Appendix 1 – Type 2 Information Package

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Dunkley Lumber Ltd.

Tree Farm Licence #53
Strategic Silviculture Analysis
Information Package
June 2001 (Edited April 2002)

A project submitted by: Forest Ecosystem Solutions Ltd.
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TFL #53 Strategic Silviculture Analysis
Information Package

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1 Introduction

Dunkley Lumber Ltd and the Ministry of Forests (Prince George Forest Region) have initiated the development of a Type 2 Forest Level Silviculture Strategy for Tree Farm Licence (TFL) 53. This information package documents the procedures, assumptions, data and model used in the analysis. Forest Ecosystem Solutions Ltd. (FESL) has been engaged to prepare the information package and conduct the Type 2 analysis. While not as detailed as an information package for a timber supply analysis, this package will utilize where appropriate the format and requirements within the *Provincial Guide for the Submission of Timber Supply Information Packages for Tree Farm Licences, Version 3*.

The purpose of this information package is to:

- Provide a mechanism for communication of technical analysis issues prior to undertaking the Type 2 analysis;
- Provide an opportunity for Dunkley Lumber Ltd., the MoF, and participants to review those technical issues and assumptions that will be used in the preparation of the Type 2 analysis;
- Create a dynamic document which, over time, will ensure that all relevant information is accounted for appropriately in the Type 2 analysis; and
- Increase the efficiency of the Type 2 analysis process by reducing the risk of having analyses discarded due to inappropriate content.

Spatial data was delivered to FESL by Spatial Mapping Ltd. Forest cover data was provided by Chartwell Consultants Ltd. and was updated to January 2001. A complete description of the data inputs is included in Section 2.2.

All data summarized in this package uses spatial GIS data and forest inventory polygon (FIP) labels, allowing all Forest Simulation Optimization System (***FSOS***) analyses to be spatially and temporally referenced. ***FSOS*** will be used to assess silviculture strategies for TFL 53 over a 200 year planning horizon.

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2 Process

The Type 2 Strategic Silviculture Analysis for TFL 53 is directed through the project contract.

This information package is the first of two reports produced for the Type 2 project. The second report will be the analysis report.

The background information that guided the assumptions and processes employed in this information package includes, but is not limited to, the following reports:

- *Dunkley Lumber Ltd. Tree Farm Licence #53 – Timber Supply Analysis Information Package, December 1998.*
- *Dunkley Lumber Ltd. Tree Farm Licence #53 – Timber Supply Analysis Report.*
- *Dunkley Lumber Ltd. Tree Farm Licence #53 – Management Plan #3 for the period January 2001 – December 31, 2004.*
- *Incorporating Biodiversity and Landscape Units in the Timber Supply Review*
- *Timber Supply Review Base Case Modeling Assumptions for Biodiversity and Landscape Units*
- *Tree Farm Licence Information Package Guidelines*
- *Request for Proposals – Development of Type 2 Forest Level Silviculture Strategies (July 27, 1999)*

2.1 Growth and Yield

Benchmark growth and yield information is generated using the variable density yield prediction (VDYP) and the table interpolation program for stand yields (TIPSY) developed by the BC Ministry of Forests (MoF). VDYP is used to generate yield curves for all naturally established stands while TIPSY is used to estimate timber volumes for managed stands.

The MoF Research Branch developed growth and yield information for the intensive silviculture regimes using the Tree and Stand Simulator (TASS).

2.2 Data Preparation and Missing Data

Spatial Mapping Ltd provided most of the spatial source data for this analysis. Forest Ecosystem Solutions Ltd. assessed this data and used it with the following exceptions:

Forest cover information was provided by Chartwell Consultants Ltd. and was updated to January 2001.

The Timber Supply Review (TSR) 2 analysis for Management Plan #3 used environmentally sensitive areas (ESA) information associated with forest cover polygons. For this analysis, Dunkley Lumber Ltd. chose to utilize terrain stability information assembled in 1994. The Terrain Stability Mapping data was provided spatially in IGDS (Microstation) format as individual 1:20,000 scale BCGS mapsheets, and non-spatially as individual dbase files. Forest Ecosystem Solutions Ltd. translated the data into Arc/Info format, and produced a seamless Terrain Stability Mapping coverage for the entire TFL #53 to replace the forest cover ESA information.

Dunkley Lumber Ltd. directed Forest Ecosystem Solutions Ltd. to integrate an updated Visual Quality Objective (VQO) coverage that is based on an inventory carried out between August and December of

1997 by Timberline Forest Inventory Consultants, Prince George. Spatial Mapping Ltd. provided the updated VQO data in IGDS format (spatial data only). Forest Ecosystem Solutions Ltd. re-digitized some missing polygons and prepared a VQO database from the information provided on the hardcopy maps.

Forest Ecosystem Solutions Ltd. created riparian reserve and management areas based on criteria published in Management Plan #3. Because of different processing methodologies employed for the TSR 2 analysis and by Forest Ecosystem Solutions Ltd., the riparian reserve and management zone areas are somewhat different.

Forest Ecosystem Solutions Ltd. created road buffers as well. Again, the road buffer coverage used for this analysis was slightly different from the coverage used for the TSR 2 analysis, mostly because the road network had been updated.

Spatial Mapping Ltd. also provided data relating to the 2001-06 Five-Year-Development Plan. Wildlife Tree Patches (WTP) and approved, proposed and small business blocks were extracted from the Five-Year-Development Plan and incorporated into the analysis.

3 Analysis and Scenario Planning

3.1 Analysis Methods

The objective of the Type 2 analysis is to meet forest-level objectives using incremental silviculture treatment regimes. Through forest level modeling using ***FSOS***, the variety of treatments can be considered in light of their ability to satisfy forest-level objectives. A single treatment at the stand level may result in a yield improvement; however, at the forest level this treatment may be a poor investment when considered together with all other investments, budgets and objectives. Conversely, a treatment at the stand-level that does not represent a significant benefit may in fact be an important action to satisfy an objective at the forest-level.

Stand management options or treatment regimes describe a series of silviculture actions that are possible for a given stand type. Each treatment within the regime occurs in a sequential order and has an associated set of costs, values, employment levels, and timber quality and quantity impacts at a given point in time.

FSOS will determine the appropriate treatment regime for each stand following harvest or for those stands that were previously harvested and are still eligible for treatment. Each regime provides a timeframe of treatments, including harvesting and stand development. Following harvest, the regenerated stand may follow the same treatment regime, transform to another regime or receive no treatment at all based on decisions of costs and overall satisfaction of objectives.

A number of forest-level scenarios will be developed and analyzed. These scenarios are designed to move gradually toward a preferred option. This process allows for the impacts of changes made between scenarios to be more easily interpreted. The final step in the process is the development of the preferred option, where the analysis results and interpretation from the previous scenarios are synthesized into one preferred silviculture strategy. This approach presents a sequential and iterative process of analysis - each step providing insight, understanding and direction for the next.

3.2 Scenarios

The development of a strategic silviculture plan is not an easy process. A variety of stand- and forest-level objectives or desired future outcomes, elaborate stand treatment regimes, and long time horizons create complexity in forest dynamics.

Scenario planning helps to understand those significant issues that control future outcomes by simplifying the complex interactions. Scenarios are developed to test options through sensitivity analysis or alternatively can be based on individual management interests and questions. This allows the forest managers to develop management decisions based on a better understanding of the consequences of proposed regimes and their interactions.

Each scenario result describes the silvicultural and forest-level outcome for the management approach defined in that scenario. The scenarios are assessed and presented individually. The preferred silvicultural strategy may be composed of elements of some or all of the other scenarios.

Key items that are assessed within each scenario are the response of important indicators (e.g., timber supply), similar trends across scenarios, tradeoffs between scenarios, and short- and long-term variations.

Both simulation and heuristic analysis techniques will be used in the TFL 53 analysis. Table 1 provides a summary of different analysis scenarios.

Table 1: Analysis Scenarios

Scenario	Title	Scenario Description
1	Benchmark	▪ Simulation ▪ Recreation of TSR 2 supplemental analysis run A.1. ▪ Includes genetic improvement for spruce from 1998 on.
2	No Stand Tending	▪ Simulation ▪ Compares to Scenario 1. ▪ Uses regeneration delay to reflect impacts of not undertaking past and future treatment of backlog NSR.
3	Silviculture Strategy Base Case	▪ Optimization ▪ Serves as starting point for all subsequent silviculture strategy runs. ▪ TASS curves replace TIPSY curves from Scenario 1. ▪ Low biodiversity emphasis applied everywhere. ▪ Otherwise follows Scenario 1 assumptions.
4	Road Rehabilitation	▪ Optimization ▪ Compares to Scenario 3. ▪ $500,00 budget. ▪ Investigates opportunity to increase harvest flows through expenditures on road rehabilitation.
5	Fertilization	▪ Optimization ▪ Compares to Scenario 3. ▪ $500,000 budget. ▪ Investigates opportunity to increase harvest flows through expenditures on fertilization.
6	Commercial Thin	▪ Optimization ▪ Compares to Scenario 3. ▪ Commercial thinning modeled as cost-recovering (i.e. no budget). ▪ Investigates opportunity to increase harvest flows through commercial thinning in VQO zones.
7	Volume Impact	▪ Optimization ▪ Compares to Scenario 3. ▪ Budget levels: - $1,000,000 - $500,000 - $250,000 ▪ Investigates opportunity to increase harvest flows by use of road rehabilitation and fertilization in combination.
8	Preferred	▪ Optimization ▪ Compares to Scenario 3. ▪ Budget level and treatment options are selected based on analysis of results of Scenarios 3 – 7.

3.2.1 Benchmark (Scenario 1)

This scenario uses Dunkley's TSR 2 base case assumptions and serves as a benchmark between this analysis and TSR 2. Re-creating the TSR 2 base case makes it possible to evaluate the model's performance as well as monitor differences between this analysis and TSR 2.

The benchmark includes some genetic improvement as in TSR 2. Between 1982 and 1997, approximately 20% of seedlings planted were from improved seed and Dunkley intends to use improved seed for all spruce reforestation in the year 2000 and beyond. Therefore, the expected genetic worth of 18% was applied to TIPSY yield volumes for spruce beginning in 1998 to reflect past and future use of genetically improved stock.

The TSR 2 base case applied landscape biodiversity forest cover constraints at the NDT level. A supplemental analysis was performed to test the application of these constraints at the BEC variant level. It was decided that this analysis should follow the latter method; thus Scenario 1 is a recreation of supplemental analysis run A.1.

3.2.2 No Stand Tending (Scenario 2)

This scenario investigates the impact that historical and future stand tending has had on the current forest condition, specifically what harvest volumes would be if past and future backlog treatments had not been undertaken. First, all past and current backlog areas will be removed from the THLB. If no timber supply impact results from the removal of these areas no further analysis will be done. However, if there is an impact on harvest volume resulting from this removal, a run will be performed where the volume of the backlog stands is adjusted by increasing the regeneration delay. Guidance for the selection of regeneration delays will come from the Ministry of Forest, Forest Practices Brach report *Worksheets for Assessing Backlog Treatment Costs Relative to Expected Gains* (May, 2001).

3.2.3 Silviculture Strategy Base Case (Scenario 3)

This scenario uses assumptions as per the benchmark (Scenario 1) with two exceptions. First, TASS curves replace TIPSY curves for managed stands. Second, low biodiversity emphasis is applied to all three NDT groups by BEC variant as opposed to the 45/45/10 split between low, intermediate, and high in the benchmark. This change reflects the draft biodiversity emphasis of TFL 53. The Silviculture Strategy Base Case includes no incremental silviculture treatments and serves as the base case for all subsequent incremental silviculture scenarios (Scenarios 4 – 10).

3.2.4 Road Rehabilitation (Scenario 4)

This scenario explores the impact of road rehabilitation within the TFL as intended through Dunkley's access management plan. In this scenario the model has the option to spend some or all of a silviculture budget of $500,000 to rehabilitate on-block roads and add their area back to the THLB. As the access management plan was not available spatially at the time of this analysis, the rehabilitation of roads is modeled non-spatially; that is, as a percent addition to the land base rather than the addition of the specific geographic areas.

3.2.5 Fertilization (Scenario 5)

This scenario explores the opportunity for fertilization treatments to increase timber volumes. A budget of $500,000 is available for fertilization of stands in appropriate analysis units.

3.2.6 Commercial Thin (Scenario 6)

This run explores the possibility of increasing harvest volumes by using commercial thinning in areas with constraints for visual quality. Commercial thinning can be used to obtain harvest volume while maintaining adequate tree cover to fulfill visual quality objectives. For the purposes of this analysis commercial thinning is assumed to be cost recovering; that is, it is modeled as having zero net cost.

3.2.7 Volume Impact Scenarios (Scenarios 7, 8, and 9)

This set of runs investigates the opportunity for increasing timber volume though road rehabilitation and fertilization treatments. Scenarios 7, 8, and 9 have available silviculture budgets of $250,000, $500,000, and $1,000,000, respectively. The model can choose to spend the budget on road rehabilitation, fertilization, or any combination of the two treatments to produce volume gains.

3.2.8 Preferred Scenario (Scenario 10)

The results of the incremental silviculture scenarios (Scenarios 4 – 9) as they compare to the Silviculture Strategy Base Case (Scenario 3) will be used to design this Preferred Scenario. Effective treatments and budget levels will be selected based on the outcomes of the Scenarios 4 – 9.

3.3 Analysis Assumptions

1. "Normal" market conditions will prevail for demand and prices for timber and fibre.

2. Current Forest Practices Code requirements are maintained throughout the planning horizon.

3. MoF timber supply concepts and harvest flow rules are followed (maintain current harvest as long as possible with reasonable declines in the future - 10%/decade). No patch objectives are applied to this analysis on seral requirements.

4. Specific levels of precision are used in the optimization analysis are as follows:
   - +/- 10% change in timber flow between decades.
   - Silviculture investment not to exceed maximum budget level by more than 10%.
   - Maximum 5% tolerance around age-class targets specified in TSR 2 for optimization to allow for smooth transition strategies to be achieved without impacting timber flows.

4 Model

The following software were used in the preparation of the strategic silviculture analysis and data package for TFL 53:

- ***FSOS*** time-step simulation model and ***FSOS*** forest estate optimization model;
- MoF Variable Density Yield Program (VDYP);
- MoF Table Interpolation Program for Stand Yields for Microsoft Windows (WinTIPSY).
- MoF Tree and Stand Simulator (TASS)

4.1 Landscape Design Model - *FSOS*

Model Name: ***FSOS***
Model Developer: Guoliang Liu
Model Development: Hugh Hamilton Limited and UBC
Model Type: Landscape Design Model

Description:
Forest Ecosystem Solutions Ltd. combines the power of advanced computer modeling techniques and GIS tools with expert professional experience. At the centre is a landscape optimization model called ***FSOS*** (Forest Simulation Optimization System). The model uses C++ programming language and can be run with both Windows '98 and Windows NT operating systems. The model interfaces directly with Microsoft Access for data management. The Timber Supply Branch of the MoF accepted the use of FSOS for timber supply analysis in August 1998. ***FSOS*** uses dynamic heuristic and simulation techniques to schedule harvest units based on 1) patch and seral objectives defined by non-timber (e.g. old-growth, biodiversity, visuals, habitat, watershed, etc.) resource values and 2) timber management objectives (e.g. even flow, volume levels, opening size distribution, species quotas). Harvest and approximate cut block shape and size over the planning horizon are an output of the model. Modeling of strict adjacency and seral constraints is accomplished using simulation modeling. The data structure is identical for both heuristic and simulation models, which prevents extensive data loading procedures when switching between techniques.

FSOS uses the multiple resultant polygons created by GIS overlay as the basic model unit, allowing great flexibility in creating a variety of potential harvest unit configurations by amalgamating these resultant polygons. Amalgamations of the harvest units through time create early seral openings and mature and old growth patches consistent with planned patch management strategies defined by higher level plans. Managing for specific patch size distributions within each seral class is also inherent within the model framework and is an extremely effective way to meet long-term biodiversity objectives. High weightings can be applied to relatively important resource objectives or objectives which are difficult to achieve. The objective function (evaluation equation) provides the means to evaluate the relative "success" between differing solutions. For each iteration, the model calculates a "penalty" based on the deviation of a given solution from the target values. Optimal solutions achieve targets quickly for highly weighted parameters in order to minimize the total "penalty" over the planning horizon. With optimization, "constraints" can be violated. As all resource values are tracked throughout the planning horizon, where and when this occurs is part of the model output.

The initial inventory data represents the gross land base, which includes both operable and inoperable areas and the contributing and non-contributing timber harvesting land base. This is required as inoperable and other reserve areas contribute to the achievement of non-timber objectives. From GIS overlay, the land base is divided into resultant polygons, each with a unique set of attributes. Treatments are applied to each polygon based on these attributes. Analysis unit, forest type, forest age, silvicultural treatment, user allocation, site index, non-timber resource objectives or any other parameter can define treatment type and regime.

FSOS uses individual stand ages to project the current age structure of stands in the analysis area. As stands age, they move into and out of age classes established as a basis for meeting target objectives. For example, age classes may be established as ≤40 yrs, 41-120 yrs, 121-250 yrs, and >250 yrs.

The planning horizon length can vary as required. ***FSOS*** can produce spatially and temporally explicit plans over 20 years or for multiple rotations. A unique feature of ***FSOS*** is its ability to integrate strategic, tactical and operational planning phases into one process. Analysis runs include harvest timing and location for each period, as well as long-term, sustainable harvest levels.

Harvest rules that are used in ***FSOS*** are:

- Minimum stand age before a stand can be harvested;
- Maximum stand age, at which the stand is scheduled for cutting within a certain number of years (i.e. 10);
- Green-up period required before adjacent patches can be harvested (this is not between openings but between patches. Patch size in early seral can reflect desired cut block size distributions).

A range of priorities can also be applied to include the following:

- Stands at risk from fire, disease or insects;
- Species preferences to meet mill requirements;
- Opening size distribution;
- Piece size requirements;
- Silviculture investment;
- Even volume flow; and
- Minimize transportation costs.

The reporting functions of ***FSOS*** are extensive. The data for each period is easily accessible for any analysis unit, zone, polygon, landscape unit, etc. and gives an overview of the forest state at any point in time. Species compositions, age structure, patch distribution, harvest scheduling, treatment cost, product values and many other variables are tracked and reported by period. Reporting functions are highly effective for the direct comparison of sensitivity analysis and scenario options. ***FSOS*** is linked directly to the powerful ArcView environment for the easy production of high-quality maps.

Updates to the land base can be applied by two methods. Changes to applied net downs occur in the database framework by reapplying net down percentages. Changes to layer boundaries or additions or subtractions from the land base require the data be altered in the G.I.S. environment.

Although it is possible to use height as a target definition, cover targets are usually applied by age as a surrogate for height. Using patch and age class distribution indicators can achieve all cover targets. Age class distribution targets can be set as minimums, maximums, or desired levels. For example, wildlife habitat cover requirements may be achieved by having 70% of the management zone greater than 100 years of age.

Some other capabilities of ***FSOS*** include:

- Negative ages;
- Multiple constraints (guidelines) by unit, zone or group;
- Yearly age distribution;
- Volume Operational Adjustment Factors (OAFs) and land OAFs;
- Equivalent Clearcut Area curve constraints;
- Spatial and temporal referencing of neighbouring polygons;
- Multi-species stands;
- No maximum planning horizon;
- Opening size distribution;
- Timber flow management;
- Landscape metrics options; and
- Economic indicators.

5 Forest Inventory

Spatial data was provided in two data formats: Arc/Info and IGDS. If data was presented in IGDS format, Forest Ecosystem Solutions Ltd. translated the data into Arc/Info format. All data is projected to UTM, Zone 10, North American Datum (NAD) 83.

Chartwell Consultants Ltd. (formerly Hugh Hamilton Limited) provided an updated forest cover. The forest inventory conforms to Ministry of Forests standards. The update is to January 2001 for disturbances, and also includes a site index adjustment for stands identified as having an incorrect site index in Management Plan #3. This site index adjustment is a separate procedure from the SIBEC adjustment described in Section 8.1.1. Since completion of the management plan and timber supply analysis, an update to Dunkley's forest cover inventory was completed. This included a site index update for these areas identified as having an incorrect site index. For the SIBEC adjustment, site series information was obtained from J.S. Thrower and Associates. For further information, refer to the TSR 2 information package, Chapter 5: Current Forest Cover Inventory.

6 Description of Land Base

Determination of the timber harvesting land base (THLB) results from a sequential procedure where stands ineligible for harvest due to poor stand quality, non-merchantable species, specific geographical or management reductions, or site sensitivity are systematically removed from the land base. Although portions of the land base are reserved from harvesting, their attributes within forested crown land still contribute to forest cover objectives. The netdown procedure for the strategic silviculture analysis followed that of TSR 2.

6.1 Timber Harvesting Land Base

The netdown procedure is an exclusionary process. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area removed is often greater than the net area removed, a result of overlapping resource issues. Table 2 presents the netdown procedure for the Strategic Silviculture Analysis as it compares to that of the TSR 2 analysis.

Table 2: Timber Harvesting Land Base determination

Classification	Type 2 Netdown Area (ha)	TSR 2 Netdown Area (ha)
Total Land base:	**87,660.4**	**87,660.7**
Not directly managed by B.C. Forest Service	33.2	0.0
Non-forest	4,825.3	4,881.0
Non-productive	1,487.3	1,462.0
Total Productive Forest	**81,314.6**	**81,317.7**
Reductions to Total Productive Forest:		
Non-commercial cover	329.8	330.3
Environmentally sensitive areas	1,798.4	1,366.3
Recreation sites	192.8	160.2
Legislated lakeshore reserves	293.0	70.5
Legislated wetland reserves	772.3	322.2
Stream riparian reserves	1,769.4	1,856.8
Wetland management zones	671.2	229.3
Stream riparian management zones	1,558.9	1,362.6
District policy lake management area	45.8	233.8
Low productivity sites	817.7	539.1
Problem forest types	3,025.3	3,422.4
Existing roads, trails, and landings	1,412.1	1,281.9
Plantations with incorrect site index	42.6	733.7
Not Satisfactorily Restocked	1,295.5	1,451.7
Total Reductions to Productive Forest	**14,024.8**	**13,360.8**
Net Land Base	**67,289.8**	**67,956.9**
Additions to Net Land Base:		
Not Satisfactorily Restocked	1,295.5	1,451.7
Plantations with incorrect site index	42.6	733.7
Current Timber Harvesting Landbase	**68,627.9**	**70,142.3**
Future Reductions:		
Future Roads (1.09% of current timber harvesting landbase)	748.0	764.5
Long-Term Timber Harvesting Land Base	**67,879.9**	**69,377.8**

6.2 Total Area

The total area in TFL 53 (including water) is 87,660.4 hectares.

6.3 Not Managed by B.C. Forest Service

A total of 33.2 hectares of private land is removed from the THLB. In the TSR 2 analysis, this area was removed as non-forest area.

6.4 Non-forest

A total of 4,825.3 hectares was removed as non-forest area. Non-forest information was derived from the forest inventory file as Type Id #6 and details of the reductions are provided in Table 3 below.

Table 3: Reductions for non-forest areas

Description	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Rock	6.4	6.3
Clay Bank	5.0	5.0
Lake	1,740.0	1,740.4
Gravel Pit	2.3	0.0
Gravel Bar	1.5	2.3
River	64.7	64.7
Swamp	2,881.2	2,905.2
Clearing	24.1	26.9
Urban	100.1	130.2
Total	***4,825.3***	***4,881.0***

6.5 Non-productive Forest

A total of 1,487.3 hectares was removed from the THLB as non-productive forest. Non-productive forest areas are defined as being incapable of supporting commercial forests. These areas are identified in the forest inventory file as Type Id #5 and include alpine forest, non-productive brush, and non-productive areas. Details are provided in Table 4 below.

Table 4: Reductions for non-productive areas

Description	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Alpine Forest	26.5	26.6
Non-productive Brush	693.6	666.2
Non-productive	767.2	769.2
Total	***1,487.3***	***1,462.0***

6.6 Inoperable/Inaccessible

There are no areas within TFL 53 that are currently inoperable or inaccessible other than areas removed through ESA reductions (Section 6.8). Economic viability is addressed through reductions for low productivity sites (Section 6.12) and problem forest types (Section 6.16).

6.7 Non-commercial Cover

A total of 329.8 hectares are removed as non-commercial cover. This is defined as areas that are potentially productive but not currently supporting forested stands and identified in the inventory file using Type Id #5.

Table 5: Reductions for non-commercial cover

Description	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Non-commercial Brush	329.8	330.3

6.8 Environmentally Sensitive Areas

In the TSR 2 analysis, environmentally sensitive area reductions were derived from the forest cover information and totalled 1,366.3 hectares. For this analysis, these areas were identified from the terrain stability mapping information. All areas of Terrain Stability Class 5 were removed from the THLB. An area reduction of 16% was applied to all areas of Terrain Stability Class 4. Dunkley calculated these reductions by reviewing historical operations in their terrain stability class 4 and 5 areas.

Table 6: Reductions for Environmentally Sensitive Areas defined by stability class

Description	***Total Area (ha)***	***Commercial Forest Area (ha)****	***Reduction Percent***	***Netdown Area (ha)***
Stability Class 4	3,208.4	3,147.4	16	503.6
Stability Class 5	1,326.4	1,294.8	100	1,294.8
Total				***1,798.4***

* This represents areas of terrain stability class 4 or 5 that have not already been subtracted through an earlier step in the netdown procedure.

6.9 Recreation Sites

Recreation sites were identified in a GIS coverage provided by Spatial Mapping Ltd. and 192.8 hectares were removed from the THLB to account for them.

Table 7: Reductions for recreation sites

Description	***Netdown Area (ha)***
Ahbau Lake	134.7
Genevieve Lake	7.1
Naver Creek	4.1
Stony Lake	22.1
Teapot Lake	24.8
Total	***192.8***

6.10 Lakeshore and Wetland Reserve and Management Zones

Lakeshore and wetland reserve and management zones were derived using GIS buffering following procedures described in the TSR 2 information package; however, slight differences existed between the buffering processes used in the TSR 2 analysis and this analysis. As a result, more area was removed for lakeshore and wetland reserve and management zones in this Type 2 analysis.

Table 8: Reductions for lakeshore and wetland reserves and management zones

Description	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Lakeshore Reserve Zones	293.0	70.5
Lakeshore Management Zones	45.8	233.8
Wetland Reserve Zones	772.3	322.2
Wetland Management Zones	671.2	229.3
Total	***1,782.3***	***855.8***

6.11 Steam Riparian Reserve and Management Zones

As with lakeshores and wetlands, stream reserve and management zones were derived using GIS buffering following procedures described in the TSR 2 information package. Again, a different buffering procedure resulted in more areas being removed for stream riparian reserve and management zones than in the TSR 2 netdown procedure.

Table 9: Reductions for stream riparian reserve and management zones

Description	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Stream Riparian Reserves	1,769.4	1,856.8
Stream Riparian Management Zones	1,558.9	1,362.6
Total	***3,328.3***	***3,219.4***

6.12 Low Productivity

Low productivity sites are identified using the criteria applied in the TSR 2 analysis. Table 10 describes these criteria by species used to identify these sites as well as the area subtracted from the THLB for each. Reductions for low productivity, as well as reductions for problem forest types (Section 6.16) are used to identify and remove non-merchantable stands.

Table 10: Reductions for areas of low productivity

Timber Type	***Site Index***	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Fir	≤ 8.8	6.5	0
Balsam	≤ 7.8	361.1	167.2
Spruce	≤ 7.5	294.2	247.6
Spruce/Pine	≤ 7.5	73.3	65.0
Spruce/Deciduous	≤ 7.5	0.0	0.0
Pine	≤ 7.8	40.3	53.0
Pine/Spruce	≤ 7.8	37.3	0.0
Pine/Deciduous	≤ 7.8	0.0	0.0
Deciduous Leading	≤ 7.5	5.0	6.3
Total		***817.7***	***539.1***

6.13 Wildlife Habitat Reductions

As in the TSR 2 analysis, wildlife habitat management is achieved through constraints applied for biodiversity, adjacency, and integrated resource management. There are no known wildlife habitat features that require area deductions within the TFL.

6.14 Cultural Heritage Resource Reductions

There are no known cultural heritage resources within the TFL.

6.15 Other Sensitive Site Reductions

There are no known “other sensitive sites” on the TFL.

6.16 Problem Forest Types

Problem forest types are stands which exceed low site criteria and are physically operable but are removed from the THLB as they are considered too old, too short, and/or of too small a diameter. Changes in timber value, timber availability, and sawmill requirements may change the reduction of these areas in the future. Reductions for problem forest types followed the procedure described in the TSR 2 information package. These criteria and areas reduced to account for problem forest types are provided in Table 11 below.

Table 11: Reductions for problem forest types

Species	*Inventory Type Group*	*Age/Height/Stocking*	*Reduction %*	*TYPE 2 Total Area*	*TYPE 2 Net Area Reduction*	*TSR 2 Total Area*	*TSR 2 Net Area Reduction*
Fd	1 – 8	Age Class ≥ 7 Height Class = 2 Stocking	100	0	0	23.3	23.3
C, H	9 – 17	All	100	0	0	0	0
B	18 – 19	Age Class ≥ 6 and [Height Class = 2 or	100	963.1	752.1	944.4	824.3
Bl	20	Age Class ≥ 6 Height Class	100	1188.5	1,034.8	1,247.4	1,157.4
S	21 – 26	Age Class ≥ 7 Height Class = 2 Stocking	100	144.1	9.5	45.3	27.3
Pl	28 – 31	Age Class ≥ 5 Height Class = 2 Stocking	100	166.5	8.9	280.4	109.8
Ac, Dr, Mb,	35 – 39, 42	All	100	1100.4	946.2	1,101.6	1,014.3
Ep	40	All	100	297.3	273.8	290.0	266.0
Total					***3,025.3***		***3,422.4***

6.17 Roads, Trails, and Landings

Roads, trails and landings were identified and removed from the land base as per the TSR 2 information package. Table 12 provides the buffers applied to roads by road class in GIS and Table 13 provides the area reductions for roads, trails, and landings.

Table 12: Buffer widths by road class

Road Class	*Buffer Width (m)*
Forest Service Road	20.9
Primary Operational	20.9
Secondary Operational	12.2
On-block	4.3

Table 13: Reductions for existing roads, trails and landings

Description	*TYPE 2 Netdown Area (ha)*	*TSR 2 Netdown Area (ha)*
Roads, Trails, and Landings	1,412.1	1,281.9

6.18 Plantations with Incorrect Site Index

A site index adjustment included in the forest cover information eliminated much of the area with incorrect site index identified in TSR 2. The remaining area (42.6 hectares) is identified based on the criteria defined in TSR 2 and is added back to the timber harvesting land base. These 42.6 hectares represents net area; that is, all necessary reductions such as reductions for ESA's, recreation, etc has been completed and 42.6 hectares is added back to the THLB.

6.19 Not Satisfactorily Restocked

The net area of Not Satisfactorily Restocked (NSR) is 1,295.5 hectares. Of this, 406 hectares are current NSR (harvested after 1987) and 889.5 hectares are backlog NSR (harvested prior to 1987). As in the TSR 2 analysis, backlog NSR is assumed to be treated and completely eradicated over the next decade.

Table 14: Not Satisfactorily Restocked areas

Description	***TYPE 2 Netdown Area (ha)***	***TSR 2 Netdown Area (ha)***
Current NSR	406.0	269.3
Backlog NSR	889.5	1,182.4
Total	***1,295.5***	***1,451.7***

7 Inventory Aggregation

Inventory aggregation is a process of simplifying the landscape into similar units. It identifies management zones or resource emphasis areas for the application of unique forest cover and spatial structure requirements, as well as for the application of growth and yield information. The aggregation must recognize both the similarities and differences in forest stand productivity as well as management objectives and prescriptions. This section describes the criteria and rationale behind the aggregation in this analysis.

7.1 Management Zones

Management zones are geographically referenced areas that require unique management considerations. Areas requiring the same management regime or the same forest cover requirements are grouped into management zones. Table 15 lists the management zones in the TFL and the rationale used to define these zones.

Multiple resource issues may be present on the same forest area. For example, the watershed management zone may also have areas, which are visually sensitive and require an old growth objective. ***FSOS*** can accommodate multiple overlapping resource layers by establishing target levels for each layer. The model then schedules harvest units and/or treatments, which best meet the target levels for all resource layers simultaneously.

Table 15: Management zones

Management Zone	Criteria used to Delineate Zone	Applied Areas
IRM Zone	THLB area without visual quality constraints	Timber harvesting land base
Visually Sensitivity		Total forested area
Preservation	PVQO	
Retention	RVQO	
Partial Retention	PRVQO	
Modification	MVQO	
Maximum Modification	MMVQO	
BEC Variants:	.	Total forested area by BEC variant
ESSF wk1	Low emphasis biodiversity forest cover constraints are applied with draw down as per the biodiversity guidebook.	
SBS wk1		
SBS dw		
SBS mk		
SBS mw		

7.2 Analysis Units

Table 16 lists the principal criteria used in the aggregation of stands with similar biological characteristics into larger homogeneous units called analysis units (AUs). This aggregation provides the mechanism for application of stand-level modeling and reporting. Each forest cover polygon was assigned to an AU based on the criteria in Table 16.

Table 16: Analysis Units

AU	Species & Site Class	Inventory Type Group	SI Range
1	Fir	1, 4, 5, 8	>8.8
2	Balsam good	18, 20	>16
3	Balsam medium	18, 20	>13 and ≤16
4	Balsam poor	18, 20	>7.8 and ≤13
5	Balsam IU*	18, 20	All
6	Spruce good	21, 22, 24	>18
7	Spruce medium	21, 22, 24	≥14.6 and ≤18
8	Spruce poor	21, 22, 24	>7.5 and <14.6
9	Spruce/Pine good	25	>20
10	Spruce/Pine medium	25	≥14.6 and ≤20
11	Spruce/Pine poor	25	>7.5 and <14.6
12	Spruce/deciduous good	26	>18
13	Spruce/deciduous medium/poor	26	>7.5 and ≤18
14	Pine good	28	>20
15	Pine medium/poor	28	>7.8 and ≤20
16	Pine/Spruce good	29, 30	>16
17	Pine/Spruce medium/poor	29, 30	>7.8 and ≤16
18	Pine/deciduous good	31	>16
19	Pine/deciduous medium/poor	31	>7.8 and ≤16
20	Aspen conifer	7.5 +	>7.5

* Historic intermediate utilization logging.

For purposes of comparison Table 17 provides the net area for each analysis unit and the average SI for the Type 2 and MP3 TSR analysis.

Table 17: MP3 TSR and Type 2 Analysis Unit net areas and average SI

AU	Species & Site Class	Type 2 Net Area	TSR Net Area	Type 2 Mature SI	TSR Mature SI	Type 2 Imm. SI	TSR 2 Imm. SI	Type 2 Future SI	TSR Future SI
1	Fir	1285.0	1305.5	21.6	21.1	17.9	20.7	21.2	20
2	Balsam good	943.7	607.6	19.1	18	n/a	n/a	20.3	17.6
3	Balsam medium	1934.4	1736.2	14.4	14.4	n/a	n/a	14.9	17.7
4	Balsam poor	3373.4	3422.9	11.4	11.2	n/a	n/a	11.4	17.6
5	Balsam IU*	1535.5	1819.5	13.8	13.6	n/a	n/a	14	18.5
6	Spruce good	13881.8	10074.3	20.3	19.8	20.1	19.7	20.2	19.6
7	Spruce medium	7835.3	10553.7	16.4	15.8	16.1	18.7	16.3	19.1
8	Spruce poor	6708.7	7910.7	12.2	12	11.7	18.4	12.4	19
9	Spruce/Pine good	3461.2	3055.3	22.3	22.2	23.1	19.1	22.4	19.2
10	Spruce/Pine medium	5150.3	5617.9	17.8	17.3	19.3	19.4	18.6	19.4
11	Spruce/Pine poor	914.6	831.3	12.4	12.4	11.1	21	12.2	19.2
12	Spruce/deciduous	2634.4	2039.1	21	20.2	20.1	19.7	20.6	19.6
13	Spruce/deciduous medium/poor	261.0	1547.1	17.1	15.3	15.3	19.4	16.6	19.5
14	Pine good	5106.8	4187.5	23	23	21.5	20.3	22.7	20.6
15	Pine medium/poor	1756.6	2390.6	17.5	17.8	16.7	21.1	17.3	19.9
16	Pine/Spruce good	8673.1	7437.1	21.7	21.3	21.5	20.4	21.7	20.7
17	Pine/Spruce	708.5	1967.1	13.8	15.5	14.3	20.2	14	20.2
18	Pine/deciduous good	1019.9	905.4	21.3	21	21.1	19.6	21.2	21.3
19	Pine/deciduous medium/poor	32.5	164.8	13.8	15.6	13.9	19	13.9	19.7
20	Aspen conifer	1411.3	1117	18.9	19.2	n/a	n/a	19.1	17.4
	Total Area	68,628	68,691						

8 Regeneration Assumptions

Within the strategic silviculture analysis there are two levels of regeneration assumptions. Scenarios 1 and 2 regenerate to TIPSY curves as in the TSR 2 analysis. All other scenarios regenerate to TASS curves as TASS is the program used to generate the silviculture treatments regimes.

8.1 Yields for Base Case Managed Stands

This section describes the current regeneration assumptions (i.e. conditions for managed stands) as consistent with TSR 2.

The assignment of existing managed immature stands is separated into three groups. Table 18 below is adapted from the TSR 2 information package and describes these groupings.

Table 18: Existing managed regenerated yield tables.

Logging History	Analysis Units	Regenerated Yield Curve	Rationale
Prior to 1972	1 - 20	VDYP	IU logging
1973 – 1997	22 - 40	TIPSY	Basic silviculture
1998+	101 - 120	TIPSY + (genetic gain)	Plant genetically improved Sw seed

Table 19 describes the regeneration assumptions and parameters for the Silviculture Strategy Analysis. The rationale for these regeneration assumptions is provided in the TSR 2 information package.

Table 19: Regeneration Assumptions

Current AU			Future AU		% conversion		Initial density[b]	Site Index[c]			Regen delay	Natural or Planted	OAF 1	OAF 2	Genetic Gain[d]	Yield Table Source
Mat	Species	Immatu	A	Species[a]				Matur	Immatu	Future						
1	Fd	22	1	Fd	100		1800	21.6	17.9	21.2	1	P	15	5	0	TIPSY
2	Bl - g	n/a	2	Bl	5			19.1			1	N			0	VDYP
			10	Sw	95	90	1800			20.3	1	P	12	5	16.2	TIPSY
			03	Pl		10										
3	Bl - m	n/a	10	Sw	75		1800	14.4		14.9	1	P	12	5	13.5	TIPSY
				Pl	25											
4	Bl - p	n/a	4	Bl	10			11.4			1	N			0	VDYP
			10	Sw	90	80	1800			11.4	1	P	12	5	14.4	TIPSY
			04	Pl		20										
5	Bl - IU	n/a	1	Sw	100		1800	13.8		14.0	0	P	12	5	18	TIPSY
6	Sw - g	27	1	Sw	100		1800	20.3	20.1	20.2	1	P	12	5	18	TIPSY
7	Sw - m	28	1	Sw	100		1800	16.4	16.1	16.3	1	P	12	5	18	TIPSY
8	Sw - p	29	1	Sw	76		1800	12.2	11.7	12.4	1	P	12	5	13.6	TIPSY
			08	Pl	24											
9	SwPl - g	30	1	Sw	76		1800	22.3	23.1	22.4	1	P	12	5	13.6	TIPSY
			00	Pl	24											
10	SwPl - m	31	1	Pl	40		1800	17.8	19.3	18.6	1	P	12	5	10.8	TIPSY
			10	Sw	60											
11	SwPl - p	32	1	Pl	40		1800	12.4	11.1	12.2	1	P	12	5	10.8	TIPSY
			11	Sw	60											
12	SwDec - g	33	1	Pl	50		1800	21.0	20.1	20.6	1	P	12	5	9	TIPSY
			12	Sw	50											
13	SwDec-m/p	34	1	Pl	50		1800	17.1	15.3	16.6	1	P	12	5	9	TIPSY
			13	Sw	50											
14	Pl - g	35	1	Pl	86		1800	23.0	21.5	22.7	1	P	10	5	2.5	TIPSY
			14	Sw	14											
15	Pl - m/p	36	1	Pl	86		1800	17.5	16.7	17.3	1	P	10	5	2.5	TIPSY
			15	Sw	14											
16	PlSw - g	37	1	Pl	86		1800	21.7	21.5	21.7	1	P	10	5	2.5	TIPSY
			16	Sw	14											
17	PlSw - m/p	38	1	Pl	86		1800	13.8	14.3	14.0	1	P	10	5	2.5	TIPSY
			17	Sw	14											
18	PlDec - g	39	1	Pl	80		1800	21.3	21.1	21.2	1	P	10	5	3.6	TIPSY
			18	Sw	20											
19	PlDec - m/p	40	1	Pl	80		1800	13.8	13.9	13.9	1	P	10	5	3.6	TIPSY
			10	Sw	20											
20	AtCon	n/a	1	Pl	80		1800	18.9		19.1	1	P	10	5	3.6	TIPSY
			20	Sw	20											

[a] Immature and future managed yield curves are generated based on this species mix.

[b] This is establishment density. Initial density reported in TSR2 of 1600 stems per hectare reflects mortality after planting.

[c] Site indices for immature and future managed stands underwent a SIBEC adjustment. Mature site indices were not adjusted.

[d] A genetic gain of 18% applies only to future managed spruce. This number reflects the spruce component of the future managed yield curve.

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Yield curves have been attached in Appendix I.

As described in Table 17, stands on a "Current AU – mature" curve are those stands, which were harvested prior to 1972 as well as those stands that have never been harvested. Harvesting prior to 1972 was primarily done using intermediate utilization. As such, unmanaged yield tables better represent these stands. The yield curves for these stands (numbering from 1 – 20) were generated using VDYP. A curve was generated for each of these analysis units in two steps. First, a temporary yield curve for every forest cover polygon in each analysis unit was generated using VDYP. Second, a single curve was created from these polygon-specific yields by taking an area-weighted average. The site indices used to generate these curves are the site indices provided in the forest cover information and were not adjusted. The volume for analysis unit 5 (Balsam intermediate utilization) was capped at 100 m^3/ha as in the TSR 2 analysis.

Stands on a "Current AU – immature" curve are those managed stands harvested between 1973 and 1997. The curves for these stands (numbering from 22 – 40) were generated using TIPSY and included no genetic improvement. The site indices for these stands were adjusted following the procedure described in Section 8.1.1.

Stands that have been harvested since 1998 as well as future managed stands are modeled on the "Future AU" curve (numbering from 101 – 120). These curves were generated using TIPSY and included positive volume adjustments for spruce to reflect the planting of genetically improved spruce stock (described in Section 8.1.2 below). As with the current immature stands, the site indices for these curves were adjusted following the procedure in Section 8.1.1. All future managed stands are modeled on the "Future AU" curves created using TIPSY with the exception of future managed balsam stands which are modeled on the existing VDYP curves. As TIPSY cannot model balsam, it was decided in TSR 2 that future balsam stands would be better represented by the VDYP curves. Aspen-conifer stands regenerate to pine-spruce stands following seral succession and harvesting. Stands currently less than 41 years of age are assumed to be converted to conifer stands through treatment and therefore grown on curve 120. Stands older than 140 are assumed to grow on curve 20 and be eligible for harvest after seral succession has occurred. This age is assumed to be 161 years. To account for a lower number of coniferous stems resulting from aspen mortality and snags, the volumes in yield curve 20 are reduced by 50%. The rationale for these assumptions is provided in the TSR 2 information package.

For analysis units where a species conversion exists, site indices were converted to reflect this in the determination of the average site index for future managed stands. The equation for converting site indices is:

$SI_{\text{target species}} = a + b*SI_{\text{reference species}}$, where a and b are coefficients.

The conversion equation and coefficients used are found in publications by Gordon Nigh of the Ministry of Forest Research Branch (1995). Table 20 below provides a list of analysis units where this conversion took place and the coefficients used. Spruce-deciduous and pine-deciduous stands were converted as 100% spruce and pine stands, respectively.

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Table 20: Species conversion coefficients.

AU	*Conversion*	*Coefficients*
102	Bl → 90% Sw, 10% Pl	Sw: a = -1.95, b = 1.16 ; Pl: a = -0.517, b = 1.09
103	Bl → 95% Sw, 5% Pl	Sw: a = -1.95, b = 1.16 ; Pl: a = -0.517, b = 1.09
104	Bl → 80% Sw, 20% Pl	Sw: a = -1.95, b = 1.16 ; Pl: a = -0.517, b = 1.09
105	Bl → 100% Sw	Sw: a = -1.95, b = 1.16
108	Sw → 76% Sw, 24% Pl	Pl: a = 1.97, b = 0.92
112	SwDec → 76% Sw, 24% Pl	Pl: a = 1.97, b = 0.92
113	SwDec → 50% Sw, 50% Pl	Pl: a = 1.97, b = 0.92
114	Pl → 14% Sw, 86% Pl	Sw: a = -2.15, b = 1.09
115	Pl → 14% Sw, 86% Pl	Sw: a = -2.15, b = 1.09
118	PlDec → 20% Sw, 80% Pl	Sw: a = -2.15, b = 1.09
119	PlDec → 20% Sw, 80% Pl	Sw: a = -2.15, b = 1.09

Procedures for assigning stands to analysis units differed between the Type 2 analysis and TSR 2. In the TSR 2 analysis, stands were assigned to analysis units prior to the site index adjustment. The Type 2 analysis assigned stands to analysis units after the site index adjustment had been performed. This means that the average site index used to develop curves within each analysis unit differs between the two analyses and results in different yield predictions. An area-weighted average site index calculation across all analysis units was performed for both the Type 2 and the TSR 2 analyses. While the average site index for individual analysis units differs significantly in some cases, this average site index for the entire landbase differs by only 0.2 metres between the two analyses. As such, differences in harvest flow between TSR 2 and the Type 2 benchmark run are not anticipated to result from this change.

8.1.1 Site Index Adjustments

Site indices for spruce and lodgepole pine were adjusted based on a BEC classification for TFL 53. Biogeoclimatic zone, subzone and variant information was loaded into GIS and intersected with forest cover information to determine the new site indices. Site indices for species other than spruce and pine remained unadjusted. Table 21 below provides the adjusted site index estimates used for pine and spruce. The information for this site index adjustment came from J.S. Thrower and Associates.

Table 21: Adjusted site indices by site series.

Site Series	SBS mw		SBS mk1		SBS dw1		SBS wk1		ESSF wk1	
	Sx	Pl	Sx	Pl	Sx	Pl	Sx	Pl	Sx	Pl
01	20	22	19	21	18	20	20	21	16	18
02	10	13	10	12	10	12	10	12	12	13
03	13	15	12	13	13	15	13	15	15	17
04	16	19	16	18	16	18	17	19	17	19
05	18	20	18	20	17	19	19	21	19	19
06	21	23	15	16	20	22	18	20	12	14
07	22	24	21	22	19	21	22	24	16	17
08	24	26	24	25	22	24	24	26	6	7
09	17	17	16	16	17	17	18	18	19	19
10	10	10	10	10			24	25		
11							10	10		
12							15	16		

8.1.2 Genetic Gain Allowances

Genetically improved spruce stock used in TFL 53 has a genetic worth of 18%. This is applied as a positive adjustment factor for TIPSY yields based on the amount of spruce planted (for example, AU 110 received a volume adjustment of 10.8% as spruce comprises 60% of the stand (0.6*0.18 = 0.108 or 10.8%). Functions currently included in TIPSY for applying genetic gain were not available at the time of TSR 2. In order to more closely benchmark the TSR 2 analysis, the TIPSY curves created for the Type 2 analysis applied genetic gain as a linear increase of 18% as was done in TSR 2. In developing TASS curves, genetic gain was applied using the algorithm provided in TASS. Only future managed AUs are adjusted for genetic worth.

8.2 Not Satisfactorily Restocked

In ***FSOS***, NSR is modeled using negative ages, which are applied to reflect the NSR restocking schedule. All current NSR is assumed to regenerate within the specified regeneration delay period as per Table 19. NSR is restocked on a pro-rata basis within each analysis unit.

8.3 TASS Curves

The strategic silviculture analysis focuses on determining the optimal timing and treatments given certain forest cover objectives, employment objectives, budgeting, timber flow criteria, timber volumes, costs of treatments, etc. For each AU, the stakeholder group in Workshop #1 identified potential treatment regimes. The TASS curves were generated for each regime for testing from a forest-level perspective using ***FSOS***. TASS was chosen for development of the treatment regimes in order to accommodate multiple fertilization treatments as well as to obtain output regarding quality attributes (e.g. piece size and diameters). These functions are not available in TIPSY. The treatment regimes are

shown in Table 22. These curves were developed using the parameters provided in Table 19 above. The site indices were adjusted using the procedure described in Section 8.1.1.

Table 22: Incremental silviculture treatment regimes.

AU	Treatment Options		
	Fert	CT	Do Not Treat
101 Fir		✔	✔
102 Balsam Good		✔	✔
103 Balsam Medium		✔	✔
104 Balsam Poor		✔	✔
105 Balsam IU		✔	✔
106 Spruce Good	✔	✔	✔
107 Spruce Medium	✔	✔	✔
108 Spruce Poor	✔	✔	✔
109 Spruce/Pine Good	✔	✔	✔
110 Spruce/Pine Medium	✔	✔	✔
111 Spruce/Pine Poor	✔	✔	✔
112 Spruce/Decid Good		✔	✔
113 Spruce/Decid Medium/Good		✔	✔
114 Pine Good	✔	✔	✔
115 Pine Medium/Poor	✔	✔	✔
116 Pine/Spruce Good	✔	✔	✔
117 Pine/Spruce MediumPoor	✔	✔	✔
118 Pine/Decid Good		✔	✔
119 Pine/Decid Medium/Poor		✔	✔
120 Aspen Conifer		✔	✔

[1] Parameters for Treatments:
Fert – every 6 years after dominance (4.5 metres) to harvest
CT – only in VQO zones

8.4 Minimum Harvest Age Criteria

Minimum harvest ages are simply minimum criteria defining harvest eligibility; most stands will not be harvested at these minimum limits in order to fulfill other objectives. For existing unmanaged stands, minimum harvest age is set to the regional priority cutting age, with the exception of AU 20, which is harvested after seral succession has occurred. Rationale for this is provided in the TSR 2 information package. For all managed stands, minimum harvest age is set to culmination age. The minimum harvest ages, which will be used in the silviculture analysis, are listed in Table 23 – 25.

Table 23: Minimum harvest ages, unmanaged stands.

AU	Type 2 Regional Priority		MP3 Regional Priority	
	Age	Volume	Age	Volume
1	111	355	111	354
2	121	321	121	327
3	121	199	121	248
4	121	144	121	167
5	121	100	121	224
6	101	321	101	321
7	101	238	101	238
8	101	145	101	161
9	101	373	101	406
10	101	282	101	278
11	101	159	101	169
12	101	313	101	312
13	101	229	101	202
14	81	324	81	346
15	81	215	81	230
16	81	292	81	296
17	81	138	81	158
18	81	245	81	249
19	81	108	81	134
20	161	154	161	140

Table 24: Minimum harvest ages, existing managed stands.

AU	Type 2 Culmination		MP3 Culmination	
	Age	Volume	Age	Volume
22	135	395	110	441
27	85	430	80	404
28	105	401	90	424
29	140	343	90	399
30	70	427	80	374
31	85	382	80	375
32	165	309	70	370
33	75	360	80	379
34	110	336	80	370
35	60	336	70	344
36	90	316	70	367
37	60	336	70	347
38	95	247	70	341
39	60	322	70	324
40	105	261	80	351

Table 25: Minimum harvest ages, future managed stands.

AU	Culmination Benchmark (TIPSY)		Culmination SS Basecase at MAI (TASS)		Culmination SS Basecase at 90% MAI (TASS)		Culmination MP3 Future Managed Stands (TIPSY)	
	Age	Volume	Age	Volume	Age	Volume	Age	Volume
101	105	437	100	369	75	254	110	411
102	80	408	70	379	60	309	90	446
103	110	366	100	354	80	260	90	428
104	145	346	130	338	105	250	90	432
105	115	373	105	366	85	276	90	494
106	80	408	70	390	60	317	80	473
107	100	386	90	380	70	267	80	455
108	130	341	120	342	95	245	80	421
109	70	410	60	362	50	277	80	428
110	85	360	80	362	65	277	80	415
111	145	315	130	347	100	245	80	409
112	80	400	70	354	55	257	80	410
113	100	349	90	340	70	243	80	406
114	55	339	55	302	45	229	70	362
115	85	318	85	294	65	211	70	340
116	60	342	60	305	50	241	70	365
117	100	250	110	264	85	194	70	350
118	60	326	65	324	50	230	70	388
119	105	261	105	268	80	185	70	339
120	75	337	75	316	60	239	80	311

8.5 Past Silviculture Treatments

Past silviculture treatments appear in the forest cover information. Treatments identified include fertilization, pruning, conifer release, spacing, and brushing and weeding.

8.6 Regeneration Delay

The regeneration delay used in the strategic silviculture analysis is the same as that used for the TSR 2 analysis. The regeneration delay is set to 1 year and is consistent with the average regeneration delay from the commencement of harvesting a block until planting is competed.

9 Protection

9.1 Non-Recoverable Losses

Non-recoverable losses are losses due to natural events that are not salvaged and result in a decrease in the productivity of the TFL. These losses focus on the epidemic losses (such as losses due to fire, insects and diseases) that are not salvaged, whereby the endemic losses are accounted for through operational adjustments and netdown reductions. This analysis uses the values and rationale from the TSR 2 data package. The TFL 53 reductions for non-recoverable losses total 678 m^3/year. This volume is removed from the modeled harvest levels to represent net available volume.

10 Integrated Resource Management

The intent of this section is to describe how non-timber resource values will be modeled.

10.1 Forest Cover Requirements

Table 26 outlines the forest cover objectives for TFL 53 for maintaining non-timber values. Forest cover objectives are applied to model biodiversity values and visual quality objectives by placing maximum and/or minimum boundaries on specific age distributions, focusing largely on young age classes and old forests.

In ***FSOS***, forest cover objectives can be viewed as either targets or constraints. In simulation mode, forest cover constraints can be applied that must coincide with harvesting actions. In the optimization approach, targets will be set which will attempt to develop and schedule harvest units to best achieve age class and timber flow objectives. Some trade-offs between objectives may occur.

Table 26: Forest cover requirements.

Resource	Zone	Type 2 Area (ha)			Cover Requirement			
		Forested	THLB	Applied to	Age 1 (years)[d]	Max % <	Age 2 (years)	Min % > (1/ 70/ 140)
IRM		66,270.9	65,847.9	THLB Area	17 (3m)	33	-	-
Visual Quality	Preservation	13.4	3.6	Forested Area	20 (5.4m)	1	-	-
	Retention	41.7	1.5	Forested Area	16 (4.4m)	5	-	-
	Partial Retention	1,269.1	1,071.4	Forested Area	16 (4.6m)	15	-	-
	Modification	1,853.4	1600.8	Forested Area	23 (4.6m)	25	-	-
	Maximum Modification	107.5	102.6	Forested Area	26 (5.3m)	33		
BEC Variants/ NDT[a]	ESSF wk1 / NDT 2[b]	8,426.3	7,490.2	Forested Area	-	-	250	3.0/ 5.9/ 9.0
	SBS wk1 / NDT 2	27,131.9	23,587.1	Forested Area	-	-	250	3.0/ 5.9/ 9.0
	SBS dw / NDT 3	2,861.5	2,215.5	Forested Area	-	-	140	3.6/ 7.3/ 11.0
	SBS mk1 / NDT 3	25,315.2	20,452.1	Forested Area	-	-	140	3.6/ 7.3/ 11.0
	SBS mw / NDT 3	17,579.7	14883.0	Forested Area	-	-	140	3.6/ 7.3/ 11.0
WTP[c]	4% of THLB area			THLB Area	-	-	160	50

[a] Low biodiversity emphasis is applied to each BEC variant for this analysis beginning with the Silviculture Strategy Base Case (Scenario 3). The forest cover constraints in this table reflect this low emphasis. In TSR 2, 45% low, 45% intermediate, and 10% high biodiversity emphasis was applied within each NDT.

[b] ESSF wk1 will be modeled as NDT 2, not as NDT1.

[c] A description of the methodology used to calculate and model WTP areas is provided in Section 10.1.1.

[d] Age is calculated as a surrogate for visually effective green-up height by an area-weighted average of age to height by future managed analysis unit.

10.1.1 Wildlife Tree Patches

A review of Dunkley's silviculture prescriptions submitted following the implementation of the Forest Practices Code revealed that approximately 2% of the THLB was being held in each cut block for wildlife tree patches (WTPs). In this analysis, as in the TSR 2 analysis, WTPs are modeled by applying a 50% age constraint to 4% of the THLB. This maintains the required two percent of the area in WTPs at any given time. Rationale for this approach is provided in the TSR 2 information package.

Spatial WTPs have also been designated that were not included in the TSR 2 analysis. To account for the contribution of these areas to the 4% WTP requirement, the areas in spatial WTPs were identified for each biogeoclimatic variant and the remaining requirement was reduced based on these areas. Table 27 below outline the procedure used.

Table 27: WTP requirement calculation.

Biogeoclimatic Variant	THLB Area (ha)	WTP Requirement		Designated WTP Area	Remaining WTP Requirement	
		Percentage of THLB	ha	ha	ha	Percentage of THLB
ESSF wk1	7,490.2	4	299.6	11.7	287.9	3.8
SBS wk1	23,587.1	4	943.5	90.3	853.2	3.6
SBS dw	2,215.5	4	88.6	2.2	86.4	3.9
SBS mk1	20,452.1	4	818.1	73.7	744.4	3.6
SBS mw	14,883.0	4	595.3	30.3	565.0	3.8
Total	***68,627.9***		***2,745.1***	***208.2***	***2,536.9***	

11 Timber Objectives

11.1 Treatment Costs

Treatment costs were provided by Doug Perdue of Dunkley Lumber Ltd. Table 28 summarizes these costs.

Table 28: Treatment costs

Treatment	Cost ($/ha)
Road Rehabilitation	Manual Site Preparation – $2,045 Planting – $880 Total – $2,925
Fertilization	$350
Commercial Thinning	No net cost

11.2 Commercial Thinning

Commercial thinning is currently not commonly undertaken in TFL 53. In Scenario 6, commercial thinning will be modeled in only VQO zones to test the ability of this treatment to increase harvest volumes by reducing the impacts of visual quality constraints. Commercial thinning is modeled as cost recovering; that is, no net cost is attributed to the treatment.

The commercial thinning treatment is a single removal of 30% of basal area 20 years before minimum harvest age with a 12.5 cm minimum diameter limit. Within TASS, the treatment progresses in three steps. First, all trees below 12.5 cm diameter are excluded from possible removal. Second, the remaining trees are ordered by basal area from smallest to largest. Finally, trees are removed from this eligible group beginning with the tree of smallest diameter until the target 30% is removed.

11.3 Fertilization

Fertilization treatments are available in Scenarios 5 and 7 and, if it proves effective in meeting analysis objectives, will also be included in the preferred scenario (Scenario 10). Fertilization will occur every 6 years after seedling dominance. Seedling dominance is assumed to occur at a stand height of 4.5 metres in height.

TASS includes volume response information for pine but not for spruce. Spruce response was modeled as 25% relative increase in volume increment following treatment. This parameter was developed based on information provided by Rob Brockley of the Kalamalka Research Station. Application for pine assumed 200 kg Nitrogen plus 50 kg Sulphur; for spruce, 200 kg Nitrogen (urea).

11.4 Road Rehabilitation

A reduction of 1.09% is applied to the timber harvesting land base to account for future roads, trails, and landings. The road rehabilitation option will include permanent deactivation of 50% of on-block roads. Assuming 100% productivity of rehabilitated areas, the reduction for future roads, trails, and landings would decrease to 0.83%. As a treatment options response, this difference will be applied as a positive volume gain of 0.26% to treated stands.

A knowledge gap exists with respect to the productivity of rehabilitated roads. One site that was rehabilitated in 1993 has shown to increase productivity (greater than 100% relative productivity) above the rest of the site. In the absence of more complete information, the assumption was made that rehabilitated roads are 100% productive. As these areas represent a small percent of the land base, adjustment for productivity are not likely to have a significant effect on results.

11.5 Value and Quality Analysis

Harvest costs and values were not included in the analysis. Treatment activities and costs are tracked and reported at various resolutions (e.g. individual polygons, analysis units, period in planning horizon, and so on). Although quality will not be targeted in the analysis, reports will be produced to reflect the impact of treatments on quality as reflected in average piece sizes and diameters.

Appendix I

Yield Tables

Unmanaged Stand Yield Tables

Age	Fd 1	Bl g 2	Bl m 3	Bl p 4	Bl - IU 5[a]	Sw g 6	Sw m 7	Sw p 8	SwPl g 9	SwPl m 10	SwPl p 11	Sw Dec g 12	Sw Dec m/p 13	Pl g 14	Pl m/p 15	Pl Sw g 16	Pl Sw m/p 17	Pl Dec g 18	Pl Dec m/p 19	At Con 20[b]
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	2	0	0	0	0	0	0	0	0	0	0	0	25	0	15	0	7	0	0
30	13	16	0	0	1	0	0	0	0	0	0	0	0	63	14	49	0	28	0	0
35	35	35	5	0	5	4	0	0	5	0	0	3	0	98	37	83	4	55	1	3
40	60	58	14	2	13	21	2	0	30	3	0	17	0	132	60	114	16	83	9	8
45	85	81	25	7	23	54	9	1	66	17	0	43	7	163	83	143	31	108	20	17
50	109	104	39	13	36	88	29	3	102	41	1	73	22	191	105	170	48	132	32	26
55	133	125	54	22	50	119	56	8	136	70	5	103	43	217	126	194	65	154	45	35
60	156	145	68	32	63	149	81	19	169	98	17	133	67	242	146	216	81	174	58	44
65	178	166	84	44	79	176	105	34	200	125	32	160	90	264	164	237	96	194	71	53
70	200	184	97	57	94	202	128	50	229	151	49	187	113	285	182	256	110	212	84	61
75	221	201	109	67	100	226	149	67	257	175	67	211	135	304	198	274	124	228	96	69
80	241	217	121	77	100	248	169	84	282	199	85	234	155	322	213	290	137	243	107	76
85	260	232	132	86	100	268	188	100	306	221	104	256	175	340	229	306	149	258	118	84
90	279	247	143	95	100	286	205	116	329	241	122	276	193	358	244	321	161	272	128	90
95	296	260	153	104	100	304	221	130	350	261	140	294	211	374	258	335	172	285	138	96
100	312	273	163	113	100	319	236	144	371	280	157	311	227	390	272	349	183	298	148	102
105	327	286	172	121	100	334	251	158	389	297	173	327	243	405	285	362	194	310	157	107
110	341	298	181	129	100	347	264	170	407	314	189	341	257	420	298	374	204	321	165	111
115	354	309	190	136	100	360	276	182	423	329	205	354	271	434	310	385	213	331	174	115
120	366	320	198	143	100	371	288	194	438	344	220	366	283	448	322	397	223	341	181	118
125	378	331	207	151	100	382	299	205	452	358	234	377	294	461	333	407	232	351	189	121
130	389	342	215	158	100	392	309	215	465	372	248	387	305	474	345	418	241	359	196	123
135	399	352	224	165	100	401	319	225	476	383	260	396	314	482	353	425	247	365	201	125
140	408	363	232	172	100	410	328	235	485	394	272	404	323	490	360	432	253	371	206	128

145	417	372	239	179	100	418	336	244	494	403	283	412	332	497	366	438	259	376	210	130
150	425	382	247	186	100	426	344	252	503	412	293	419	339	502	371	443	264	380	214	131
155	433	391	254	192	100	432	352	260	510	420	303	424	345	507	376	447	268	383	216	132
160	440	400	261	199	100	439	359	268	516	428	312	429	350	511	379	451	272	386	219	133
165	447	409	268	205	100	445	366	276	522	435	320	434	355	513	382	454	275	388	221	134
170	453	417	274	211	100	450	372	283	527	441	328	438	359	515	384	456	277	389	222	135
175	458	425	281	217	100	456	378	289	531	446	335	442	363	515	385	457	279	390	223	135
180	464	433	287	223	100	460	383	296	535	451	342	446	367	515	385	458	281	390	224	136
185	468	440	293	228	100	465	388	302	539	456	348	449	370	514	385	458	282	389	224	136
190	473	448	299	234	100	469	393	308	541	460	353	452	373	511	383	457	282	388	224	136
195	478	455	305	239	100	473	398	313	545	464	359	455	376	512	384	458	283	388	225	137
200	483	462	311	245	100	477	403	319	548	469	365	458	379	513	385	459	285	389	226	137
205	487	469	317	250	100	481	407	324	551	473	371	460	382	514	386	461	287	390	227	138
210	492	476	322	255	100	484	411	329	555	477	376	463	385	515	388	462	288	391	228	138
215	496	482	327	260	100	487	415	333	558	480	381	465	387	517	389	464	290	392	229	139
220	501	488	333	265	100	490	418	338	560	484	386	468	390	518	390	465	292	393	229	139
225	505	495	338	270	100	493	422	342	563	487	391	470	392	519	391	467	293	393	230	139
230	509	501	343	275	100	496	425	346	566	490	395	472	395	521	393	468	295	394	231	140
235	513	506	348	279	100	498	428	350	568	493	399	474	397	522	394	469	296	395	232	140
240	517	512	353	284	100	501	431	354	571	496	404	476	399	523	395	471	298	396	233	140
245	521	518	357	288	100	503	434	358	573	499	407	477	401	525	396	472	299	397	234	141
250	524	523	362	293	100	505	437	361	575	502	411	479	403	526	398	474	300	398	235	141
255	524	524	363	294	100	507	439	364	577	504	415	481	404	527	399	475	301	399	236	141
260	524	525	364	294	100	508	441	366	578	506	418	482	406	529	400	476	302	400	236	141
265	524	526	364	295	100	510	442	368	580	508	421	483	408	530	401	477	304	400	237	142
270	524	527	365	296	100	511	444	370	581	510	424	484	409	531	402	478	305	401	238	142
275	524	527	366	297	100	512	446	372	583	512	426	485	411	532	403	479	305	402	238	142
280	524	528	366	297	100	514	447	374	584	514	429	486	412	533	404	480	306	403	239	142
285	524	528	367	298	100	515	448	376	585	515	432	487	413	534	405	481	307	403	239	142
290	524	529	368	298	100	516	450	378	587	517	434	488	414	535	406	482	308	404	240	142
295	524	530	368	299	100	517	451	379	588	518	436	489	416	536	407	483	309	405	240	143
300	524	530	369	300	100	518	452	381	589	520	438	490	417	537	407	483	310	405	241	143

[a] Volumes have been capped at 100 m^3/ha for this balsam intermediate utilization yield curve.

[b] Volumes have been reduced by 50% to reflect aspen mortality and snags resulting from seral succession.

Existing Managed Stand Yield Tables

Age	Fd 22	Sw g 27	Sw m 28	Sw p 29	Sw Pl g 30	Sw Pl m 31	Sw Pl p 32	Sw Dec g 33	Sw Dec m/p 34	Pl g 35	Pl m/p 36	Pl Sw g 37	Pl Sw m/p 38	Pl Dec m/p 39	Pl Dec m/p 40
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	3	0	0	1	0	3	0	3	0	2	0
25	0	0	0	0	15	5	0	10	0	31	2	31	0	25	0
30	2	3	0	0	42	18	0	28	3	74	14	74	2	63	1
35	10	23	1	1	95	41	0	60	11	127	34	127	12	110	9
40	32	65	10	3	152	78	1	104	23	178	63	178	26	161	19
45	55	113	32	7	210	119	3	148	42	223	96	223	45	207	36
50	79	161	63	13	263	161	8	190	66	265	129	265	68	249	56
55	101	211	98	23	307	202	13	232	93	303	158	303	94	287	78
60	121	253	136	41	354	239	20	269	122	336	188	336	116	322	103
65	145	292	175	60	396	271	30	302	149	362	214	362	140	348	126
70	166	335	209	84	427	302	45	328	175	387	239	387	162	373	147
75	187	374	239	105	450	329	60	360	201	408	259	408	182	396	168
80	207	404	270	130	468	359	78	384	224	427	278	427	202	416	186
85	225	430	297	151	482	382	96	404	245	443	297	443	218	432	204
90	244	445	326	172	495	404	113	420	263	458	316	458	233	448	220
95	263	459	356	196	507	418	131	434	282	470	330	470	247	461	234
100	284	470	379	213	516	430	146	445	301	481	343	481	260	473	247
105	301	482	401	231	516	443	162	456	320	487	354	487	273	481	261
110	318	490	416	248	516	452	180	464	336	494	363	494	286	489	273
115	335	501	428	264	516	460	194	473	350	499	371	499	295	493	284
120	348	508	439	279	516	468	207	481	361	504	379	504	306	498	296
125	364	515	449	295	516	474	221	487	371	506	385	506	316	502	308
130	380	521	457	314	516	481	233	491	379	512	393	512	325	507	316
135	395	525	464	327	516	485	243	494	385	512	399	512	332	509	323
140	408	526	472	343	516	490	256	499	392	512	402	512	338	512	331

145	419	527	478	351	516	496	266	499	397	512	408	512	343	512	338
150	433	527	481	364	516	497	277	502	403	512	412	512	346	512	343
155	440	525	486	372	516	499	288	502	407	512	417	512	349	512	347
160	450	524	491	380	516	501	298	503	412	512	421	512	355	512	351
165	461	524	497	386	516	500	309	502	415	512	426	512	357	512	353
170	467	523	498	392	516	500	316	503	419	512	427	512	360	512	357
175	476	523	501	398	516	498	325	503	422	512	429	512	363	512	358
180	483	524	503	402	516	501	331	503	425	512	431	512	366	512	364
185	491	524	507	406	516	500	338	503	429	512	433	512	369	512	367
190	498	521	509	411	516	499	342	503	431	512	436	512	371	512	368
195	505	524	510	413	516	499	346	503	432	512	437	512	373	512	371
200	511	522	509	416	516	498	350	503	434	512	439	512	374	512	373
205	517	520	508	419	516	500	352	503	436	512	440	512	376	512	373
210	526	519	508	423	516	500	357	503	439	512	441	512	379	512	377
215	529	517	506	423	516	500	363	503	441	512	443	512	380	512	378
220	535	517	506	428	516	500	363	503	440	512	443	512	380	512	379
225	538	516	503	427	516	500	366	503	443	512	442	512	380	512	380
230	544	513	503	430	516	500	368	503	442	512	444	512	381	512	380
235	547	514	502	432	516	500	371	503	443	512	445	512	381	512	381
240	550	512	503	433	516	500	371	503	443	512	446	512	382	512	379
245	552	512	502	435	516	500	374	503	442	512	447	512	385	512	382
250	557	511	500	436	516	500	375	503	441	512	447	512	384	512	380
255	559	511	499	438	516	500	378	503	441	512	449	512	384	512	382
260	562	511	500	438	516	500	380	503	437	512	448	512	383	512	381
265	565	511	496	440	516	500	381	503	439	512	448	512	385	512	384
270	567	511	495	439	516	500	382	503	437	512	447	512	384	512	382
275	568	511	495	440	516	500	383	503	437	512	442	512	386	512	380
280	570	511	494	442	516	500	385	503	435	512	440	512	387	512	381
285	572	511	493	440	516	500	386	503	433	512	437	512	387	512	382
290	573	511	494	442	516	500	386	503	433	512	434	512	385	512	380
295	575	511	492	442	516	500	388	503	431	512	431	512	386	512	381
300	575	511	491	442	516	500	389	503	429	512	429	512	387	512	381

Future Managed Stand Yield Tables [a]

	Fd	Sw Pl g	Sw Pl m	Sw Pl p	Sw m	Sw g	Sw m	Sw Pl p	Sw Pl g	Sw Pl m	Sw Pl p	Pl Sw g	Pl Sw m/p	Pl g	Pl m/p	Pl g	Pl m/p	Pl g	Pl m/p	Pl m
Age	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	2	0	0	1	0	10	0	4	0	2	0	1
25	1	2	0	0	0	0	0	0	14	3	0	13	1	46	2	34	0	26	0	11
30	12	10	2	0	0	4	0	0	40	17	0	38	9	100	17	80	2	66	1	36
35	40	41	8	0	0	28	1	1	93	38	1	77	22	159	44	134	10	118	9	71
40	71	91	17	2	1	79	13	5	156	70	3	126	41	215	77	189	22	171	20	115
45	100	146	34	5	13	136	41	11	218	113	9	177	71	264	114	235	42	218	37	157
50	130	203	66	10	34	194	81	22	276	156	16	225	106	312	149	279	63	261	58	197
55	161	259	100	22	66	253	123	36	327	198	27	270	141	347	182	317	87	300	81	234
60	191	304	133	37	100	301	166	62	375	240	40	308	174	377	211	351	112	338	107	267
65	220	351	169	59	138	348	212	90	428	275	61	344	207	406	239	376	134	365	131	296
70	248	400	203	84	173	398	255	115	466	309	82	379	238	434	262	402	157	391	152	324
75	278	442	237	109	212	448	290	145	494	341	104	408	266	453	287	424	177	414	174	349
80	309	474	264	135	244	481	326	173	516	372	127	436	290	474	306	445	195	434	193	370
85	335	500	291	159	276	507	356	200	534	399	150	455	314	488	326	459	213	452	211	389
90	360	518	317	186	303	527	395	227	550	422	170	470	338	502	343	475	229	465	228	403
95	387	533	342	212	333	545	430	249	561	442	192	488	361	510	357	488	243	479	242	416
100	412	547	369	233	358	558	455	269	573	459	212	499	380	518	370	498	256	490	256	429
105	437	560	396	255	388	570	478	292	582	470	229	507	396	522	379	504	268	502	270	441
110	456	572	415	273	417	583	499	309	591	483	247	521	412	522	391	510	281	509	283	451
115	473	582	432	293	440	594	512	329	591	491	261	530	422	522	397	516	292	514	294	460
120	492	589	445	310	458	602	525	350	591	502	276	535	432	522	404	519	302	518	307	469
125	507	595	457	327	476	609	536	368	591	510	294	540	439	522	412	525	311	523	319	476
130	524	601	466	348	491	615	543	387	591	516	307	545	449	522	419	525	320	524	327	483
135	541	608	477	365	498	621	551	402	591	523	320	549	455	522	425	525	329	527	335	487
140	556	608	484	382	511	622	559	415	591	529	335	550	460	522	432	525	336	527	343	492

145	567	608	489	396	519	620	568	426	591	533	349	552	468	522	437	525	342	527	350	495
150	577	607	495	407	527	621	575	436	591	537	360	554	473	522	441	525	347	527	355	500
155	587	607	502	420	535	620	578	445	591	543	368	554	479	522	445	525	351	527	359	501
160	597	607	507	432	542	620	584	452	591	544	378	554	482	522	449	525	354	527	364	502
165	608	607	512	438	546	620	590	457	591	550	389	554	488	522	451	525	358	527	366	502
170	613	607	516	447	552	618	591	465	591	546	393	554	491	522	454	525	360	527	370	502
175	621	607	520	453	557	618	597	469	591	547	401	554	493	522	456	525	366	527	371	503
180	629	607	523	459	562	620	599	474	591	546	402	554	494	522	457	525	367	527	377	506
185	636	607	528	463	564	617	601	477	591	545	410	554	497	522	461	525	368	527	380	506
190	639	607	530	468	571	618	603	481	591	545	413	554	500	522	462	525	372	527	381	506
195	647	607	532	471	571	618	601	485	591	545	418	554	500	522	465	525	373	527	384	508
200	652	607	535	476	576	618	603	485	591	544	421	554	502	522	467	525	376	527	386	508
205	657	607	537	482	577	615	601	491	591	546	424	554	504	522	468	525	377	527	386	509
210	663	607	538	483	581	612	599	494	591	546	429	554	502	522	467	525	380	527	391	510
215	666	607	540	485	581	611	598	495	591	546	431	554	502	522	472	525	383	527	392	511
220	671	607	540	490	583	610	598	498	591	544	435	554	502	522	472	525	382	527	393	511
225	677	607	540	491	585	609	597	499	591	544	437	554	502	522	469	525	382	527	394	511
230	680	607	539	492	586	605	594	502	591	544	438	554	504	522	469	525	382	527	394	511
235	682	607	539	496	589	607	595	504	591	542	440	554	502	522	468	525	382	527	395	511
240	688	607	537	499	588	605	592	506	591	544	440	554	504	522	466	525	383	527	393	511
245	690	607	536	500	585	604	591	507	591	543	440	554	501	522	464	525	382	527	396	511
250	692	607	535	502	582	604	590	508	591	542	443	554	501	522	464	525	386	527	394	511
255	699	607	535	502	584	604	590	509	591	543	444	554	501	522	463	525	384	527	396	511
260	698	607	532	505	582	604	586	511	591	543	447	554	502	522	461	525	385	527	395	511
265	703	607	531	503	579	604	586	510	591	543	449	554	502	522	460	525	385	527	398	511
270	706	607	531	503	579	604	585	509	591	543	448	554	502	522	459	525	386	527	396	511
275	710	607	529	506	577	604	584	510	591	543	448	554	501	522	460	525	384	527	394	511
280	711	607	529	506	576	604	584	511	591	543	448	554	500	522	458	525	383	527	395	511
285	716	607	527	509	576	604	584	509	591	543	450	554	498	522	457	525	386	527	396	511
290	714	607	527	506	573	604	583	507	591	543	448	554	502	522	456	525	386	527	394	511
295	721	607	526	510	572	604	583	504	591	543	450	554	504	522	454	525	385	527	395	511
300	721	607	524	509	570	604	583	503	591	543	450	554	502	522	452	525	385	527	395	511

[a] The volumes of the spruce component of yield curves has been positively adjusted by 18% to reflect genetic gain.

Treatment Regime Yield Tables (TASS) [a]

	Fd	Fd ct	Sw Pl g	Sw Pl g ct	Sw Pl m	Sw Pl m ct	Sw Pl p	Sw Pl p ct	Sw m	Sw m ct	Sw g	Sw g ct	Sw g f
Age	101	101 ct	102	102 ct	103	103 ct	104	104 ct	105	105 ct	106	106 ct	106 f
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0.3	0.3	0	0	0	0	0	0	0	0	0
25	0.3	0.3	4	4	0	0	0	0	0	0	0.5	0.5	1.5
30	10.9	10.9	23.8	23.8	2	2	0	0	0	0	18	18	31.9
35	38.8	38.8	66.1	66.1	8.4	8.4	0.1	0.1	0.9	0.9	63	63	91
40	68.7	68.7	115.6	115.6	25.4	25.4	1.2	1.2	9.5	9.5	115.2	115.2	156.4
45	95.4	95.4	166.6	166.6	50.3	50.3	5.3	5.3	31.2	31.2	168.4	168.4	223.4
50	120.9	120.9	216.9	162.9	80.1	80.1	15.2	15.2	60.4	60.4	221.5	166.1	289.5
55	147	147	264.9	207	110.3	110.3	31.7	31.7	91.9	91.9	271.6	212.8	351.6
60	173.4	173.4	309	251.2	140.5	140.5	51.2	51.2	123.6	123.6	316.7	259	407.6
65	200.2	200.2	347.8	293	171.1	171.1	72.6	72.6	155.3	155.3	356.5	302.3	456.8
70	227	227	379.1	329.7	201.8	201.8	94.7	94.7	187.1	187.1	389.6	341.7	497.3
75	253.5	253.5	404.5	361	231.6	231.6	117.3	117.3	218	218	415.9	375.7	528.8
80	279.1	217.5	425.7	390.6	259.8	199.4	139.7	139.7	247.9	247.9	436	403.7	553
85	303.7	242.5	443.9	415.5	286.4	225	162.4	162.4	275.9	209.8	449.4	427.2	568.7
90	327	266.5	457.8	437.2	310.9	249.9	185.1	185.1	301.9	234.9	463.6	449.6	585.9
95	348.7	289.3	473.1	456	333.3	273.8	207.3	207.3	325.3	259.5	477.5	467.5	602.8
100	368.8	310.9	484	472.9	353.6	295.7	229.1	229.1	347	283.3	489	485.9	616.8
105	387.7	331.2	486.7	486.1	370.8	316	250.1	250.1	366.1	306.1	492.6	497.4	620.8
110	405.1	350.4	487.9	492.6	386.9	335.6	270.1	208.5	382.5	326.4	494.3	507.9	622.6
115	421.2	368.4	491.5	504.1	399.7	353.1	288.9	226.9	398.4	345.6	500.8	513.8	630.5
120	436.3	385.4	492.4	510.7	412.3	368.5	306.5	245.1	411.5	362.9	503.3	522	633.4
125	450.8	401.3	495.4	516.7	422.8	382.1	322.9	262.7	423	378.8	509.1	527.6	640.4
130	463	416.4	498.8	520.7	432.1	395.3	337.6	279.3	432.7	392.8	511.1	530.9	642.8
135	475.4	430.5	499.9	524.9	439.4	407.5	351.3	295	439.8	405.1	509.6	534.8	640.8
140	487.5	443.9	499	527.9	446.3	418.2	363.4	309.8	446.3	416	508.4	540.4	639.2
145	498.4	456.5	500.8	530.2	452.3	427	374.8	324.2	453.7	426.3	510.2	538.9	641.3
150	508.3	468.4	499.4	529.3	460.2	435.4	385.5	336.5	460.1	436.9	501.4	538	630.1
155	516.9	479.3	494.9	527.5	465.4	443.9	396.3	348.9	466.1	446	501	535.7	629.6
160	525.7	489.7	497.5	526.8	470	451	404.5	360.4	473.1	454.1	500.8	533.3	629.2
165	534.8	499.7	492.5	522.1	471.3	455.3	412.3	371	478	461.8	497	533.6	624.4
170	542.4	509.2	491.7	521.4	474.4	461.3	419.2	381	480.9	467	496.5	533.1	623.7
175	550.1	517.8	489.1	520.2	476.3	463.9	424.9	389.8	484.2	471.8	493.7	532.6	620
180	556.9	525.9	489	517.1	479.3	468.4	430.7	397.6	485.1	476	490.9	533.3	616.5
185	563.5	533.7	488.6	518.7	481.6	473	436.3	406.2	484.8	480.2	488.8	530.4	613.8
190	569.2	541.1	484.5	517.2	480.7	475	442.7	414.5	486.8	484	487.1	525.5	611.7
195	574	547.9	485	517.8	477.8	475.6	447.4	421	489.4	488	487.6	521.9	612.2
200	579.1	554.8	484	516.7	478.4	478.4	452.4	427.4	490.2	488.5	487.6	515.6	612.2

[a] 'ct' denotes commercial thinning; 'f' denotes fertilization; other curves are the no treatment curves.

	Sw m	Sw m ct	Sw m f	Sw Pl p	Sw Pl p ct	Sw Pl p f	Sw Pl g	Sw Pl g ct	Sw Pl g f	Sw Pl m	Sw Pl m ct	Sw Pl m f
Age	107	107 ct	107 f	108	108 ct	108 f	109	109 ct	109 f	110	110 ct	110 f
5	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	4.3	4.3	5	0.1	0.1	0.1
25	0	0	0	0	0	0	21.3	21.3	29	5.2	5.2	6.8
30	0.6	0.6	1.6	0	0	0	61.9	61.9	83.7	21.2	21.2	29.7
35	11.4	11.4	21.7	0.6	0.6	0.7	114.8	114.8	150.7	50.5	50.5	69.6
40	39.9	39.9	61.7	4.1	4.1	6	170.3	125.7	219	87.9	87.9	117.1
45	76.8	76.8	108.4	13.2	13.2	20.2	225.5	174.4	287.1	126.7	126.7	165.9
50	115.6	115.6	157.1	29.6	29.6	43.1	277.3	223.7	351.3	165.5	165.5	214.7
55	154.4	154.4	206	51.6	51.6	70.1	323.7	271.2	408.8	204	204	263
60	193.5	193.5	254.5	75	75	99	361.7	313.4	457.2	241.6	183.4	309.5
65	231.4	231.4	301.5	99.1	99.1	128.7	391.1	349.9	493.4	277.3	216.4	353.3
70	267.1	202.9	345.7	123.5	123.5	158.1	413.7	381.5	521.1	309.5	248.7	393.9
75	300.2	234.4	386.7	148.5	148.5	188	434.2	408.1	546.7	338.5	279.1	429.5
80	329.5	265.4	423.1	173.1	173.1	218	449.9	430.1	567.4	362.2	306.3	460.8
85	356.8	294.8	456.7	197.7	197.7	247.8	458.4	449.7	579.6	382	330.6	486.9
90	379.9	322.4	485	221.7	221.7	276.6	464.1	460.3	584.4	396.5	352.1	506.2
95	400.5	347.7	510.1	244.8	244.8	304.3	464.6	469.1	581.8	410.6	371	522.2
100	416.4	368.9	528.9	267.1	206.9	330.4	464.5	481.2	583	421.8	387.1	536.6
105	431.4	388.9	547.1	287.9	227.4	355.3	464.1	485.9	585.4	433.1	401.7	550.7
110	441.7	405.6	559.4	307.4	247.5	378.3	468.2	491.1	590.1	441.9	414.9	561.5
115	448.7	418.6	567.6	325.5	266.9	400.5	473.7	499.8	589.3	450.8	425.2	571.7
120	458.8	434.5	579.8	341.7	284.8	420.7	473.3	501.8	593.5	455.3	434.8	575.3
125	466.8	446.8	589.4	356.2	302.4	439.7	474.9	507.2	592.1	460.2	441.6	584.1
130	475	458.9	599.4	369.8	318.7	456.9	479	506.6	594.1	465.6	448.3	587.3
135	481.9	468	607.8	382.6	333.8	473.2	479.7	510.9	594.7	468.2	454.1	588.3
140	485.6	475.6	612.2	393.5	348.1	487.5	481.5	511.4	597.6	469.5	461.7	587.4
145	487.8	482.7	614.7	404.5	361.6	501	476.9	512.4	594.9	469.6	464.5	586.4
150	491.3	487.2	618.8	413.9	374.3	511	473.7	510.3	594.4	471.2	467.4	588.9
155	493.8	492.4	621.9	421.7	383.9	521.2	469.2	509.4	584.3	474	470.5	589.2
160	494.8	495.7	622.9	430.2	394.8	530.4	470	510.5	585.1	476.1	473	589.3
165	498.6	500.6	627.5	435.9	404.9	538.4	473.1	504.1	588	477.5	476.8	592.8
170	500.4	503.1	629.7	442.6	412.9	546.5	470.2	505.3	588.2	476.7	477.3	593.3
175	501	504.5	630.3	448.1	420.9	554.1	471.7	505.1	586.3	479	478.6	591.8
180	501.4	503.4	630.7	454.1	428.4	561.8	471.6	503.3	585.2	478.5	478.4	591.6
185	501.5	507.3	630.8	458.8	434.8	569.6	471.7	502.6	588.5	480.5	480.7	588.2
190	503.2	511.3	632.8	463.6	441.6	574	471.5	503.2	589.3	479.6	479.2	586.5
195	499.4	512.2	628	468.2	447.9	580.7	472	502.3	591.2	478.5	481.1	583
200	499.9	513.3	628.5	471.9	452.9	584	470.6	502.6	590.1	478.9	483.7	581.9

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	Sw Pl p	Sw Pl p ct	Sw Pl p f	Pl Sw g	Pl Sw g ct	Pl Sw m/p	Pl Sw m/p ct	Pl g	Pl g ct	Pl g f	Pl m/p	Pl m/p ct	Pl m/p f
Age	111	111 ct	111 f	112	112 ct	113	113 ct	114	114 ct	114 f	115	115 ct	115 f
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	1.9	1.9	0	0	10.8	10.8	14.4	0	0	0
25	0	0	0	18	18	1	1	49.5	49.5	62.8	2.8	2.8	4.1
30	0	0	0	47.8	47.8	9.7	9.7	96.4	96.4	120.4	18.9	18.9	27.9
35	0.6	0.6	0.7	88.1	88.1	28.6	28.6	142.6	106	176.1	45.8	45.8	65.1
40	4	4	5.3	130.8	130.8	55.7	55.7	186.9	145.2	230.5	76.1	76.1	104.1
45	12.5	12.5	17.7	173.8	173.8	87.3	87.3	229.4	185.1	282.9	104.9	104.9	141.7
50	28	28	37.9	216.1	162.1	118.7	118.7	268.3	223.3	331.2	132.7	132.7	178.4
55	47.3	47.3	63.1	257.1	199	150.5	150.5	302.2	257.5	373.7	159.6	159.6	214.6
60	69.3	69.3	88.6	295	235.4	181.9	181.9	329.1	288	409	185.9	185.9	250.4
65	91.1	91.1	114.9	327	269	213	213	351.3	315	437.3	211.2	162.8	285.1
70	112.9	112.9	141.2	353.5	299.8	242.8	186.9	370.7	338.4	463.4	235.1	185.7	317.4
75	135.2	135.2	167.9	374.9	326.7	270.9	214.1	388.8	360	485.7	257	207.5	346.5
80	157.6	157.6	194.6	390.8	349.6	297.1	240.4	394.8	374.9	497	276.1	227.6	372.8
85	180.3	180.3	221.5	406.5	370.1	319.4	265.3	401.9	384.8	501.8	294.2	246.9	396.2
90	202.3	202.3	247.7	419.6	390.3	340.3	288.3	406.5	395.1	505.5	308.4	264	416.9
95	223.7	223.7	272.8	428.1	403.1	358.2	309.9	409.5	405.2	508.3	322	279.8	435.6
100	244.5	244.5	297	436.3	415.6	374.2	329.3	410.8	409.7	509.4	332.7	293.4	453.8
105	264.4	264.4	320	436.8	425.1	387.6	346.9	410.8	414.2	511.1	343.3	306.9	466.9
110	283.3	222.7	341.7	439.3	430.2	397	363.1	412.1	420.1	513.6	353.5	320.2	480.1
115	301	240.8	362.4	442.8	437.2	407.3	376.1	415	424.3	513.6	362.1	330.5	490.6
120	317.1	258.1	381.9	444.4	443.6	416.4	388.6	414.1	427.8	511.7	370.2	340.3	502.7
125	332.8	274.9	399.5	447.6	445.7	425.2	399	412.8	429.3	509.1	377.3	349.5	512.7
130	346.5	290.8	415.6	449	446.9	431.5	408.6	414.7	428.2	513	384.4	358.1	522.7
135	358.5	305.7	430.6	452.8	451.4	438.1	418.1	414.7	432.2	515.9	391.5	365	530.7
140	369.1	319.3	444.2	455.3	454.1	444.7	426.8	415.4	430	514.6	397.7	372.4	537
145	379.5	332.8	456.6	457.7	458.6	449.3	433.5	417	432.3	517.4	403.5	379.5	543.9
150	388.9	344.4	468.7	454.5	459.5	453.8	439.8	416.8	434.1	516.5	407.6	385.3	549.6
155	396.2	355	479.2	454.9	462.1	457.8	444.3	415.9	434.8	515.8	411	388.8	553.6
160	404	365.5	489.4	454.7	464	461.2	449.7	415.3	436.9	515.6	413.6	393	556.3
165	410.4	374.7	499.3	453.4	465.1	464.9	454.8	415.3	439.1	514.6	413.4	396.1	555.9
170	417.6	384.2	507.4	452.1	466.2	468.4	458.8	417.1	442	515	415.5	399	560.1
175	423.8	392.4	514.8	453.1	466.9	471.5	463	417.6	443.1	517.3	415.9	400.7	560.5
180	428.5	400.1	521.6	451.3	466.5	471.6	466.5	416.3	444.4	515.7	416.6	402.5	562.1
185	433.2	406.8	528.1	450.2	463.3	473.2	470.2	415.4	443	517.9	415.6	404	562
190	438.3	414	533.4	450.4	461.5	473.7	471.3	417.4	439.7	515.2	414.7	406.6	561.6
195	443.5	419.5	539.4	450.2	461.7	473.8	472.8	416.2	437.7	511.3	414.6	407.6	558.2
200	448	425.7	543.8	450.6	462.1	475.5	474.2	416.7	439	511.3	414.8	408.9	557.5

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				Pl m/p						Pl m/p		
	Pl g	Pl g ct	Pl g f	Pl m/p	ct	Pl m/p f	Pl g	Pl g ct	Pl m/p	ct	Pl m	Pl m ct
Age	116	116 ct	116 f	117	117 ct	117 f	118	118 ct	119	119 ct	120	120 ct
5	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
20	6.6	6.6	8.7	0	0	0	3.9	3.9	0	0	0.4	0.4
25	37.9	37.9	48.9	0	0	0	30.2	30.2	0	0	11.7	11.7
30	79.4	79.4	102.1	1.4	1.4	1.9	69.2	69.2	0.8	0.8	38.9	38.9
35	122.1	122.1	155	9	9	12.9	111.4	111.4	7.9	7.9	73	73
40	163.2	122.1	205.8	24.5	24.5	34.8	151.8	151.8	22.1	22.1	108.3	108.3
45	202.9	158.1	255.8	43.4	43.4	61.8	191.6	144.7	41.4	41.4	142.4	142.4
50	240.9	194.3	303.7	64.1	64.1	90.2	229.8	179.7	62.4	62.4	175.5	175.5
55	275	228.7	347.9	84	84	118	265.8	214.4	83.5	83.5	208	158.3
60	305.3	260.2	387.2	103.7	103.7	145.7	297.9	246.9	104.6	104.6	239.2	187.5
65	329	287.6	419.2	122.9	122.9	172.3	323.7	276.3	125.4	125.4	268	216.2
70	348.9	311.6	444.4	141.6	141.6	198.7	344.2	302.3	145.7	145.7	294.2	243.4
75	366	333.4	469.1	159.9	159.9	224.8	361.5	325.1	165.8	165.8	316.3	268.1
80	383.7	353.6	489.7	177.3	137	250.5	378.2	346.2	185.4	185.4	334	290.2
85	396.4	368.8	507.7	194.3	153	274.5	393.3	365.1	204.3	159.3	348.8	309.4
90	399.7	381.6	514.6	210.1	168.7	296.9	405.1	380.8	222.1	176.9	360.9	326.8
95	404.4	391.7	516.7	224.9	183.8	317.8	407.4	389.8	239	194.1	374	342.8
100	410.3	402.1	519.3	238.7	198.2	337.7	408	399.1	253.9	210.1	386.4	357.3
105	411.3	409.5	519.5	251.5	211.7	356.1	408	403.1	268.3	225.7	398.1	371
110	415.7	415.5	523.8	263.6	224.1	374.1	412.4	410.8	281.9	240.7	409.3	383.7
115	419.1	421.1	525.3	274.3	235.8	389.3	416.8	417.4	293.8	254.2	417.8	394.2
120	419.6	423.7	525.6	283.3	246.4	403.6	420.2	423.7	305.2	267.5	420.2	402
125	422.6	427	521.6	291.6	256.7	417.6	420.7	426.7	314.9	279.4	422.4	408.8
130	423.3	426.3	521	300.5	266.3	429.8	423.7	430.8	323.8	290.6	423.3	414
135	421.3	428.7	521.2	308.5	275.5	440.2	426.3	433.8	333	300.6	421.2	417
140	420.6	427.4	521.7	315.7	283.9	450.4	426.2	434.7	340.6	309.8	424.1	422.1
145	421.4	431.1	522.6	321.8	290.8	459.9	428.9	433.8	347.8	318.2	424.5	424.7
150	417.3	430.8	524.1	328.2	298.5	469.1	431.5	436	354.5	326	425.5	426.9
155	419.5	429.2	524.2	334	305.2	477.8	433	437.9	360.6	333.6	428.5	431
160	419.4	428.8	520.1	339.7	311.5	483.4	429.9	437.4	366.7	341.2	428.6	432.3
165	420.7	429.2	519.8	344.6	316.7	490.2	427.5	438.2	372.3	348	428.2	434.9
170	421.2	429.6	516.9	349.1	321.6	495.4	427.2	439.5	377.1	353.1	427.9	434.1
175	420.3	431.7	516.2	353.2	326.9	500	426.7	439.8	382.1	359.3	427.1	436
180	420.5	432.5	516.2	356.7	331.1	505.1	427.8	441	385.9	364	426.3	435
185	418.4	432.4	516.9	360.2	335.5	510.1	423.9	442	389.9	368.7	423.8	435.1
190	419.3	431.1	516.2	363.8	339.3	514.2	425.5	440.5	391.7	372	423.7	436.4
195	418.3	431	515.7	366.3	342.8	517	423.9	438.3	395	375.2	423.7	436.9
200	419.7	432.5	516.3	368.6	345.2	520.8	422.3	439.7	398	378.9	423.2	436.5

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