Mackenzie Timber Supply Area
Timber Supply Review

Data Package

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1. Introduction

This data package outlines the basic information and assumptions required for the Mackenzie Timber Supply Area (TSA) timber supply analysis.

The completed data package contains information on inputs that represent current performance in the timber supply area. For the timber supply review, "current performance" is defined by:

- the current forest management regime — the productive forest land available for timber harvesting, silviculture treatments, harvesting systems and integrated resource management guidelines used in the area;
- the standards used to approve or reject forest development plans;
- fully implemented land-use plans;
- land-use decisions approved by Cabinet;
- approved higher level plans under the Forest Practices Code (FPC), and
- other approved B.C. Forest Service and joint agency forest management practices and policy.

The purpose of the timber supply review program is to model "what is" not "what if". Changes in forest management objectives and data, when and if they occur, will be captured in future timber supply analyses.

Each section of this data package includes:

1) a short explanation of the data in the data table;
2) a data table; and
3) a discussion of data sources and other relevant considerations.

This data package includes the best available knowledge and information at the time of publication, but is subject to change. A public review period has been established to allow submission of comments and concerns about the data package to the Ministry of Forests. Submissions and new information made available prior to the analysis may lead to changes in the data package. As noted in several places, until the timber harvesting land base is determined, it is not possible to finalize the values for some of the data tables. In some cases the criteria are shown but the final value is not yet filled in. In these cases, the table columns are shaded grey. Finally, if any major changes to management regimes occur over the next few months, attempts will be made to incorporate them into the timber supply analysis. The final timber supply analysis report will include a technical appendix that highlights any changes made to this package.

2. Current forest management considerations and issues

2.1 Base case management assumptions

The base case assumptions reflect current performance with respect to the status of forest land, forest management practices and knowledge of timber growth and yield. The base case harvest forecast developed using these assumptions will be used as a baseline reference. Section 7, "Sensitivity Analyses," identifies areas of uncertainty with the data and assumptions and outlines intended sensitivity analyses.

2.2 Statement of major forest management considerations and issues

Table 1 lists the major forest management issues and considerations for the Mackenzie TSA. Issues that are defined within legislation, regulations or standards, and that can be represented in the computer model will be incorporated into the base case. If there are important uncertainties in defining current management, sensitivity analysis may assist in assessing the potential timber supply implications and assigning degrees of risk to timber supply during allowable annual cut (AAC) determination.

Table 1 Major forest management considerations

Consideration/Issue	Description
Scenic landscapes, highway corridors and populated areas	Tourism and recreation are important commercial activities in the Mackenzie TSA. Visual quality objectives (VQO) from the recommended 8 known scenic areas and their associated forest cover guidelines will be factored into the analysis.
Proposed protected areas	Sensitivity analyses will examine impacts of proposed protected areas contained in the database for the proposed LRMP (see Table 22).
Interim and draft landscape unit objectives	District-approved interim biodiversity emphasis options (BEOs) are being used in current management, and will be incorporated in the base case. Draft regional landscape unit planning (RLUP) strategy BEOs will be examined in sensitivity analysis
Stand-level biodiversity	The wildlife tree requirements described in the Forest Practices Code *Landscape Unit Planning Guide* are currently implemented and will be modeled in the base case
McLeod Lake Treaty	The McLeod Lake treaty agreement has been signed off by all parties and is now in effect. The transfer of land (about 500 hectares within the Mackenzie TSA) is expected to be complete by the fall. See section 5.2.11.

2. Current forest management considerations and issues

Table 1 Major forest management considerations (continued)

Consideration/Issue	Description
Deciduous timber	The district plans to sell deciduous timber through the small business program. Timber supply from deciduous leading stands will be examined.
Forest health issues	Damage caused by mountain pine bark beetle, spruce budworm, balsam bark beetle, and spruce bark beetle contribute to unsalvaged losses, and will be accounted for in the analysis.
Objectives from proposed land and resource management plan (LRMP)	Special resource management zone objectives; Visual quality objectives; Fish and fish habitat constraints; Access management strategies; Constraints for protection of caribou, grizzly bear, moose, and sheep habitat. These objectives/constraints will be examined in the base case or through sensitivity analysis depending on the designation status.

Data Source and Comments:

The eight known scenic areas are: Fort Ware, Estella/Ed Bird Lakes, Omineca/Manson view shed corridor, Peace arm, town of Mackenzie, highway 39/97 corridors, Wazi Lake, and Tutizzi Lake.

Interim biodiversity emphasis options (BEOs) were developed for landscape units in the Mackenzie TSA where operations are currently occurring. The interim BEOs are currently being used as a guide to forest management. A draft set of BEOs were subsequently developed using the Landscape Unit Planning Guide for all landscape units in the Mackenzie TSA as an initial step in the landscape unit planning process.

3. Inventories

3.1 Background information

Table 2 lists the inventories that will be used to define the timber harvesting land base, and to model forest management activities.

Table 2 Inventory information

Data	Source	Vintage	Update	Scale
Forest cover inventory	MoF	1999	1998/1999	1:20 000
Biogeoclimatic	MoF – Research Branch	1998	1998	1:250 000
Natural disturbance type (NDT)	MoF – Research Branch	1997	1998	1:250 000
Resource management zones - (Proposed)	MoF/MELP	1996 - 97		1:250 000
Protected areas (Proposed LRMP)	MoF/MELP			1:250 000
Physical operability logging system	MoF	1998	2000	1:250 000
District haul zones	MoF	1995	2000	1:250 000
Visual landscape inventory (recommended VQOs): 1) Current known scenic areas 2) LRMP proposed scenic areas/VQOs	MoF	1998	1999	1:250 000
Landscape units (draft)	MoF	1996	1998	1:250 000
Biodiversity emphasis options 1) Interim 2) Revised-April/98 RLUP	MoF/MELP	 1) 1996 2) 1998		1:250 000
Planning cells	MoF	1991	2000	1:50 000
Terrain stability	Licensees/FRBC	1998	1998	1:20 000
Recreation inventory	MoF	1993 -1998	1998	1:50 000
Wildlife habitat				
- Caribou management strategy	MELP/LRMP	1998		1:250 000
- Grizzly bear management strategy	MELP/LRMP	1999		1:250 000
- Moose management strategies.	LRMP	1999		1:250 000
- Arctic grayling management strategy	MELP	1995		
Mugaha marsh sensitive area proposal	MELP	1998		1:20 000
Woodlot update	MoF	1988	1998	1:20 000
McLeod Lake Treaty 8 map	MoF	1999		1:20 000

3. Inventories

Data Source and Comments:

Forest cover inventory - forest inventory file has been projected for growth to 1999 for the Mackenzie TSA.

The updated forest cover file contains new physical operability information. Re-inventory is complete for most of the TSA, except for the northern third. Re-inventory of the northern third is still incomplete due to a lack of aerial photography in this area.

Backlog Silviculture Database: Based on aerial photography, information on approximately 2500 pre-1987 openings is available in a GIS database, providing silviculture and ground survey information.

4. Division of the Area into Management Zones

4.1 Management zones, groups and multiple objectives

Management zones represent areas with distinct management emphasis. For example, a management zone may be based on a harvesting system, silviculture system, visual quality objective, or wildlife consideration. Some areas may be subject to more than one management objective. For simulation modeling, a "group" function enables application of overlapping constraints. After assessing the inventory data, the timber supply analyst will determine whether to put an objective into a group or a mutually exclusive management zone.

The non-contributing forest (land considered unavailable for timber harvesting) will be included for consideration in attaining some forest cover objectives.

Further information on the forest cover requirements to be applied to these areas can be found in Section 6.4 "Integrated resource management."

Table 3 Objectives to be tracked

Group	Description	Inventory definition	Function
1	Timber harvesting land base by landscape unit	Crown forested operable area where timber harvesting may occur.	Reporting. Provide an assessment of the timber harvesting land base by landscape unit.
2	All forested land by landscape unit	Type id projected 1, 2, 3, 4 and 9.	Reporting. Provide an assessment of the total forest by landscape unit. All Crown forest included.
3	Landscape-level biodiversity — all forest	Non-standard mapped layer.	Application of biodiversity targets at the landscape unit/emphasis/BEC zone-variant level. All Crown forest included.
4	Visual quality	Non-standard mapped layer.	Resource emphasis area — visual quality. Application of visual quality objective (VQO) guidelines by landscape unit. Total forest included. Retention (R), partial retention (PR), and modification (M) will be modelled.
5	Integrated resource management (IRM)	Crown forested: operable area where timber production is the primary objective.	No specific forest requirements applied. IRM forest cover requirements are expected to be achieved through management for landscape- and stand-level biodiversity.
6	Harvesting opportunities by distance	Timber harvesting land base	Harvest emphasis: near zone (immediately available for harvesting) and far zone (harvesting is limited by distance).
7	Draft land and resource management plan (LRMP)	Crown forested operable area. Non-standard mapped layer	Objectives from the draft LRMP (see Table 1)
8	Wildlife habitat	Non-standard mapped layer.	Objectives from the draft LRMP strategies

4. Division of the Area into Management Zones

4.2 Analysis units

An analysis unit represents a combination of stands dominated by specific tree species or silviculture regime with a specific timber growing capability, as indicated by the inventory type group and site index in the forest inventory file. Each analysis unit (Table 4) is assigned its own timber volume projections (yield tables) for existing and future stands.

Table 4 Definition of analysis units

Analysis unit number and leading tree species	Inventory type groups	Site productivity	Site index* range
1. Balsam	18-20	good	
2. Balsam	18-20	medium	
3. Balsam	18-20	poor	
4. Spruce	21-26	good	
5. Spruce	21-26	medium	
6. Spruce	21-26	poor	
7. Pine	28-31	good	
8. Pine	28-31	medium	
9. Pine	28-31	poor	
10. Poplar/Cottonwood	35,36	good/medium	
11. Poplar/Cottonwood	35,36	poor	
12. Aspen	41, 42	good/medium	
13. Aspen	41, 42	poor	
14. Birch	40	good/medium	
15. Birch	40	poor	

*Site index is the expected tree height, in meters, at breast height at age 50 years

Data source and comments:

Once the timber harvesting land base has been defined, the analyst and forest district staff will determine the site index ranges for each general site productivity class. Site index ranges and the final number of analysis units will depend on the overall site productivity range, and the area of the timber harvesting land base occupied by each species.

Yield tables for existing natural stands will be derived using the variable density yield projection (VDYP) model. Yield tables for recent plantations and future stands will be derived using the table interpolation program for stand yields (TIPSY).

5. Timber Harvesting Land Base Definition

5.1 Identification of the timber harvesting land base

This section outlines the steps used to identify the timber harvesting land base (the productive forest expected to support timber harvesting) within the timber supply area. Land may be unavailable for timber harvesting for three principle reasons:

- it is not administered by the British Columbia Forest Service (e.g., private land, parks, etc.);
- it is not suitable for timber production; and
- it is required for other forest values.

Land may also be added to the timber harvesting land base by:

- improving productivity or operability (e.g., the stocking of land currently classified as non-commercial brush);
- acquiring productive forest land (e.g., timber licence reversions).

No opportunities to increase the timber harvesting land base are presently anticipated in the Mackenzie TSA.

Only land where no harvesting is expected will be excluded from the timber harvesting land base. Areas where some timber harvesting is anticipated remain in the timber harvesting land base, even if the area will be subject to stringent constraints. Any such constraints will be reflected in the analysis.

After all areas that do not contribute to the timber harvesting land base have been identified and excluded, the resulting area is defined as the "current timber harvesting land base" for the Mackenzie TSA.

Even if excluded from the timber harvesting land base, forested areas that are administered by the province may contribute to forest management objectives, such as biodiversity, visual quality and wildlife habitat.

5.2 Details on land base classification

5.2.1 Land not administered by the British Columbia Forest Service for timber supply

Ownership codes are generally used to identify whether the land is expected to contribute to timber supply. Ownership codes 62C and 69C indicate Crown land in a forest management unit and miscellaneous reserves, respectively. All areas with other ownership codes will be removed from the land base considered available for timber supply. These include areas under woodlot licences because their AACs are determined and administered independently from the timber supply review process.

5.2.2 Land classified as non-forest or non-productive forest

Type identity 6 areas such as alpine, lakes, rocks, power lines, highway, etc. and type identity 8, where no typing is available, will be excluded from the land base considered for timber supply.

5.2.3 Non-commercial cover

Type identity 5 represents areas currently occupied by non-commercial brush species. These areas are considered unlikely sites for timber production and are excluded from the area considered available for timber harvesting.

5.2.4 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources. These areas are identified and delineated during a forest inventory as environmentally sensitive areas (ESAs). Table 5 lists the proportion of areas in each ESA category where harvesting will not occur.

Table 5 Description of environmentally sensitive areas

ESA category	ESA description	Reduction percent
Es1	Extremely unstable soils	90
Es2	Unstable soils but less than Es1	50
Ep1	Severe regeneration problems caused by geoclimatic factors	90
Ep2	Regeneration problems caused by biotic factors	30
Ea	Severe snow chute and avalanche problems	90
Er1	Exceptionally high recreational values	90
Er2	High recreational values but less than Er1	30
Ew1	Critical importance to wildlife	90
Ew2	High value for wildlife but less than Ew1	30
Eh1	Extremely high watershed values	90
Eh2	High watershed values but less than Eh1	30
Ec	Areas of management concern (any of the categories noted above but surveyed prior to 1976).	90

Data source and comments:

The percentage reductions are based on the history of harvesting activity carried on within the respective categories of ESAs.

5. Timber Harvesting Land Base Definition

5.2.5 Areas considered inoperable

Operability classification accounts for the presence or absence of physical and economic barriers to harvesting the different forest stands found in the Mackenzie TSA. Operability is influenced by three main variables: physical operability (logging chance based on slope classes and soils that is expressed as conventional, cable, helicopter, or inoperable); development/haul zone (near or far based on proximity to Mackenzie); and forest stand attributes (age, height, stocking, and site index classes). Table 7 deals with economic operability, which is affected by forest attributes and distance from mills.

Physical operability combines slope and soils information into five spatially explicit classes described in Table 6.

Table 6 Description of inoperable areas

Inventory description	Code	Reduction per cent (%)
Conventional harvesting practices	A	0
Cable harvesting practices	C	0
Cable or helicopter harvesting practices	H	0
Inoperable areas	I	100
Not typed	N	100

Data source and comments:

1. Conventional harvest – slopes <55% (<30% on lacustrine soils);
2. Cable harvest – slopes from 55-100% (30 - 100% on lacustrine soils);
3. Cable or helicopter harvest – slopes >100%; and
4. Inoperable – unstable lacustrine soils identified by regional photo interpretation.

Mackenzie TSA is divided into two development/haul zones (near and far) that reflect the cost of transportation to Mackenzie's processing centres.

Forest stand attributes influence which stands will be harvestable in any given zone. The base case information is displayed in Table 7 in which marginal stands (noted with *) are included for conventional logging methods in the near zone, and excluded in the far zone.

5. Timber Harvesting Land Base Definition

Table 7 Area exclusion factors for merchantable stands for conventional (Conv), cable, and helicopter (Heli) logging in near and far zones to be used for the base case

	Harvest zone:	Near			Far			
	Logging system:	Conv	Cable	Heli	Conv slope <30%	Conv slope ≥30%	Cable	Heli
Type group number (leading species)	Age, height and stocking class							
18 – 20	Age ≥ 7, Height<2	100	100	100	100	100	100	100
(Balsam)	742, 842, 942	0	100	100	0	0	100	100
B, BH, BS	732, 832, 932	0	100	100	0	0	100	100
	(721, 821, 921)*	0	100	100	100	100	100	100
	(722, 822, 922)*	0	100	100	100	100	100	100
21 – 26	Age ≥ 7, Height <2,	100	100	100	100	100	100	100
(Spruce)	742, 842, 942	0	100	100	0	0	100	100
S, SF, SH,	732, 832, 932	0	100	100	0	0	100	100
SB, SPl,	(721, 821, 921)*	0	100	100	100	100	100	100
& Sdec	(722, 822, 922)*	0	100	100	100	100	100	100
28 – 31	Age ≥5, Height <2	100	100	100	100	100	100	100
(Pine)	542, 642, 742, 842, 942	0	100	100	0	0	100	100
Pl, PlF,	532, 632, 732, 832, 932	0	100	100	0	0	100	100
PlS, &PlDec	(521, 621, 721, 821, 921)*	0	100	100	100	100	100	100
	(522, 622, 722, 822, 922)*	0	100	100	100	100	100	100
	(533, 633, 733, 833, 933)*	0	100	100	100	100	100	100
	(534, 634, 734, 834, 934)*	0	100	100	100	100	100	100
	(523, 623, 723, 823, 923)*	0	100	100	100	100	100	100
	(524, 624, 724, 824, 924)*	0	100	100	100	100	100	100
35,36, 40, 41, &42	Age≥4, Height<2, All stock	100	100	100	100	100	100	100
(Cttnwd, Birch, &	Age≥4, Height≥2, Stock=1	0	100	100	100	100	100	100
Aspen)	Age≥4, Height≥2, Stocknot=1	100	100	100	100	100	100	100

Notes: (for Table 7)

1. ( )* indicates stands listed in the row are marginal stands. Hence they may not be harvestable in poor market years or if they are overly abundant in particular areas. Sensitivity analyses will investigate the effect of excluding all or a portion of these stands in the near zone, as well as including a portion or all in the far zone.
2. 100 indicates stands that are to be excluded and 0 indicates that the stands are not to be excluded as unmerchantable;
3. There are no existing or planned operations in the helicopter zone.
4. The near zone for deciduous-leading stands extends north from the southern boundary approximately to the Peace Arm.

5.2.6 Sites with low timber growing potential

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. Typically, these stands are intermixed with other stands within the forested land base. For the Mackenzie TSA, low productivity stands that are not expected to produce an economically harvestable crop of trees in a reasonable length of time will be excluded from the timber harvesting land base, as detailed in Table 8.

Table 8 Sites with low growing potential

Species group	Inventory type group	Older Stands			Younger Stands		Reduction percent*
		Age (years)	Height (m)	Volume (m^3/ha)	Age (years)	Site index (m@ 50 yrs)	
Balsam	18-20	>140	—	≤140	≤140	<8.1	100
Spruce	21-26	>140	—	≤140	≤140	<7.2	100
Pine	28-31	>140	—	≤140	≤140	<8.1	100
Poplar/ Cottonwood	35,36	>80	≤18	≤120	≤80	<16.0	100
Aspen	41,42	>80	≤18	≤120	≤80	<16.0	100
Birch	40	>80	≤18	≤120	≤80	<16.0	100

Data source and comments

1. Older stands will be excluded from the timber harvesting land base if the specified minimum volume per hectare is not met.
2. Younger coniferous stands will be excluded from the timber harvesting land base if their site index is below that specified (the minimum required to reach a volume of 140 m^3/ha by age 141).
3. Younger deciduous stands will be excluded from the timber harvesting land base if their site index is below that specified (the minimum required to reach a height of 18 metres by age 81).
4. Criteria for conifer species were developed based on current performance and discussions with regional analysts, and licensees in the Mackenzie TSA.
5. Since there is very little deciduous performance history in the Mackenzie TSA, criteria for deciduous species are based on the professional opinions of Mackenzie District staff and supporting data from regional analysts.

5.2.7 Roads, trails, and landings

Separate estimates are made to reflect the loss in productive forest land because of existing and future roads, trails and landings (RTL). Existing RTL estimates are applied as reductions to the current productive forest land considered available for harvesting, and future RTL reductions are applied after stands are harvested for the first time.

All highways and larger municipal roads are of a sufficient size to be mapped as polygons and classified as non-forest areas in the forest inventory file. These polygons are thus removed from the timber harvesting land base as non-forest area, as discussed in Section 5.2.2, "Land classified as non-forest and non-productive forest." All other roads, trails and landings are depicted only as lines on forest cover maps, and have no associated polygons. These areas are described in Table 9.

Table 9 Estimates for existing and future roads, trails, and landings

Road status	Road length (meters)	Road width (meters)	Area reduction (ha)
Existing RTLs			
Non - Status	4 042 787	20	8 086
Mainline	1 126 970	20	2 254
Operational	1 247 480	15	1 871
Future RTLs			**(ha/year)**
All	150 000	20	300
All	150 000	10	150

Data Source and comments

Non - Status road information was collected through the Watershed Restoration Program. Mainline and operational road reductions (includes access & in-block roads) were compiled from the major licensee's 1994 - 1998 Road Construction Financial reports. Road width includes the running surface, ditch line plus the area cleared for visibility/safety concerns. The percent reduction for existing road will be determined after the inventory file is reviewed, and will be applied to stands with a harvesting history.

It is estimated that the major licencees will require 300 km of future road per year to access timber until the TSA is fully roaded. Fifty percent will be 20m wide and 50% will be 10m wide. The amount of future road is estimated at 450 hectares per year or a 4.5% reduction for future RTLs assuming an annual harvest of 10 000 hectares. These figures are based on information from the Engineering Department of the Mackenzie Forest District.

5.2.8 Cultural heritage resource reductions

An archaeological overview assessment of Mackenzie TSA was completed in 1997. This assessment is currently being refined to increase its operational utility. As part of their operational planning, the major licensees and the Small Business Forest Enterprise Program complete additional archaeological and cultural heritage assessments when appropriate.

Based on the studies to date, cultural heritage resources (both known and those identified in future inventory projects) will be protected or managed through the careful location of old-growth management areas, riparian reserves, wildlife tree patches, and other reductions to the timber harvesting land base. Furthermore, since natural succession changes the timing and location of traditional harvests of berries, herbs, medicinal plants, and wildlife, it is expected that changes induced through harvesting and silviculture can be accommodated in a similar manner. Therefore, no additional reductions are included to address this resource.

5.2.9 Wildlife habitat reductions

Some wildlife habitat areas are coded as ESAs, and are therefore partially excluded from the timber harvesting land base as described in Table 5. The proposed LRMP includes measures to protect caribou, grizzly bear, moose and mountain sheep habitat. Since the LRMP has not been formally approved, these wildlife measures cannot be considered current management. The potential timber supply impacts of the LRMP recommendations will be examined in a sensitivity analysis.

The previous analysis for the Mackenzie TSA incorporated deferrals and old forest requirements for several areas of wildlife habitat, including the Upper Ospika Valley and Russell Range. These measures are not current practice at this time. However, provisions for maintaining old-seral forest to manage landscape-level biodiversity are believed to achieve many of the wildlife habitat objectives that the measures modeled in the last analysis were designed to achieve. In addition, the proposed LRMP contains significant wildlife management provisions, which will be assessed in a sensitivity analysis.

5.2.10 Riparian reserve zones

Regional BCFS staff studied the impact of Forest Practices Code provisions on three map sheets in 1995 and recommended the reductions that will be used in the analysis (Table 10).

Table 10 Riparian reserve and management zones

Location	Reduction percent
Riparian reserves	5.16
Riparian management zones	1.95
Regional lakeshore guidelines	0.06
Total reduction	7.17

Data Source and Comments:

After reviewing the three maps (93N.059, 93O.055 & 94C.035) it was found that only one stream that was previously unclassified had now been classified (map 93N.059, from unclassified to stream class S3 [500m long * 2.39m wide {avg. stream width}]). BCFS and BC Environment representatives reviewed the information from the three map sheets and are satisfied that the existing information is representative of the TSA. The deduction will be applied equally to all stands after deductions discussed in previous sections have been performed.

5.2.11 Exclusions of specific, geographically defined areas

This section specifies the location of areas to be excluded from the timber harvesting land base to account for area exclusions that are part of current forest management, and are not accounted for in other sections.

The Kemess power line and Kemess mine site will be removed from the timber harvesting land base. The power line right-of-way is 70 meters wide and is shown as a power line on the forest cover inventory. The cleared area of the power line consists of 2827.4 hectares (gross) and 2280.9 hectares of timber harvesting land base as indicated in appraisals of the licences to cut. The gross area of the mine site is 7415.6 hectares as specified by the licence-to-cut (exhibit A) of which 938.6 hectares have been cleared.

The McLeod Lake treaty agreement has been signed off by all parties. The treaty provides for transfer of approximately 21,000 hectares from the Crown land bases of the Prince George and Mackenzie TSAs to members of the McLeod Lake Band. There is also the option for a limited number of Band members to take land as individuals within the McLeod Lake traditional territory, mostly in the Prince George TSA. Only about 500 hectares of the area to be transferred is within the Mackenzie TSA. Details of the transfer of land are expected to be complete by fall 2000. Since the details are uncertain at this time, no adjustments are planned for the Mackenzie TSA base case. Any impact of the treaty agreement on timber supply in the Mackenzie TSA will be acknowledged in the AAC determination; however, given the small area involved in the Mackenzie TSA, the impact is likely to be negligible.

6. Current Forest Management Assumptions

6.1 Harvesting

6.1.1 Utilization levels

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

Table 11 Utilization levels

Analysis unit	Utilization		
	Minimum diameter at breast height (cm)	Maximum stump height (cm)	Minimum top diameter inside bark (cm)
All conifer units	12.5	30	10
All deciduous units	12.5	30	10

Data Source and Comments:

Table 11 reflects current regional standards, licence requirements and current performance.

6.1.2 Volume exclusions for mixed species stands

In the Mackenzie TSA, the deciduous species in predominantly coniferous stands are not normally harvested. As shown in Table 12, the unharvested deciduous portion of coniferous-leading stands will not contribute to the estimated stand volumes.

Table 12 Volume exclusions for mixed species types

Inventory type group	Species	Volume exclusion (%)
All coniferous leading	Deciduous	100

Data source and comments:

The exclusion pertains to only the deciduous timber volumes in coniferous-leading types. The deciduous trees may contribute to biodiversity and coarse woody debris objectives at the stand level. Deciduous-leading stands do contribute to the harvesting land base, except where excluded for other netdowns noted in the data package.

6.1.3 Minimum harvestable age derivation

The minimum harvestable age is the time required for stands to grow to harvestable size; it defines the lower limit for harvesting. Harvesting may occur in stands at the minimum age to meet a harvest target for a short period of time or avoid large and abrupt changes in harvest levels. However, most stands will not be harvested until well past the minimum ages to maximize long-term timber production, maintain consistent harvest flow and manage objectives for other resource values (e.g., requirements for the retention of older forest).

Information compiled for the minimum criteria to harvest in near and far zones is listed in Table 13 for conventional, cable, and helicopter logging.

Table 13 Minimum harvestable age criteria

Operating zones	Height (m)	Diameter (cm)	Volume (m^3/ha)
Spruce			
Conventional			
Near	18	20	140
Far	18	22	160
Cable			
Near	22	25	200
Far	22	28	250
Helicopter			
Near	22	30	200
Far	22	28	270
Pine			
Conventional			
Near	18	20	140
Far	17	22	160
Cable			
Near	22	25	200
Far	22	28	250
Helicopter			
Near	22	30	240
Far	22	28	270
Balsam			
Conventional			
Near	18	20	140
Far	18	22	180
Cable			
Near	22	25	220
Far	22	28	250
Helicopter			
Near	22	30	240
Far	22	30	270

6. Current Forest Management Assumptions

The criteria listed in Table 13 above are based on:

1) the Mackenzie Forest District staff experience with present harvesting operations; and
2) a review of yield tables for a range of site indices (10 to 36 metres @ 50 years in 2 metre increments) for the commercial species in the forest district. This review indicated that stands were generally harvestable when they have attained two of the criteria listed in Table 13.

Once the timber harvesting land base is defined and yield tables developed, the minimum harvestable ages will then be inferred for conifer species. The minimum harvest age for deciduous-leading stands is 60 years, based on the minimum regional standard.

6.1.4 Harvest scheduling priorities

For the Mackenzie TSA , the timber supply model will place first priority for harvest on stands furthest from their minimum harvestable age (relative oldest first).

6.1.5 Logging method

The primary logging method in the Mackenzie TSA is conventional, ground-based harvesting. Cable and helicopter logging account for less than 14 percent of the harvest (Table 14).

Table 14 Logging method

Logging method	Percent of annual harvested area
Conventional	86%
Conventional/Cable	5%
Cable	7%
Helicopter/Combination	1%
Helicopter	1%

Data Source and Comments:

The figures are based on the percent of annual harvest per year (1994 to 1998) by major licencees and the Small Business Forest Enterprise Program.

6.1.6 Silviculture systems

Clearcutting is the harvest method used for all analysis units within the Mackenzie TSA. Silviculture prescriptions (SPs), and the Ministry of Forests computerized tracking systems (FTAS and MLSIS) indicate that a significant number of openings are clearcuts with reserves. These openings are clearcuts, with riparian reserves and wildlife tree patches forming the “reserves” identified in the silviculture system label. The reserves are included in the landbase not available for harvesting. Therefore, clearcuts with reserves will be modelled as clearcuts.

6. Current Forest Management Assumptions

6.2 Unsalvaged losses

Table 15 shows the estimated average annual unsalvaged volume loss to catastrophic events such as insect epidemics, and fires, on the timber harvesting land base. The unsalvaged loss column reflects only those areas in which the volume will not be recovered or salvaged.

Table 15 Unsalvaged losses

Cause of loss	Unsalvaged losses (m^3/year)
Fire	39 900
Spruce bark beetle	91 600
Balsam bark beetle	40 500
Mountain pine beetle	800
Total	172 800

Data Source and Comments:

Unsalvaged losses resulting from fire and balsam bark beetle (Table 15) were determined using the ratio of timber harvesting land base and crown forested area from the LRMP database. Fire losses were determined using data from the Protection Branch fire reporting system for the period from 1988 to 1998. Nineteen ninety eight fire data was collected by district staff. Gross volume losses for fire are based on ocular estimates and district staff experience.

Estimates of spruce and balsam bark beetle losses are based on data collection and mapping of attacked areas for ten-year and eight-year periods, respectively. Mountain pine beetle is a relatively new problem in the Mackenzie TSA and has been tracked for a three-year period. Data collection for budworm has not been completed; however, the effects of budworm damage are factored into the yield curves for unmanaged stands. There is no information regarding unsalvaged losses for wind damage in the Mackenzie TSA.

6. Current Forest Management Assumptions

6.3 Silviculture

6.3.1 Regeneration activities

The silviculture program reflects the mix of treatments expected to be carried out to achieve basic silviculture on all sites. Table 16 shows the proportion of each analysis unit to be treated under each silviculture regime.

Recent plantations and future stands will be projected using managed stand yield tables (MSYTs) produced using the Forest Service table interpolation program for stand yields (TIPSY) growth and yield model. A MSYT may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables are produced for the different regeneration methods (each method and species combination) and then combined into one table.

Table 16 Regeneration assumptions by analysis unit

Analysis unit	Species composition	Regen delay (years)	OAFs (%)		Regen method	Regen species	Per cent (%)	Density initial (sph)
			1	2				
1, 2, 3	Balsam	3	15	5	Plant	Spruce	100	1400
4, 5, 6	Spruce	3	15	5	Plant	Spruce pine	80 20	1400
7, 8, 9	Pine	3	15	5	Plant	Pine	100	1300
10, 11	Poplar/ cottonwood	3	15	5	Natural	Poplar/ cottonwood	100	1400
12, 13	Aspen	3	15	5	Natural	Aspen	100	1400
14, 15	Birch	3	15	5	Natural	Birch	100	1400

Data Source and Comments:

Operational adjustment factors (OAFs) are used to adjust timber yield estimates to account for operational factors. OAF1 is a constant percentage reduction to account for small stocking gaps within stands. OAF2 accounts for losses that increase with stand age, for example decay due to disease. In this case OAF2 increases from 0 at stand establishment and passes through 5% at 100 years of age. Provincial average operational adjustment factors (OAFs) values will be applied to the managed stand yield curves as recommended by the Ministry of Forests, Research Branch, as no local OAFs are available.

No thinning is expected based on the initial density values. Regeneration delays reflect current operational practice.

6.3.2 Immature plantation history

This section identifies areas of existing immature forest where the density (stems per hectare) has been controlled, therefore justifying growth projection based on managed stand yield tables (MSYTs).

Table 17 Immature plantation history

	Area managed/unmanaged (%)			
	Age 1 - 12	**Age 13 - 20**	**Age 21 - 30**	**Age 31 - 40**
Managed	100	60	60	60
Unmanaged	—	40	40	40

Data Source and Comments

Data was obtained from the Integrated Silviculture Information System (ISIS) and the Major Licensee Silviculture Information System (MLSIS). Growth for managed stands will be projected using TIPSY, where information is available. The unmanaged portion will be projected using VDYP.

6.3.3 Not satisfactorily restocked (NSR) areas

Type identity classifications of 4 or 9 identify the land base that is not satisfactorily restocked (NSR). An NSR label is used to denote forest lands that are not growing to their full potential due to insufficient stocking of preferred and/or acceptable tree species. Table 18 identifies the total area of NSR in the timber harvesting land base from the forest district silviculture records.

Table 18 Not satisfactorily restocked (NSR) areas

	Total	**Hectares of NSR (time since disturbance)**		
	Area (ha)	**1 – 10 years**	**11 – 20 year**	**>20 years**
CURRENT NSR				
logging disturbance				
all Analysis Units (MLSIS)	1172	1172		
all Analysis Units (SBFEP)	1143	1143		
Subtotal	2315	2315		
wildfire disturbance				
all Analysis Units	9362	9362		
Total CURRENT NSR	11677	11677		
BACKLOG NSR				
logging disturbance				
all Analysis Units	5857		2293	3564
wildfire disturbance				
all Analysis Units	21207		7951	13256
Total Backlog NSR	27064		10244	16820
TOTAL NSR	**38741**	**11677**	**10244**	**16820**

6. Current Forest Management Assumptions

Data Source and Comments:

Data is from the Integrated Silviculture Information System (ISIS) and Major Licensee Silviculture Information System (MLSIS) databases.

Information from a (1995-1998) reclassification project and the planting of 1648 hectares of backlog NSR indicate that the amount of backlog NSR land base from logging is 5857 hectares. The amount of NSR in the forest inventory file will not be available until processing of the file is complete. Any discrepancy in area between the forest inventory files and district MLSIS/ISIS records (which are more up-to-date), aside from inoperable considerations, will be assumed to have already been restocked, and will be assigned an age between 1 and 5 years old. This area will be assigned to analysis units in proportion to the distribution of analysis units by biogeoclimatic zone on the timber harvesting land base, as the previous stand label is no longer available on the inventory file.

ISIS indicates that 21 600 hectares have been subject to wildfire disturbance since 1987. Of this area, 9362 hectares are classified in ISIS as NSR. These areas have differing levels of disturbance severity, site quality, accessibility, and operability. NSR estimates in the future will be adjusted as new information becomes available. Where reforestation investments cannot be justified, the NSR label will be replaced with an accurate inventory label.

All NSR within the operable land base will be included in the timber harvesting land base. Any NSR within the inoperable portion of the land base will be reviewed with district staff when the forest inventory file is available to determine if this area should contribute to the timber harvesting land base.

Current NSR caused by logging will be planted within the three-year regeneration delay period to a target stocking density. The reforestation efforts on backlog NSR areas will be based on provincial priority guidelines (1982-1987 backlog NSR on good, medium, poor sites and pre-1982 backlog NSR on good and medium sites) aiming to eliminate all backlog NSR areas by the year 2010. Backlog NSR will be restocked to analysis units in proportion to the current species distribution in stands 10 years of age and under in each analysis unit. This is based on the assumption that the overall species distribution of harvests has not changed significantly over the last 10 years.

6.4 Integrated resource management

6.4.1 Forest cover objectives

As noted in Section 4.1, "Management zones, groups and multiple objectives," forest cover requirements may be applied to a number of different types of areas including landscape units, wildlife areas, or visual quality areas. Forest outside of the timber harvesting land base may contribute to some forest cover requirements (i.e., maximum allowable disturbance or minimum area retention). The following forest cover requirements will be applied to each resource emphasis group within each landscape unit.

6. Current Forest Management Assumptions

Table 19 Forest cover requirements

Forest cover objectives					
Resource emphasis	**Green-up height (metres)**	**Green-up maximum allowable disturbance %**	**Minimum older age (years)**	**Minimum area of older age retained (%)**	**Land base constraints apply to**
Visual quality — retention	3	3	N/A	N/A	Crown forested area
Visual quality — partial retention	3	10	N/A	N/A	Crown forested area
Visual quality — modification	3	20	N/A	N/A	Crown forested area
Visual quality — maximum modification	3	32.5	N/A	N/A	Crown forested area

Data Source and Comments:

The non-contributing forest (area outside the timber harvesting land base) within each landscape unit is assumed to age over time.

All stand heights shown in the table above refer to top heights (inventory definition).

No specific forest requirements for an integrated resource management zone will be applied. IRM forest cover requirements are expected to be achieved through management for landscape- and stand-level biodiversity. Sensitivity analysis will be used to examine the potential timber supply impacts of green-up requirements in areas not subject to visual quality requirements.

Visual quality objectives (VQO)

VQO constraints restrict the amount of harvesting within visual landscapes. The *Framework for Managing Visual Resources to Mitigate Impacts on Timber Supply* was used in determining the visually effective green-up (VEG) heights. *Procedures for Factoring Visual Resources into Timber Supply Analyses* were used in determining green-up disturbance percentages.

6. Current Forest Management Assumptions

Old growth retention

Landscape-level biodiversity guidelines will be modelled using information from the *Forest Practices Code Landscape Unit Planning Guide* (LUPG).

To ensure that older forests are maintained throughout the TSA, forest cover requirements will be applied to each biogeoclimatic variant within each draft landscape unit. The landscape units are not yet finalized; however, as the draft units are available in digital format they will be used as a modelling tool to simulate the geographic retention of older forest characteristics across the Mackenzie TSA. This does not imply these units are final.

A process to formally establish biodiversity objectives for each landscape unit is currently underway and will be completed over the next several years. As a first step in this process, interim biodiversity emphasis options (BEOs) were developed by Mackenzie Forest District staff for approximately two-thirds of the TSA in consultation with MELP staff and licensees. While these interim BEOs have not been formally designated, they are currently being used in development plan approvals. The interim BEOs will be incorporated in the base case for the Mackenzie TSA. Draft biodiversity emphasis options and landscape unit boundaries for use in the regional landscape unit planning (RLUP) process were approved by the Mackenzie forest district manager and the designated environment official. However, these boundaries and emphasis options are not currently being used operationally.

Sensitivity analysis will be undertaken to assess the timber supply impacts of both the RLUP draft BEOs, and average weighted old-seral requirements, based on the anticipated distribution of approximately 45% lower, 45% intermediate and 10% higher biodiversity emphasis. The latter approach is often used when LUs and BEOs have not been formally designated, and it is unknown which landscape units will be assigned specific BEOs.

It will be assumed that in areas subject to low biodiversity emphasis, the old-seral requirements will be phased in over three 80-year rotations, as discussed in the LUPG. If the weighted average requirements are used, they will be adjusted to reflect the phase-in.

6.4.2 Reduction to reflect volume retention in cutblocks

Wildlife Trees (WT) and Tree Patches (WTP)

Wildlife tree patches (WTPs) are the primary method used by major licensees to maintain mature stand structure elements over time. Plans are to maintain WTPs for one rotation. If harvested before that time WTPs of comparable size and structure will be identified as replacements.

An area reduction will be used to model wildlife tree patch requirements because it more accurately reflects current management and thus the area upon which harvesting will occur. These wildlife tree patches, in conjunction with other riparian reserves and area removals, are generally larger than two hectares in size and are left to maintain stand structure within the landscape over time. As the wildlife tree patches are larger than two hectares in size, this area will contribute to meeting seral-stage forest requirements at the landscape level. It is assumed that wildlife tree patches will not be economical to harvest at a later date, and will be retained as WTPs during subsequent harvests of the stand.

Table 20 Reductions to reflect volume retention in cutblocks for wildlife tree patches

Management zone	Analysis unit	Persistence	Per cent (%) recommended in applicable guidebook	Residual area estimate on the timber harvesting land base (%)
All	All	Long term	8	4

Data Source and Comments:

The figure of 4% shown in Table 20 is based on a review of the Mackenzie TSA land base by landscape unit and variant and guidance from the *Forest Practices Code Biodiversity Guidebook* (BG), and the *Landscape Unit Planning Guide* (LUPG) Table A3.1. The percentage of the timber harvesting land base logged since 1970 was calculated along with the percentage of the available timber harvesting land base and the appropriate wildlife tree patch retention number was selected from Table A3.1. These percentages were prorated by landscape unit and variant area to arrive at the 8% figure for the Mackenzie TSA. The number was halved since up to 50% of the target can be met by forest outside of the timber harvesting land base (BG).

One hundred and twenty silviculture prescriptions approved within the last 5 years from 12 operating areas within the TSA were sampled by district staff. The sample, after adjustment for other factors indicates a wildlife tree patch percent of 3.7% for the gross area (6331 ha) from the silviculture prescriptions. This figure is only an approximation; however, it indicates that a 4 % net down is reasonable.

7. Sensitivity Analyses

Sensitivity analysis provides a measure of the timber supply impact of uncertainty in management assumptions and/or data. By developing and performing a number of sensitivity analyses, it is possible to determine which variables most affect results. Issues that are particular to the Mackenzie TSA (Table 21) are listed separately from standard sensitivity analysis that are carried out for all TSAs (Table 22).

Table 21 Sensitivity issues specific to the Mackenzie TSA

Issue to be Tested	Sensitivity Levels
Marginal stands option 1 (see Table 7)	Include both near and far zone marginal stands
Marginal stands option 2	Exclude both near and far zone marginal stands
Conventional logging in the far zone	Exclude stands in the far zone with slopes $\geq$30%
Deciduous-leading stands	Include areas north of Peace Arm in the near access zone Include deciduous-leading areas in the far zone
Resource management zones from LRMP	Assign the objectives from the Mackenzie LRMP for the proposed resource management zones representing 5 categories: Settlement/Agriculture; Multi-Value; Resource Development; Special Management.
Proposed protected areas (draft Mackenzie LRMP)	Exclude the area covered by the following proposed protected areas: Gataga, Kwadacha Park addition; Finlay-Russel, Ospika Cones, Ed Bird – Estella Lakes, Chase, Omineca, Muscovite Lakes, Germansen Lake, Heather – Dina Lakes, Pine Pass,
Proposed wildlife management included in the draft Mackenzie LRMP (caribou, grizzly bear, moose, elk, sheep, bull trout, and arctic grayling)	Include constraints on harvesting as indicated in the draft LRMP.
Fish habitat	Objectives for fish habitat management area from LRMP
Proposed and recommended VQO	Forest cover requirement from LRMP
Management of conifer in deciduous leading stands	Where conifer comprises at least 40% of the stand assess the effect of managing these stands for conifer (planting) versus natural regeneration.
Draft Regional Landscape Unit Planning Strategy (RLUP) biodiversity emphasis options	Objectives from the Draft RLUP Strategy – assess timber supply impacts of biodiversity emphasis options for specific landscape units.
Deciduous timber in conifer leading stands	Assess the impact of including deciduous component in the analysis.
Helicopter operability	Exclude helicopter operable areas from timber harvesting land base.
Balsam-leading stands	Asses contribution of balsam stands to timber supply.
Average landscape-level old-seral requirements	Assess impacts of old-seral requirements that assume 45% lower, 45% intermediate and 10% higher biodiversity emphasis.

7. Sensitivity Analyses

Table 22 Standard sensitivity analysis

Issue to be Tested	Sensitivity Levels
Existing stand yields	+/- 10%
Regenerated stand yields	+/- 10%
Minimum harvestable age	+/- 10 years
Land base changes	+/- 10%
Green up periods	+/- 5 years
Old-growth site index adjustement	adjust site indexes according to provincial study results
Tree improvement	consult with Tree Improvement and Research Branches

There are no studies on site index adjustments specific to the Mackenzie forest district. Therefore, provincial figures for old-growth site index (OGSI) adjustments will be used for sensitivity analysis. Sensitivity analysis will also be conducted to test the potential effect of using genetically improved seedling stock in the Mackenzie TSA.