Memo

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To: Ross Lennox, *RPF*
From: Hamish Robertson, *RPF*
cc: Tara McCormick, *BSc*
Date: October 20, 2004
Project: Mackenzie TSA Site Index Adjustment
File: \\Madrid\clients\Canfor\Mackenzie\CFM-003\Correspondence\CFM-003 sample plan memo to Mackenzie licensees (2004Oct20).doc
Re: Statistical adjustment of the SBS & BWBS

The Problem:
Typically, we focus Site Index Adjustment (SIA) sampling on post-harvest regenerated stands to develop the most representative site index estimates for existing and future managed stands on the landbase. However, we often have to include natural age class 3 and 4 stands because there is insufficient harvest history in some areas. In the original version of the SIA sample plan for the Mackenzie TSA,[1] we proposed sampling Pl- and S-leading stands in age classes 1 to 4 in the operable landbase of the SBS, BWBS, and ESSF. We included age class 3 and 4 stands because there was insufficient harvest history, especially in the ESSF, to support a statistical adjustment across the proposed landbase.

In theory, the sample population originally proposed would produce statistically-reliable estimates of site index for the SBS, BWBS, and ESSF for use in the base case and provide the maximum volume gain to the Mackenzie licensees. However, following a review of the proposed plot locations in the ESSF and in Pl-leading age class 3 and 4 stands in the BWBS and SBS, it was clear that most of these sample locations have a high likelihood of being rejected because of unsuitable stand conditions for site index sampling. Specifically:

1. All Pl plots in the ESSF and in age class 3 and 4 stands in the SBS and BWBS are in fire-origin stands that most likely exhibit repression, and thus will not express the true potential of the sites. Our original sample selection attempted to exclude stands with the highest likelihood of repression by focusing on mixed stands (≤70% Pl).[2] A review of the ortho-photos illustrated that the inventory labels were inaccurate, and that most of the selected stands were dense, Pl stands that were most likely repressed. Including these stands in the sample would understate the growth potential of the Mackenzie TSA and minimize the overall gain for the TSA.
2. Based on our previous field experience in the ESSF in the Mackenzie TSA, many of the S-leading stands classified in the inventory as age class 3 and 4 are much older and not suitable for site index sampling. A review of the ortho-photos illustrated that many of the selected S samples located in the ESSF had a high likelihood of being rejected because they are too old. Including these samples would under-estimate the growth and volume on the landbase.
3. Most of the ESSF samples (Pl and S) are in remote locations and require helicopter access. A large portion of the field budget would be used to access these plots with a high probability of rejection. Ultimately, the overall number of successful plots (with site index observations) would be reduced, potentially leading to a decreased confidence in the final estimates for the whole population. This could potentially undermine the strength given to the results in the timber supply analysis by the Forest Analysis Branch.

[1] J.S. Thrower & Associates. 2004. Site index calibration for the Mackenzie TSA. Sample Plan. Contract report submitted to Canadian Forest Products Ltd., Mackenzie, BC. October 8, 2004. 20 pp.

[2] based on the inventory label.

The Solution:
We held detailed internal discussions at J.S. Thrower[3] and talked with Ross Lennox, *RPF* (Canfor) and Albert Nussbaum, *RPF* (Forest Analysis Branch) regarding the proposed sample plan. From this, we propose revising the sample plan (version 2.0) to:

- Develop the biophysical model for the entire operable landbase defined in the original sample plan (2.2 million ha)
- Reduce the target population for the statistical adjustment to the operable SBS and BWBS (exclude the ESSF)
- Focus the sample population in the SBS and BWBS in managed Pl-leading stands in age classes 1 and 2 (to avoid impacts of repression) and in S-leading stands in age classes 1 to 4
- Statistically adjust the SBS and BWBS and provide unadjusted site index estimates from the biophysical model for the ESSF. The adjusted site index estimates will be applied in the base case, and the unadjusted site index estimates will be applied in a sensitivity analysis.

The Impact:
Excluding the ESSF portion from the SIA field program will: (1) receive better buy-in from the Forest Analysis Branch, (2) decrease the risk to the overall SIA program, and (3) improve the results by developing the most reliable site index estimates for managed stands.

The adjusted site index numbers will be applied to approximately 55% of the timber harvesting landbase.[4] This portion of the landbase is more productive (relative to the ESSF) and is where the most significant volume gains will be achieved. Unadjusted site index estimates will be provided for another 40% of the timber harvesting landbase for use in sensitivity analyses. Hence, although the ESSF portion is being excluded from the statistical adjustment, it may also contribute an upward pressure on timber supply. The Forest Analysis Branch has stated that the weight given to the unadjusted portion of the landbase (i.e., the ESSF) in the sensitivity analysis will depend on the relationship observed between the field and biophysical model estimates in the SBS and BWBS. Ultimately, we do not expect the updated sample plan to cause significant reductions to the expected volume gains from this project.

Over the winter, we will discuss potential options with the Mackenzie Licensees (through Canfor) and the MOF to increase the Forest Analysis Branch's level of comfort with the unadjusted site index estimates in the ESSF. The goal would be to make the ESSF site index estimates suitable for use in the base case. This could involve completing an "audit" of the biophysical estimates in the ESSF by ***subjectively***[5] locating plots or transects in areas where suitable site index estimates can be derived (likely age class one stands at lowest elevations).

Cost Implications
Reducing the area of the SIA target population (area where sampling occurs) by excluding the ESSF does not translate to a reduction in the cost of the SIA program because the number of plots required to complete the statistical adjustment is independent of the landbase area. The SIA program uses statistical methods to adjust predicted estimates of site index using field observations. Typically, this requires a minimum of 30 field observations per species to capture the site index variability between the field and predicted site index. Thus, the SIA program costs on a small landbase (30,000 ha) are almost the same as on a large landbase (2 million ha, as in the Mackenzie TSA).

[3] The project team included Hamish Robertson, *RPF* (project manager), Tara McCormick, *BSc* (project advisor), Guillaume Thérien, *PhD* (senior biometrician), René deJong, *RPF* (technical support), George Jennings, *DiplTech* (GIS manager), and Jim Thrower, *PhD* (senior advisor).

[4] Timber harvesting landbase defined in TSR2.

[5] By design, the SIA approach uses a representative random sample to remove the potential bias in the preliminary site index estimates. Therefore, there is no option of incorporating subjective sampling into the SIA process. However, a subjectively located sample in the ESSF could provide more comfort in the predicted estimates. Subjective sampling is more flexible and will be more successful than random sampling in the ESSF because samples are subjectively established in the limited area of managed stands or in natural stands that express the potential site index (no repression, suppression, significant height growth damage).