NSC 2020 Winter Conference:
How to Meet the Demands of our Changing Forests?

February 25-26, 2019
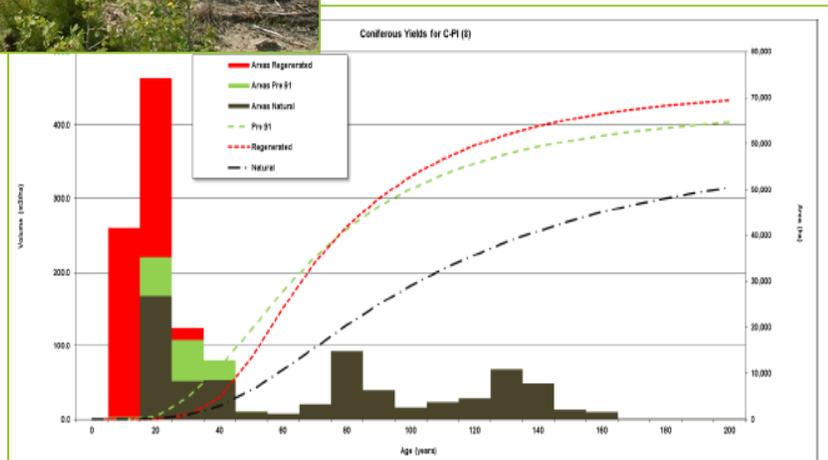
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Outline

- Overview – Alberta Reforestation Requirements

- Reforestation Targets – Strata Declarations

- Establishment Survey Process

- Performance Survey Process

- Evaluation of Outcomes

- Feedback in to Forest Management Plans – TSA and AAC implications

Terminology & Acronyms

- RSA – Regeneration Standard of Alberta

- Opening – An individual harvested area with a defined regeneration strata – Usually (but not always) is analogous to a cutblock.

- MAI – Mean Annual Increment – stand or strata level projection of merchantable volume yield in **m^3 /ha / year.**

- FMP – Forest Management Plan. Highest level forestry plan in Alberta and includes development of yield curves, timber supply analysis, and MAI targets for reforestation for a defined geographic area. Completed every 10 years.

- Timber Year (May 1 – April 30)

Overview – Alberta Reforestation Requirements

- Reforestation Requirements are defined in the Regeneration Standard of Alberta (RSA).

- Key timelines:

  - Year 1: Submit opening-level strata declarations (sets reforestation targets).

  - Year 4-8: Establishment Survey must be completed on all openings.

  - Year 12-14: Performance Survey must be completed on all openings

Alberta Government

Reforestation Standard of Alberta
Effective May 1, 2018 to April 30, 2019

Effective: 1 May, 2018   Reforestation Standard of Alberta   Page 1 of 376
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Regeneration Strata Declarations & Landbase Balancing

- Regenerated Yield Classes are defined in the Forest Management Plan (FMP).

- Must include the "base 10" Alberta strata (if present in the defined operating area), but may be further subdivided.

- Base 10:

  - Conifer leading: Px, Sw, Sb, Fd

  - Conifer leading mixedwood: Px/Hwd, Sw/Hwd, Sb/Hwd

  - Deciduous leading mixedwood: Hwd/Px, Hwd/Sx

  - Deciduous leading: Hwd (Aw, Pb, Bw)

Regeneration Strata Declarations & Landbase Balancing

- Pre-harvest stand composition (strata) is defined by the forest inventory (AVI).

- Total area of each strata harvested within a year is summarized.

- Required to regenerate equivalent area of each harvested stratum.
  - This requirement is at the annual population level, not the individual opening.

- Strata declarations are required for every harvested opening by the end of the first timber year following the year of harvest.

- Strata declarations each year must demonstrate that the total area harvested of each stand type will be regenerated, within 5% or 10 hectares.

- Example: If within one timber year a company harvests a total of 450 hectares of Px/Hwd – 450 hectares must be declared to Px/Hwd.

- Strata declarations assign the reforestation targets (forest composition & MAI target) for each opening.

Mean Annual Increment (MAI) Targets

- Regenerated yield curves are created through the Forest Management Planning Process.

- Regenerated yield curves are required for the base 10 strata at a minimum.

- Data used to generate yield curves: permanent sample plots, temporary sample plots, previous regeneration survey data.

- MAI target is defined as the maximum MAI of each regenerated yield curve in cubic meters per Hectare per year (m^3/ha/yr).

Mean Annual Increment (MAI) Targets
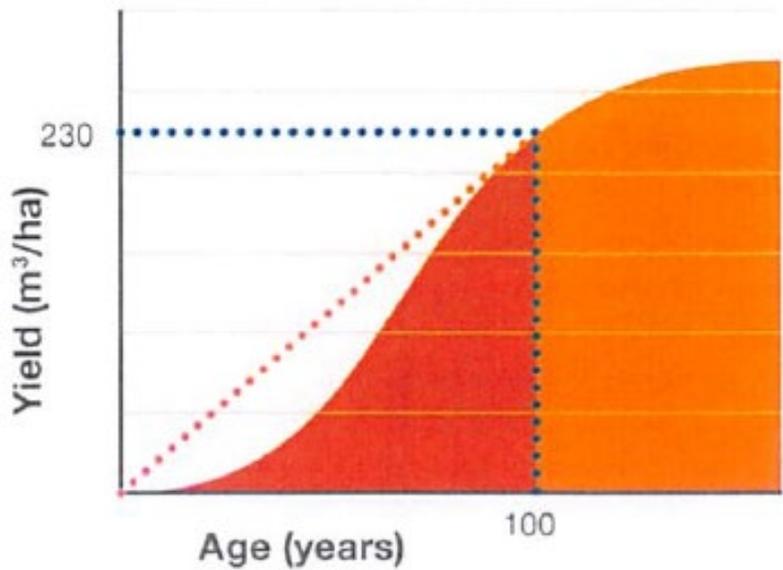
- ► Every Regenerated yield stratum has a conifer MAI target and Deciduous MAI target.

- ► Examples:

Stratum	MAI Target	
	Conifer	Deciduous
Px	3.32	0.35
Sw	2.85	0.71
Sb	1.89	0.62
Px/Hwd	2.64	1.41
Sw/Hwd	2.25	1.58
Sb/Hwd	1.63	1.22
Hwd/Px	1.99	1.83
Hwd/Sx	2.04	1.87
Deciduous	0.94	3.10

Establishment Survey

▶ First legally required reforestation assessment.

▶ Must be completed no sooner than 4 years after harvest, and no later than 8 years after.

▶ Objective of the survey is to assess / confirm that basic initial reforestation has been completed and that the regenerated stand is generally on track to meet its strata declaration targets.

▶ This is a stocking survey – assesses percentage stocking of conifer and deciduous crop trees at the opening level.

▶ Stocking is determined based on the percentage of 10 m^2 (1.78m radius) plots containing acceptable crop trees.

▶ May be completed via grid-based ground plot survey, or via visual reconnaissance.

▶ All individual openings must meet percent stocking targets for their declared stratum.

Establishment Survey

- Percent Stocking Targets:
  - All openings must meet a minimum 80% total stocking (includes conifer and deciduous).
  - Conifer strata (Px, Sw, Sb) must meet a minimum 70% or 80% conifer stocking (differs by natural subregion). Leading conifer species is tallied by plot and summarized.
  - Conifer-leading mixedwood strata (Px/Hwd, Sw/Hwd, Sb/Hwd) must meet a minimum 50% conifer stocking and 30% deciduous stocking. Leading conifer species is tallied by plot and summarized.
  - Deciduous-leading mixedwood strata (Hwd/Px, Hwd/Sx) must meet a minimum 30% conifer stocking and 50% deciduous stocking. Leading conifer species is tallied by plot and summarized.
  - Deciduous strata must meet a minimum 60% deciduous stocking.

Establishment Survey - Methodology

- Surveys may be completed via visual reconnaissance or plot-based "intensive" survey

- Reconnaissance survey: Aerial or walkthrough

  - Based on visual assessment, total stocking and conifer and deciduous stocking is estimated.

  - If stocking is estimated as >85% - no further action required. Block is "SR" (sufficiently restocked)

  - If stocking is estimated as <85% and >70% - field (plot-based) survey required to confirm status

  - If stocking is estimated as <70% - block is "NSR". Retreatment required.

Establishment Survey - Methodology

1.78m

▶ **Intensive survey method.**

▶ Plot based - 10 m² (1.78m radius) plots.

▶ Each plot is assessed to determine if it is stocked with an acceptable conifer and/or acceptable deciduous.

▶ % conifer and deciduous stocking is calculated for the opening.
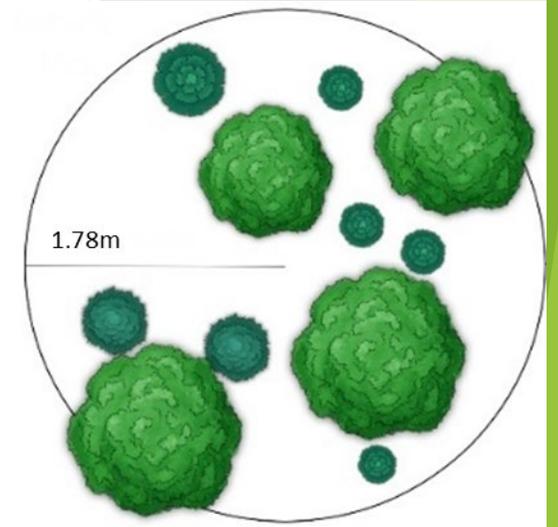
Opening area (ha)	Number of sample plots required
0.1 – 1.9	Establish a minimum of 12.4 plots per hectare.
2.0 – 4.0	Establish a minimum of 41 plots per opening or as many as are needed to cover the opening. Optional: If stocking is between 73.0% and 79.9%, increase the number of plots to 54.
4.1 – 24.0	Establish a minimum of 64 plots per opening or as many as needed to cover the opening. Optional: If stocking is between 73.0% and 79.9%, increase the number of plots to 84.
> 24.0*	2.77 plots per hectare.

Establishment Survey - Outcomes

- Openings not meeting minimum stocking standard must be re-treated.

- Openings meeting total stocking requirement, but not meeting stratum-specific target must either be re-treated, or re-declared to another stratum.

Performance Survey

▶ Final legally required regeneration assessment.

▶ Must be completed no sooner than 12 years after harvest, and no later than 14 years after.

▶ Survey objective is to assess regenerated stand performance at the strata level, compared to forest growth (MAI) targets.

▶ The population of openings included in an annual survey program are stratified based on current aerial imagery.

▶ Field sample population is selected based on the stratification. Not all openings have field surveys completed.

▶ Field survey data is input into a growth model to project stand and strata-level MAI results.

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FRIAA / WOLF RSA
training modules

Performance Survey - Methodology

▶ Aerial photography (20 cm leaf-off) must be acquired for every opening no sooner than 11 full growing seasons after the year of harvest (ie spring of year 12 is first year of eligibility).

▶ Stratification is completed to the RSA standard (usually by a consultant).

　　▶ Stratification process assesses all openings and delineates areas of each stratum (Px, Hwd/Sx, etc).

　　▶ Minimum polygon size = 2 ha.

　　▶ Stratum is determined based on estimated **density** by species.

　　▶ Other interpreted values: Total density category (L,M,H,D), average height, spatial distribution of density, mixedwood pattern (intimate, aggregate), residual layer, stocking (optional).

Performance Survey - Methodology

- Sample selection:
  - Sample Units (SUs) from each stratum are selected randomly from the stratified survey population.
  - Number of field samples per stratum is based on meeting a required coefficient of variation.
  - Sample selection tool is a component of RSA. Data input is the stratification data. Output is the sample units required for ground sampling (field survey)
  - For an average size program, can expect about 15%-20% of the total program area to be field surveyed.
    - Smaller programs will have a higher percentage of field sampling
    - "rare" strata are often sampled at a higher % than common strata. (ie. if you only have polygons of Hwd/Px – all 5 will probably be field sampled)

Performance Survey - Methodology

▶ Example sample selection summary:

Stratum	Area (ha)	Polygons	Sample_size	area_sampled	plots_sampled
Hw	763.0	36	14	179.9	759
HwPl	82.6	6	6	65.1	297
Pl	4011.5	189	19	236.5	989
PlHw	241.4	17	14	139.3	610
Sb	14.5	5	5	14.5	160
Sw	651.1	54	16	143.1	699
SwHw	21.4	4	4	21.4	130
	5785.5	**311**	**78**	**799.8**	**3644**

Performance Survey - Methodology

- Field survey methodology:
  - Plot locations pre-determined based Sample Unit size; 50m and 25m grid spacing.
  - Minimum 32 plots per SU, maximum 64 plots per SU
- Two plot types: Basic plots and Detailed plots
- Basic Plots
  - 1.78m radius ($10m^2$)
 - Tally of all acceptable crop trees by species (>30cm for conifer, 130cm for decid)

Performance Survey - Methodology

- Detailed Plots
  - 5.64m radius (100m^2)
  - Selection and measurement of Top Height trees for each species group
  - Top Height tree: The largest DBH tree
  - Species groups:
    - Pine (includes Pl, Pj, Lt)
    - White Spruce (includes Sw, Sx, Fb)
    - Black Spruce (includes Sb only)
    - Aspen (includes Aw, Pb, Bw)
  - Required measurements for each top height tree: Height, DBH, Total age

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Performance Survey – Data Compilation & results

- Data from all field measured sample units is input into the RSA Performance Survey compiler.

- RSA Compiler utilizes the Alberta growth model *GYPSY* (Growth & Yield Projection System) to project stand growth

- Conifer and Deciduous MAI results are calculated for each individual sample unit, and then averaged to calculate stratum-level MAI.

- Stratum-level MAI averages are then used to calculate an MAI projection for every opening included in the annual survey population based on the openings stratification (ie how much area of each strata is contained within the opening).

- Opening MAI results and stratification data are then reported to Alberta.
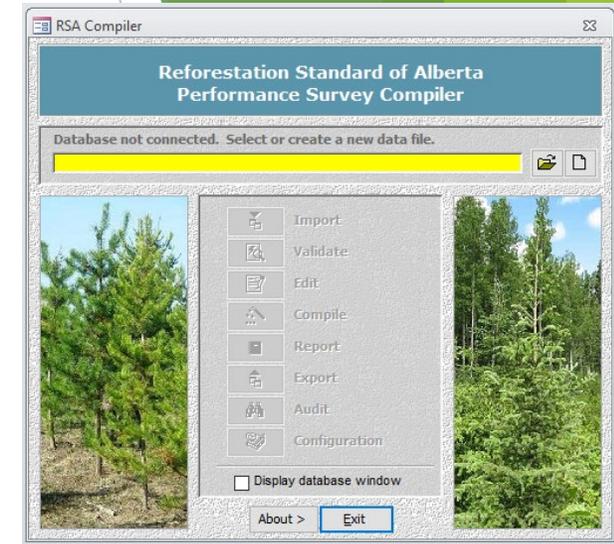
Performance Survey – Data Compilation & results

▶ Example compilation summary:

Strata Summary

Strata	Planned Population		Sampled		Model	Optional Diameter	Merch. Mean Annual Incr. (m3/ha/year)				
	Units	Area (ha)	Units	Area (ha)			Con	Decid	Sb	Sw	Pine
0_Pl	189	4,011.5	19	236.5	GYPSY version 1.0	No	2.88	1.09	0.4885	0.5620	1.8317
0_Hw	36	763.0	14	180.0	GYPSY version 1.0	No	0.69	3.14	0.0600	0.3614	0.2677
0_Sw	54	651.1	16	143.1	GYPSY version 1.0	No	2.42	1.33	0.3058	1.7743	0.3394
0_PlHw	17	241.4	14	139.3	GYPSY version 1.0	No	2.30	1.91	0.2242	0.5663	1.5123
0_HwPl	6	82.6	6	65.1	GYPSY version 1.0	No	2.13	1.94	0.4753	0.4095	1.2464
0_SwHw	4	21.5	4	21.5	GYPSY version 1.0	No	2.48	1.66	0.0353	2.0642	0.3785
0_Sb	5	14.5	5	14.5	GYPSY version 1.0	No	2.31	0.81	1.0194	0.5383	0.7518
Total	311	5,785.5	78	799.8							

Performance Survey – Outcomes

▶ No "Pass / Fail" at the individual opening level.

▶ Annual Strata MAI projections are compared to MAI targets

  ▶ If a stratum (ie Px) is meeting or exceeding the MAI target, no further concern

  ▶ If a stratum is continually not meeting the MAI target, need to evaluate why.

  ▶ May lead to changes in reforestation tactics for that stratum, or changes to the MAI target in future DFMPs.

How do regeneration survey results affect the timber supply analysis and AAC?

- Annual Allowable Cut (AAC) calculation is a primary outcome of the Detailed Forest Management Plan.

- In simplest terms, the AAC is determined based on the volume of merchantable timber that can produced annually on the contributing landbase.

- How is this calculated?

  - Classify the landbase into contributing / non-contributing areas (ie define the areas that are eligible for forest management activities)

  - Classify the contributing landbase into yield classes (ie forest types)

  - Create yield curves for each forest type

  - Assign every stand in the contributing landbase to a yield curve

  - Complete a Timber Supply Analysis to project total forest growth over time.

How do regeneration survey results affect the timber supply analysis and AAC?

▶ Alberta Performance Survey data may be used to develop regenerated yield curves for use in timber supply analysis.

▶ Regenerated stand yields commonly exceed natural stand yields due to prompt reforestation and full site occupancy.

▶ AAC is based on the volume the landbase is producing in a year. If we can **demonstrate** that regenerated stands are producing volume faster than natural stands, we can apply this assumption in a timber supply model to stands that will be harvested in the future.

How do regeneration survey results affect the timber supply analysis and AAC?

- **Simple AAC impact example: 150,000 hectares of Pine contributing landbase**

- Natural stand yield (MAI) = 2.3 m^3/ha/year
- 150,000 x 2.3 = 345,000 m3/ha/year

- Regenerated stand yield (MAI) = 3.1 m^3/ha/year
- 150,000 ha x 3.1 = 465,000 m3/ha/year

- Total potential increase resulting from transition to regenerated stand yields = 120,000 m3/ha/year
- Every 0.1 increase in MAI results in a potential further increase of 15,000 m3/ha/year

Assumptions, Risks, and Monitoring Requirements

▶ Government approval of AAC calculations involving "aggressive" regenerated yield assumptions requires robust data with rigorous quality control mechanisms, as well as a long term monitoring plan to validate projections.

▶ Allowable Cut Affect (ie. harvesting more today based on the projection that forests will go faster tomorrow) poses a risk to sustainability if not properly supported.

▶ Using past performance to project future results assumes we will be harvesting the same types of stands, using the same harvest methods, using equivalent (or better) reforestation tactics. This needs to be explicitly documented in the DFMP.

▶ Projecting growth based on year 14 survey results carries some risk as well. Monitoring of older regenerated stand performance through permanent and temporary sample plots is required.

Thank you! Questions?

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