TIMBER SUPPLY ANALYSIS

DATA PACKAGE

NORTH COAST TIMBER SUPPLY AREA

TIMBER SUPPLY REVIEW 2006

VERSION 4

Prepared for:
The North Coast DFAM Group
FIA Project NC 6466 001

In Partnership with Tsimshian Nations:
Lax Kw'alaams
Metlakatla
Gitga'at
Kitkatla Gitxaala

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Timberline
Forest Inventory Consultants

This document was prepared to support an allowable annual cut determination by British Columbia's Chief Forester. To learn more about this process please visit the following website:

http://www.for.gov.bc.ca/hts/

Or contact:

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DOCUMENT HISTORY

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1	Initial Outline	March 14th, 2004	Davide Cuzner
2	First Draft	March 25th, 2004	Davide Cuzner
3	Second Draft	June 9th, 2004	Davide Cuzner
4	Final Report	June, 2006	Timberline

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1.0 INTRODUCTION

A timber supply review process has been initiated for the North Coast Timber Supply Area (TSA). Viking Ecosystem Consultants Ltd., on behalf of the North Coast Forest Licence Group, is preparing timber supply information for the analysis. These reviews are conducted every five years and assist the Forest Service's Chief Forester in re-determining allowable annual cuts (AAC). For the North Coast Timber Supply Area, the Chief Forester will determine a new AAC late in 2006.

The allowable annual cut for the North Coast TSA was set in 1985 at 600,000 m^3 per year and was maintained at that level in the 1995 Timber Supply Review No.1 (TSR 1) AAC determination. The second TSR rationale for AAC determination was published in January of 2001. At that time the AAC was reduced to 573,624 m^3 per year. Since then there has been and order of reduction for 25,600 m^3 per year to address the Nisga'a land claim (Section 177 of the Forest Act) and an order of reduction for 27,000 m^3 per year to address the Central Coast Designated areas (Section 173 or the Forest Act). The current AAC at the time of this timber supply process (TSR 3) is 521,024 m^3 per year.

This data package was provided to the public and First Nations for review prior to initiation of the timber supply analysis for TSR 3. Although it is a technical document for a technical audience, every effort has been made to ensure that it is self-explanatory.

The data package allows the reader to consider the inputs and assumptions to be used in the timber supply analysis. This includes:

- The documentation of inventory data and sources;
- Classification of the land base according to each hectare's contribution to management (harvest, resource management for wildlife, etc.);
- Land productivity estimates and prediction of stand growth and timber yield;
- Silviculture and harvesting regimes;
- Action taken to model multi-resource requirements;
- Modelling structures to address the North Coast Local Resource Management Plan (LRMP); and
- Timber supply scenarios and sensitivity analyses to be evaluated.

This document will evolve and be finalized when published as an appendix to the timber supply analysis report. There will be another public review at that time.

Defined Forest Area Management (DFAM), developed by the provincial Ministry of Forests and Range (MoFR), is a policy framework to identify the obligations and opportunities for collaborative forest management within the province's TSAs. Under DFAM, forest companies and BC Timber Sales (BCTS) will assume collective responsibility for timber supply analysis and forest health activities within each TSA.

Although DFAM imposes a collective responsibility, it does not impact on harvesting rights or obligations associated with each forest license. The Chief Forester will continue to hold responsibility for the determination of the AAC as per the current legislation. DFAM is intended

to provide a foundation for advanced stewardship activities including strategic and tactical level planning, enhanced forest management and certification. Under the proposed legislation, DFAM participants within each TSA will be required to collaboratively carry out a timber supply analysis at least once every five years.

This document is a key component of the timber supply analysis and is a required component of the provincial TSR for the North Coast. The timber supply analysis forms the major body of technical information used by the Chief Forester to determine AAC for TSAs under Section 8 of the *Forest Act*. Timberline Forest Inventory Consultants Ltd. will be conducting the timber supply analysis on behalf of the North Coast DFAM group using the information contained in this Data Package.

The DFAM analysis for the North Coast TSA will attempt to model current harvesting and silviculture practices using the best available inventories to determine how they affect short and long-term timber supply. Upon completion of the analysis, the Chief Forester will consider the results, public input, related economic, environmental and social factors to determine the appropriate AAC for the TSA. As part of his determination, the Chief Forester may identify areas where improved information is required for future timber supply forecasts.

Section 8 of the *Forest Act* requires the Chief Forester to consider the following factors when determining the AAC for public forestland in British Columbia:

1. The rate of timber production that may be sustained *from* the area, taking into account:
    - The composition of the forest and its expected rate of growth;
    - The time that it will take the forest to become re-established;
    - Silviculture treatments, including reforestation;
    - Standards of timber utilization; and
    - Constraints on the amount of timber that may be produced due to use of the forest for other purposes.

2. How alternative rates of timber harvesting will impact the province in the short and long terms.
3. The nature, production capabilities and timber requirements of established and proposed processing facilities.
4. The economic and social objectives of the Crown for the area, region and province as expressed by the Minister of Forests and Range.
5. Abnormal insect or disease infestations and major timber salvage programs planned for the area. Some of these factors can be measured and analysed while others may not be part of the analysis due to lack of information.

There have been several changes since the last timber supply analysis which was completed as part of the MoFR TSR program. These changes include:

1. TSA boundary change (approx. 92,000 ha from the North Coast TSA was transferred to the Nass TSA and 6,000 ha from the Kalum TSA was transferred to the North Coast TSA).

2. Transfer of North Coast TSA to the Nisga'a Lands (approximately 58,000 ha).
3. Forest re-inventory.
4. New operability lines, which increased the area considered operable for timber harvesting.
5. Riparian stream classification study -- increase in area reserved for riparian reserve zones (7.49% from 4.8%).
6. Increase in the area of existing unclassified roads, trails and landings (1,697 ha from 1,430 hectares).
7. Increase in the volume of unsalvaged losses to account for blowdown (from 2,034 to 10,084 cubic metres/year).
8. Decrease in all volume over age curves by 1% to account for identified wildlife.
9. Managed stands were defined as 24 years old (from 21 years, three years ago).
10. Forest cover requirements for about 300 hectares of community watersheds within the timber harvesting land base were applied.
11. Decrease in area managed by the MoFR to account for the potential Kitasoo Spirit Bear Protection Area.
12. Decrease in allowable annual cut from 600,000 m^3/year to 573,624 m^3/year.

Under the DFAM initiative DFAM groups, made up of licensees, will be responsible for performing timber supply analyses and other activities related to the TSR. The licensees for the North Coast DFAM area are:

- International Forest Products Ltd.;
- Triumph Timber Ltd.;
- Boyle & Dean Forest Products Ltd.;
- Thomson Industries Ltd.; and
- BCTS.

This document describes the purpose of the timber supply analysis data package. It reviews the obligations, roles and responsibilities of different parties, and provides the framework for submission of data and information needed for timber supply analysis. The data package will be made available to the public and First Nations for consultation. First Nations' whose traditional territories lie within the North Coast TSA include:

- Lax Kw'alaams – Port Simpson;
- Gitga'at – Hartley Bay;
- Metlakatla;
- Gitxaala- Kitkatla;
- Haisla;

This document will be made available to staff from the MoFR, and Ministry of Environment (MoE) for review and comment.

A detailed analysis of the data package assumptions will be completed following the public review. It is expected that the Chief Forester will determine the new AAC late in 2006 after considering all relevant information, including public input. His determination will be put forward in a *rationale statement* at the end of the North Coast DFAM process.

Questions or comments on the Data Package should be directed to the Regional Timber Supply Forester at your earliest convenience:

Regional Timber Supply Forester
Ministry of Forests and Range
Coast Forest Region
2100 Labieux Road
Nanaimo, B.C.
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1.1 Description of the North Coast TSA

The North Coast TSA is located along the coast of northwestern British Columbia and is administered by the North Coast Forest District office in Prince Rupert. The TSA covers approximately 1.91 million hectares and includes the communities of Prince Rupert, Port Simpson, Metlakatla, Kitkatla and Hartley Bay.

North coast forests are rich in natural resources including timber, water, fish and wildlife. The rugged coast mountain terrain is dominated by western hemlock and western red cedar, with rich valley bottoms along the Skeena River that have isolated pockets of cottonwood and alder stands.

This diverse landscape is home to a variety of terrestrial and marine wildlife, including black-tailed deer, grizzly and black bears, wolves, sea mammals, raptors, and sea birds. Some of the most beautiful and productive rivers are located in the North Coast TSA, and are popular destinations for anglers pursuing salmon, Steelhead, Dolly Varden, char and various other species.

The Khutzeymateen Provincial Park, Canada's first grizzly bear sanctuary, offers exceptional wildlife viewing opportunities. Other recreation opportunities abound in forest and marine environments, particularly salt water angling for salmon and halibut, along with ocean kayaking, scuba diving and big-game hunting. The North Coast forms part of the Inside Passage, a world-renowned cruise ship route enjoyed by close to one million visitors every year.

The North Coast TSA is one of the few areas in the province, outside of the lower mainland, where forest-based employment is exceeded by other industrial sectors. Historically commercial

fishing and fish processing were the largest commercial sectors, followed by pulp manufacturing, lumber manufacturing and timber harvesting.

Within the last decade, the economy in the North Coast has been hard hit by a downturn in the commercial forestry and fishing industries. A significant blow to the Northwest economy occurred in 2001 with the temporary closure of the Skeena Cellulose Inc. pulp mill at Watson Island and associated sawmills and logging operations in Terrace and Hazelton.

Prior to the cessation of the New Skeena operations, the forest industry manufacturing and harvesting sectors generated close to 540 direct and indirect jobs within the TSA, and over 1000 additional direct and indirect jobs in other parts of the Province.

Timber supply is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth and the social and economic factors that affect the availability of trees for harvest, changes over time.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit, or timber supply area (TSA). Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

The tables and discussion provided in this document outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the North Coast TSA timber supply analysis. This information represents current forest management in the North Coast TSA. The LRMP area follows the TSA boundary approximately, but does not include Princess Royal Island. Although a portion of TFL 25 is within the North Coast LRMP area, it is not currently included in this timber supply analysis due to data issues.

1.2 Land Use Planning within the North Coast TSA

There is currently an LRMP in progress, which will be presented to Government for review by the summer of 2004. Cabinet has endorsed the initiation of the North Coast LRMP. The Plan is intended to support sustainable economic development by contributing to the economic well being of First Nations and coastal communities and protecting the environmental values unique to the north coast of BC.

The process is intended to reflect government's new streamlined approach to land use planning with an emphasis on smaller table size, tighter timeframes and enhanced Government leadership.

Decisions from that process that may impact area available for harvesting may be considered as sensitivities in the analysis if there are specific issues identified during the public consultation process.

1.2.1 Purpose of the Data Package

The purpose of the timber supply analysis data package is to:

- Provide a detailed account of the management unit-specific land base, growth and yield, and management assumptions related to timber supply. The Chief Forester must consider how the management assumptions will be modelled in the timber supply analysis and be applied under the *Forest Act* when determining the AAC;
- Provide a means for communicating data inputs and analysis methodology among licensees, MoFR, MoE, and other users;
- Provide MoFR staff with the opportunity to review the data and information that will be used in the timber supply analysis before it is initiated;
- Ensure that all relevant information accounted for in the analysis is to a standard acceptable to MoFR staff; and
- Provide the evidentiary basis for the information used in the analysis.

The Data Package provides information on:

- Forest and other resource inventories and adjustments;
- Definition of the land base suitable for timber harvesting;
- Classification of the land base into management zones, and growth and yield classes (analysis units);
- Development and provision of timber growth and yield information;
- Forest protection and salvage;
- Resource management emphasis; and
- Timber supply analysis methods, including model choice and management scenarios.

1.2.2 Process, Roles and Responsibilities

The MoFR plays a key role in reviewing and accepting the Data Package and the analysis. They have provided technical support, facilitated resolution of issues, and validated technical information. The following table shows the general roles and responsibilities associated with the timber supply analysis leading to an AAC determination.

Table 1.1 - Roles and responsibilities

DFAM group obligations	Government obligations
Collect and prepare a data package based on the best available information.	Set standards for the data package Review and accept the data package
Complete an analysis for the North Coast TSA	Set standards for the analysis Review and accept the analysis
Provide information to the public and First Nations	Consult with First Nations Determine the AAC for the North Coast TSA

1.3 Inventory and Model Files

The Data Package had been prepared using the best available inventory information. A digital ArcInfo format file and a detailed inventory file (digital ASCII format) were used to generate a resultant file with all relevant analysis data. This resultant file included the definition of the timber harvesting land base (THLB) for the base case and all management zones and analysis units.

All attributes of the detailed resultant file were accompanied by the detailed field descriptors. This information will enable the timber supply analyst to review the applied land base reductions and facilitate TSA-level strategic analysis. Table 1.2 lists the digital coverages that will be used in the analysis.

Table 1.2 – Digital inventory coverages

Coverage	Description / Source	Version or Year of Creation
Forest Cover	Ministry of Forests, VRI conversion prepared by Inventory Branch in 2001	Updated in 1999
Denudation Areas	Major Forest Licensees updates from Forest Development Plans	2004
TSA Boundaries	O.I.C. changes in 2002	2002
Operability	MSRM update	Updated in 2002
Woodlots	Tenures Branch, Ministry of Forests	2000
Environmentally Sensitive Areas	ESA's from forest cover attribute file, not updated in re-inventory	1991
Landscape Units	LUCO (from biodiversity emphasis option report)	2002
Predictive Ecosystem Mapping (PEM)	Collection data from 1997-2002	2004
3rd order Watersheds	WLAP GIS analysis using 1:20,000 TRIM	2003
Ownership	Tenures Branch, Ministry of Forests	1999
Terrain mapping (SINMAP)	MoF, Predictive terrain modelling using TRIM and Forest Cover	2004
Existing Roads	Forest Development plans, Major Licensees	2004
Scenic Areas Mapping	MoF, Made Known by District Manager in 2002	2002
Visual Landscape Inventory	MoF, Regional Landscape Forester update in 2001	1999
Community Watershed	MoF, Tenures Branch	1999
Site Index adjustments (SIBEC)	MoF & Major Forest Licensees	2004
First Nations Traditional Territories	MoF, Aboriginal Affairs Branch	2000

First Nations and licensees have requested sensitivity analyses. These will be based on similar information to the base case and will provide a better understanding of timber supply where insufficient data was available or where there is evidence supporting variation from existing inventories or management practices.

The following forest cover inventory information was collected and formatted to better understand land base definition methods, growth and yield issues and facilitating interpretation of results:

- Standards and format (VEG, FIP) of the inventory;
- Update year;
- Projection year;
- Adjustments applied;
- A description of, and reasons for, any changes or corrections made to the inventory for this analysis (i.e. changes to polygon labels);
- Date of the original inventory or re-inventories; and
- Any other information that is necessary for a complete understanding of the inventory and any associated uncertainties, including relevant audits or studies.

2.0 LAND BASE

2.1 Timber Harvesting Land Base Definition

The data package includes a description of issues, information sources, assumptions, and criteria used to estimate the land base available for timber harvesting, including any relevant data processing or adjustments.

Table 2.1 provides an example of the format for summarizing the area reductions made to the total management unit to determine the land base that is available for timber harvesting. This table lists the reductions and additions to the total land base in the order they are applied.

Table 2.1 - North Coast timber harvesting land base determination

Land Base Classification	Area excluded (ha)	Percent of total area	Percent of productive forest
Total area (incl. fresh water)	**1 830 883**	**100**	
Non-crown	40 138	2.2	
Nisga'a lands	55 389	3.0	
Non-productive	859 454	46.9	
Total Crown managed productive forest[1]	**850 794**	**46.4**	**100**
Reductions from the productive forest area:			
Inoperable/inaccessible	685 627		80.5
Non-commercial	23		0
Low site	5 844		0.7
Non-merchantable	1 161		0.1
Non-timber resources, including:			
Environmentally sensitive areas	20 345		2.4
Riparian reserves	12 201		1.4
Culturally significant	1 507		0.2
Wildlife tree patches and retention	1 492		0.2
Unclassified roads, trails and landings	1 592		0.2
Woodlots	212		0
Permanent NSR	91		0
Total reductions to productive forest:	**730 095**	**39.9**	**85.8**
Total reduced land base (including NSR)	**145 808**	**8.0**	**17.1**
Timber harvesting land base			
Less future roads, trails and landings	**7 838**		
Long-term timber harvesting land base	**137 970**	**7.5**	**16.2**

(1) Productive forest in this context denotes the forest area that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality.

Some of the land base and volume reductions and additions listed in the table may only apply to specific locations within the management area. Where appropriate, the DFAM group has listed categories over and above standard assumptions considered in the THLB definition. This is due to sensitivities surrounding land use and current forest practices.

The total productive area in the management unit is categorized and the area is deducted to determine the THLB. This includes any overlaps with other categories that were deducted during the land base reduction process. This information may be changed in the Analysis Report in October of 2004 to reflect current zoning and/or analysis unit groupings provided by the Ministry of Forests' timber supply specialists.

2.2 Exclusions from the Timber Harvesting Land Base

With Forest Inventory Planning (FIP) files (pre-VRI), ownership codes were generally used to identify land that was expected to contribute to forest management objectives, specifically timber supply, within a TSA. Areas designated as ownership code 62C or 69C were included in the productive forest. Other types such as private land, Indian reserves, ecological reserves, parks, woodlots, etc, were excluded from the THLB in the North Coast TSA.

It has been difficult for the DFAM group to collect up-to-date ownership information from the agency responsible for warehousing the data ownership coverage. The information for the North Coast has not been updated because the government determined the update to be low priority. It is likely that separate coverages for the various ownership classifications may need to be overlaid to generate accurate analysis.

2.2.1 Non-Forest and Non-Productive Forest

The North Coast inventories have been converted to VEG format based on the FIP format that classifies non-forested areas as TYPID_PR = 6 and non typed areas as TYPID_PR = 8. Table 2.2 lists the areas classified as non-forest and non-productive as used in preparation of the analysis data set along with the areas removed for each category.

Table 2.2 – Non-forest and non-productive reductions

Non-Productive Description	Area Removed (ha)
Alpine	407,719
Alpine forest	84,725
Ice	7,043
Lake	59,653
NP	207,825
NPBR	37,813
Rock	14,736
River	19,154
Swamp	7,486
Urban	1,533
NTA	11,371
Others	404
Total	859,462

The DFAM group has defined the forested land base that contributes to forest management objectives as separate reductions to the land base for the North Coast TSA. It has also been determined and documented the extent to which the forest can reasonably be expected to contribute to management objectives for both timber and non-timber resources.

Other land base deductions, such as operability, merchantability and site productivity based on site index by biogeoclimatic ecological classification (SIBEC), will address timber harvesting and production related issues, so there is no need to delineate the Crown managed productive forest. The definition of the productive forest area will, in most cases, focus on the criteria needed for an area to contribute to any forest management objective related to forest cover.

2.2.2 Inoperable/Inaccessible

Inoperable areas are areas that are not available for timber harvesting because of adverse terrain characteristics such as steep slopes, unfeasible road access or uneconomic yarding or flight distance. Specific geographic areas, like woodsheds (3rd order watersheds), have been identified as physically inaccessible to timber harvesting. Stand attributes from the inventory have also been used to account for areas not available to timber harvesting.

In October 2001, staff from MoF, MSRM and licensees updated the 1994 operability maps. The new operability presents a realistic view of where harvesting occurs. They used the Three Phase Method to determine which stands were operable. All stands coded as inoperable (I) are not included in the THLB.

PHASE 1
Physical operability limits identify a road development plan and a helicopter-zoning plan for undeveloped drainages. The road development plan includes log dumps, mainlines and log handling/storage areas. The helicopter-zoning plan includes heli-drop zones, flight distances and log handling/storage areas.

PHASE 2
Cutblock configurations from the past 9 years of logging were overlaid onto the forest cover maps to identify a timber inventory profile. The profile was then separated into six categories that were used to develop the new operability map. The six categories were:

Conv_Log Areas previously harvested under conventional harvesting systems.

Conv_4 All tree species >=400m^3/ha within a conventional zone, on slopes <60% and height class >=4 (>=28.5m).

Cony_marg Combination western redcedar stands >=250m3/ha within a conventional zone, on slopes <60% and height class >=3 (>=19.5m).

Heli_Log Areas previously harvested under non-conventional harvesting systems.

Heli_350 All tree species with *leading volume >=350 m^3/ha* within a helicopter zone, on slopes >=60% and height class >=4.

HeIi_CW_250 Leading western redcedar stands with *leading volume>=250 m^3/ha* within a helicopter zone, on slopes >=60% and height class >=3.

There is some uncertainty in the reliability of the information used to determine whether future stands would be harvested conventionally or by helicopter. However, no distinction is made in this analysis for the THLB between harvesting methods. A stand was either considered operable or inoperable.

PHASE 3
There were 32 operable areas that were considered unlikely to be harvested under any market condition, but still met the criteria according to the forest cover inventory. These areas, totalling 1,320 hectares, were further reviewed using air photos. This comparison found that errors in the forest cover file and/or TRIM data resulted in the delineation of these areas as operable. Twenty-seven of these areas (1,112 hectares) were manually coded as inoperable.

2.2.3 Non-Commercial Cover

The amount of non-commercial cover that exists on the North Coast management unit where timber production is considered to be unlikely is classified in as TYPID_PR = 5. Non-commercial forest cover areas are not considered to be significant on the North Coast.

2.2.4 Low Productivity Sites

Low productivity sites are areas that are not suitable for timber harvesting due to low timber growing potential. Sites may have low productivity because of inherent site factors or because they are not fully occupied by commercial tree species. All stands with site index estimates of less than 10 metres at 50 years of age are excluded from the THLB. Also, all age class 5 stands (81-100 years) that have not attained a height greater than height class 2 (10.5 - 19.4 metres) are excluded.

For purposes of the AAC determination it is clearer if low productivity sites are identified separately from stands that currently have insufficient volumes or timber quality and size to be merchantable. Table 2.3 summarizes the low site definitions used in identifying the THLB. Note that 100% of the stands meeting the low site definition are excluded from the THLB, most of which are removed during the inoperable step.

Table 2.3 - Low site removals

Leading species	Upper site index threshold[1]	Diameter at breast height (cm) at upper limit of low site	Volume/hectare (m^3/ha) at upper limit of low site	Total Crown managed productive forest (ha)	Area excluded (ha)[2]
Cw	31.5	35 cm	250 m^3/ha	240,871	848
Ss	38.4	35 cm	350 m^3/ha	217	2
Hw	34.1	35 cm	400 m^3/ha	166,963	4,814
Ba	35.7	35 cm	400 m^3/ha	4,996	161
Total				**413,047**	**5,825**

Notes: [1] "Upper" limit means the site index threshold below which stands are not suitable for harvest.

[2] Area removed at this stage of the netdown process.

2.2.5 Non-Merchantable Forest Types

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume. Non-merchantable types may be wholly or partially excluded from the THLB. Examples on the North Coast are generally hemlock-leading stands that contain a high proportion of decay; overstocked pine stands; and deciduous-leading cottonwood stands in areas along the Skeena River and the area known as the "North of the Nass" which may or may not be considered economically viable.

The land base reductions are described according to inventory file attributes (type group, site index breaks, age, height, stocking, minimum volume per hectare and/or minimum average stand diameter).

Where the deciduous trees in mixed conifer-deciduous stands are not utilized, exclusion of deciduous volumes from yield tables has been accepted as an appropriate modelling method. The North Coast DFAM group has decided to include mature red alder stands in this timber supply review based on the increased market demand and the 2 year red alder study prepared by John Kendall, *Red Alder Feasibility Assessment for the North Coast, 1999.* Table 2.4 summarizes the reductions for non-merchantable forest types.

Table 2.4 – Non-merchantable forest types

Inventory type group	Age	Stocking	Reduction (%)	Total Productive (ha)	Area excluded (ha) [1]
All	All	>1	100%	119,428	301
Pine leading	All	n/a	100%	22,655	3
Leading cottonwood	> 60	n/a	100%	611	0
Red alder	> 60	n/a	100%	2,301	11
Total				**144,995**	**315**

Notes: [1] Area removed at this stage of the netdown process.

2.2.6 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are environmentally sensitive sites and areas of significant value for other resource uses. ESA's cover sensitive soils (Es), forest regeneration problems (Ep), snow avalanche risk (Ea), recreation values (Er), wildlife habitat (Ew), and water use (Eh).

ESA inventories for sensitive soils and terrain (Es) are currently being replaced by a more detailed and current terrain predictability modelling called SINMAP. It will be up to MoFR staff to review the statistical analysis from the current SINMAP product to determine if the new terrain sensitivity predictive analysis will be part of the base case or run as a sensitivity analysis.

In the context of timber supply analysis, two approaches are typically used to account for any reduction in harvesting opportunity associated with ESAs:

- Percent area reductions, and
- Site-specific evaluation of individual ESA polygons to determine if they should be excluded from the timber harvesting land base.

Some forest lands are environmentally sensitive and/or significantly valuable for other resources to warrant their exclusion from timber harvesting. These areas are identified and delineated during a forest inventory and are called environmentally sensitive areas (ESAs). The ESA system employs the following categories:

- Soil (Es);
- Forest regeneration problems (Ep);
- Snow avalanche (Ea);
- Recreation (Er);
- Wildlife (Ew); and
- Water (Eh).

Two ESA classes are recognized within each category: high (1) and moderately sensitive (2). Table 2.5 lists the percent of the area classified that did not contribute to the timber harvesting land base.

Table 2.5 - Environmentally sensitive area exclusions

ESA category	ESA description	Reduction percent
Es 1	High soil sensitivity	100
Es 2	Moderate soil sensitivity	25
Ep 1	High regeneration problems	100
Ep 2	Moderate regeneration problems	50
Eh 1	High water quality	100
Eh 2	Moderate water quality	100
Ea	Snow avalanche hazard	100

No reductions were made for Ew, as wildlife habitat requirements are met in areas outside of the THLB in wildlife tree patches (wildlife tree retention areas - 1% reduction) and riparian reserve zones (7.49% reduction).

No reductions were made for recreation areas, as visual landscape management requirements apply to these areas.

Areas identified as Ep 1 are difficult to reforest due to wildlife browsing on seedlings and brush competition. Areas identified as Ep 2 may have problems associated with natural tree density and brush, which is controllable on about one-half of the area.

Reductions of 100% were applied to areas identified with Eh and Ea, since areas with important water quality considerations and avalanche hazard sensitivity are not harvested. These assumptions may change in the analysis report depending on the outcome of the SINMAP statistical results. The actual areas contributing to productive, inoperable and THLB areas in Table 2.1 will be determined only after the statistical accuracy of SINMAP has been determined as part of the base case or sensitivity analysis.

2.2.7 Riparian Management Areas

2.2.7.1 Riparian Reserve Zones

Riparian areas occur next to the banks of streams, lakes, and wetlands and include both the area dominated by continuous high moisture content and the adjacent upland vegetation that exerts an influence on it. Riparian ecosystems contain many of the highest value non-timber resources in the natural forest.

A stream class inventory was made available for the North Coast management unit in order to determine the area of reserve zones to be excluded from the THLB in accordance with Table 1 (page 14) of the *Riparian Management Area Guidebook.*

If gullies cover sufficient area to warrant additional land base reductions, the methods used to identify the gullies and manage for them, are described in the *Gully Assessment Procedures Guidebook.*

Riparian management areas consist of a riparian reserve zone (RRZ) directly adjacent to the water, and a riparian management zone (RMZ) beyond that. Forest practice constraints are applied within the RMZ.

Within the RRZ, the THLB is reduced by **7.49%** after all the previously discussed exclusions are made. This reduction is based on the *North Coast Riparian Classification Inventory, September 2001*, which examines eleven representative watersheds in the North Coast Forest District. An inventory of streams within these watersheds was completed and the RRZ area within the operable area was measured using the Forest Practices Code *Riparian Management Area Guidebook*. The percent of area excluded from the THLB is calculated by dividing the RRZ area by the operable area (from TSR II data) for these 11 watersheds:

$$\frac{\textbf{RRZ}}{\textbf{Operable area}} = \textbf{Total net loss (\%)}$$

Stand-level biodiversity is managed in part by retaining reserves of mature timber or wildlife tree reserves (WTR) within cutblocks. Adjacent inoperable and other retained areas also provide structural diversity and wildlife habitat. Cutblocks in the North Coast TSA tend to be linear, relatively small and generally proximal to a number of streams. These characteristics mean that locating the WTP within riparian reserve zones can fulfil most of the WTR requirements.

2.2.7.2 Riparian Management Zones

Management practices within riparian management zones may be reflected in the analysis using a volume reduction. The volume reduction requirement has been designed to reflect management practices in riparian management zones. This approach best reflects current practice.

The provincial reduction of 4.2% is applied to the yield tables. This reduction is based on the *Wild Stone Resources* study and is accepted provincially as being reflective of current practices.

2.2.8 Wildlife Habitat Land Base Deductions

Wildlife habitat may be identified and managed through several processes including the *Identified Wildlife Management Strategy*, identification and approval of ungulate winter range (UWR), and management practices specified in higher level plans.

For many management units, wildlife habitat that is sensitive to timber harvesting is identified in the ESA inventory. This inventory is gradually being replaced with current and detailed habitat mapping. Where no new habitat mapping is available, the ESA inventory may constitute the best available information for the management unit, and may be used in planning processes. In such cases wildlife ESAs should be used to reflect current performance in the base case of the timber supply analysis.

Depending on the management regime applicable in the habitat areas, land base reductions and/or forest cover requirements are typically used to model management objectives. Information sources and methods are then used to estimate the area of wildlife habitat to be excluded. Application of forest cover requirements will be covered later under Section 8 Resource Management Emphasis.

Licensees have consulted local MoE and MoFR with comparisons to the IWMS recommended reductions to the THLB and have recommended applying a reduction of 1% to coincide with operational policies related to management of wildlife.

2.2.9 Cultural Heritage Resource Deductions

A cultural heritage resource is an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people. Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites.

In consultation with First Nations on the North Coast regarding the areas and appropriate protection or management measures with regards to cultural heritage protection, it was recommended that a 1% reduction to the THLB be used for the base case scenario. Current practices for protecting these areas reflect the best available information at this time.

It should be noted however, that there was no consensus reached on the exact percent reduction and a First Nation has requested that the Archaeological Overview Assessment (AOA) prepared in 1999 by the North Coast Forest District be incorporated into the data set in order to potentially run scenarios on various zoning categories to test alternate harvesting methods in the high, medium and low AOA classifications.

2.2.10 Roads, Trails and Landings

Road, trail and landing estimates only account for the area that is permanently removed from the THLB and only apply to unclassified areas. All highways and larger municipal roads are of a sufficient size to be mapped as polygons and are classified as non-forest areas in the forest inventory.

The exclusions apply to the area expected to remain non-productive. Portions of access routes that are to be permanently deactivated and returned to their original condition should remain in the THLB. All future roads will be deactivated in accordance to standards and licensee obligations however it is not expected to contribute significantly to the THLB.

2.2.10.1 Classified Roads, Trails and Landings

To account for existing unclassified roads, trails and landings, a GIS exercise was completed based on a new road inventory. The road linework was assigned a classification and the non-productive component was identified along each side of the road lines. This “buffering” exercise resulted in the generation of the *RD_EX_BUF* attribute. Resultant polygons with *RD_EX_BUF* = “Y” were excluded from the THLB.

The road buffering exercise produced a total of 2,929 hectares (current to July 2001) of existing roads on the entire TSA land base, of which 2,054 ha is within the productive forest. After other productive forest removals, 1,591 ha of land were excluded to account for existing roads.

2.2.10.2 Future Roads, Trails and Landings

This section provides an estimate of the area of all roads, trails, and landings that will be constructed in currently undeveloped areas (mature and immature stands). Information on current performance including the method and applicable data sources has been provided to support the modelling assumptions. The area contributing to the long-term harvest level is net of the area that will be covered by roads in the future.

The reduction is applied either as a percent reduction equally against all stands that will be disturbed in the future, or as an area reduction to each analysis unit, zone, group, broad maturity class or specific area.

All future road, trail and landing development is accounted for by applying an area reduction of 8.4% to existing, natural, conventionally operable stands after harvest.

From several planning documents, district staff estimate the length of road required per conventionally harvested cubic metre of wood to be 0.09 metres. Using the district average of 607 m3/ha, and the estimate of 1.53 ha/km of road constructed calculated for existing roads, trails and landings:

$$\frac{\textbf{607 m3/ha x 0.09 m/m3 x 1.53 ha/km}}{\textbf{1,000 m}} = \textbf{8.4\%}$$

Future roads are removed during the modelling process. During the first 40 years of simulation 7,838 ha of additional land will be removed from the THLB after harvesting has occurred on the area to account for future road development on the TSA.

2.2.11 Other Reductions

Other reductions applied to the resultant database to determine the THLB included:

- Woodlots, identified by *woodlot_tag* attribute = 1,2; and
- Permanent NSR identified by *NSR_NP* attribute = “Y”.

These additional reductions were the final steps in the netdown process used to develop the THLB for the North Coast TSA.

3.0 LAND BASE AGGREGATION – ZONES AND ANALYSIS UNITS

3.1 Management Zones, Groups and Objectives

This section describes the criteria and rationale used to delineate areas that are subject to unique forest cover objectives. The forest cover requirements that will apply are discussed under Section 8, "Resource Management Emphasis."

The various forest-level models use different approaches for modelling forest cover objectives. Based on the functionality of CASH6 (version 6.2l), the forest estate model to be used for the North Coast TSA analysis, a number of modelling groups and zones were developed. Due to the large number of zones, only the general categories are listed in Table 3.1 below. Since zoning will significantly impact the number of sensitivity analysis runs, priorities will be subject to the available budget for the second phase of this TSR process.

Table 3.1 – Modelling zones and groups

Zone or Group	Productive Area (ha)	THLB Area (ha)	Criteria Used to Define Zone or Group	Comments
VQO – Preservation 9 modelling zones	3,888	787	*vqo_tag* > 0 and *vqo* = "P" attributes	Mapped by Lloyd Davies as per regional/provincial landscape guidelines
VQO – Retention 144 modelling zones	53,502	9,960	*vqo_tag* > 0 and *vqo* = "R" attributes	Mapped by Lloyd Davies as per regional/provincial landscape guidelines
VQO - Partial retention 361 modelling zones	149,210	31,894	*vqo_tag* > 0 and *vqo* = "PR" attributes	Mapped by Lloyd Davies as per regional/provincial landscape guidelines
VQO – Modification 28 modelling zones	11,466	2,037	*vqo_tag* > 0 and *vqo* = "M" attributes	Mapped by Lloyd Davies as per regional/provincial landscape guidelines
Integrated Resource Mgmt (IRM) 53 modelling zones	100,919	100,919		Areas not assigned to specific resource objectives (wildlife, VQO, etc.)
Landscape-level biodiversity 131 modelling zones	875,902	145,808	*lu_name* and *beclabel* attributes	Landscape unit and BEC variant aggregates
Priority watersheds 25 modelling zones	22,738	22,738	*wsd_priority* attribute between 1 and 25	Partition to direct harvesting during initial 10 years of simulation

3.2 Analysis Units

To reduce the complexity and volume of information used and generated in timber supply models, individual stands may be aggregated into fewer, larger and more or less homogeneous units called "analysis units". Analysis units are usually comprised of combinations of stands with similar tree species, timber growing capability (site index) and occasionally silvicultural management regimes.

Yield tables representing the growth of trees on each polygon within the analysis unit are combined to represent average growth of stands on the unit. Yield tables for current and future stands are developed using this approach. Analysis units are formed in order to track growth characteristics of similar stands.

The following numbering scheme was used to define the various analysis units (AUs):

- Existing natural stands – AUs 1 – 25;
- Existing natural stands with heli-log variable retention management - AUs 51 – 74;
- Existing and future managed stands – AUs 101 – 125;
- Existing and future managed stands with variable retention – AUs 151 – 174; and
- Existing and future managed stands with thinning management – AUs 201 – 224.

Table 3.2 lists the existing natural analysis units (1 – 74) used in North Coast TSA analysis.

Table 3.2 - Existing natural stand analysis unit descriptions

Analysis Unit		Inventory Type Groups	Site Index Range	THLB Area (ha)
Clearcut Managment				
1	Cw-Nat-G	9	< 13	26
2	Cw-Nat-M	9	13 – 17	684
3	Cw-Nat-P	9	> 17	1,917
4	CwHw-Nat-G	10 11	< 13	1,829
5	CwHw-Nat-M	10 11	13 – 17	15,479
6	CwHw-Nat-P	10 11	> 17	8,916
7	Hw-Nat-G	12	< 15	778
8	Hw-Nat-M	12	15 – 19	1,040
9	Hw-Nat-P	12	>19	3,144
10	HwCw-Nat-G	14	< 15	953
11	HwCw-Nat-M	14	15 – 19	3,178
12	HwCw-Nat-P	14	>19	16,737
13	HwBa-Nat-G	13 15	< 15	2,871
14	HwBa-Nat-M	13 15	15 – 19	9,011
15	HwBa-Nat-P	13 15	>19	19,203
16	HwSx-Nat-G	16 17	< 15	3,597
17	HwSx-Nat-M	16 17	15 – 19	4,732
18	HwSx-Nat-P	16 17	>19	6,738

Analysis Unit		Inventory Type Groups	Site Index Range	THLB Area (ha)
19	BaHw-Nat-G	18 19 20	< 15	257
20	BaHw-Nat-M	18 19 20	15 – 20	1,683
21	BaHw-Nat-P	18 19 20	> 20	2,715
22	SxHw-Nat-G	21 – 26	< 16	1,638
23	SxHw-Nat-M	21 – 26	15 – 22	3,344
24	SxHw-Nat-P	21 - 26	> 22	3,420
25	Dr-Nat-A	34 - 42	all	354
Heli-log Variable Retention				
51	Cw-VRet-G	9	< 13	71
52	Cw-VRet-M	9	13 – 17	381
53	Cw-VRet-P	9	> 17	1,125
54	CwHw-VRet-G	10 11	< 13	457
55	CwHw-VRet-M	10 11	13 – 17	3,640
56	CwHw-VRet-P	10 11	> 17	1,714
60	HwCw-VRet-G	12	< 15	222
61	HwCw-VRet-M	12	15 – 19	369
62	HwCw-VRet-P	12	>19	640
63	HwBa-VRet-G	14	< 15	34
64	HwBa-VRet-M	14	15 – 19	95
65	HwBa-VRet-P	14	>19	94
66	HwSx-VRet-G	13 15	< 15	35
67	HwSx-VRet-M	13 15	15 – 19	128
68	HwSx-VRet-P	13 15	>19	6
69	BaHw-VRet-G	18 19 20	< 15	37
70	BaHw-VRet-M	18 19 20	15 – 20	19
71	BaHw-VRet-P	18 19 20	> 20	16
72	SxHw-VRet-G	21 – 26	< 16	39
73	SxHw-VRet-M	21 – 26	15 – 22	31
74	SxHw-VRet-P	21 - 26	> 22	157

Note that “G”, “M”, and “P” refer to good, medium, and poor sites respectively. These references are not associated with historic inventory attributes for site quality.

Heli-log variable retention areas were defined by:

- *heli* attribute in (OP_HCW250, OP_HELI350, OP_HELILOG);
- Non VQO areas; and
- At least 20% cedar volume.

Table 3.3 lists the managed analysis units (101 – 125). The area listed for each AU represents the existing managed stands, those areas currently less than 25 years old.

Table 3.3 - Managed stand analysis unit descriptions

Analysis Unit		Inventory Type Groups	Site Index Range	THLB Area (ha)
Clearcut Managment				
101	Cw-Manag-G	9	< 13	34
102	Cw-Manag-M	9	13 – 17	704
103	Cw-Manag-P	9	> 17	1,955
104	CwHw-Manag-G	10 11	< 13	2,024
105	CwHw-Manag-M	10 11	13 – 17	15,957
106	CwHw-Manag-P	10 11	> 17	9,272
107	Hw-Manag-G	12	< 15	1,637
108	Hw-Manag-M	12	15 – 19	1,372
109	Hw-Manag-P	12	>19	3,620
110	HwCw-Manag-G	14	< 15	2,165
111	HwCw-Manag-M	14	15 – 19	3,312
112	HwCw-Manag-P	14	>19	17,152
113	HwBa-Manag-G	13 15	< 15	8,222
114	HwBa-Manag-M	13 15	15 – 19	9,408
115	HwBa-Manag-P	13 15	>19	20,003
116	HwSx-Manag-G	16 17	< 15	7,234
117	HwSx-Manag-M	16 17	15 – 19	5,010
118	HwSx-Manag-P	16 17	>19	6,834
119	BaHw-Manag-G	18 19 20	< 15	1,526
120	BaHw-Manag-M	18 19 20	15 – 20	1,863
121	BaHw-Manag-P	18 19 20	> 20	3,053
122	SxHw-Manag-G	21 – 26	< 16	2,640
123	SxHw-Manag-M	21 – 26	15 – 22	4,433
124	SxHw-Manag-P	21 - 26	> 22	3,800
125	Dr-Manag-A	34 - 42	all	1,356
Heli-log Variable Retention				
151	Cw-VRet-Manag-G	9	< 13	
152	Cw-VRet-Manag-M	9	13 – 17	
153	Cw-VRet-Manag-P	9	> 17	
154	CwHw-VRet-Manag-G	10 11	< 13	
155	CwHw-VRet-Manag-M	10 11	13 – 17	
156	CwHw-VRet-Manag-P	10 11	> 17	
160	HwCw-VRet-Manag-G	12	< 15	
161	HwCw-VRet-Manag-M	12	15 – 19	
162	HwCw-VRet-Manag-P	12	>19	
163	HwBa-VRet-Manag-G	14	< 15	
164	HwBa-VRet-Manag-M	14	15 – 19	

Analysis Unit		Inventory Type Groups	Site Index Range	THLB Area (ha)
165	HwBa-VRet-Manag-P	14	>19	
166	HwSx-VRet-Manag-G	13 15	< 15	
167	HwSx-VRet-Manag-M	13 15	15 – 19	
168	HwSx-VRet-Manag-P	13 15	>19	
169	BaHw-VRet-Manag-G	18 19 20	< 15	
170	BaHw-VRet-Manag-M	18 19 20	15 – 20	
171	BaHw-VRet-Manag-P	18 19 20	> 20	
172	SxHw-VRet-Manag-G	21 – 26	< 16	
173	SxHw-VRet-Manag-M	21 – 26	15 – 22	
174	SxHw-VRet-Manag-P	21 - 26	> 22	

Existing natural stands regenerate to the analysis unit represented by (100+AU number). Therefore AU 1 will regenerate to AU 101 after harvest during modelling. Note that heli-log variable retention is a new management regime and at the time of preparing the inventory for the timber supply analysis no stands had been harvested operationally with this approach.

Table 3.4 summarizes the analysis units describing stands that have had a thinning treatment. It is assumed that these areas will receive the same treatment in the future. Therefore these stands will regenerate back to the same analysis unit after harvest during analysis simulations.

Table 3.4 - Managed stand analysis unit descriptions – thinned stands

Analysis Unit		Inventory Type Groups	Site Index Range	THLB Area (ha)
Thinned Stands				
207	Hw-Thin-G	12	< 15	115
209	Hw-Thin-P	12	15 – 19	6
210	HwCw-Thin-G	14	< 15	44
212	HwCw-Thin-P	14	>19	21
213	HwBa-Thin-G	13 15	< 15	319
215	HwBa-Thin-P	13 15	>19	131
216	HwSx-Thin-G	16 17	< 15	983
218	HwSx-Thin-P	16 17	>19	23
219	BaHw-Thin-G	18 19 20	< 15	15
221	BaHw-Thin-P	18 19 20	> 20	3
223	SxHw-Thin-M	21 – 26	15 – 22	43

4.0 GROWTH AND YIELD

This section describes the issues, information sources, assumptions, methods, and any relevant data processing or adjustments related to growth and yield estimates for existing and future stands. These are for both unmanaged and managed conditions, and include:

- Methods, principles, and information sources underlying site productivity estimates;
- The silvicultural management regimes assumed for regenerated stands;
- Utilization levels and operational adjustments;
- Methods and information underlying site productivity estimates and yield tables that reflect any planned innovative management;
- Any relevant studies;
- The models used for developing timber yield tables; and
- The yield tables used for each growth and yield analysis unit (normally species and site quality group and silvicultural regime).

Yield tables for natural stands were developed with the MoFR program *Variable Density Yield Predictor* (VDYP). Managed stands used the MoFR *Table Interpolation Program for Stand Yields* (TIPSY) growth and yield model. JS Thrower and Associates created the yield tables that will be used in the North Coast TSA analysis.

4.1 Site Index

Site Index (SI) is a measure of productivity used during yield analysis. Site index is an estimate of potential height growth on a site over a fixed period of time, normally 50 years. The productivity of a site largely determines how quickly trees grow and when rotation age or age of harvest, is reached.

The inventory site index estimate from the forest cover database is used to develop standing volume and yield tables for the base case in the timber supply analysis.

4.1.2 Site Index Adjustments for Managed Stands

In recent years, extensive studies have indicated that site productivity estimates for regenerated stands from forest cover inventory are low. (Olivotto and Meidinger 2001, Bnigh 1998. Nussbaum 1998).

Site index is tied to ecological site factors such as soil moisture and nutrient regime. Within the Biogeoclimatic Ecosystem Classification system the site series expresses soil moisture and nutrient regime. The SIBEC Project has produced a database summarizing site index estimates (from second growth field data) by site series for coniferous tree species in BC (J.S. Thrower & Associates 2004).

Using Predictive Ecosystem Mapping (PEM), SIBEC site index estimates have been assigned to site series polygons in order to generate yield estimates for growth of regenerated stands. The PEM mapping approach used forest cover and TRIM inventories to develop site series estimates based on local knowledge tables (Meidinger et al. 2000). EcoGen is a PEM approach being

developed by the Ministry of Forests. An Eco Yield module has also been developed to produce an ecologically-based yield analysis from the EcoGen mapping; the pilot has recently been completed in the North Coast Forest District (Meidinger et al. 2001).

Because of the uncertainty regarding the accuracy and reliability of PEM, the new JS Thrower SIBEC estimates will be not used in the base case as instructed by MoFR staff. The impact on timber supply of the adjusted SI values will be reviewed in a sensitivity analysis.

4.2 Utilization Levels

The utilization level defines the maximum height of stumps that may be left on harvested areas and the minimum top diameter (inside bark) and minimum diameter (dbh) of stems that must be removed from harvested areas. These factors are needed to calculate merchantable stand volume for use in the analysis. The levels used in the analysis reflect the current operational levels.

The North Coast TSA utilization standards specify a 15 cm minimum top diameter and a 30 cm maximum stump height with a 17.5 cm minimum dbh for old growth stands (> 120 years). However, the volume estimates are only available for a 10 cm top diameter inside bark (dib). The MoFR's Analysis and Inventory Branch has conducted research that shows the difference in volume between a 10 cm and a 15 cm top is less than 1 %. In younger second-growth stands a minimum top diameter of 10 cm (dib) and 12.5 cm minimum dbh is specified. Table 4.1 summarizes the utilization levels modelled in the yield tables for the North Coast TSA analysis.

Table 4.1 - Utilization levels

Species	Utilization		
	Minimum DBH (cm)	Maximum stump height (cm)	Minimum top DIB (cm)
Managed	12.5	30	10
Existing	17.5	30	10

4.3 Decay, waste and breakage for unmanaged stands

The decay, waste and breakage factors that are applied to unmanaged stand yield tables to obtain net volume per hectare. Since there is no new and improved information on the coast of BC, these factors will comply with the standard values incorporated into the Variable Density Yield Prediction (VDYP) model. VDYP uses forest inventory zone (FIZ) A, and public sustained yield unit (PSYU) 173 references to assign decay, waste and breakage.

4.4 Operational Adjustment Factors for Managed Stands

Operational adjustment factors (OAFs) are applied in order to adjust potential yields generated by growth and yield models (e.g., TASS/TIPSY) to reflect operational factors, such as gaps in stands and decay.

The default factors most commonly used in B.C. today are an OAF 1 of 15 percent and an OAF 2 of 5 percent. OAF 1 is a constant percentage reduction to account for openings in stands, distribution of stems, endemic pests and diseases, and other risks to potential yield. OAF 2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. The 5 percent factor originates from estimates for older immature stands documented in the *1976 Metric Diameter Class Decay, Waste and Breakage Factors*.

OAF 2 is applied after OAF 1 and increases linearly over time from 0 percent at age 0 to the specified percentage at 100 years of age. If OAF2 were 5 percent, the increase rate would be 0.05% per year, reaching 5 percent at 100 years, 10 percent at 200 years, 15 percent at 300 years etc.

The North Coast DFAM group has not been able to provide any additional information to this subject and have recommended that the provincial averages be used as described above.

4.5 Volume Reductions

In mixed species stands, one or more species may be partially or completely unmerchantable. For example, the deciduous species in a predominantly coniferous stand may not be harvested, or may only be partially harvested. In these cases, the deciduous components should not contribute toward the estimated stand volume and cut control. Volume reductions have also been used where evidence indicates that the decay factors do not fully account for decay. In such cases, revision of the decay factors may be more appropriate and direct than a supplementary reduction to yield curves.

During the yield table development deciduous content in mixed species stands was excluded so that only the conifer volume contributes to periodic harvest.

An additional reduction of 4.2% is applied to the clearcut yield tables to account for riparian management zone, as described in Sections 3.2.7.2 and 8.5.

4.6 Other Issues Related to Yield Table Development

To enable comprehensive review, it is useful to provide both of the models used to generate timber yield tables, as well as the version numbers of the models.

Yield tables can be derived in a number of ways:

1. Area-weighting yield tables generated for each polygon into an aggregate table;
2. Employing average area-weighted attributes (e.g., site index, species composition) to generate a single table; and
3. Using area-weighted inventory plot volumes for each analysis unit.

All yield tables for the North Coast DFAM area have been confirmed by the consultant to meet the provincial standards using the latest version of VDYP and TIPSY/TASS.

5.0 SILVICULTURE

5.1 Silviculture Management Regimes

Silviculture management regimes are needed to develop timber yield tables for regenerated stands. In TSR 2, partial-harvesting regimes were estimated to account for 1% of the current harvesting. That has changed significantly and as a result, all of the following sections on regeneration delay, stand conversion, stand rehabilitation and appropriate yield assumptions are subject to change.

Since silviculture performance information provides support for the management regimes that will be modelled in the base case, recognition for the increased practice of partial harvesting has been recommended to apply clear-cut assumptions to only 50% of the harvesting schedule. The DFAM group work closely with the timber supply analysts to best capture the most appropriate approach to this change in management regime.

The following assumptions were recommended by the DFAM group:

- Clear-cut will apply to only 50% of the total THLB (67,804 ha.)
- Partial harvesting (aggregate retention) will apply to 17.4% of the total THLB (23,595 ha.)
- Partial harvesting (dispersed retention) will apply to 17.4% of the total THLB (23,595 ha.)
- Complete reduction to the THLB is expected to apply to 12.7% of the total THLB (17,222 ha.)
- Remaining 2.5% THLB (3,390 Ha.) will be subject to zoning of areas to be determined from SINMAP, VQO's and non-spatial reductions such as WTR, and cultural heritage sites (could potentially be determined by AOA mapping)

However, due to the lack of specific geographic locations for these various operational harvesting regimes, modelling of the timber supply was simplified into clearcut and variable retention areas.

5.2 Regeneration Delay

Regeneration delay is the time elapsed between harvesting and the time when stand growth begins. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable. Based on the assessment of blocks harvested in the past 5 years, it was determined that the average regeneration delay was 1.2 years. This was accepted as a reasonable assumption and reflects current practice. This will be modelled as two years in the timber supply analysis.

5.3 Species Conversion

Based on a wide range of input from MoFR, Licensees and First Nations, a decision on species conversion could not be agreed to as being part of the current management regime.
Although the DFAM group recognizes the controversial views from the participants, it is difficult to determine if the concerns surrounding the harvesting of western redcedar is expected to continue over a period of time. It has therefore been suggested to monitor harvesting for the next timber supply review.

5.4 Backlog and Current Non-Satisfactorily Restocked Areas

Land classified in the TSA inventory file as type identity 4 or 9 is included in the THLB and correspond to non-satisfactorily restocked (NSR) areas. Backlog NSR refers to an area that was denuded prior to 1987 (when basic silviculture became the obligation of licensees) that is not yet fully stocked. All other NSR is considered "Current NSR". The following is a summary of the backlog and current area in the THLB and a description of how and when these areas will be regenerated.

NSR area is expected to regenerate within the two-year regeneration delay specified in the table of regeneration assumptions.

The Integrated Silvicultural Information System (ISIS/RESULTS) reports a total of 4,591 hectares of NSR as of October 5, 2003, while the forest inventory file indicates a total of 3,368 hectares of NSR, with 1,259 hectares within the timber harvesting land base. Table 5.1 presents the NSR distribution of the TSA.

Table 5.1 - Backlog and current NSR

NSR Description	Area (ha)
Backlog NSR:	
Estimated stocked but not updated in ISIS	1,511
Estimated to be stocked with mixed red alder and a low conifer component	526
Estimated to be non-productive	101
Area estimated to never reach full site potential until next rotation	597
Total Backlog	**2,735**
Current NSR	**1,856**
Total NSR from ISIS	**4,591**

Under a mostly alder canopy, it is estimated that only 50 % site occupancy will be attained. There is a discrepancy between these two databases and they are not directly reconcilable. Discrepancies in area of NSR between ISIS and forest inventory information can be attributed to inaccuracies in both databases, lags in data entry and the potential for backlog areas recorded by ISIS to be classified as restocked or non-forest during re-inventory.

Because the amount of NSR is very small, the area of NSR recorded on the inventory file is used in the timber supply analysis. The inventory NSR is assigned to the THLB according to the distribution of analysis units in the 1-24 year age group, based on species and site description. A study currently underway is looking at making prescriptions on the backlog NSR areas based on return on investment. If the recommendations from that study provide the DFAM group with a list of areas that no longer contribute to the THLB before the analysis report is completed, the areas listed in Table 11 could be subject to revision.

5.5 Stand History on Immature Managed Stands

This section identifies areas of existing immature forest where density (stems per hectare) is controlled and therefore should be assigned to appropriate managed stand yield tables. All NSR and future harvested stand volume projections are based on managed stand yield curves.

A juvenile spacing program has treated 2,393 hectares of hemlock/balsam stands from 1985 to November 2001. To reflect this, hemlock and balsam stands on good and medium sites, with an activity code of 'J' assigned (analysis units 201 - 223), are grown on yield curves reflecting density management through thinning.

The expectation noted in TSR 2 that juvenile spacing would continue, as funding is no longer available for spacing. However, those stands assigned to yield curves to reflect thinning will continue to grow on those curves.

5.6 Stand History on Regeneration Activities

Regeneration delay reflects current practices and is defined as the time between harvest and restocking of cutover areas. Regeneration delays are applied within the forest estate models, not in the TIPSY / TASS yield model.

Yield estimates for current (< 24 years) and future managed stands are based on the Forest Service TIPSY growth and yield model. Because TIPSY does not include data for Cottonwood stands, yield estimates for these stands are based on a VDYP curve for existing, natural stands. As well, because densities of 10 000 trees/ha are not available for planted stands in TIPSY, 4444 stems per hectare was used for the initial density for analysis units 10 and 30. Table 5.2 presents the silviculture regimes for managed stands that were used to develop the TIPSY yield tables for the analysis.

Table 5.2 - Silviculture regimes for managed stands

Stand Description	Regen Delay (years)	OAF 1	OAF 2	Method	Initial Density (stems/ha)	Thinned Density (stems/ha)
Cedar, Hemlock / Cedar: Good	1	15	5	Natural	10 000+	
Cedar, Hemlock / Cedar: Med.	1	15	5	Natural	10 000+	
Cedar, Hemlock / Cedar: Poor	1	15	5	Natural	10 000+	
Hemlock, Balsam: Good	2	15	5	Natural	10 000+	
Hemlock, Balsam: Med.	2	15	5	Natural	10 000+	
Hemlock, Balsam: Poor	2	15	5	Natural	10 000+	
Hemlock, Balsam: Good w. thinning	2	15	5	Natural	10 000+	700
Hemlock, Balsam: Med. w thinning	2	15	5	Natural	10 000+	700
Spruce: Good	2	15	5	Plant	1000	
Spruce: Med.	2	15	5	Plant	4444	
Spruce: Poor	2	15	5	Natural	10 000+	

While there is significant planting in the TSA, there is often considerable ingress of existing species, which causes regenerated stands to develop more like a natural stands. Future analysis units are therefore assumed to regenerate to the same species composition as the existing analysis unit.

6.0 UN-SALVAGED LOSSES

This section quantifies the average un-salvaged (timber) losses that occur due to insect and disease epidemics, fire and blow-down. Un-salvaged losses are typically applied as a factor covering the entire unit. If available, specific un-salvaged loss information may be applied to a specific location or species. Otherwise the standard loss information will apply to the entire management unit.

Since un-salvaged losses are typically applied over the long term, the average losses are derived from long-term historic data. Average annual un-salvaged losses due to fire only are estimated at 2,034 cubic metres per year. These losses are based on a 20-year average loss of timber.

A report estimating blowdown losses in the North Coast TSA was completed in 1998. This study estimates the annual un-salvaged losses to wind to be 13 417 m^3 on the operable land base. MoFR staff reviewed this report, and adjusted the blow-down estimate to 8050 m^3/year to reflect un-salvaged losses on the timber harvesting land base.

While porcupine damage is evident in some second-growth stands, the long-term effect on timber production is not fully understood. Possible effects include lengthened regeneration delays, lower stocking, and lower volume yields. Un-salvaged losses due to porcupine damage have not been quantified, and as such, no un-salvaged losses have been attributed to this pest.

Losses from insects and other pests have been accounted for through operational adjustment factors and, decay, waste and breakage factors.

Therefore un-salvaged volume losses due to epidemics of fire and wind damage total 10,084 cubic metres per year. This amount will be deducted from the total annual harvest developed in the forest estate model prior to reporting volume harvested in the analysis report.

7.0 RESOURCE MANAGEMENT

According to the *Land Use Planning Guide* (LUPG), biodiversity is managed at both landscape and stand levels. While the primary mechanism for landscape-level biodiversity management is retention of old seral forest, for stand-level biodiversity management wildlife tree retention is the mechanism. The following sections outline the policy framework and modelling issues associated with management for biodiversity.

Chapter 6 of the LUPG describes the process for establishing landscape unit (LU) boundaries and objectives. Currently draft LUs, and in many cases draft biodiversity emphasis options (BEO), are in place throughout the province. In some areas LUs and BEOs have been established pursuant to Section 4(1) of the *Forest Practices Code of B.C. Act*.

Management strategies for specific forest resources are often expressed in terms of maintaining a desired age distribution of forest cover. Operationally, low biodiversity emphasis is assumed for all landscape units when options have not been defined. This is specified in the *Biodiversity Guidebook*. Although interim BEOs have been assigned to each recommended landscape unit, they have not been legally established. Therefore, they cannot be used for the base case analysis.

As it is unknown which landscape units will be assigned low, intermediate or high biodiversity objectives a constraint for old seral stage requirements are applied based on the anticipated distribution of 10% for high, 45% for intermediate and low emphasis. The values shown in the North Coast reflect the *Biodiversity Guidebook* values. The forest cover requirements increase over time, ensuring that retention of old-seral forest is met by the end of three rotations. This is considered to be an appropriate assumption for the North Coast TSA.

It is assumed that the application of full requirements at the beginning of the third rotation will ensure the required forest cover will be built up over that rotation. Minimum retention objectives are applied to the productive land base in each recommended landscape unit/BEC variant combination.

Appendix 3 of the Biodiversity Guidebook notes all areas within the Prince Rupert Forest Region are in Natural Disturbance Types (NDT) 1 or 2. The Research Branch of MoFR agreed that essentially all of the CWH vh2 and CWH vm within the North Coast TSA should be considered to be NDT 1.

7.1 Estimating Green Up Age

The age to green-up is an important operational scheduling parameter and a key element in timber supply analysis. Green-up age is used as a measure of tree height and site occupancy to meet visual, hydrological, wildlife or other objectives. Achievement of green-up height is often required before adjacent areas may be harvested.

Height-age curves have been used for timber supply analysis to approximate the age at which green-up heights are achieved. The MoFR application *SiteTools* provides site index and height growth equations for B.C. commercial species. In addition, the MoFR publication *Age to Green-*

up Height: Using Regeneration Survey Data provides height *versus* age estimates by site index. These are derived from data available in ISIS along with a comparison of these green-up ages to those derived by *SiteTools.*

The forest estate model CASH6.2 allows height-based green-up to be modelled directly using height information from the yield tables used for each analysis unit. Height information is output from VDYP and TIPSY during yield table development. As a result each stand is assessed during each simulation period for height and compared with the minimum green-up height defined for the assigned resource management objective(s) rather than using an average age for green-up for a group of stands. CASH6.2 is able to model age-based green-up where that is the definition used for the resource objective in a particular area.

7.2 Visual Resources

Under the *Forest Practices Code* (FPC), the intent was to "make known" scenic areas and establish visual quality objectives (VQOs) for them. The processes for identifying scenic areas are at various stages of completion. Some districts' scenic areas have been made known and the VQOs established by the district manager or through a planning process. For the North Coast TSA, the district's scenic areas have been made known but VQOs have not been established.

The *Forest and Range Practices Act (FRPA)* will not change establishment and management of scenic values significantly except that in the future MoFR will be responsible for designating scenic areas as this seen as a land use decision. Under FRPA, scenic areas not grand parented and which are not identified by MoFR will not be managed for VQOs.

Visually effective green-up heights should be determined using the procedures described in *Procedures for Factoring Visual Resources into Timber Supply Analyses* (Table 6); based on current performance (operational approvals); or based on direction from a planning process or the district manager.

There are four different scenic area zones in the North Coast TSA:

1) Inside Passage,
2) Skeena River Corridor,
3) Portland/Work Channel, and
4) Douglas/Gribbell.

In the analysis each of the 542 VQO polygons will be modelled for disturbance individually. Therefore the four scenic areas listed above will be addressed by default because the VQO polygons do not overlap scenic area boundaries.

In past analyses, all visually sensitive areas within a landscape unit, or even across the TSA, were grouped together and assessed for disturbance as a large aggregate. This approach can be unrealistic in that areas that are physically separate can impact each other's timber availability.

Table 7.1 summarizes the disturbance and green-up forest cover requirements for non-timber resources identified for the timber supply analysis.

Table 7.1 - Forest cover requirements for non-timber resources

Resource Emphasis		Maximum Allowable Disturbance (%)	Minimum Green-up Height (m)	Applied to
IRM	Integrated Resource Management areas	33	3	THLB
Water quality	Community Watershed	5	5	THLB
Visual resources	Preservation (VQO-P)	1	7	productive forest
Visual resources	Retention (VQO-R)	5	7	
Visual resources	Partial retention (VQO-PR)	15	7	
Visual resources	Modification (VQO-M)	25	4	

Note that community watersheds were not explicitly modelled in the analysis because of the small area assigned to this category, less than 35 hectares of THLB.

The visual objectives vary between VQO categories to reflect differences in visual sensitivity and management techniques. The forest cover requirements are applied to the total productive forest area in a given VQO area within each visual polygon.

Integrated Resource Management (IRM) requirements are applied, by landscape unit, to all areas outside of these four scenic zones. IRM objectives are specified as a proxy for adjacency constraints associated with maximum clear-cut and patch size guidelines. The maximum allowable disturbance constraint for IRM areas is applied to the THLB only.

All stand heights shown in Table 13 refer to top heights (inventory definition), not to average stand height.

7.3 Recreation Resources

Recreation objectives have not been identified through a higher level plan, nor through the district manager who can identify “known features”. No additional modelling objectives will be considered as impacting the current base case.

7.4 Wildlife

Ungulate winter ranges are areas that have been "identified as being necessary for the winter survival of an ungulate species". These areas have not yet been identified through a higher level plan, by the deputy minister of MoE under *Section 69* of the *Operational Planning Regulation*, or by a wildlife management plan or strategy approved before October 15, 1998 by the district or

regional manager and the designated environment official; the chief forester; or the authorized ministers.

Three species identified in the *Identified Wildlife Management Strategy* depend on habitat requirements that cannot be managed solely through Wildlife Habitat Areas (WHA's) because they have large home ranges, occur at low densities, have widely and sparsely distributed limiting habitats, or are sensitive to forest level disturbances. These species have been called "higher-level plan species" and include bull trout, fisher and grizzly bear.

Management strategies for these species will most often flow from higher-level plans. The 1% reduction to the current THLB is considered to be adequate to address identified wildlife species that includes protection of their habitat, even though WHAs have not yet been established.

7.5 Wildlife Tree Retention

Wildlife tree retention for the North Coast TSA will be accounted for through a land base reduction of one percent, as outlined in Section 3.2.8. An additional 4.2% reduction for riparian management zones is applied to the yield tables. This reduction is also expected to contribute to wildlife tree retention.

At this time, legislation has not provided clear direction regarding whether or not wildlife trees are permanently retained in retention areas. If wildlife trees will be replaced over time, a volume reduction at harvest is considered to be more appropriate for the North Coast.

7.6 Watersheds

All of the community watersheds for the North Coast TSA area are considered sensitive to water quality and have therefore been excluded from the THLB.

7.7 Higher Level Plans

The management objectives of higher level plans for the North Coast LRMP are not in place. Information relevant to many of the issues related to the LRMP are described under other applicable sections of Section 8, Resource Management.

If the declaration of a higher level plan is imminent, the DFAM group will consider any legislative direction from the Provincial government, should there be sufficient time to do so.

7.8 Landscape Level Biodiversity

Appendix 3 of the *Biodiversity Guidebook* notes all areas within the Prince Rupert Forest Region are in NDT 1 or 2. The MoFR's Research Branch staff clarified that essentially all of the CWHvh2 and CWHvm within the North Coast TSA should be considered to be NDT 1.

Table 7.2 summarizes the forest cover constraints that will be applied to the landscape unit – BEC/NDT (LU-BEC/NDT) variants to address landscape-level biodiversity objectives.

Table 7.2 - Forest cover requirements for landscape-level biodiversity

Biogeoclimatic Unit (variant)	NDT	Minimum age (years)	Old seral stage requirement minimum retention area by decade (%)		
			1	7	14
CWHvh2	1	250	9.7	11.65	13.6
CWHvm	1	250	9.7	11.65	13.6
CWHvm1	1	250	9.7	11.65	13.6
CWHwm	1	250	9.7	11.65	13.6
CWHvm2	1	250	9.7	11.65	13.6
MHmm1	1	250	14.2	17.05	19.9
MHmm2	1	250	14.2	17.05	19.9
MHwh1	1	250	14.2	17.05	19.9
CWHws1	2	250	6.7	8.1	9.4
CWHws2	2	250	6.7	8..1	9.4

In CASH6.2 it is not possible to change forest cover requirements during the analysis simulation, therefore the old seral requirement specified for decade 1 in Table 7.2 will be modelled for the entire planning horizon. The percentage of old forest within each LU-BEC/NDT will be monitored during each 10-year simulation period. It is expected that old forest requirements will not impact on timber supply given that the THLB is only 17% of the total productive forest.

8.0 TIMBER HARVESTING

8.1 Minimum Harvestable Age / Merchantability Standards

The minimum harvestable age is the criterion that forest stands within an analysis unit must meet to be eligible for harvest. In most cases, economic factors will dictate the threshold beyond which stands are available for harvest. For the purpose of timber supply modelling, these characteristics are often expressed in terms of volume per hectare and/or average diameter. Culmination age, the age at which mean annual increment (MAI) reaches a maximum, or some proportion thereof can also be used as the threshold for minimum harvestable age. In timber supply modelling the age at which the minimum threshold is attained is called the "minimum harvestable age" (MHA).

Note that these are minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives; however, other stands may not be harvested until well past the age for "optimal" timber production due to management objectives for other resource values

In the North Coast TSA, stands other than those in marginally operable areas must meet three criteria before being eligible for harvest:

- Achievement of 95% of culmination of mean annual increment (CMAI);
- A minimum standing volume of 375 m^3/ha ; and
- A minimum average diameter of 35 cm for the 250 largest trees (managed stands only).

For natural stands in marginally operable areas, a minimum standing volume of 250 m^3/ha is required. After these marginal stands are harvested, the same three criteria as the other managed areas must be met before these stands can be harvested again. Tables 8.1 and 8.2 present the ages when these criteria are met.

Table 8.1 - Minimum harvestable ages for existing natural stands.

Analysis Unit		95% CMAI Age	375 m^3/ha Age	Minimum Harvest Age
Clearcut Managment				
1	Cw-Nat-G	80	100	100
2	Cw-Nat-M	90	170	170
3	Cw-Nat-P	100	180	180
4	CwHw-Nat-G	80	100	100
5	CwHw-Nat-M	90	160	160
6	CwHw-Nat-P	100	250	250
7	Hw-Nat-G	60	70	70
8	Hw-Nat-M	80	110	110
9	Hw-Nat-P	100	170	170
10	HwCw-Nat-G	70	80	80
11	HwCw-Nat-M	80	120	120
12	HwCw-Nat-P	100	180	180

Analysis Unit		95% CMAI Age	375 m^3/ha Age	Minimum Harvest Age
13	HwBa-Nat-G	60	70	70
14	HwBa-Nat-M	80	100	100
15	HwBa-Nat-P	90	150	150
16	HwSx-Nat-G	60	70	70
17	HwSx-Nat-M	70	100	100
18	HwSx-Nat-P	90	150	150
19	BaHw-Nat-G	60	70	70
20	BaHw-Nat-M	80	100	100
21	BaHw-Nat-P	110	150	150
22	SxHw-Nat-G	50	60	60
23	SxHw-Nat-M	70	80	80
24	SxHw-Nat-P	90	120	120
25	Dr-Nat-A	40	50	50
Heli-log Variable Retention				
51	Cw-VRet-G	80	80	80
52	Cw-VRet-M	90	190	190
53	Cw-VRet-P	90	180	180
54	CwHw-VRet-G	80	110	110
55	CwHw-VRet-M	80	160	160
56	CwHw-VRet-P	90	250	250
60	HwCw-VRet-G	70	80	80
61	HwCw-VRet-M	80	110	110
62	HwCw-VRet-P	90	170	170
63	HwBa-VRet-G	60	70	70
64	HwBa-VRet-M	80	100	100
65	HwBa-VRet-P	90	150	150
66	HwSx-VRet-G	70	80	80
67	HwSx-VRet-M	70	100	100
68	HwSx-VRet-P	80	130	130
69	BaHw-VRet-G	60	240	240
70	BaHw-VRet-M	90	140	140
71	BaHw-VRet-P	120	250	250
72	SxHw-VRet-G	50	60	60
73	SxHw-VRet-M	70	80	80
74	SxHw-VRet-P	100	130	130

Because the existing (natural) stands in the North Coast TSA are very old, they are harvested well beyond the stated minimum ages provided in the table.

Table 8.2 - Minimum harvestable ages for managed stands.

Analysis Unit		95% CMAI Age	375 m^3/ha Age	Diameter 35 cm Age	Minimum Harvest Age
Clearcut Managment					
101	Cw-Manag-G	90	90	100	100
102	Cw-Manag-M	100	120	150	150
103	Cw-Manag-P	130	230	280	280
104	CwHw-Manag-G	90	90	90	90
105	CwHw-Manag-M	100	110	140	140
106	CwHw-Manag-P	120	160	220	220
107	Hw-Manag-G	80	80	80	80
108	Hw-Manag-M	100	100	120	120
109	Hw-Manag-P	120	140	200	200
110	HwCw-Manag-G	80	80	80	80
111	HwCw-Manag-M	100	100	130	130
112	HwCw-Manag-P	120	180	260	260
113	HwBa-Manag-G	80	80	80	80
114	HwBa-Manag-M	100	100	130	130
115	HwBa-Manag-P	120	150	200	200
116	HwSx-Manag-G	80	80	80	80
117	HwSx-Manag-M	100	100	110	110
118	HwSx-Manag-P	120	140	180	180
119	BaHw-Manag-G	80	80	80	80
120	BaHw-Manag-M	100	100	120	120
121	BaHw-Manag-P	130	140	190	190
122	SxHw-Manag-G	70	70	70	70
123	SxHw-Manag-M	80	80	80	80
124	SxHw-Manag-P	120	120	130	130
125	Dr-Manag-A	30	50	50	50
Heli-log Variable Retention					
151	Cw-VRet-Manag-G	90	n/a	90	90
152	Cw-VRet-Manag-M	110	n/a	110	110
153	Cw-VRet-Manag-P	130	n/a	130	130
154	CwHw-VRet-Manag-G	90	n/a	90	90
155	CwHw-VRet-Manag-M	100	n/a	100	100
156	CwHw-VRet-Manag-P	120	n/a	120	120
160	HwCw-VRet-Manag-G	80	n/a	80	80
161	HwCw-VRet-Manag-M	100	n/a	100	100
162	HwCw-VRet-Manag-P	120	n/a	120	120
163	HwBa-VRet-Manag-G	80	n/a	80	80
164	HwBa-VRet-Manag-M	100	n/a	100	100
165	HwBa-VRet-Manag-P	120	n/a	120	120
166	HwSx-VRet-Manag-G	80	n/a	80	80

Analysis Unit		95% CMAI Age	375 m^3/ha Age	Diameter 35 cm Age	Minimum Harvest Age
167	HwSx-VRet-Manag-M	100	n/a	100	100
168	HwSx-VRet-Manag-P	120	n/a	120	120
169	BaHw-VRet-Manag-G	80	n/a	80	80
170	BaHw-VRet-Manag-M	110	n/a	110	110
171	BaHw-VRet-Manag-P	130	n/a	130	130
172	SxHw-VRet-Manag-G	70	n/a	70	70
173	SxHw-VRet-Manag-M	80	n/a	80	80
174	SxHw-VRet-Manag-P	130	n/a	130	130
Thinned Stands					
207	Hw-Thin-G	90	90	90	90
209	Hw-Thin-P	130	140	140	140
210	HwCw-Thin-G	90	90	90	90
212	HwCw-Thin-P	140	200	200	200
213	HwBa-Thin-G	90	90	90	90
215	HwBa-Thin-P	150	180	180	180
216	HwSx-Thin-G	90	90	90	90
218	HwSx-Thin-P	130	130	130	130
219	BaHw-Thin-G	90	90	90	90
221	BaHw-Thin-P	130	130	130	130
223	SxHw-Thin-M	90	90	90	90

For the variable retention helicopter units (151 - 174), the minimum volume requirement is ignored because only a portion of the volume is removed during each harvest entry. These areas must meet the minimum diameter requirement in the subsequent entries into the stand for harvest.

8.2 Harvest Profile

The general harvest rule of oldest first will be modelled in all simulations for the analysis. However, a number of other harvest profiling rules will be included in the analysis:

- Direct as much of the annual harvest into the 25 priority operating areas (watersheds) identified by the licensees during the first 20 years of modelling simulation. Harvesting will move out of these watersheds if forest cover requirements for non-timber resources suspend access to timber; and
- Limit the annual harvest in visually sensitive (VQO) areas to approximately 80,000 m^3/year.

The long-term steady harvest level will always be slightly below the theoretical long-term level, attainable only if all stands are harvested at the age when MAI maximizes. This is due to the imposition of minimum harvest ages and forest cover requirements, which alter time of harvest.

8.3 Timber Supply Model

Timberline's proprietary simulation model CASH6 (**C**ritical **A**nalysis by **S**imulation of **H**arvesting), version 6.2l will be used to develop aspatial harvest schedules for the North Coast timber supply analysis. This model uses a geographic approach to land base and inventory definition in order to adhere as closely as possible to the intent of forest cover requirements on harvesting. CASH6 can simulate the imposition of overlapping forest cover objectives on timber harvesting and resultant forest development.

These objectives are addressed by placing restrictions on the distribution of age classes, defining maximum or minimum limits on the amount of area in young and old age classes found in specified components of the forest. For the purposes of this analysis objectives are of two types:

1. Disturbance (green-up*)*

The disturbance category is defined as the total area below a specified green-up height or age. This disturbed area is to be maintained below a specified maximum percent. The effect is to ensure that at no time will harvesting cause the disturbed area to exceed this maximum percent. This category is typically used to model adjacency, visual, wildlife or hydrological green-up requirements in resource emphasis areas, and early seral stage requirements at the landscape unit level.

2. Retention (old growth)

The retention category is defined as the total area above a specified age. This retention area is to be maintained above a specified minimum percent. The effect is to ensure that at no time will harvesting cause the retention area to drop below this minimum percent. This category is typically used to model thermal cover and/or old growth requirements in wildlife management resource emphasis areas, and mature and old growth seral stage requirements at the landscape unit level.

The model projects the development of a forest, allowing the analyst to impose different harvesting and silviculture strategies on its development, in order to determine the impact of each strategy on long-term resource management objectives. CASH6 was used to determine aggregated (aspatial) harvest schedules that incorporate all integrated resource management considerations. Explicit spatial feasibility factors, for example silviculture block green-up and adjacency, were not modelled in the analysis. Given the number of land base netdown factors which were not determined spatially, such spatial resolution was not deemed to be useful.

In the North Coast TSA TSR3 analysis, timber availability will be forecasted in decadal time steps (periods). The main output from each analysis is a projection of the amount of future growing stock (inventory), given a set of growth and yield assumptions, and planned levels of harvest and silviculture activities. Growing stock is characterized in terms of:

- *Operable* volume - total volume on the timber harvesting land base;
- *Merchantable* volume - operable volume above minimum harvest age; and
- *Available* volume - maximum merchantable volume that could be harvested in a given decade without violating forest cover constraints.

MoFR Forest Analysis Branch staff are familiar with the features of CASH6 and have reviewed a number of TSR analyses which used the model for developing timber supply forecasts.

9.0 TIMBER SUPPLY OPTIONS & SENSITIVITY ANALYSES

This section provides a summary of the harvest forecasts to be provided. The set of assumptions pertaining to each option and sensitivity analysis will be covered in detail in later sections.

9.1 Base Case

When reviewing timber supply for a management unit, a reference timber supply forecast is needed against which timber supply implications of different management assumptions may be measured. This reference harvest forecast is commonly referred to as the *base case*. It is based on current performance or a reasonable extrapolation of current performance. All considerations that guide design and implementation of forest practices, such as plans, guidebooks and permits, including requirements for the management of non-timber resources, current harvest systems and methods, and silvicultural management regimes, will be considered when developing current performance assumptions for the base case.

9.2 Sensitivity Analyses

The data and assumptions used in timber supply analysis are often subject to uncertainty. To provide a perspective on the impacts of uncertainty of data or assumptions on timber supply, sensitivity analyses are commonly performed. Usually only one variable (data or assumption) from the information used in the base case is changed for each sensitivity analysis.

Experience with AAC determination has shown that "standard" sensitivity analyses or those in which variables are altered by a somewhat arbitrary amount such as 5, 10 or 20 percent, can prove very useful during AAC determinations when assessing the implications of uncertainties that have not been evaluated specifically in an analysis.

Table 9.1 lists potential sensitivity analyses to be modelled in the timber supply analysis.

Table 9.1 - Planned sensitivity analyses

Issue	Sensitivity Levels to be Tested
Land base	Adjust timber harvesting land base by +/- 10% Remove landscape units north of Nass from the THLB Remove new protected and biodiversity areas from the THLB
Growth and yield	Adjust natural stand yields by +/- 10% SIBEC SI adjustments for managed stand yields SIBEC less 15% SI adjustments for managed stand yields Adjust minimum harvest ages +/- 10 years
Visual landscape	Adjust VQO green-up requirements by +/- 1 metre
Old-growth	Full OG requirements from year 1 of simulation Reduce OG age to 200 years
Ecosystem-based management	EBM 1 – revised old seral based on site series surrogates EBM 2 – exclude new protected and biodiversity areas and revised old seral EBM 2 – exclude new protected and biodiversity areas and revised old seral, additional harvesting in visual areas

This list is not necessarily exhaustive. Not all types of sensitivity analyses may be required, and specific local conditions may warrant a type of analysis not mentioned above. The choice of sensitivity analyses should reflect local conditions and knowledge.

Where necessary, assumptions will be described in more detail in the timber supply analysis report.

During preparation of the analysis, more issues that warrant sensitivity analysis may become apparent. Licensees will use professional judgement to decide which sensitivity analyses are required to provide the chief forester with a good understanding of the timber supply dynamics of the unit.

9.3 Other Options

In addition to the base case and sensitivity analyses, timber supply analysis may include options that quantify the impacts of pursuing management directions that are different from current management on timber supply.

9.4 Harvest Flow Objectives

One of the requirements of *Section 8* of the *Forest Act* is that the chief forester considers the short and long-term implications of alternative rates of timber harvesting from the area to British Columbia. Several alternative flow forecasts that will enable the chief forester to assess short, medium, and long-term trade-offs will be evaluated in the analysis.

Both the *Interim Standards for Data Package Preparation and Timber Supply Analysis* and *Harvest flow Considerations for the Timber Supply Review* available on the FIA website (http://www.for.gov.bc.ca/hcp/fia/landbase/tsa_ifpa.htm) describe considerations related to harvest flow.

Over the next rotation it may be necessary to reduce harvest levels prior to achieving the long-term level. Unless otherwise stated in the timber supply forecasts, the decadal rate of decline will be limited to 10%, and the mid-term harvest level will not be permitted to drop below a level reflecting the long-term productive capacity of the land base.

At this point and time, there are no significant harvest flow issues in the North Coast management unit, and sensitivity analyses planned to examine those issues.

A 250-year time horizon will be modelled in the analysis, to ensure that short and mid-term harvest targets do not compromise long-term growing stock stability. Also, modelled harvest levels will include allowances for un-salvaged losses (10,100 m^3/year). Un-salvaged losses reflect the volume of timber lost each year to fire and blowdown based on the 20-year average.

APPENDIX 1 - ACRONYMS

AAC	Allowable Annual Cut	MSYT	Managed Stand Yield Tables
Analysis	Timber Supply Analysis	MWLAP	Ministry of Water, Land and Air Protection
AU	Analysis Unit	NCC	Non-Commercial Cover
AUM	Animal Unit Month	NRL	Non-Recoverable Losses
BEO	Biodiversity Emphasis Options	NSR	Not Sufficiently Restocked
BGB	Biodiversity Guidebook	NSYT	Natural Stand Yield Tables
CF	Chief Forester	OAF	Operational Adjustment Factor
CORE	Commission on Resources and Environment	OGMA	Old-Growth Management Areas
CWAPS	Coastal Watershed Assessment Procedure System	OGSI	Old Growth Site Index
DFO	Department of Fisheries and Oceans	PFG	Post Free Growing
DM	District Manager	PMP	Proposed Management Plan
ESA	Environmentally Sensitive Area	PSP	Permanent Sample Plot
FEN	Forest Ecosystem Network	PSYU	Public Sustained Yield Unit
FES	Forest Ecosystem Specialist	RIC	Resources Inventory Commission
FIZ	Forest Inventory Zone	RM	Regional Manager
FPC	Forest Practices Code	RMZ	Riparian Management Zone
FRBC	Forest Renewal British Columbia	ROS	Recreation Opportunity Spectrum
FSSIM	Forest Service Simulation Model	RTEB	Resource Tenures and Engineering Branch
GIS	Geographic Information System	SBFEP	Small Business Forest Enterprise Program
HLP	Higher Level Plan	SUD	Satisfactory User Days
IWAPS	Interior Watershed Assessment Procedure System	TFL	Tree Farm Licence
LRMP	Local Resource Management Plan	THLB	Timber Harvesting Land base
LU	Landscape Unit	TIPSY	Table Interpolation Program for Stand Yields
MoF	Ministry of Forests	TSA	Timber Supply Area
MP	Management Plan	TYP	Twenty-Year Plan
MPR	Management Plan Review	VQO	Visual Quality Objective