Morice LRMP: Government Technical Team

Morice Land and Resource Management Plan

Final Plan Analysis

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Executive Summary

The Morice Land and Resource Management Plan (LRMP) table has reached agreement on a range of issues in the Morice planning area. The LRMP government technical team interpreted aspects of the currently agreed strategic plan that could be assessed for both timber and ecological risks/benefits using the Morice Landscape Model (MLM; Fall et al. 2003). A set of experiments to assess timber supply impact was undertaken on scenarios capturing the full plan, as well as sensitivities around the various components of the plan. In addition, a detailed timber supply assessment was made for the full plan. This document presents the methods and results of these experiments. Some of the concepts build on the temporal experiments made previously (Fall 2004a). The Morice Landscape Model was used to project landscape state, forest age, composition and roads through time under different forest management strategies to conduct these experiments. The underlying basis of the MLM is a spatial timber supply model that generates timber indicators and spatial time-series information of projected landscape states. Ecological indicators are generated by the MLM in a post-processing step for interpretation by the environmental risk assessment team.

Key components of the plan that differ from the base case in terms of timber supply include (i) new no harvest and protected areas; (ii) various forest cover requirements for area-specific management zones; (iii) forest cover requirements for tourism buffers around lodges, cabins, trails and special features; (iv) modified caribou management zone; (v) modified application of agricultural conversion; and (vi) modified visual objective zones.

Overall, the current plan as captured by the above changes requires a maximum reduction of about 10% of the current harvest level. The more detailed timber supply assessment showed that little if any immediate reduction may be needed, but that the drop to the long-term (in steps of at most 5%/decade) will have to start after 10 years.

Acknowledgements

We would like to acknowledge the input of Allan Edie (consultant), Geoff Recknell (MSRM), Don Morgan (MoF) and Albert Nussbaum (MoF) regarding the methods and scenarios assessed in these experiments.

Audience

This report is intended primarily for the Morice LRMP Government Technical Team, Forest Analysis Branch, and domain experts, and may be useful for some table members.

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1. Introduction

The Morice Landscape model (MLM; Fall et al. 2003) was designed to project landscape state, forest age, composition, roads and ecological risk indicators through time under different forest management strategies. The MLM is an extension of the "SELES Spatial Timber Supply Model" (Fall, 2002) developed with the BC Ministry of Forests, adapted to the Morice timber supply area to address temporal landscape analysis questions relevant to the Morice LRMP.

A detailed assessment of current management ("spatial base case") was previously reported (Fall et al. 2003). The spatial base case provides a baseline for assessing alternate land-use scenarios in terms of timber supply and ecological risk. A series of experiments was conducted to explore timber supply impacts (expressed as a percentage reduction of the harvest flow from the last timber supply analysis, Min. of Forests 2002) for a range of scenarios designed to help gain a better understanding of the decision space, interactions among policies, and most constraining elements (Fall 2004a). These experiments included (i) Sensitivity of the spatial base case to application of landscape level biodiversity policies; (ii) Biodiversity conservation strategies based on forest cover targets derived from an assessment of the range of natural variability; (iii) Protection of individual areas of interest; (iv) Area-specific management rules; (v) Changes to visual quality objective targets; (vii) Agricultural conversion; and (viii) Application of no-harvest buffers around resorts, cabins and special features for maintaining tourism values.

The current plan agreement includes variations of some of the components assessed in these temporal experiments, as well as some new refinements. In addition, final plan assessment requires a more detailed timber supply assessment. We applied methods generally consistent with the approaches suggested by Fletcher (2004) to find a harvest levels that satisfy the following criteria (see Fall 2004b):

(i) *Timber supply is sustainable*: The annual harvest target must be achievable in all periods of a 400-year time horizon, and long-term growing stock must be stable. If this is declining, harvests are higher than can be supported, while if it is lower, there are some harvest opportunities. We define "long-term" as 3-4 centuries, "stable growing stock" as effectively non-declining between years 200-400. As in the experiment document, we allow a slight decline of 2% per century to match the spatial base case.

(ii) *No drops below long-run*: The harvest target must be maintained at or above the long-run level. This condition may not always be desirable, in particular for management units that have conditions for which a drop in some periods below the long-run may be necessary to achieve management objectives. In the Morice TSA, however, this goal effectively captures the criteria that short to mid-term management should not compromise long-term harvest levels.

(iii) *Maximize short-term levels*: The maximum short-term harvest level, up to the current AAC, should be attempted and maintained as long as possible. This condition is designed to minimize short-term impacts, in particular if the current harvest flow must initially be reduced to meet objectives for a given land-use scenario.

(iv) *Limit maximum drops between decades*: The maximum decline between subsequent 10-year planning periods is 5% of the period harvest target. This condition is designed to minimize the social and economic impacts of declining timber supply within any given decade.

2. Timber Supply Methods

Prior analysis showed that the variability between simulation runs was close to 0 (since the logging sub-model is mostly deterministic). In all simulations, we ran single-replicate simulations of 40 decades using a decadal time step. In addition, as in the TSR, the non-contributing ages remain static throughout the time horizon (Min. of Forests 2002).

Our goal is to provide information to domain experts (and by extension to the table and decision-makers) to gain understanding of the consequences of the final plan in its entirety and by sub-component. We need to estimate a reasonable harvest flow for each scenario (i.e. determine a timber supply impact), but due to the number of scenarios, it is not feasible to do a full analysis for each. However, more detailed harvest flow forecasting is needed for the full plan.

We applied a procedure to perform a coarse timber supply impact analysis using the MLM. We define the "direct" *timber supply impact* of a scenario as the difference in volume between the amount harvested in the base case and the amount that can be sustainably harvested (and with a level long-term growing stock) when applying the scenario rules and using the same “shape” of harvest flow (i.e. a proportional change in harvest flow). The goal is not to do a full timber supply assessment, but rather to assess how the current harvest flow may need to be revised to maintain sustainability of timber resources and meet the scenario constraints. To achieve this, we designed a general experimental methodology that attempts to find the maximum harvest flow that has the same basic shape as the current harvest flow in terms of timing and magnitude of changes in timber supply over time. In other words, the experiment attempts to find the proportion p such that p is between 0 and 1 and a harvest level of p*(current harvest flow) can be sustained. The timber supply impact is then 1-p.

To ensure valid comparison with the spatial base case, we need to consider what is meant by “level growing stock”. Nominally, this means growing stock with a slope of 0 over the long-term. However, on close examination, we find that the growing stock in the spatial base case has a slope of –0.0004 (i.e. it declines by 4% over the 3rd and 4th centuries, an average decline of 0.02%/year). For the purposes of the timber supply impact experiments, we use this as our threshold for “level growing stock”.

An efficient binary search method was employed to quickly converge on the timber supply impact for each scenario (Fall 2004b). Note that this method identifies an upper bound on timber supply impacts. That is because it demonstrates that the modified harvest flow is sustainable using timber supply criteria. More detailed timber supply analyses could refine this and find the impacts could be reduced in some periods (but not all periods).

To make a more detailed timber supply assessment of the final plan, we used the methods outlined in (Fall 2004b). This assessment is generated independent from the current harvest flow. It first involves estimating the maximum long-term harvest level. From this, the short term is incrementally increased, ensuring sustainability and the guidelines described in the previous section until no more increases are possible.

3. March 2004 Final Plan

The plan description required some interpretation by the GTT to describe details of those components that could be assessed quantitatively by the MLM. Data inputs used for the final analysis are outlined in Appendix 1. This section outlines the key components included in the timber supply analysis.

3.1 Changes to THLB

3.1.1 Reductions from THLB

No harvest areas (Grease Trail Core, Herd Dome, Lower Morice River Core, Morice Lake, Nadina River Core, Starr Creek, Swan Lake/China Nose, Troitsa/Tahtsa, Upper Morice River Core) and proposed protected areas (Atna Bay Ecological Reserve, Burnie Shea Lakes, Nadina Mountain, Nanika/Kidprice, Old Man Lake, North Spit, Sanctuary Bay, Old Fort, Bear Island, Port Arthur, Sand Point, Long Island/Cottonwood Point, Wrights Bay/Wilkinson Bay) amounted to 24,427 ha of THLB.

A furhter 793 ha of THLB (998 ha gross) were removed for island exclusions, and 314 ha of THLB was removed in the Morrison Lake/Babine East area to satisfy the rule for no harvesting in 30m lakeshore buffers.

In total, 25,534 ha (3.7%) were removed from the base case THLB (which was 687,497 ha in the base case).

3.1.2 Agricultural land conversion

In the TSR analysis, areas marked as agricultural land reserve (ALR) were removed entirely from the THLB as a netdown. The directions for the final plan analysis were to restore the THLB in this area, and to explicitly model the process of agricultural land conversion as it is described by the plan. To achieve this the THLB netdown process applied in TSR was used, without applying the ALR rule, which resulted in an increase of 10,223 ha of THLB (gross of 10,389 ha) over the prior reductions for no harvest areas. See section 3.3.3 for a description of how agricultural conversion was captured.

3.2 Forest Cover rules

3.2.1 Forest cover requirements

Targets for forest cover across the entire plan area were specified by both area specific management (ASM) polygons and general management direction (GMD; everywhere else). These targets replace the landscape level biodiversity targets applied in TSR2. Area specific polygon forest cover requirements were applied as either: High Biodiversity Emphasis Areas (HBEA) was applied in areas with relatively stringent forest cover requirements or unique forest cover specifications in certain areas with even higher requirements. Forest cover requirements for GMD were applied elsewhere. These requirements were applied to all forest within each area by BEC zone. Some small BEC zones were merged with larger BEC zones at the request of the table. The HBEA and GMD forest cover forest cover requirements are in Table 1.

Table 1 GMD and HBEA forest cover requirements

BEC	Max. young (≤ 40 years)		Min. mature (> 100 years)		Min. old (> 140 years)	
	GMD	**HBEA**	**GMD**	**HBEA**	**GMD**	**HBEA**
Atp	N/A	N/A	N/A	N/A	N/A	N/A
CWHws2 / MHmm2	26.8%	16%	58.8%	71.0%	58.3%	69.9%
ESSFmc / ESSFmv3	37.7%	28.1%	37.0%	47.8%	34.3%	42.4%
ESSFmk	9.4%	6.6%	82.6%	86.3%	81.7%	84.5%
SBSdk	64.2%	50.0%	10.3%	20.6%	7.8%	15.6%
SBSmc2 / SBSwk3	47.6%	36.7%	20.2%	32.8%	16.9%	26.2%

GMD was applied in 91.1% of the forested area and 91.0% (611,381 ha) of THLB. This corresponds to the GMD polygon as well as the following ASM areas: Babine Lake East Arm Buffer, Matzehtzel Mountain and Nez Lake, Morice Mountain, Twinkle Horseshoe Chain, Bulkley River.

Basic HBEA was applied in 1.5% of the forested area and 1.3% (8,986 ha) of THLB, in the Friday Lake - Nakinilerak Lake - Hautete Lake and Morrison Lake ASM areas.

Some areas specified higher targets than HBEA. These are identified as HBEA50 (minimum mature and old 50%) or HBEA70 (minimum mature and old 70%). The differences from HBEA (as described in Table 1) are shown in Table 2; otherwise HBEA targets were applied.

Table 2 HBEA50 and HBEA70 additional min. old forest cover requirements

BEC	Min. mature (> 140 years)	
	HBEA50	**HBEA70**
ESSFmc / ESSFmv3	44%	61%
SBSdk	38%	53%
SBSmc2 / SBSwk3	40%	55%

Note: mature + old minimum is 50% and 70% respectively; the minimum old target was calculated proportionally based on same ratio (of old) determined for HBEA (A. Edie, pers. comm.).

Table 3 shows the particular forest cover rules applied to these special management areas. Note that some zones specify targets for which at least 50% is to be met in the THLB. Such targets were captured using two rules, with the THLB target reflecting requirements scaled by the proportion of THLB in the area.

Table 3 Additional rules for special management areas

Area Name	Management Direction Notes	Forest cover rules applied
Gosnell / Thautil	Minimum mature and old 50% throughout; HBEA criteria including min. old and max young apply simultaneously. At least 50% of required mature and old and 50% of required old must be from contributing forest.	HBEA50 Min. 50% older than 100 years Min 33.1% of THLB older than 100 years Min. 28.3% of THLB older than 140 years
Grease Trail Buffer	400m each side of core area managed for wildlife connectivity/biodiv. 70 % mature and old through time. The intent is to manage for biological objectives as well as maintenance of trail/cultural integrity.	HBEA70 Min. 70% older than 100 years
Lower Morice River Buffer	50% mature and old, HBEA applies	HBEA50 Min. 50% older than 100 years
Morrison LK & Babine East core (0-130 m)	Mimic 30m harvest exclusion plus a portion to account for extra management constraints in the 100m "buffer".	GMD 30m buffer removed from THLB as a netdown (see previous section)
Nadina-Owen	Minimum 70% mature and old. HBEA provisions for min. old and max young.	HBEA70 Min. 70% older than 100 years
Nadina River Buffer	50 % mature and old, HBEA applies.	HBEA50 Min. 50% older than 100 years
Nanika River	Minimum 70% mature and old. HBEA provisions for min. old and max young.	HBEA70 Min. 70% older than 100 years
Upper Morice Buffer	70% mature and old; HBEA for min old, and max young apply simultaneously.	HBEA70 Min. 70% older than 100 years

HBEA50 was applied in 5.3% of the forested area and 5.5% (37,082 ha) of THLB, and HBEA70 was applied in 2.1% of the forested area and 2.2% (14,737 ha) of THLB.

3.2.2 Forest cover requirements for tourism buffers

Table 4 shows the cover rules applied for tourism features. The 90% rule was applied on 0.2% of the THLB and the 70% rule was applied on 1.3% of the THLB.

Table 4 Forest cover rules for tourism buffers

Feature	Buffer radius	Forest Cover rule
Lodges and resorts	1000m	Min. 90% of THLB > 100 years
Cabins	500m	Min. 90% of THLB > 100 years
Trails, waterfalls, special features	200m	Min. 70% of THLB > 100 years

3.2.3 Modified caribou management zones

As in TSR, the caribou forest cover rules were applied by landscape unit (Table 5)

Table 5 Forest cover rules for caribou management

Herd Area	Forest Cover rule	Area affected
Telkwa	Max. 50% of forest younger than 90 years	2.9% of forest; 2.7% of THLB
Takla High	No harvesting	0.2% of forest; 0.1% of THLB
Takla Medium	Max. 30% of forest younger than 80 years	0.1% of forest; 0.1% of THLB

3.2.4 Modified visual objective zones.

The visual objective rules changed only slightly from December 2003 scenario reported in (Fall 2004a). To assess the new scenic classes, we incrementally shifted the base case visual rules to the new visual rules. As the age to reach greenup height was estimated for each LU/VQO combination in the base case, we needed a more general approach for the new mapping. Since an assessment of the impact of using the mean age to reach greenup for each VQO showed no difference compared to the base case, we used this approach for the new visuals. We next modified the original VQO ratings based on the new scenic area classes (see Fall 2004a). As some of the new scenic areas have no VQO mapping, we needed to generate some VQO polygons. To do this, we computed the proportion of each original visual class covered by VQO polygons, as well as patch size distribution and shapes. Then polygons were randomly placed in scenic class areas with no previous VQO polygons using proportions, sizes and shapes consistent with prior VQO polygons. This resulted in the following visual rules and areas:

Table 6 Forest cover rules for visual objectives

VQO	Forest Cover rule	Area affected
Preservation	Max. 1% of forest younger than 27 years	0.9% of forest; 0.8% of THLB
Retention	Max. 5% of forest younger than 26 years	3.3% of forest; 2.9% of THLB
Partial retention	Max. 15% of forest younger than 25 years	10.2% of forest; 9.8% of THLB
Modification	Max. 25% of forest younger than 24 years	6.3% of forest; 6.5% of THLB
IRM	Max. 25% of THLB than 18 years	80.0% of THLB

3.2.5 Cultural Heritage

Sensitivity was assessed for the following cultural buffers, which applied to 12.1% of the THLB.

Feature	Buffer radius	Forest Cover rule
Cultural sites, trails and features	500m	Min. 90% or 70% of THLB > 100 years

3.3 Other Management Modifications

3.3.1 Extended rotations

Extended rotations were applied to 4.2% of blocks, randomly selected during harvesting. This target was based on a median of 5-10% = 7.5% applied to 55% of the blocks. In these blocks, Table 7 specifies the "ecological rotation age" used for the min. rotation age (which supersedes min. harvest age in these areas).

Table 7 Ecological extended rotation lengths

BEC Variant	Stand Type Leading Species	Min. Rotation Age
MHmm2	All stands	350
CWHws2	All stands	200
ESSFmk	Pine	300
	All stands	650
ESSFmc and ESSFmv3	Pine	180
	All other stands	219
	Balsam/Spruce	350
SBSmc2 and SBSwk3	All stands	133
	Balsam/Spruce	200
SBSdk3	All stands	93
	Spruce	250

3.3.2 Wildlife tree patches

In TSR2 and the base case, yield curves were reduced by 3.6% to account for volume left standing as wildlife trees and patches (WTPs). We assessed sensitivity of final scenario to increasing this adjustment to incorporate higher WTP retention on large blocks. Table 8 shows the expected proportion of the plan area (broken out by GMD and HBEA areas) to which large blocks will be applied.

Table 8 Stratification of plan area according to GMD/HBEA and expected block size

	% of Plan Area		
Patch Size	**GMD**	**HBEA**	**Total**
Large	46.75%	8.25%	55%
Other	38.25%	6.75%	45%

Table 9 shows the target WTP reduction to yield curves. These were applied separately in GMD and HBEA portions of the landscape proportionally based on the target levels of large blocks. Note that these reductions, as in TSR2, were not applied spatially. The model was also enabled to assess WTPs spatially, while explicitly accounting for amounts in the non-contributing landbase.

Table 9 Target WTP rules by GMD/HBEA and block size

	Biodiversity Emphasis	
Patch Size	**GMD**	**HBEA**
Large	-7.5%	-12.5%
Other	-3.2%	-3.2%

3.3.3 Agricultural Land Conversion

Table 10 shows the rates and maximum forest areas to be converted in each agricultural expansion area. Agricultural conversion was applied as a separate process in the landscape model. For each conversion zone, the specified amount of forest per decade was converted to non-forest. Preference for stand selection was made based on proximity to private land (increased preference for stands closer to private land), species (non-THLB deciduous where available, deciduous leading), and elevation (lowest available elevation). Hence the amount of THLB converted will be less than the target.

Table 10 Agricultural conversion amounts and rates

Agricultural zone	Maximum area (ha)	Rate (ha per 5 year period)
Fulton	2,500	250
Bulkley	10,000	600
Parrott	6,000	400
Morice West	2,000	200
Poplar Lake	1,500	200
Ootsa	500	200
Total	22,500	N/A

3.4 Scenarios

To explore the final plan package, we designed a set of experiments to assess each key component separately, and then combined into a full package.

4. Results and Discussion

4.1 General Timber Supply Impacts and Sensitivities

The estimated timber supply impacts for each main type of experiment are summarized in Table 11. Results include unsalvaged losses of 171,959 m^3/year for the first 50 years and 104,572 m^3/year thereafter along with harvest levels (including results reported for the TSR analysis) because new unsalvaged losses would need to be estimated for each scenario based on THLB netdowns and assumptions regarding implementation of GMD/HBEA rules in response to natural disturbance (see section 4.4). If we assume that USL changes in proportion to changes in THLB, then USLs should decrease by 3.7%. As this is less than the plan impact, the actual impact of the plan on harvest levels will be slightly more (around 0.2%).

Impact results should be considered accurate only to the nearest percentage, although they are shown to one decimal place to allow comparison among scenarios. In order to maintain accuracy at the expense of precision, they should be rounded to the nearest percentage due to uncertainties in data and methods. Note that a long-term harvest impact of 0.1% corresponds to approximately 1800 m^3/year, or about 7ha/year.

Overall, the LRMP table agreement has an expected impact of about 7% of the current harvest flow. The effect of spatial rules (blocks, access, etc.) in the final plan is about 2.6% (difference between “Final Plan” and “Aspatial Final Plan”). Hence the timber impact of the full plan should be based on the “Aspatial Final Plan” results of 7.2% (and the harvest flows should use aspatial rules and account for USLs, as presented in section 4.4). The column “Over Spatial Base Case” shows the impacts above the spatial base case (i.e. Total – 3.2%), while the column “Over Plan Spatial Effects” shows the impacts above the spatial effects in the final plan (i.e. Total – 2.6%). Actual scenario impacts will in general be between these two bounds, with values closer to the latter for scenarios closer to the final plan.

The sources of the plan impacts are partly due to the following components:

- No harvest and protected areas: ~1.9%, derived from the difference between the “SBC” and “SBC + harvest exclusions” scenarios, or from the difference between the “Final Plan” and “No harvest exclusions” scenarios.
- Wildlife tree patch rules: ~3.3%, derived from the difference between the “Final Plan” and “NoWTP” scenarios.
- Agricultural conversion: ~2.6%, derived from the difference between the “Final Plan” and “NoAg” scenarios.
- ASM forest cover rules.

Due to non-linear inter-dependencies and feedbacks in the system, we don’t expect to be able to completely separate causal components precisely (i.e. the impacts sum to more than the total plan impact). The impact of plan components other than harvest exclusions is about 5.3% (7.2% - 1.9% for harvest exclusions), which is consistent with the 5.3% impact see for the final plan with GMD rules applied instead of harvest exclusions (“No harvest exclusions” scenario).

Table 11. Summary of timber supply impacts of March 2004 final plan. The timber supply impact shows the overall impact, plus the portion attributable to LRMP decisions (i.e. subtracting the portion due to assumptions about how spatial effects impact timber supply).

Experiment Name	**Brief Description**	**Timber Supply Impact**		
		Total	**Over Spatial Base Case**	**Over Plan Spatial Effects**
SBC	Spatial base case	3.2%	0%	n/a
Final Plan	Components of the final plan including no harvest areas, ASM, agricultural conversion, modified forest cover rules, extended rotations. Used TSR2 reductions for WTPs.	9.9%	6.6%	7.2%
Aspatial Final Plan	Same as Final Plan, but with spatial effects disabled	7.2%	n/a	7.2%
No harvest exclusions	Same as Final Plan, but with no harvest exclusions (applying GMD rules instead)	7.9%	4.7%	5.3%
SBC + harvest exclusions	Same as SBC, but applying no harvest areas of final plan	5.0%	1.8%	n/a
Scenario B	Same as Final Plan, but with WTP rule proposed by table included	12.0%	8.8%	9.4%
Scenario A	Same as Scenario B, but without applying additional min. mature rules in Table 2.	11.8%	8.6%	9.2%
Spatial WTP	Same as Final Plan, but applying spatially explicit WTP rule using double the target and accounting for non-contributing	11.2%	8.0%	8.6%
NoWTP	Same as Final Plan, but with no WTP rule	6.5%	3.3%	3.9%
GMD_WTP	Same as Final Plan, but with GMD WTP target applied everywhere	11.8%	8.6%	9.2%
NoAg	Same as Final Plan, but with no agricultural conversion (but with same starting THLB)	7.2%	4.0%	4.6%
CultBuf90	Same as Final Plan, but with 90% rule applied for cultural buffers	16.9%	13.7%	14.3%
CultBuf70	Same as Final Plan, but with 70% rule applied for cultural buffers	14.2%	10.9%	11.5%

Additional sensitivity analysis was done to assess the rule applied in the Gosnell/Thautil ASM for meeting at least 50% of the required mature and old, plus 50% of required old from the THLB. We found that this rule has no incremental effect (i.e. the impact was identical when this rule was entirely disabled, or when it was applied in most of the HBEA50 and HBEA70 areas) because most areas have a high proportion of THLB and so in general at least 50% of the forest required to meet the overall target for the ASM is from the THLB.

4.2 Comparison Final Plan, Base Case and TSR Results

Figure 1 compares the harvest flows from TSR, the coarse timber supply impact (PlanS10, with "S" for "spatial" and "10" for the approximately 10% impact) and the detailed analyses (PlanS A, which shows the results with a max. 5% step size and PlanS B, which allows a 10% step size). In the detailed analysis with 5% steps (PlanS A), the first period start at about 2.11 million m^3 (approximately 1.3% less than the current harvest flow). This is followed by 4 decadal steps of about 5% of the previous period (i.e. decreasing step sizes). One last step of about 1% in the 6^{th} decade is made to the long-run harvest level of about 1.72 million m^3. In the detailed harvest flow with 10% steps (PlanS B), the first decade can be maintained. This is followed by a 2.3% step in the second decade, 10% in the third, 8% in the fourth and 0.5% in the fifth decade.

Note: these new harvest flow results include the spatial effects (about 3% in the spatial base case), which should be removed when assessing LRMP plan impacts. Whether the spatial effects of modelling assumptions regarding spatial constraints on timber supply are an artefact of our approach or reflect actual operational constraints, they don't directly relate to decisions made by the LRMP table. Hence, any impacts shown in harvest flows should be reduced by about 3%. These flow results also include unsalvaged losses, which should be removed to assess impacts on harvest alone. See sections 4.3 and 4.4 for comparison of results with these components excluded.

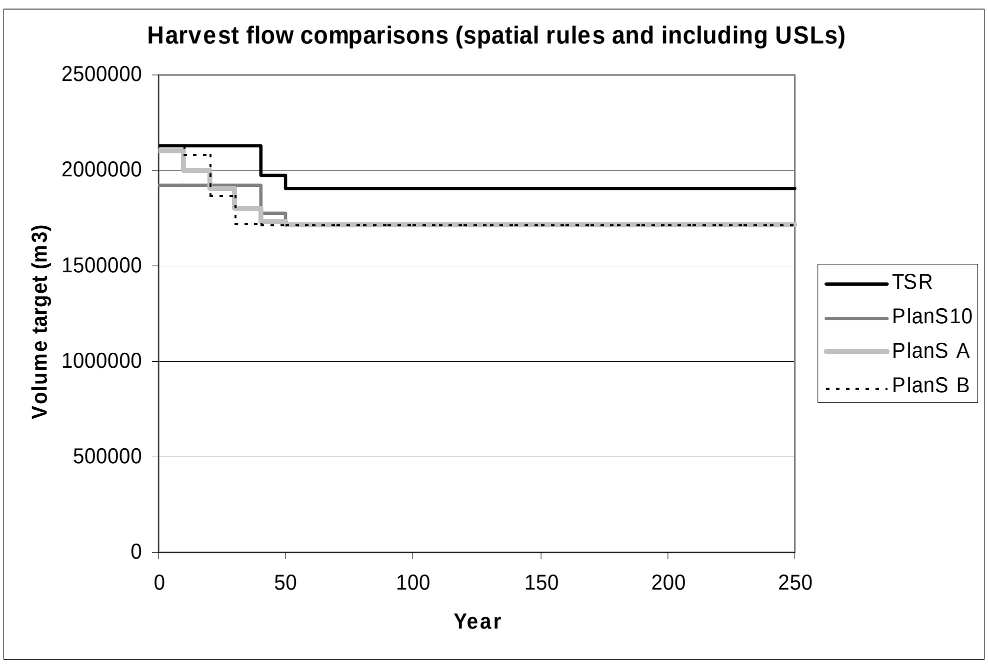

Figure 1. Comparison of harvest flow from TSR2, 10% timber supply impact in Table 11 (PlanS10) and detailed flow assessments (PlanS A and B). These flows include USLs and apply spatial harvesting rules.

The following graphs compare timber supply indicators for the TSR2 results (TSR), the spatial base case (SBC), the aspatial base case (TSR alignment case; ASB) and the detailed harvest flow analysis "PlanS A" (called "Plan" in the figures that follow). The total THLB growing stock (Figure 2) and merchantable growing stock (Figure 3) show

how the aspatial base case tracks the TSR results quite closely. The spatial base case and plan result in higher growing stock in the mid-term, but converging in the long-term with the aspatial base case.

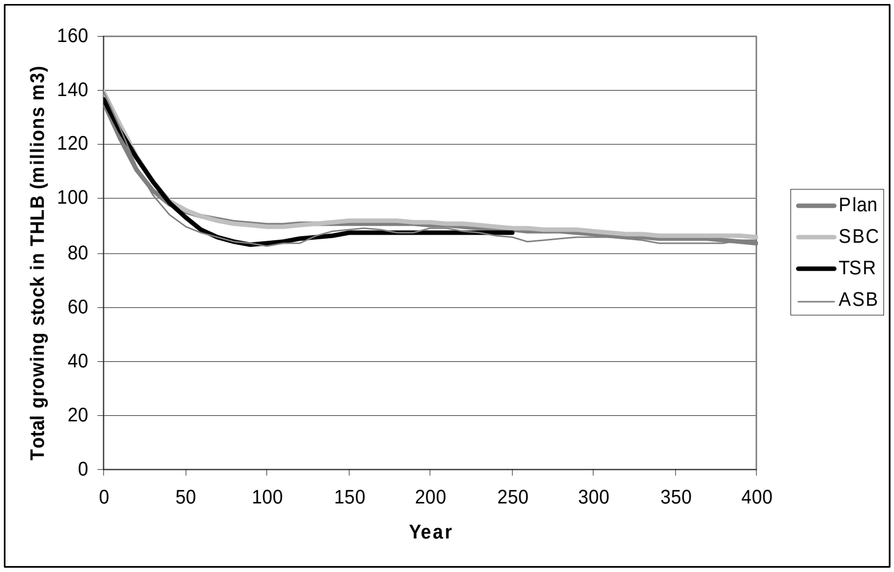

Figure 2. Total growing stock in millions of m^3.

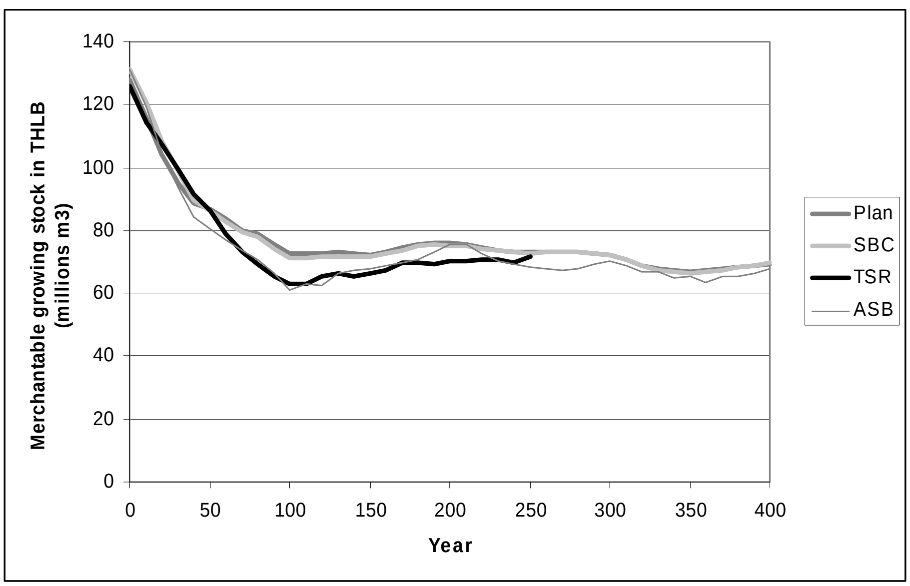

Figure 3. Merchantable growing stock in millions of m3.

The area harvested (Figure 4) is identical between the TSR and aspatial base case, since the aspatial base case was run using an area-based harvest target. The plan analysis initially harvests about the same as in TSR, but then decreases due to the declining harvest flow. After a century this rises and gradually increases from about 6,500 ha/year to about 7,000 ha/year. Figure 5 shows the mean volume harvested per hectare, which is fairly comparable across scenarios (but somewhat higher for the aspatial base case in the early periods). Mean harvest age (Figure 6) drops in all cases from about 175 years to a long term level of just under 100 years between 100-130 years. Figure 7 shows the area of THLB converted to agriculture in the plan analysis in each of the conversion zones, while Figure 8 shows how the plan analysis shifts harvesting from old (unmanaged) and thrifty stands to managed stands, mostly between 70-90 years.

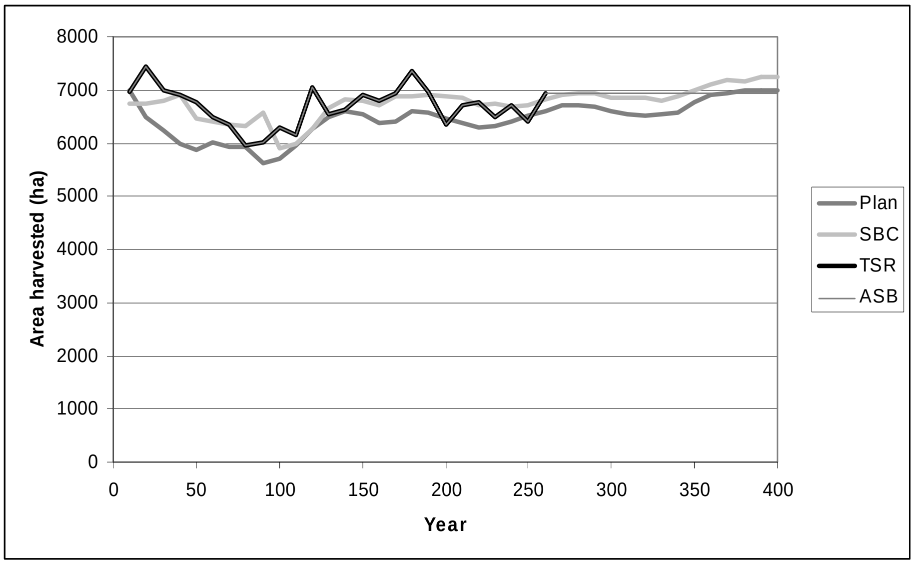

Figure 4. Area harvested in hectares

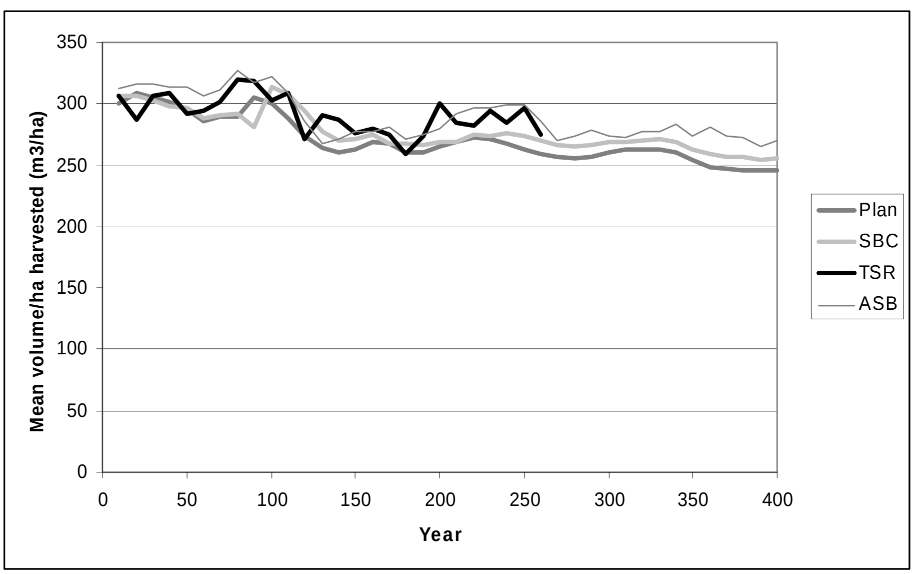

Figure 5. Mean volume per hectare harvested in m^3/ha.

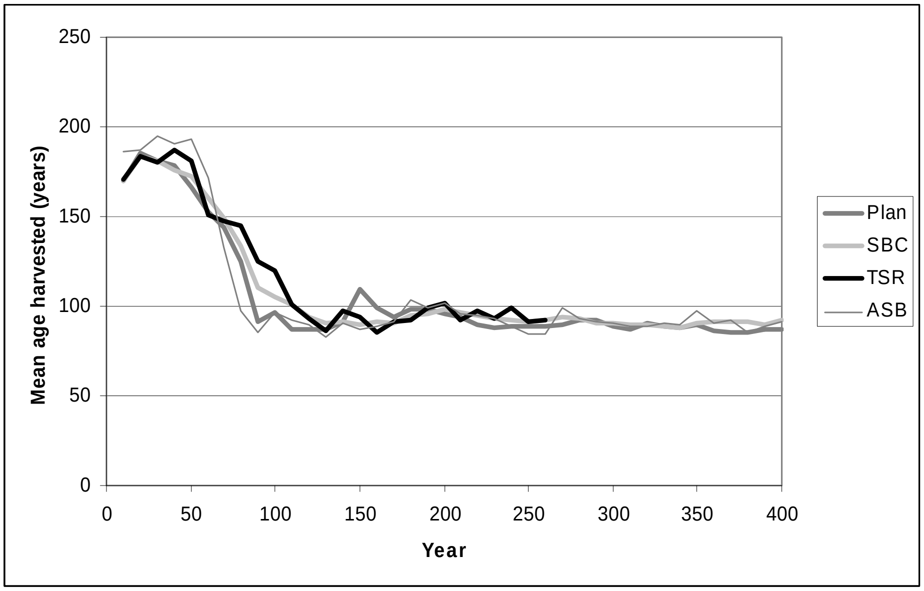

Figure 6. Mean age harvested in years/ha.

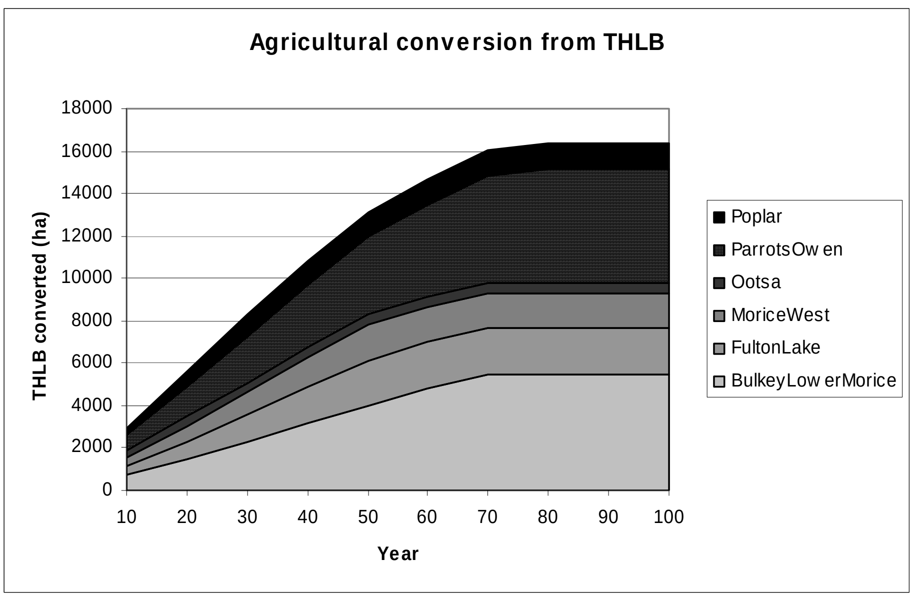

Figure 7. Area of THLB converted to agricultural land in final plan over first century.

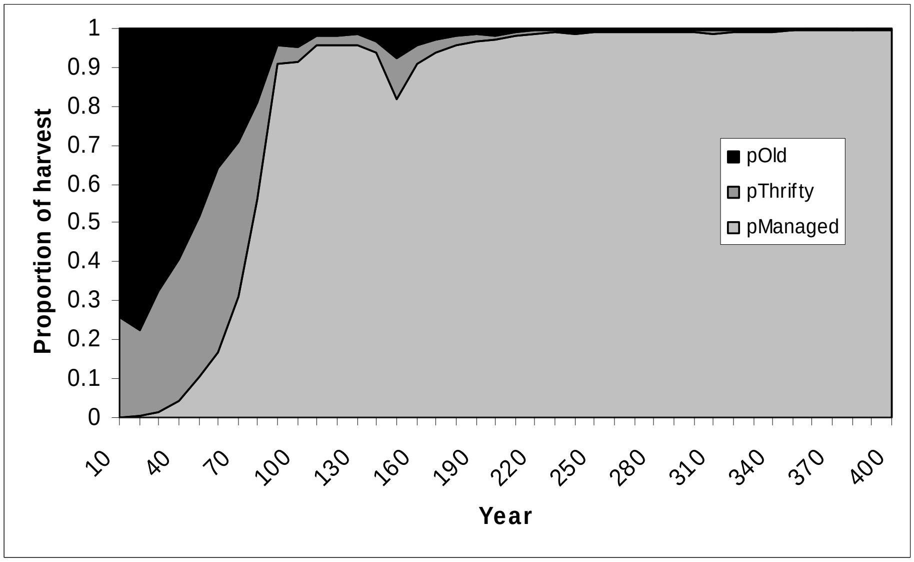

Figure 8. Proportion of harvest in unmanaged (Old), thrifty and managed stands over time in the final plan.

4.3 Assessing Effects of Spatial Modelling Rules on Results

Figure 9 compares the harvest flows from TSR with results from plan harvest flows that don't include spatial rules (e.g. block size and access). The coarse timber supply impact assessment showed a long-term impact of about 7% (and hence is named PlanNS7). Two detailed non-spatial harvest flows were generated (PlanNS A and PlanNS B). These flows differ in the short and mid-term, but converge on the long-term level. Table 12 shows the volumes (including USLs) for these and the spatial flows (Figure 1).

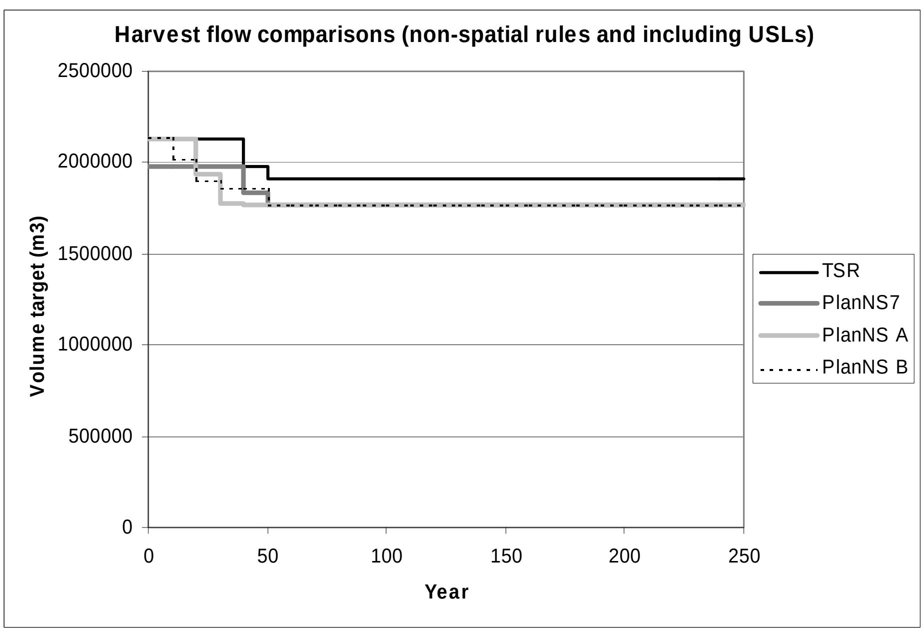

Figure 9. Comparison of harvest flows using non-spatial rules (7.2% timber supply impact in Table 11 and two detailed flow assessments, PlanNS1 and PlanNS2). These flows include USLs.

Table 12. Comparison of harvest flows, and flows using spatial rules and non-spatial rules. Constant reduction harvest flows are 9.9% using spatial rules (PlanS10) and 7.2% using non-spatial rules (PlanNS7). Volumes are in millions of m^3 and include USLs.

	TSR2	Spatial rules			Non-spatial rules		
Decade	Harvest Flow	PlanS10	PlanS A	PlanS B	PlanNS7	PlanNS A	PlanNS B
10	2.133	1.921	2.106	2.133	1.979	2.133	2.136
20	2.133	1.921	2.001	2.083	1.979	2.133	2.017
30	2.133	1.921	1.901	1.875	1.979	1.934	1.904
40	2.133	1.921	1.806	1.725	1.979	1.780	1.859
50	1.975	1.778	1.732	1.717	1.832	1.770	1.859
Thereafter	1.908	1.717	1.717	1.717	1.770	1.770	1.770

4.4 Assessing Effects of Unsalvaged Losses on Results

Figure 10 presents the harvest flows from Figure 1 (i.e. using spatial harvesting rules) with USLs removed. USLs for the plan flows were reduced by 3.7% over the TSR values to account for the reduction in THLB (i.e. the TSR analysis applied unsalvaged losses of 171,959 m^3/year for the first 50 years and 104,572 m^3/year thereafter, while the plan analysis applied 165,597 m^3/year for the first 50 years and 100,703 m^3/year thereafter). This shows how the "PlanS A" and "PlanS B" flows actually result in a mid-term dip below the long-term level due to decreasing USL levels in the 6th period. Figure 11 presents the harvest flows from Figure 9 (i.e. using non-spatial harvesting rules) with USLs removed. This shows how the "PlanNS A" flow has a mid-term dip below the long-term level due to decreasing USL levels in the 6th period. The "PlanNS B" flow has no mid-term dip by design. Table 13 shows the volumes for these flows.

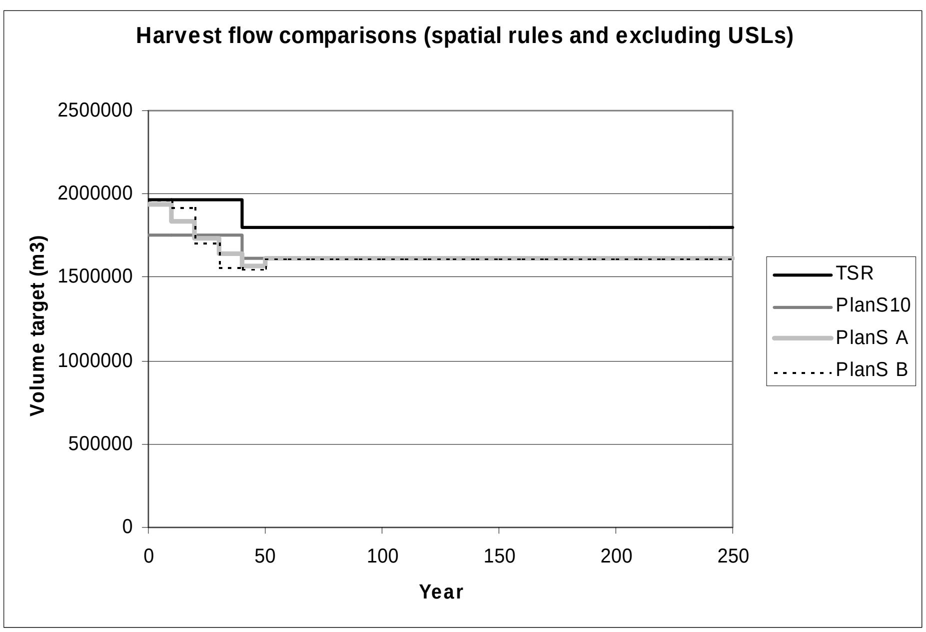

Figure 10. Comparison of harvest flows from Figure 1, but excluding USLs. These flows apply spatial harvesting rules.

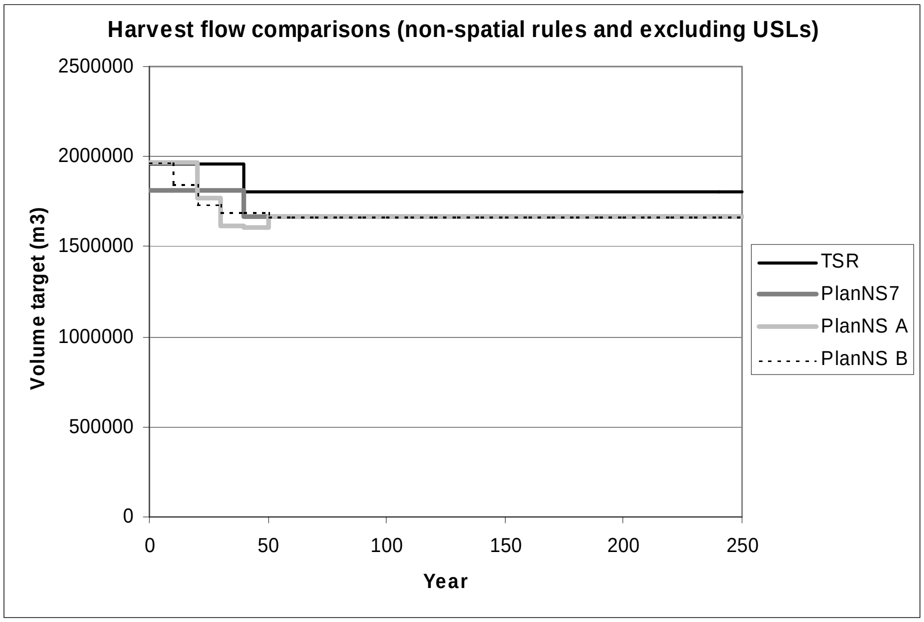

Figure 11. Comparison of harvest flows from Figure 9, but excluding USLs. These flows apply non-spatial harvesting rules.

Table 13. Comparison of TSR2 harvest flow, and flows using spatial rules and non-spatial rules. Constant reduction harvest flows are 9.9% using spatial rules (PlanS10) and 7.2% using non-spatial rules (PlanNS7). Volumes are in millions of m^3 and do not include USLs.

	TSR2	Spatial rules			Non-spatial rules		
Decade	**Harvest Flow**	**PlanS10**	**PlanS A**	**PlanS B**	**PlanNS7**	**PlanNS A**	**PlanNS B**
10	1.961	1.755	1.941	1.967	1.813	1.967	1.971
20	1.961	1.755	1.835	1.917	1.813	1.967	1.851
30	1.961	1.755	1.735	1.709	1.813	1.769	1.738
40	1.961	1.755	1.640	1.560	1.813	1.614	1.693
50	1.803	1.613	1.567	1.551	1.667	1.604	1.693
Thereafter	1.803	1.616	1.616	1.616	1.669	1.669	1.669

These results indicate that the long-term impact of the plan is approximately 7.4% (100% - 1.669/1.803), assuming that the current harvest is maintained before stepping down in a controlled manner to the long-term level.

5 Conclusion

The long-term timber supply impact of the plan was estimated to be about 7%, with no immediate reductions in harvest level required and with controlled steps after 1-2 decades to the long-term level. This result generally holds with respect to both methods of accounting for spatial effects (i.e. subtracting the spatial effects relative to the base case from a spatial plan analysis, or performing an explicit aspatial plan analysis), and whether USLs are removed from the impact levels or not, with a range of estimated long-term harvest level impacts of 6.6% to 7.4%. A long-term impact of about 7.4%, or approximately -134,000 m^3/year, is indicated by the harvest flows that (i) apply non-spatial rules; (ii) assume unsalvaged losses decrease in proportion to THLB reductions; and (iii) maintain the current harvest level for at least one decade (Table 13). Given uncertainty in data and methods, timber impacts should be considered accurate only to the nearest percentage (i.e. an overall impact of 7%). As the estimates reported are the results from a strategic planning model, differences can be expected when the plan is implemented operationally.

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Appendix 1. Data inputs to MLM

	Coverage	Comment
Physiography		
Double Sided Water	twtra_mo	
Single Water Feature	twtr_mo	line grid
LRMP boundary	tlrmp_mo	
BEC - 1:20,000 scale	tbec	
Forest Cover		
Inventory Type Group	fc_mo1102alb	
Projected Age	fc_mo1102alb	
Site Index	fc_mo1102alb	
Percent Pine	pcpine	an existing grid created by moriceprep.aml
Stems per hectare	fc_mo1102alb	
Logging History	f_fc_mo	logging attribute populated with act=L and actyr1 created by moriceprep.aml
Roads		
Amalgamated roads	mor_road	
Management Zones		
Landscape units	tflu	
Type ID	fc_mo1102alb	
Operability	f_oper	
Operating Areas	dmo_op_alb	from dmo
Operating Areas-Canfor	dfa_20021018	from Jim McCormack Canfor
Morice LRUP Zone A	mor_lrup	
VQO	hubvqo2	$MOMOF/nonstandard/tvli_dmo does not have water clipped in
Telkwa Cariboo	tcar_mo	
IRM	?	What's left after other removals!
MPB Hazard Rating	m_mpbhaz	These are based on fc queries and therefore change with update.
SBB Hazard Rating	m_sbbhaz	
BBB Hazard Rating	m_bbbhaz	
5-year development plan and blocks		These are all from TSR2 - IFPA data?
Updated forest cover	fc_mo1102alb	Updated FC from Canfor
Small Biz blocks	sbfep_fdp	IFPA small biz blocks are just line work
Canfor Blocks & Proposed	cfp_blks01alb	Sent by Barry Watson, Canfor
HFP blocks	hfp_blkharv	Use harvest as subclass from hfp_blocks02? Sent by Lyle McNab of HFP
THLB		
Contributing Class	athlb_dmo	Contributing class
Inclusion factor	athlb_dmo	percent included in THLB
Ownership	f_own_mo	61C, 62C, 69C as per Albert N. netdown code
Timber Supply Block	f_tsab	Ken? Most recent? - lines up with operating areas from dmo
Woodlots	woodlot_alb	More recent from dmo? - part of operating areas? Still being discussed - Liz S.
Agricultural Land Reserve	f_alr	
Recreate Areas	hub_rec	rec_netdown as per Albert's code from the tsr/wgis/hub_rec file had to be modified by moriceprep.aml. Bob C may have more recent.
ESA1	fc_mo1102alb	

	Coverage	**Comment**
ESA2	fc_mo1102alb	
Parks	qpark_mo	
PAS Goal 1	qpasai1_mo	
PAS Goal 2	lpasai2_mo	
Road buffer	road_buf	
Riparian Buffers		
Riparian Reserves Zones	rrz_mo	merged all riparian reserve zones
Riparian Management Zones	rmz_mo	merged all riparian management zones
MPB data		
Infestation Spot Data		
Stand Density		
Susceptability/Risk Rating		
Weather Stations		
Other Beetle data		
Spruce BB		
Balsam BB		
FSSIM files		
vol.dat		
axs.dat		