Lakes TSA – Type IV Silviculture Strategy

DRAFT Situational Analysis

Version 1.0

December 2012

Project 419-24

Prepared by:

Forsite Consultants Ltd.
330 – 42nd Street SW
PO Box 2079
Salmon Arm, BC V1E 4R1
250.832.3366

FORSITE
Forest Management Specialists

Prepared for:

BC Ministry of Forest, Lands and Natural Resource Operations
Resource Practices Branch
PO Box 9513 Stn Prov Govt
Victoria, BC V8W 9C2

BRITISH COLUMBIA

FOREST SERVICE BRITISH COLUMBIA

Table of Contents

1 Introduction 1
1.1 Context 1

2 Summary of current plans and strategies 2
2.1 TSR4 2
2.2 Morice & Lakes IFPA 2
2.3 Silviculture Type II 3
2.4 Mid-term Timber Supply Technical Working Group Report for the Lakes TSA 3
2.5 Forest Health – FREP Report #13 3
2.6 Fire Management 4
2.7 Species Monitoring Report Lakes TSA 4

3 Timber Supply Situation 6
3.1 Base Case harvest forecast 7
3.2 Timber supply projections considering MPB 8
3.3 Mid-term dip in harvest levels 10
3.4 Shelf-life 11
3.5 MPB attack on young stands 11
3.6 Unsalvaged MPB-killed timber with poor/no regeneration 12
3.7 Reliance on non-pine leading stands 12
3.8 Impacts on age class distribution 12
3.9 Forest Inventory 13

4 Timber Quality Issues 15

5 Biodiversity and habitat issues 16
5.1 Overarching planning requirements 16
5.2 Ecosystem restoration 16

6 OBJECTIVES OF WORKSHOP 17

Appendix 1 IFPA/Type II Synopsis 1

List of Figures

Figure 1 Estimate of observed and projected annual attack for the Lakes TSA 6
Figure 2: Estimate of observed and projected cumulative attack for the Lakes TSA 7
Figure 3: TSR4 scenario 1- projected harvest levels. Year 0 is 2009 8
Figure 4: Compilation of 11 harvest forecasts 9
Figure 5: Mid-term close-up and variability in harvest forecasts 10
Figure 6: Age class distribution from TSR4 13
Figure 7: Fire history for the Lakes TSA 14
Figure 8: Premium log definition from the type II strategy 15

List of Tables

Table 1 Species distribution from several sources and several time periods 4
Table 2: Historical and current AAC 7
Table 3: Mid-term harvest forecast scenarios (millions m^3/yr) 11
Table 4: Shelf life estimates from TSR4 11

1 Introduction

The BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO) have initiated a Type IV Silviculture Strategy for the Lakes Timber Supply Area (TSA). A timber supply review (TSR4) was recently completed and an allowable annual cut (AAC) was determined at 2,000,000 m^3 per year including a partition cut of 350,000 m^3 for non-pine species effective July 12, 2011. The Morice and Lakes Innovative Forest Practices Society completed an extensive analysis of a variety of management options between 2007 and 2010, and completed a Silviculture Type II analysis in 2009. In addition FLNRO recently completed a special timber supply analysis as part of the Mid-term Timber Supply Project. All of these documents were reviewed and the most relevant options, learning's and factors were selected to provide a good base from which to pursue silviculture strategy development and/or more fully explore critical issues such as mountain pine beetle (MPB) related salvage strategies, priorities, and post-beetle timber supply. Given the focus of this project a new data package is in development and will take advantage of existing information from the TSR4, IFPA and Type II data packages as required. **This Type 4 silviculture strategy aims to develop updated TSA objectives and strategic guidance on harvesting and basic / incremental silviculture - resulting in a tactical plan to support implementation. It will also be used to guide allocation of Land Base Investment Strategy (LBIS) resources.**

1.1 Context

This document is the first of four documents that make up a Type IV Silviculture Strategy, the documents are:

1. Situational Analysis – describes in general terms the situation for the unit.
2. Data Package - describes the information that is material to the analysis including the model used, data inputs and assumptions.
3. Modeling and Analysis report –provides modeling outputs and rationale for choosing a preferred scenario.
4. Silviculture Strategy –provides treatment options, associated targets, timeframes and benefits.

2 Summary of current plans and strategies

Much work has occurred in the Lakes TSA in recent years, with four different publically funded timber supply projects, and dozens of separate scenarios in total. Key points from each of the four projects are identified below. In addition highlights from several other key assessments are discussed.

2.1 TSR4

TSR focuses on "what is" during its analytical and decision making process and does not speculate on "what if" or "what could be". Plans and strategies are not a TSR product; however comments and suggestions that usually highlight data/information weaknesses or specific concerns can be extracted during the TSR process. Some of the more important comments that are relevant to review and discuss in this process include:

- Two alternative harvest flows were examined during the TSR process. Scenario 2 shifted the harvest priorities to focus on pine-leading stands, followed by harvesting non-pine at a level higher than the long-term harvest level. These harvest priorities were slightly modified in Scenario 3 to focus on stands with pine > 70% first, and then harvest pine-leading stands with Pl< 70% second. In addition the minimum harvest volume was lowered from 140m^3/ha to 100m^3/ha. **The implications indicate that harvest priorities and minimum operable volumes have a major impact on harvest levels.**
- FLNR and licencee staff should continue to consider ways of mitigating negative impacts on hydrologic integrity during operations. For the next timber supply analysis, I expect the timber supply analyst to incorporate ECA assumptions, where appropriate.
- I am encouraged that licensee and FLNR staff have committed to collecting secondary stand structure information for the TSA from visual surveys during cruise checks and the monitoring of survey results and expect this information to be incorporated in future timber supply analysis.
- Not sufficiently restocked areas – not accounting for areas that remain deforested following small-scale salvage and the 2010 fire season resulted in a less than one-percent overestimation of the mid- to long-term harvest levels.
- Non-recoverable losses – not accounting for the Binta Lake fire resulted in a small unquantified overestimation in short-term timber supply.
- Interior log grade changes – not accounting for the inclusion of logs that were previously considered Grade 3 endemic or Grade 5 resulted in up to a seven percent underestimation in the short-term timber supply.
- Visual quality objectives – not accounting for the March 2010 GAR Orders resulted in about a one-percent underestimation in the harvest levels throughout the entire forecast period.

2.2 Morice & Lakes IFPA

The analysis was based on TSRII base case assumptions, and contained many similarities to the expedited TSR (TSR3). Initially the analyses addressed the forecasting of Integrated Resource Management indicators for SFM Plans but the last four years were heavily focussed upon timber supply options subsequent to the mountain pine beetle epidemic. Not counting the SFMP component there are five main management scenarios with twenty two sensitivities for a total of twenty seven harvest flow forecasts to inform management decisions.

Many of the harvest flow forecasts provided valuable information on the impacts of deferring and/or removing policy/legislative requirements. Harvest rules, salvage priorities and minimum operability had significant impacts on mid-term harvest levels as did utilizing improved site productivity information. From a silviculture perspective, increasing the percent of spruce on appropriate sites showed significant volume gains in the mid- and long-term.

A synopsis was completed for the Morice/Lakes IFPA and the Silviculture Type II and is in Appendix I.

2.3 Silviculture Strategy Type II

Following the comprehensive analyses completed in 2008 the Morice & lakes IFPA undertook a Type II Silviculture Investment Analysis and published the "*Lakes TSA Type II Analysis and Preferred Silviculture Strategy Report"* in March 2009. The Base Case was based upon the data package being prepared for TSR4, and four strategies and a composite were tested. The sensitivities tested were:

- Genetic worth, with significant white spruce gains (31% for 2018 stock)
- Fertilization within natural and managed stands aged 20 to 60 between site indices of 12 and 18
- Rehabilitation of natural and managed stands aged 20 to 60, above a site index of 10. Two types of rehab were examined "basic rehab" and "bioenergy rehab". Basic focused on MPB-killed stands that were not harvested under "normal harvest rules", and bioenergy rehab focused on stands below the minimum operable volume.
- Future species mix, which varied the amount of spruce because it has a higher culmination of volume than pine.

Each strategy had a different impact on both mid- and long-term timber supply, and the composite had a significant impact relative to the base case.

2.4 Mid-term Timber Supply Technical Working Group Report for the Lakes TSA

Timber supply analysis was undertaken to explore opportunities to mitigate the forecasted drop in harvest levels. Two categories were explored: forest sector management practices and administrative opportunities, and relaxation or deferral of objectives for non-timber forest values.

Five options were identified under the forest sector management practices and administrative category; continued focus of harvest in pine, fertilization of young stands, reduce minimum harvest volume from 140m^3/ha to 100 m^3/ha, harvest sites with low productivity, and harvest deciduous leading stands. Impacts were identified for each of these options in isolation, not collectively, however the range is from a low value of 20,000 m^3/yr for fertilization alone, to a collective of 235,000m^3/yr (assuming no overlap). An additional option was examined, extending shelf life by 5 years, which increased mid-term timber supply by 40,000m^3/yr.

Five options were examined in the relaxation or deferral category; eliminate cutblock adjacency, eliminate VQO's, eliminate riparian and WTP requirements, eliminate OGMA's, eliminate wildlife habitat requirements. Impacts were identified for each of these options in isolation, not collectively, however the range is between a low value of 15,000 m^3/yr for elimination of cutblock adjacency alone, to a collective of 157,000m^3/yr (assuming no overlap).

2.5 Forest Health – FREP Report #13

This report examined whether the free growing declaration point in time assessment was an accurate predictor of future stand productivity and whether assumptions of stand performance were

valid. The report concludes that mean values for free growing stems for the Lakes TSA remained relatively stable after the free growing declaration point. The report also identified that there appeared to be significant increases in hard pine rusts since free growing, but acknowledge that earlier data collection deficiencies may contribute to this observation. This high degree of rusts anecdotally corroborates the 20% OAF 1 used in TSR2 (which was a Regional Pathologist recommendation in the 1999 data package) and the value is used in the FREP analysis to calculate yield. In addition the report also mentions in several places that there appears to be a high degree of natural ingress due to large differences in total stocking in subsequent measurements.

2.6 Fire Management

To assist in identifying priority areas for treatments, documentation providing overarching strategies for treatments and/or hazard abatement for various fuel types or locations/structures within the TSA was requested. This information was not provided in time for this document, however an overview map was provided, showing known backcountry features, communities, and resource management zones. Information and input will be sought to ensure linkages with the fire management program.

2.7 Species Monitoring Report Lakes TSA

Concerns have been expressed about what may be occurring to the diversity of tree species over time. A recent report from FLRNO[1] focuses on the harvested landbase and provides an assessment of the species distribution from a variety of data sources and points in time. Species distribution by leading species and by overall species will be tracked in the model to allow comparisons with this data as well as with other recent data (in process) that identifies draft species distribution targets by Biogeoclimatic variant. Data from these reports indicate a high degree of mixed species regeneration. For those sites disturbed in 2003 (oldest complete data), the trend indicates that for those sites disturbed in 2003, Pl comprised 75% of the billed volume, 55% of the planting stock, and 62% of the species at the regeneration survey. Of these blocks 75% have two or more species in the inventory label, with up to as many as 4 different species.

Table 1 Species distribution from several sources and several time periods

Disturbance year		1995	2000	2003	2005	2011
HBS	% Pl	65	76	75	80	74
HBS	% Sw	27	20	22	18	20
HBS	% Other	8	4	3	2	6
Planted	% Pl	78	67	55	55	No data
Planted	% Sw	22	30	43	42	No data
Planted	% Other	0	3	2	3	No data
Regen >= 7 years	% Pl	75	65	62	No data	No data
Regen >= 7 years	% Sw	13	28	32	No data	No data
Regen >= 7 years	% Other	12	6	6	No data	No data
% mixed at regen	Na	50	70	75	No data	No data

[1] Species Monitoring Report Lakes TSA, May 2012, FLNRO Resource Practices Branch

% mono at regen	Na	50	30	25	No data	No data
# species at regen	Na	5	5	4	5	No data

3 Timber Supply Situation

The MPB infestation is the dominant factor affecting forest management in the Lakes TSA. Since the start of the epidemic, approximately 54,000,000 m³ have been killed by the MPB. TSR4 utilized the British Columbia Mountain Pine Beetle (BCMPB) Version 5 model. These projections are compared to the most recent projections from 2012 in Figures 1 & 2 below, and the graphs show a high correlation between the forecasted mortality that was used in TSR and the actual mortality documented in subsequent years. Differences between projected and actual annual mortality rates commenced in 2007, and the cumulative impact of this difference is that TSR forecasted more dead (3 million m^3 approximately) than what the latest forest health overview surveys and model projections indicate.

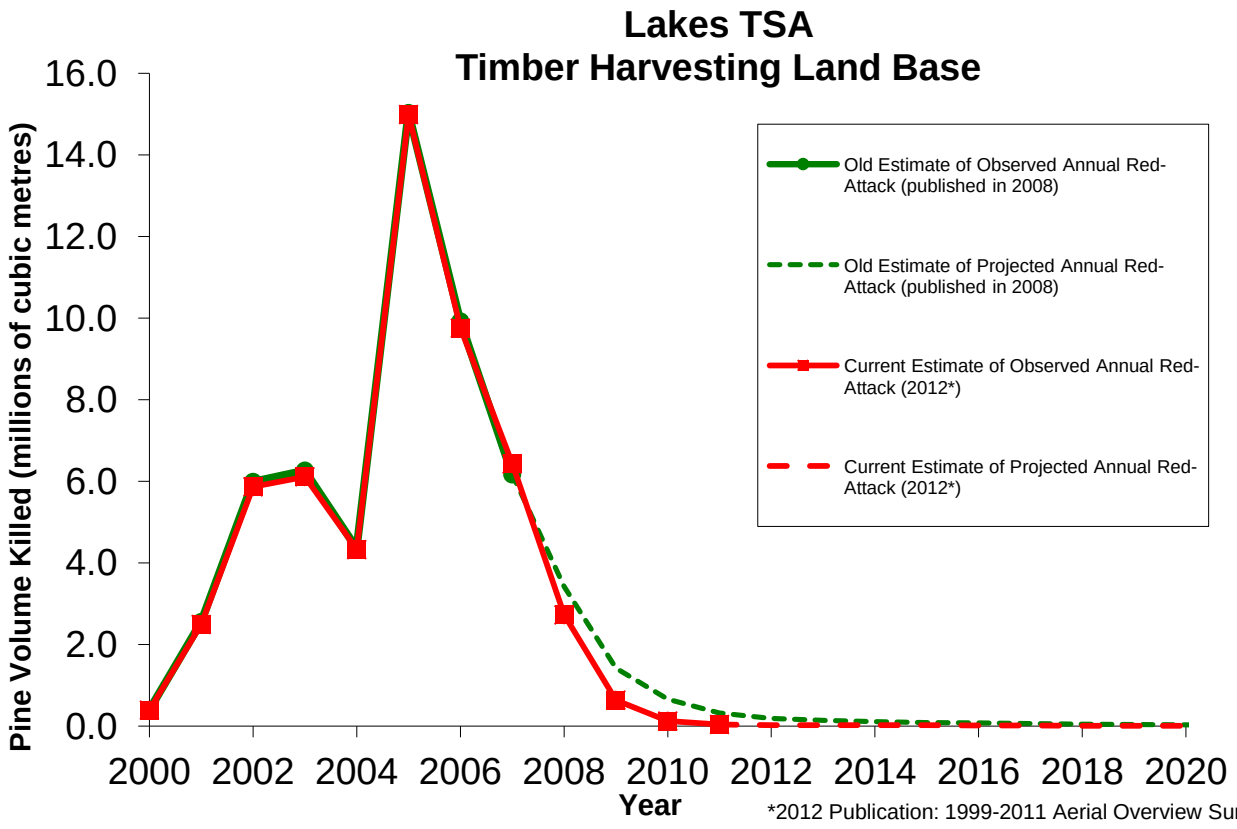


Figure 1 Estimate of observed and projected annual attack for the Lakes TSA

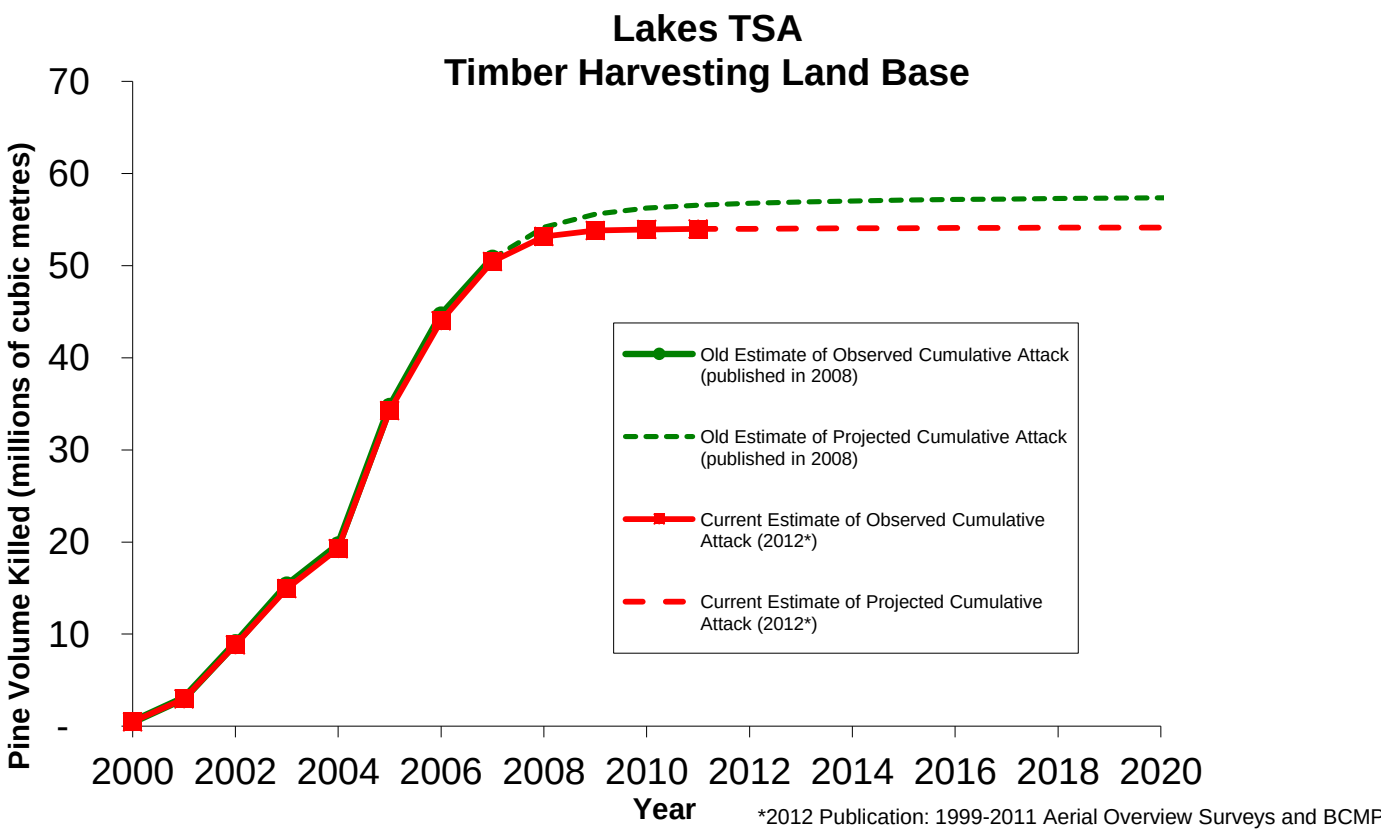


Figure 2: Estimate of observed and projected cumulative attack for the Lakes TSA

Historic AAC's are shown in Table 2. The AAC for the TSA was stable for many years, and increases in 2001 and 2004 reflected the growing mountain pine beetle epidemic. The 2011 AAC of 2,000,000 m^3 per year remains in effect until a new AAC is determined which must take effect within 10 years. From this AAC, 250,000 m^3 per year is attributable to non-pine volume.

Table 2: Historical and current AAC

	1982	1987	1996	2001	2004	2011
AAC (000,000m^3)	1.5	1.5	1.5	2.96	3.16	2.0

3.1 Base Case harvest forecast

Figure 3 shows the base case harvest forecast (Scenario 1) from the recently completed TSR4. The initial harvest volume is 3.41 million m^3/year and reflects a combination of the 3.16 million m^3/year of pine-leading stands and the 250,000 m^3/yr of non-pine. After the first decade the pine leading stands have either been salvaged or fallen over and are no longer merchantable and the harvest level drops to the 250,000 m^3/year sustainable harvest level of non-pine. At the beginning of the third decade regenerated volume becomes merchantable and the harvest level increases to 450,000 m^3/year. Over time additional pulses of regenerated volume become available and the harvest level increases.

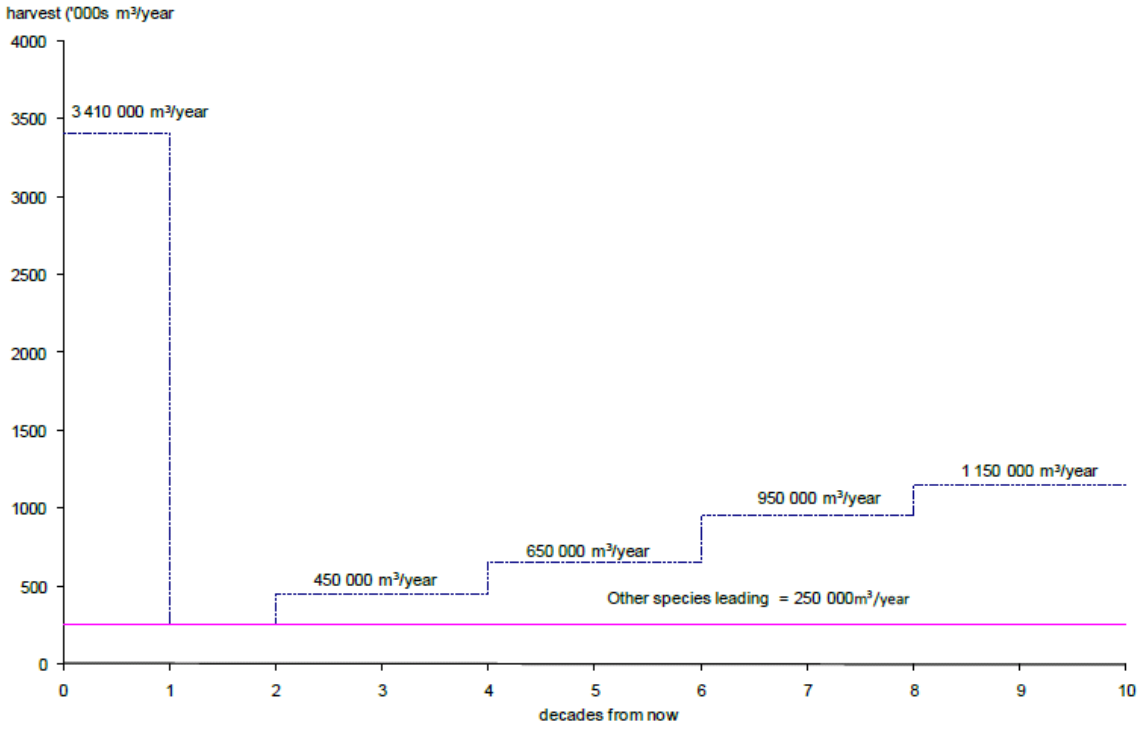


Figure 3: TSR4 scenario 1- projected harvest levels. Year 0 is 2009

3.2 Timber supply projections considering MPB

Estimates vary, but greater than 65% of the growing stock is lodgepole pine, and with the significant mortality that has occurred, most of the analyses depict similar harvest flows. Figure 4 shows 11 different harvest forecasts from four different timber supply projects:

- TSR4 – Scenarios 1, 2 and 3
- MTMC – Mid-term mitigation committee scenarios 1 and 2
- IFPA – Morice & Lakes IFPA scenarios, including a mitigation and mitigation composite assessment
- T2 – Silviculture Type II analysis base case and composite

Several trends are persistent in all of the different analyses:

- The trough commences in 2018 and continues until a minimum of 2027
- The recover post-2027 varies, and is largely based upon silviculture assumptions
- The pre-trough harvest levels and the rate of entering the trough varies, and is based upon shelf-life and dead pine operability assumptions

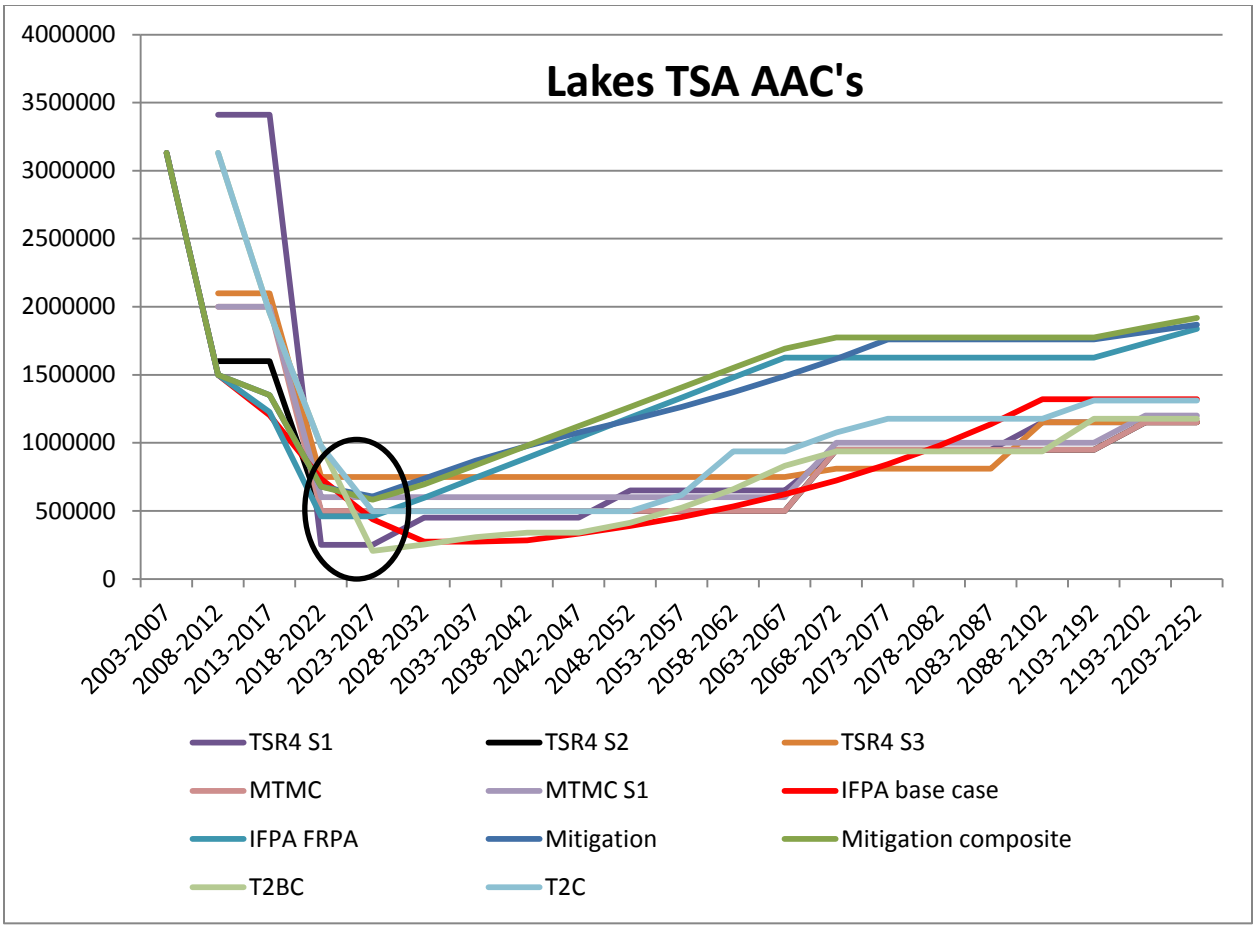


Figure 4: Compilation of 11 harvest forecasts

Each of the four timber supply projects focused on different objectives and the 11 different scenarios incorporated different underlying assumptions regarding silviculture treatments, shelf-life, minimum operability thresholds and the operable landbase. These combined effects of these differences on the depth and duration of the mid-term trough are illustrated further in Figure 5. Opportunities exist to influence the harvest level.

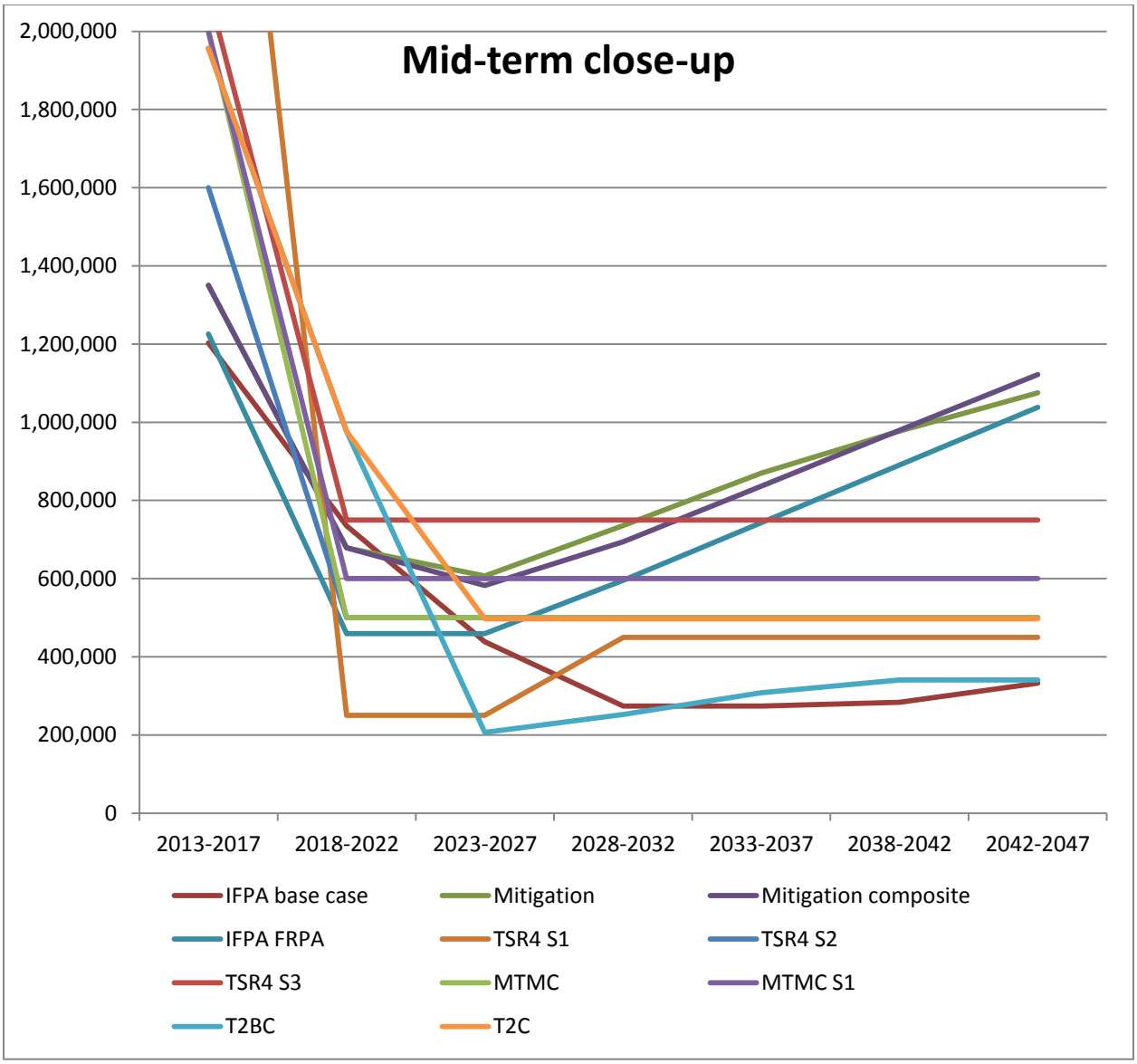


Figure 5: Mid-term close-up and variability in harvest forecasts

3.3 Mid-term dip in harvest levels

As a result of the severe outbreak and forecasted reduction in growing stock, harvest flow will exhibit a significant midterm trough for many years. Table 3 shows the estimated harvest levels for three scenarios explored in the TSR[2], the four scenarios explored in the IFPA, and the two scenarios explored each in the mid-term timber supply investigation and the Silviculture Type II analysis.

[2] Lakes TSA Timber Supply Analysis Technical Report, June 2010

Table 3: Mid-term harvest forecast scenarios (millions m^3/yr)

Time	TSR4 S1	TSR4 S2	TSR4 S3	IFPA base case	Mitigation	Mitigation composite	IFPA FRPA	MTMC	MTMC S1	T2BC	T2C
08-12	3.41	1.60	2.10	1.50	1.50	1.50	1.50	2.00	2.00	3.13	3.13
13-17	3.41	1.60	2.10	1.20	1.35	1.35	1.23	2.00	2.00	1.96	1.96
18-22	0.25	0.50	0.75	0.73	0.68	0.68	0.46	0.50	0.60	0.98	0.98
23-27	0.25	0.50	0.75	0.44	0.61	0.58	0.46	0.50	0.60	0.21	0.50
28-32	0.45	0.50	0.75	0.27	0.74	0.69	0.60	0.50	0.60	0.25	0.50
33-37	0.45	0.50	0.75	0.27	0.87	0.84	0.74	0.50	0.60	0.31	0.50
38-42	0.45	0.50	0.75	0.28	0.98	0.98	0.89	0.50	0.60	0.34	0.50
43-47	0.45	0.50	0.75	0.33	1.08	1.12	1.04	0.50	0.60	0.34	0.50

The range in mid-term forecasts is substantial from a low of between 210,000 and 250,000 m^3/yr (dark shading) to a high of between 610,000 and 750,000m^3/yr (light shading). The mid-term harvest level depends on the economic availability of timber supply and the ability to harvest dead pine. In addition to changing the size of the landbase through relaxation in or deferral of non-timber protection measures, the speed at which managed stands can be brought online has an impact on the size and depth of this mid-term trough.

3.4 Shelf-life

TSR4 utilized the "year-of-attack" from the BC MPB model, to determine how long stands were dead. Shelf-life was related to years since attack according to the Table 3 below. In addition the analysis assumed that the dead trees fell over 35 years after initial attack.

Table 4: Shelf life estimates from TSR4

Years since attack	% sawlog	Other wood product %
1 to 5	85	16
6 to 10	70	30
11 to 15	50	50
16 to 20	30	70
greater than 20	0	100

No other analyses examined the implications of different shelf-life assumptions.

3.5 MPB attack on young stands

Some data was collected in pine leading stands during the period 2006 to 2008. Of the area surveyed, 4%, 29% and 48% of the area surveyed for age class 1, 2 and 3 respectively was found to contain MPB. Within these areas, 0, 1 and 24% were found to fall below minimums and secondary structure minimum requirements. Anecdotal information from the TSA indicates low levels of mortality within regenerated stands. It appears that this data was not utilized in the development of regenerated yield curves for TSR4.

3.6 Unsalvaged MPB-killed timber with poor/no regeneration

Harvest is currently focused on severely attacked stands in the TSA. However, it is likely that a large portion of the forest will die with no salvage harvesting. Estimates of the area of appropriate secondary structure, and subsequent growth rates and contribution to the AAC are under intense review within the Province. Recent work by Coates[3], the Resource Practices Branch[4] and Griesbauer[5] 's are being examined to better understand the variability, occurrence and growth rates of secondary structure. TSR discussed the possible implications that secondary structure may have; specific estimates will be included in this analysis.

3.7 Reliance on non-pine leading stands

Because of the losses expected in Pl stands and the current concentration of harvest in Pl stands, harvesting will be forced into other species during the mid-term period where timber availability is at its lowest. The range in mid-term harvest estimates discussed above is partially influenced by the amount of non-pine that is harvested in the short-term.

3.8 Impacts on age class distribution

Given the magnitude of area affected by the mountain pine beetle across many age classes (as low as 30 years to 200+ years old) there will be a large shift of area into a narrow range of age classes. The current age class structure from TSR4 is shown in Figure 6 below and is typical of the BC Interior with a significant deficit of area in age classes 30 through 50. These age classes represent the area of timber that largely controls the depth and duration of the mid-term trough. This small amount of area likely means the depth of the trough will be deep and the duration will be long, relative to pre-beetle harvest levels.

[3] Coates, K.D., Sachs, D.L. Current State of Knowledge Regarding Secondary Stand Structure in Mountain Pine Beetle Impacted Landsacpes. Second Draft, January 2012.

[4] Current Knowledge of stocking status after the Mountain Pine Beetle, Resource Practices Branch Backgrounder, July 2011

[5] Griesbauer, H. Green, S. Examining the utility of advance regeneration for reforestation and timber production in unsalvaged stands killed by the mountain pine beetle: Controlling factors and management implications. BC JEM, 2006.

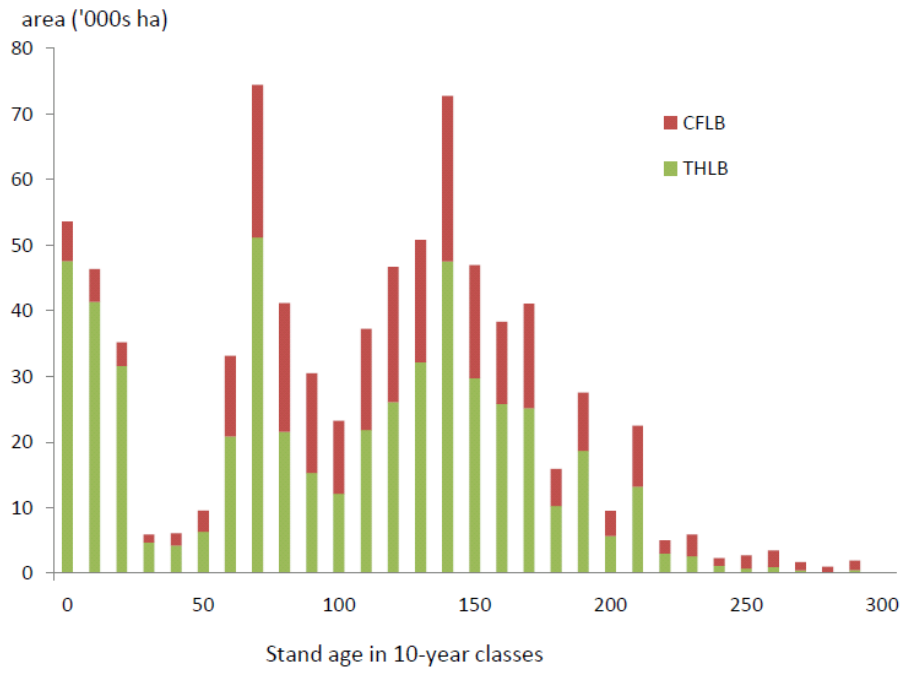


Figure 6: Age class distribution from TSR4

3.9 Forest Inventory

The majority of the air photos on which the forest cover inventory is based were acquired in the late 1980s and early 1990s. In Tweedsmuir Park the inventory dates from the 1950s. The forest cover attributes for the majority of the area conform to the FIP standard. (ie a FIP roll-over to VRI format). The publicly posted inventory file contained a relatively complete coverage of the TSA (with the exception of some minor gaps resulting from private land, GIS slivers, and other factors).

Harvest and reforestation updates to the inventory file are current to 2011. Harvest detection mapping based on satellite imagery is current to 2011. Figure 7 below shows the fire history for the TSA. Recent fires and free-growing survey results have not been integrated into the inventory file, and will be for this project. The inventory file has been projected to 2011 and polygon volumes have been adjusted to reflect MPB mortality observed in the 2010 forest health overview flight.

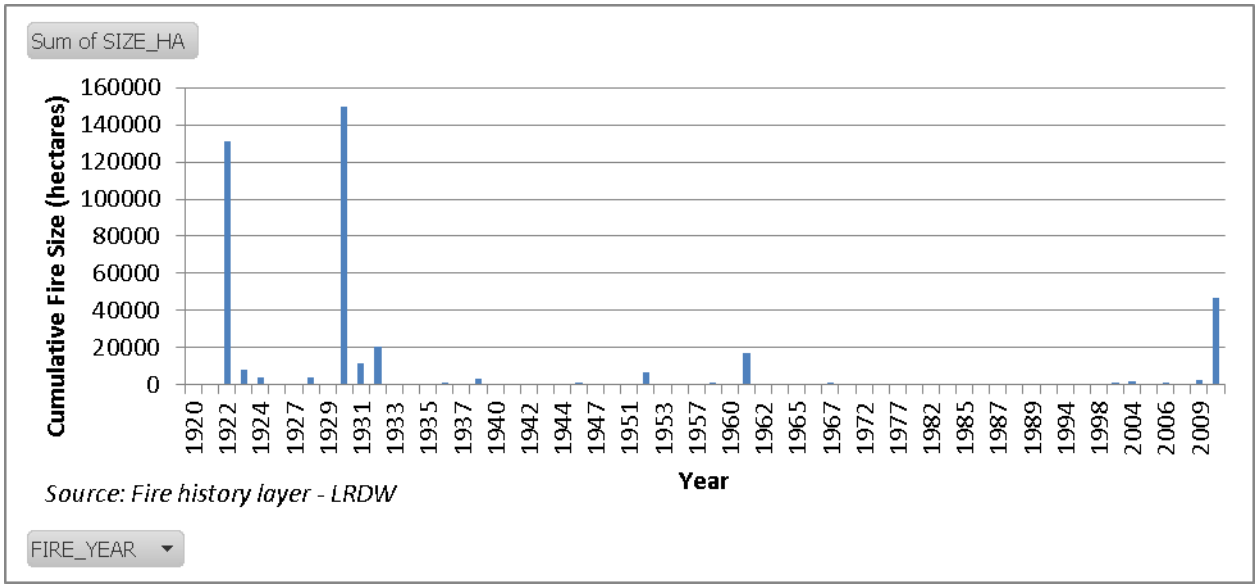


Figure 7: Fire history for the Lakes TSA

Within the TSA, there are 31 inventory permanent sample plots (PSPs), 80 VRI Phase 2 ground samples from 2000, 115 VRI Phase 2 ground samples from 2008, and 124 trees sampled for NVAF. An inventory audit analysis was completed in 2008. VRI Phase 2 ground sample volume exceeded VDYP7 inventory file volume by 10%.

The entire TSA is mapped for site index, primarily based on PEM or TEM coverage and SIBEC site index estimates. Forest Analysis and Inventory Branch is completing a Provincial site index coverage that will be examined for its utility.

4 Timber Quality Issues

The current provincial target for premium logs to be produced is 10% of AAC. Premium logs were defined for the previous Type II strategy and shown in Figure 8 below. These need to be reviewed and confirmed, or adjusted to fit the situation today.

Table 46. Definition of Premium, Standard and Merchantable Sawlogs

Quality Class	Products	Species	Min Stand DBH
Premium Sawlog	Peelers, poles, house-logs and high grade sawlogs	All except deciduous	>32.5
Standard Sawlog	Sawlogs		27.5-32.5
Merchantable			>12.5 ,15 or 17.5 (depending on initial DBH utilization spec.)

Figure 8: Premium log definition from the type II strategy

5 Biodiversity and habitat issues

5.1 Overarching planning requirements

Various sections for three higher-level plans have been implemented in the Lakes TSA:

- The Lakes District Land and Resource Management Plan
- The Lakes South Sustainable Resource Management Plan
- The Lakes North Sustainable Resource Management Plan

These plans provided specific direction for the management and protection of wildlife species, management and protection of riparian and water values, delineation of Old Growth Management Areas and the identification of seral stage and patch size targets.

The Mid-term Timber Supply Project under the direction of the FLNRO will examine the consequences of relaxing or deferring these objectives. All legally-binding objectives from the above three plans, as well as direction from FRPA-FPPR/GAR/FSW/LUOR will be incorporated into the base case for this project. The model will be constructed in such a way that deferrals and relaxations can also be examined.

Changes in hydrology can be estimated by equivalent clear cut area (ECA) and road density. The Chief Forester stated in the TSR4 determination "For the next timber supply analysis, I expect the timber supply analyst to incorporate ECA assumptions, where appropriate". Significant work was undertaken in the tenure of the Morice and Lakes Innovative Forestry Practices Agreement examining peak flow impacts and the production of fine sediments.

5.2 Ecosystem restoration

The vision of the Provincial ecosystem restoration program is to restore identified ecosystems to an ecologically appropriate condition creating a resilient landscape that supports the economic, social, and cultural interests of British Columbia[6]. Ecosystem Restoration is defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed by re-establishing its structural characteristics, species composition, and ecological processes.

In the Lakes TSA there are no biogeoclimatic variants that meet the definition of the NDT4 fire-maintained ecosystems. As a result this program will not be examined in any further detail. For clarification or specific guidance see the 2009 Ecosystem Restoration Provincial Strategic Plan.

[6] Ecosystem Restoration Provincial Strategic Plan, BC Ministry of Forests and Range. Neal, Allen 2009

6 OBJECTIVES OF WORKSHOP

The objective of this initial workshop is to:

- Review basic data and clarify key issues around future timber supply, timber quality, and habitat supply (non-timber issues).
- Define working targets for timber supply, timber quality, and habitat supply (non-timber issues).
- Review draft strategies and discuss additional strategies to address issues and achieve the working targets;
- Review key strategies/recommendations from IFPA and Type II
- Review options/discuss management of secondary structure
- Define indicators to be used to evaluate the results of the forest level modeling.

Appendix 1 IFPA/Type II Synopsis

Morice Lakes IFPA

Analysis of the Lakes TSA within the Morice & Lakes IFPA process spanned a period of seven years and evolved to address a number of resource management questions ranging from social and environmental values for sustainable forest management plans, emergency timber supply measures in response to the mountain pine beetle epidemic and changing legal and policy environments resulting from land use plans and the new Forest and Range Practices Act. Initial analyses initially addressed forecasting of Integrated Resource Management indicators for SFM Plans but the last four years were heavily focussed upon timber supply options subsequent to the mountain pine beetle epidemic. Not counting the SFMP component there are five main management scenarios with twenty two sensitivities for a total of twenty seven harvest flow forecasts to inform management decisions.

These analyses were done using a relatively sophisticated spatially explicit forecasting model that tracks activities in forest stands, harvest units, resource development zones, special management areas, and references other unique resource information to provide direct links between strategic, tactical, and operational planning criteria specific treatment unit polygons. This feature enabled learning scenarios to be explored in more detail than normal. The most recent analysis "*Lakes TSA Timber Supply Analysis Report for Current Status, Beetle Mitigation, FRPA Implementation, and Full SRMP Scenarios*" was completed on March 2008 and it provides a comprehensive description of all twenty seven harvest flow scenarios. An overview of these scenarios paraphrased from the above report is below.

The Base Case Scenario drew on TSR II base case assumptions with adaption for the expedited TSR III assumptions as a benchmark and modeled current management practices and harvest levels designed to provide a foundation for comparisons with the subsequent scenarios. Due to the imperative of the MPB epidemic the Base Case Scenario had built into its foundation a set of projections for MPB spread and associated pine mortality. It would not be a realistic basis for comparison if these mortality projections were not included.

The Beetle Mitigation Scenario modeled increased productivity within plantations, decreased non recoverable losses along with management activities designed by the IFPA Lakes TSA Technical Committee to minimize the MPB epidemic's impact on timber supply to the maximum extent within practical limits. These ideas were applied within the scenario itself as well as in the group of five sensitivity analyses that were tested. A main focus was on maximizing the harvest of recently killed but merchantable trees and stands with increasing levels of attack thereby converting them to managed stands that were no longer susceptible to this threat.

The Beetle Mitigation Composite Scenario selected a number of mitigation strategies tested through sensitivities as a modification of the initial Beetle Mitigation Scenario.

The FRPA Implementation Scenario included some of the ideas generated in the Beetle Mitigation Scenario that were found to be effective. However, more so than the Beetle Mitigation Scenario, this scenario was more firmly grounded in what forest licensees expected to be their legal obligations for the foreseeable future. The objective of this scenario was to demonstrate the timber supply impacts of these

legal obligations. There were twelve sensitivities tested within the FRPA Implementation Scenario. Some of these test actual mitigation measures. Others test alternative means of modeling forest management requirements. The ninth of these tests the impacts of Lakes North Old Growth Management Areas.

The Full SRMP Scenario examined the influence of objectives brought in through sustainable resource management planning in the Lakes North and Lakes South. Five sensitivity tests were conducted to examine the collective and isolated effects of localized partial cutting, THLB exclusions for Old Growth Management Areas, and various levels of wildlife tree retention.

Summary of Analyses Inputs and Assumptions for the Sensitivities:

Base Case Scenario Inputs and Assumptions

- Similarities with Expedited TSR
- LRMP Objectives Applied

Beetle Mitigation Scenario Inputs and Assumptions

- Harvest Priorities
- Growth and Yield
- Volume Matching for Natural Succession after MPB Epidemic
- VQO Depletion Adjustment: Plan to Perspective
- Green-up Adjacency
- Candidate OGMAs
- Reduced Future Landings

Beetle Mitigation Scenario Sensitivity Analyses

- Reserved Candidate OGMAs in Lakes South SRMP Area
- Reduced Minimum Harvest Volume in Beetle Attacked Stands
- Relaxed Binding Seral Targets
- Future Managed Species Mix - Sx 60%: Pl 40%
- Future Managed Species Mix - Sx 80%: Pl 20%

Mitigation Composite Scenario Inputs and Assumptions

FRPA Scenario Inputs and Assumptions

- Mitigation driven modeling assumptions that differ from Base Case
- Policy based modeling assumptions that differ from those in Base Case and Beetle Mitigation Scenarios
- Old Growth Management Areas
- Landscape Corridors
- Green-up Adjacency
- Patches
- Wildlife Tree Retention
- Community Forests
- Growth and Yield

FRPA Implementation Scenario Sensitivity Analyses Inputs and Assumptions

- Adjusted Desired Patch Distribution
- Adjusted MPB Mortality Projections
- Waive Early Seral Targets
- Rehabilitate MPB Affected Stands – Case 1
- Rehabilitate MPB Affected Stands – Case 2
- Forest Genetics Council – Genetic Gains
- Adjusted Operational Adjustment Factor 1
- Old Growth Site Index Adjustment
- Lakes North OGMAs
- Adjusted Visual Quality Objectives
- Under-storey Secondary Structure 1
- Under-storey Secondary Structure 2

Lakes North and South, Full SRMP Scenario Inputs and Assumptions

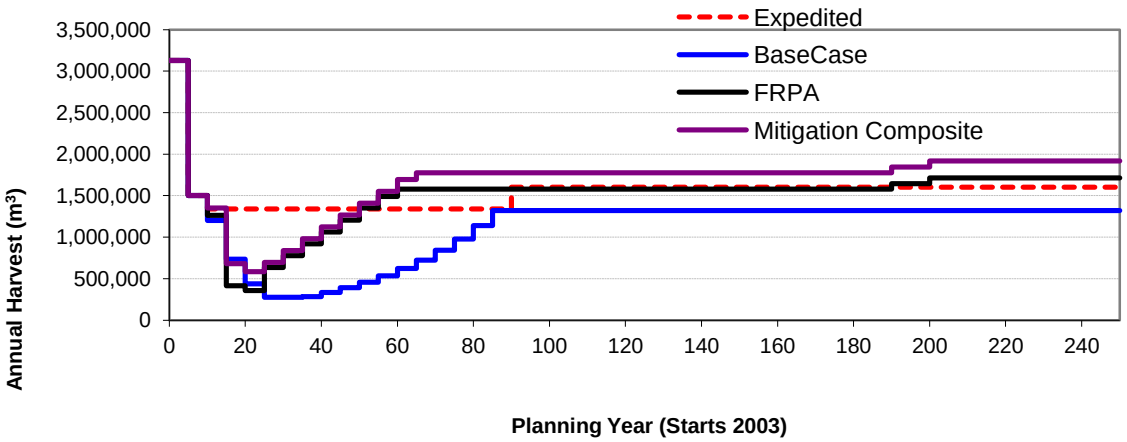
- OGMAs
- Wildlife Tree Retention Levels
- Timber Harvesting Land Base
- Partial Cuts

Lakes North and South, Full SRMP Scenario Sensitivity Analyses Inputs and Assumptions

- WTR Sensitivity: Adjusted WTR levels in the North
- OGMAs Sensitivity: Include OGMAs in THLB
- Partial Cuts Sensitivity: Apply partial cuts throughout Lakes North VC and HR
- Connectivity Corridors Sensitivity
- Lakes North SRMP Cumulative Impacts Sensitivity

The table and figure on the following pages present a summary of the tight harvest forecasts net of non-recoverable losses determined for each of the Lakes IFPA scenarios along with the results of the Expedited TSR. The table was shortened by spanning more years than just one planning period in some rows (years in bold) where there was no change in harvest levels.

Scenario Harvest Flow Forecasts



Lakes TSA Scenario Projected Harvest Levels

Planning Horizon	Year	Expedited TSR	Base Case	Mitigation	Mitigation Composite	FRPA	Full SRMP
Short-Term	2003-2007	3,130,000	3,130,000	3,130,000	3,130,000	3,130,000	3,130,000
Short-Term	2008-2012	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Short-Term	2013-2017	1,341,000	1,202,824	1,350,000	1,350,000	1,226,033	1,091,837
Short-Term	2018-2022	1,341,000	734,824	678,824	678,824	459,096	459,096
Mid-Term	2023-2027	1,341,000	438,824	606,605	582,383	459,096	406,936
Mid-Term	2028-2032	1,341,000	274,024	736,127	694,223	595,762	548,849
Mid-Term	2033-2037	1,341,000	274,024	869,995	836,862	743,228	701,563
Mid-Term	2038-2042	1,341,000	283,296	977,504	979,502	890,694	854,276
Mid-Term	2043-2047	1,341,000	332,731	1,075,013	1,122,141	1,038,160	1,006,990
Mid-Term	2048-2052	1,341,000	389,918	1,167,523	1,264,781	1,185,626	1,159,703
Mid-Term	2053-2057	1,341,000	456,071	1,265,032	1,407,421	1,333,092	1,312,417
Mid-Term	2058-2062	1,341,000	532,597	1,372,542	1,550,060	1,480,558	1,459,131
Mid-Term	2063-2067	1,341,000	621,123	1,490,051	1,692,700	1,625,024	1,459,131
Mid-Term	2068-2072	1,341,000	723,529	1,617,561	1,774,839	1,625,024	1,459,131
Mid-Term	2073-2077	1,341,000	841,993	1,759,070	1,774,839	1,625,024	1,459,131
Mid-Term	2078-2082	1,341,000	979,033	1,759,070	1,774,839	1,625,024	1,459,131
Mid-Term	2083-2087	1,341,000	1,137,560	1,759,070	1,774,839	1,625,024	1,459,131
Mid-Term	**2088-2102**	1,341,000	1,320,944	1,759,070	1,774,839	1,625,024	1,459,131
Long-Term	**2103-2192**	1,600,000	1,320,944	1,759,070	1,774,839	1,625,024	1,459,131
Long-Term	2193-2202	1,600,000	1,320,944	1,813,547	1,846,432	1,731,524	1,574,258
Long-Term	**2203-2252**	1,600,000	1,320,944	1,868,024	1,918,024	1,838,024	1,689,385

Significant Scenario Outcomes and Factors:

Base Case Assumptions

When compared to the Expedited TSR III analysis the Base Case Scenario showed much more acute timber supply fall down in the short term. This is largely attributable to two factors; the projection of future MPB mortality and seral constraints. The Base Case applied the BC Mountain Pine Beetle Project projections of mortality to 2013 while the Expedited TSR III analysis used only known 2004 mortality. In Base Case stands that fell below 140 m3 per hectare in the mortality projections were not harvested and those that didn't were put onto yield curves that reflected the projected mortality.

As well, seral stage targets were applied in the spatial analysis that created forest cover constraints that compounded to bring the low point of the harvest flow far below the Expedited TSR II harvest level.

Mitigation Scenario Assumptions

The key scenario to reference for this Type IV analysis is the Mitigation Scenario as it substantially improves the harvest flow projections over both the Base Case and the Expedited TSR II analyses in the long term and significantly reduces the term and magnitude of the Base Case short term fall down. The low point of harvest flow is increased from 274,000 m^3 to 607,000 m^3 and the recovery begins ten years earlier than Base Case.

The Expedited TSR III AAC was maintained for ten years and then modelled according to a number of assumptions that were effective in mitigating the MPB induced short term timber supply trough as shown in the following figure and table. These modelling factors included;

- Avoiding widespread seral target binding by switching MPB depleted stands that were not harvested to VDYP recovery curves later in the planning horizon and therefore not dropping the age of these stands down to zero to make this transition.
- Allowing stands to retain residual live volume when succeeding to VDYP recovery curves.
- Allowing increased levels of denudation within VQO areas using an accepted plan to perspective ratio adjustment.
- Removing the spatially explicit green up adjacency and maximum block size requirements in areas known in TSR2 as integrated resource management areas.
- Use of forest productivity yield curve sets which incorporate first generation genetic worth values and SIBEC site productivity estimates.
- Improved targeting of stands experiencing significant pine mortality through 'best of the worst first' harvest priorities

Mitigation Scenario Sensitivities

As summarized earlier, mitigation scenario sensitivities included: reserved candidate OGMAs in Lakes South SRMP Area, reduced minimum harvest volume in beetle attacked stands, relaxed binding seral targets, and future managed species mixes. The results of these sensitivities are summarized in the following tables;

- Removing candidate OGMAs from the Lakes South SRMP had negligible impact in the short term

- Reducing minimum harvest volumes from 140 m^3 per hectare to 100 m^3 had a positive timber supply impact of 5% in the short and midterm and a 3% impact in the long term
- Relaxing identified binding seral targets by 20% had the most significant mitigating effect on the short term timber supply trough, 240,000 m^3 compared to the deepest point in the mitigation scenario and the average midterm AAC was increased by 146,000 m^3.
- Increasing the percentage of spruce on appropriate sites in future plantations decreases the low point of the short term trough by 50,000 to 70,000 m^3 and shows significant volume gains of 4% to 9% over the mid and long term.

IFPA Lakes TSA Beetle Mitigation Scenario Sensitivities' Projected Harvest Flows

Planning Horizon	Year	Mitigation	COGMA	Reduce MHV	Relax Seral	Spruce 60: Pine 40	Spruce 80: Pine 20
Short-Term	2003-2007	3,130,000	3,130,000	3,130,000	3,130,000	3,130,000	3,130,000
Short-Term	2008-2012	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Short-Term	2013-2017	1,341,000	1,341,000	1,409,109	1,341,000	1,381,865	1,381,865
Short-Term	2018-2022	1,005,750	1,005,750	1,057,096	1,005,750	1,077,635	1,087,904
Mid-Term	2023-2027	754,313	798,824	793,087	1,005,750	808,597	824,107
Mid-Term	2028-2032	817,914	798,824	859,869	1,005,750	876,651	851,478
Mid-Term	2033-2037	863,612	788,024	908,392	994,950	926,304	899,436
Mid-Term	2038-2042	924,065	924,065	971,867	994,950	981,428	962,307
Mid-Term	2043-2047	988,750	988,750	1,039,786	994,950	1,049,993	1,029,579
Mid-Term	2048-2052	1,057,962	1,057,962	1,112,459	1,166,956	1,145,157	1,145,157
Mid-Term	2053-2057	1,163,759	1,163,759	1,223,545	1,283,332	1,259,417	1,259,417
Mid-Term	2058-2062	1,280,134	1,280,134	1,345,740	1,411,345	1,385,103	1,385,103
Mid-Term	2063-2067	1,408,148	1,408,148	1,480,154	1,552,160	1,523,358	1,523,358
Mid-Term	2068-2072	1,548,963	1,548,963	1,628,010	1,707,056	1,675,438	1,675,438
Mid-Term	**2073-2102**	1,703,859	1,703,859	1,790,651	1,877,442	1,703,859	1,703,859
Long-Term	2103-2112	1,703,859	1,703,859	1,790,651	1,877,442	1,703,859	1,703,859
Long-Term	**2113-2172**	1,843,584	1,843,584	1,903,024	1,937,362	1,993,629	2,031,140
Long-Term	**2173-2252**	1,873,584	1,843,584	1,918,024	1,968,862	2,026,029	2,064,140

IFPA Lakes TSA Beetle Mitigation Scenario Sensitivities' Average Projected Harvest Levels

Sensitivity		Mitigation	COGMA	Reduce MHV	Relax Seral	Spruce 60: Pine 40	Spruce 80: Pine 20
Short Term Average 2003-2022	Achieved	1,744,188	1,744,188	1,774,051	1,744,188	1,772,375	1,774,942
	Vs Mitigation	0	0	29,864	0	28,188	30,755
		0.00%	0.00%	1.71%	0.00%	1.62%	1.76%
Mid Term Average 2023-2102	Achieved	1,314,423	1,311,288	1,381,676	1,461,366	1,365,912	1,361,158
	Vs Mitigation	0	-3,135	67,252	146,943	51,489	46,735
		0.00%	-0.24%	5.12%	11.18%	3.92%	3.56%
Long Term Average 2103-2252	Achieved	1,850,269	1,834,269	1,903,532	1,950,167	1,992,342	2,026,921
	Vs Mitigation	0	-16,000	53,263	99,898	142,073	176,652
		0.00%	-0.86%	2.88%	5.40%	7.68%	9.55%
Minimum Harvest Level	Achieved	754,313	788,024	793,087	994,950	808,597	824,107
		0	33,712	38,774	240,638	54,284	69,794
	Vs Mitigation	0.00%	4.47%	5.14%	31.90%	7.20%	9.25%
		2023-2027	2023-2037	2023-2027	2018-2047	2023-2027	2023-2027

Mitigation Composite Scenario

The only difference between the Mitigation Scenario and the Composite Mitigation Scenario was an adjustment in species mix for future managed stands. Impacts are similar to those in the table above, significant and increasing with time.

FRPA and SRMP Scenarios

The FRPA and SRMP scenarios informed policy decisions of the day but are not particularly relevant to the Type IV analysis which is based on fixed legal framework. Both scenarios had negative impacts on harvest flow as might be expected. Sensitivities worth exploring from the FRPA Scenario would be the Rehabilitation and the Understory Secondary Structure analyses which have significant management implications. Waiving VQO constraints on pine stands had minimal effect.

Silviculture Type II

Following the comprehensive analyses completed in 2008 the Morice & lakes IFPA undertook a Type II Silviculture Investment Analysis and published the "*Lakes TSA Type II Analysis and Preferred Silviculture Strategy Report"* in March 2009. The parameters for Type II analyses are quite structured so only four strategies tested in the broader analyses were brought forward into this analysis. The Composite Scenario shows considerable improvement in harvest flows with the largest gains coming from stand rehabilitation. Genetic Worth is not included in the Base Case but is current status so while significant this activity does not present a new opportunity. Fertilization and species composition of future managed stands area real opportunities for management enhancements.

The **Base Case Scenario** was prepared based on the information in the Lakes TSR4 Data Package since many of the assumptions within the package are based on current forest management practices. Modeling assumptions include:

Land base Info

- Old Growth Management Areas (OGMAs) were excluded from the Total Harvestable Land base (THLB);
- Wildlife connectivity corridors; and
- Updated land base and forest inventory data (e.g. used 2007 VRI for forest inventory, included mapped existing and proposed harvest activities, etc.).

Growth &Yield

- Volume matching to recovery curves for MPB depleted stands;
- Future managed stand site indices from new layer PEM and SIBEC;
- Increased spruce and decreased pine content on plantations in specific BEC zones that provided enhanced growing conditions;
- 2% increase in volume resulting from a 15cm reduction in stump height;
- Updated MPB reductions to include mature and immature stands;
- 1600 stems per hectare planting density; and
- Supplemented TSR3 OAF1 values with OAF1 values defined in IFPA studies. IFPA OAF1 studies provided values based on Biogeoclimatic Zones.

Management Considerations

- 'Best of the worst first' harvest priorities;
- Increased wildlife tree retention;
- Adjacency was not strictly modeled based on a height to reach green-up rule, rather adjacency was inferred within the model through setting patch size distribution targets. These targets would allow creation of blocks (patches) over time;
- Visually Sensitive Area disturbance adjustments; plan to perspective ratio; and
- No area reductions for future landings.

The **Genetic Worth Sensitivity** is the same as the Lakes Base Case Scenario but included genetic worth values for Pine and Spruce seedling stock based on the BC Forest Genetics Council species plans. These plans provide estimates on availability and improved genetic worth of the seedlings. The Forest Genetics Council Species Plan numbers for seedling availability and volume gains shown below were applied to applied the dataset's managed stand yield tables.

Lakes genetic worth Factors for Future Managed Stands by See Planning Unit (SPU)

SPU Code	Seedling availability/Volume gain	
	2008	2018
Pl BV low	54%/10%	100%/13%
Sx BV low	80%/16%	100%/23%
SX PG high/SX BVP high	100%/19%	100%/20%
SX PG low/SX BVP	87%/28%	100%/31%

The **Fertilization Sensitivity** is the same as the Lakes Base Case Scenario but included estimates of fertilization treatment areas. The fertilization program is to occur on natural and managed stands within ages 20-60 (age class 2-4) and be prioritized based on a number of criteria.

Fertilization of candidate stands was performed annually during a 10-year window. In calculating the amount of fertilization to be performed annually, the total candidate stands available were determined and treated at a rate of 10% per year. The fertilization program was started in the model in

2010 and was continued to 2020. The criteria for selecting eligible stands for the fertilization program include medium sites, having an SI between 12 and 18, and within Age Classes 2 (21-40 yrs), 3 (41-60yrs) and 4 (61-80 yrs).

The fertilization curves were developed in TIPSY version 4.1 and were derived so that each yield curve maintained its initial age and then fertilization and harvest deferrals occurred as per the specifications above. The default growth response in BatchTipsy was used (can not customize responses in Tipsy).

The **Rehabilitation Sensitivity** is the same as the Lakes Base Case Scenario but included estimates of rehabilitation (rehab) treatment areas. The rehab program is to occur on natural and managed stands within ages 20-60 (age class 2-4) and above a Site Index (SI) of 10. There were two types of rehab modeled, Basic Rehab and BioEnergy Rehab. Basic Rehab was prioritized over BioEnergy Rehab. Additionally, BioEnergy Rehab stands were prioritized by the projected sawlog volumes in the stands, the higher the stands sawlog volumes, the higher they were in the rehab queue.

Harvesting was used as a rehab measure within the model – essentially this was a treatment that reset the stands age and status. Stands were identified stands that did not achieve Minimum Harvest Criteria (140 m^3/ha for all species) after the MPB epidemic. These stands were forced to be harvested to simulate rehab. If any sawlog volumes exist in these stands it will contribute to the AAC since shelf life reductions already reduce the pine sawlog volumes appropriately. A product profile for three log categories was tracked in the analysis; standard sawlog, premium sawlog and merchantable non sawlog (or bio-energy log).

The criteria for the rehab of eligible stands are listed below:

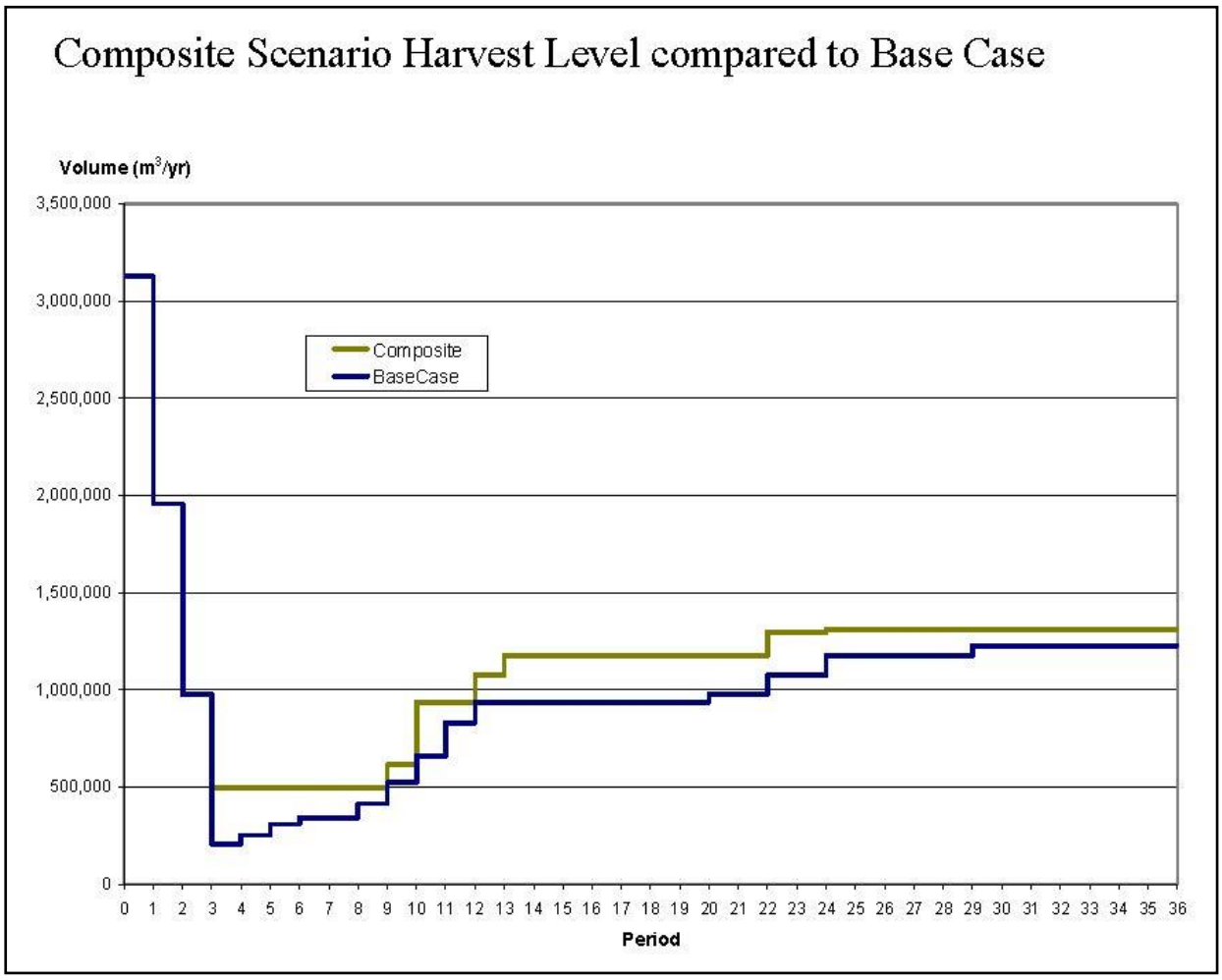
- Basic Rehab: SI >10 within age classes 2 & 3 and within stands that do not recover from MPB.
- BioEnergy Rehab: Age classes 4+ with an SI >10.
- Rehab costs will come from the Type 1 SIS.
- Rehab targets are from the amount of projected NSR in the Lakes due to MPB

The **Future Species Sensitivity** is the same as the Lakes Base Case Scenario but within the managed stands on certain sites, spruce was regenerated as the dominant species since spruce has a higher culmination volume than pine on these sites. The following site series were selected as areas where more spruce in the planting mix could provide a timber volume advantage in the mid-term: SBS mc2, and SBS dk on mesic and subhygric site series (01, 06, 07, and 08). In this sensitivity the species mix was 60% spruce and 40% pine for future managed stands in these BEC units.

- Other considerations that went into this decision were;

- Spruce genetically improved stock is more widely available;
- Spruce has a higher genetic worth (i.e. increased growth/yield gain) than Pine;
- Mix species stands reduce the potential for future forest health epidemics.

These scenarios were analyzed individually and then combined in a **Composite Scenario** to confirm the expected cumulative effect. A further analysis for a **Premium Sawlog Scenario** was included as a condition of the Type II analysis standard which required that 10% of sawlogs be greater than 32.5 cm DBH.



Period	Base Case (m^3/yr)	Genetic Worth (m^3/yr)	Species Mix (m^3/yr)	Fertilization (m^3/yr)	Rehabilitation (m^3/yr)	Composite (m^3/yr)
2009-2013	3,130,000	3,130,000	3,130,000	3,130,000	3,130,000	3,130,000
2014-2018	1,956,732	1,956,732	1,956,732	1,956,732	1,956,732	1,956,732
2019-2023	976,732	976,732	976,732	976,732	976,732	976,732
2024-2028	206,732	226,732	206,732	272,052	476,732	496,732
2029-2033	252,732	266,732	252,732	272,052	476,732	496,732
2034-2038	307,932	327,932	307,932	331,116	476,732	496,732
2039-2043	341,052	361,052	341,052	366,554	476,732	496,732
2044-2048	341,052	361,052	341,052	366,554	476,732	496,732
2049-2053	413,916	393,916	413,916	444,519	476,732	496,732
2054-2058	523,212	523,212	523,212	561,466	605,184	616,732
2059-2063	659,832	659,832	659,832	659,832	826,732	936,732
2064-2068	830,607	830,607	830,607	830,607	1,076,732	936,732
2069-2073	936,732	1,036,732	936,732	936,732	1,076,732	1,076,732
2074-2078	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2079-2083	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2084-2088	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2089-2093	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2094-2098	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2099-2103	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2104-2108	936,732	1,036,732	936,732	936,732	1,076,732	1,176,732
2109-2115	976,732	1,176,732	976,732	976,732	1,076,732	1,176,732
2116-2125	976,732	1,176,732	976,732	976,732	1,076,732	1,176,732
2126-2135	1,076,732	1,296,732	1,101,732	1,076,732	1,126,732	1,296,732
2136-2145	1,076,732	1,296,732	1,101,732	1,076,732	1,126,732	1,296,732
2146-2155	1,176,732	1,296,732	1,201,732	1,176,732	1,176,732	1,311,732
2156-2165	1,176,732	1,296,732	1,201,732	1,176,732	1,176,732	1,311,732
2166-2175	1,176,732	1,296,732	1,201,732	1,176,732	1,176,732	1,311,732
2176-2185	1,176,732	1,296,732	1,201,732	1,176,732	1,176,732	1,311,732
2186-2195	1,176,732	1,296,732	1,201,732	1,176,732	1,176,732	1,311,732
2196-2205	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732
2206-2215	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732
2216-2225	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732
2226-2235	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732
2236-2245	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732
2246-2255	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732
2256-2265	1,226,732	1,296,732	1,251,732	1,226,732	1,226,732	1,311,732