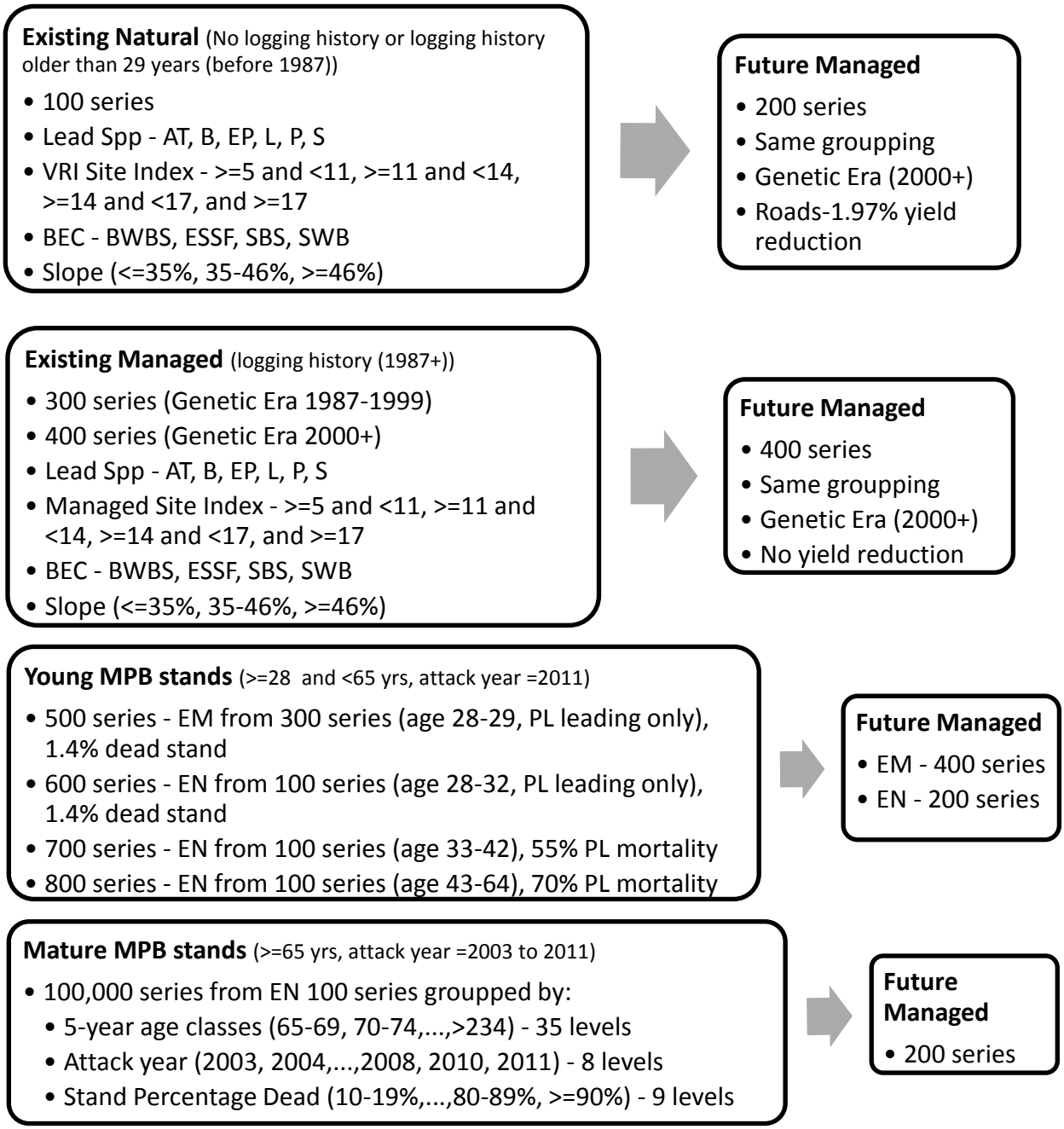
Finally, one analysis unit was assigned to all stands within the agricultural development and settlement reserve areas.

Overall, there were 19,745 different AUs (out of which 144 AUs described the NHLB).

Differences from TSR

BEC zone was not used to stratify AUs. Young MPB stands had identical assumptions. Mature MPB stands assumed attack year of 2005 for the southwest portion of the TSA, and 2009 for the rest of the TSA. The pine mortality (e.g., percentage of pine dead) was assumed 75% for all mature MPB stands

regardless the leading species. It was unclear if an age grouping occurred. The Forsite TSR Benchmark scenario assumed a 20-year age class split, in line with the assumptions for young MPB stands. No assumptions for IBS.



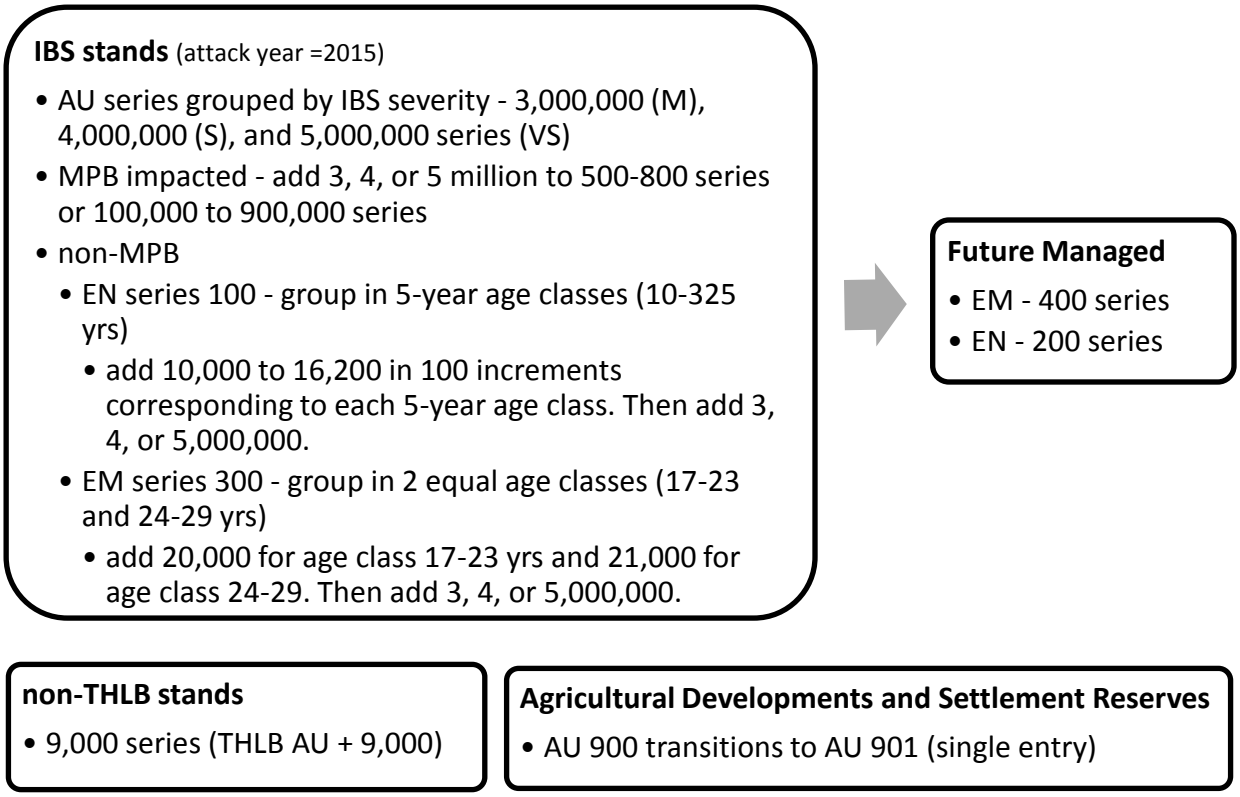


Figure 5 Analysis Units Assignment

2.4.2 Stand Projection Models

Yield curves developed for the forest estate model were prepared using the following stand projection models:

- Existing natural stands: Variable Density Yield Prediction (VDYP) 7 at a polygon level
    - Area-weighted averages for each AU
- Existing and future managed stands: Table Interpolation Program for Stand Yields (TIPSY) 4.3, modeled by AU (Appendix 3)

Differences from TSR

TSR applied VDYP 7 and TIPSY v4.2.

2.4.3 Yield Reductions

Reductions to the raw yields generated by VDYP and TIPSY were applied due to 6 factors:

1. Future roads yield reduction for future managed stands regenerated from existing natural stands (1.97%) (section 2.1.16),
2. Yield component associated with non-commercial species (willow and unknown) was removed from all existing natural stands,
3. Yield component associated with deciduous species was removed from all existing natural coniferous-leading stands,

4. Yield loss due to balsam beetle – the sub-alpine fir yield component was reduced by 28% in all existing natural sub-alpine fir leading stands older than 140 years,
5. Yield loss due to MPB (discussed below), and
6. Yield loss due to IBS (discussed below).

The assumptions adopted in this analysis to account for yield losses due to MPB are exemplified in Figure 6 and detailed in Table 25. Note that the age refers to the age of stands in current year (2016) after all inventory updates were conducted (e.g., depletions).

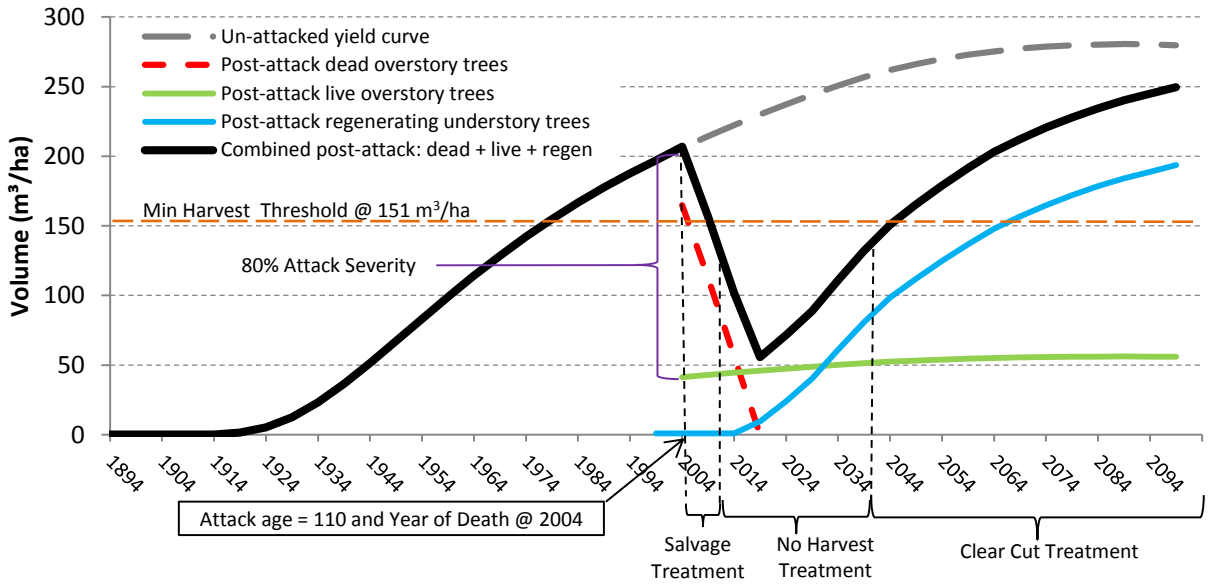


Figure 6 Example of how natural yields are impacted by MPB

Table 25 MPB Yield Reductions Methodology

Factor	Assumption
Shelf life curve	Y=17.5*EXP(0.079*X) where Y is the loss percentage and X is the post-MPB attack year (values 1 to 22). Starting in year 23 post MPB attack, the dead pine component is removed from the stand.
Live overstorey trees	Same natural yield curve as the original stand; yield reduced according to attack severity (i.e., area-weighted stand percentage dead for each AU).
Understorey regeneration	The understorey regeneration yields were developed for each AU without the stratification of the MPB factors. Only the leading species, site index, and BEC were used to stratify the regen yields for the MPB impacted stands. Ten years advanced regeneration was considered (i.e., regeneration layer yield (from age 10 on the yields curve) kicks in the MPB attack year). <u>Rationale:</u> The regen yield is not identical to the original yield impacted by MPB. Given the many stratification factors used to determine each AU (especially the age class), VDYP sample size cannot cover the entire age range in a typical yield curve (e.g., years 0-350). For example, the backward projection of old stands (e.g. older than 200 years) is not accurate. It was observed that in many cases there were no yield values for a good portion of the start of the yield curve (i.e., age 0 to 50). Similarly, the VDYP projection forward of the young stands is believed to be less accurate.

<table>
<tr><td></td><td></td></tr>
<tr><td>Young pine mortality (28-64 years)</td><td>
<table>
<tr><th>Age 2016</th><th>Attack Year</th><th>Attack Age</th><th>Pine Mortality</th><th>Stands</th></tr>
<tr><td>28-32</td><td>2011</td><td>25</td><td>1.4%</td><td>Pine leading</td></tr>
<tr><td>33-42</td><td>2011</td><td>33</td><td>55%</td><td>All stands</td></tr>
<tr><td>43-64</td><td>2011</td><td>48</td><td>70%</td><td>All Stands</td></tr>
</table>
Yield reduction not applied where VRI indicated no MPB disturbance. Attack age on the yield curve was determined by subtracting the difference between current year (2016) and attack year from the mid-point of the age class. Example: Age 2016 33-43, mid-point is 38, attack age is 38-(2016-2011) = 33 years.
</td></tr>
<tr><td>Mature pine mortality (>=65 years)</td><td>
• Age 2016 split in 35 x 5-year age classes (65-69, 70-74… 230-234, >234).
• 8 attack year (2003-2008, 2010-2011).
• Attack age on the yield curve was determined by subtracting the difference between current year (2016) and attack year from the mid-point of the age class.
  ○ Example: Age 2016 is 65-69, mid-point is 67, attack age is 67-(2016-2003) = 54 years.
  ○ Age >234, area-weighted average is determined for the age class mid-point.
• 9 stand percentage dead classes (10-19%, 20-29…80-89, >=90%).
  ○ Area weighted averages were calculated for each AU.
  ○ Percentage dead applied to entire original yield at attack age.
• Shelf life curve is applied for the next 22 years following MPB attack. It takes 22 years for the killed volume to become zero.
  ○ After the 22 years, any killed volume left is removed from the yield.
• Add understorey regeneration (match attack age on the original yield with age 10 on the understorey regeneration yield).
  ○ Understory regeneration yield reduced according to stand percentage dead removed by MPB.
</td></tr>
</table>

The assumptions adopted in this analysis to account for yield losses due to IBS include:

- IBS attack year was 2015. IBS kill age on the yield curve was mid-age class minus 1. Shelf life was assumed 5 years.
- At kill age, the spruce component (area-weighted spruce component for each AU * IBS severity) was killed and maintained for the entire shelf-life period. No decay curve was assumed for the killed IBS volume. IBS severities were 20% for M, 40% for S, and 60% for VS.
- Understorey regeneration was assumed to occur, the original yield (without MPB or IBS stratification) was added with a 10 year regeneration delay to each IBS stand corresponding to the IBS volume proportion removed.

Differences from TSR

Different MPB volume loss and shelf life assumptions. No regen was assumed in the case of the non-salvaged MPB stands (i.e., the dead MPB component was removed from the yield after the 15-year shelf life while the live component continued to grow in perpetuity without any emergence of understory regeneration). No IBS assumptions.

2.4.4 Decay, Waste, and Breakage

For natural stands, default reductions to stand volume for decay, waste and breakage factors are the provincial stand loss factors. These factors are applied in the developments of the VDYP7 yield curves.

For managed stands, operational adjustment factors (OAF) were applied. The OAF1 was set to 15% and OAF2 was set to 5%.

Differences from TSR

No differences.

2.4.5 Site Index Assignments

Managed stand site index reflects the potential productive capacity of a managed stand. The inventory site index was used as the site productivity input to develop yield curves for existing natural stands (Section 2.4.2) while the managed site index was used for existing and future managed stands.

For this analysis, site index for managed stands was calculated as area-weighted averages from provincial site productivity estimates. These estimates were based on SIBEC estimates and site series identified in the predictive ecosystem mapping (PEM) for Mackenzie TSA. A distribution of the site index by area is presented in Figure 7. It can be observed that the site index difference between natural and managed stands is 3.6m. This value is closer to the top end of the typical increase of 2-4m observed in other TSAs. One explanation is that so far, licenses have harvested only higher productive sites (i.e., average harvest > 200 m³/ha) which skewed the area-weighted average of currently existing managed stands on the THLB toward higher values. It is expected that the difference would decrease as more low productivity stands will be harvested.

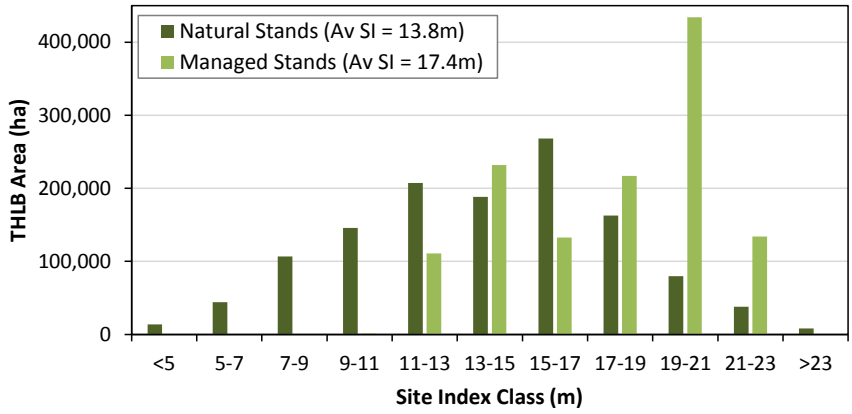


Figure 7 Distribution of natural and managed stand site indices over the THLB

Differences from TSR

No differences in the assumptions.

2.4.6 Not Satisfactorily Restocked

Not satisfactorily restocked (NSR) is defined as a forested area that does not have a sufficient number of well-spaced trees of desirable species. This definition does specify why the area is NSR (harvesting or natural disturbances) but does suggest that NSR areas require some remedy or consideration (i.e., it is not satisfactory).

Current NSR typically refers to stands recently disturbed (i.e., since 1987) that are not yet declared as being stocked while *backlog* NSR refers to stands disturbed prior to 1987 that are not declared as satisfactorily restocked.

Current NSR is not addressed in this analysis.

Differences from TSR

No differences in the assumptions.

2.4.7 Select Seed Use / Genetic Gain

The RESULTS data sources were queried to determine the regeneration practices post-1987. The query indicated that no genetic worth seedlots were used to regenerate stands pre-2000. The genetic worth values for post-2000 managed stands were pro-rated by the degree of deployment (e.g., if the genetic worth for a particular seedlot was 10% and genetically improved seedlings were used only half the time in the block, the genetic worth was prorated to 5%).

The pro-rating process indicated that the genetic worth applied in the post-2000 managed stands, ranged from 0.6-4.5% for the spruce component and 0-1% for the pine component. These values were included in the regeneration assumptions for each AU, and used to develop the yield curves (Appendix 3).

Differences from TSR

No differences in the assumptions.

2.4.8 Regeneration

Regeneration delay is the time between harvesting and establishment; either by planting or utilizing natural regeneration. The RESULTS data sources were queried to determine the regeneration practices post-1987. The query indicated that regeneration delay ranged between 1 and 2 years (Appendix 3).

Differences from TSR

No differences in the assumptions.

2.4.9 Fertilization

No fertilization assumptions were modelled in this analysis or the TSR.

2.4.10 Stands Impacted by Wildfires

No volume/yield reductions were modelled in this analysis or the TSR.

2.5 NATURAL DISTURBANCE ASSUMPTIONS

Natural disturbance assumptions define the extent and frequency of natural disturbances across the land base. Assumptions used to model disturbance within the THLB and NHLB are explained below.

2.5.1 Natural Disturbance within the THLB

Throughout the planning horizon, natural disturbance within the THLB are addressed as non-recoverable losses (NRL). These are estimates of annual volume losses resulting from catastrophic events such as insect epidemics, fires, wind damage or other agents.

Table 26 shows the NRL figures adopted from TSR 3 based on salvaged loss on the THLB. In these summaries, forest cover information was used to derive impacted merchantable volume within areas mapped in annual overview flights. NRLs for damaging agents were estimated as follows:

Table 26 Non-recoverable losses

Analysis Unit	Damaging Agent	Annual NRL (m^3/yr)
All	Fire	30,000
All	Wind	165,000
	Total	**195,000**

Modelling natural disturbance within the THLB involved removing the total NRL (195,000 m^3/yr) from the annual target harvest level.

Differences from TSR

No differences.

2.5.2 Natural Disturbance within Non-THLB

For this analysis, a constant area is disturbed annually within each LU and natural disturbance type (NDT). The area of disturbance varies based on the biogeoclimatic variants present, their associated natural disturbance intervals and old seral definitions, as outlined in the Biodiversity Guidebook (B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks, 1995). To reduce the number of modeled zones required, modeling disturbance is simplified BGC/NDT combinations for applying annual disturbances. Stands are randomly selected to account for these natural disturbance areas.

Using the negative exponential equation, the proportion of the forest that would typically occur as old seral forest can be calculated based on the disturbance interval (% area old = exp[-(old age / interval)]). Using this % area in old, the calculation of an effective rotation age associated with this seral distribution is possible (effective rotation age = interval / (1 – proportion old)). The effective rotation age can then be used to define an annual area of disturbance.

For example, ESSF variants in NDT1 have a disturbance interval of 350 years and an old definition of 250 years. This translates into a typical age class distribution where 49% of the area is “old” (>250 years) and the oldest stands are around 686 years. Thus, 1/686th of the area needs to be disturbed each year to maintain this age class distribution.

Table 27 shows the process used to determine the annual disturbance limits applied to the forested non-THLB by LU/NDT. Overall, approximately 0.37% of the NHLB is disturbed annually.

Table 27 Annual natural disturbance limits in the forested non-THLB by BGC Zone/NDT

BEC	NDT	Dist interval	Old def	%Area >OLD	Effective Rot Age	NHLB_ha	Annual Area disturbed
BWBS_Conif	NDT3	125	140	33%	186	340,559	1,831
BWBS_Decid	NDT3	100	100	37%	158	62,331	394
ESSF	NDT1	350	250	49%	686	198,582	289
ESSF	NDT2	200	250	29%	280	667,768	2,385
ESSF	NDT5	0	0	0%	0	68,832	0
SBS	NDT2	200	250	29%	280	86,134	308
SBS	NDT3	125	140	33%	186	126,055	678
SWB	NDT2	200	250	29%	280	450,431	1,609
Total						**2,000,692**	**7,494**

** % area old = exp (-[old age / disturbance interval]), Effective rotation age = old age / (1 – % area old)*

Differences from TSR

No assumptions for the NHLB, it was assumed as part of the non-recoverable losses.

2.6 MODELING ASSUMPTIONS

General assumptions were incorporated into the model to improve its efficiency or to produce results that are more realistic spatially. Table 28 summarizes the modelling assumptions employed in this analysis.

Table 28 Modelling assumptions

Criteria	Assumption
Minimum Polygon Size	Sliver polygons were merged with adjacent polygons based on their origin and size in order to maintain realistic shape of buffered features: **Origin** / **Size** Admin Boundaries and Large Polygons / <1,000 m^2 Forest Cover, Inventories / <100 m^2 Buffers (roads and utility, riparian) / <10 m^2
Maximum Polygon Size	Maximum polygon size within CFLB was limited to 20 ha to allow flexibility in creating patches and reduce operational complexity
Blocking	To improve modelling performance, resultant polygons were blocked (or grouped) where possible by maintaining the same AUs and 5-year age classes. The model was configured for a target harvest opening size of 20 ha. Distribution of opening sizes (i.e., patches) were controlled only for Fox and Obo River LUs.
Planning Horizon	A 300 year planning horizon was applied reported in 5-year increments (i.e., 60 periods).
Harvest Flow Objectives	○ First 15 years: At least 67% of the harvest must come from pine leading stands. The harvest generated by the non-pine leading coniferous stands does not exceed 950,000 m^3/year, and 300,000 m^3/year from the southwest portion of the TSA (i.e., west of Williston Reservoir and south of Omineca Park and Omineca Arm). ○ Mid-term: Minimized the depth and duration of the mid-term timber supply short-fall resulting from the MPB-pine mortality. ○ Long-term: Adjusted the long-term harvest flow until the harvest level reflected managed stand yields while producing growing stock that neither declined nor increased. ○ Entire planning horizon: Volume from deciduous leading stands capped at 100,000 m^3/year. Volume from sub-alpine fir leading stands modelled as even-flow at 92,000 m^3/year.

Differences from TSR

Unclear assumptions for minimum and maximum polygon sizes, and blocking. Planning horizon was 200 years, unclear the length of the planning period. The short term harvest flow objectives were to maintain the current AAC of 3.05 Million m^3/year while salvaging the MPB infested stands. During the salvage period, identical priority for pine stands, but slightly different for non-pine – 905,000 m^3/year. The deciduous and sub-alpine fir partitions were identical.

2.7 CARIBOU HABITAT ANALYSES

Caribou habitat analyses were conducted as a test case to assess the status of anthropogenic disturbance over time. Post-processing exercises were completed on the modelled results for the Wolverine and Chase caribou herd range and results were combined for both Mackenzie and Stuart TSAs. The post-processing exercises produced 'snapshots' of anthropogenic and natural disturbance status for 7 periods along the planning horizon (P0 – initial, P1 – 5 years, P2 – 10 years, P4 – 20 years, P10 – 50 years, P20 – 100 years, and P40 – 200 years). Anthropogenic disturbances (AD) included disturbed blocks <40 yrs old and permanent AD (e.g., camps, mines, and linear features - existing and future roads). The AD were buffered based on federal recovery strategy[2] methodology while the natural disturbances were not.

After an initial analysis (i.e., Base Case), the modelled timber harvesting within caribou herd boundaries was reduced in an attempt to maintain disturbance levels below the maximum disturbance target level of 35% over the planning horizon. In each of the 7 periods, caribou habitat analyses were completed and compared for both the Base Case and Caribou Sensitivity analyses, and for two versions of caribou herd boundaries (federal and provincial), accordingly:

1) **Assessed caribou habitat status and examined potential impacts on timber harvest from implementing maximum disturbance thresholds according to the federal recovery strategy within federal herd boundaries.**
    a) Buffer all linear features (roads, seismic, hydro lines, pipelines, etc.) and polygonal features <40 years old (cut-blocks, well pads, etc.) by 500m.
    b) Merge into an "anthropogenic disturbance" layer (AD).
    c) Determine the natural disturbances.
        i) In P0, fire history since 1976
        ii) In P1-P4, the last 40-year of fire history corresponding to each analyzed period, the THLB blocks harvested by the model, and the non-THLB disturbed areas (section 2.5) loaded into the model
        iii) In P10-P40, relative to the period in question, the THLB blocks harvested by the model in the last 40 years, and the non-THLB disturbed areas (section 2.5) in the last 40 years
        iv) The NRLs were determined to be 1% of the maximum target disturbance of 35%
    d) Assess disturbance levels for each herd and the impact on harvest rate when the maximum 35% disturbance level is achieved.
2) **Assessed caribou habitat status and examined potential impacts on timber harvest from implementing maximum disturbance thresholds according to the federal recovery strategy within provincial herd boundaries.** Same assumptions as for federal recovery strategy, except areas are different (Figure 8).

[2] Environment Canada. 2012. Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138 pp.

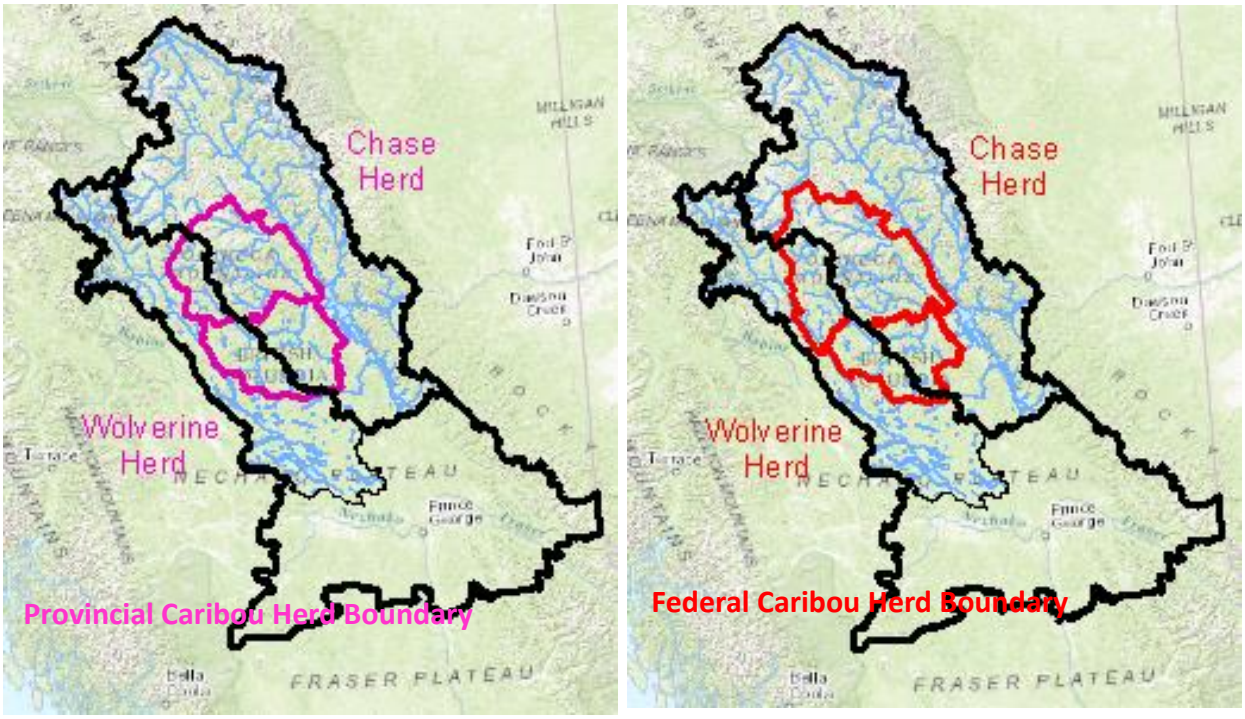


Figure 8 Federal and Provincial Herd Boundaries for Mackenzie and Stuart Project Areas

Separate from other scenarios examined in this project, these caribou habitat analyses were used to demonstrate caribou habitat disturbance levels over time using various methods.

Differences from TSR

TSR did not complete similar caribou habitat analyses.

2.8 ACCESS TIMING CONSTRAINTS

To promote a certain range of values and maximize long-term productivity, access timing constraints (ATC) zones were mocked up as a proof-of-concept exercise that prioritizes wilderness areas and key grizzly bear habitat. Within these ATC zones, harvesting was periodically deferred in order to maintain hunting and recreation opportunities, manage road usage, construction, and maintenance over time to reduce land base impacts, and maintain grizzly bear habitat.

For each of the 15 ATC zones identified (Table 29, Figure 9), the area allowed to be disturbed during one 5-year period, every 35 years, was set to a maximum 30% of the THLB. The first 5-year period to be disturbed was determined as follows:

- Run the model with no constraints on area to be harvested from each ATC zones.
- For each ATC zone, determine the period when cumulated harvested area is at least 30% of the THLB within the ATC zone (e.g., the cumulated harvested area from Gagnon ATC (Table 29) needs to be >= 162 ha). This is the first period where maximum harvested area target is set to 30%.
- For the next 30 years, the maximum harvested area target is set to zero, then the 30% maximum disturbance is set again. For example, if the first 5-year period to be disturbed is period 1 (or

model year 1-5), the next six 5-year periods (or 30 years) harvested area has to be zero. In period 7 (or model years 36-40), a minimum harvested area of 30% is set again.

- This cycle repeats throughout the 300-year (or sixty 5-year periods) planning horizon.

The ATC approach was modelled as a sensitivity analysis to explore the impact on harvest rates.

Table 29 Access Timing Constraint Criteria

ATC Location	THLB (ha)	Maximum one 5-year Period Disturbance Every 35 Years	
		% THLB	Area (ha)
Gagnon	541	30%	162
Gauvreau	2,850	30%	855
Hornway	6,985	30%	2,095
Ivor	990	30%	297
Jackfish_N	970	30%	291
Jackfish_S	1,206	30%	362
Mischinsinlika	2,601	30%	780
Mugaha	706	30%	212
Osilinka	498	30%	149
Ospika	658	30%	197
Pesika_E	708	30%	213
Pesika_W	512	30%	154
Tony	2,613	30%	784
Tutu	969	30%	291
Wasi	25	30%	7
Total	**22,831**		**6,849**

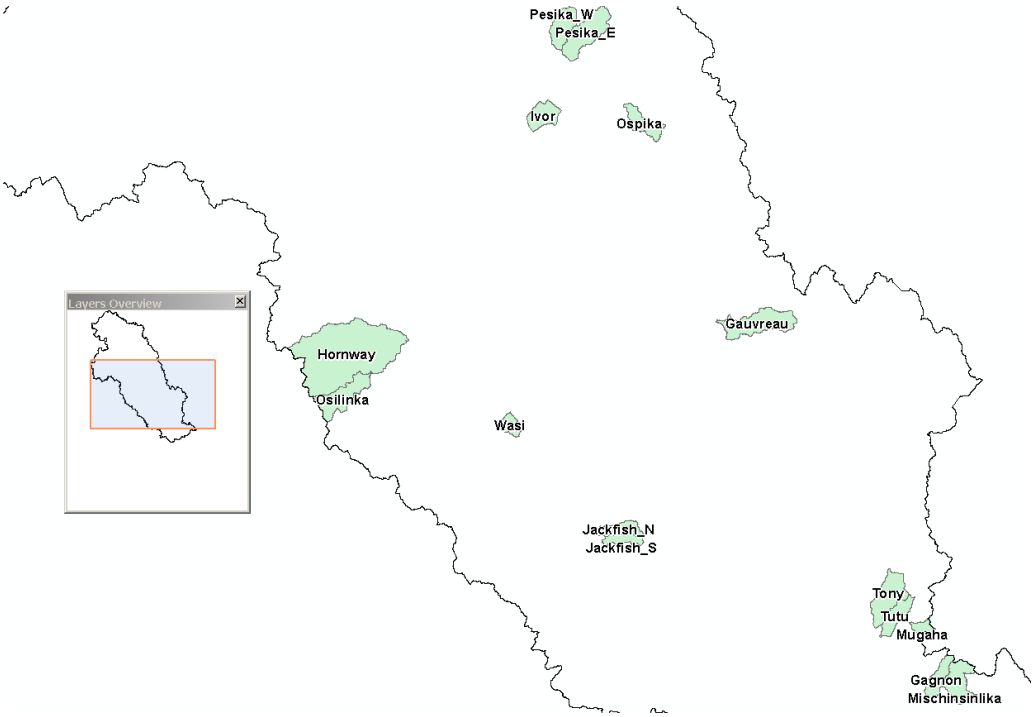


Figure 9 Location of ATC Zones

3 Reserves Scenario

The Reserves scenario is designed to address the question, "Where and how should we reserve forested stands to address landscape-level biodiversity and non-timber values while, wherever possible, minimizing impacts to the working forest?" It emphasizes various requirements to maintain non-timber values, as well as, practical issues to identify areas that are less or more attractive for timber harvesting. The reserve scenario examines additions or changes to assumptions associated with non-timber values that were built into the ISS Base Case Scenario. Recall, spatial OGMAs were only designated for some landscape units throughout the southern section of the Mackenzie TSA, while for the rest of TSA, the landscape level biodiversity objectives were addressed through non-spatial old growth orders. The underlying purpose of this scenario is to explore tactics aimed to maintain the harvest area while providing a wide range of values on the land base (i.e., co-location). This could be done by maximizing relative scores assigned across the land base for:

- old forests;
- rare sites/ecosystems;
- identified cultural interests; and
- wildlife habitat for selected species.

In accordance with the Chief Forester's guidance (FLRNO 2005), this scenario will also increase stand-level retention within forests attacked by mountain pine beetle.

The candidate reserves selected, guided by thresholds described in various stand- and landscape-level objectives, will meet multiple criteria and thresholds and can provide a preliminary spatial resultant to work from. However, it must be emphasized that these polygons **must first be confirmed and reconfigured by planners, and field checked before they can be considered spatial OGMAs**. Finally, the implementation in the Combined Scenario is to 'lock' these areas from harvesting for some period over the short term (e.g., 20 years). In this case, edge polygons identified to maintain forest interior thresholds will also be included with the candidate reserves.

3.1 APPROACH

Two options were considered for approaching this scenario:

1. Spatial exercise - static assessment at time 0 (current); then incorporate spatial results into the combined scenario; "pre-process" GIS assessment possibly including internal buffers for interior forest; because there was not enough time to undertake detailed assessments for each LU, a systematic approach was developed to score stands based on : a) existing anchors/constraints, and b) stand attributes (Figure 10).
2. Temporal exercise - incorporate scoring into the forest estate modelling exercise; possibly allow reserves to move across the land base through time.

For this first iteration of the ISS, the team elected to approach this scenario as a spatial exercise (i.e., no forest estate modelling) as a preliminary step towards possible future work, for example: a) spatially refine the polygons into temporary non-legal reserves (teams to review candidate reserves on a LU-by-LU basis); and apply scoring methodology into a forest estate model (temporal exercise) that will select reserves appropriately over the landscape and into the future (i.e., shifting locations but maintaining requirements).

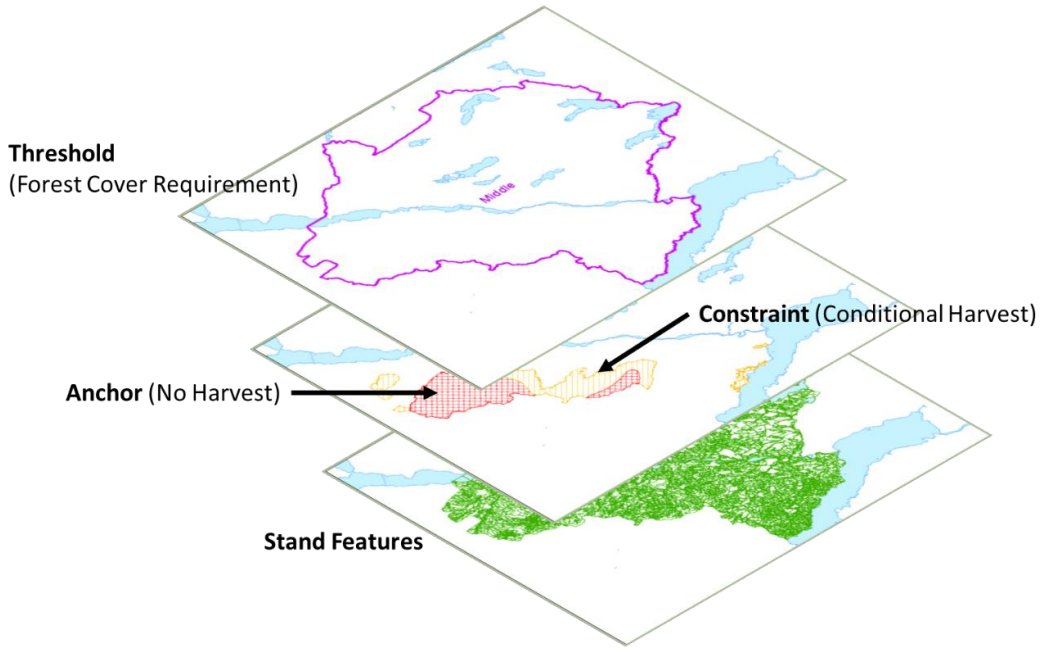


Figure 10 Cumulative Scoring of Reserve Criteria

A stand's total score, determined by the spatial exercise, is the sum of the anchor scores (number of overlapping anchors), constraint scores, and stand features. Stands are then sorted by their total scores – those with the highest values are the most desirable candidate reserves. Candidate reserves are selected through a forest modelling exercise that assesses the combined score for each stand relative to established one or more landscape-level thresholds. In this case, candidate reserves must address multiple thresholds. In addition, to maintain an appropriate spatial pattern for reserves, stands with higher scores are also grouped to accommodate patch size distribution criteria. This prevents the 'shot-gun' pattern that otherwise results if only the highest scoring stands are selected.

3.2 STAND FEATURES

The objective of stand features is to rank and score stands independently based on their ability to meet landscape biodiversity values (Table 30). The indicators are defined as the structural or functional ability of the stands to contribute to old growth attributes and any critical elements identified for retention. Once defined, the indicators are scored from -2 to 10 and summed up for each stand, independently from anchors and constraints. Negative values were used to account for undesirable characteristics (e.g., Pl-Leading).

Here is an example for scoring stand features: a stand in the old seral stage (9 points), that's non-pine leading (0 points), 26 m tall (3 points), with 25% deadwood (2 points) and a vertical complexity of 4 (2 points) has a total score of 16 points. Stand scoring may also consider/incorporate other criteria associated with forest resilience (e.g., site productivity; aspect; slope; fire risk).

Table 30 Stand Feature Scoring Matrix

Indicator	Rationale	Category	Score
Forest Management	Differentiate between anthropogenic and natural disturbances	Primary/Natural	5
		Managed/Harvested	0
Seral Stage	Overarching intent is to designate reserves in old seral stand types because they typically do not occur when	Young	1
		Mid	2

Indicator	Rationale	Category	Score
	forests are managed using economic rotation ages. Retaining old stands on the land base ensures habitat / biodiversity niches continue to exist. Seral stage is assigned to VRI polygons using age and BEC zone.	Mature	5
		Old	9
		Very Old (Old+50 yrs)	10
Species Composition	Non-pine leading or deciduous leading stands are higher contributors to biodiversity and old growth habitats. A higher diversity of species mix lends to a higher potential for biodiversity, however species mix will be to a certain extent captured in the rare ecosystem classification.	Deciduous-leading	3
		Mixed with cottonwood	6
		Mixed conifer (multiple/<50% leading species)	5
		Other conifer	1
		Douglas-fir leading	7
		Pine-leading (≥ 70%)	-1
Deadwood Abundance	Desirable stands consist of old, large, living and dead trees with coarse woody debris. Snags are an important contributor to biodiversity.	5 to 30% dead stems	2
		> 70% dead stems	-2
Vertical Complexity	Higher levels of vertical structure / complexity are linked with old growth stands.	4 – Non-Uniform	2
		5 – Very Non-Uniform	3
Tree Height	Connection between height, age and site productivity – taller trees for a given age can provide valuable habitat and recruitment for future snags.	≥ 20 < 25 m	2
		≥ 25 < 30 m	3
		≥ 30 m	4
Old / Mature Interior Forest	The quality of old growth habitat is affected by edge conditions versus old interior forest. Areas large enough to provide interior condition are preferred.		3

3.3 ANCHORS

Anchors are areas where timber harvesting is not permitted. The objective of anchors is to score existing resource management areas based on their overall suitability as a candidate reserve. Scoring based on an anchor's potential impact on timber availability, independently of the scoring matrices developed for stand features and constraints (Table 31). Each anchor is given a score of 10 (i.e., all anchors are considered equal as they represent no-harvest stands), then stands are scored based on the number of overlapping anchors (i.e., the more anchors occurring in a stand, the higher the total score). Note that additional anchors were identified, yet the data was not available for this analysis. The additional anchors with incomplete data were included here for consideration in a future iteration. Detailed criteria for scoring anchors and constraints are included in Appendix 4.

Table 31 Anchors Scoring Matrix

No.	Anchors Included	Mackenzie	Score
1	Parks and Protected Areas	All	10
2	Ecological Reserves	All	10
3	Ecological Reserve (Mugaha Marsh)	All	10
4	Spatial OGMAs	All	10
5	Riparian Management Areas	All	10
6	Inoperable – Terrain Slope Class 5	All	10
7	Cultural Heritage Resources (Arch Sites)	All	10
8	Wildlife Tree Retention	All	10
9	UWR Mountain Goat	u-7-004, (AP3, AP4, AP5, AP6), u-7-029, u-7-030	10
10	UWR Elk, Moose, Mountain Goat	u-7-017	10

No.	Anchors Included	Mackenzie	Score
11	UWR Northern Caribou	u-7-001, u-7-009 (PP-001, PP-002, PP-004), u-7-025 (core), u-9-002, u-9-004	10
12	UWR Stone's Sheep	u-7-006, u-7-028 (1-11)	10
13	WHA Mountain Goat	9-001	10
14	WHA Northern Caribou	9-035 to 9-040, 9-102, 9-103	10
15	Proposed WHA Northern Caribou	9-146	10
16	Draft WHA Northern Caribou	9-999	10
17	Draft WHA Northern Caribou (Chase-Wolverine) – Mar 9, 2017	Post-Rut	10
18	Draft WHA Northern Caribou (Chase-Wolverine) – Mar 9, 2017	Calving	10
19	Draft Amended WHA (Peace Northern Caribou) – May 16, 2017	High Elevation Summer Range High Elevation Winter Range	10
20	Draft WHA Bull Trout	All 5 Units	10
21	Draft WHA Fisher – Feb 27, 2017	7-012, 7-013, 7-014, 7-015, 7-016	10
22	Draft FSW	All	10
Anchors NOT Included at this time			
1	Identified First Nations Interests		
2	Recreation Sites and Trails (buffers)		
3	Research Sites		
4	Conservation Lands (Sec 16/17 Reserves)		
5	Karst		
6	Mineral Licks (Wildlife Habitat Feature)		
7	Rare ecosystems		
8	Water Intakes (50m buffer)		
9	Fisher Type 1 Habitat (Boreal)		
10	Fisher Rearing Habitat (SBS moist)		

3.4 CONSTRAINTS

Constraints are areas where timber harvesting is restricted (i.e., conditional harvesting). The objective of scoring constraints is to influence the selection of reserves within constrained areas – within required thresholds – thereby alleviating pressure on THLB elsewhere. Scoring is based on constraints' potential impact on timber availability, on a scale from 1 to 10, independently of the scoring matrices developed for stand features and anchors (Table 32). A stand's total score is the sum of all applicable constraint scores occurring over that stand (can have multiple overlapping constraints). Note that additional constraints were identified with the potential to be included in future iterations. Detailed criteria for scoring anchors and constraints are included in Appendix 4.

Table 32 Constraints Scoring Matrix

No.	Constraints	Mackenzie	Score
1	Non-Harvestable Land Base	Yes	**10**
2	UWR: Caribou Low Elevation	u-7-001, u-7-007	**4**
3	UWR: Caribou High Elevation	u-7-009 (PP-003), u-7-025 (SA), u-9-004	**3**
4	UWR: Elk	u-7-005, u-7-008	**4**
5	UWR: Mountain Goat	u-7-017 (AP1, AP2)	**3**
6	Draft WHA: Caribou - Migration Corridors	60 units (7-244 to 7-322)	**4**
7	Community Watersheds	Where Harvest Permitted	**5**

No.	Constraints	Mackenzie	Score
8	Draft Fisheries Sensitive Watersheds	Where Harvest Permitted	**2**
9	VQO: Preservation	Preservation	**10**
10	VQO: Retention	Retention	**8**
11	VQO: Partial Retention	Partial Retention	**4**
12	MPB Salvage Zones	Small, Medium, Large, Very Large	**6**
13	High value Fisher habitat	SBS and Boreal	**3**
14	Crown Reserve Notations	Fish & Wildlife Only	**7**
	Constraints NOT included at this time		
1	Mack RMZ: Agriculture/Settlement		
2	Mack RMZ: Enhanced		
3	Mack RMZ: General		
4	Mack RMZ: Special		
5	FSJ RMZ: Multi-Value		
6	FSJ RMZ: Protected		
7	FSJ RMZ: Resource Development		
8	FSJ RMZ: Settlement/Agriculture		
9	FSJ RMZ: Special Management		

3.5 ASSESSMENT UNITS AND THRESHOLDS

Assessment units and thresholds are used to establish when enough candidate reserves are selected. The assessment unit defines the spatial extent where specific thresholds apply. For consistency reasons, the BEC grouping defined for landscape-level biodiversity objectives (section 2.2.1) were adopted in this scenario. Additional options that could be used in future iterations include landscape unit, natural disturbance type, or watersheds.

The thresholds define the indicators and targets (i.e., objectives) to be maintained or enhanced through the scenario analysis. In modelling terms, these are typically forest cover requirements configured as target levels that the model seeks to achieve as (1) minimum or maximum levels, (2) units in percent or area, (3) over a given unit (i.e., Assessment Unit), and (4) across specified periods (not applicable for this reserve scenario). Thus, the landscape-level biodiversity objectives were adopted in this scenario as the assessment unit and thresholds (Table 33). Note that Table 33 includes the amended order from 2010, whereas the base case scenario (Appendix 1) did not. At the time of analysis, the base case scenario was developed with TSR assumptions – without the 2010 amendment – and was not refined due to budget and time constraints. Initial results indicated that landscape-level biodiversity objectives did not constrain the model. It can be argued that the amendment would not have a significant impact on the harvest rate, but on the spatial distribution of old stands. In addition, the reserve scenario results with the 2010 amendment will be incorporated into the combined scenario, which is the guiding scenario for this analysis.

Table 33 Landscape-Level Biodiversity Objectives (Amended 2010)

BEC Group	BEC Units	Old Def (yrs)	BEO/ RMZ *	Min % Old (of CFLB)	Min % of Old Interior (of the Old)	Landscape Unit or Group
1	ESSFmcp, ESSFmvp, SWBmksx, ESSFwcp3	≥140	n/a	n/a	n/a	n/a

BEC Group	BEC Units	Old Def (yrs)	BEO/ RMZ *	Min % Old (of CFLB)	Min % of Old Interior (of the Old)	Landscape Unit or Group
2	ESSFmc, ESSFmv, SWBmk	≥140	high	13	25	Connaghan Creek, Eklund, Jackfish, South Germansen-Upper Manson, Fox, LowAkie, LowPesika, Nina Creek, North Ingenika, Swannell, Obo River, Pelly, Selwyn, Thutade, Tutizza, Upper Ospika
			Int	9	25	Aiken, Clearwater, Discovery, Duckling, Gillis, Klawli, Ingenika, Lower Ospika, Nabesche, Parsnip, Pesika, Schooler, Twenty Mile, Philip Lake
			Low	9	10	Akie, Akie River, Blackwater, Buffalohead, Chunamon, Collins-Davis, Gaffney, Manson River, Germansen Mountain, Mesilinka, Misinchinka, Osilinka, Philip
3	ESSFwc3, ESSFwk2	≥140	high	28	50	Kennedy, Selwyn
				13	50	Upper Ospika
			Int	19	50	Clearwater, Lower Ospika, Morfee, Nabesche, Parsnip
			Low	19	25	Collins-Davis, Misinchinka
				9	25	Blackwater
4	SBSmk, SBSwk1	≥120	high	16	25	Connaghan Creek, Eklund, Jackfish, Nation, Selwyn, South Germansen-Upper Manson, Upper Ospika
				13	25	Kennedy
			Int	11	25	Gillis, Klawli, Lower Ospika, Morfee, Nabesche, Parsnip, Philip Lake, Tudyah B, Tudyah A
			Low	11	10	Blackwater, Chunamon, Collins-Davis, Gaffney, Manson River, Misinchinka, Osilinka, Philip
5	SBSvk, SBSwk2	≥140	High	16	25	Nation
				13	25	Connaghan Creek, Eklund, Jackfish, South Germansen-Upper Manson, Kennedy, Selwyn
			Int	9	25	Clearwater, Lower Ospika, Morfee, Nabesche, Parsnip
			Low	11	10	Buffalohead
				9	10	Collins-Davis, Gaffney, Manson River, Philip
6	BWBSmw1, BWBSwk2	≥140 conifer	high	16	25	Selwyn
			Int	11	25	Nabesche, Schooler
7	BWBSdk1	≥140 conifer	high	16	25	Connaghan Creek, Eklund, Jackfish, South Germansen, Upper Manson, Fox, LowAkie, LowPesika, Nina Creek, North Ingenika, Swannell, Obo River, Pelly, Thutade
				13	25	Tutizza
			Int	11	25	Aiken, Discovery, Duckling, Gillis, Klawli, Ingenika, Pesika, Twenty Mile
			Low	11	10	Akie, Akie River, Blackwater, Chunamon,

BEC Group	BEC Units	Old Def (yrs)	BEO/ RMZ *	Min % Old (of CFLB)	Min % of Old Interior (of the Old)	Landscape Unit or Group
						Collins-Davis, Mesilinka, Osilinka
				9	10	Germansen Mountain
6&7	BWBSmw1, BWBSwk2, BWBSdk1	≥100 decid	Special	19	25	Bluff Creek, Braid, Connaghan Creek , Eklund, Frog, Fox, Jackfish, LowAkie, Lower Pesika, Nina Creek, North Ingenika, Obo River, Pelly, Upper Manson, Tutizza, Upper Akie River, Upper Gataga, Upper Pelly
			General	13	25	Aiken, Gillis, Ingenika, Klawli, Nabesche, Pesika, Schooler , South Germansen, Swannell, Thutade, Twenty Mile, Discovery
			Enhanced	13	10	Akie, Akie River, Blackwater, Buffalohead, Chunamon, Collins-Davis, Duckling, Germansen Mountain, Mesilinka, Osilinka, Selwyn

Note: LUs within BEC Groups 6&7 are grouped by Resource Management Zones (RMZ) rather than BEO. LUs included in Special Resource Management Zones – Wildlands (approved Apr 08, 2009) with no targets – McCusker, North Firesteel, South Firesteel, Wicked River. All have BEO="High" but various BEC groups (2-5).

3.6 ANALYSIS STEPS

This scenario needed to assess reserves relative to multiple thresholds and group reserves into larger areas. This scenario was approached via a GIS exercise combined with spatially-explicit modelling via Patchworks™. The GIS exercise prepared the data needed for the modelling approach (seral stage, old forest, old interior, and scores) while the modelling approach aimed to maximize the cumulative score towards a target patch size distribution.

The following steps were employed for the GIS exercise:

- A copy of the 'resultant' spatial overlays from the ISS Base Case provided an initial dataset to work with.
- Additional spatial data, not required for the ISS Base Case, were added to the resultant:
  - Fisher habitat capability, and
  - Fish and wildlife reserve notations.
- Assessment criteria were then calculated as separate fields in the database:
  - assign seral stage; specifically to determine old seral forest, and
  - create interior old forest patches defined as the area of 'old forest' or 'natural forest area' buffered from younger age classes or disturbances (i.e., 200 m from adjacent stands >80 years/age class 5). The 200m buffer area of interior forest stands were maintained as edge buffer areas.
- Scores for stand features, anchors, and constraints were assigned to separate fields, then combined into additional fields. These were assigned as a script that accesses Excel spreadsheets recorded with the indicators and scores transferred from Table 30, Table 31, and Table 32.

The following steps were employed for the spatially-explicit modelling via Patchworks™:

- Product area accounts for the thresholds defined in section 3.5 (i.e., unique combinations of BEC group, BEO, and LU) were created to account for Old and Interior forest:
  - OLD,
  - OLD + Mature,
  - OLD + Mature + Mid, and
  - OLD + Mature + Mid + Young.
- Ratio accounts were developed for each of the product accounts (divided by total CFLB area within each BEC group, BEO, and LU combination). The minimum targets in Table 33 were set with decreasing weights from OLD. Here, preference is given to OLD area first, then recruiting from Mature, Mid, and finally from Young stands.
- To give priority first to the non-THLB stands, the non-THLB stands with anchor score >=10 were hard-coded so they will always be selected as candidate reserves. In addition, a product area for non-THLB was created and an unreachable minimum target area was set (e.g., 4 Million ha) with a soft weight. Here, priority to NHLB stands was given over THLB stands within same seral stage (e.g., if the model had to choose between an OLD THLB stand and an OLD non-THLB stand, the candidate reserve will be selected first from a non-THLB stand).
- To group candidate reserve stands, patch sizes and targets were set for the total product area account according to the table below. This rule set influences the model to create larger candidate reserves rather than many small polygons scattered throughout each assessment unit.

Area (ha)	Min %	Max %	Attractor
1-10		0	
10-100		10	
100-500			
500-1000	40		
1000-1500	30		
1500+			Yes

- A basic “maximize score” target was applied across the entire land base so that scores would accumulate as the model selected candidate reserves.

Unfortunately, Patchworks™ does not track interior forest dynamically as candidate reserves are selected. As described above, initially there were identified interior and edges, then influenced the model to maintain the interior forest thresholds. However, if polygons within edges that define the interior forest are not selected, then the interior forest is no longer ‘interior’. So, an additional assessment of the candidate reserves must be undertaken to confirm that the old forest interior thresholds are, in fact, maintained and identify where they are not.

4 Harvest Scenario

The Harvest scenario is designed to answer the question “Which stands should be prioritized for harvest/salvage in the short term (and what are the mid/long term consequences of not following this strategy)?” The underlying purpose of this scenario is to explore tactics aimed to improve timber harvesting opportunities by adding and changing harvest-related assumptions to the ISS Base Case scenario. Besides salvage, the harvest scenario has the potential to alleviate economic challenges related to harvest distribution shortcomings (e.g., species profile, haul distance). In this ISS iteration, the

Project Team identified 3 tactics to be explored: 1) minimum harvest criteria, 2) wildfire management, and 3) harvest priorities.

The minimum harvest criteria set for the ISS Base Case scenario remains unchanged (i.e., minimum 151 m^3/ha conifer on <46% slope; 250m^3/ha on slopes ≥46%; dead pine salvage only on slopes <36%; plus minimum average volume limit of 200 m^3/ha per period; exclude deciduous from all conifer-leading stands). The Project Team also considered, but not explored in this ISS iteration, adjusting the minimum harvest criteria in order to explore physical and economic operability limits such as steep terrain, timber quality and product profile, log delivery methods and hauling distances, and available facilities.

The wildfire management tactic aims to incorporate stand- and landscape-level wildfire management strategies to address the potential impact or risk of fire. Harvest is prioritized for those stands that are rated as extreme by the 2015 Provincial Strategic Threat Analysis (PSTA) – wildfire threat component dataset for Mackenzie TSA. The extreme fire threat rated stands cover approximately 135,000 ha THLB. The Project Team also considered, but not explored in this ISS iteration, the fire loss risk mitigation through landscape-level strategies (e.g., fuel breaks) and implement fire stocking standards within Wildland Urban Interface (WUI) designated areas.

The harvest priority tactic aims to influence the model prioritize or limit harvesting in certain areas, for certain stands/species, or for certain land base conditions. For the Harvest scenario, none of the harvest flow priorities set for the Base Case scenario are changing (section 2.6). However, in addition to the Base Case, the following features are modelled in the Harvest scenario:

- Access Timing Constraints.
- Control harvest opening sizes in each 5-year period without a harvest flow penalty (Table 34).
- Add a 'gentle' harvest priority for stand impacted by IBS.

Table 34 Harvest Scenario – Opening Size Targets

Size (ha)	Min %	Max %	Weight	Attractor
<20		0	10	
20-<50		0	1	
50-<100				
>=100				Yes

The Project Team also considered, but it was not explored in this ISS iteration, investigating the most logical and cost-effective timber harvest opportunities by incorporating key operational considerations (e.g., access or distance limitations), prioritize or limit stand types/locations according to expected returns (e.g., site index, haul distance, and terrain/harvest constraints), and assign targets for stands/analysis units to prioritize specific product profile distributions.

A sensitivity analysis is planned for the Harvest scenario to explore the effect of the harvest flow priorities (i.e., harvest partitions) (Table 28) on the mid-term harvest flow. Here, the harvest partitions are turned off and priority is given to MBP, IBS, and extreme fire threat rated stands.

5 Silviculture Scenario

The Silviculture Scenario is designed to answer the question, "Are there alternatives to current basic silviculture practices that would benefit future outcomes (both timber and non-timber)?" The underlying purpose of this scenario is to explore tactics aimed to enhance timber quantity and quality over the mid- and long-term, as well as, improve biodiversity, wildlife habitat, and cultural interests. In

addition, the Silviculture Scenario examines incremental silviculture investments that would best serve the TSA's future, given an expected government funding level of $3 million per year for the first 20 years of the planning horizon. In this ISS iteration, the Project Team identified 3 tactics to be explored: 1) rehabilitating MPB/IBS impacted stands, 2) fertilization, and 3) enhanced basic silviculture. Each of these tactics are detailed in Table 35.

Table 35 Silviculture Scenario Tactics

<table>
<tr><th>Tactic</th><th>Element</th><th>Description</th><th>Criteria</th></tr>
<tr><td rowspan="6">Rehabilitation of MPB/IBS impacted stands</td><td>Eligible Stands</td><td>Unlogged existing natural stands by the end of the salvage period</td><td>○ Conifer Leading
○ Slope <=35%
○ >=40% stand percentage dead
○ <=150m³/ha live volume at the end of salvage period, or live + dead volume during the salvage period
○ Stand Age >=40 yrs at time of MPB attack
○ BEC: SBS, ESSF
○ Inventory SI >=11</td></tr>
<tr><td>Timing</td><td>Period within the planning horizon</td><td>First 42 years</td></tr>
<tr><td>Treatment Response</td><td>Transition stands onto future managed stands as if harvested</td><td>Regular future AUs, or enhanced future AU (where stand eligibility overlaps)</td></tr>
<tr><td rowspan="3">Costs</td><td>Marginally Economic (>= 50m³/ha) - Harvest/Knockdown/Site Prep/Plant</td><td>$1,500/ha</td></tr>
<tr><td>Uneconomic (<50m³/ha) - Knockdown/Site Prep/Plant</td><td>$2,000/ha</td></tr>
<tr><td>Distance cost beyond 2 hrs (one way)</td><td>$50/ha each 2 hrs (one way)</td></tr>
<tr><td>Anticipated Issues</td><td>Access limitations (new road construction prohibitive)</td><td>N/A</td></tr>
<tr><td rowspan="5">Fertilization</td><td rowspan="2">Eligible Stands</td><td>Existing natural stands not impacted by MPB/IBS</td><td>○ Age 26 to 60
○ Sx + Pl >=80%
○ BEC: SBS, ESSF
○ Inventory SI >=14
○ Slope <= 35%</td></tr>
<tr><td>Existing managed stands not impacted by MPB/IBS</td><td>○ Age <=25
○ Sx + Pl >=80%
○ SBS, ESSF
○ Managed SI >=14
○ Slope <= 35%</td></tr>
<tr><td>Timing</td><td>Minimum and Maximum age defining opportunity window, for up to 4 applications, every 10 years</td><td><table><tr><th>Applications (every 10 yrs)</th><th>Age Window (yrs)</th></tr><tr><td>1</td><td>25 - 75</td></tr><tr><td>2</td><td>25 - 65</td></tr><tr><td>3</td><td>25 - 55</td></tr><tr><td>4</td><td>25 - 55</td></tr></table></td></tr>
<tr><td rowspan="2">Treatment Response</td><td>Growth increase 10 years after application (entire stand) – existing natural stands</td><td>10m³/ha for each application.</td></tr>
<tr><td>Growth increase 10 years after application (entire stand) – existing managed stands</td><td><table><tr><th>Applications (every 10 yrs)</th><th>Sx-Leading (m³/ha)</th><th>Pl-Leading (m³/ha)</th></tr><tr><td>1</td><td>17</td><td>17</td></tr><tr><td>2</td><td>36</td><td>34</td></tr><tr><td>3</td><td>57</td><td>49</td></tr></table></td></tr>
</table>

Tactic	Element	Description	Criteria
			4 | 76 | 64
		Transitions to future stands	Locked from harvesting, 10 years after last application.
	Costs	Fertilization costs for all stands	$450/ha for each application.
	Anticipated Issues	First Nations' concerns	
Enhanced Basic Silviculture	Eligible Stands	Existing natural and managed stands.	○ Leading Species: Pl, Sx ○ BEC: SBS, BWBS ○ SI (inventory or managed): PL stands >=17; Sx stands >=14
	Timing	Period within the planning horizon	First 40 years
	Treatment Response	Transition to future enhanced managed stands that remain enhanced after the 20-yr period	
		Regeneration method	100% planted
		Density	Increase to 1,700 stems/ha
		Genetic gains	No changes from current
		Regeneration delay	From 2yrs to 1yr
		OAF1	From 85% to 89%
	Costs	Incremental planting of trees sown with select seed	$385/ha
	Anticipated Issues	Currently lacks funding source; possibly operational cost allowance	

6 Combined Scenario

The Combined Scenario aims to guide the development, implementation, and monitoring of tactical plans over the first 20 years of the planning horizon. Key elements from all four scenarios – Base Case, Reserves, Harvest, and Silviculture – are included to provide an integrated strategy to this first iteration of the ISS process. Specific tactics and approaches are briefly summarized in Table 36.

Table 36 Tactics applied in the Combined Scenario

	Modelling Run	Approach
Base Case	New Tenures	○ Kwadacha FNWL removed from CFLB (section 2.1.1)
Base Case	Wildlife Habitat	○ Spatial delineation of approved, proposed, and draft habitat areas added to the resultant; adjusts landbase description (section 2.1.8).
Base Case	Riparian Reserves	○ Spatial delineation of riparian reserves and adjust landbase description (section 2.1.13).
Base Case	Watershed ECA	○ Monitor and/or implement a forest cover requirement within identified watersheds (section 2.2.4).
Base Case	Pine Beetle	○ Implement a number of assumptions for adjusting yields to reflect stand dynamics associated with MPB-impacted stands (section 2.4.3). ○ Implement a No Salvage Line around Williston Reservoir (a combination of distance from the Williston Lake and elevation) to reflect current operational reality. Here, rehabilitation treatments are given priority over the rest of the TSA. ○ Adjust wildlife tree retention based on opening size by implementing patch groups adjusted relative to the current distribution (section 2.2.2).

	Modelling Run	Approach
Base Case	Spruce Beetle	○ Implement a number of assumptions for adjusting yields (section 2.4.3). ○ Include Aerial Overview Surveys up to year 2017.
Base Case	Harvest Priority	○ Five partitions are set to prioritize harvest (pine-leading, non-pine-leading, go-north, deciduous, and balsam) (section 2.6). ○ Maximum 5-hours haul time (one way) to log dump or processing facility (section 2.6).
Reserve	Candidate Reserves	○ Include candidate reserves and implement access timing constraints that prevent these areas from being harvested over the first 40 years (section 3).
Harvest	Wildfire Management	○ Prioritize harvest on stands identified with wildfire risk as extreme (section 4). ○ Apply even higher weights and shorter period (i.e., 10 years) while accepting some impact to harvest flow.
Harvest	Harvest Priority	○ Control harvest opening sizes in each 5-year periods to spatially group harvested blocks into more realistic opening sizes (section 4). Add a new size classes (<1ha – maximum 0% and 1-5ha – maximum 5%) and accept up to 5% harvest flow impact in order to create better block shapes/location.
Silviculture	Combined Treatments	○ Maximize harvest flow with annual budget of $3 million on a combination rehabilitation, fertilization, and enhanced basic treatments (section 5). ○ Harvest flow target excludes volume recovered through rehabilitation but reports include this volume plus harvest by age class and state.

Appendix 1 Landscape Unit, Biodiversity Emphasis Option, and BEC Groups

LU	BEO	BEC Group	Area THLB (ha)		Area NHLB (ha)		Current Old (%)	Min Target Old (%)
			Total	Old	Total	Old		
Aiken	Intermediate	1	1	0	555	121	22	
Aiken	Intermediate	2	2,408	1,408	6,370	3,682	58	9
Aiken	Intermediate	7	2,724	1,889	1,603	1,441	77	11
Aiken	Intermediate	67	54	44	76	67	86	13
Akie	Low	1	80	3	3,236	1,464	44	
Akie	Low	2	8,295	5,290	33,803	23,921	69	9
Akie	Low	7	14,545	7,682	9,017	5,656	57	11
Akie	Low	67	2,770	1,304	1,301	660	48	13
Akie River	Low	1	4	2	1,000	378	38	
Akie River	Low	2	2,042	747	13,199	7,135	52	9
Akie River	Low	7	1,535	815	3,121	1,481	49	11
Akie River	Low	67	28	19	76	61	77	13
Blackwater	Low	1	23	20	83	37	54	
Blackwater	Low	2	14,250	6,870	4,543	3,034	53	9
Blackwater	Low	4	62,353	14,455	23,823	10,707	29	11
Blackwater	Low	5	44,914	6,654	11,589	3,392	18	9
Blackwater	Low	7	104	49	216	67	36	11
Blackwater	Low	67	0	0	19	1	6	13
Buffalohead	Low	1	65	13	4,176	1,809	43	
Buffalohead	Low	2	24,353	12,029	51,576	29,618	55	9
Buffalohead	Low	7	50,136	21,454	26,694	11,894	43	11
Buffalohead	Low	67	10,188	1,889	2,746	895	22	13
Chunamon	Low	1	125	10	2,712	1,015	36	
Chunamon	Low	2	29,387	16,864	44,642	28,149	61	9
Chunamon	Low	4	39,232	12,856	13,360	8,695	41	11
Chunamon	Low	5	6,681	2,220	2,055	1,011	37	9
Chunamon	Low	7	8,962	3,390	4,469	1,601	37	11
Chunamon	Low	67	2,206	423	352	103	21	13
Clearwater	Intermediate	1			593	119	20	
Clearwater	Intermediate	2	5,082	777	5,236	929	17	9
Clearwater	Intermediate	3	8,866	5,381	32,721	24,014	71	19

LU	BEO	BEC Group	Area THLB (ha)		Area NHLB (ha)		Current Old (%)	Min Target Old (%)
			Total	Old	Total	Old		
Clearwater	Intermediate	5	12,652	5,687	9,191	3,979	44	9
Collins - Davis	Low	1	381	101	7,738	3,981	50	
Collins - Davis	Low	2	18,639	8,920	31,566	19,716	57	9
Collins - Davis	Low	3	9,755	3,191	25,038	13,973	49	19
Collins - Davis	Low	4	18,426	5,662	3,948	1,629	33	11
Collins - Davis	Low	5	22,577	5,476	9,923	3,205	27	9
Collins - Davis	Low	7	6,674	2,697	3,872	2,342	48	11
Collins - Davis	Low	67	2,621	1,832	1,033	528	65	13
Connaghan Creek	High	1	4	2	209	124	59	
Connaghan Creek	High	2	1,859	852	2,505	1,491	54	13
Connaghan Creek	High	4	1,442	1,024	534	460	75	16
Discovery	Intermediate	1	1	0	484	127	26	
Discovery	Intermediate	2	2,249	927	4,445	2,217	47	9
Discovery	Intermediate	7	2,941	1,160	1,186	493	40	11
Discovery	Intermediate	67	36	22	15	3	48	13
Duckling	Intermediate	1	95	22	1,313	462	34	
Duckling	Intermediate	2	3,126	2,212	8,982	5,733	66	9
Duckling	Intermediate	7	4,648	2,070	2,025	1,307	51	11
Duckling	Intermediate	67	53	53	74	70	97	13
Eklund	High	1	11	10	384	376	98	
Eklund	High	2	6,127	4,447	6,987	6,172	81	13
Eklund	High	4	1,021	686	813	670	74	16
Eklund	High	5	827	347	393	226	47	13
Eklund	High	7	473	143	118	22	28	16
Eklund	High	67	7	0	9	4	22	19
Gaffney	Low	1	0	0	175	116	66	
Gaffney	Low	2	50,246	21,838	17,891	11,092	48	9
Gaffney	Low	4	48,053	14,935	16,937	11,465	41	11
Gaffney	Low	5	3,862	347	858	213	12	9
Germansen Mountain	Low	1	0	0	97	84	87	
Germansen Mountain	Low	2	3,007	1,574	2,876	2,082	62	9
Germansen Mountain	Low	7	581	80	217	62	18	9
Gillis	Intermediate	1			90	29	32	

LU	BEO	BEC Group	Area THLB (ha)		Area NHLB (ha)		Current Old (%)	Min Target Old (%)
			Total	Old	Total	Old		
Gillis	Intermediate	2	9,965	5,442	9,689	7,097	64	9
Gillis	Intermediate	4	100	27	129	127	68	11
Gillis	Intermediate	7	3,621	1,020	1,732	459	28	11
Gillis	Intermediate	67	90	49	39	27	59	13
Ingenika	Intermediate	1	29	2	1,958	815	41	
Ingenika	Intermediate	2	3,963	2,137	23,850	12,625	53	9
Ingenika	Intermediate	7	14,454	6,529	13,591	2,699	33	11
Ingenika	Intermediate	67	1,707	546	638	236	33	13
Jackfish	High	1	7	7	180	118	67	
Jackfish	High	2	1,745	1,151	1,875	1,118	63	13
Jackfish	High	4	22	4	96	78	70	16
Jackfish	High	7	5,210	2,112	3,276	1,309	40	16
Jackfish	High	67	414	299	493	485	86	19
Kennedy	High	3	1,275	815	11,351	10,339	88	28
Kennedy	High	4	126	78	139	108	70	13
Kennedy	High	5	613	172	4,847	1,035	22	13
Klawli	Intermediate	1	20	18	428	110	28	
Klawli	Intermediate	2	14,172	6,085	36,276	20,505	53	9
Klawli	Intermediate	4	3,509	1,234	10,199	4,160	39	11
Lower Akie	High	1	1	0	183	52	28	
Lower Akie	High	2	769	354	2,965	1,546	51	13
Lower Akie	High	7	6,608	3,613	2,929	1,142	50	16
Lower Akie	High	67	2,349	780	2,027	1,278	47	19
Lower Ospika	Intermediate	1	471	141	3,603	1,314	36	
Lower Ospika	Intermediate	2	13,880	4,669	23,539	7,344	32	9
Lower Ospika	Intermediate	3	6,920	4,309	7,365	4,217	60	19
Lower Ospika	Intermediate	4	12,710	5,174	7,545	2,673	39	11
Lower Ospika	Intermediate	5	4,738	2,110	1,356	432	42	9
Manson River	Low	2	4,609	2,916	3,989	3,450	74	9
Manson River	Low	4	6,142	2,996	4,193	2,573	54	11
Manson River	Low	5	146	62	1,147	715	60	9
Mesilinka	Low	1	21	13	3,837	2,297	60	
Mesilinka	Low	2	17,608	8,601	28,889	17,903	57	9

LU	BEO	BEC Group	Area THLB (ha)		Area NHLB (ha)		Current Old (%)	Min Target Old (%)
			Total	Old	Total	Old		
Mesilinka	Low	7	15,673	5,690	6,420	3,485	42	11
Mesilinka	Low	67	724	384	384	201	53	13
Misinchinka	Low	1			5	0	8	
Misinchinka	Low	3	8,967	7,402	22,482	20,346	88	19
Misinchinka	Low	4	5,497	1,002	4,859	1,860	28	11
Misinchinka	Low	5	17,584	7,399	9,202	6,884	53	9
Morfee	Intermediate	3	279	193	1,334	1,056	77	19
Morfee	Intermediate	4	1,799	767	737	430	47	11
Morfee	Intermediate	5	1,526	596	564	234	40	9
Nabesche	Intermediate	1	1,481	297	7,324	1,420	20	
Nabesche	Intermediate	2	9,739	5,519	12,677	7,275	57	9
Nabesche	Intermediate	3	17,218	10,119	24,679	11,132	51	19
Nabesche	Intermediate	4	3,033	434	1,503	190	14	11
Nabesche	Intermediate	5	6,530	2,421	6,047	2,156	36	9
Nabesche	Intermediate	6	6,286	1,737	2,858	943	29	11
Nabesche	Intermediate	67	43	0	127	0	0	13
Nation	High	4	8,375	3,006	3,005	1,390	39	16
Nation	High	5	520	0	199	10	1	16
Nina Creek	High	1	11	8	856	243	29	
Nina Creek	High	2	1,924	827	7,530	4,004	51	13
Nina Creek	High	7	2,758	791	1,999	852	35	16
Nina Creek	High	67	4	0	251	58	23	19
North Ingenika	High	1			250	73	29	
North Ingenika	High	2	4,255	2,891	10,795	5,289	54	13
North Ingenika	High	7	10,156	6,140	7,562	2,684	50	16
North Ingenika	High	67	2,710	1,371	789	291	48	19
Osilinka	Low	1	196	112	6,664	4,361	65	
Osilinka	Low	2	40,405	24,260	64,046	50,409	71	9
Osilinka	Low	4	805	407	381	285	58	11
Osilinka	Low	7	20,656	8,067	10,853	6,910	48	11
Osilinka	Low	67	761	298	475	234	43	13
Parsnip	Intermediate	1			324	189	58	
Parsnip	Intermediate	3	7,490	5,606	40,422	34,778	84	19

LU	BEO	BEC Group	Area THLB (ha)		Area NHLB (ha)		Current Old (%)	Min Target Old (%)
			Total	Old	Total	Old		
Parsnip	Intermediate	4	12,193	3,308	2,915	1,366	31	11
Parsnip	Intermediate	5	13,164	5,698	9,241	5,538	50	9
Pelly	High	1	114	22	3,741	1,759	46	
Pelly	High	2	7,225	4,406	30,605	16,497	55	13
Pelly	High	7	7,241	3,746	8,426	3,561	47	16
Pelly	High	67	367	174	245	86	42	19
Pesika	Intermediate	1	29	6	3,224	1,158	36	
Pesika	Intermediate	2	3,837	1,327	22,171	8,938	39	9
Pesika	Intermediate	7	4,086	1,095	3,096	637	24	11
Pesika	Intermediate	67	476	354	551	127	47	13
Philip	Low	2	45,050	15,075	9,078	4,352	36	9
Philip	Low	4	83,573	23,399	16,801	6,843	30	11
Philip	Low	5	4,268	349	721	47	8	9
Philip Lake	Intermediate	2	3,221	1,070	695	403	38	9
Philip Lake	Intermediate	4	5,296	1,773	1,297	778	39	11
Schooler	Intermediate	1	94	37	3,146	857	28	
Schooler	Intermediate	2	7,124	2,667	25,138	9,803	39	9
Schooler	Intermediate	6	7,076	1,133	7,295	917	14	11
Schooler	Intermediate	67	227	9	579	8	2	13
Selwyn	High	1			168	159	95	
Selwyn	High	2	41	4	89	0	3	13
Selwyn	High	3	1,440	993	10,784	8,137	75	28
Selwyn	High	4	506	220	514	131	34	16
Selwyn	High	5	10,187	2,497	8,484	1,931	24	13
Selwyn	High	6	2,381	122	1,890	97	5	16
Selwyn	High	67	73	1	74	0	1	13
South Germansen - Upper Manson	High	1			1	1	100	
South Germansen - Upper Manson	High	2	4,666	2,844	2,544	1,750	64	13
South Germansen - Upper Manson	High	4	696	691	361	359	99	16
South Germansen - Upper Manson	High	7	3,888	998	1,845	446	25	16
South Germansen - Upper Manson	High	67	146	40	97	43	34	13
Swannell	High	1	7	7	1,642	759	46	
Swannell	High	2	3,054	1,590	16,959	9,952	58	13

LU	BEO	BEC Group	Area THLB (ha)		Area NHLB (ha)		Current Old (%)	Min Target Old (%)
			Total	Old	Total	Old		
Swannell	High	7	862	131	711	188	20	16
Swannell	High	67	5	5	6	6	100	13
Thutade	High	1	735	387	23,066	13,015	56	
Thutade	High	2	17,312	11,600	73,210	53,638	72	13
Thutade	High	7	2,068	1,312	2,798	2,011	68	16
Thutade	High	67	4	0	34	24	64	13
Tudyah A	Intermediate	4	3,564	1,074	755	359	33	11
Tudyah B	Intermediate	4	2,184	527	980	560	34	11
Tutizza	High	1	0	0	527	434	82	
Tutizza	High	2	5,664	4,317	8,106	6,348	77	13
Tutizza	High	7	593	263	400	284	55	13
Tutizza	High	67	4	0	11	8	55	19
Twenty Mile	Intermediate	1	48	34	257	207	79	
Twenty Mile	Intermediate	2	5,100	3,233	5,816	4,407	70	9
Twenty Mile	Intermediate	7	1,883	321	1,424	295	19	11
Twenty Mile	Intermediate	67	8	8	46	46	100	13
Upper Ospika	High	1	56	24	1,950	1,205	61	
Upper Ospika	High	2	5,253	4,804	11,651	9,489	85	13
Upper Ospika	High	3			8	5	60	13
Upper Ospika	High	4	1,699	1,661	908	671	89	16
Total			**1,178,009**	**477,441**	**1,265,919**	**728,314**	**49**	

Note: NDT5 is not included here. Thus, CFLB area reported in Table 2does not match with the grand total values. Yellow highlighted represent objectives that were not modelled in order to increase the modelling efficiency – these objectives include sufficient amount of NHLB to meet the old seral target, or have little THLB area, or they represent small-size reporting units with little impact on the harvest level. The performance of the non-modelled objectives was tracked – the results indicated that the yellow highlighted targets were not violated.

Appendix 2 ***Watersheds***

Source	Watershed, Basin or Sub-basin	Total Area (ha)	CFLB (ha)	Non-Forest (ha)	Private (ha)	AD (ha)	Max ECA (%)	Max ECA (ha)	New Max ECA (%)
Mackenzie LRMP	BlackwaterCreek	17,199	11,977	4,923	0	298	Report Only	N/A	N/A
Mackenzie LRMP	EklundCreek	6,964	4,961	1,892	0	110	Report Only	N/A	N/A
Mackenzie LRMP	GermansenRiver	22,918	17,997	4,317	185	358	Report Only	N/A	N/A
Mackenzie LRMP	MansonCreek	20,331	15,876	4,216	43	182	Report Only	N/A	N/A
Watershed Reserve	MorfeeCreek	7,185	2,692	1,212	2,182	371	Report Only	N/A	N/A
Mackenzie LRMP	StrandbergCreek	18,308	13,301	3,936	525	371	Report Only	N/A	N/A
Draft FSW	f_7_024_WAT_DavisRiver	48,272	33,402	14,816	0	54	Report Only	N/A	N/A
Draft FSW	f_7_025_WAT_ChowikaCreek	47,794	26,598	21,138	0	58	Report Only	N/A	N/A
Draft FSW	f_7_026_WAT_SwannellRiver	105,342	53,783	51,063	15	476	20	21,068	38
Draft FSW	f_7_027_WAT_McConnellAttichikaCreek	62,239	22,093	40,002	0	144	20	12,448	56
Draft FSW	f_7_028_WAT_FredricksonCreek	46,410	9,242	37,168	0	0	20	9,282	100
Draft FSW	f_7_029_WAT_PortionsofKwadachaRiver	243,829	70,853	172,823	102	14	20	48,766	69
Draft FSW	f_7_030_WAT_PortionsofFoxRiver	185,251	91,712	93,422	6	106	20	37,050	40
Draft FSW	f_7_031_WAT_ScottCreek	21,047	14,024	6,758	121	103	20	4,209	28
Draft FSW	f_7_032_WAT_PointCreek	9,959	3,712	6,183	0	64	20	1,992	52
Draft FSW	f_7_033_BAS_HoneymoonCreek	1,670	1,066	599	3	1	30	501	47
Draft FSW	f_7_033_BAS_MisinchinkaTributary1	512	494	15	0	3	30	154	30
Draft FSW	f_7_033_BAS_MisinchinkaTributary1aboveH60	3,340	2,323	1,017	0	0	20	668	29
Draft FSW	f_7_033_BAS_OldFriendCreek	2,483	1,251	1,232	0	0	30	745	60
Draft FSW	f_7_033_BAS_TrappersCreek	1,741	1,492	212	3	33	30	522	33
Draft FSW	f_7_033_BAS_UpperMisinchinka	7,097	4,966	2,079	0	52	30	2,129	42
Draft FSW	f_7_033_SUB_DeclierCreek	3,077	1,755	1,220	36	54	30	923	47
Draft FSW	f_7_033_SUB_MisinchinkaTributary2	288	278	0	0	10	30	86	28
Draft FSW	f_7_033_SUB_MisinchinkaTributary2AboveH60	2,328	1,589	739	0	0	20	466	29
Draft FSW	f_7_033_SUB_MisinchinkaTributary3	3,640	2,272	1,365	0	2	30	1,092	48
Draft FSW	f_7_033_SUB_StackCreek	1,847	842	1,002	0	4	30	554	65
Draft FSW	f_7_033_SUB_UpperMisinchinka	8,673	4,148	4,525	0	0	30	2,602	63
Draft FSW	f_7_033_WAT_MisinchinkaRiver	23,506	18,322	4,523	165	442	30	7,052	35
Draft FSW	f_7_035_SUB_LowerEastKlawliAboveH60	3,902	3,426	471	0	4	25	976	28
Draft FSW	f_7_035_SUB_TributarytoKlawliLakeaboveH60	1,651	1,269	382	0	0	25	413	33
Draft FSW	f_7_035_WAT_KlawliRiver	56,458	44,310	11,729	0	420	Report Only	N/A	N/A

Source	Watershed, Basin or Sub-basin	Total Area (ha)	CFLB (ha)	Non-Forest (ha)	Private (ha)	AD (ha)	Max ECA (%)	Max ECA (ha)	New Max ECA (%)
Draft FSW	f_7_038_BAS_BraathenCreekAboveH60	2,560	2,247	314	0	0	20	512	23
Draft FSW	f_7_038_BAS_FastCreekAboveH60	3,467	3,151	317	0	0	20	693	22
Draft FSW	f_7_038_WAT_ColbourneCreek	5,232	4,525	378	164	109	30	1,570	29
Total		**996,520**	**491,950**	**495,989**	**3,550**	**3,841**		**156,472**	

Appendix 3 TIPSY Regeneration Assumptions

AU	Description	BEC	SPH	Regen Delay	OAF1	OAF2	Species Composition	SI Spp1	GW Spp1	SI Spp2	GW Spp2	SI Spp3	GW Spp3
200	FM_AT_8_BWBS	BWBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	16.64	3.1	12.24		19.80	1
201	FM_AT_13_BWBS	BWBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	17.19	3.1	13.09		21.25	1
202	FM_AT_15_BWBS	BWBS	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	17.21	0.4	20.70	1.2	12.58	
203	FM_AT_17_BWBS	BWBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	17.61	0.7	20.74	0.6	12.46	
204	FM_B_8_BWBS	BWBS	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	20.57	4.5	15.65		12.85	
205	FM_B_13_BWBS	BWBS	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	19.45	4.5	16.19		13.27	
206	FM_B_15_BWBS	BWBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	20.60	4.2	16.23	0.1	13.83	
207	FM_B_17_BWBS	BWBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	23.08	4.2	16.12	0.1	12.73	
208	FM_EP_8_BWBS	BWBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	17.23	3.1	14.80		22.96	1
209	FM_EP_13_BWBS	BWBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	17.43	3.1	14.70		22.91	1
210	FM_EP_15_BWBS	BWBS	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	18.27	0.4	22.80	1.2		
211	FM_EP_17_BWBS	BWBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	18.31	0.7	22.98	0.6		
216	FM_P_8_BWBS	BWBS	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	17.05		23.34	2.3	13.89	
217	FM_P_13_BWBS	BWBS	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	17.07		22.66	2.3	13.67	
218	FM_P_15_BWBS	BWBS	1,287	1	0.85	0.95	Pl73 Sw22 Bl5	17.06	0.2	21.86	2.8	13.33	
219	FM_P_17_BWBS	BWBS	1,231	1	0.85	0.95	Pl71 Sw26 Bl3	17.13	0.1	21.60	2.5	13.28	
220	FM_S_8_BWBS	BWBS	1,331	1	0.85	0.95	Sw48 Pl40 Bl12	21.10	2.8	16.32	0.1	13.16	
221	FM_S_13_BWBS	BWBS	1,221	2	0.85	0.95	Sw54 Pl30 Bl16	20.88	1.6	16.73	0.1	13.29	
222	FM_S_15_BWBS	BWBS	1,226	1	0.85	0.95	Sw49 Pl39 Bl12	20.84	3.8	16.96	0.4	13.50	
223	FM_S_17_BWBS	BWBS	1,237	1	0.85	0.95	Pl48 Sw45 Bl7	17.42	1	20.99	4.1	13.81	
225	FM_AT_8_ESSF	ESSF	1,436	1	0.85	0.95	Pl52 Bl32 Se16	15.87	3.1	13.35		12.09	1
226	FM_AT_13_ESSF	ESSF	1,436	1	0.85	0.95	Pl52 Bl32 Se16	16.49	3.1	14.24		12.99	1
227	FM_AT_15_ESSF	ESSF	1,413	1	0.85	0.95	Pl58 Se40 Bl2	16.29	0.4	12.99	1.2	13.98	
228	FM_AT_17_ESSF	ESSF	1,382	1	0.85	0.95	Pl78 Se20 Bl2	16.84	0.7	13.80	0.6	14.65	
229	FM_B_8_ESSF	ESSF	1,311	1	0.85	0.95	Se44 Pl30 Bl26	12.65	4.5	16.06		13.87	
230	FM_B_13_ESSF	ESSF	1,311	1	0.85	0.95	Se44 Pl30 Bl26	13.49	4.5	16.50		14.47	
231	FM_B_15_ESSF	ESSF	1,168	1	0.85	0.95	Se55 Pl27 Bl18	13.75	4.2	16.74	0.1	14.68	
232	FM_B_17_ESSF	ESSF	1,168	1	0.85	0.95	Se55 Pl27 Bl18	13.86	4.2	16.78	0.1	14.86	
233	FM_EP_8_ESSF	ESSF	1,436	1	0.85	0.95	Pl52 Bl32 Se16	17.00	3.1	14.80			1
234	FM_EP_13_ESSF	ESSF	1,436	1	0.85	0.95	Pl52 Bl32 Se16	17.00	3.1	14.70			1
235	FM_EP_15_ESSF	ESSF	1,413	1	0.85	0.95	Pl58 Se40 Bl2	19.30	0.4	15.00	1.2	16.50	
236	FM_EP_17_ESSF	ESSF	1,382	1	0.85	0.95	Pl78 Se20 Bl2	15.20	0.7	11.10	0.6	13.50	

AU	Description	BEC	SPH	Regen Delay	OAF1	OAF2	Species Composition	SI Spp1	GW Spp1	SI Spp2	GW Spp2	SI Spp3	GW Spp3
241	FM_P_8_ESSF	ESSF	1,204	1	0.85	0.95	Pl53 Se40 Bl7	16.26		13.12	2.3	14.23	
242	FM_P_13_ESSF	ESSF	1,204	1	0.85	0.95	Pl53 Se40 Bl7	16.26		12.99	2.3	14.18	
243	FM_P_15_ESSF	ESSF	1,287	1	0.85	0.95	Pl73 Se22 Bl5	16.39	0.2	13.10	2.8	14.29	
244	FM_P_17_ESSF	ESSF	1,231	1	0.85	0.95	Pl71 Se26 Bl3	16.80	0.1	13.52	2.5	14.73	
245	FM_S_8_ESSF	ESSF	1,331	1	0.85	0.95	Se48 Pl40 Bl12	13.33	2.8	16.35	0.1	14.30	
246	FM_S_13_ESSF	ESSF	1,221	2	0.85	0.95	Se54 Pl30 Bl16	13.73	1.6	16.65	0.1	14.66	
247	FM_S_15_ESSF	ESSF	1,226	1	0.85	0.95	Se49 Pl39 Bl12	13.93	3.8	16.85	0.4	14.87	
248	FM_S_17_ESSF	ESSF	1,237	1	0.85	0.95	Pl48 Se45 Bl7	17.12	1	14.06	4.1	15.14	
250	FM_AT_8_SBS	SBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	19.46	3.1	17.02			1
251	FM_AT_13_SBS	SBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	19.72	3.1	17.23		19.78	1
252	FM_AT_15_SBS	SBS	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	19.85	0.4	21.01	1.2	17.20	
253	FM_AT_17_SBS	SBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	20.17	0.7	20.10	0.6	17.42	
254	FM_B_8_SBS	SBS	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	18.46	4.5	18.46		16.23	
255	FM_B_13_SBS	SBS	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	18.74	4.5	18.74		16.47	
256	FM_B_15_SBS	SBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	19.21	4.2	19.21	0.1	16.77	
257	FM_B_17_SBS	SBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	19.58	4.2	19.58	0.1	16.98	
258	FM_EP_8_SBS	SBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	20.10	3.1	16.90			1
259	FM_EP_13_SBS	SBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	20.20	3.1	16.76			1
260	FM_EP_15_SBS	SBS	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	20.14	0.4		1.2	17.05	
261	FM_EP_17_SBS	SBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	20.23	0.7		0.6	17.45	
266	FM_P_8_SBS	SBS	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	19.19		22.80	2.3	16.87	
267	FM_P_13_SBS	SBS	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	19.39		20.57	2.3	16.92	
268	FM_P_15_SBS	SBS	1,287	1	0.85	0.95	Pl73 Sw22 Bl5	19.32	0.2	20.34	2.8	16.84	
269	FM_P_17_SBS	SBS	1,231	1	0.85	0.95	Pl71 Sw26 Bl3	19.59	0.1	20.50	2.5	17.02	
270	FM_S_8_SBS	SBS	1,331	1	0.85	0.95	Sw48 Pl40 Bl12	21.06	2.8	18.98	0.1	16.62	
271	FM_S_13_SBS	SBS	1,221	2	0.85	0.95	Sw54 Pl30 Bl16	21.28	1.6	19.19	0.1	16.81	
272	FM_S_15_SBS	SBS	1,226	1	0.85	0.95	Sw49 Pl39 Bl12	21.01	3.8	19.44	0.4	16.84	
273	FM_S_17_SBS	SBS	1,237	1	0.85	0.95	Pl48 Sw45 Bl7	19.82	1	21.30	4.1	17.14	
275	FM_AT_8_SWB	SWB	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	15.70	3.1				1
276	FM_AT_13_SWB	SWB	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	15.70	3.1	13.50		20.50	1
277	FM_AT_15_SWB	SWB	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	15.40	0.4	20.06	1.2	13.20	
278	FM_AT_17_SWB	SWB	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	15.40	0.7		0.6		
279	FM_B_8_SWB	SWB	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	14.56	4.5	13.94		11.33	
280	FM_B_13_SWB	SWB	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	22.01	4.5	15.19		12.54	

AU	Description	BEC	SPH	Regen Delay	OAF1	OAF2	Species Composition	SI Spp1	GW Spp1	SI Spp2	GW Spp2	SI Spp3	GW Spp3
281	FM_B_15_SWB	SWB	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	15.65	4.2	15.65	0.1	13.35	
282	FM_B_17_SWB	SWB	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	22.40	4.2	16.18	0.1	13.39	
291	FM_P_8_SWB	SWB	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	14.71		21.57	2.3	10.88	
292	FM_P_13_SWB	SWB	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	14.68		21.92	2.3	11.26	
293	FM_P_15_SWB	SWB	1,287	1	0.85	0.95	Pl73 Sw22 Bl5	14.55	0.2	20.54	2.8	11.04	
294	FM_P_17_SWB	SWB	1,231	1	0.85	0.95	Pl71 Sw26 Bl3	15.99	0.1	20.72	2.5	12.23	
295	FM_S_8_SWB	SWB	1,331	1	0.85	0.95	Sw48 Pl40 Bl12	19.18	2.8	15.01	0.1	12.53	
296	FM_S_13_SWB	SWB	1,221	2	0.85	0.95	Sw54 Pl30 Bl16	20.40	1.6	15.44	0.1	12.12	
297	FM_S_15_SWB	SWB	1,226	1	0.85	0.95	Sw49 Pl39 Bl12	21.63	3.8	17.00	0.4	12.70	
298	FM_S_17_SWB	SWB	1,237	1	0.85	0.95	Pl48 Sw45 Bl7	15.81	1	22.52	4.1	12.75	
301	EM_AT_13_BWBS_Pre_2000	BWBS	1,148	1	0.85	0.95	Pl63 Sw35 Bl2	15.16		15.53		12.22	
302	EM_AT_15_BWBS_Pre_2000	BWBS	1,074	2	0.85	0.95	Pl53 Sw39 Bl8	17.67		22.75		13.58	
303	EM_AT_17_BWBS_Pre_2000	BWBS	1,151	1	0.85	0.95	Pl60 Sw31 Bl9	18.48		23.18			
305	EM_B_13_BWBS_Pre_2000	BWBS	1,097	2	0.85	0.95	Bl59 Sw24 Pl17	12.58		21.24		16.68	
306	EM_B_15_BWBS_Pre_2000	BWBS	1,091	2	0.85	0.95	Bl54 Pl27 Sw19	14.79		16.70		22.02	
309	EM_EP_13_BWBS_Pre_2000	BWBS	1,068	1	0.85	0.95	Sw68 Pl23 Bl9	20.47		17.06		14.33	
317	EM_P_13_BWBS_Pre_2000	BWBS	1,193	1	0.85	0.95	Pl57 Sw23 Bl20	13.19		16.29		12.00	
318	EM_P_15_BWBS_Pre_2000	BWBS	1,117	2	0.85	0.95	Pl70 Sw18 Bl12	16.01		20.59		13.01	
319	EM_P_17_BWBS_Pre_2000	BWBS	1,175	2	0.85	0.95	Pl70 Sw21 Bl9	17.73		22.87		15.26	
321	EM_S_13_BWBS_Pre_2000	BWBS	1,180	2	0.85	0.95	Sw53 Bl30 Pl17	21.66		13.68		16.86	
323	EM_S_17_BWBS_Pre_2000	BWBS	1,115	1	0.85	0.95	Sw70 Bl16 Pl14	23.77		15.71		17.62	
326	EM_AT_13_ESSF_Pre_2000	ESSF	1,148	1	0.85	0.95	Pl63 Se35 Bl2	16.51		14.23		15.02	
327	EM_AT_15_ESSF_Pre_2000	ESSF	1,074	2	0.85	0.95	Pl53 Se39 Bl8	16.85		12.82		14.26	
328	EM_AT_17_ESSF_Pre_2000	ESSF	1,151	1	0.85	0.95	Pl60 Se31 Bl9	19.90		15.00		17.40	
329	EM_B_8_ESSF_Pre_2000	ESSF	1,276	1	0.85	0.95	Bl57 Se29 Pl14	10.51		8.82		12.97	
330	EM_B_13_ESSF_Pre_2000	ESSF	1,097	2	0.85	0.95	Bl59 Se24 Pl17	13.01		11.13		15.54	
331	EM_B_15_ESSF_Pre_2000	ESSF	1,091	2	0.85	0.95	Bl54 Pl27 Se19	15.25		17.03		14.35	
332	EM_B_17_ESSF_Pre_2000	ESSF	1,097	2	0.85	0.95	Bl55 Se27 Pl18	17.00				19.60	
334	EM_EP_13_ESSF_Pre_2000	ESSF	1,068	1	0.85	0.95	Se68 Pl23 Bl9	14.74		16.74		15.24	
336	EM_EP_17_ESSF_Pre_2000	ESSF	1,162	1	0.85	0.95	Se68 Pl18 Bl14	14.80		19.00		16.30	
342	EM_P_13_ESSF_Pre_2000	ESSF	1,193	1	0.85	0.95	Pl57 Se23 Bl20	13.51		9.30		11.90	
343	EM_P_15_ESSF_Pre_2000	ESSF	1,117	2	0.85	0.95	Pl70 Se18 Bl12	16.19		12.68		14.06	
344	EM_P_17_ESSF_Pre_2000	ESSF	1,175	2	0.85	0.95	Pl70 Se21 Bl9	17.47		14.76		15.65	
345	EM_S_8_ESSF_Pre_2000	ESSF	1,184	2	0.85	0.95	Se47 Bl30 Pl23	10.44		12.88		15.49	

AU	Description	BEC	SPH	Regen Delay	OAF1	OAF2	Species Composition	SI Spp1	GW Spp1	SI Spp2	GW Spp2	SI Spp3	GW Spp3
346	EM_S_13_ESSF_Pre_2000	ESSF	1,180	2	0.85	0.95	Se53 Bl30 Pl17	12.63		14.30		16.55	
347	EM_S_15_ESSF_Pre_2000	ESSF	1,128	1	0.85	0.95	Se59 Bl22 Pl19	14.71		15.51		17.25	
351	EM_AT_13_SBS_Pre_2000	SBS	1,148	1	0.85	0.95	Pl63 Sw35 Bl2	18.64				17.07	
352	EM_AT_15_SBS_Pre_2000	SBS	1,074	2	0.85	0.95	Pl53 Sw39 Bl8	19.17		24.00		16.65	
353	EM_AT_17_SBS_Pre_2000	SBS	1,151	1	0.85	0.95	Pl60 Sw31 Bl9	20.50				17.59	
355	EM_B_13_SBS_Pre_2000	SBS	1,097	2	0.85	0.95	Bl59 Sw24 Pl17	13.26				16.75	
356	EM_B_15_SBS_Pre_2000	SBS	1,091	2	0.85	0.95	Bl54 Pl27 Sw19	16.28		18.46			
357	EM_B_17_SBS_Pre_2000	SBS	1,097	2	0.85	0.95	Bl55 Sw27 Pl18	17.38				20.22	
359	EM_EP_13_SBS_Pre_2000	SBS	1,068	1	0.85	0.95	Sw68 Pl23 Bl9	18.10		18.10		15.80	
361	EM_EP_17_SBS_Pre_2000	SBS	1,162	1	0.85	0.95	Sw68 Pl18 Bl14	19.99		19.99		17.00	
367	EM_P_13_SBS_Pre_2000	SBS	1,193	1	0.85	0.95	Pl57 Sw23 Bl20	19.39					
368	EM_P_15_SBS_Pre_2000	SBS	1,117	2	0.85	0.95	Pl70 Sw18 Bl12	16.53				14.29	
369	EM_P_17_SBS_Pre_2000	SBS	1,175	2	0.85	0.95	Pl70 Sw21 Bl9	19.69		22.50		17.09	
371	EM_S_13_SBS_Pre_2000	SBS	1,180	2	0.85	0.95	Sw53 Bl30 Pl17	15.36		15.36		17.23	
372	EM_S_15_SBS_Pre_2000	SBS	1,128	1	0.85	0.95	Sw59 Bl22 Pl19	13.90		13.90		16.60	
373	EM_S_17_SBS_Pre_2000	SBS	1,115	1	0.85	0.95	Sw70 Bl16 Pl14	22.85		16.71		19.30	
380	EM_B_13_SWB_Pre_2000	SWB	1,097	2	0.85	0.95	Bl59 Sw24 Pl17	11.54		22.00		16.89	
392	EM_P_13_SWB_Pre_2000	SWB	1,193	1	0.85	0.95	Pl57 Sw23 Bl20	14.68					
396	EM_S_13_SWB_Pre_2000	SWB	1,180	2	0.85	0.95	Sw53 Bl30 Pl17	23.10		13.30		16.55	
401	FM_AT_13_BWBS_Post_2000	BWBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	15.16	3.1	12.22		15.53	1
402	FM_AT_15_BWBS_Post_2000	BWBS	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	17.67	0.4	22.75	1.2	13.58	
403	FM_AT_17_BWBS_Post_2000	BWBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	18.48	0.7	23.18	0.6		
405	FM_B_13_BWBS_Post_2000	BWBS	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	21.24	4.5	16.68		12.58	
406	FM_B_15_BWBS_Post_2000	BWBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	22.02	4.2	16.70	0.1	14.79	
409	FM_EP_13_BWBS_Post_2000	BWBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	17.06	3.1	14.33		20.47	1
417	FM_P_13_BWBS_Post_2000	BWBS	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	13.19		16.29	2.3	12.00	
418	FM_P_15_BWBS_Post_2000	BWBS	1,287	1	0.85	0.95	Pl73 Sw22 Bl5	16.01	0.2	20.59	2.8	13.01	
419	FM_P_17_BWBS_Post_2000	BWBS	1,231	1	0.85	0.95	Pl71 Sw26 Bl3	17.73	0.1	22.87	2.5	15.26	
421	FM_S_13_BWBS_Post_2000	BWBS	1,221	2	0.85	0.95	Sw54 Pl30 Bl16	21.66	1.6	16.86	0.1	13.68	
423	FM_S_17_BWBS_Post_2000	BWBS	1,237	1	0.85	0.95	Pl48 Sw45 Bl7	17.62	1	23.77	4.1	15.71	
426	FM_AT_13_ESSF_Post_2000	ESSF	1,436	1	0.85	0.95	Pl52 Bl32 Se16	16.51	3.1	15.02		14.23	1
427	FM_AT_15_ESSF_Post_2000	ESSF	1,413	1	0.85	0.95	Pl58 Se40 Bl2	16.85	0.4	12.82	1.2	14.26	
428	FM_AT_17_ESSF_Post_2000	ESSF	1,382	1	0.85	0.95	Pl78 Se20 Bl2	19.90	0.7	15.00	0.6	17.40	
429	FM_B_8_ESSF_Post_2000	ESSF	1,311	1	0.85	0.95	Se44 Pl30 Bl26	8.82	4.5	12.97		10.51	

AU	Description	BEC	SPH	Regen Delay	OAF1	OAF2	Species Composition	SI Spp1	GW Spp1	SI Spp2	GW Spp2	SI Spp3	GW Spp3
430	FM_B_13_ESSF_Post_2000	ESSF	1,311	1	0.85	0.95	Se44 Pl30 Bl26	11.13	4.5	15.54		13.01	
431	FM_B_15_ESSF_Post_2000	ESSF	1,168	1	0.85	0.95	Se55 Pl27 Bl18	14.35	4.2	17.03	0.1	15.25	
432	FM_B_17_ESSF_Post_2000	ESSF	1,168	1	0.85	0.95	Se55 Pl27 Bl18	19.60	4.2	19.60	0.1	17.00	
434	FM_EP_13_ESSF_Post_2000	ESSF	1,436	1	0.85	0.95	Pl52 Bl32 Se16	16.74	3.1	15.24		14.74	1
436	FM_EP_17_ESSF_Post_2000	ESSF	1,382	1	0.85	0.95	Pl78 Se20 Bl2	19.00	0.7	14.80	0.6	16.30	
442	FM_P_13_ESSF_Post_2000	ESSF	1,204	1	0.85	0.95	Pl53 Se40 Bl7	13.51		9.30	2.3	11.90	
443	FM_P_15_ESSF_Post_2000	ESSF	1,287	1	0.85	0.95	Pl73 Se22 Bl5	16.19	0.2	12.68	2.8	14.06	
444	FM_P_17_ESSF_Post_2000	ESSF	1,231	1	0.85	0.95	Pl71 Se26 Bl3	17.47	0.1	14.76	2.5	15.65	
445	FM_S_8_ESSF_Post_2000	ESSF	1,331	1	0.85	0.95	Se48 Pl40 Bl12	10.44	2.8	15.49	0.1	12.88	
446	FM_S_13_ESSF_Post_2000	ESSF	1,221	2	0.85	0.95	Se54 Pl30 Bl16	12.63	1.6	16.55	0.1	14.30	
447	FM_S_15_ESSF_Post_2000	ESSF	1,226	1	0.85	0.95	Se49 Pl39 Bl12	14.71	3.8	17.25	0.4	15.51	
451	FM_AT_13_SBS_Post_2000	SBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	18.64	3.1	17.07			1
452	FM_AT_15_SBS_Post_2000	SBS	1,413	1	0.85	0.95	Pl58 Sw40 Bl2	19.17	0.4	24.00	1.2	16.65	
453	FM_AT_17_SBS_Post_2000	SBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	20.50	0.7		0.6	17.59	
455	FM_B_13_SBS_Post_2000	SBS	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	16.75	4.5	16.75		13.26	
456	FM_B_15_SBS_Post_2000	SBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	18.46	4.2	18.46	0.1	16.28	
457	FM_B_17_SBS_Post_2000	SBS	1,168	1	0.85	0.95	Sw55 Pl27 Bl18	20.22	4.2	20.22	0.1	17.38	
459	FM_EP_13_SBS_Post_2000	SBS	1,436	1	0.85	0.95	Pl52 Bl32 Sw16	18.10	3.1	15.80			1
461	FM_EP_17_SBS_Post_2000	SBS	1,382	1	0.85	0.95	Pl78 Sw20 Bl2	19.99	0.7		0.6	17.00	
467	FM_P_13_SBS_Post_2000	SBS	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	19.39			2.3		
468	FM_P_15_SBS_Post_2000	SBS	1,287	1	0.85	0.95	Pl73 Sw22 Bl5	16.53	0.2		2.8	14.29	
469	FM_P_17_SBS_Post_2000	SBS	1,231	1	0.85	0.95	Pl71 Sw26 Bl3	19.69	0.1	22.50	2.5	17.09	
471	FM_S_13_SBS_Post_2000	SBS	1,221	2	0.85	0.95	Sw54 Pl30 Bl16	17.23	1.6	17.23	0.1	15.36	
472	FM_S_15_SBS_Post_2000	SBS	1,226	1	0.85	0.95	Sw49 Pl39 Bl12	16.60	3.8	16.60	0.4	13.90	
473	FM_S_17_SBS_Post_2000	SBS	1,237	1	0.85	0.95	Pl48 Sw45 Bl7	19.30	1	22.85	4.1	16.71	
480	FM_B_13_SWB_Post_2000	SWB	1,311	1	0.85	0.95	Sw44 Pl30 Bl26	22.00	4.5	16.89		11.54	
492	FM_P_13_SWB_Post_2000	SWB	1,204	1	0.85	0.95	Pl53 Sw40 Bl7	14.68			2.3		
496	FM_S_13_SWB_Post_2000	SWB	1,221	2	0.85	0.95	Sw54 Pl30 Bl16	23.10	1.6	16.55	0.1	13.30	
517	EM_P_13_BWBS_Pre_2000_MPB	BWBS	1,193	1	0.85	0.95	Pl57 Sw23 Bl20	13.19		16.29		12.00	
518	EM_P_15_BWBS_Pre_2000_MPB	BWBS	1,117	2	0.85	0.95	Pl70 Sw18 Bl12	16.01		20.59		13.01	
519	EM_P_17_BWBS_Pre_2000_MPB	BWBS	1,175	2	0.85	0.95	Pl70 Sw21 Bl9	17.73		22.87		15.26	
542	EM_P_13_ESSF_Pre_2000_MPB	ESSF	1,193	1	0.85	0.95	Pl57 Se23 Bl20	13.51		9.30		11.90	
543	EM_P_15_ESSF_Pre_2000_MPB	ESSF	1,117	2	0.85	0.95	Pl70 Se18 Bl12	16.19		12.68		14.06	
544	EM_P_17_ESSF_Pre_2000_MPB	ESSF	1,175	2	0.85	0.95	Pl70 Se21 Bl9	17.47		14.76		15.65	

AU	Description	BEC	SPH	Regen Delay	OAF1	OAF2	Species Composition	SI Spp1	GW Spp1	SI Spp2	GW Spp2	SI Spp3	GW Spp3
567	EM_P_13_SBS_Pre_2000_MPB	SBS	1,193	1	0.85	0.95	Pl57 Sw23 Bl20	19.39					
568	EM_P_15_SBS_Pre_2000_MPB	SBS	1,117	2	0.85	0.95	Pl70 Sw18 Bl12	16.53				14.29	
569	EM_P_17_SBS_Pre_2000_MPB	SBS	1,175	2	0.85	0.95	Pl70 Sw21 Bl9	19.69		22.50		17.09	
592	EM_P_13_SWB_Pre_2000_MPB	SWB	1,193	1	0.85	0.95	Pl57 Sw23 Bl20	14.68					

Appendix 4 Criteria for Scoring Anchors and Constraints

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
Draft Amended UWR: Kennedy Siding - Low Elevation (Northern Caribou)	*U-7-001*	Revised shape and GWM.	No Harvest.
Approved UWR: Northern Caribou	*U-7-001*	Harvest max. 50% of entire area at a time on 100-yr rotation so 45-55% is 0-50 years old and 45-55% is 50-100 years old. Harvest patches 250 to 1,400 ha. Maintain visual screen between roads and adjacent cutblocks (so caribou within that cutblock are not visible from road). No silv activity to increase site productivity for trees (i.e. no fertilization). Avoid harvesting between Oct 1 – Feb 28, and ensure adequate snow cover when winter harvesting. Do not increase current road density, and future roads built to lowest class practicable.	Harvest max. 50% of area at one time (100-yr rotation) so that 45-55% is 0-50 years and 45-55% is 50-100 years. Harvest patches 250 to 1,400 ha.
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_001.pdf			
Approved UWR: Mule Deer	*U-7-002 (*1-5, 11, 12, 14)	Minimum 40% winter range area in age class 8 or greater at all times with crown closure > 56% (Douglas-fir, Spruce); Minimum 50% species composition of Douglas-fir leading; Timber harvesting openings irregular shape and smaller than 1 ha in size and less than 250 m wide	≥ 40% ≥ 140 years Regen ≥ 50% Fd
	*U-7-002 (*6-8, 13)	Minimum 50% species composition of Douglas-fir leading; Timber harvesting openings irregular shape and smaller than 1 ha in size and less than 250 m wide	Regen ≥ 50% Fd
	*U-7-002 (*9, 10, 15-18)	Minimum 50% of stand in age class 8 or greater at all times with crown closure > 66% (Douglas-fir, Spruce); Minimum 50% species composition of Douglas-fir leading; Timber harvesting openings irregular shape and smaller than 1 ha in size and less than 250 m wide	≥ 50% ≥ 140 years Regen ≥ 50% Fd
	*U-7-002 (*T-001, 2, 4, 7, 8, 11, 13, 15, 17, 18, 19)	Medium habitat – harvest < 30% volume removal on cutblock every 80 years, opening sizes do not exceed 1 ha with mean opening size < 0.5 ha	≥ 30% ≥ 160 years old ≤ 30% < 80 years
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_002.pdf			
Approved UWR: Southern Caribou	*U-7-003 (*T-005, 009, 010, 012)	Travel corridors – harvesting results in minimum 20% of forest within each unit as 100+ years of age in corridor with no more than 20% of productive forest area of unit < 3 m green-up condition	≥ 20% of forest ≥ 100 years ≤ 20% < 3 m

[3] Orange highlighted records identify adjusted criteria from legally-established designations; that are highlighted grey.

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-003_order_09Dec09.pdf			
Approved UWR: Mountain Goat	*U-7-004*	No harvest within winter ranges.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_004.pdf			
Approved UWR: Elk	*U-7-005*	Maintain min. 40% of stands in winter range in age class 6 + (> 100 years) with crown closure > 40%.Plan major/secondary roads to avoid winter ranges, and de-activate any future built roads/trails (in UWR).	≥ 40% of forest > 100 years and crown closure > 40%
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_005.pdf			
Approved UWR: Stone's Sheep	*U-7-006*	No harvest within winter ranges. Plan major/secondary roads to avoid winter ranges, and de-activate any future built roads/trails (in UWR).	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_006.pdf			
Approved UWR: Northern Caribou	*U-7-007*	Within terrestrial lichen habitat (TLH) no new mainline road construction. Each TLH aggregate (TLHA) (Table 1 of Order) managed with 2-pass harvest system over 140-year rotation. Each pass results in large openings on one side of TLHA, forested leave area within TLHA equivalent to size of harvested area ± 10%. No increase in site productivity through use of fertilizer. Re-established forested stand consistent with pre-harvest species composition.	2-pass harvest system over 140-yr rotation. Leave areas equiv. size of harvested area ± 10%.
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_007.pdf			
Approved UWR: Elk	*U-7-008*	Maintain min. 40% of forest stands in winter range in age class 6+ (> 100 years) with crown closure > 40%. Plan major/secondary roads to avoid winter ranges, and de-activate any future built roads/trails (in UWR).	Min 40% of forest > 100 years and crown closure > 40%
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_008.pdf			
Draft Amended UWR: Pine Pass Northern Caribou	*U-7-009 (*PP-003)	Slightly changed to accommodate U-7-001.	Min 20% > 100 years Max 20% of area < 3 m (green-up)
	*U-7-009 (*PP-001, PP-002, PP-004)	Revised shape and GWM.	No harvest
Approved UWR: Northern Caribou	*U-7-009 (*PP-003)	Maintain min. 20% forested stands with 100+ years in contiguous, windfirm corridor with max. 20% of unit < 3 m green-up condition.	Min 20% > 100 years Max 20% of area < 3 m (green-up)
	*U-7-009 (*PP-001, PP-002, PP-004)	Retain all forest cover, with exception if purpose is to enhance quality of winter range. No roads constructed within winter ranges.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_009.pdf			
Approved UWR: Northern Caribou	*U-7-015 (*9a-001, 2, 7	Manage defined non-terrestrial Lichen habitat and terrestrial Lichen habitat through a two-pass, 140 year rotation – within each pass harvest 50% +/- 20%	Max 50% < 70 years old

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
	9b-001, 2 9c-001, 2, 3 10-001, 2, 4)	of total area	
http://www.env.gov.bc.ca/wld/documents/uwr/uwr_u7_015.pdf			
Approved UWR: Moose, Elk and Mountain Goat	*U-7-017* *(*AP1, AP2)	Maintain forest cover so that min. 20% of each UWR unit has coniferous-leading stands ≥ 100 years and crown closure ≥ 40%. Maintain forest cover so that min. 25% of each UWR unit has stands (regardless of leading species) ≥ 80 years and crown closure ≥ 40%. Maintain min. 20 % forested stands in each UWR unit are < 20 years. Max disturbance to forest cover (i.e. WTRA) should not exceed 200 m from any point in opening.	Conifer-leading: Min 20% ≥ 100 years and crown closure ≥ 40% Other-spp-leading: Min 25% ≥ 80 years and crown closure ≥ 40% All stands: Min 20% < 20 years
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-017_order.pdf			
Approved UWR: Moose, Elk and Mountain Goat	*U-7-017* *(*AP3, AP4, AP5, AP6)	No harvesting within mountain goat UWR.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-017_order.pdf			
Approved UWR: Mountain Goat	*U-7-019*	No harvesting within mountain goat winter range.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-019_Order.pdf			
Approved UWR: Caribou and Mountain Goat	*U-7-025*	No removal of forest cover within northern caribou high elevation habitat (defined in Table 1 of Order). Forest activities in northern caribou high elevation specified area units (SA1 to SA35) and within areas of early seral moose WR potential must limit, up to free growing date, production of preferred moose browse to not more than 8% cover (unless to provide permanent access structure/ road defined in FPPR).	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-025_order.pdf			
Approved UWR: Northern Caribou	*U-7-026*	No removal of forest cover within northern caribou high elevation habitat (defined in Table 1 of Order). Forest activities in northern caribou high elevation specified area units (SA1 to SA6) and within areas of early seral moose WR potential must limit, up to free growing date, production of preferred moose browse to not more than 8% cover (unless to provide permanent access structure/ road defined in FPPR).	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-026_order.pdf			
Approved UWR: Stone's Sheep	*U-7-028*	No removal of forest cover within Stone Sheep's winter ranges. All heli-logging within 2,000 m line-of-sight to core UWR must take place July	No harvest

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
		15 – Oct 31. Within 500 m of core UWR harvesting must take place July 15 – Oct 31 (unless sheep not present). All roads constructed within 500m must be decommissioned within 3 years following harvest.	
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-028_order.pdf			
Approved UWR: Mountain Goat	*U-7-029*	No removal of forest cover within mountain goat winter range. All heli-logging within 2,000 m line-of-sight to UWR must take place July 15 – Oct 31. Within 500 m of core UWR harvesting must take place July 15 – Oct 31 (unless goat not present). All roads constructed within 500m must be decommissioned within 3 years following harvest.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-029_order.pdf			
Approved UWR: Mountain Goat	*U-7-030*	No removal of forest cover within mountain goat winter range. All heli-logging within 2,000 m line-of-sight to UWR must take place July 15 – Oct 31. Within 500 m of core UWR harvesting must take place July 15 – Oct 31 (unless goat not present). All roads constructed within 500m must be decommissioned within 3 years following harvest.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-7-030_order.pdf			
Approved UWR: N. Caribou, Mountain Goat, and Bighorn Sheep	*U-9-002*	Primary forest activities will result in the retention of all forest cover within the ungulate winter ranges.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/u-9-002_Order.pdf			
Approved UWR: N. Caribou and Stone's Sheep	*U-9-004 (*GR-011, GR-021, GR-022)	Activities will not result in removal of forest cover, construction or roads/trails, use of domestic sheep or goats, use of pesticides, or development of recreation sites or trails.	No harvest
http://www.env.gov.bc.ca/wld/documents/uwr/U-9-004_ord.pdf			
Approved WHA: Mountain Goat	9-001	Do not harvest or salvage within WHA.	No harvest
http://www.env.gov.bc.ca/wld/documents/wha/ORAM-9-001_ord.pdf			
Approved WHA: Northern Caribou	9-035 to 9-040 9-102, 9-103	Activities will not result in removal of forest cover, construction or roads/trails, use of domestic sheep or goats, use of pesticides, or development of recreation sites or trails.	No harvest
http://www.env.gov.bc.ca/wld/documents/wha/RATA_9-035_040,102,103_ord.pdf			
Riparian Management Areas		Stream classifications are not available/complete for the area so criteria were developed and applied to classify and buffer streams, lakes and wetlands.	No harvest
Recreation			No harvest
Parks and Protected			No harvest

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
Areas			
Inoperable – Terrain Slope Class 5			No harvest
Research Sites (i.e. PSP)			No harvest
Water Intakes			No harvest
Wildlife Tree Patches & Reserves			No harvest
Cultural Heritage Resources & First Nations Interests	Arch. sites, heritage features, traditional use sites, etc.	Protected and/or conserved areas under the *Heritage Conservation Act* or through consultation with First Nations.	No harvest
Spatial OGMAs (Mackenzie TSA) *Ministerial Order*	Maps 1-7	Retain all timber within identified OGMAs.	No harvest
Mackenzie LRMP – Resource Management Zones	Protected	Areas to be protected for their natural, cultural heritage, and/or rec values – logging, mining, hydroelectric dams, and oil % gas development are prohibited	No harvest
	Special - Wildland	Emphasis on remote and natural back-country characteristics, priority for ecological conservation while providing opportunities for commercial and industrial activities – timber harvesting is not allowed and is excluded from the THLB – road access is temporary and must be deactivated	No harvest
https://www.for.gov.bc.ca/tasb/slrp/lrmp/princegeorge/mackenzie/plan/files/lrmp/Mackenzie_LRMP_Feb2001.pdf			
https://www.for.gov.bc.ca/tasb/slrp/pdf/lrmp/Fort%20St%20James_LRMP.pdf			
Non-Legal Draft UWR – Mule Deer		TBD	TBD
Proposed WHA: Northern Caribou		TBD	TBD
Proposed WHA: Grizzly Bear		TBD	TBD
Draft WHA: Fisher		TBD	TBD
Draft WHA: White Pelican	Core		No Harvest
	Specified Area		Score for reserve

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
Draft WHA: Northern Caribou	Post Rut		No Harvest
	Calving		No Harvest
	Migration		Max 35% of forest < 40 years
Community Watersheds			Max 30% of stands (by CWS) < 2 m
Draft Fisheries Sensitive Watersheds		TBD	TBD (ECAs)
Bull Trout		5 of 6 within FSWs	No Harvest
Visual Quality Objectives: Prince George District *GAR Order*	Preservation (P)	No visible activities – perspective view below VEG	Max 0%
	Retention (R)	Activities not visually evident – perspective view below Visually Effective Green-up (VEG)	Max 0.8%
	Partial Retention (PR)	Activities visible but minimal – perspective view below VEG	Max 4.3%
Visual Quality Objectives: Mackenzie District *Non-Legal but recommended*	Retention (R)	Activities not visually evident – perspective view below VEG by Visual Absorption Capacity (VAC)	Low - Max 0.1% Med - Max 0.7% High - Max 1.5%
	Partial Retention (PR)	Activities visible but minimal – perspective view below VEG by VAC	Low - Max 1.6% Med - Max 4.3% High - Max 7.0%
Mackenzie LRMP – Resource Management Zones	Agriculture / Settlement		
	Enhanced	Emphasis on timber growth and utilization – fewer restrictions on industrial development, permanent and more intensive access network is allowable – may have small areas with restrictions for wildlife and habitat	
	General	Applies across the plan area – emphasis on the extractive and non-extractive uses – restrictions based on type of subzone	
	Special	Emphasis on non-extractive uses with respect to wildlife and wildlife habitat, heritage and culture, scenic areas and rec – commercial and industrial activities allowed while managing identified special values – some areas are restricted – may have permanent access with remaining roads temporary	
https://www.for.gov.bc.ca/tasb/slrp/lrmp/princegeorge/mackenzie/plan/files/lrmp/Mackenzie_LRMP_Feb2001.pdf			
Stuart / FSJ LRMP – Resource Management Zones	Multi-Value	Integration of a wide range of resource values – access relatively unrestricted, exception of specific areas recommended for special mgmt. consideration	
	PPA (Protected Areas)	Minimum intervention	
	Resource	Intensive resource development – managed with consideration for other	

Designation[3]	Units	Criteria (Based on Timber Impact)	Modelling
	Development	resource values and within guidelines of specific zone objectives and strategies – emphasis on mineral extraction, harvesting, while minimizing impacts on other resource values through IRM strategies – access relatively unrestricted	
	Settlement / Agriculture (S&E)	Farming, proposed settlements	
	Special Management	Managed for wide array of resources but in general indicate need for sensitive resource mgmt. – resource development may proceed as long as impacts to other resource are minimized and values are maintained	
https://www.for.gov.bc.ca/tasb/slrp/pdf/lrmp/Fort%20St%20James_LRMP.pdf			