DISTRICT OF MISSION
MISSION MUNICIPAL FOREST

TIMBER SUPPLY ANALYSIS AND TWENTY-YEAR PLAN

-TREE FARM LICENCE #26 -

Submitted to the Timber Supply Branch,

B.C. Ministry of Forests

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction

Timber supply is defined as the rate at which timber is available for harvesting in response to social, economic, environmental and biological factors. The timber supply analysis for a given management unit provides the Chief Forester with information regarding the short- and long-term timber supply and is a key component in determining the allowable annual cut (AAC). This analysis involves the testing and reporting of a variety of management strategies, assumptions and parameters using the current approved resource inventories of Tree Farm Licence 26 (TFL 26). All the data and assumptions to be used in the timber supply analysis are described in the information package. With the aid of a computer model, various harvest levels are calculated and reports on non-timber values are created and compiled in this analysis report and provided to the Chief Forester in support of the AAC determination.

This report describes the timber supply analysis and twenty-year plan process for TFL 26, held by the District of Mission (Mission). Traditionally, the timber supply analysis and twenty-year plan have been separate processes. The timber supply analysis was presented non-spatially and the role of the twenty-year plan was to present twenty years of harvesting activities spatially. This process does not provide an understanding of the harvesting opportunities available beyond year 20. Mission has opted to undertake a fully spatial timber supply analysis to verify that the timber supply levels are sustainable, given the current state of the inventory and spatial non-timber resource objectives. Both the timber supply analysis and twenty-year plan will be presented in this report.

This analysis provides the opportunity to advance the timber supply analysis and twenty-year plan into a process that can be used, not only for appropriate strategic analysis to meet a regulatory process, but more specifically:

1. The analysis results provide a linkage to direct future operational planning;

2. The analysis results enable the resource manager to develop plans that have spatial indicators that can be monitored and provide feedback to the strategic plan;

3. The model used for the analysis has the potential to spatially model the proposed harvest development on non-timber resources over time. This could provide a starting point for development of a sustainable forest management system; and

4. The spatial output can be evaluated manually, modified and incorporated in further spatial analysis.

2 Timber Supply Analysis

Hugh Hamilton Limited (now Forest Ecosystem Solutions Ltd. (FESL)) was contracted by Mission to prepare the information package and undertake the timber supply analysis utilizing Forest Optimization and Simulation System ***(FSOS)***. A broader description of ***FSOS*** is provided in Section 5.0 and detailed documentation is included in the information package (Section 4.0). The model can operate in a simulation mode that allows the sensitivity testing of various assumptions and parameters. It can also be operated in optimization mode, targeting desired set of objectives.

The integrated timber supply and twenty-year harvest analysis process has four primary sets of established scenarios:

Base case - The forest management scenario that is based on current practices and regulations. This scenario provides a baseline to which sensitivities and alternate scenarios are compared.

Sensitivity analyses – Using the model in simulation mode, various tests are undertaken to examine how timber supply could change if some of the information used in the analysis is inaccurate or changes. Sensitivity analyses provide an understanding of the land base dynamics and reveal issues associated with uncertainty in the data and management assumptions.

Base Optimization – This scenario provides a recommended forest management strategy that may or may not differ from the base case. It also sets the base for the development of the twenty-year plan.

Twenty Year Plan – As part of the management plan process, the licencee must submit a twenty-year harvest plan that spatially represents the feasibility of the first twenty years of the timber supply. Building upon the proposed option, this scenario emphasizes the achievement of short-term (<20 years) spatial harvest scheduling while considering the long-term timber supply. FSOS maintains the spatiality of the resultant polygons and associated resource inventory attributes throughout the planning horizon and provides a mapped representation of harvesting opportunities necessary to meet the proposed harvest rate.

Due to the estate model's linkage to operational planning, the preparation of the twenty-year plan has been integrated with the timber supply analysis and the two reports will be presented together. A map showing potential twenty-year harvest blocks is included in this report. Please refer to the associated map folio for the twenty-year plan maps and associated overlays.

3 Description of the Licence Area

TFL 26 is located in the northern part of the District of Mission, a municipality of about 30,000 people in the north-central Fraser Valley.

The total area of the TFL is 10,560 hectares (ha) of which 88% are Crown lands (Schedule B lands) and 12% are municipal lands (Schedule A lands). The current timber harvesting land base (THLB) is approximately 7,294 ha. The current standing volume for TFL 26, based on the projected inventory to January 1, 2000, is 2,580,391 m^3.

4 Information Preparation

4.1 Land Base Inventory

All spatial information was received in IGDS (Microstation) format and translated into ARC/INFO. All data is controlled to the North American Datum (NAD) 83 base. The previous re-inventory for TFL 26 updated forest cover spatial and non-spatial attributes to 1988. The forest cover inventory has been updated since the re-inventory for depletions to January 1, 1998 and for growth to January 1, 2000. Annual projections are completed using VDYP. The spatial and attribute data are stored in both the FC1 and FIP file formats as per the provincial inventory standard database. The spatial inventory data is currently managed through ARC/INFO, which maintains the spatial relationships within the forest inventory as well as the other resource inventory information.

The inventory file represents the gross land base for TFL 26, representing both the contributing and non-contributing land base. The file contains information on land that is non-forested and forested where timber harvesting is excluded due to parks, areas required for wildlife protection, power lines, and residential and industrial development.

The following table summarizes the lands that have been excluded from the THLB. A more detailed description of the categories in the table is provided in Section 6 of the information package.

Table 1 - Timber harvesting land base determination for TFL 26

Classification	Productive Area (ha)	Netdown Area (ha)
Total Land base	**10,564.1**	**10,564.1**
Non Forest	686.3	686.3
Total Productive Forest	9,877.7	9,877.7
Reductions to Total Productive Forest:		
Non-commercial	30.4	30.4
Inoperable	180.0	176.7
Non-merchantable	214.3	134.7
Environmentally Sensitive Areas	2,301.4	763.3
Deciduous leading - not utilized	806.6	739.9
Roads and Trails	180.6	171.6
Riparian Areas	243.5	173.9
Specific Geographic Areas	156.1	137.9
Wildlife Tree Patches		192.3
Total Reductions to Productive Forest		**2,520.7**
Total Reductions to Land base		**3207.0**
Total Reduced Land base		**7,356.9**
Current Timber Harvesting Land base		**7,356.9**
Future Reductions:		
Proposed Roads	23.2	23.2
Future Roads		98.0
Total Long-Term Land base		**7,235.7**

[a] Includes 52.9 net ha of NSR (Schedule A 9.6 ha; Schedule B 43.3 ha)

The current THLB in TFL 26 represents about 69% of the gross TFL area. Figure 1 further illustrates the reductions applied to the land base.

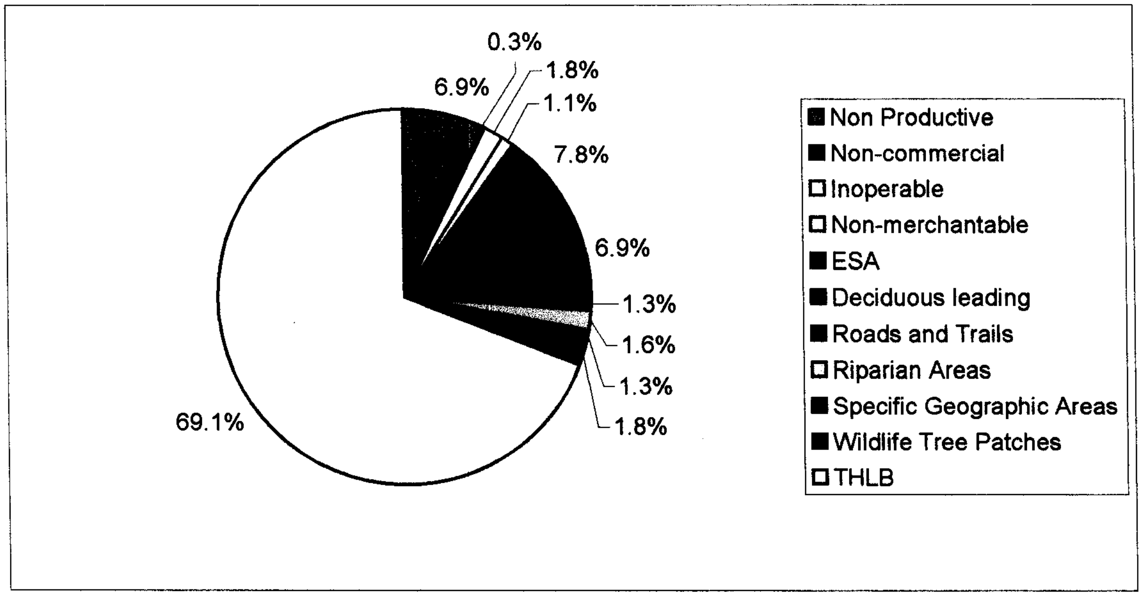

Figure 1 - Timber harvesting land base.

Figure 2 illustrates overall distribution of biogeoclimatic variants within the TFL. The figure also shows the proportion of each BEC variant in the THLB and non-THLB land base. As shown, the majority of the THLB and gross land base is represented by the CWHdm biogeoclimatic variant.

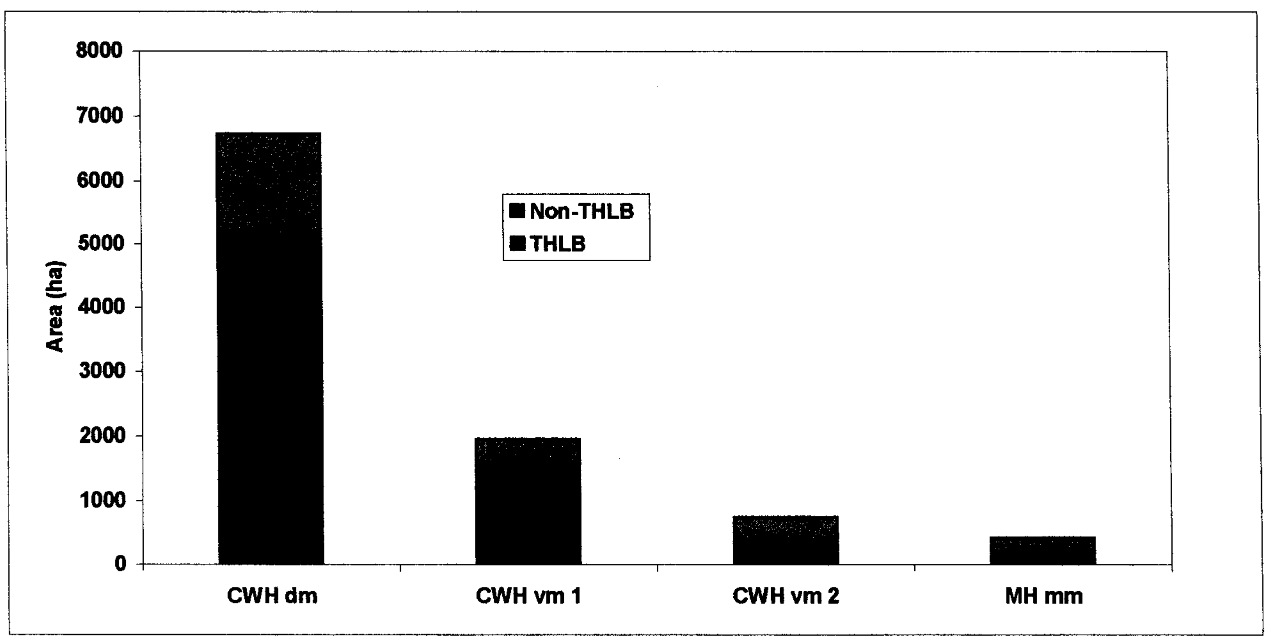

Figure 2 - Area in biogeoclimatic variants within TFL 26.

Figure 3 illustrates the current composition of the THLB by dominant tree species. Western hemlock and sub-alpine fir dominate the stands on about 55% of the THLB (plus 5% for high elevation western hemlock and sub-alpine fir). Douglas-fir and western redcedar cover 24% and 13% of the THLB respectively. After harvest, 40% of the cedar leading stands and 60% of the hemlock/balsam dominated stands are expected to be converted to Douglas-fir. The remaining stands will be regenerated to the existing leading species.

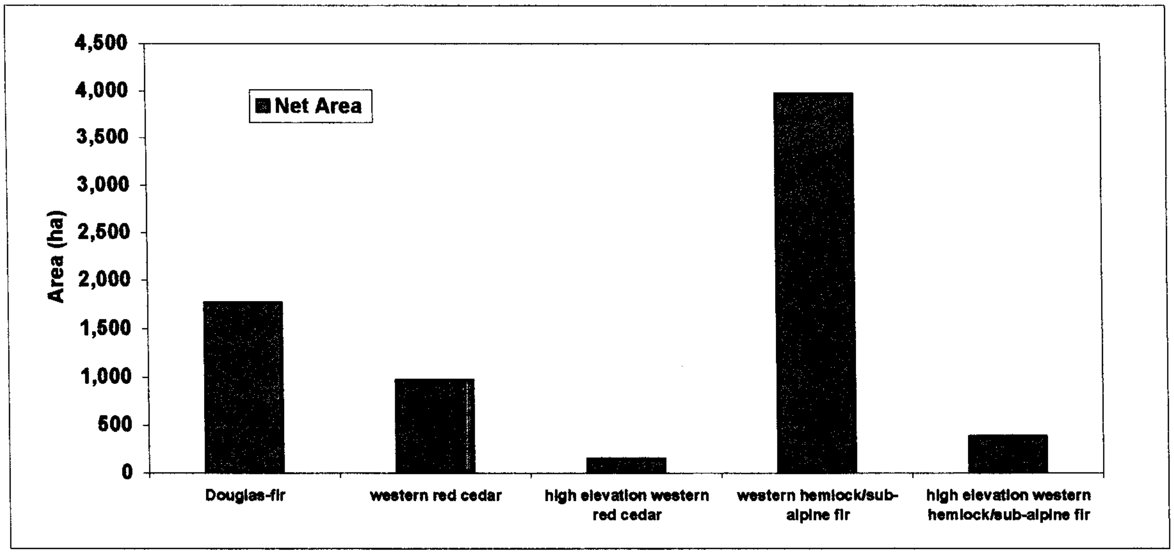

Figure 3 - Dominant tree species distribution within the timber harvesting land base.

Figure 4 illustrates the distribution of site productivity of the dominant stand types within the timber harvesting land base. Site productivity is defined as good, medium and poor based on site index. Good sites occupy approximately 54% of the land base; medium sites about 34% and about 12% are poor sites. Sites with very low productivity (stands greater than 200 years in age occurring on generally poorer sites and having crown closures of less than 50%) are excluded from the THLB. Mid-point definitions for good, medium and poor sites are represented in Table 2.

Table 2 – Mid-point site index definitions of good, medium, and poor sites.

Leading Species	Good site	Medium site	Poor site
western redcedar	29	23	15
Douglas-fir	32	27	18
western hemlock/sub-alpine fir	28	22	14
high elevation western red cedar	29	23	15
high elevation western hemlock/sub-alpine fir	28	22	14

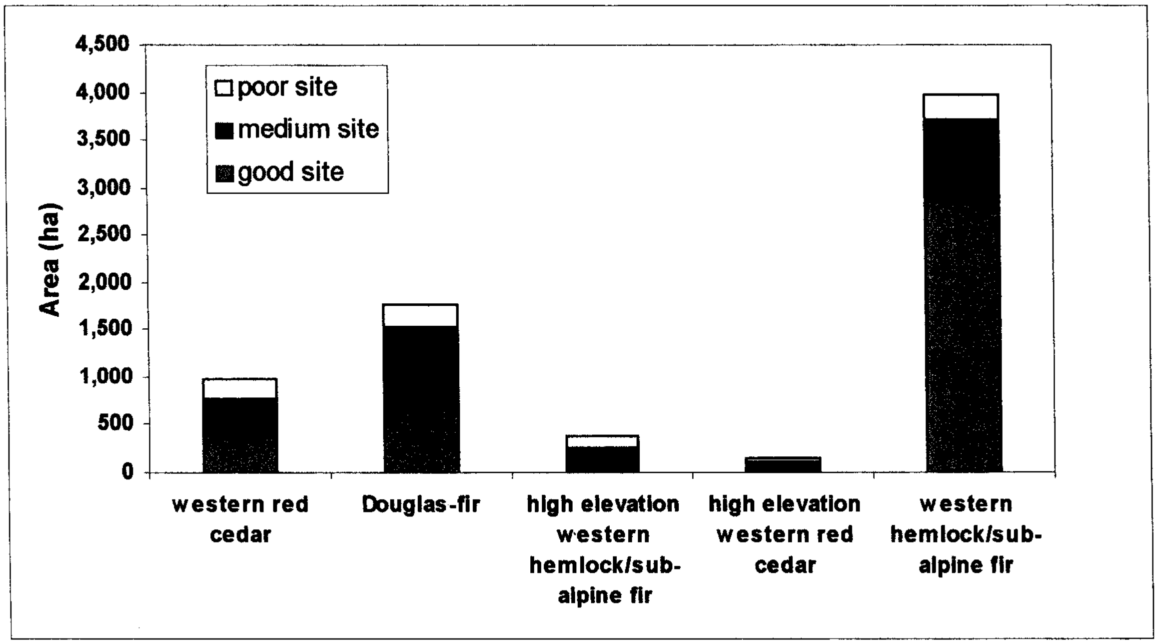

Figure 4 - Dominant tree species distribution within the timber harvesting land base by site productivity.

Figure 5 illustrates the current age class composition of the total Provincial Crown forested area and the THLB. Forested areas within the Crown land base outside the THLB may contribute to landscape seral stage targets but are not eligible for harvesting. Approximately 15% of the THLB is less than 20 years old and about 68% of the THLB is between 21 and 80 years old leaving 17% for stands older than 80 years. Only 1.45 % of the THLB is older than 250 years.

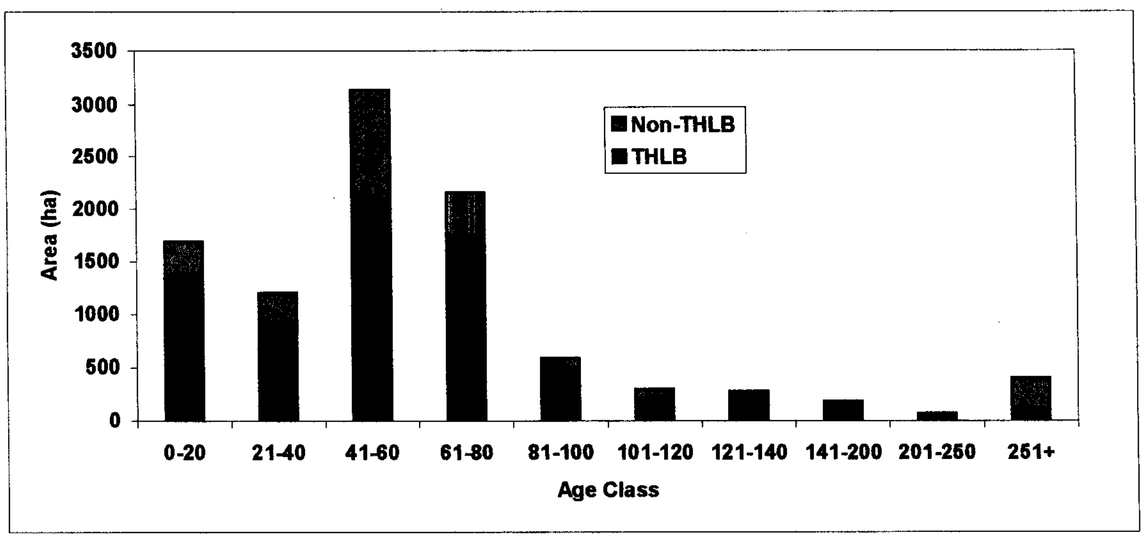

Figure 5 - Current age class distribution within TFL 26.

The forested stands outside of the THLB represent 26% percent of the total forested land base and are a significant factor in the availability of timber supply. Currently about 12% of the forested area outside of the THLB is older than 250 years and does not fulfill all of the old forest seral objectives. Therefore, some THLB may have to be recruited for old forest seral objectives, as there is relatively little non-THLB area in the 141-200 and 201-250 age class. The impact of age class and biodiversity on timber supply will be further discussed in Sections 6.1.3, 6.2.3 and 6.3.12.

4.2 Inventory Aggregation

In its basic inventory format, TFL 26 contains a large number of individual forest stand polygons, each with unique combinations of species composition, site index and age. For the application of timber supply analysis, stand-level modeling and reporting, these stands are amalgamated into relatively homogeneous strata called analysis units (AU).

Site index, leading species, and biogeoclimatic variant were the dominant criteria for creating the AUs for TFL 26. See Table 7.2 in the Information Package for further information regarding the AU descriptions and assignments.

4.3 Timber Growth and Yield

Predicting growth and yield over time is one of the main inputs to the timber supply analysis process. While growth and yield could represent any forest attributes that change over time, they usually represent an estimate of volume, height, mean annual increment, and density for a given period. Yield curves are available for every species and site index combination and can be aggregated on an area-weighted basis for every analysis unit. Each species attribute of every polygon was summarized for the development of the curves. Specific utilization standards were assumed for this analysis to establish minimum merchantable tree and log sizes by identifying minimum base and top tree diameters.

Two growth and yield models were used to estimate timber volumes for TFL 26. The variable density yield prediction (VDYP) model, developed by the British Columbia Forest Service Resources Inventory Branch, was used to estimate volumes of existing unmanaged coniferous stands. The table interpolation program for stand yields (TIPSY), developed by the British Columbia Forest Service Research Branch, was used to estimate yields for existing and future coniferous managed stands.

This analysis did not consider deciduous stands or deciduous components in coniferous stands. All deciduous stands were removed from the THLB. In addition, all deciduous components were removed from the coniferous stands prior to yield table development.

In the base case scenario, the definition of managed immature stand followed the same assumptions used in the *Fraser Timber Supply Area Analysis Report*. All stands harvested over the last 10 years, hemlock stands harvested over the last 20 years, Douglas-fir stands harvested up to 40 years ago and all stands that will be harvested in the future are assumed to grow according to managed stand volume estimates from TIPSY.

Volume estimation and prediction are subject to uncertainty due to ambiguities in estimating site productivity, limited experience with second growth stands in British Columbia, and the length of time it takes for trees to reach maturity. Section 6.3 investigates these uncertainties and their impact on timber volumes through various sensitivity analyses.

Based on existing forest cover timber volume estimates, the current timber inventory within the THLB is approximately 2.6 million m^3. Figure 6 illustrates the standing timber volume distribution by age class within TFL 26 and shows that the majority (80%) of the volume is in the 41-100 age class groups.

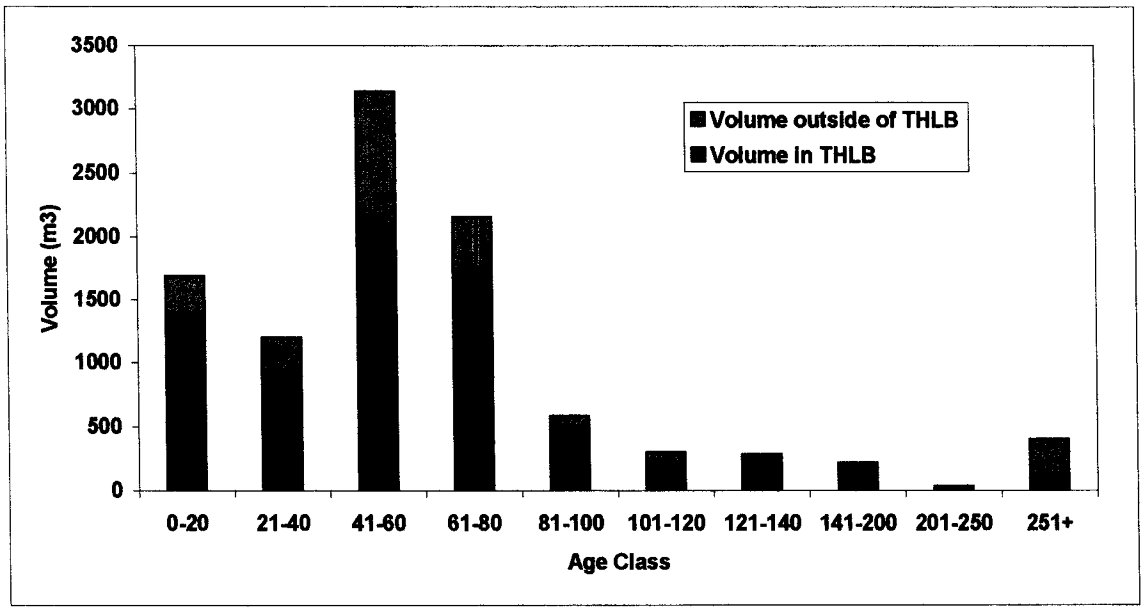

Figure 6 - Standing timber volume distribution within TFL 26.

4.4 Management Practices

Management of both timber and non-timber values will influence timber supply forecast results. For the purposes of the timber supply analysis process, the base scenario is developed for current management. The following provides a brief description of current management practices within TFL 26:

- Silviculture practices - Mission harvests most areas within the TFL using a clearcut with reserves silviculture system with harvested areas usually regenerated in one year. More recently, commercial thinning has been proposed in Mission's latest forest development plan. These commercial thinning areas have been identified and are applied in the analysis. Mission estimates that between 2.5% and 5% of the merchantable volume is left in reserves on harvested blocks in addition to permanent reserves and wildlife tree patches. In the analysis, a 3.5% volume reduction was applied to account for the reserves and is applied to those polygons that had received less than a 10% area net down due to other resource value reductions.

- Incremental silviculture - Mission is using genetically improved seed for all planting. A total of 172 hectares has been spaced in the past. This analysis assumes that the majority of regenerated stands will be spaced as per table 8.7.1.b of the Analysis Information Package.

- Forest health and unsalvaged losses - Timber losses to fire, wind and pest damage are assumed to average 115 m^3 per year over the planning horizon.

- Green-up - Before harvesting can occur in a stand, adjacent stands must reach a green-up height of 3 m in integrated resource management (IRM) zones. The area that does not meet green-up conditions cannot exceed 33% in IRM zones at any given time. This prevents over concentration of harvest in any specific area.

- Protection of environmentally sensitive areas (ESA) – ESA's represent areas with potentially unstable soils, avalanche tracks, recreation activities, regeneration problems, and habitat for various wildlife species. These areas have been completely or partially removed from the THLB.

- Domestic and community watersheds – Since there is no harvesting within the Cannell Lake community watershed, it was removed from the THLB. Within the Kenworthy Creek watershed a maximum of 30% of the watershed area is allowed to be less than the green-up height of 7 m. This green-up height, which is substantially more than that of the IRM zone, is used as a surrogate for equivalent clearcut area rule.

- Maintenance of scenic values - Visible evidence of harvesting must be kept within specific limits within visually sensitive areas of the TFL. The maximum proportion of each scenic area that may be covered by young stands that are shorter than the green-up height varies throughout the TFL depending on visual quality class and characteristics of the forest. In areas classified as partial retention, 5-15% may be less than 4 meters tall. In areas classified as modification, 20% may be less than 4 meters tall.

- Minimum harvestable ages (MHA) – MHA refers to the time it takes for stands to reach a merchantable condition. The analysis units classified as having a good site index will be available for harvest at 600 m^3/ha or at max MAI, while 500 m^3/ha and 400 m^3/ha are the minimum volume requirements for the medium and poor analysis units respectively, unless maximum MAI is achieved first.

Figure 7 illustrates proportions of the THLB affected by the different forest management objectives.

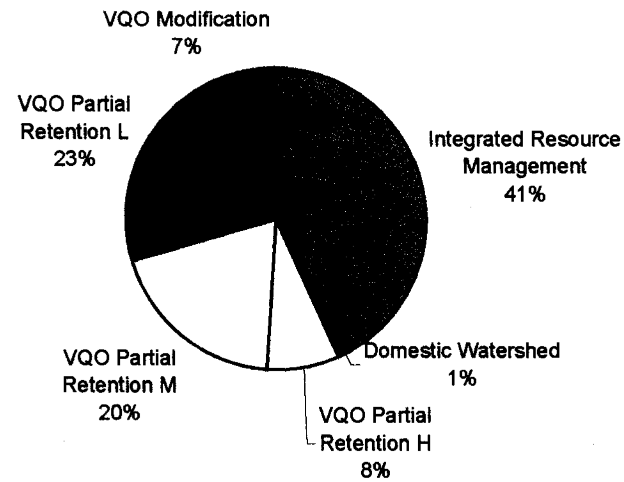

Figure 7 - Area distribution of forest management objectives within TFL 26.

5 Timber Supply Analysis Methods

FESL offers the combined data management capabilities of ARC/INFO and MS Access™, with a target-based landscape simulation and optimization model FSOS (Forest Simulation Optimization System), and expert professional experience. FSOS is capable of analyzing forest systems in a spatial manner, using both simulation and optimization techniques.

In simulation mode, FSOS incorporates a time step simulation modeling technique that uses constraints to limit harvesting activities. Volumes are an input to the model and manipulation of flow dynamics is performed manually. Harvest scheduling is sequential, period-by-period, based on "what can be cut" in each period and therefore options for designing the landscape are limited. An "oldest first" rule is primarily used in prioritizing eligible stands, but different cutblock patterns can be incorporated if necessary to meet the objectives of the analysis. Adjacency regulations (based on minimum distance and green-up height) are applied in simulation.

In optimization mode, FSOS provides a target-oriented approach to landscape design, based on user-defined criteria for desired future conditions (DFC). Setting "soft" targets as opposed to "hard" constraints used in simulation allows for trade-offs between and within resource values, even if the DFC has not been achieved. Cutblock building and scheduling is completed simultaneously within the model run in accordance with operational requirements and non-timber guidelines. Blocks are built from small independent polygons, offering flexibility in creating block size distributions to best-fit management needs. Each optimization run consists of numerous iterations with one iteration representing one potential solution. Complex equations evaluate each iteration, applying penalties based on each resource's deviation from the desired future condition and its "weighted" importance to the overall management objectives. Feedback mechanisms ensure progression towards a "near-optimal" solution (the point at which further iterations do not result in solution improvement). Timber volumes and flow characteristics are outputs of the model, based on ecosystem characteristics, the productive capacity of the land base and the management objectives.

This current timber supply analysis differs significantly from the previous analysis in the following ways:

- New VQO zones;
- More restrictive riparian regulations;
- Application of draft old-growth targets;
- Multiple regeneration assumptions with site index adjustments for species conversion applied;
- Harvesting activities and targeted associated volumes are spatially and temporally referenced;
- Different definition for minimum harvestable age.

5.1 Simulations

In modeling timber supply in simulation mode, several guidelines were sequentially applied, in order of importance, based on management objectives and the current state of the TFL:

- Sustain the AAC as long as possible without compromising the mid- and long-term timber supply;
- Decline the periodic harvest rate in acceptable steps if decreases are required (≤10% per decade);
- Improve mid-term gaps - if any and if possible - without compromising timber flow.

5.2 Optimizations

Modeling timber flows in optimization mode requires the model to utilize a series of weightings for each objective and indicators to evaluate the relative success of each solution. Near-optimal solutions achieve highly weighted targets quickly over the planning horizon to minimize the total penalty. The same harvest flow parameters as used in simulation are applied to optimization to maintain a common strategic harvest level balanced with the achievement of complex targets such as the twenty-year plan desired block size.

6 Results

6.1 Base Case and Alternative Flow Harvest Forecasts

The base case and all the further timber supply runs model only coniferous stands. Deciduous stands are not part of the THLB as they are not currently utilized. In addition, deciduous volumes in coniferous leading stands were deducted from the inventory data before the analysis. The current AAC in this report refers to the coniferous AAC only.

Figure 8 shows the base case harvest forecast for TFL 26. It suggests that a harvest level of 43,168 m^3 per year can be maintained for 9 decades following an increase up to 46,877 m^3 at 95 years and yet another increase at 155 years up to the long-term harvest level (LTHL) of 50,187 m^3.

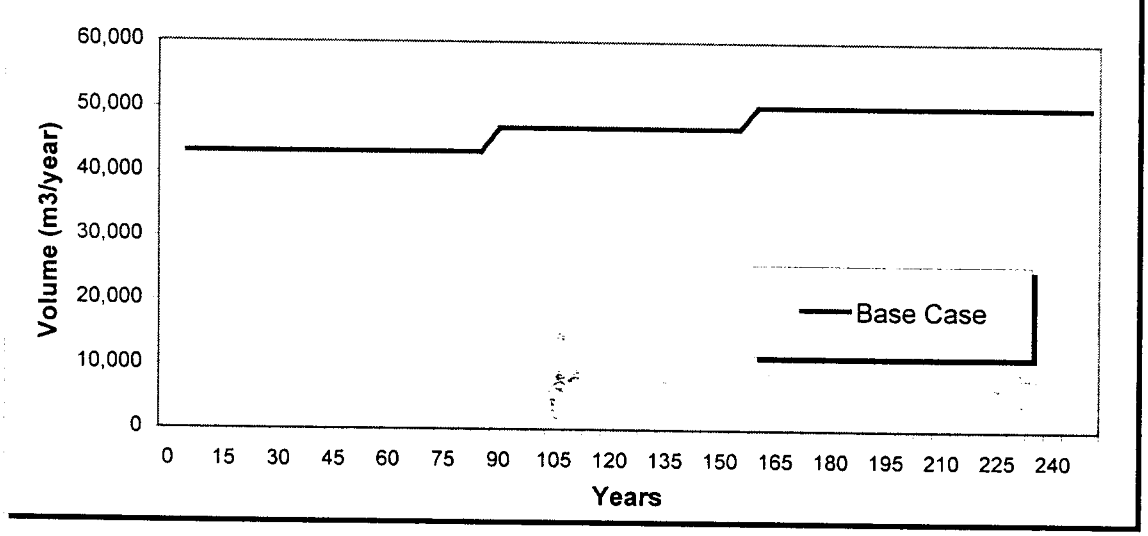

Figure 8 - Base case harvest forecast for TFL 26.

The short-term harvest level of 43,168 m^3 in the base case is approximately 3% higher than the current coniferous AAC, despite the smaller THLB (9.5%) compared to the last timber supply review. The current, less restrictive VQOs and changes in minimum harvestable ages since the last timber supply review account for most of this increase. This was confirmed by an additional analysis using the minimum harvestable age definition and mimicking the VQO classes from the last analysis. This brought the AAC down to 37,700 m^3 for the first 85 years, after which the long-term harvest level was reached.

Several harvest forecasts are feasible for TFL 26 within the current management regime. Many forecasts were developed and investigated before selecting the base case. Figures 9 and 10 illustrate these forecasts.

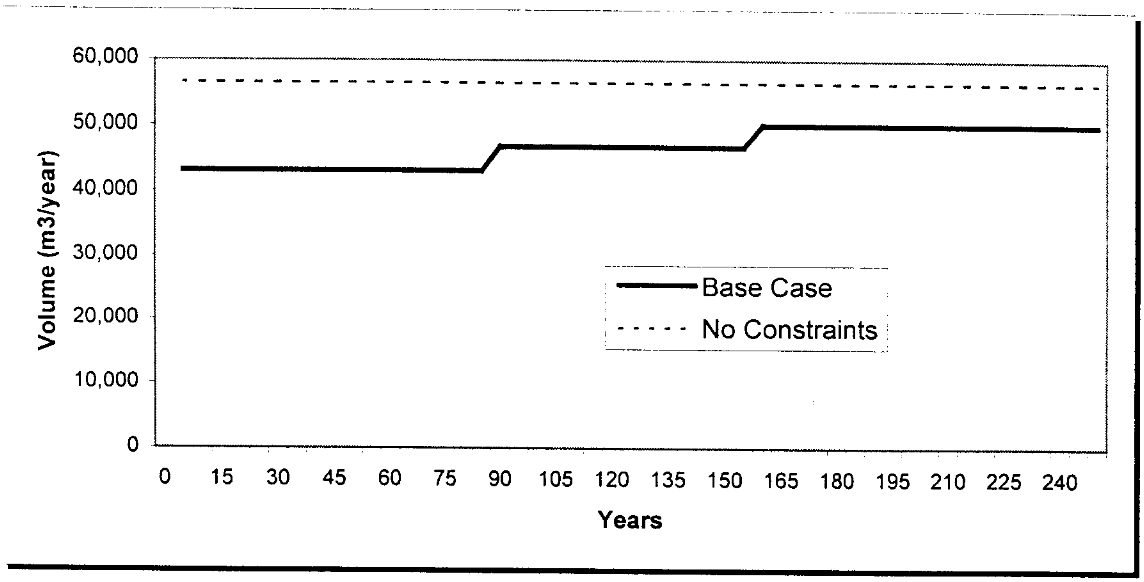

Figure 9 - Base case and no land base constraints harvest forecasts.

Figure 9 shows the sustainable even-flow harvest level with no land base constraints. The harvest flow is 56,492 m^3, 31%, 21% and 13% higher than the base case short-, mid and long-term levels, respectively. The unconstrained scenario illustrates the maximum potential timber supply available from the THLB if there were no restrictions required.

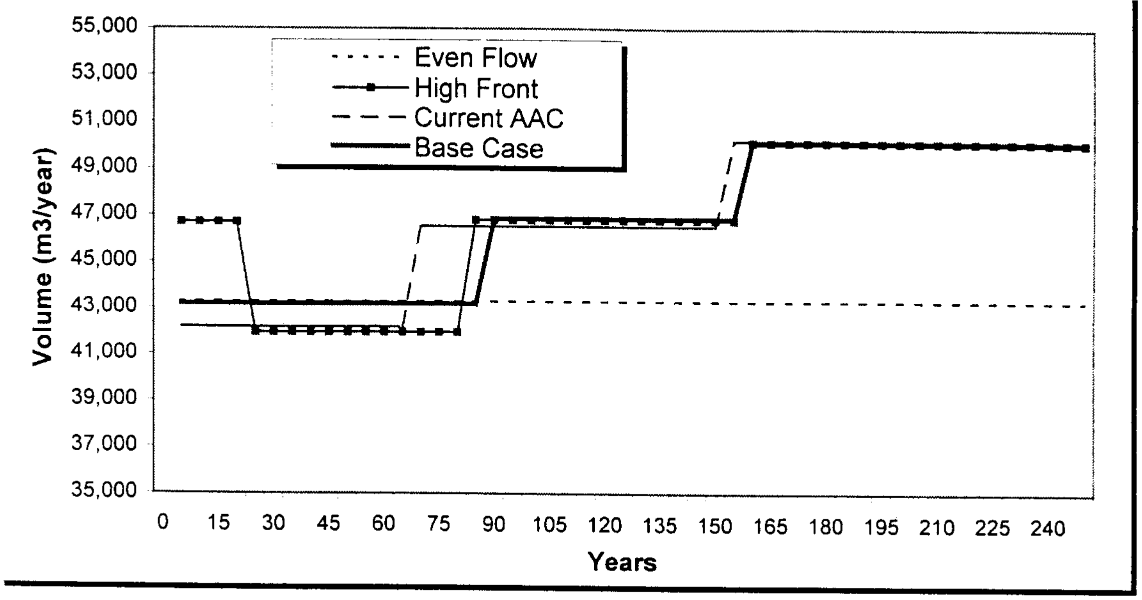

Figure 10 - Base case and alternative base case harvest forecasts.

While Figure 8 represents the defined base case scenario for TFL 26, many other harvest flow forecasts are possible by employing different initial harvest levels, varying decline rates and allowing different short- and long-term harvests. Figure 10 illustrates three alternative harvest flow forecasts generated for TFL 26. The existing AAC of 42,163 m^3 is maintained for 70 years after which the harvest increases up to 46,500 m^3 reaching the long-term harvest level 5 years earlier than the base case.

The second forecast represents maximization of the short-term harvest. The initial harvest level of 46,706 m^3 is higher than current AAC; however, it is maintained only for two decades decreasing to 41,936 m^3 at 25 years. The harvest stays at this level until year 85 after which it increases up to 46,822 m^3 and reaches the long-term harvest level at year 160.

The third forecast tested the feasibility of maintaining a highest possible even non-declining harvest flow identical to the base case short-term harvest level and represents the maximum rate of harvest that can be sustained over the 250 year forecast horizon.

6.1.1 Base Case Timber Supply Dynamics

Figure 11 illustrates the transition of harvest from existing to managed stands and their contribution to the overall harvest volume projected in the base case. Over the first six decades, the timber supply is provided almost entirely by existing stands. In the 7th decade managed stands have reached a harvestable age and form 80% of the harvest. The maintenance of VQOs and landscape level biodiversity, particularly old growth, result in the harvest of significant volumes of natural existing stands later in the planning horizon as demonstrated by the "peaks" in Figure 11.

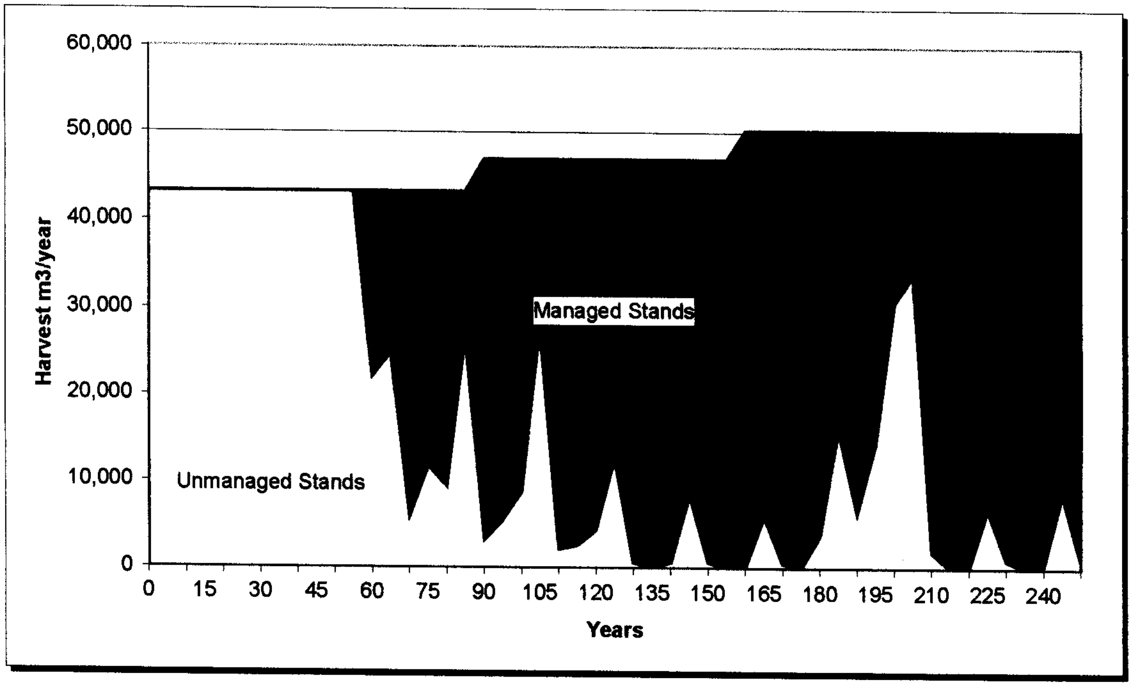

Figure 11 – Base case harvest volume from existing and managed stands.

Figure 12 shows the development of total growing stock and merchantable growing stock over time. The total growing stock represents the volumes of stands of all ages while the merchantable growing stock is the volume of only those stands that have reached harvestable condition. After the transition to managed stands, both the total growing stock and the merchantable growing stock increase until the 15th decade when they level off. In most management units, growing stock generally declines as existing natural stands with relatively high volumes are harvested and replaced by younger stands with lower volumes. This does not happen in TFL 26. Dominated by second growth with very little old forest remaining, a significant amount of retention must occur, which in fact increases the growing stock until year 160. The increased merchantable growing stock also provides a confidence in the general robustness of the timber supply in the TFL.

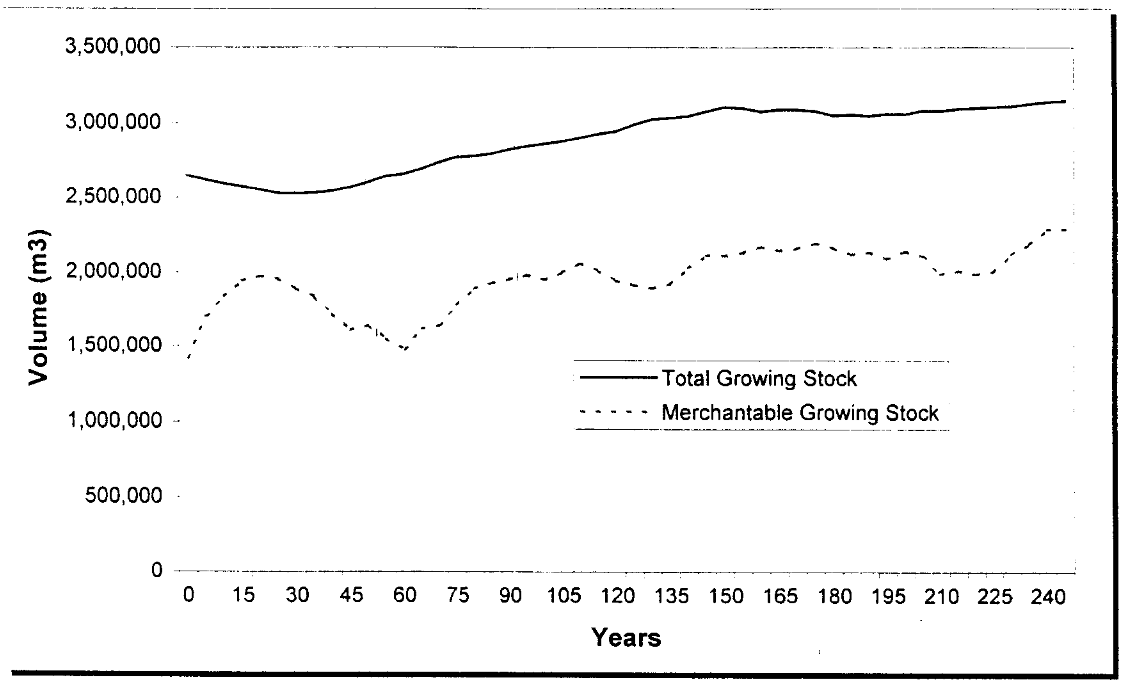

Figure 12 - Base case, total and merchantable growing stock over the planning horizon.

6.1.2 Average Age, Area and Volume Harvested

Figure 13 shows the area harvested over the next 250 years following the base case harvest forecast. The average harvest area for the base case is approximately 65 hectares and ranges from 41 hectares to 76 hectares. There is a general trend for smaller annual harvest area in the long-term due to the increasing per hectare harvest volumes over time (Figure 14). The significant variation from one period to the next is predominately due to the need to reserve areas for VQOs. These management zones accumulate high per hectare volumes and less area is harvested to meet a given harvest level.

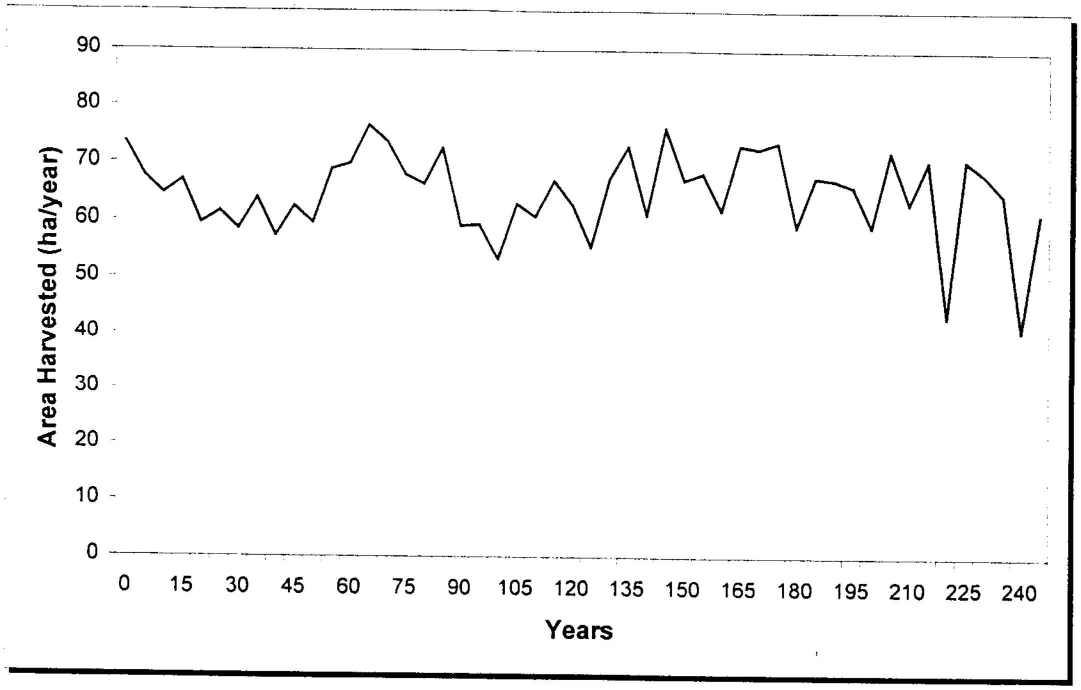

Figure 13 - Area harvested over planning horizon.

In many cases, there is a inverse relationship between area and volume harvested. As the area harvested decreases, the volume harvested must be increased to maintain the long-term harvest level. As shown in Figure 14, the average volume per hectare harvested within the base case forecast increases slightly over the planning horizon, inverse to the decreasing area harvested in Figure 13. This is not typical, particularly for coastal forest estates, which often have a large portion of old forest remaining resulting in high per hectare harvest volumes at the beginning of the planning horizon. Similar to the cause of the increasing growing stock, older age stands must be retained and recruited for landscape level biodiversity and VQOs. These forests have somewhat higher per hectare volumes when harvested.

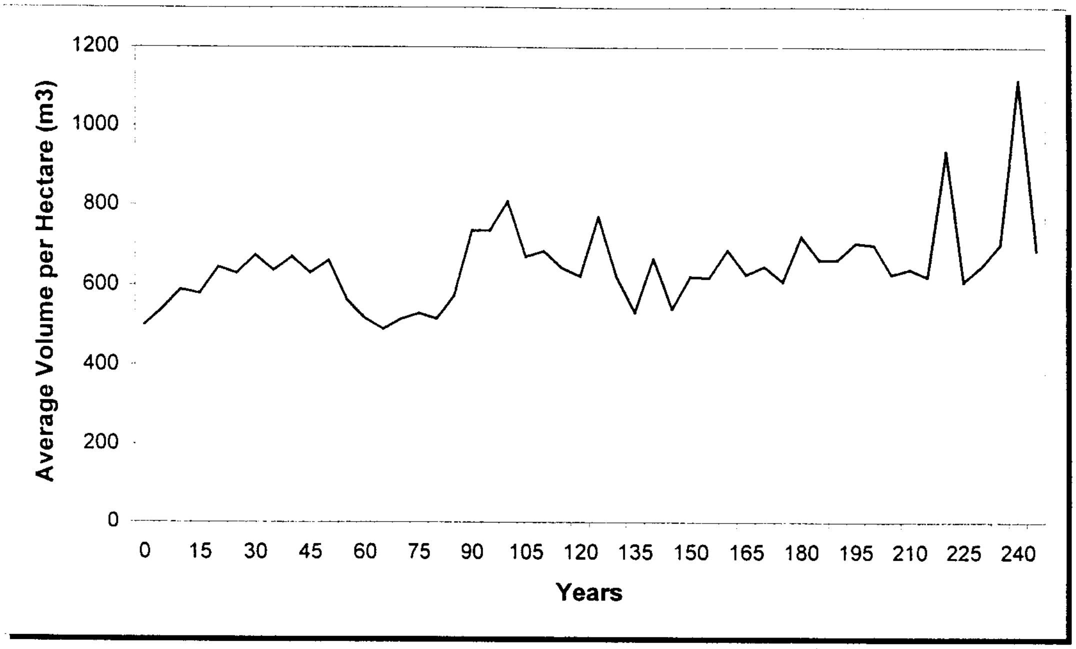

Figure 14 - Average volume harvested per hectare over planning horizon.

As illustrated in Figure 15 the average harvest age fluctuates around 100 years until the 17th decade after which it exhibits great variation reaching 270 years at year 200 and maintaining a slightly higher average near the end of the planning horizon. Retaining stands to meet VQO and old growth requirements and eventually harvesting these stands, some of them at very old ages, cause the large variation in the average harvest age.

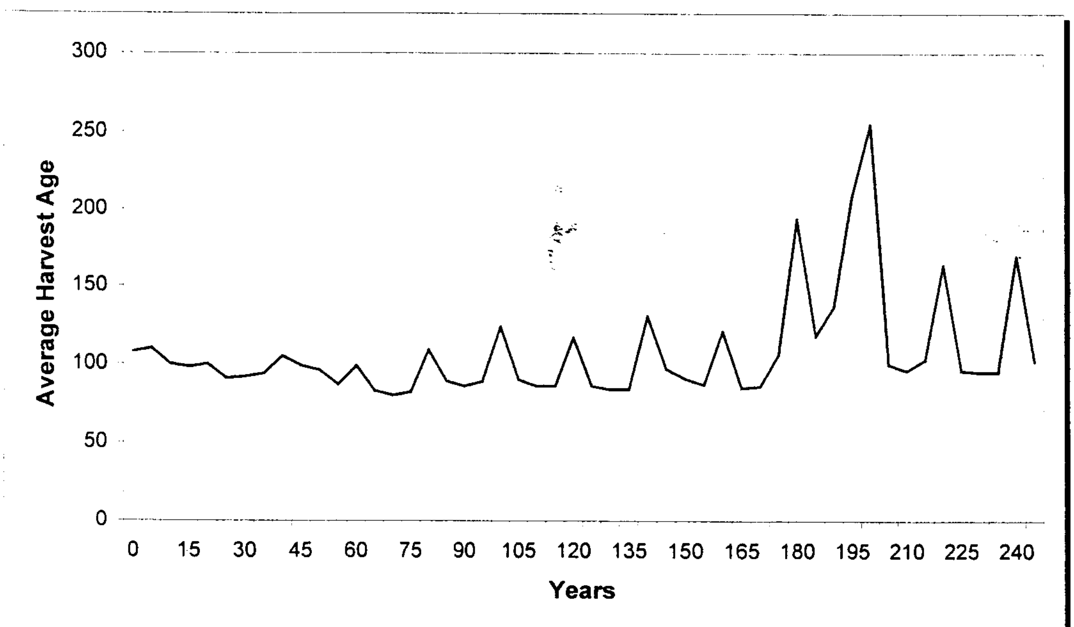

Figure 15 - Average harvest age over the planning horizon.

6.1.3 Age Class Profile Over Time

An assessment of the age class profile over time within the TFL indicates how the land base would change over the next 250 years for the base case harvest forecast. Figures 16 – 21 show the predicted age class distribution for the base case scenario at 50-year intervals.

Strategic timber supply analysis is based on incorporating the management of age classes across a forest estate for both the assessment of an achievable harvest level and non-timber forest cover requirements. The area in distinct age classes determines the opportunity for harvest, satisfaction of forest cover requirements, and future sustainability. It is also important to realize the temporal changes with forest age composition and a given harvest forecast.

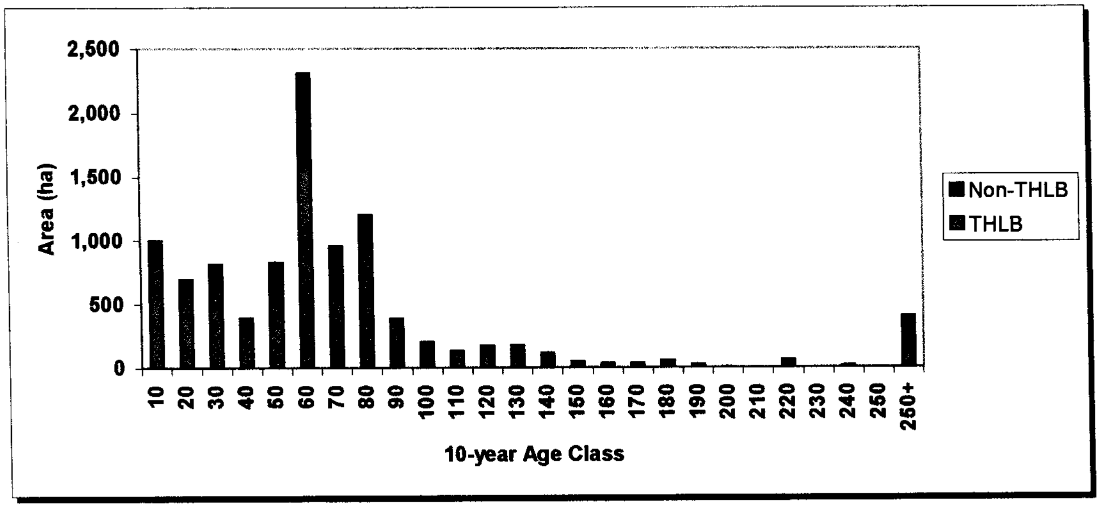

Figure 16 - Current age class distribution.

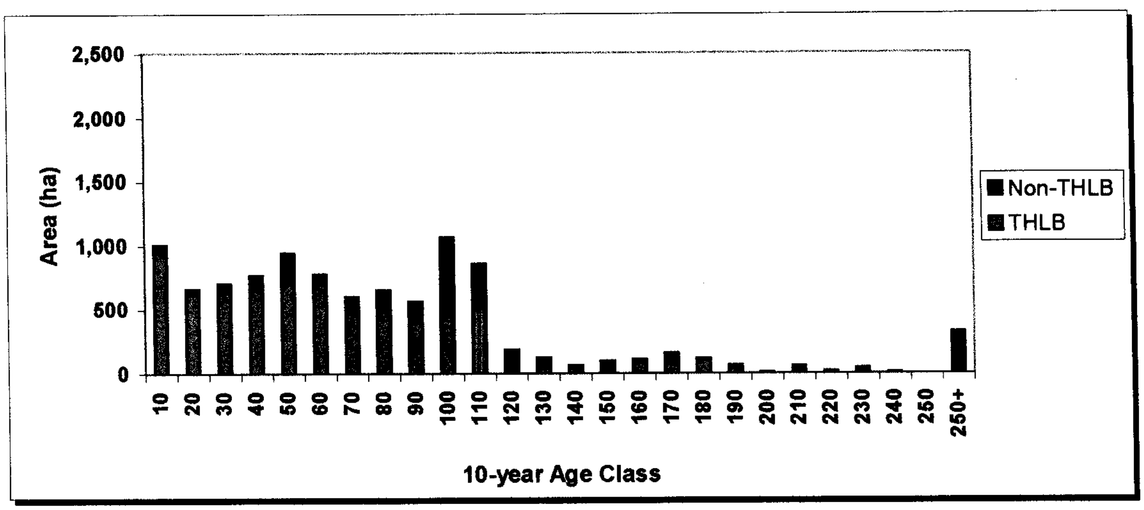

Figure 17 - Age class distribution in 50 years.

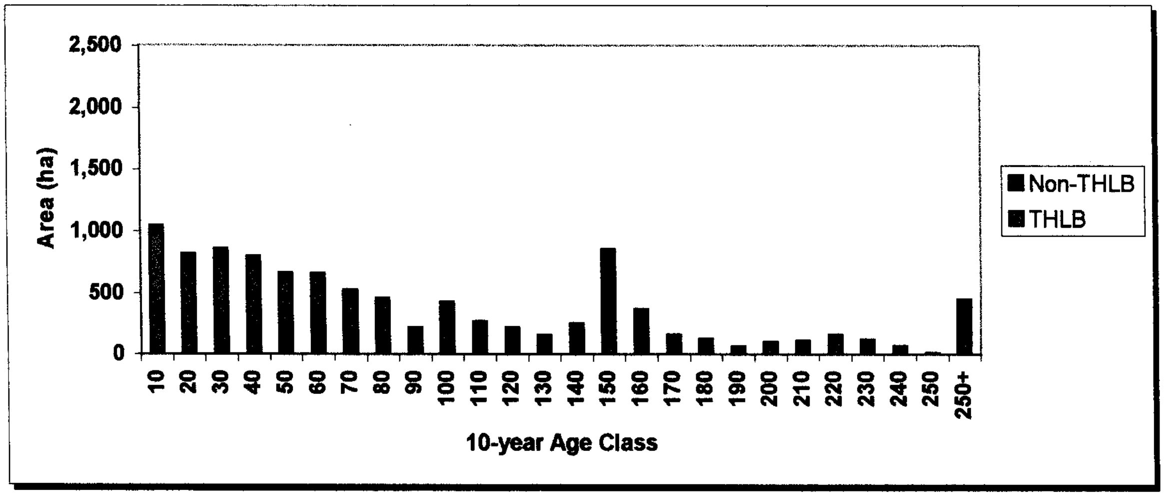

Figure 18 - Age class distribution in 100 years.

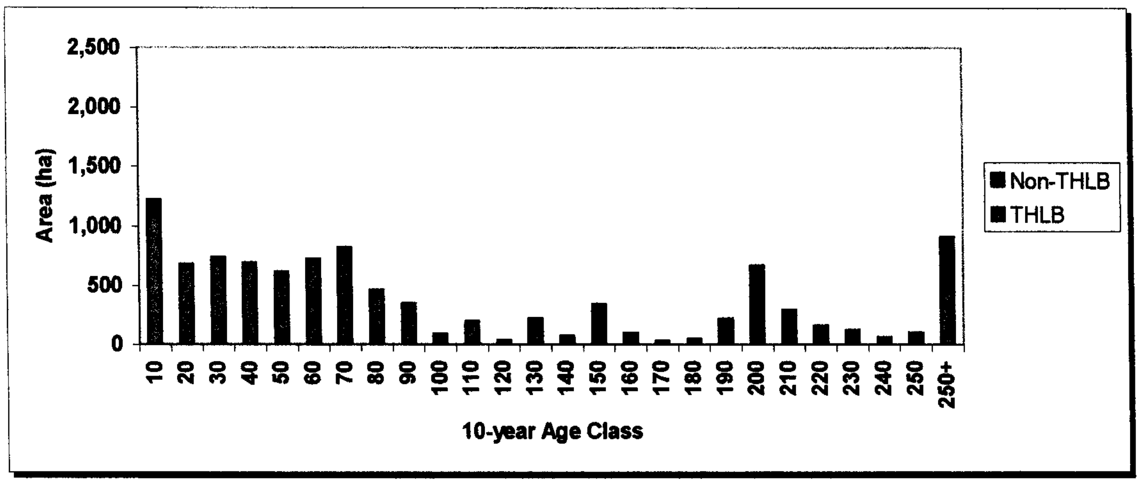

Figure 19 - Age class distribution in 150 years.

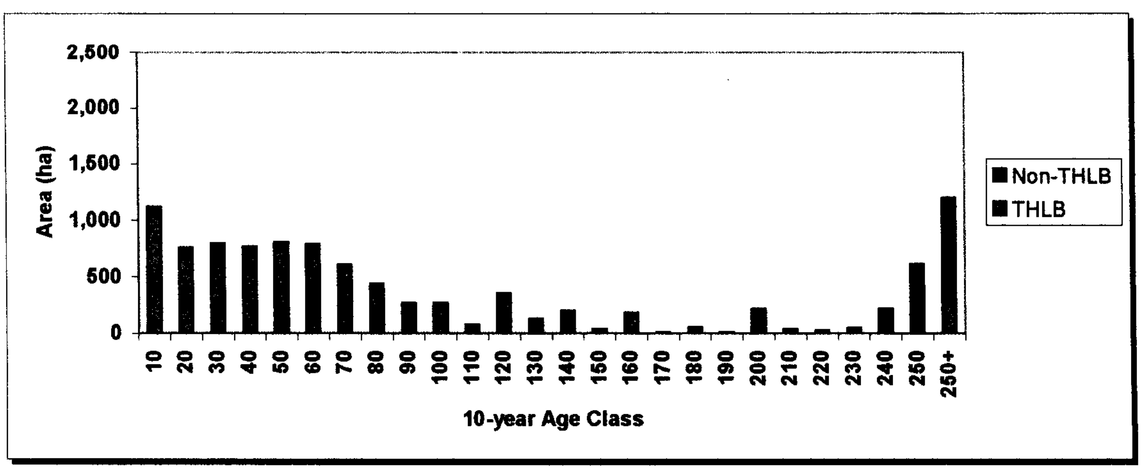

Figure 20 - Age class distribution, year 200.

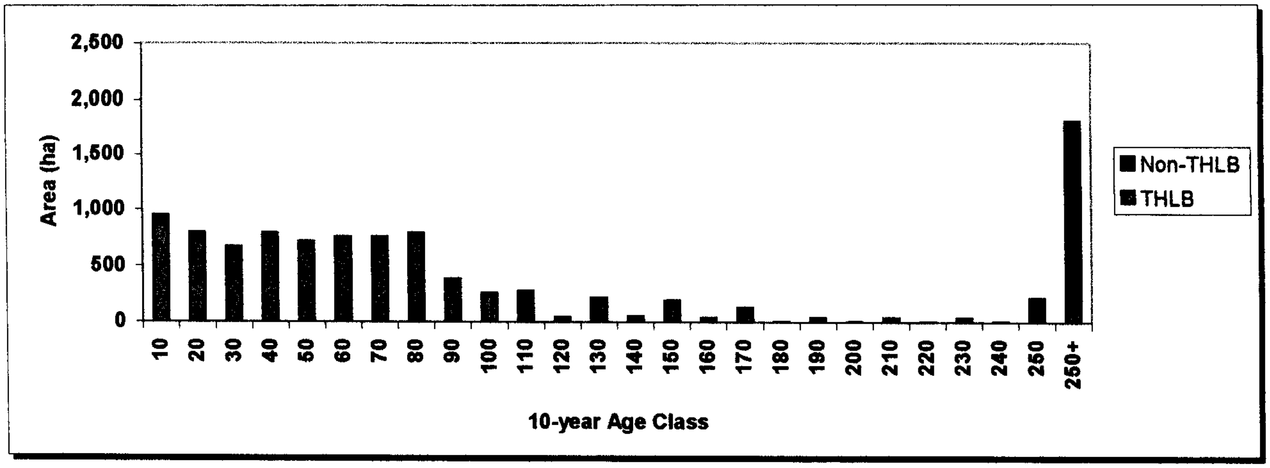

Figure 21 - Age class distribution in 250 years.

The current age class distribution shows a concentration of stands in the 51-60 age class. By 100 years, the age class forest structure is mostly in a regulated state with the exception of a small portion of stands that must be retained for old growth and for VQOs.

Stands older than 250 years cover only a small portion of the current THLB and throughout the planning horizon old age stands are retained to meet the old growth biodiversity retention targets. At 150 years there are approximately 450 hectares of stands within the THLB that are older than 250 years. By year 200, half of these stands are harvested. Finally, at 250 years most of the old growth retention targets can be met in the non-THLB areas. Only 130 hectares of old forest remain in the THLB at year 250.

6.2 Base Case - Resource Emphasis Reports

The analysis of timber supply must account for specific objectives or constraints for different resource emphasis zones. Representing the integrated resource management of crown forests, timber harvest impacts must be limited in such emphasis zones. Or stated another way, a specific target or condition must be maintained within the management zone. As an indicator of emphasis zone condition such constraints or objectives can be tracked and reported on over the strategic analysis planning horizon. The indicator reports for each resource emphasis zones are provided.

6.2.1 Watersheds

Watershed emphasis zones are defined to recognize sensitivity of the drainage area to harvesting. As presented in Table 10.2 of the information package, the Kenworthy domestic watershed would receive a forest cover objective of a maximum 30% less than a green-up height of 7 metres. As illustrated in Figure 22, the disturbance within the Kenworthy watershed zone remains well within the allowable maximum. Much of the watershed area likely contributes to old forest cover requirements based on landscape biodiversity resulting in multiple objectives being satisfied on the same land base.

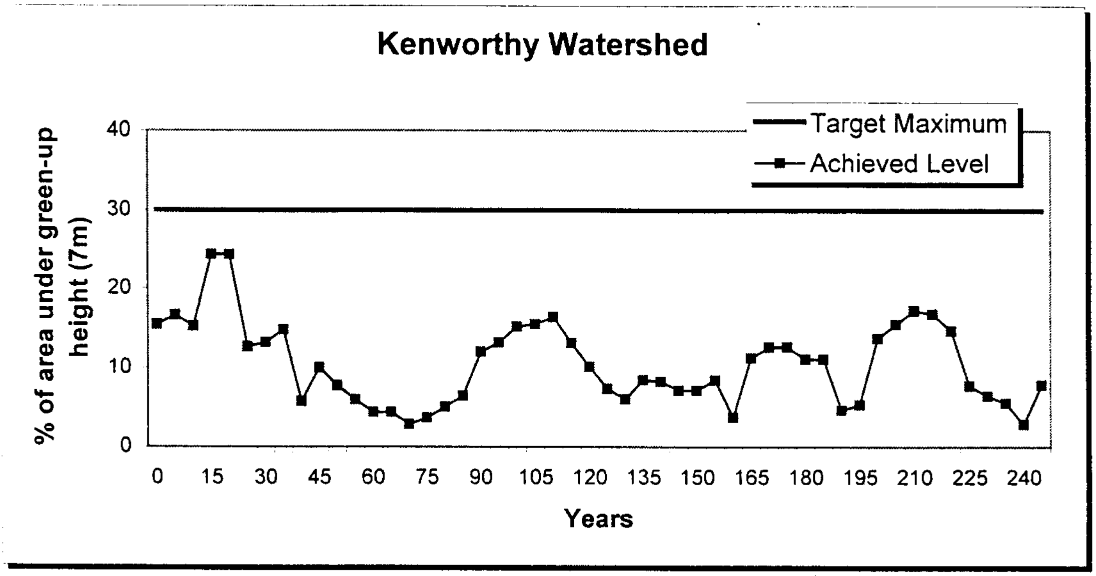

Figure 22 – Base Case: maximum and achieved disturbance within the Kenworthy watershed.

6.2.2 Visually Sensitive Areas

Figures 23 – 26 illustrate the condition of the various visually sensitive areas in TFL 26. Visually sensitive resource areas represent a management emphasis to satisfy visual quality guidelines to maintain scenic values. Based on the assessment of recreational use and the associated terrain and forest cover conditions, visual quality guidelines establish a maximum proportion of young forests required to reach a given height otherwise known as the visually-effective green-up height (VEG). As presented in Table 10.2 in the information package, the VEG for TFL 26 is a regenerated stand height of 4.0 m.

Visual quality guidelines are modeled by limiting the percentage of forested area within the visual quality class that has not reached VEG height. For each visual class area the maximum allowable disturbance was assigned at the upper range of disturbance allowed reflecting current practice TFL 26 sensitivity analysis.

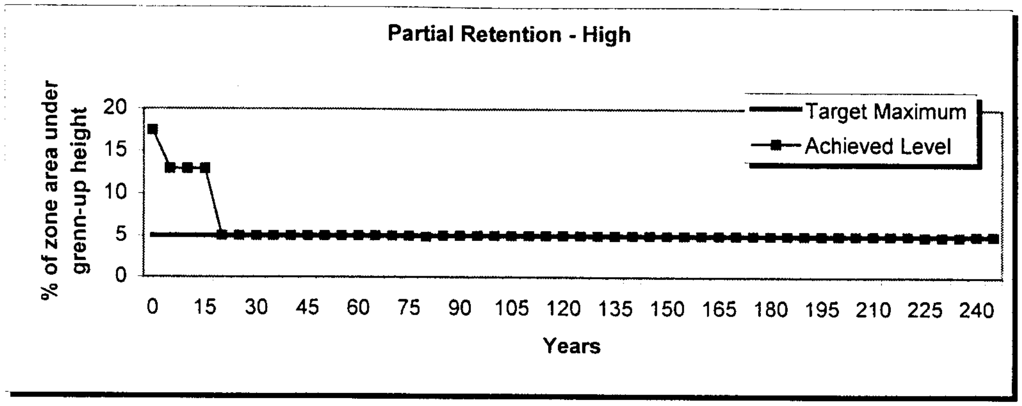

Figure 23 - Target and achieved disturbance levels within Partial Retention – High zones.

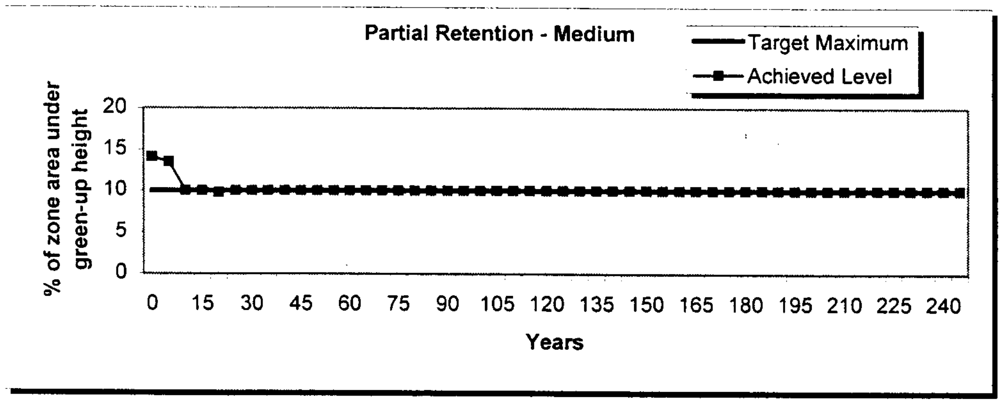

Figure 24 - Target and achieved disturbance levels within Partial Retention – Medium zones.

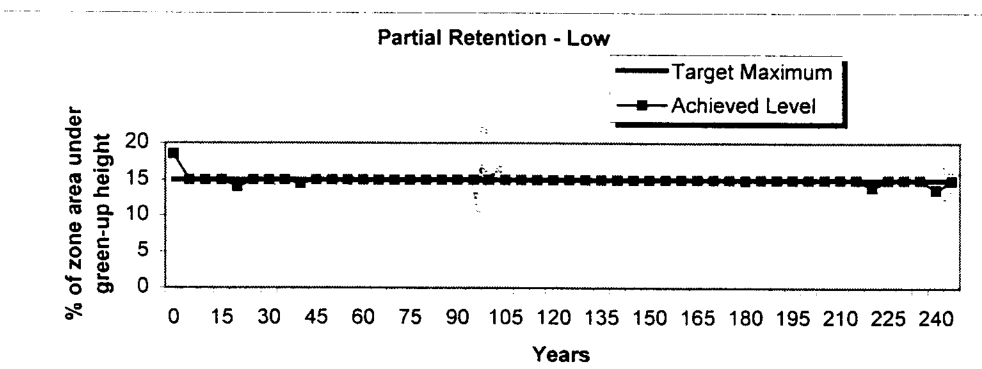

Figure 25 - Target and achieved disturbance levels within Partial Retention – Low zones.

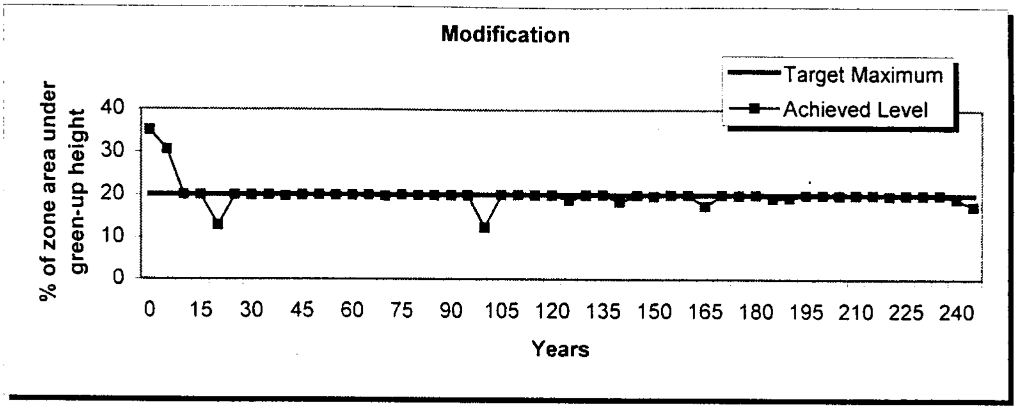

Figure 26 - Target and achieved disturbance levels within Modification zones.

As will be discussed in Section 6.3.8, the harvest level is sensitive to visual quality objectives and highly restricted in the short-term. Figures 23 – 26 show that the levels of disturbance are held at the maximum allowable level throughout the entire planning horizon in the partial retention zones and the majority of the planning horizon in the modification zone. The short-term condition of each of the visually sensitive areas exceeds the maximum allowable disturbance level. This is due to the inherent difference between actual management in these areas and a planimetric assessment within timber supply analysis. As visually sensitive areas are established and managed based on a perspective view, using a planimetric assessment does not provide an equivalent evaluation. A planimetric view is not able to recognize the flexibility in managing visually sensitive areas and a planimetric report may show that the visually sensitive area disturbance allowance may be exceeded when in a perspective view it is within the allowable limit.

The sensitivity of the harvest forecast to changes in the VQO constraints is evaluated further in section 6.3.8 of this report.

6.2.3 Landscape Level Biodiversity

As directed by the *Forest Practices Code (FPC)*, namely the *Biodiversity Guidebook (BGB)* and the *Landscape Unit Planning Guide (LUPG)*, the maintenance of landscape biodiversity is based on the prioritization of achieving old age forest retention and wildlife trees across all landscape units. The *FPC* guidelines require a minimum percent of the forested area within each landscape unit biogeoclimatic ecosystem classification (BEC) variant to be retained in old age forest. While the percentage to be retained is dependent on the emphasis assigned to each landscape unit, they remain in "draft" form and in the interim assume an average emphasis. The average emphasis is calculated for each LU based on the assumption that the entire forested area is divided into 45% low, 45% intermediate and 10% high biodiversity emphasis.

The following 4 figures illustrate the current and future landscape level biodiversity condition for the base case harvest forecast by BEC variant. The current age class distribution in the CWH vm1 and CWH dm variants does not currently satisfy the old growth targets. This results in the need to recruit and reserve stands to meet the old growth targets in the future. For CWH vm1, the old growth target is reached in about 170 years, and for CWH dm in about 160 years. The other two BEC variants, CWH vm2 and MH, have adequate existing old growth to meet the targets immediately. It should be recognized that these old targets represent new objectives that were not in place on the TFL until the *FPC* and therefore were not considered in the previous timber supply analysis, AAC determination or pre-Code management of the TFL.

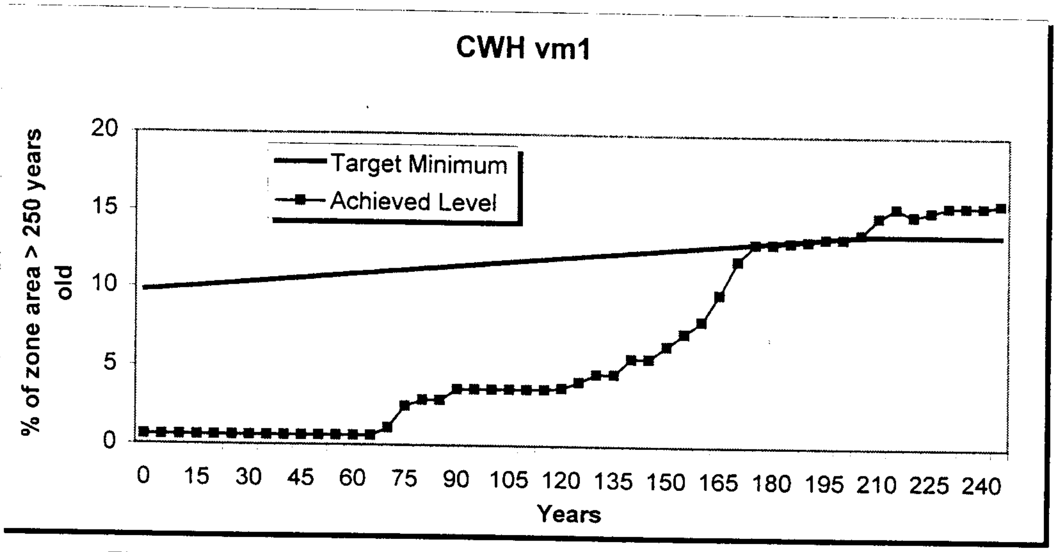

Figure 27 – Target and achieved old growth area levels within CWHvm1.

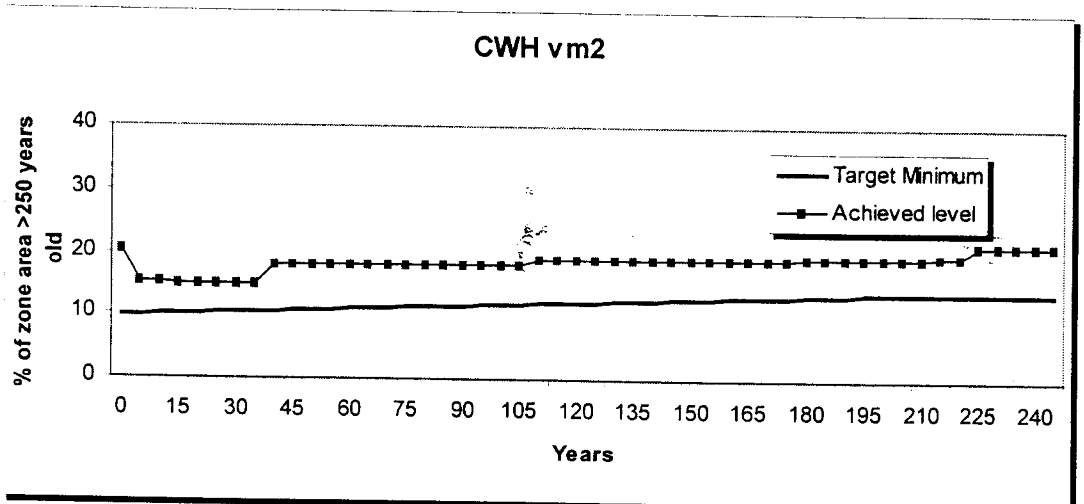

Figure 28 – Target and achieved old growth area levels within CWHvm2.

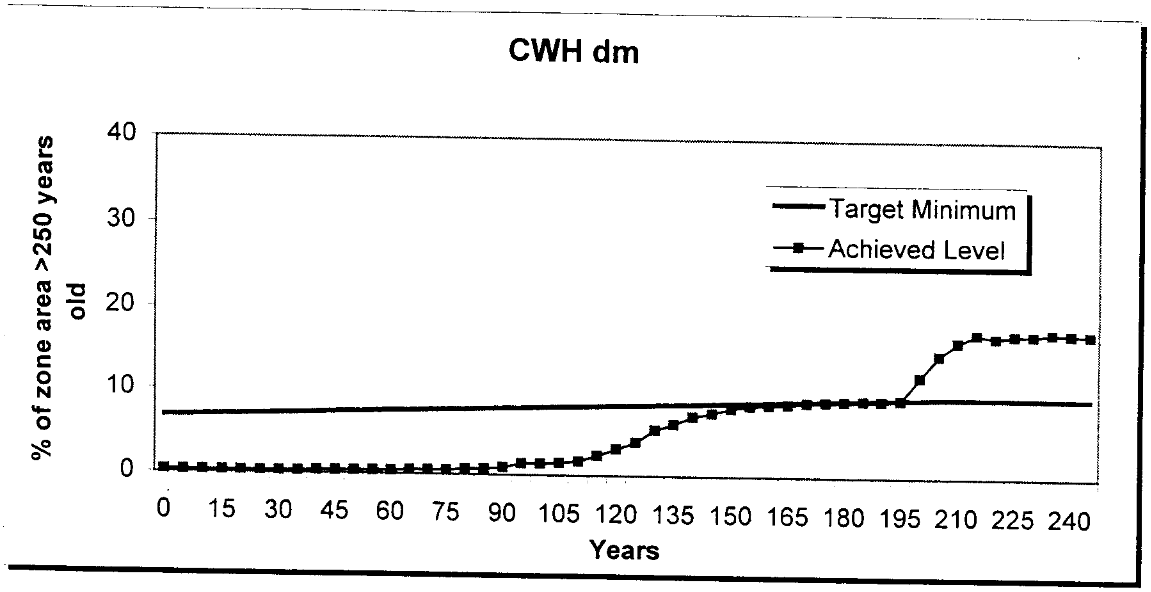

Figure 29 – Target and achieved old growth area levels within CWHdm.

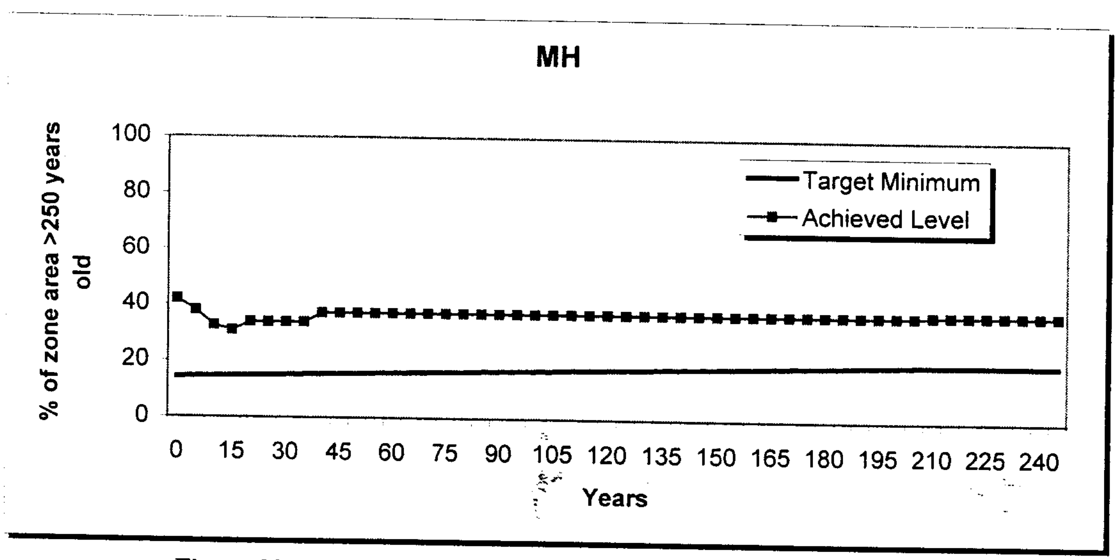

Figure 30 – Target and achieved old growth area levels within MH.

6.3 Sensitivity Analyses

Analyses of natural systems, such as forest ecosystems, involve a certain amount of uncertainty. While the best available information may be used, the task of predicting the future condition of forest attributes and the effects of different management activities proves a difficult task. The key to understanding timber supply dynamics and interpreting these results is the recognition that results are directly influenced by the data used and assumptions made and small as well as large inaccuracies in some variables may have little or large effects on the analysis outcome.

One way to deal with the uncertainty is to make sure that plans and analyses are checked and revised frequently to ensure they utilize the most current and best information and understanding available. Sensitivity analysis is a way of evaluating how uncertainty could affect analysis results by providing an evaluation of the effects of changes in data or assumptions on the analysis results and ultimately management decisions.

Timber supply impacts can occur at various pinch points throughout the planning horizon. Throughout the sensitivity analysis, the goal was to maintain the short-term base case harvest level for as long as possible and adjust the timber flow in subsequent periods as necessary. This allows for a test of "robustness" of the timber supply and a more complete understanding of the effects a given parameter may have on the base case timber flow levels.

6.3.1 Uncertainty in the estimation of timber harvesting land base

Determination of the area estimated to be available for harvesting in TFL 26 is based on current assumptions regarding various forest management objectives, including those for timber, biodiversity, recreation, operability, merchantability standards, environmentally sensitive areas, riparian reserve zones, roads and wildlife habitat needs.

Sources of uncertainty of the THLB include the conversion or rehabilitation of currently inoperable land, fluctuations in timber prices, changes in harvesting and milling technology, and other land-use decisions. Arbitrarily increasing and decreasing the total area of all stands by 10% assessed the sensitivity of the base case to changes in the THLB. Figure 31 illustrates the impact of these changes as compared to the base case forecast.

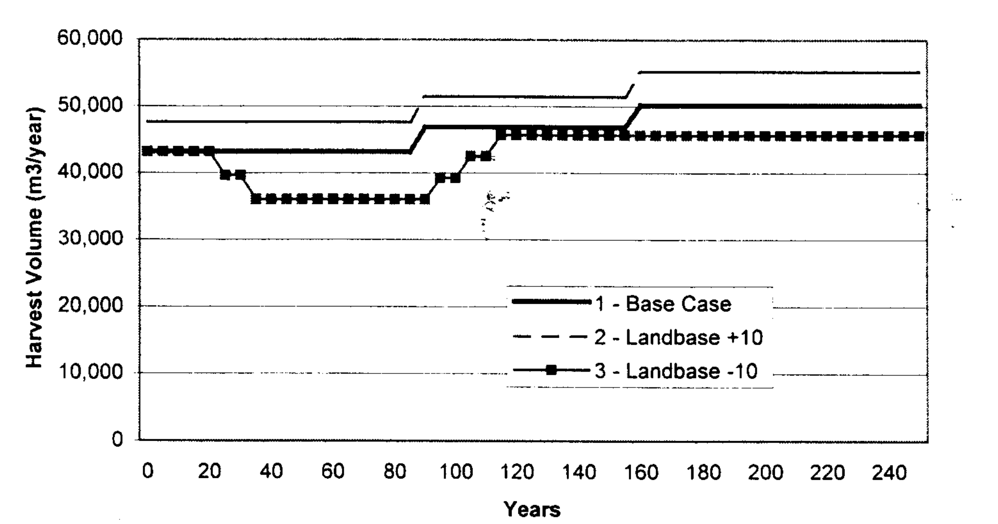

Figure 31 - Base case and land base sensitivity harvest forecasts.

Decreasing the area of the THLB by 10% causes the timber flow to decrease by 8% to 39,612 m^3 at year 25 and again by 9% to 36,044 m^3 at year 35. This level is maintained until year 90 when the timber flow is increased in successive steps to 45,623 m^3 by year 115. This long-term level is 9% lower than the base case level.

A 10% increase in the THLB allows for a short- and mid-term timber flow increase over the base case of approximately 10%. The long-term sustainable rate of harvest is achieved at period 160 at 55,250 m^3, an increase of 10% over the base case. If the land base increases or decreases had been concentrated on similar site types, the resultant changes in timber flow would not be proportional. This is a possibility if the land base expansion involves mostly poorer, previously inoperable sites or if the land base is contracted by the removal of highly productive areas.

6.3.2 Uncertainty in the estimation of volumes in existing stands

Timber volume estimates for existing natural and managed stands are subject to uncertainty from the accuracy of inventory information used in their estimations and the validity of the statistical processes used to develop the volume equations. For existing managed stands regenerated with genetically improved stock, uncertainty also arises with the estimation of actual genetic gain. The uncertainty associated with genetic gain is discussed Section 6.3.9 of this report.

Figure 32 illustrates the sensitivity of existing natural and managed stand by increasing and decreasing the existing stand volumes by 10%.

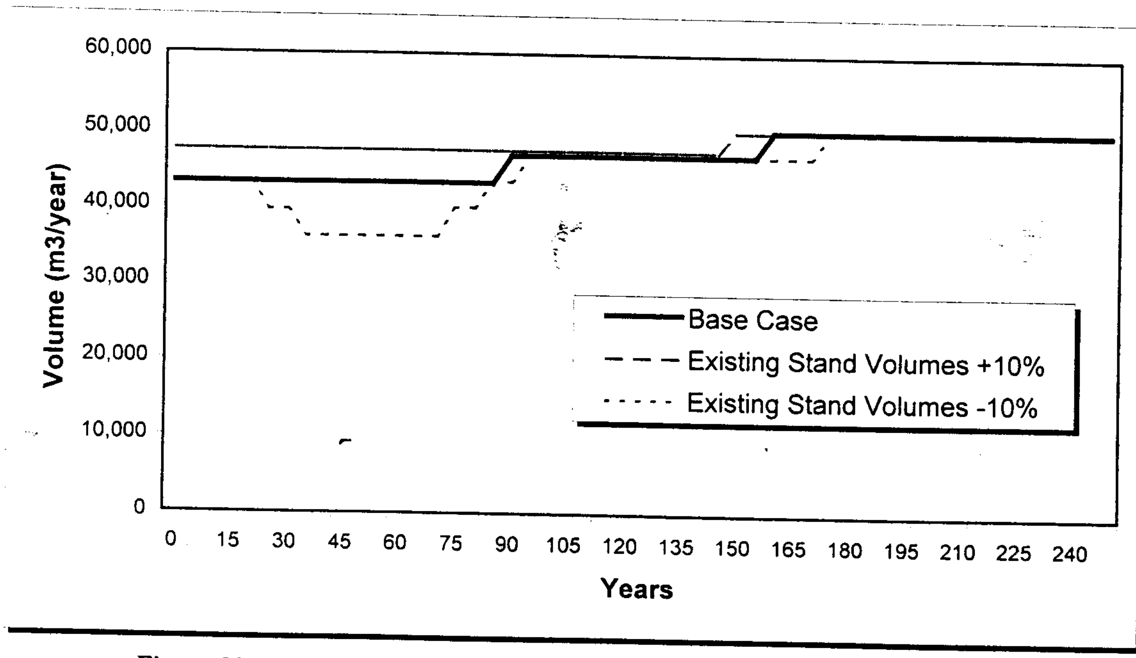

Figure 32 - Base case and existing stand volume sensitivity harvest forecasts.

Reducing existing stand volumes by 10% causes the harvest level to decline to 39,612 m^3 (an 8% reduction) at year 25 and to 36,143 m^3 (a further 9% reduction) at year 35. The timber flow then increases by 10% to 39,945 m^3 at year 75, a further 9% to 43,342 m^3 at year 85, and by 9% at year 95 to 46,804 m^3. The harvest level reaches the long-term harvest level at year 175.

An increase in the existing stand volumes of 10% allows for an immediate increase of the short-term harvest to 47,478 m^3. The long-term harvest level is reached 10 years earlier at than in the base case at 150 years.

6.3.3 Uncertainty in the estimation of regenerated stand volumes

The causes for uncertainty in regenerated stand volumes are the same as those for existing stand volumes and are intensified by the relatively limited experience and data availability for regenerated stands. Further uncertainty results from the assumption of stand tending that will occur in the future and the effects on resulting stand yields. Figure 33 illustrates the sensitivity of the timber supply to uncertainty in regenerated stand volumes.

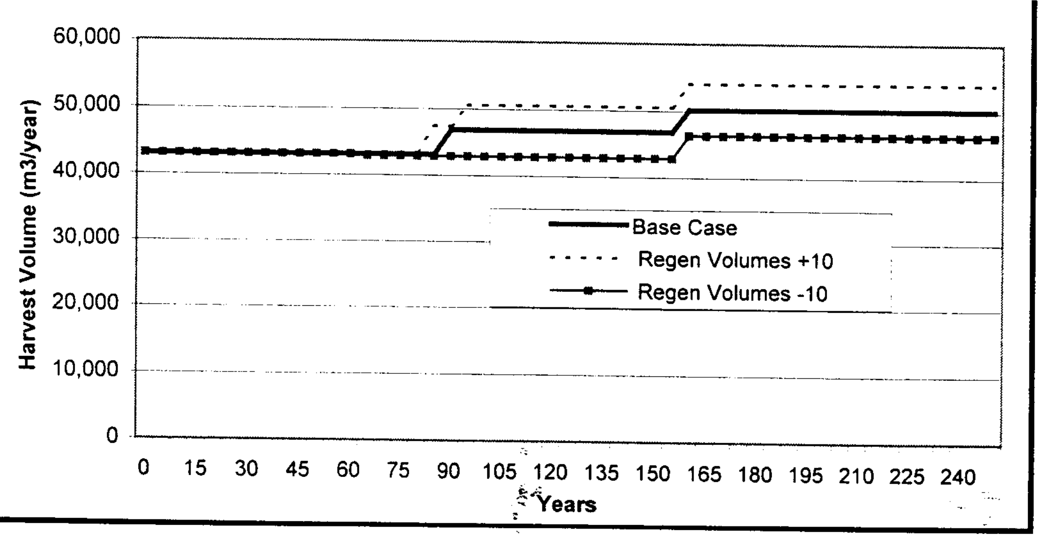

Figure 33 – Base case harvest forecast sensitivity to changes in regenerated volumes.

With a 10% decrease in regenerated volumes, an equivalent short-term harvest level as the base case (43,168 m^3) can be held for 60 years. At this point, the harvest level decreases to the long-term level of 42,899 m^3. This is an 8% decrease from the base case. Eventually the harvest volume increases at decade 16 to the long-term level of 46,361 m^3, again approximately 8% below the base case. The resultant 8% decrease in harvest level from a 10% decrease in stand volume (as opposed to a 10% decrease in harvest level) is caused by a volume shift. The reduced regenerated volumes exacerbate an existing volume shortage in the mid-term and necessitate decreasing the harvest level before the majority of the volume is coming from regenerated stands.

Increasing the regenerated volumes by 10% allows for an increase to 47,374 m^3 at year 90 and from there to 50,562 m^3 at year 95 and further to 54,690 m^3 at year 160. The increase in harvest level is 8% for the medium and short term, again less than the total volume increase of 10% above the base case. Similarly, this can be attributed to a volume shift: the harvest level is increased 10 years earlier in the sensitivity analysis. Thus, the increase in volume is applied to both increase the long-term level and reduce the time needed to achieve this level.

6.3.4 Uncertainty in the estimation of site indices

Site productivity defines tree growing potential as it relates to timber volume production, the satisfaction of merchantable size and harvest availability, height growth and the time required to achieve forest cover green-up provisions.

As documented in other management units in British Columbia site indices may be underestimated in TFL 26. A sensitivity analysis was preformed to evaluate the effects of this uncertainty by adjusting the mean site index based on SIBEC using the following steps:

1. SIBEC default value for each BEC variant – the first site series value – was determined using MoF software Site Tools.
2. Area weighted (BEC variant) average SIBEC site index was calculated for each analysis unit.
3. The average SIBEC adjustment was determined by averaging – by analysis unit - the differences between existing site indices and SIBEC site indices.
4. The average SIBEC adjustment was applied to all BEC variants within each analysis unit. Site indices were not adjusted downwards.
5. Finally, the SIBEC adjusted site indices for different analysis units were determined by averaging the site indices for each BEC variant within each analysis unit.

Figure 34 illustrates the site index adjustments for SIBEC that were used in the sensitivity analysis.

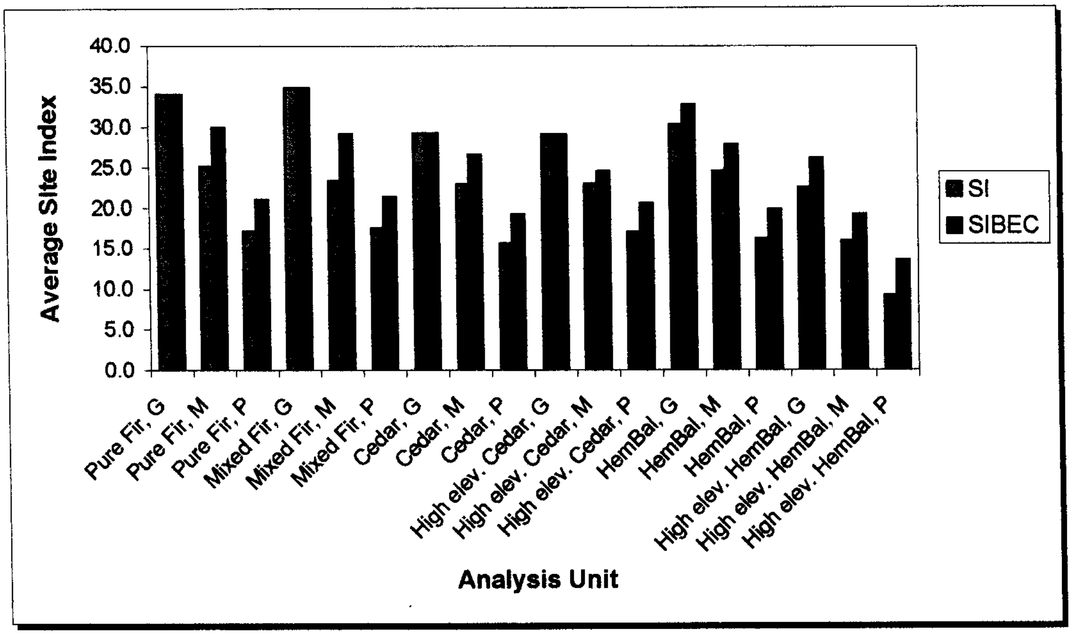

Figure 34 – Site Index Adjustments for SIBEC by Analysis Unit

The results of the sensitivity analysis are presented in figure 35.

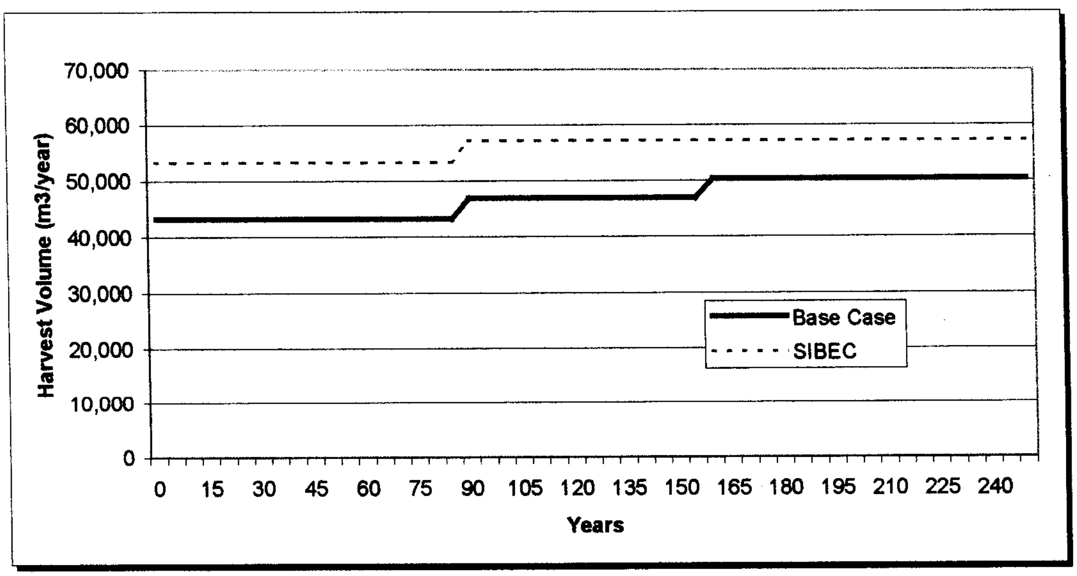

Figure 35 - Base case and SIBEC adjusted harvest forecasts.

By applying the revised site indices and generating new yield curves, the short-term volume increases by 23% to 53,256 m^3 per year and the long-term harvest level increases by 14% to 57,069 m^3. These increases are large and show how significant the impact of underestimating (or over estimating) the site indices can be on timber supply.

A local site index study is required to confirm whether the site indices within TFL 26 have been underestimated or not. The results of the study could then be incorporated in future timber supply analyses.

6.3.5 Sensitivity of the harvest forecast to OGSI adjustments

The equations for OGSI adjustment were derived from the report *Site Index Adjustments for Old-growth Stands Based on Veteran Trees, MOF.* The site index adjustments were applied to stands older than 140 years. The impacts were negligible due to the fact that only 4% of the THLB is comprised of stands greater than 140 years.

6.3.6 Uncertainty in the estimation of minimum harvestable ages

Minimum harvestable ages (MHA) designate the number of years required for stands within a given analysis unit to reach a harvestable condition, defining the lowest limit for possible harvest. Based on specific minimum harvest criteria such as volume/ha, the age or time at which this criterion is achieved defines the MHA. For TFL 26, the minimum harvestable ages are defined as the ages at which the stand either reaches minimum operability volumes (600 m^3/ha for good sites, 500 m^3/ha for medium sites, and 400 m^3/ha for poor sites) or MAI culmination age, whichever comes first.

As with other management assumptions, there is uncertainty associated with establishing minimum harvest ages both in terms of the harvest criteria used and also whether the identified age is appropriate to reach the minimum condition. Furthermore, MHA's are established based on current needs and may not best represent future economic situations and forest product objectives. Figure 36 illustrates the sensitivity of the base case forecast to a ten-year increase or decrease in minimum harvestable age.

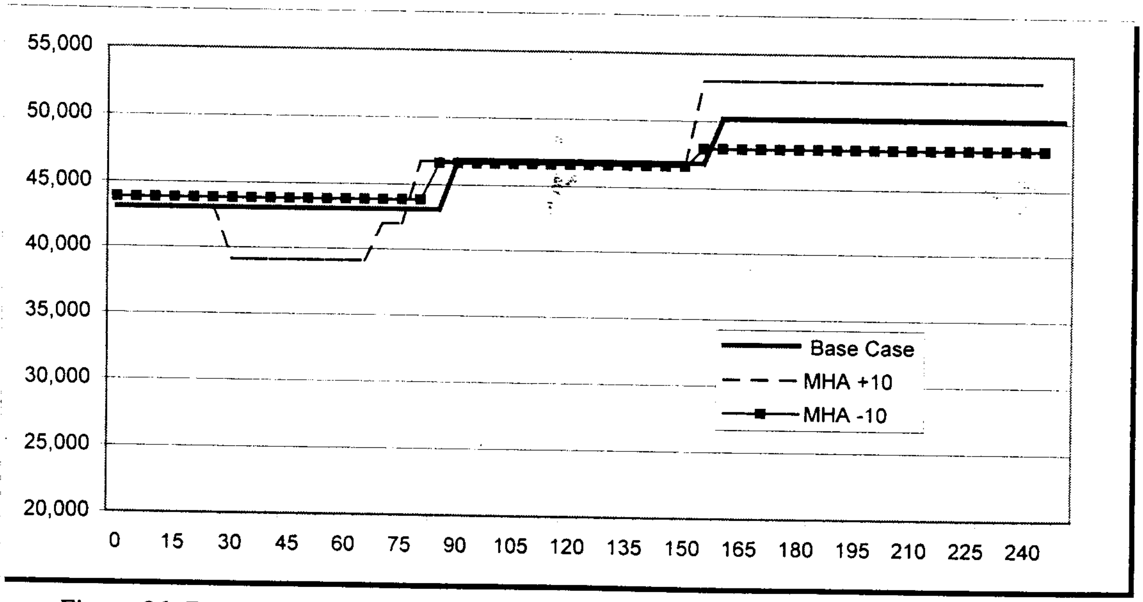

Figure 36- Base case harvest forecast sensitivity to changes in minimum harvestable ages.

As illustrated in Figure 36, most of the sensitivity from MHA adjustment occurs between years 35-85 and in the long term. As MHA is increased, it takes more time for future stands to reach harvestable condition and the mid term harvest level must be reduced until future stands reach the minimum merchantable condition. Conversely, decreasing the MHA shortens the time required for stands to be harvested resulting in a slight increase in the harvest level.

Increasing minimum harvestable ages by 10 years causes a decrease in the mid-term harvest level at year 35 by 9% to 39,125 m^3. The harvest level increases at year 75 to 41,964 m^3 and increases at year 85 to 46,762 m^3 and further up to 52,987 m^3, 6% higher than the base case.

Decreasing the minimum harvestable age results in a minor short-term harvest flow increase of 714 m^3 to 43,882 m^3. The long-term timber flow is reduced by about 4%.

6.3.7 Uncertainty in the estimation of green-up periods

Most resource emphasis zones require the satisfaction of a given green-up height to control harvest in these areas. Depending on the given emphasis zone (IRM, community watershed and VQO), a specific height is assigned that is associated with a maximum disturbance percent that is allowed to occur within the zone.

For TFL 26, green-up constraints are applied to the IRM, Kenworthy Creek Watershed, and all VQO zones. Three separate sensitivity analyses were completed, one in which all green-up age constraints were changed by +/- 5 years, one in which the only the IRM green-up constraints were changed by +/- 5 years, and finally only the VQO zones were changed by +/- 5 years.

The total net area of the Kenworthy watershed is relatively small at 102 ha and was not evaluated in a separate analysis as its total contribution to the harvest level is quite low. Fluctuations in the green-up age for the IRM zone were shown to have negligible impact on timber supply. Almost the entire impact of increasing or decreasing the green-up age by 5 years comes from the VQO zones.

Figure 37 illustrates the resultant timber flows for the VQO green-up age sensitivity.

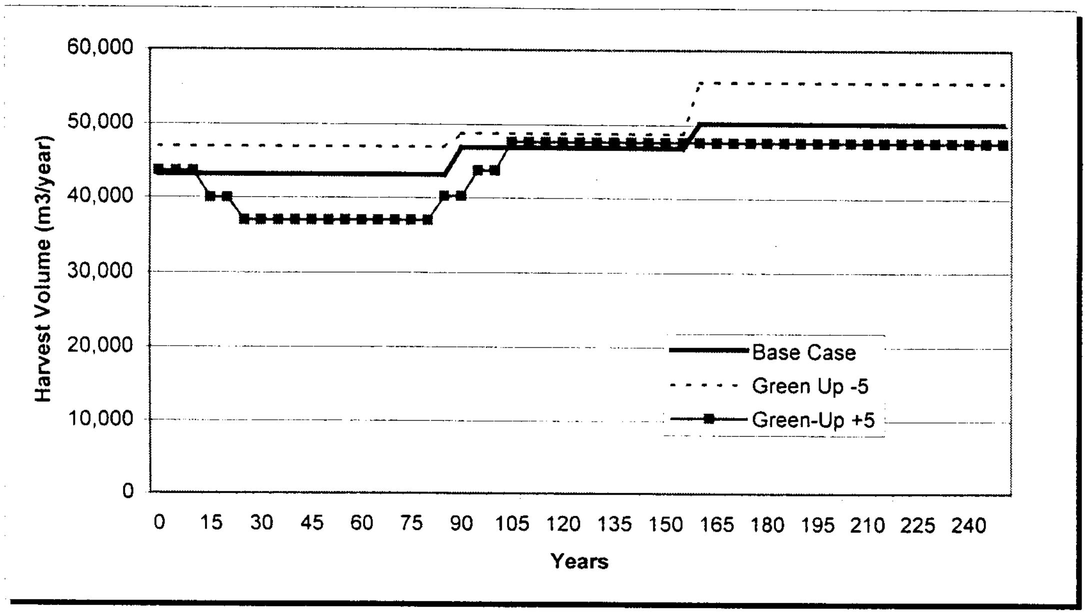

Figure 37 - Base case and green-up height sensitivity harvest forecasts.

Increasing the green-up age by 5 years forces a reduction in the harvest level after 2 decades to 40,009 m^3 and again after another decade to 37,038 m^3. This level is maintained until year 85, at which point the timber flow increases to 40,273 m^3. At year 70 the level increases to an interim point of 43,742 m^3 until it achieves the long-term harvest level of 47,595 m^3 at year 105. The long-term level is 4% lower than that of the base case.

Lowering the green-up age in the VQO zone creates an increase in available harvest volumes throughout the planning horizon. The short-term harvest level is 46,608 m^3, 9% higher than the base case level. The increase to the long-term harvest level is 11% at 55,734 m^3.

6.3.8 Sensitivity of the harvest forecast to changes in VQO disturbance targets

Increasing and decreasing VQO targets by 5 percentage points evaluated the sensitivity of timber supply to VQO disturbance levels. As the acceptable disturbance levels are determined in the most part by policy, the uncertainty in future policy decisions and the associated impact on the timber supply is of concern. Figure 38 illustrates the impact of a 5 percentage point change in VQO disturbance targets.

In addition to uncertainty associated with visually effective green-up height, there is an added unknown associated with the percentage of allowable visible alterations, which limit the amount of forest that has not yet achieved visually effective green-up.

As illustrated in Figures 23 to 26, the maximum allowable disturbance percentage was designated at the upper range for each visually quality class.

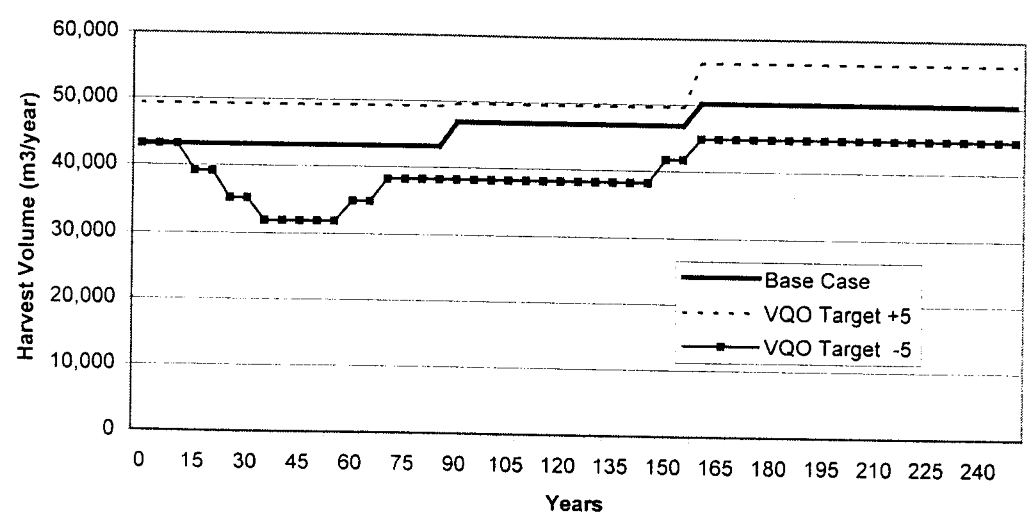

Figure 38 - Base case and visual quality objective target sensitivity harvest forecasts.

By decreasing the allowable disturbance level by 5 percentage points, the short-term harvest level forecasted in the base case can be maintained for only the first decade. At this point, the flow decreases to 39,170 m^3. It decreases again at year 20 to 35,233 m^3, and again at year 30 to 31,896 m^3. This level is maintained until year 55 when the timber flow increases to 34,924 m^3 at year 60. The harvest level increases again to 38,223 m^3 at year 70 and then is gradually increased between years 145 and 160 to the long-term harvest level of 44,894 m^3, 11% lower than the base case.

Increasing the allowable disturbance level in the VQO zones increases the sustainable harvest level throughout the planning horizon, with the greatest impact occurring in the short-term. The short-term harvest level at 49,184 is 14% higher than the base case level with a long-term harvest level 12% higher than the base case at 56,376 m^3.

6.3.9 Uncertainty in the estimation of genetic gain

The impact of using genetically improved stock for artificial regeneration is subject to uncertainty. While the use of genetically superior seedlings is not a new concept, the actual long-term volume gains remain unknown. Volume estimation of regenerated yield curves can be either over- or underestimated. For the base case, genetic gain for Douglas-fir and western hemlock was estimated to be 4% and 2%, respectively. In the sensitivity analysis, the pure Douglas-fir stands were adjusted to account for a 12% genetic gain and all other stands were adjusted for a 6% genetic gain. For mixed Douglas-fir stands, an assumption was made that the composition was 50% Douglas-fir and 50% other species and the resulting genetic gain equalled 9%. Genetic gain is applied to only existing and future managed stands. Figure 39 illustrates the effect of the genetic gain sensitivity analysis.

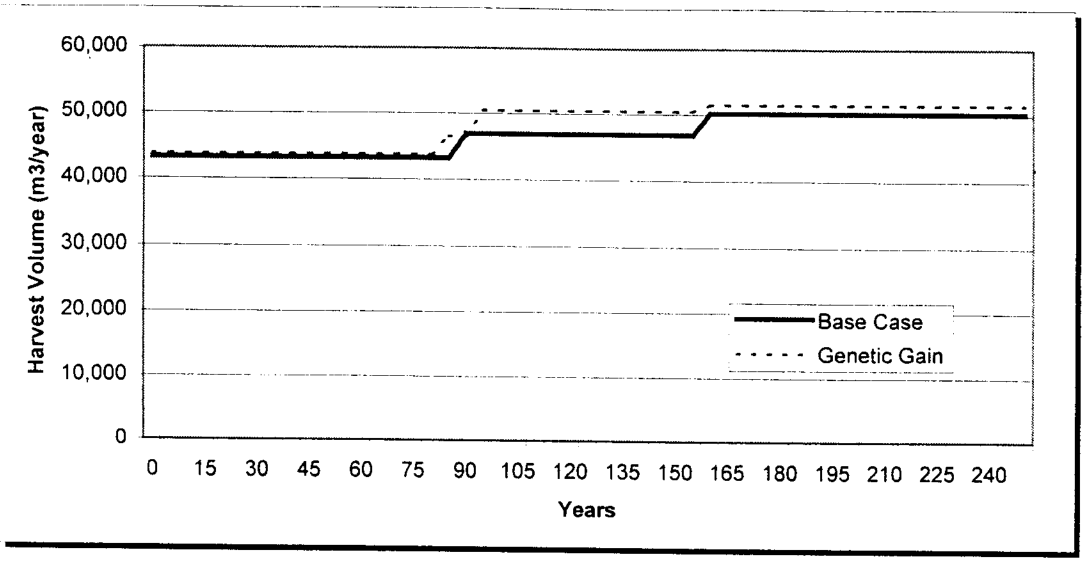

Figure 39 - Base case and genetic gain sensitivity harvest forecasts.

The impact of higher genetic gain percentages is most prominent between years 95 and 155, before the long-term harvest level is reached. The impact in this period is likely due to a volume shift; faster growing stands allow for an earlier move to the long-term harvest level. The existing unmanaged stands that are harvested in the short-term are not affected by changes in genetic gain. The harvest flow is able to achieve the base case long-term harvest level at 95 years and move upward past this level at year 160 to a long-term level of 51,471 m^3, 3% higher than the base case levels.

6.3.10 Uncertainty in the selection of operational adjustment factors

Operational adjustment factors (OAFs) 1 and 2 are applied in TIPSY to reduce the gross volume of regenerated stands. OAF1 allows for yield reductions associated with non-productive areas in the stand, uneven spacing of crop trees (clumping), and endemic and random loss while OAF 2 allows for volume losses associated with stand maturation. In the base case scenario, OAFs 1 and 2 were set at 15 and 5 % respectively. The sensitivity analysis evaluated setting OAFs 1 and 2 to 18% and 7% and then to 12% and 3%, respectively. The impacts of this sensitivity analysis are illustrated in Figure 40.

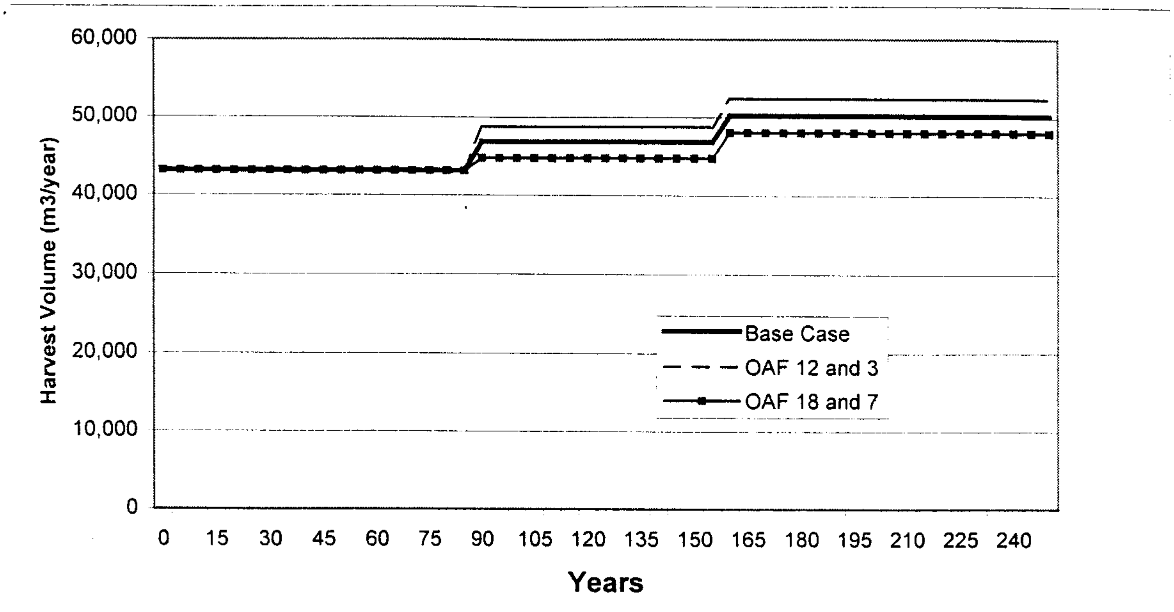

Figure 40 - Base case and operational adjustment factor sensitivity harvest forecasts.

Changes in the OAFs only have an impact in the long-term timber supply as reductions are applied to regenerated stands, which are harvested further along in the planning horizon. Decreasing the OAFs causes a mid and long-term volume flow increase of approximately 4% to 48,728 m^3 and 52,400 m^3 respectively. Increasing the OAFs caused the mid and long-term harvest level to decline by about 4% to 44,772 m^3 and 48,025 m^3, relatively equal to the percentage adjustments applied in the sensitivity analyses.

6.3.11 Sensitivity of the harvest forecast to 2% site degradation to existing and future managed stands

Future site degradation associated with harvesting activities could serve to reduce the volumes on regenerated areas. While the actual amount of degradation on a given site is extremely variable and an overall average percent reduction within a management unit is equally variable, a general assumption is made based on best information and professional understanding. For further information on site degradation refer to Section 6.15 in the information package. The sensitivity of the harvest forecast to site degradation was evaluated by reducing volumes of existing and future managed stand types by 2%. The impact of this is shown in Figure 41.

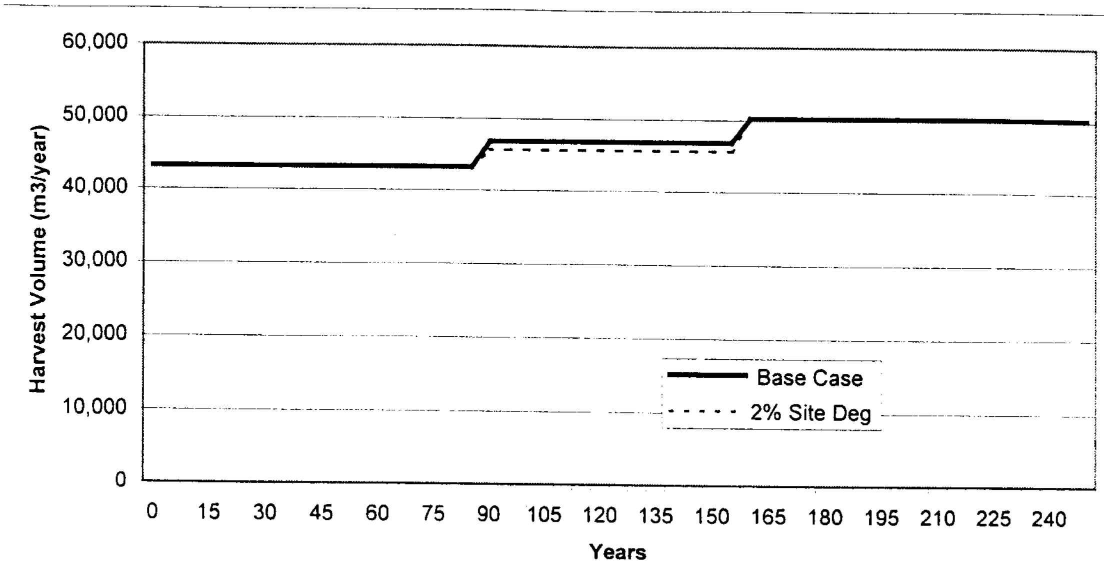

Figure 41 - Base case and site degradation sensitivity harvest forecasts.

There is a negligible impact on the short- and long-term harvest levels. The impact is greatest between years 95 and 160 at 3%.

6.3.12 Sensitivity of the harvest forecast to landscape level biodiversity

Currently, forest management in BC must coincide with the satisfaction of stand and landscape level biodiversity objectives as defined in the *Forest Practices Code of British Columbia Act*. As a process for achieving biodiversity objectives, landscape unit planning is in a transition from the initial phase of establishing LU planning strategies, delineating LU boundaries and determining biodiversity emphasis, to the development of objectives for old growth and wildlife tree retention. Through this transition, many of the biodiversity emphasis remain in a draft state as with the Hatzic and Alouette LU's covering TFL 26. Once the draft emphases are established, biodiversity emphasis will determine the amount of old forest required for each BEC variant. Until that time, the 10-45-45 average emphasis is assumed for all landscape units with draft biodiversity emphasis option.

The base case harvest forecast modeled old seral targets using a 10-45-45 biodiversity emphasis option distribution for high, medium and low biodiversity. As described in the information package (Section 10.2.2.3), three sensitivity analyses were to be performed on the base case (Figure 42):

1. Assume that TFL 26 represents only the low biodiversity emphasis option. The old growth targets can be met over the next 210 years (1/3 draw down).

   This option increased the short- and medium-term timber supply to 49,998 m^3 per year (4.2%) until year 90. There is little impact on the long-term harvest level (less than 1%).

2. Assume that TFL 26 represents only the low biodiversity emphasis option. The old growth targets must be met immediately (no draw down).

   The base case harvest forecast could be maintained for 40 years after which a reduction to 41,500 m^3 (4%) is required. The long-term impact is small (0.2-1.6%).

3. Assume that TFL 26 represents only the low biodiversity emphasis option. The old growth targets must be met over the next 210 years (1/3 draw down) and the mature targets must be met in full.

   Including mature targets in the analysis had a significant impact on the short-term timber supply; the first decade could sustain a harvest level of only 33,000 m^3 per year. The timber supply increases until year 40 when it reaches the long-term harvest level, approximately the same as that of number 2 above.

   It takes about 40 years to build the mature targets after which the challenge is to meet the old growth targets. This is relatively easy due to the 1/3 draw down effect and the associated recruitment of old forest over time.

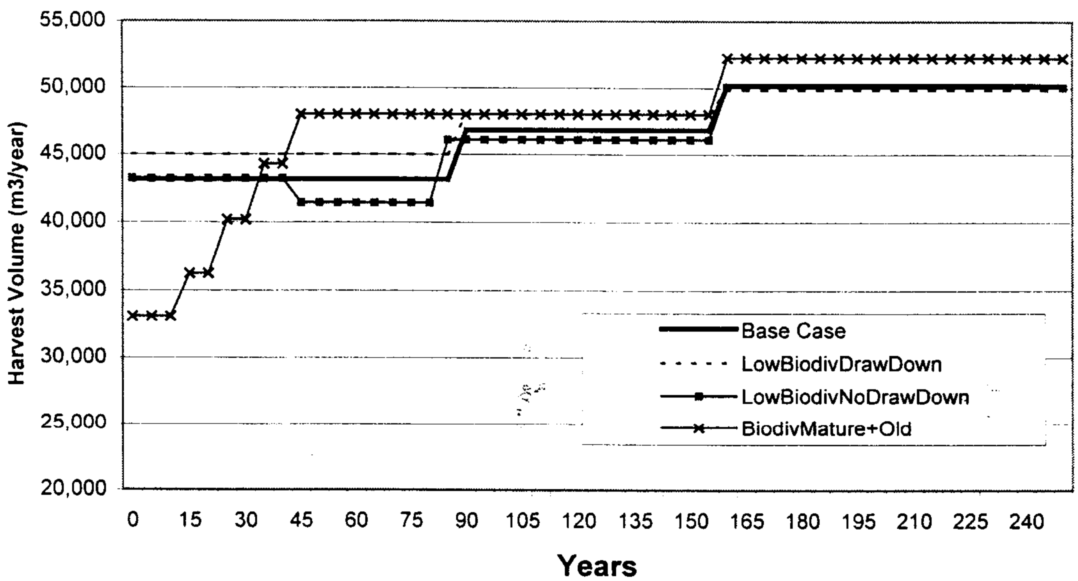

Figure 42 - Base case and biodiversity sensitivity harvest forecasts.

6.3.13 Sensitivity of the harvest forecast to Mission's Landscape Reserve Plan

In an attempt to ensure future achievement of old forest conditions and wildlife tree patch objectives, Mission Municipal forest staff prepared a landscape reserve plan to assist in operational planning. By targeting existing permanent and semi-permanent non-contributing areas, Mission attempted to minimize the initial impact on available harvesting opportunities and timber supply. The intent of the plan is to satisfy objectives for old forest conditions through a retention and recruitment of old forest over time.

In the sensitivity analysis, the old forest targets and wildlife tree patch objectives were turned off and the landscape reserve plan was applied in their place. Instead of using ***FSOS*** to recruit and retain old forest, the landscape reserve plan was assumed to fulfill old forest targets and wildlife tree patch requirements. In essence, the landscape reserve plan ensures that retention and recruitment of old growth structure is maintained over time.

This sensitivity analysis tested the timber supply outcome of Mission's proposed landscape reserve plan as compared to the base case scenario. The plan results in a minor short-term timber flow decrease of 150 m^3/year (less than one half of one percent) and a long-term harvest level impact of 6.5% as a result of the landscape reserves (Figure 43).

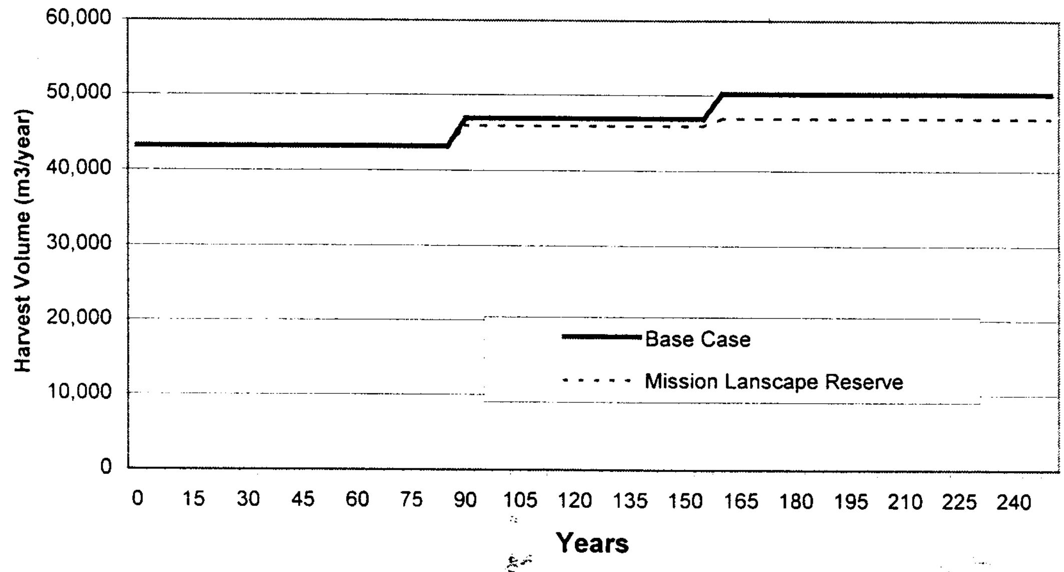

Figure 43 - Base case and mission landscape reserve harvest forecasts.

6.4 Proposed Management Option

Sections 6.1 – 6.3 presented the base case scenario and sensitivity analyses for TFL 26 utilizing a simulation modeling approach. Through the abilities of a spatial, optimization modeling approach, Mission is able to present an innovative proposed management scenario, which best combines the short and long-term timber supply and the desire to produce an effective, optimized spatial twenty-year schedule. The optimization modeling approach provides an ability to instantly test thousands of different spatial schedules while maintaining the long-term timber supply and non-timber objectives. In management units that are significantly constrained, optimization may also find a more efficient, balanced solution. The following section presents the development process for the twenty-year schedule.

6.4.1 Base Optimization Scenario

Development of a proposed management option is an addition to the timber supply analysis process and is intended to bridge the gap between timber supply analysis, twenty-year planning and tactical planning by the licensee. Development of the proposed management option initiates with the base optimization scenario built upon an understanding provided by the base case and sensitivity analyses. As there is a shift in modeling techniques and analysis objectives, the base optimization scenario provides a comparative assessment with the base case results to quantify the effects of changing analysis techniques.

Figure 44 illustrates the comparison between the base case and the base optimization scenario. It demonstrates that the base optimization results are largely consistent with the base case results with a slightly lower short-term harvest level than the base case (42,994 m^3 vs. 43,168 m^3). The long-term harvest level was not elevated at 160 as the base case was, rather it was kept at 46,900 m^3.

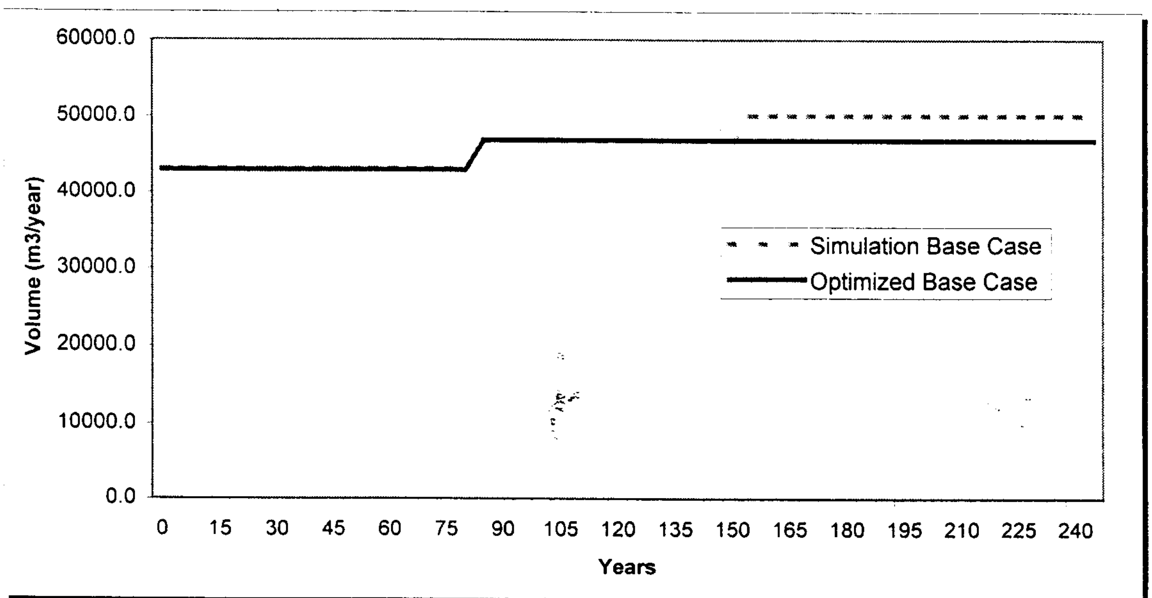

Figure 44 – Base case and base optimization harvest forecasts.

6.4.2 Base Optimization Timber Supply Dynamics

As compared to the harvest volume distribution of the base case, the distribution in the base optimization is less erratic. In the long term, the harvest peaks of existing stands are less dramatic. Thus, a minor component of the existing stands are converted to managed stands sooner in the base optimization than in the simulation base case scenario (Figure 45).

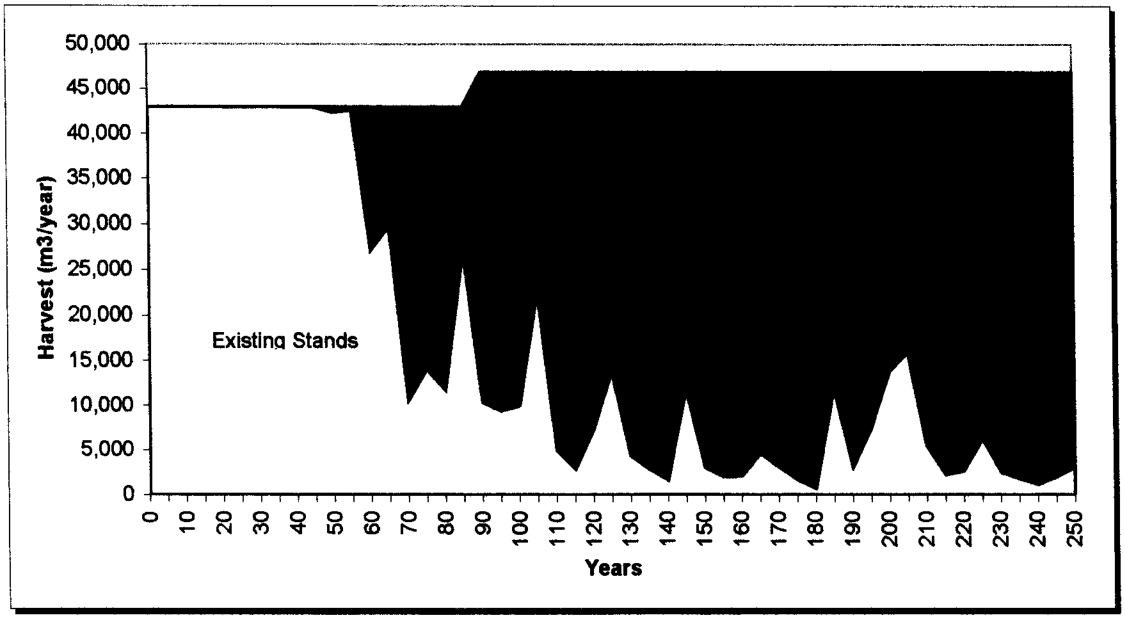

Figure 45 – Base optimization harvest volume from existing and managed stands.

The total growing stock in the base optimization scenario is relatively similar to the base case in the short- and medium term. The merchantable growing stock for the base optimization scenario is consistently higher throughout the planning horizon. The difference is particularly significant at the end of the planning horizon, as the target volumes were set lower in the optimization than in the base case.

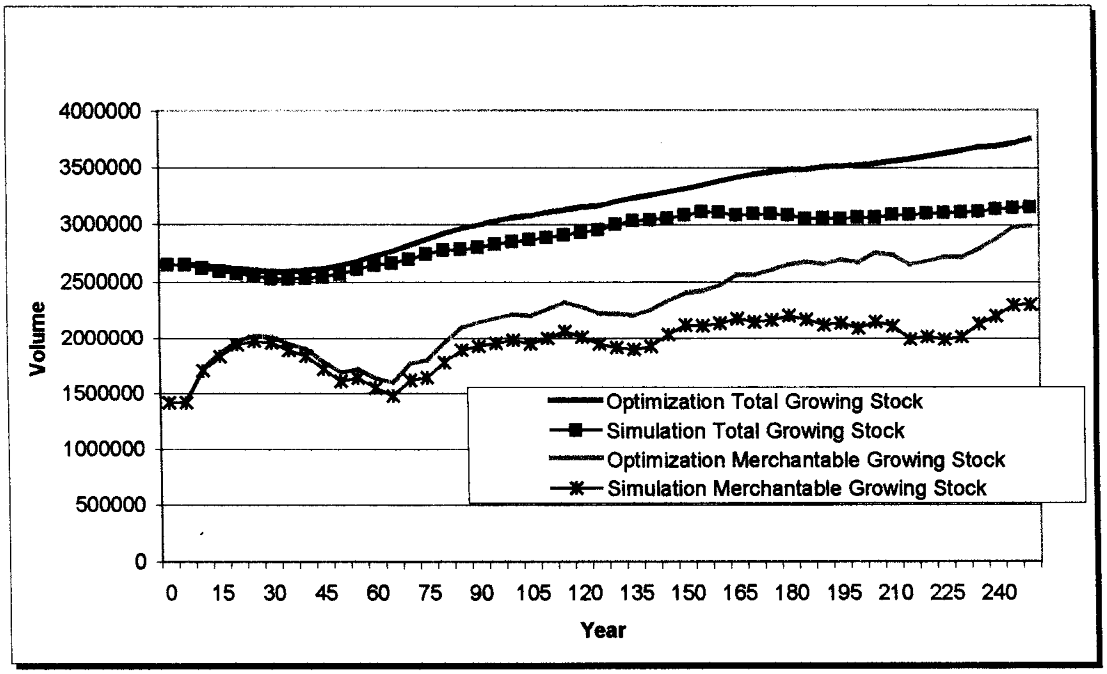

Figure 46 – Base optimization and base case simulation growing stock over planning horizon.

6.4.3 Proposed Option Average Area, Volume, and Age Harvested

The following three figures (Figures 47 – 49) illustrate the differences between the simulation solution and the proposed option for average area harvested, average volume per hectare harvested and average harvest age.

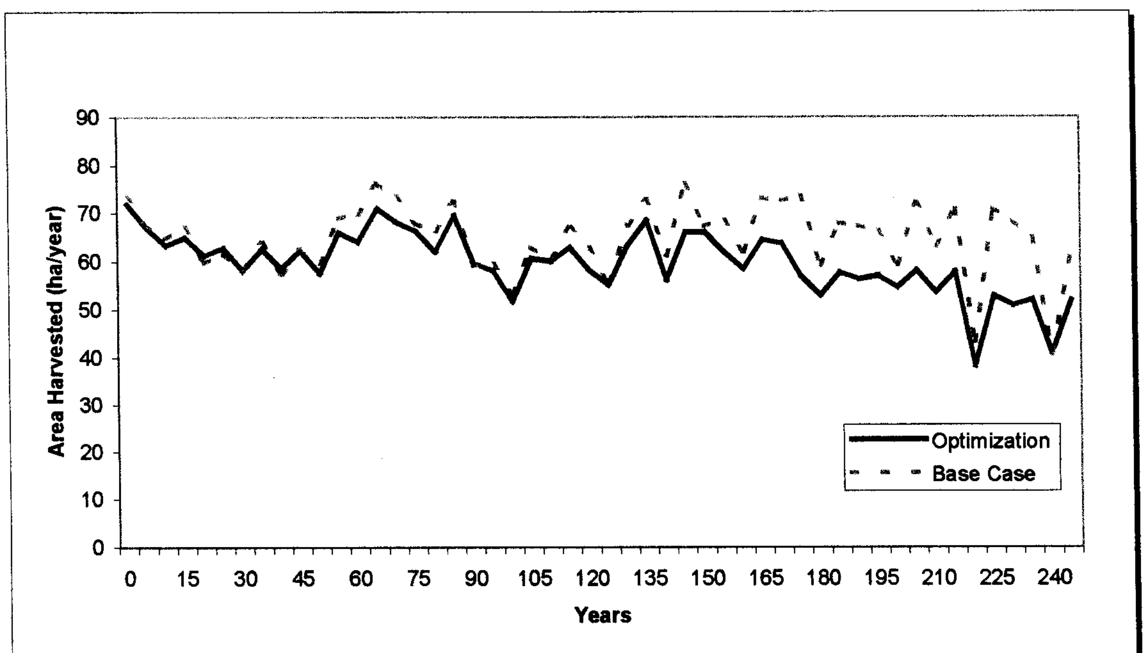

Figure 47 - Average area harvested over planning horizon.

The average area harvested in each period is slightly lower in the base optimization scenario than in the base case scenario (Figure 47). Conversely, the volume per hectare harvested is slightly higher in the base optimization scenario than in the base case scenario, as shown in Figure 48. The average harvest age is also mostly higher in the base optimization scenario, with the exception of two decades late in the planning horizon (Figure 49). The differences in timber supply dynamics between the base case and the base optimization scenario reflect differences in the modeling algorithms. One of the main differences is in the base case the simulation algorithm attempts to meet all the constraints one period at the time, while in the base optimization the algorithm attempts to optimize the objective function for all the periods within the planning horizon simultaneously.

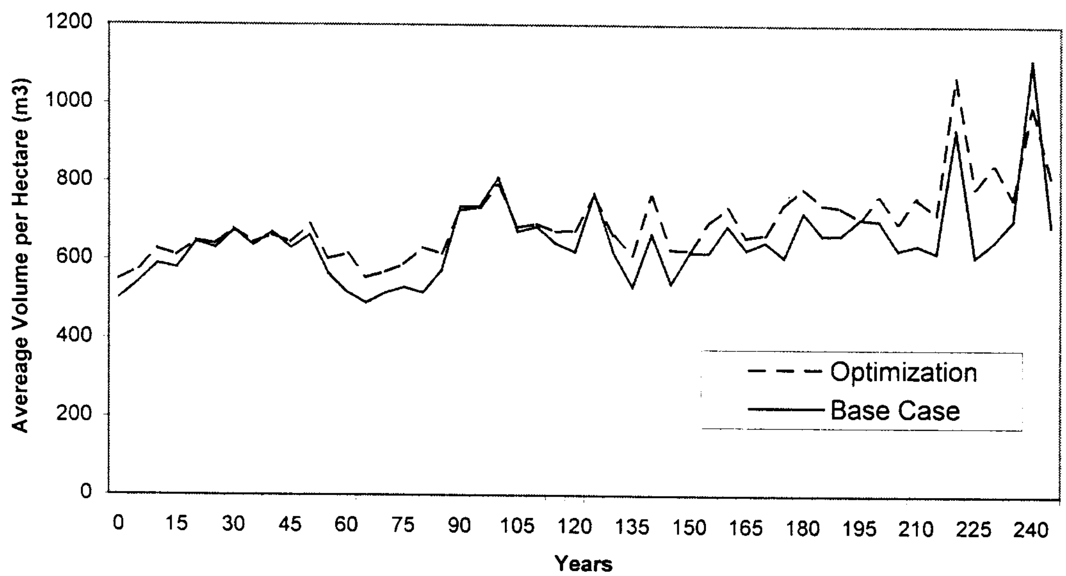

Figure 48 - Average volume harvested per hectare over planning horizon.

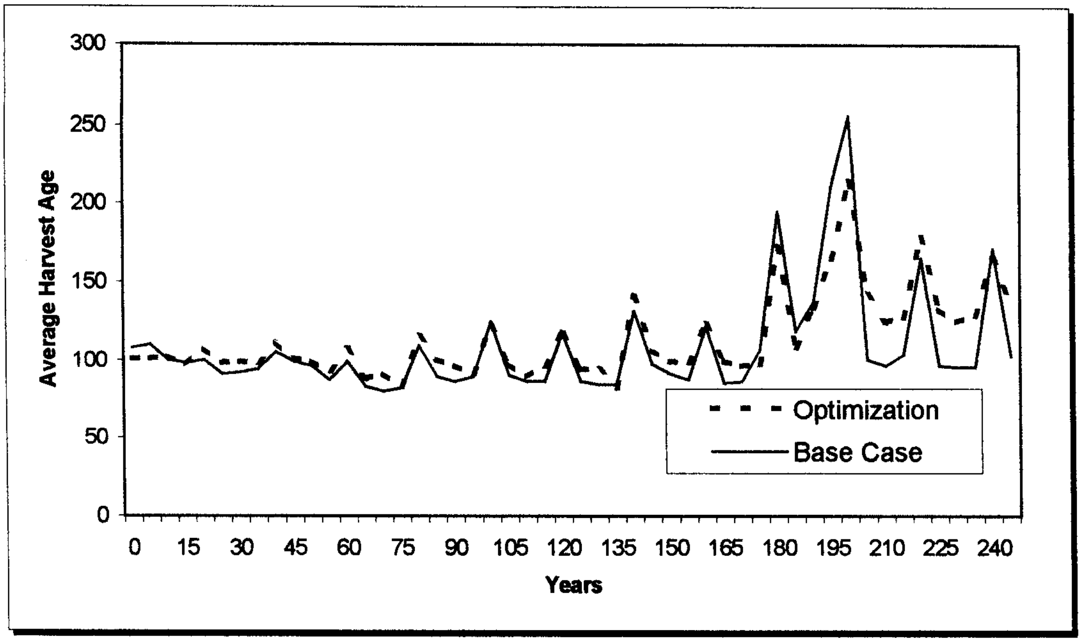

Figure 49 - Average harvested age over planning horizon.

6.4.4 Base Optimization Age Class Profile Over Time

Figures 50 to 54 illustrate the age class distributions produced from the base optimization scenario over the planning horizon. As expected, the trends are relatively similar to the base case with small differences.

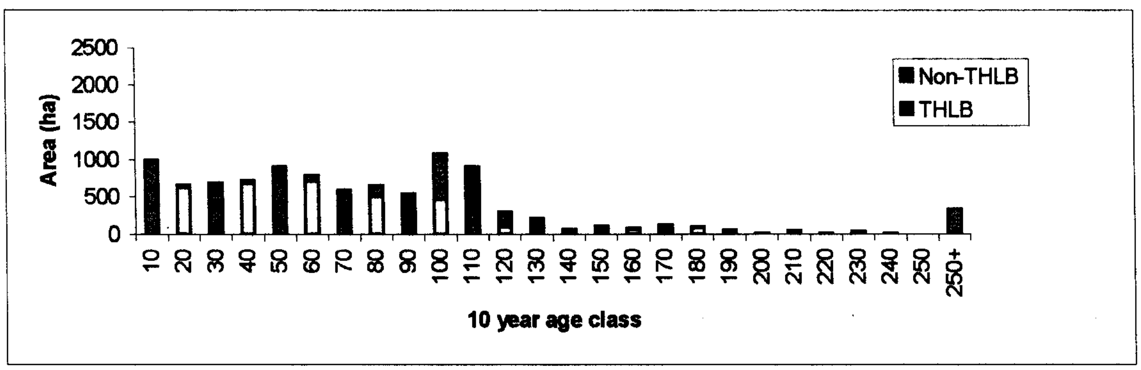

Figure 50 - Optimization and simulation age class distribution, year 50.

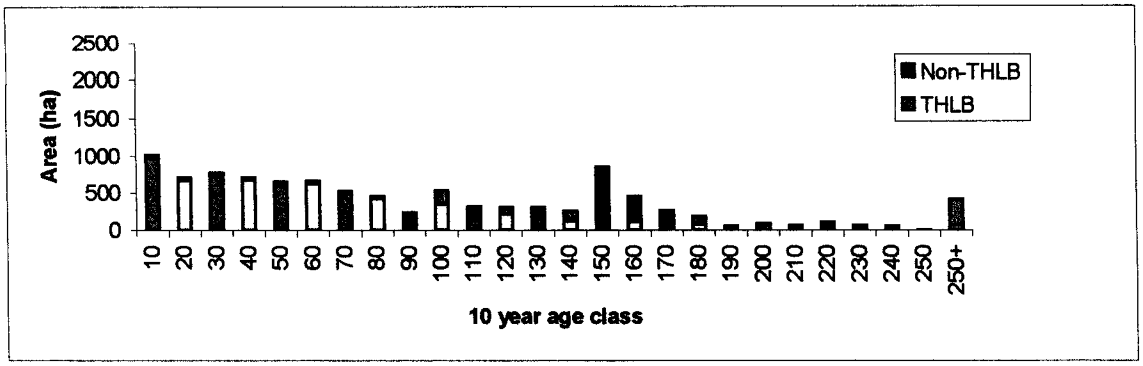

Figure 51 - Optimization and simulation age class distribution, year 100

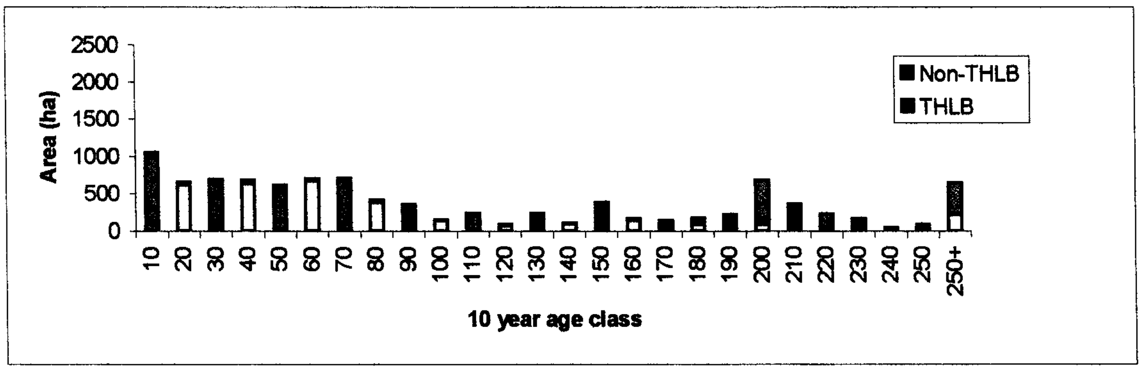

Figure 52 - Optimization and simulation age class distribution, year 150

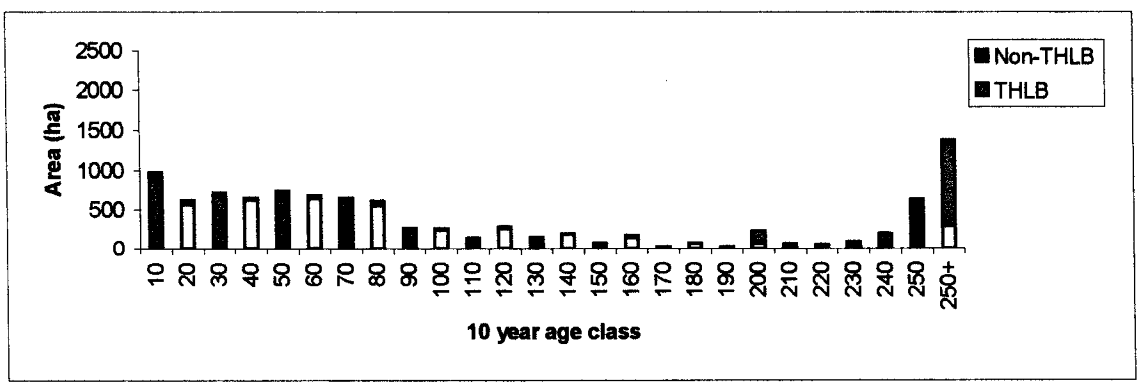

Figure 53 - Optimization and simulation age class distribution, year 200

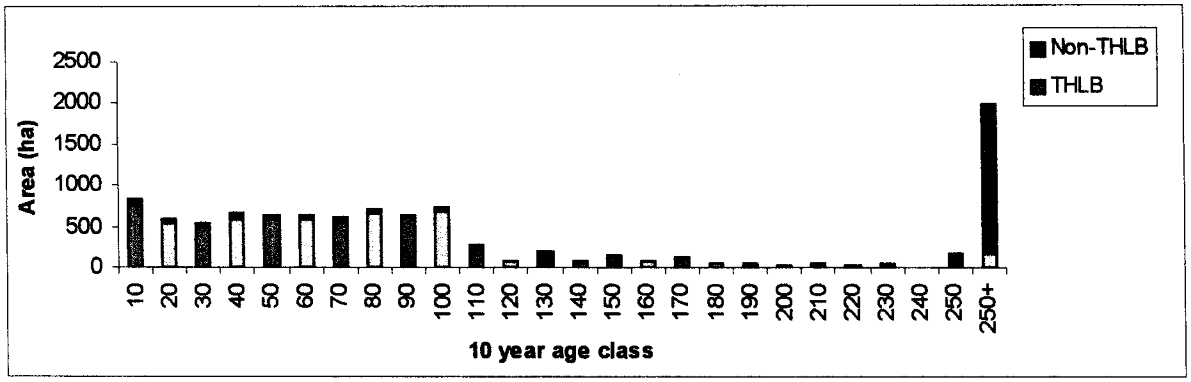

Figure 54 - Optimization and simulation age class distribution, year 250

6.5 Base Optimization - Non Timber Reports

6.5.1 Watersheds

As in the base case scenario, the maximum allowable disturbance rule for the Kenworthy Watershed is easily maintained in the base optimization throughout the entire planning horizon (Figure 55).

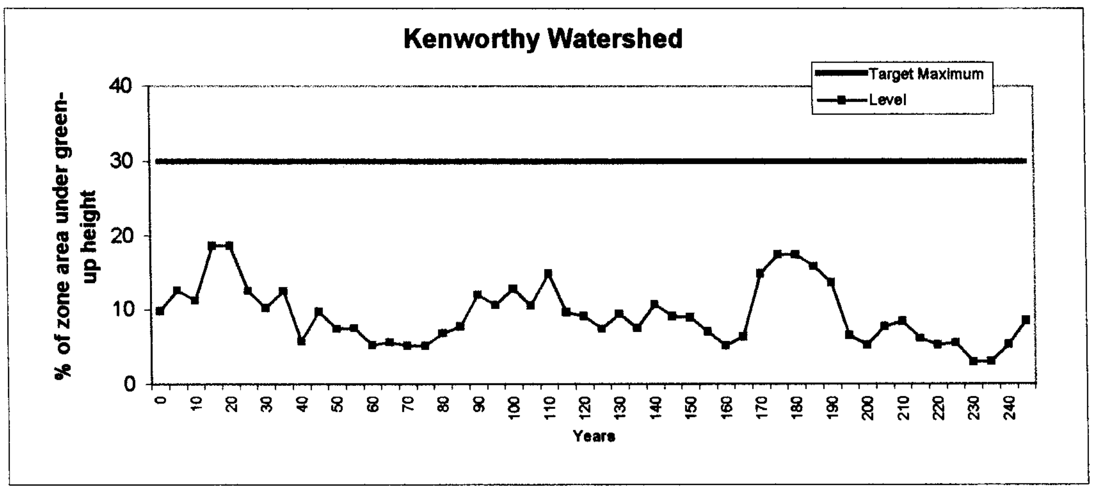

Figure 55 – Base optimization: maximum and achieved disturbance within the Kenworthy watershed.

6.5.2 Visually Sensitive Areas

As in the base case scenario, the visually sensitive area disturbance limits are met in 15 to 30 years (Figures 56 to 59). Similar to the base case scenario, the current conditions of these visually sensitive areas exceed constraints mostly because of the differences between planimetric and perspective assessment of allowable disturbance. After meeting the visual objectives, the disturbance is generally held below the maximum allowable disturbance expect for Partial Retention - High, which shows minor violations during the last 150 years of the planning horizon (Figure 56).

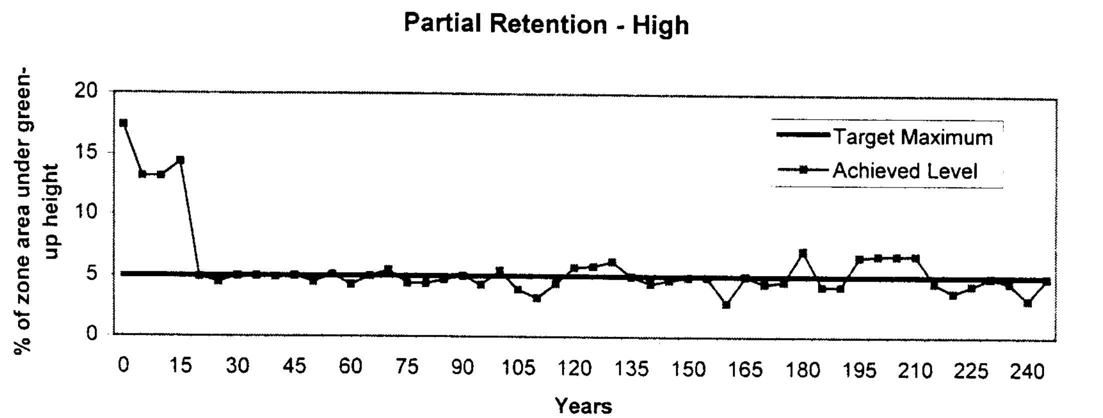

Figure 56– Base optimization: target and achieved disturbance levels within Partial Retention – High VAC areas.

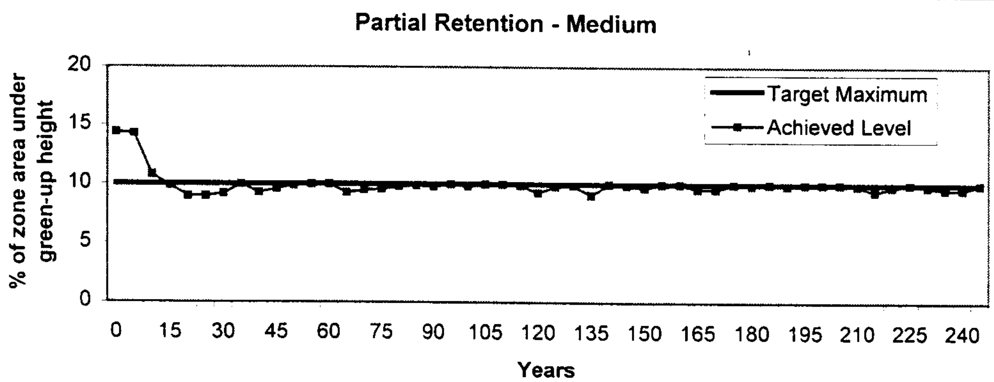

Figure 57–Base optimization: target and achieved disturbance levels within Partial Retention – Medium VAC areas.

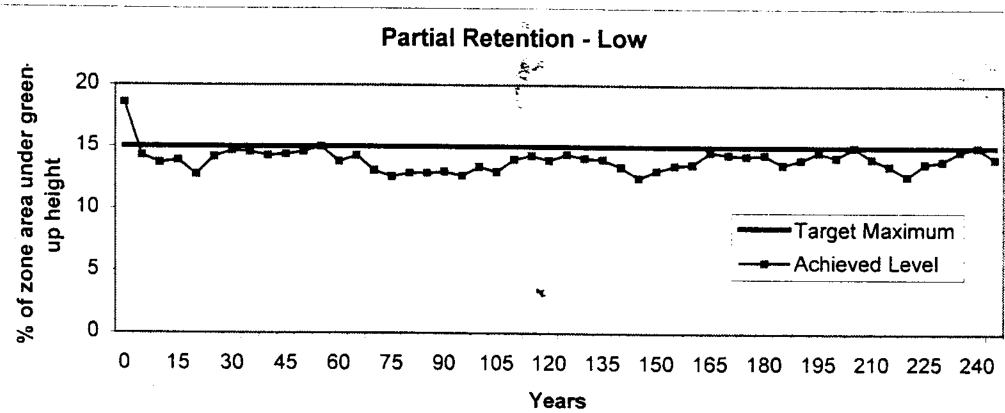

Figure 58– Base optimization: target and achieved disturbance levels within Partial Retention – Low VAC areas.

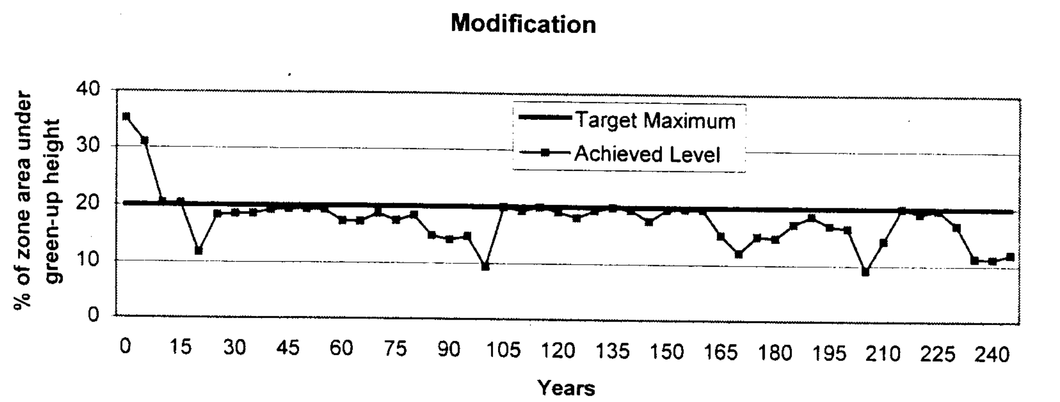

Figure 59– Base optimization: target and achieved disturbance levels within Modification VAC areas.

6.5.3 Landscape Level Biodiversity

The landscape level biodiversity results for the base optimization scenario are similar to the base case results. In both approaches stands must be reserved to meet the old forest targets by BEC variant in the future. For CHW vm1 the old forest target is reached in about 170 years and for CWH dm in about 190 years – 30 years older than in the base case. The other two BEC variants, CWH vm2 and MH, have adequate existing old forest to meet the targets immediately.

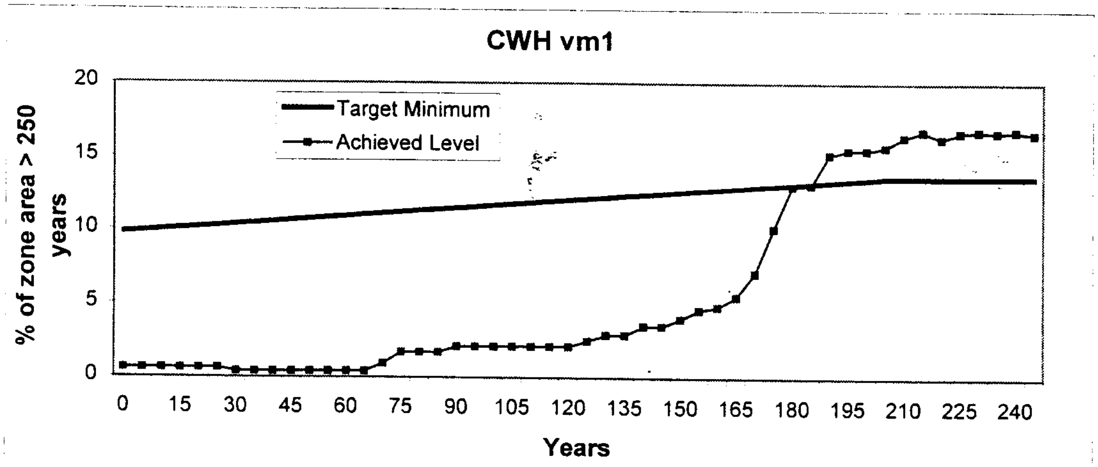

Figure 60 – Base optimization: target and achieved old growth area levels within CWHvm1.

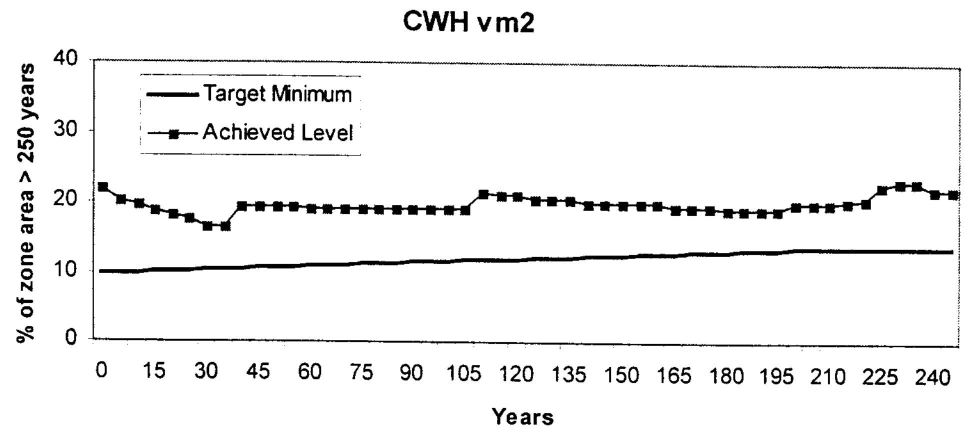

Figure 61 – Base optimization: target and achieved old growth area levels within CWHvm2.

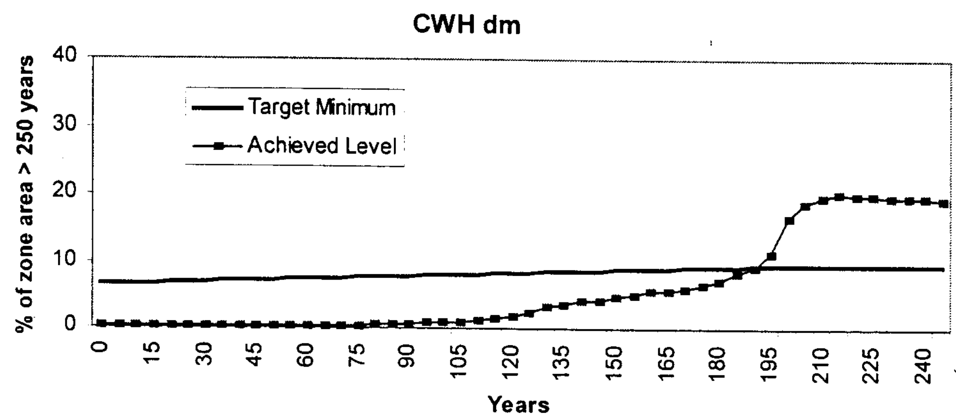

Figure 62 – Base optimization: target and achieved old growth area levels within CWHdm.

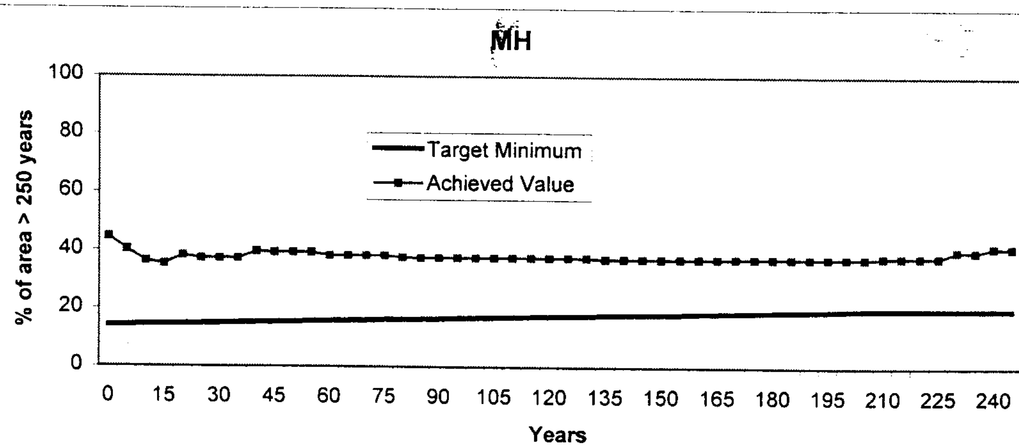

Figure 63 – Base optimization: target and achieved old growth area levels within MH.

6.6 Twenty-Year Plan

6.6.1 Introduction

The purpose of the twenty-year plan is to spatially validate the timber harvest levels presented in the timber supply analysis. Since ***FSOS*** has the capability to set spatial objectives, the timber supply analysis and twenty-year schedule can be simultaneously developed. Sections 6.4 and 6.5 described the transition from the base case scenario to the base optimization analysis in preparation of the twenty-year plan. The purpose of the base optimization scenario is to link the base case analysis and simulation analyses together with the twenty-year plan, which uses the optimization algorithm. By maintaining the same model parameters, similar results occur when using two different algorithms (Section 6.4 and 6.5). This similarity provides confidence that when using the two different algorithms, the same management problem is being analyzed.

6.6.2 Methodology

The optimization algorithm was used to generate a spatially feasible twenty-year plan by setting this objective as a high priority target and selecting the best results from millions of iterations. The blocks for the first 5 years were hardwired in the model from the latest forest development plan and the other input data, including forest cover constraints, were maintained from the base case and the proposed option.

6.6.3 Results

Following the harvest levels projected for the first 20 years of the base case and base optimization scenarios, the focus of the twenty-year plan results is on the achievement of a suitable blocking pattern and harvest schedule. By linking the timber supply analysis and twenty-year plan development, Mission has ensured that the harvest schedule presented adheres to the management practices and assumptions defined in the information package.

Table 3 – Average cut block size by 5-year period over the next 20 years.

Period	0-5 Years	6-10 Years	11-15 Years	16-20 Years
Average Block Size	11.28 ha	10.41 ha	11.30 ha	11.43 ha

The average block size in the twenty-year plan is approximately 11 hectares. The average block size for the twenty-year plan by five-year period is shown in Table 3. Figure 64 illustrates the cut block size distribution over the next twenty years.

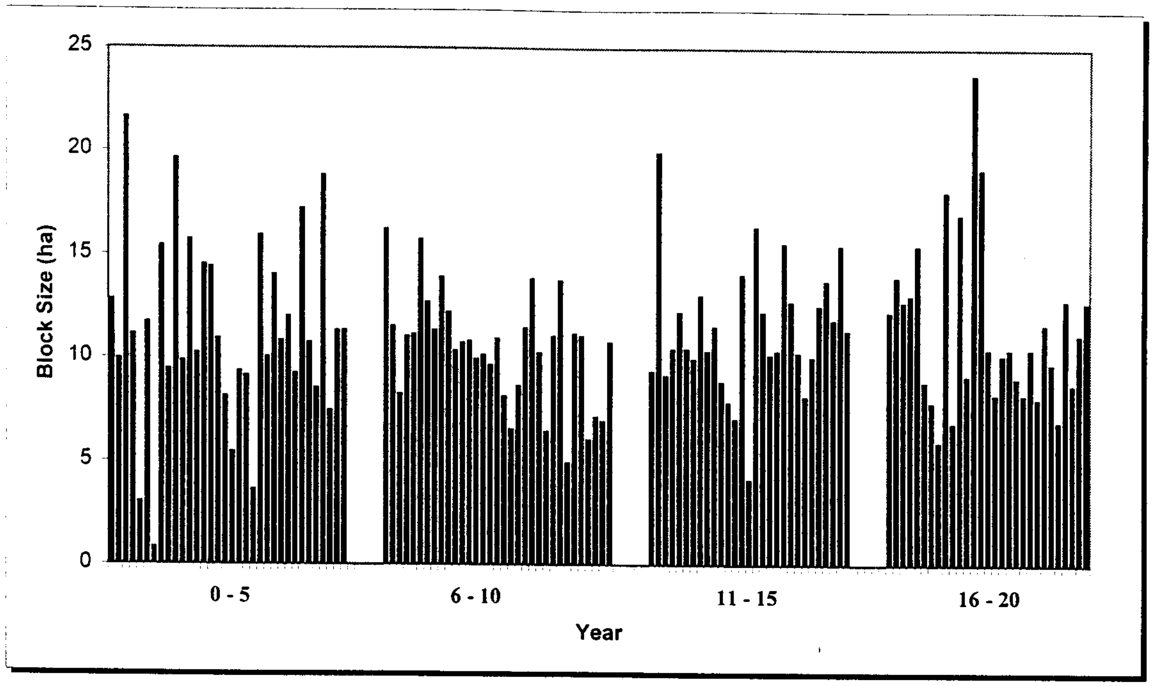

Figure 64 - Cut block size distribution in the twenty-year plan.

Mission field staff reviewed the twenty-year plan for operational feasibility and satisfaction of TFL 26 strategic objectives.

7 Summary and Conclusions

A new timber supply analysis is a significant undertaking, in terms of both time and monetary investment. The results of the process are meant to set the objectives and strategies for the upcoming five-year management period, concluding with the Chief Forester's determination of the AAC. This determination is based on supporting information provided in the management plan, timber supply analysis and twenty-year plan, considering economic, ecological and social objectives.

Since the previous timber supply analysis for TFL 26, there have been changes in the THLB and the regulations governing forest management. Specifically, the recently completed terrain analysis work classified significant areas under terrain class V. In the net down process, 90% of these areas were left outside of the THLB. In total, the THLB was 9.5% smaller compared to the last timber supply analysis.

Since the last analysis there have also been changes in the locations of visually sensitive areas, and the allowable disturbance within these area, as well as within the IRM zones. These changes have made the visually sensitive areas less constraining to timber supply in the TFL.

The last determination created a partitioned AAC of 3,000 m^3 allocated for deciduous harvest. In this analysis, all deciduous stands were removed from the THLB and all minor deciduous components were eliminated from conifer leading stands. As a result, the analysis considered only coniferous species and all the recommendations in this report apply only to coniferous species.

The above changes in the VQOs and small changes in the definition of minimum harvestable ages resulted in a small increase in the short-term harvest level. The harvest level for the proposed option is around 43,000 m^3 in the short-term and 46,877 m^3 in the long-term.

The completed sensitivity analyses indicate that the timber supply in TFL 26 is strong; current harvest level could be maintained for two decades on a 10% reduced land base or with 10% lower existing stand yields. If the old growth targets were set at full biodiversity, the base case harvest level could still be maintained over 4 decades. Allowing the 1/3 drawdown and using the draft biodiversity emphasis option would actually increase timber supply. If Mission decided to adopt their landscape reserve plan, the performed sensitivity analysis indicates that there would only be a long-term impact on the timber supply.

Based on the information presented within this timber supply analysis and the twenty-year harvest plan, District of Mission proposes that the coniferous AAC for TFL 26 be set at 43,000 m^3 per year, an increase of 1,000 m^3 from the current harvest level. No AAC is proposed for the deciduous partition.