ODF Modeling Support

Executive Summary

As a part of its intermediate and long range planning processes, ODF uses the Forest Vegetation Simulator model (FVS) as an important component of landscape planning, timber harvest scheduling, operational analysis and inventory updates. As part of its continuous effort to improve the quality of its modeling, Department staff identified a set of six topic areas related to growth and yield methodology. Based on literature, expertise and interviews with ODF staff the key recommendations are described below. More detailed descriptions of the research process and recommendations are found in corresponding chapters of this report.

Site index (SI) estimation: SI is a measure of forest productivity (higher SI stands are taller at a given age) and is used for classifying and comparing forest lands in terms of potential height growth, generating future height estimates and indexing productivity to the extent that it is correlated with biomass accumulation, and provides consistent comparisons of productivity from different areas and sources. Key recommendations related to SI are:

- Stand sampling for the purpose of estimating SI must take special account of trees that are very young (<25 years) and very old (>180 years). Bruce equations for estimating stand SI are recommended because of their large sample and more consistent estimates. Adopting a standard 50-year breast-height base age would facilitate comparisons across sites and species.
- Soil SI calculations are a major source of uncertainty but are necessary to provide "wall-to-wall" mapping of SI for stands that are not surveyed directly. A simple species-based adjustment using statistical analyses of measured SI and soil-based SI would help to make the best use of this data.

Volume estimation: Depending on the business process, tree volume is estimated using a variety of methods and units, creating challenges when there is a need to compare or reconcile the estimates. Volume estimates could become more coherent, possibly through making greater use of common volume equations across the business systems. Key recommendations related to volume are:

- The volume estimation methods found in the National Volume Estimator Library (NVEL) equations are recommended as a reliable standard. Based on NVEL, a standard set of inventory and growth and yield volume equations and standards (e.g. form factor, minimum DBH) should be consistently applied to the SLI database for total and merchantable volume, as well as provided as input to the Harvest Scheduling Model. ODF should advocate that a single estimation system be developed based on

NVEL, replacing the current cross-walk table used for the Harvest Scheduling Model (HSM).

- In spite of its complexity, Scribner board foot volume should be used for timber cruise volume estimates, using 32- or 40-foot log lengths depending on species. ODF should clearly document the standardized methodology and NVEL equations that are used.
- Depletion of cubic foot volume should the primary unit of measure for evaluating the forest plan. Board foot volume should also be included as a secondary metric for forest planning, in spite of its sensitivity to small variations in tree size.

Basal area growth calibration: Increment core data have been collected as a part of installing permanent sample plots and are used to calibrate FVS growth. Key recommendations related to basal area are:

- Inventory taken in 2001 is still appropriate, although newer data would be preferred. Over time the older inventory will become less reliable if there are systematic increases or decreases in growth rate. Allocating annual budget to systematic monitoring is a reliable way to maintain a current inventory for future planning.
- District based modifiers (including modifiers for SNC depending on location) are appropriate for individual species, based on locally collected data.

Maximum density limits: FVS growth projections recognize stand density as a growth constraint, commonly measured as maximum basal area or Stand Density Index (SDI). Key recommendations related to maximum density are:

- Although maximum basal area and maximum SDI are mathematically interchangeable, maximum basal area is the preferred basis for measuring carrying capacity, since it provides a more stable estimate that is less influenced by large numbers of small trees. Management decisions that require SDI can be derived from maximum basal area as needed.
- FVS experts generally suggest that maximum SDI should not be changed without good reason. Nevertheless, maximum SDI should be reassessed using the most recent updates to FVS. Guidelines for determining maximum SDI are in place, and any decision to modify the FVS defaults (e.g. based on District or other strata) should be documented by ODF.
- The Organon model was recently integrated into FVS. Because Organon mortality is based on a limited geographic range it may not be universally applicable in all Districts. The applicability of this new variant should be considered after consulting with District staff.

Genetic gain and disturbance modifiers: ODF uses genetically superior seed stock when it is available, which could lead to higher yield over time. Conversely insects, disease and other forms of disturbance, although a natural component of forest ecosystems, tend to reduce yield. Key recommendations related to genetic gain and disturbance are:

- Designed experiments are necessary to evaluate the benefit of genetically superior stock. Adaptive Management provides a robust framework for developing hypotheses which are tested through planned statistical trials which include ongoing monitoring and refinement of hypotheses to reduce uncertainty.
- Swiss Needle cast (SNC) effects are reasonably accounted for through basal area multipliers. Outside SNC zones, SNC-resistant stock are not expected to outgrow unimproved stock.
- Existing understanding of endemic insect and disease agents is sufficient to manage many kinds of background disturbance. Large episodic outbreaks and fire effects can be accounted for through structured simulation experiments which can be used to evaluate costs and benefits of management options.

Error and uncertainty: Bias, uncertainty and error are recognized aspects of all forest growth models. Key recommendations related to error and uncertainty are:

- Analyses which use a bounding approach can be used to explore uncertainty for a few different scenarios. Such analyses should focus on the major drivers of uncertainty related to timber productivity, including growth rate, Site Index, maximum Stand Density Index and mortality.
- Uncertainty in FVS simulations can also be reduced through the development and implementation of inventory and modeling protocols, such as the collection of height increment measurements and increment cores for small and large trees, collected over ODF's forest holdings. These can be used to calibrate FVS to local conditions and reduce uncertainty due to regional and local variability.