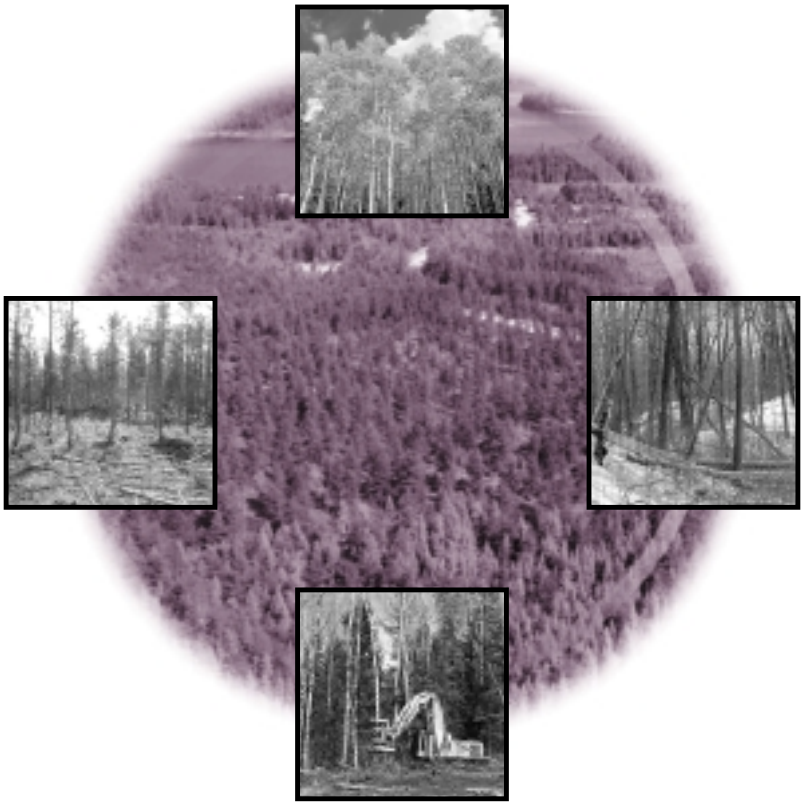
Ontario

Provincial Wood Supply Strategy

Appendix 2

Best Practices for Wood Supply Modelling



FOREST POLICY SERIES

Version June 24, 2004

APPENDIX 2: BEST PRACTICES FOR WOOD SUPPLY MODELLING

These Best Practices for Wood Supply Modelling were assembled to guide resource managers in setting-up and conducting forest level analyses for forest management planning in Ontario. They are part of the Provincial Wood Supply Strategy and are are meant to provide an analysis starting point and provoke thought on model assumptions and inputs. Those who conduct analyses should be cognizant of the impacts of choosing certain methods/inputs and the relationships between inputs.

Scope

Analytical techniques used to assess forest resource supply are necessarily simplifications of the real world. Many of the factors used as inputs to the analysis are uncertain due in part to variations in physical, biological and social conditions. Ongoing science-based improvements in the understanding of ecological dynamics will help reduce some of this uncertainty. These best practices were developed through a synthesis of current information and expert opinion. They will be updated periodically as our understanding of analytical approaches/ procedures improves, therefore please ensure to use the most recent version when conducting analyses.

The most recent version of the Best Practices for Wood Supply Modelling can be found on the Ontario's Forests website:
http://ontariosforests.mnr.gov.on.ca/

It is located under Forest Publications with the electronic version of the Provincial Wood Supply Strategy.

Principles

Analysts should attempt to reflect as closely as possible operability and forest management factors (guides, yields, etc.) of current practices. It is not appropriate to base analyses on unsupported speculation, although sensitivity and risk analyses can be used to investigate any number of hypotheses.

In keeping with the objective of good forest stewardship, projected short and medium-term harvest levels should be compatible with a smooth transition to the long-term level thus, timber supply should remain stable enough so that there will be no inordinately adverse impacts on current or future generations.

Appendix 2: Best Practices for Wood Supply Modelling

Item	Consideration
Information Preparation	
Base Inventory	Use the most up-to-date inventory available that is consistent with *Forest Information Manual* (FIM) standards and as documented in the *Forest Management Planning Manual* (FMPM). Necessary updates should be made to the forest inventory (i.e. the planning inventory) – not to the input file. Irregular Stand Type Codes such as: Stand Type Codes - Shelterwood/ Selection 17, 18, 19 etc… should be documented in the analysis package. Codes should be used in the initial assignment of silvicultural intensity; each stand should have a silvicultural intensity identified.
Projection Horizon & Period Length	Unless circumstances dictate otherwise, the Projection Horizon should be no more than 160 years. Period length should be set at 10 years unless otherwise rationalized (e.g., caribou mosaic).
Forest Unit	Define forest units (FU) using the Regional standard forest units as a basis. Regional FU's can be rolled up into provincial forest type. The more forest units that are used in the analysis, the harder it is to track and to analyze and interpret results. Forest unit assignment should reflect forest complexity of the management unit, understandability of classification and analysis. Typically the number of forest units ranges between 8 and 16 in the boreal regions and 12 to 16 in SR. More or fewer forest units is acceptable providing that the rationale is provided.
Landbase Assumptions	Consider all Crown ownership types within Forest Management Unit boundary, including Crown forest on land patent to the Crown. Exclude patent lands from analysis. Possibly conduct separate analysis on patent lands, if inventoried (and if at issue within the Management Unit). Provincial parks within the MU boundary should be included in the analysis for contribution to non-timber related objectives (wildlife habitat, old-growth, biodiversity). The analysis package should explain how you dealt with lands patent to the Crown, and Crown reservations on patent lands.
Landbase Definition	Spatially explicit reserves, defined as a reserve type in SFMM, are the preferred method of accounting for AOC related landbase removal. When this is not possible representative accumulating reserves are to be used. The percentage of gross harvest area in reserves and number of periods for which reserve allowances are applied should be carefully considered based on a review of past reserves and current AOC prescriptions. Draw the linkage between forest type and reserve type (i.e., Low wet conifer and riparian reserves). Sub-Unit establishment rules — Use SFMM's sub-unit feature to account for special management areas such as Caribou, Marten, and Tourism and zones. Don't use area factors for FMP analysis except for high-level sensitivity analysis.

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Barren & Scattered	Use the most up-to-date free-to-grow surveys available to update the inventory. To better track B&S, consider representing B&S areas in SFMM using Forest Unit and Silvicultural Intensity rather than as a non-forest class. Look at treated likelihood of success versus untreated likelihood of success. *Forest Information Manual* standards must be reflected in the planning inventory. The manner in which B&S contributes to immediate and future timber supply should be documented in the Analysis Package. The FMPM's definition of available forest includes B&S; however, B&S must not be considered the same as free-to-grow forest in contributing to the AHA (first term).
Deferred areas	Be careful not to inadvertently use deferrals as a land use decision. Conduct sensitivity analysis to determine impact of imposing a deferral versus other options. Deferrals can have a large impact on many objectives, the time period applied should be the minimum required to represent availability. Defer areas where temporal constraints exist (e.g., the need to build a bridge to access an area is unlikely for 10 years). In shelterwood, use deferrals to represent recent harvest activity, which requires a time delay before next entry.
Bypass	Address mappable bypass during inventory classification and represent it as a separate reserve type. If accumulating reserves are used to represent non-mappable bypass be careful you are not double counting.
Silvicultural Options	
Present & Future Forest	Principles for setting Silviculture costs should be based on a review of the current and forecast future conditions.
Costs	Costs should be consistent with the long-term average needed to conduct the silviculture program. Normally, silviculture costs are consistent with trust fund debits. Note, however, that trust fund debits fluctuate and may include periods with below or above average costs. Mandatory alternatives from the FMP Analyses should aid in determining investment level. Trust fund contributions or silviculture costs should be used consistently to limit silvicultural spending.
Operability ranges	Clearcut harvest operability ranges are to be set by forest unit and silvicultural intensity after a review of industrial requirements, growth & yield information, economic criteria, and scaling information. The forest manager must choose a minimum yield threshold (m^3 per hectare) or minimum piece size at which an economic forest harvest operation can be conducted. All product types should be considered.

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Operability ranges cont.	The upper operability age should be set to inf (infinity).Consider changing the operability limits for different silviculture intensities. Set shelterwood harvest operability ranges and delay periods by stage of management. For the first stage of management, specify the range of ages during which the harvest may occur by reviewing industrial requirements, growth and yield information and economic criteria. The delay periods should be the suitable amount of time required for an average stand to achieve conditions acceptable for next entry to occur.
Volumes left unharvested	Unharvested volumes are generally to be applied only for biological reasons, not for economic or market conditions. Economic and market conditions are better reflected through management objectives. Account for volumes left unharvested by review of past harvest operations areas and new practices (e.g. the Natural Disturbance Pattern Emulation Guide). Establish species, volumes and products left after harvesting. Shelterwood volumes left unharvested should reflect planned retention volumes. Contact the Provincial Forest Analyst Team (PFAT) to obtain further clarification.
Selection harvest	Basal Area removal should be based on tree marking / silviculture guide and harvest rules. In SFMMTool, specify AGS/UGS ratio for average site conditions across the forest unit, but if certain conditions exist, adjust AGS/UGS ratios for specific total basal area classes in SFMM. The cutting cycle should be based on the time to reach appropriate (economic) return volume. A linkage should exist between cutting cycle and growth rate. Improvement cut rules have ranged from 10 to 20 per cent improvement after each harvest, up to a max long term AGS ratio of 70-90 per cent.
Conversion of harvesting area to non-forest	Areas planned for conversion should be noted in the Analysis Package and subsequently reverted to non-forest status in the inventory. Only include areas where planned conversion is intended. Allowances for the conversion of available forest to roads, landings, etc should be based on a review of existing roads, etc. and forecast requirements. Rule of thumb for road allowances is ~2 per cent for rotation.
Tending, Partial harvest and CT Options	Document any tending, partial harvest, and commercial thinning options that are included in the model. Determine the proportion of the inventory on which these options could be applied. If current forest condition is conducive to applying treatments then consider analyzing the impact of conducting these treatments in filling in temporal gaps in wood supply. Normal forest renewal regimes may include tending and partial harvest options (e.g., those that occur during the first ten years). Do not include tending and partial harvest options that are already included in the forest renewal options.

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Tending, Partial harvest and CT Options Cont.	Commercial thinning and partial harvest areas should be tracked to a unique yield curve (forest unit, silvicultural intensity) post treatment. The response to treatment (i.e., future growth) should be carefully considered and where possible should be based on statistically sound data. The cost assigned to commercial thinning and tending should reflect how finances have been handled with the rest of the inputs. If silvicultural options do not include a harvest cost, then commercial thinnings shouldn't either. Commercial thinning costs should reflect costs above normal harvest costs, e.g. marking, special harvest equipment.
Forest Dynamics	
Yield Curves	Average stand conditions Forest units are described by average stand conditions and therefore average stand volumes must be used to predict volumes. Utilization The volume tables must reflect the utilization standards of the time. For example, most volume tables recognize a 10-cm diameter at the top (per the Ontario Scaling Manual). If trees are regularly utilized to a smaller standard, say a 5-cm diameter top, then the average stand yield tables should recognize this smaller dimension in the stand volumes. The utilization standards should be documented in the Analysis Package, particularly where they vary from the Ontario Scaling Manual. Plonski By default, SFMM and the forest inventory preparation software SFMMTool will use Plonski's normal yield tables and the NER modified Plonski to calculate volumes for forest units in a forest. When SFMMTool assembles the forest inventory into forest units, it calculates average stand volumes for each forest unit. These average stand volumes use Plonski volumes as a base. Sampling Modify the new average stand volumes for each forest unit on the basis of sampling information from the forest. The forest management plan must explain the development of the volumes tables as modified Plonski's, the basis for the modification, and the utilization standards that are incorporated. Document the sampling information in the Analysis Package. One source of average stand information is the sampling information collected for the original forest resources inventory (FRI). The FRI stand sampling would need to be re-organized by forest units in use for forest management planning. A program of forest stand sampling should be undertaken to help modify the average stand yield tables in preparation for the next forest management plan. Regenerated (Managed) Stands Where available, curves for regenerated stands should be based on statistically valid sample from plot data (artificial regeneration areas). Data to support volume curves for pure and mixed species should be sought and yield curves developed that deal with the variable species compositions

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Yield Curves Cont.	Y-factor adjustments (i.e., volume) could be considered for sensitivity analyses where data to substantiate modified yield curves (natural stands and managed stands). X-Factor – age shifts in yield curves are another tool to use in sensitivity analysis where yield curves do not exist. An age shift could be used for an intensive silvicultural intensity to account for quicker establishment and growth by artificially regenerated or intensively managed areas
Natural Succession	Analysis for the Forest Resource Assessment has shown that relatively small changes in natural succession rules can cause significant changes in available timber supply. Analysts should review existing inventory data for clues about successional pathways. Succession and yield curve data should be reviewed together due to the interdependent nature of these inputs. As a minimum, the yield in pre- and post-succession classes should be compared to guard against unrealistic changes in yield. Both Forest Unit conversion and age class conversion occur when succession rules apply, therefore the practitioner must be cognizant of both the timber and non-timber objectives (i.e., old-growth, wildlife habitat changes). You need to have an appropriate level of 'feathering' succession. That is, don't go overboard with too many age classes. Science and Technology are reviewing succession information and are preparing information for use in analyses.
Natural Disturbance	Analysis must make allowance for natural, stand-replacing disturbances such as fire, insect and disease. Natural disturbances and endemic outbreaks that are not stand replacing will be reflected in the yield curves. While salvage can occur on some disturbed areas, salvage is difficult to incorporate directly into the analysis. Strategies such as adjusting disturbance rates to reflect salvage often introduce other biases into the analysis. However, where defined areas are known to be available for salvage, e.g. following a burn or major budworm infestation, they can be identified in a separate forest class. Northeast and Northwest Regions have different approaches to fire disturbance cycles although both are based on the same fire occurrence database. The different approach is rooted in the use of different aggregations of years to represent the fire cycle calculation period (generally the NER uses 1960 to 2000 and NWR uses 1921-2000). There is also a problem with the fire history database being incomplete particularly during the Second World War years. Use a higher rate as a base and do sensitivity analysis with further increase/decrease in rates. . SR uses forest unit specific weighted average disturbance cycles based on ecosite mean frequency (Naylor, 2001). These ecosite frequencies are the mid-point of a range of frequencies gleaned from literature review of similar forest type conditions. Use the SR Fire Cycle Calculator tool. The provincial fire strategies should be consulted for information on fire management.

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Management Objectives	By successively changing management objectives, re-running the model, and viewing and interpreting the results, you can conduct sensitivity analyses and investigate the relationships involved in meeting an array of forest management objectives.
Management Alternatives and scenarios	As part of analyzing the ability to meet industrial demand, examine scenarios that sustain industry at current and increased levels. A minimize area harvest scenario should be conducted to determine the extent to which non-timber objectives are driving the solution. Note: harvest volume objectives and flow policies may have to be removed in order to gain the desired insight.
Harvest Volume Objectives and Flow Policy	Strive for a flow of wood that provides a continuous and predictable supply to the forest industry and concentrate on controlling the decrease in harvest volume through time as it affects the economic sustainability of communities. Most persons will be interested in limiting a decline in harvest volumes to a soft and predictable impact between planning terms. Forests with age class distribution imbalances will have the most problems with erratic or large changes in volume harvest between periods. Analysis should seek a long-term level that is in a steady state. A decrease constraint will help to smooth the decline in harvest volume between periods and 10 per cent per decade by major species group is a good starting point. The final flow policy will depend on the composition of the current forest. The sensitivity of the harvest flow policy must be tested to ensure there is no artificial reduction in short-term available volume supply. Increases in harvest volume are generally interpreted as a positive economic factor that boosts the economic sustainability of communities. The management of many forests is aimed at increasing the harvest volume over time to help modify the effects of land that has been reserved from harvesting for various reasons. A limit on increase may actually work against the desired improvements and for this reason it is not recommended to constrain the increase in harvest volumes between planning terms. Simulations should start with unrestricted increase (i.e. increase set at infinite). As modelling progresses it may become apparent that a different limit should be used; this choice must be documented in the forest management plan. The initial (term 1) harvest level will be provided to planning teams by MNR staff who specialize in regional wood flow requirements and directives as described in Strategy 2 of the Provincial Wood Supply Strategy. Sensitivity runs could include initial harvest levels consistent with past utilization on the unit. The allowable decline should be restricted to 10 per cent per decade to minimize socioeconomic impacts. Documentation to support a variation should be presented in the Analysis Package and the FMP. Harvest objectives for management planning, as documented in the *Provincial Wood Supply Strategy*, should only be used in Term 1. In subsequent terms use a 10/10 flow policy to determine future volumes.

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Upper Harvest Volume Limits	Upper limits on harvest volume should generally be avoided. However, in order for a scenario to be considered for implementation, the scenario should not project harvest volumes well in excess of what could reasonably be utilized by industry.
Silviculture budget and discount rate	Because silvicultural budgets are limited to stumpage revenue, stumpage revenues must be consistent with a) the renewal portion of stumpage and b) silvicultural costs used in the model. Conduct sensitivity analysis with more and less budget. Unless circumstances dictate otherwise, silvicultural dollars should not be limited by sub unit. If net present value feature is used, a discount rate of 4 per cent should be used.
Timber Value Weighting factor	Select weighting factors appropriate for the analysis being conducted. For a maximize timber volume run, there is no need to weight any species greater than any other where the market for all species is likely to be large enough to consume all of the commercial species. In this case, all commercial tree species should be weighted equally (at one) unless appropriately documented in the Analysis Package and forest management plan. Where the market cannot consume all volume for all species, the weightings may need to be adjusted, but the total fibre production capability of the forest should still be examined. Consider the following. If the objective of management is to produce high-valued products, then adjusting weightings is necessary to guard against producing a forest consisting of fibre for which the market is limited, e.g., creosote railroad ties and picket fences. Similarly, the demand for a particular species and/or product may be met through incidental harvest, e.g. white birch pulpwood. A judicious adjustment of weightings with supporting rationale and sensitivity analysis recorded in the Analysis Package would be in order.
Age class structure limits	Age class structure limits could be tested if future forest condition objectives are not met without imposing limits. Forest structure objectives should be representative of the management unit objectives.
Forest unit stability	Preliminary analysis should provide insight into whether or not FU stability measures are needed. Strive for consistency with proposed future forest conditions and FMP objectives. Forest units with large age class gaps or small original areas will be difficult to keep under tight limits. An examination of each forest unit's age class distribution and original area size in view of this parameter will improve the understanding of the forest's composition. There may be some forest units for which the plan is to reduce or increase their total area to some better future amount. Documentation is required in the Analysis Package. Forest units should proceed to objective levels.
Growing Stock volume limits	Growing stock limits could be imposed in unique circumstances where control of the final few terms is sought. If so, an average of the last 5 terms should suffice as a limit.

Appendix 2: Best Practices for Wood Supply Modelling Cont.

Item	Consideration
Wildlife habitat objectives	Wildlife habitat objectives are a good utility for examining general trends and conducting sensitivity analysis. Nevertheless, given SFMM's inherent assumptions and biases associated with wildlife habitat, wildlife habitat objectives should be used judiciously. Forest condition objectives or silviculture objectives may be better approaches for maintaining wildlife habitat at acceptable levels. Where wildlife habitat objectives are used, the forest conditions associated with the desired habitat should be clearly documented. Objectives for wildlife habitat should be examined in conjunction with timber objectives.
Harvest area limits by FU/Silvicultural Intensity	The Harvest Area Limits by Forest Unit screen allows you to limit the Areas harvested within each forest unit during any particular planning period. These limits adjust or completely exclude a forest unit from harvesting during a planning period and must be directly related to an objective for acceptable use in an FMP – explanation should be provided in the Analysis Package. Should only be used short term – e.g., one or two terms (10-20 years). Do not dictate AHA to the model.
Planned operations	Use the Simulate Planned Operations (FMPM 2.4.7) screen after you have selected stands for harvesting and you want to simulate these operations. Explore the sensitivity of not harvesting particular forest units (i.e., Bw), particularly for surplus harvest areas.
Forest renewal limits	Use only if required and document in the Analysis Package. Use the Forest Renewal Limits by Proportion screen to tell SFMM the proportion of area harvested in a forest unit to renew with a certain Renewal option. Limits should first reflect ecological and site condition limits, e.g. the proportion of a particular forest unit suitable for a particular silvicultural regime.
Mid-rotation tending, CT limits	Use the Mid-rotation Tending Limits by Tending Treatment screen to place limits on mid-rotation tending treatments. Limits should first reflect ecological and site condition limits. Projections should be attainable within specified budgets and future forest condition objectives.
Non-forest rehabilitation limits	Use the Non-forest Rehabilitation Limits by Treatment screen to specify non-forest rehabilitation limits. Specify rehabilitation cost limits. Transition rules for bringing other barren and scattered areas back into production forest (in the model) should be based on past experience (success, forest unit).