Industrial Timber Supply Analysis Using the Woodstock and Stanley Forest Planning Tools

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Remsoft's Invited Author Series

As part of our commitment to support education and innovation, and showcase some of the unique applications for Woodstock and Stanley, Remsoft has invited 6 key forest planners to write a short article highlighting unique and interesting approaches to forest management planning using Woodstock and/or Stanley.

This is the third article in the series.

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Introduction

Timberline Forest Inventory Consultants (Timberline) is a forestry consulting firm specializing in resource inventory, analysis, planning, GIS services and software development. Timberline offers services to more than 250 clients in Western Canada, Ontario and the Pacific Northwest.

This paper summarizes a Timber Supply Analysis (TSA) completed by Timberline for Sundance Forest Industries Ltd. (Sundance), a client in Alberta, Canada. The TSA utilized Remsoft's forest planning tools (Woodstock & Stanley).

The Problem

Sundance is a dimension lumber mill producing 95 million board feet of lodgepole pine lumber annually. They supply their mill from a Forest Management Agreement (FMA), negotiated with the Province of Alberta. The FMA allows Sundance to establish, grow and harvest timber on a sustainable basis from 267,000 hectares of Crown Land located in west-central Alberta (Figure 1). As part of the FMA Sundance must develop a Detailed Forest Management Plan (DFMP), including a Timber Supply Analysis.

Unique aspects of the TSA problem involved:

- Completing/Integrating an ecological classification into the TSA
- Integrating succession into the yield forecasts
- Completing a spatial TSA

In formulating the TSA problem a goal was to integrate an ecological stratification. No ecological classification initially existed for the FMA. Time was of the essence in the project, therefore, an ecological classification method that provided a reasonable level of reliability using existing information and a highly focused field program was required. ELDAR[1] was used, as it has proven successful in previous work for other clients. The classification combined digital elevation data, Alberta Vegetation Inventory, and edaphic landform data through GIS overlays. ELDAR used the resulting database, along with field observations to develop a predictive model and generate an ecological classification map.

The Sundance FMA, being newly allocated, lacked the type of growth and yield data necessary to develop succession-based yield curves. Permanent Growth Sample (PGS) data was used from an adjacent FMA (Weldwood of Canada Ltd.). Weldwood holds the best PGS database in the Province with growth measurements going back to the 1950's. A linkage was established between the ecosites of the Sundance FMA and the Weldwood PGS growth data. The linkage allowed the succession based yield forecasts to be developed.

To strengthen the link between the long-term and short-term planning, Sundance required a spatial TSA. A digital inventory was used to geographically identify landbase exclusions. The hierarchical approach to forest planning was then used to generate the stand-level harvest schedule. Woodstock (Optimization Mode) and Stanley were the tools chosen to carry out the forest planning.

The FMA

The 267,000-hectare FMA is divided between two separate blocks. The northern block lies south of the town of Edson, Alberta with the southern block lying further south (Figure 1). The northern portion of the FMA is mainly lodgepole pine and aspen in fire-origin stands. However, white spruce and balsam fir dominate older stands while black spruce and tamarack dominate wetter areas. The southern block is characterized as homogenous areas of fire-origin lodgepole pine with some white spruce and black spruce. The influence of fire is evident from the substantial amount of pine in the 110 year ageclass (Figure 1). The current forest condition was digitally captured recently for the entire FMA with the AVI standards.

[1] ELDAR is an acronym for "Ecological Land Classification Acquisition Resource", an evidential reasoning system developed by the Alberta Research Council in collaboration with the Foothills Model Forest and Canadian Forest Service and licensed to Timberline.

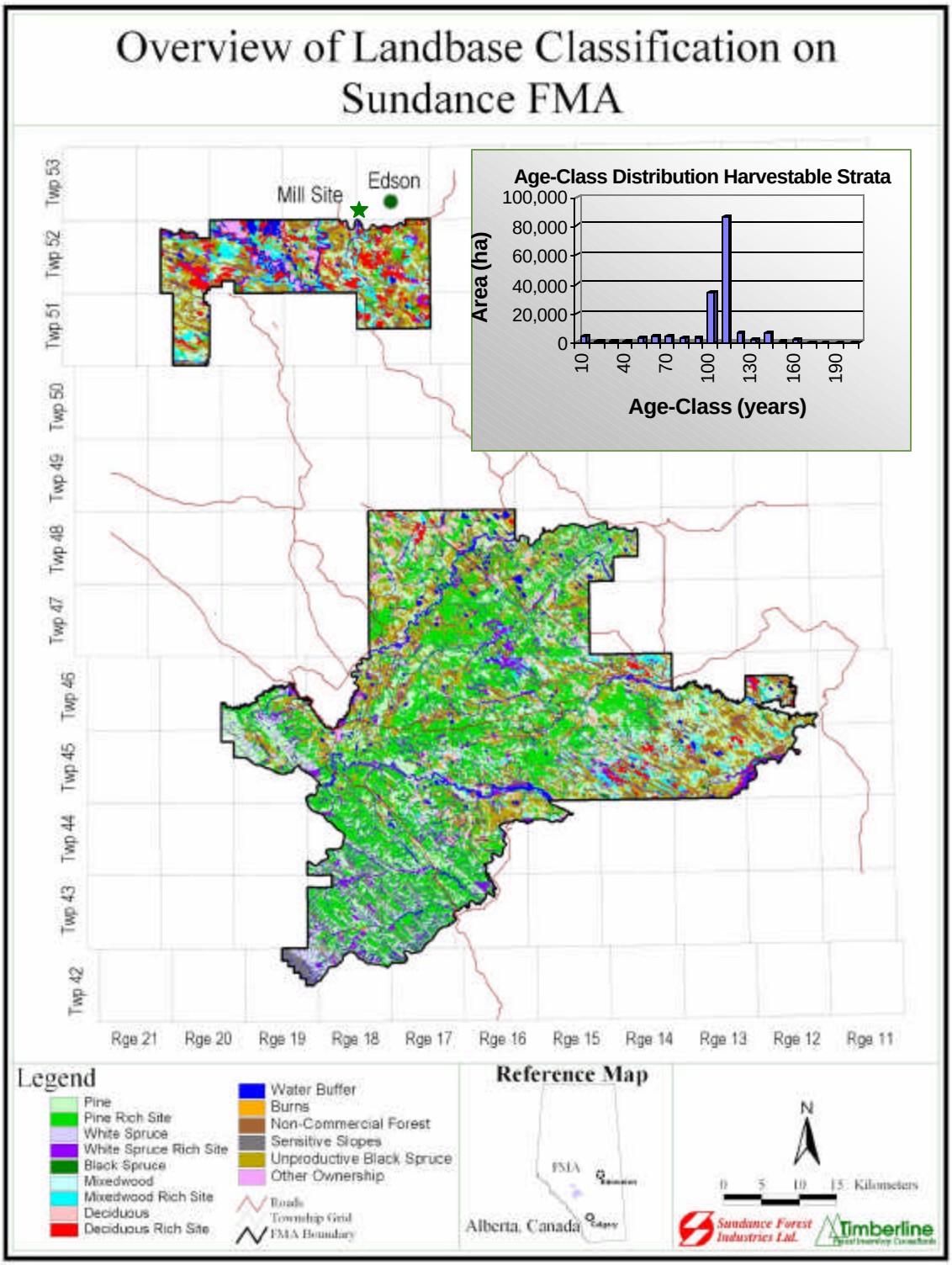


Figure 1. Sundance FMA area.

Forest Model Structure

The forest model characterized the forest using eight landscape themes (Operating Unit, Ecosite, Forest Strata, Subjective Deletions, Water Buffers & Sensitive Slopes). The 'Forest Strata' theme contained 25 different harvestable strata for which age-dependent succession based yield curves were developed.

A single treatment regime was used to model harvesting followed by reforestation. Transitions modeled the forest response to harvest and natural break-up. The responses varied by ecosite and forest strata. Resource indicators (outputs) reported on the forest composition/structure/pattern and flow of forest values.

The Solution

Generating an acceptable solution required developing a systematic approach to the TSA problem.

Approach

A three step modeling approach was developed that iterated between the Woodstock and Stanley modeling tools.

1. Initial Long - Term Strategic Runs (Woodstock)
2. Harvest Mapping Over the First Rotation (Stanley)
3. Final Long - Term Runs (Woodstock)

Initial Long - Term Strategic Runs (Woodstock)

The initial strategic runs imposed aspatial composition/structure and flow constraints. The objective was to determine the maximum even-flow harvest level that could be sustained over the 200-year planning horizon. The initial runs generated the stratum level scheduled used for harvest mapping.

Harvest Mapping over First Rotation (Stanley)

Harvest mapping ensured that forest/landscape pattern constraints were sustained. To meet the harvest objective (Total Harvest Level) while maintaining both hardwood and softwood flow constraints a two-step approach was taken to map harvest over the first rotation.

The first step involved blocking the deciduous development types only, with the primary objective being achievement of the deciduous harvest level. The resulting solution was pre-blocked. Without this first step the deciduous harvest level in the final plan had an unacceptable amount of variation, dropping to almost zero in some periods.

The second and final step involved blocking all development types with the primary objective being achievement of the total harvest level. The result was pre-blocked and the Woodstock AREA and LP SCHEDULE files were generated. The Woodstock files generated were used in the final long-term runs.

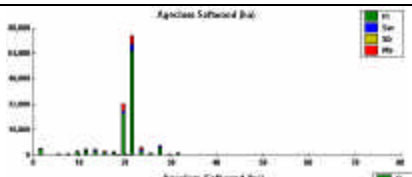
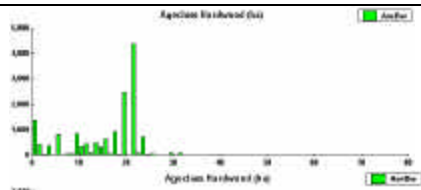
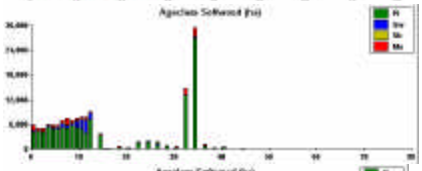
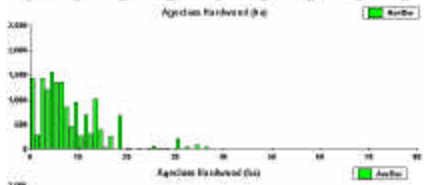
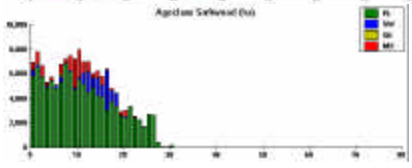
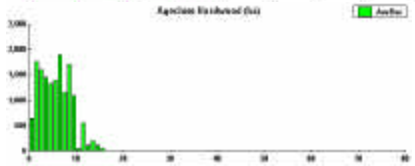
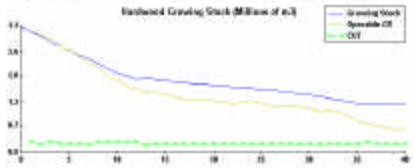
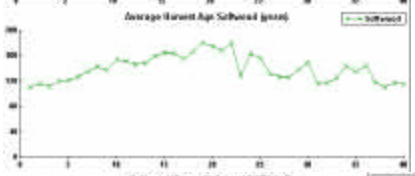
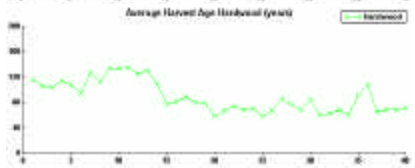
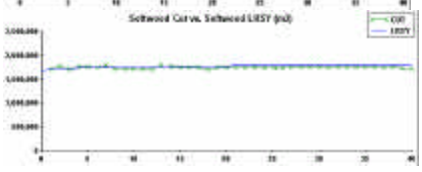
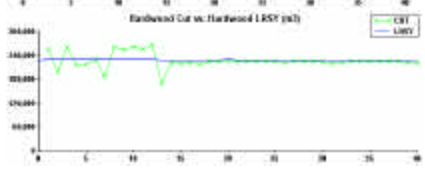
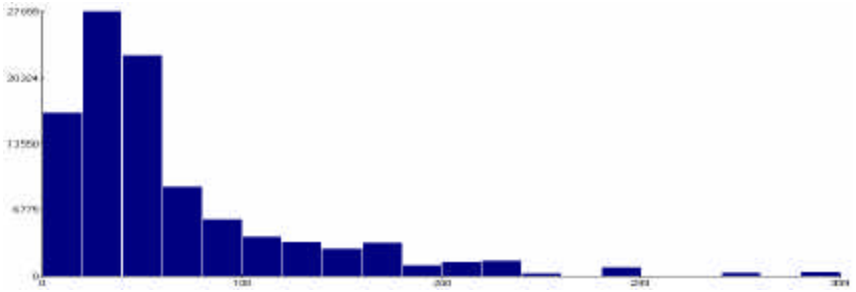
Resource Indicator	Status	
	Softwood	**Hardwood**
Initial Age Class Structure		
Age Class Structure 70 years in Future		
Final Age Class Structure 200 years in future		
Growing Stock Over Time (5yr periods)		
Average Harvest Age Over Time (5yr periods)		
Harvest vs. Long Run Sustainable Yield (LRSY) Over Time (5yr periods)		
Opening Size Limitations (ha)	Minimum 2	Maximum 399
Opening Size Distribution After One Rotation Area Vs. Opening Size		
LRSY (m^3/year)	**Softwood** 404,788	**Hardwood** 45,603	**Total** 450,391
Final Harvest Levels (m^3/year)	**Softwood** 402,639	**Hardwood** 46,105	**Total** 448,744

Figure 2. Summary of resource indicators

Final Long Term Runs (Woodstock)

The final runs integrated the mapped harvest schedule into the long-term management strategy to ensure resource value flows were stabilized to operationally feasible levels. The LP SCHEDULE controlled all harvest activity that occurred over the first rotation (13 periods). The AREA file ensured that long-term planning did not schedule any area unavailable because of the green-up delay.

Results

The final run provided the means to evaluate resource indicators associated with the proposed harvest levels (Figure 2). By examining the resource and treatment activity indicators it was clear that all resource indicators were supporting the sustainability of the long-term harvest level.

Upon completion, Sundance submitted the TSA to Alberta Lands and Forest Service (LFS) for approval. After reviewing the TSA and associated sensitivity analysis, the LFS approver the proposed hardwood and softwood harvest levels.

In reviewing the harvest mapping component of the TSA Sundance gave a positive response saying the period 1 blocks were falling on parts of the FMA where they anticipated planning in the near future. This confirmed alignment of the Woodstock / Stanley analysis assumptions with Sundance operating and management practices.

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