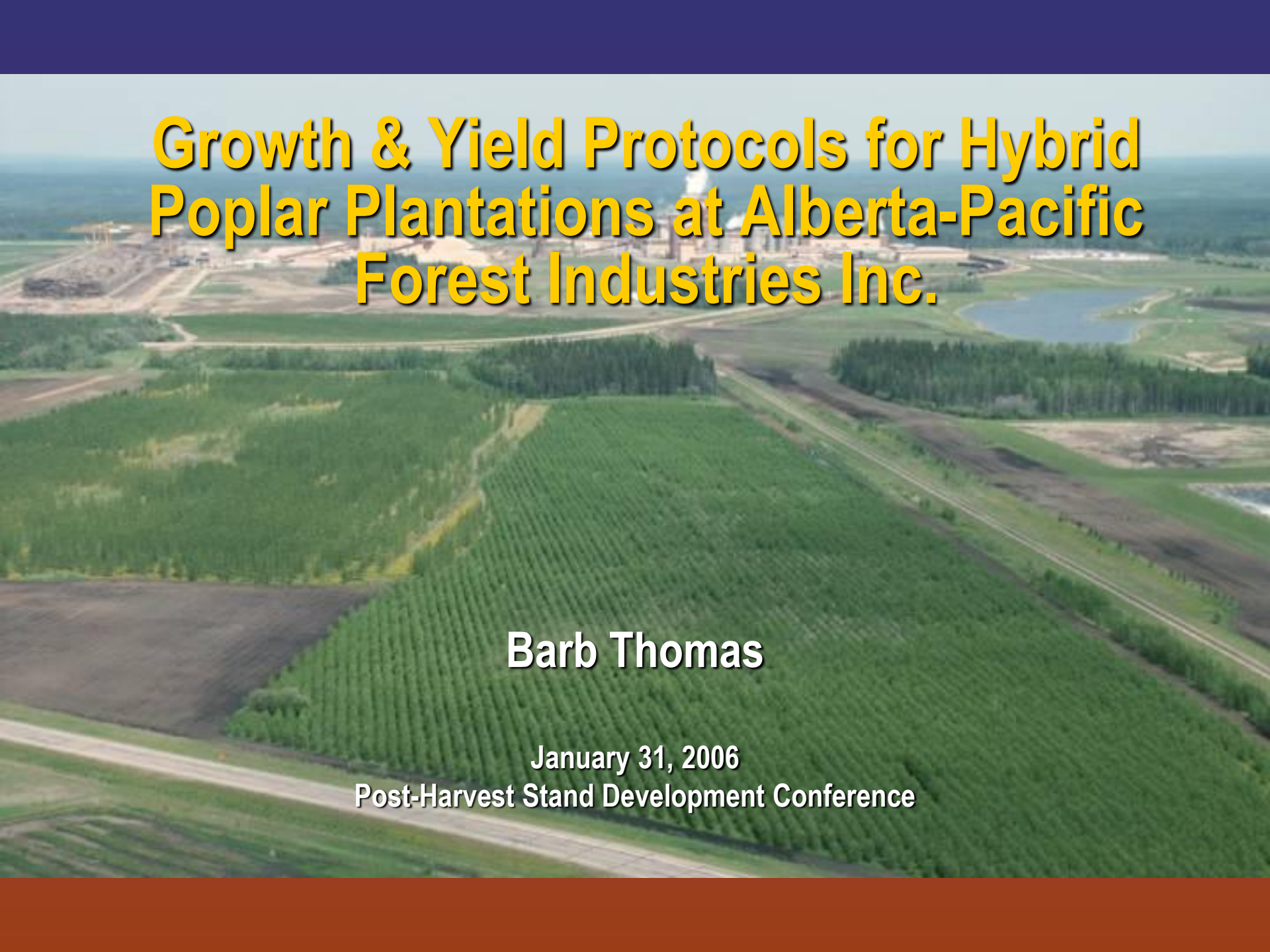




Growth & Yield Protocols for Hybrid Poplar Plantations at Alberta-Pacific Forest Industries Inc.

Barb Thomas

January 31, 2006
Post-Harvest Stand Development Conference

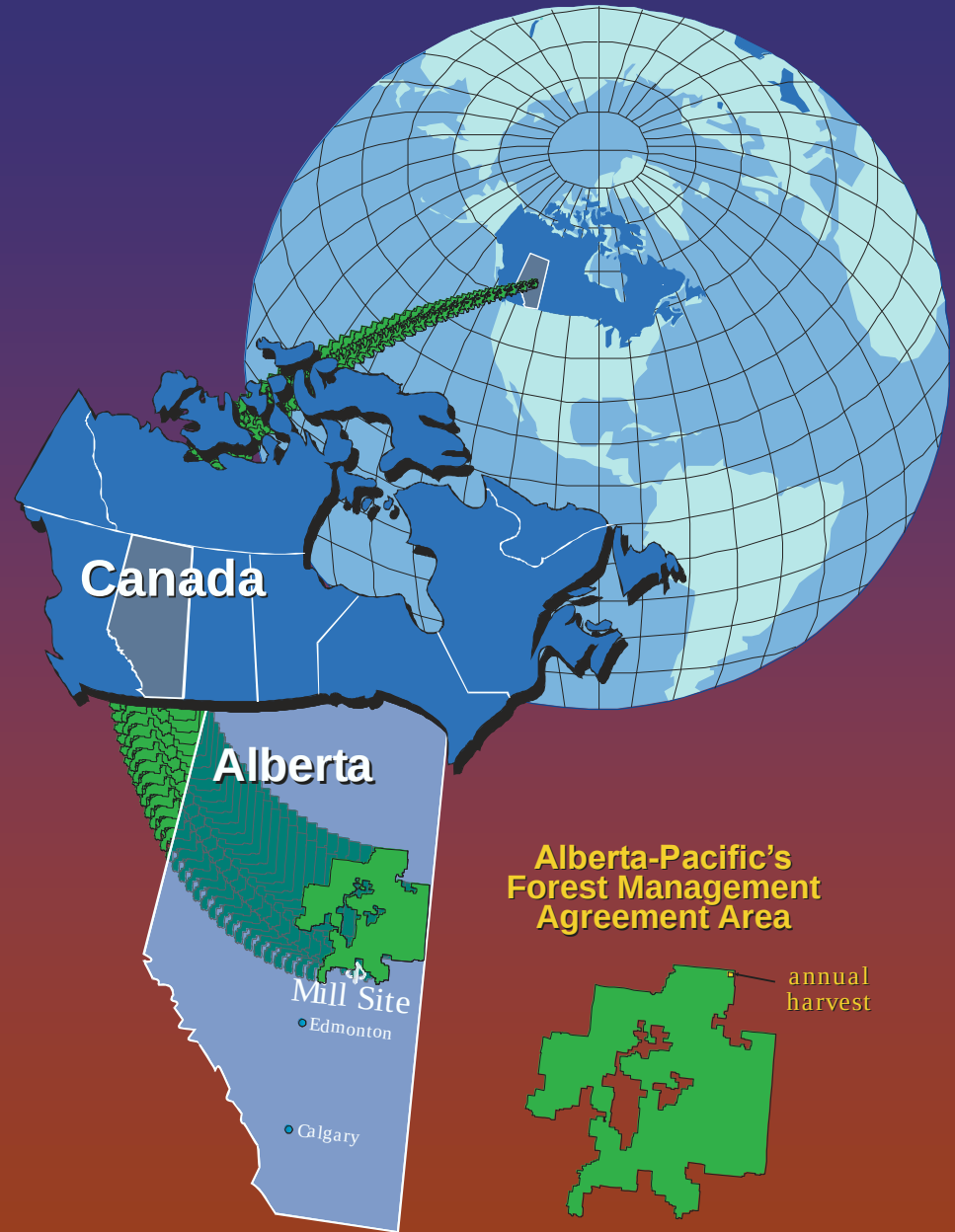


Outline

- Scope of Poplar Program
- Hybrid Poplars
- Growth & Yield Protocols
- Growth & Yield Equations
- Growth & Yield Expectations and Challenges
- New Model Development

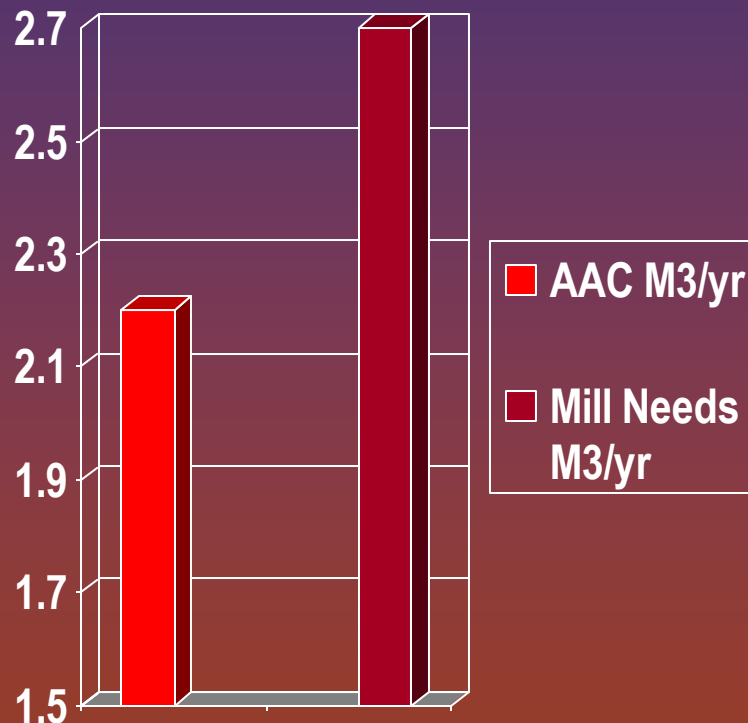


- Boreal Mixedwood
- 58,000 km²
or 5.8 million ha
Forest Management
Agreement area
- Al-Pac's annual
allowable cut
 - 2.2 million m³
deciduous
 - 370,000 m³
coniferous





Private Wood Supply Shortage



Mill Requires

- 2.7 Million m³ / yr AAC
- 2.2 Million m³ / yr (FMA area)
- Approximately 350,000 m³ private wood purchases
- Remainder chip purchases

In 20 years it is estimated 400,000 m³ needed from plantations to meet projected short fall from private wood and ↑ mill efficiencies.

- New timber supply analysis deletes 31,679 ha for anticipated oil sands mines (10-year horizon)

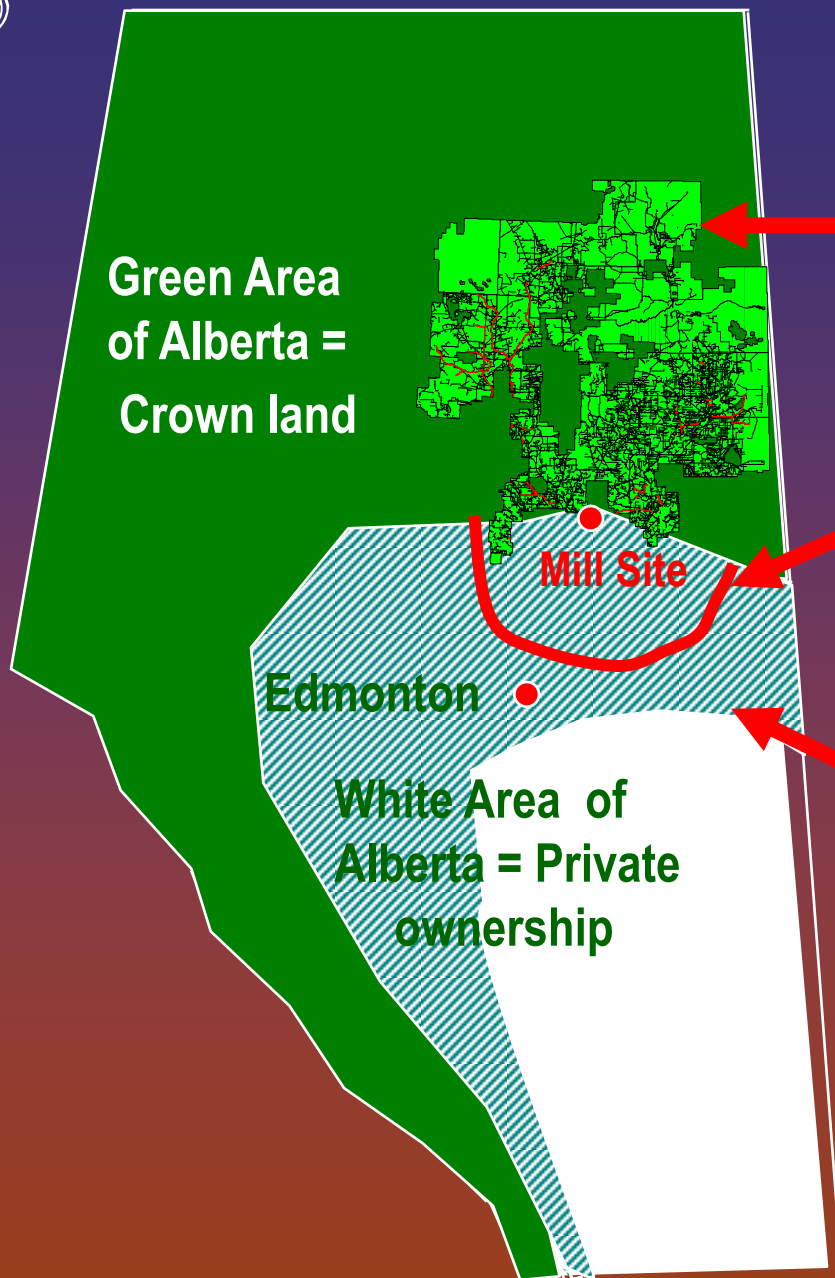


Anticipate conservatively 5,000 ha annually to be cleared over next 20-years.



550 annually from seismic alone.





Green Area
of Alberta =
Crown land

Edmonton

White Area of
Alberta = Private
ownership

Mill Site

AI-Pac's FMA area is within the
Boreal Forest

AI -Pac's Poplar Farm
Management Area
(PFMA) 200 km radius from
Mill Site

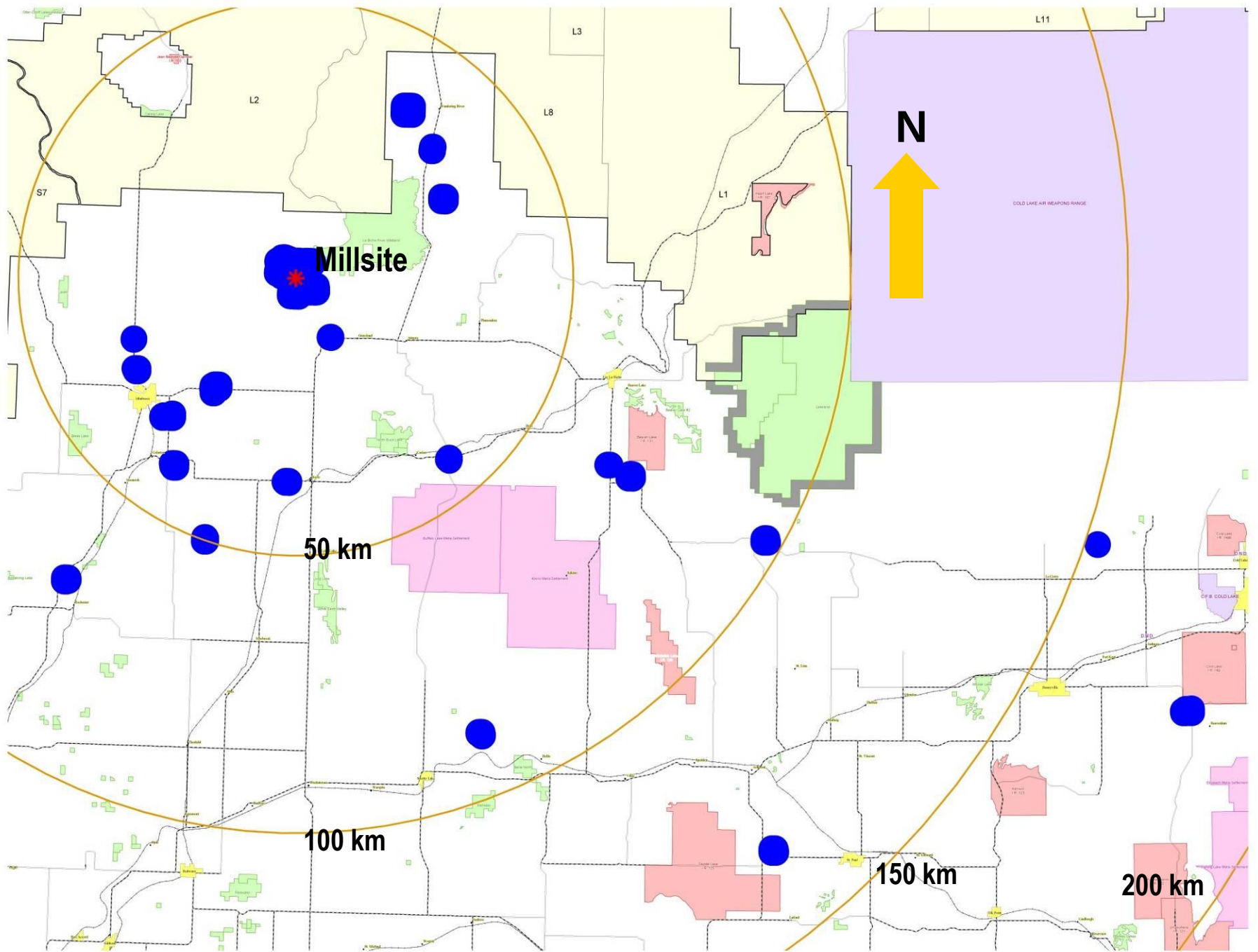
Aspen Parkland/
Converted to Agriculture

Farm Land

N

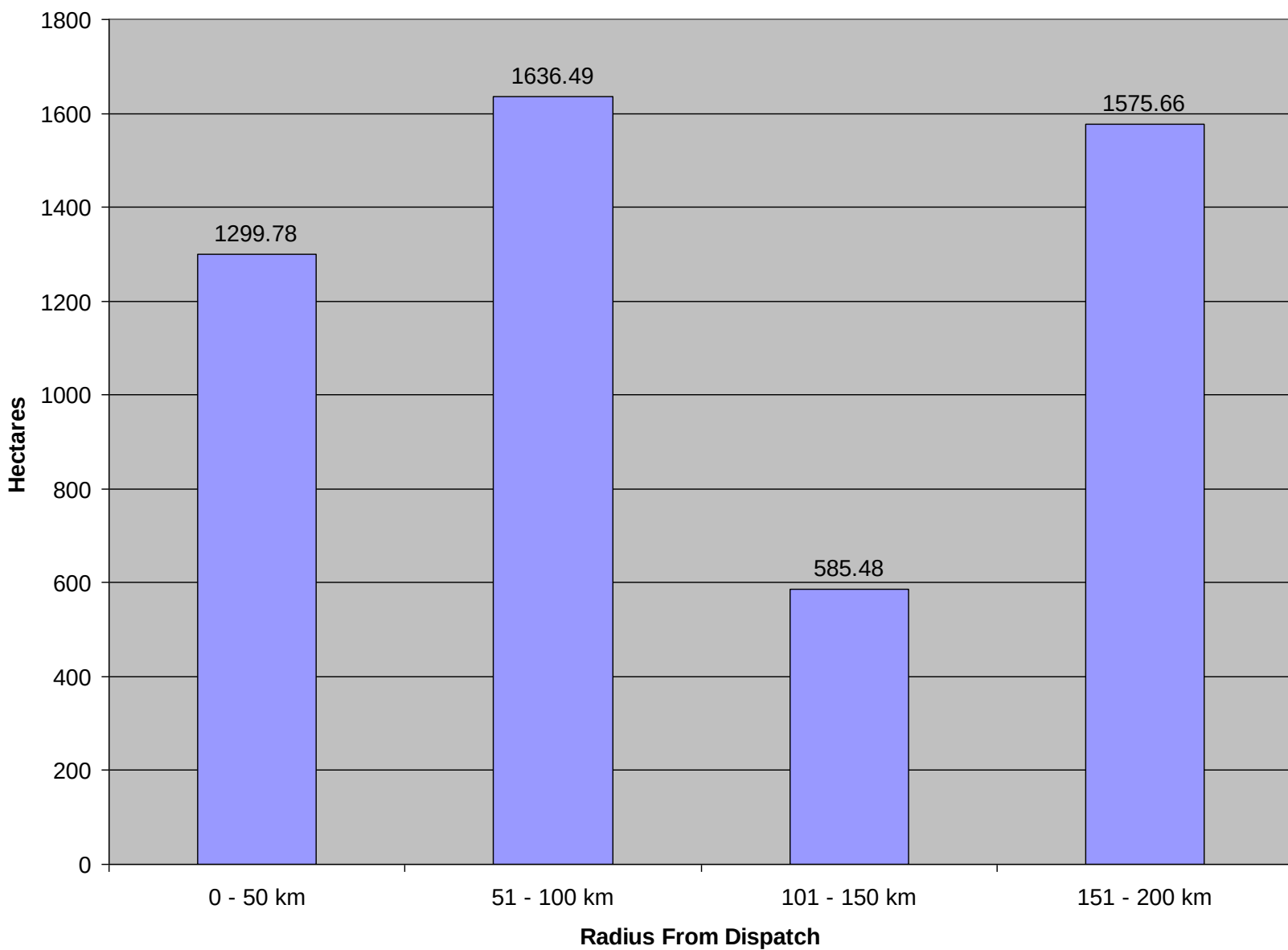
Forest Land







Al-Pac Poplar Farm Land Distribution





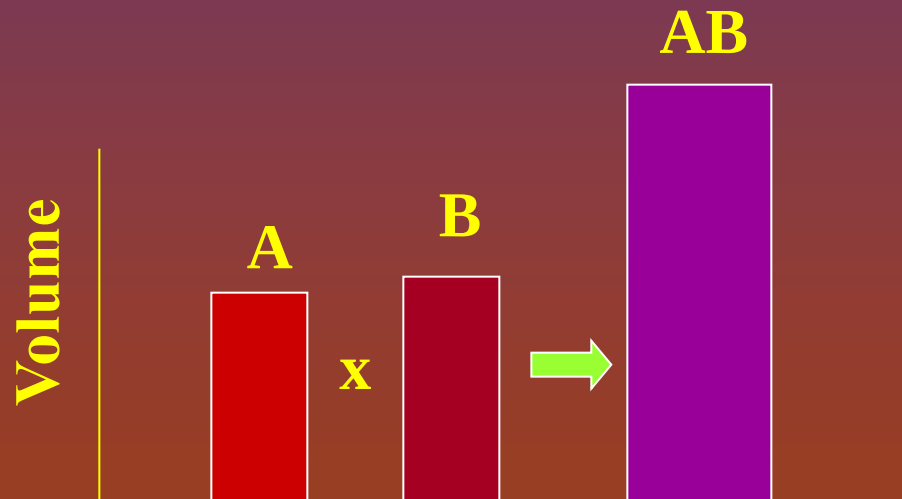
Scope of Project

- Plant 1200 hectares per year for 20 year rotation
- Final project size 24,800 hectares
 - 24,000 ha leased, 800ha AI –Pac owned land
- Lease terms 20 years (can extend)
- Expected growth rate 14-16 m³ MAI
 - ~ 400,000 m³/yr at harvest
- Current planting stock = hybrid poplar
 - 5 clones currently recommended for planting
- Comprehensive R&D breeding & testing program



Why Hybrids?

- Hybrid vigour & reduced rotation length - clonal  off-spring that exhibit superior growth compared to either parent species



hybrid aspen

pure aspen



10- yrs,

18-yrs,

4-yrs,

10-yrs



BALSAM POPLARS
(*Tacamahaca*)



BUSH BALSAM POPLAR



ASPENS
(*Populus*)

HYBRID ASPEN



BUSH ASPEN



WHITE ASPEN

Populus = *P.*

ALL STUMP COOKIES



PLAINS COTTONWOOD
Intensive Silviculture



HYBRID POPLAR
Brooks 6" or "Green Giant"



COTTONWOOD POPLARS
(*Alpeius*)



HYBRID POPLAR
"Dunlop"



HYBRID POPLAR
"Walker"

HYBRIDS

HYBRIDS



SUPERIOR BALSAM POPLAR
Intensive Silviculture

HYBRID POPLAR



HYBRID POPLAR
"Northwest"



HYBRID POPLAR



HYBRID POPLAR
"P38P38"



Current State of the Poplar Farm Program

- Implementing best practices & investigating new herbicide options
- 4,006 ha planted (16% of target)
 - Typical annual plant of 1,200 ha
- Anticipate introduction of new operational clones by 2010.

**20% of crop conversions is
agricultural cropland**



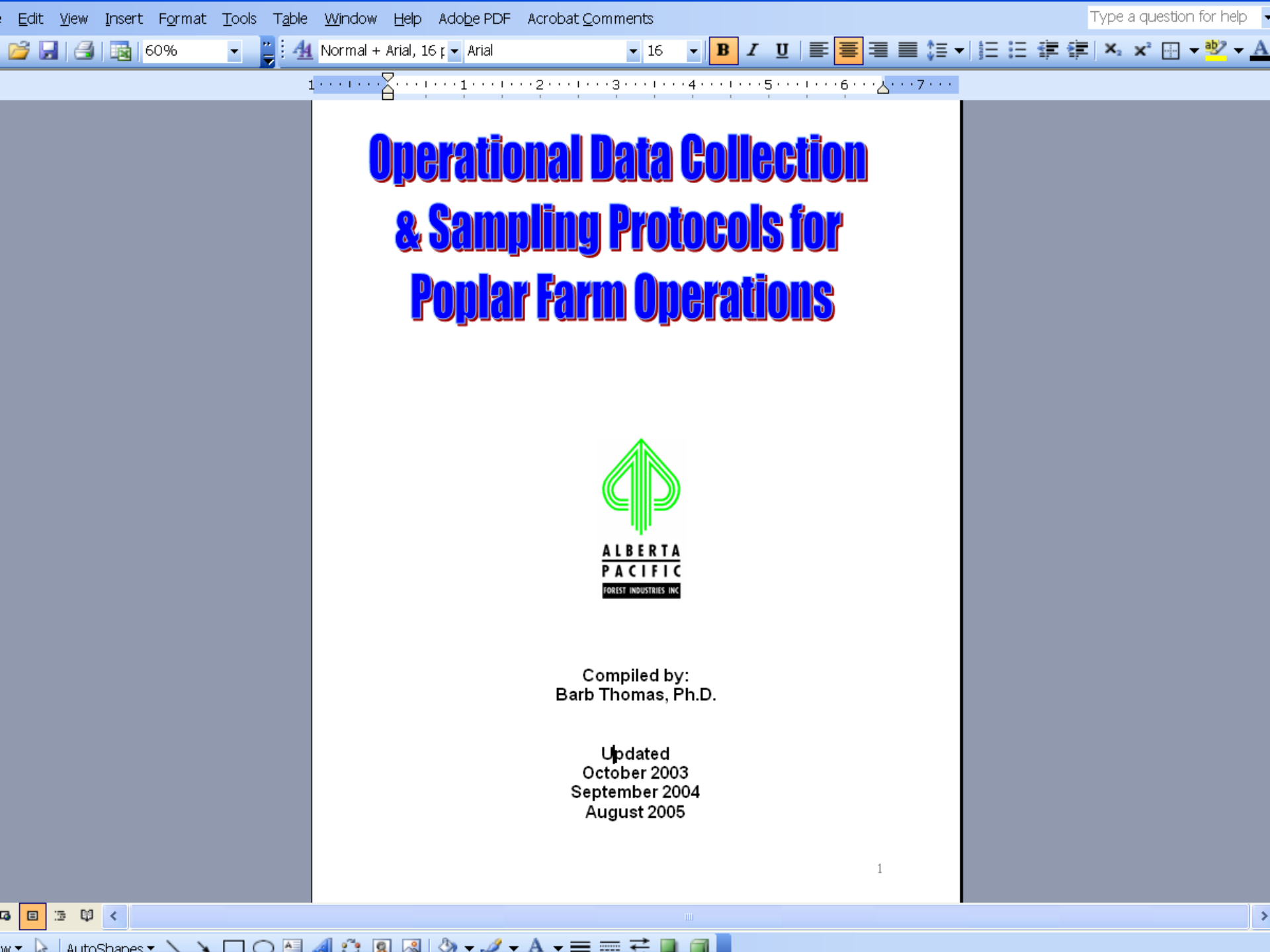
**80% of crop conversions from
as hay or pasture land**



Intensive poplar farms

~17% of future fibre
to come from farms





Operational Data Collection & Sampling Protocols for Poplar Farm Operations



ALBERTA
PACIFIC
FOREST INDUSTRIES INC.

Compiled by:
Barb Thomas, Ph.D.

Updated
October 2003
September 2004
August 2005



Protocol

Determination of a 'stand' delineated by:

- Age
- Spacing
- Clone
- Same culture (eg: stock-type, biosolid application)

For a given field or portion of a field



Protocol

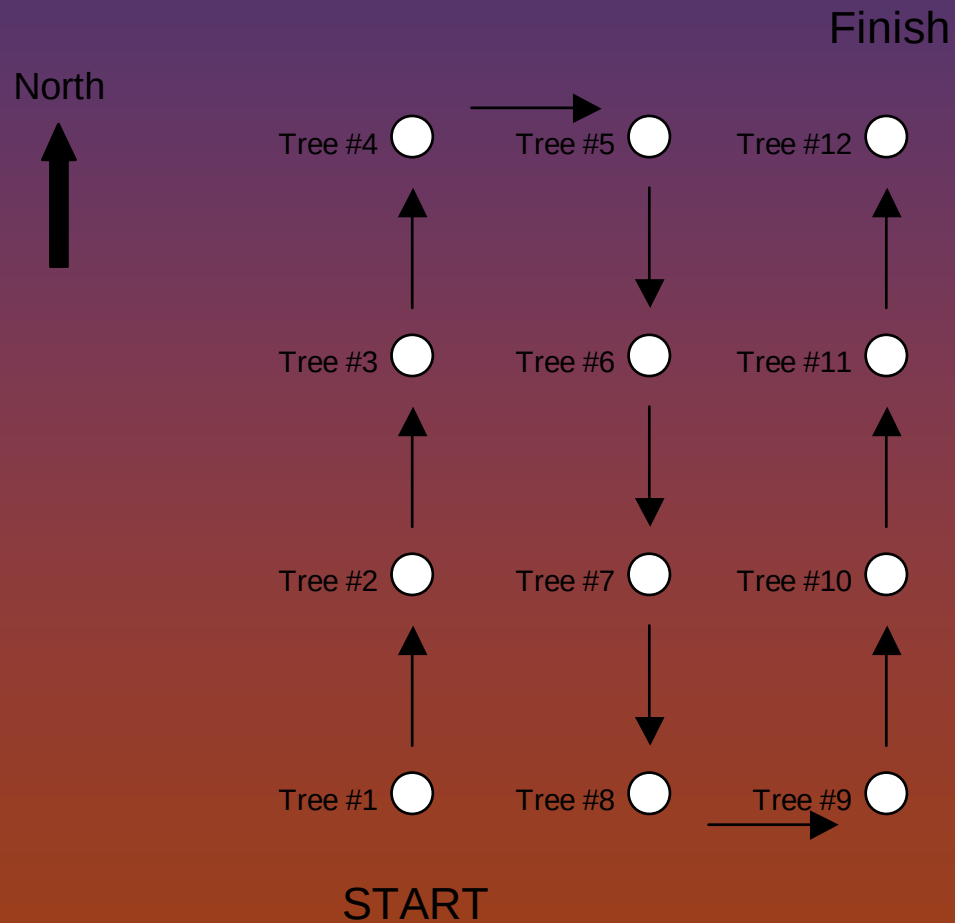
Two Types of Sampling:

- **1. Permanent sample plots**
 - Established in yrs 1-3
 - 12-tree plots
 - Soil sampling also conducted for: **soil type & pH**
 - Survival, DBH, height measured at yrs: 4, 7, 11, 16 & ~20
 - If req'd, winter dieback, browse, insect attack etc. also recorded
 - **# of PSP's per stand**
 - Stands < 5ha, no PSP
 - Stands < 10 ha, 2 plots
 - Remaining stands require 4 plots per 20 ha's



Protocol

1. Permanent sample plots





Protocol

- 2. Temporary sample plots
 - Initiated in year 3 (survival only prior)
 - 2–trees per hectare per stand to a maximum of 30 trees
 - Annual measurement, height and DBH only
 - Selection of trees random
- **COMPARE BETWEEN METHODS**



Protocol coding

- Program is divided into 7 regions

Data Code	Region included
1	Westlock, Barrhead, Lac Ste Anne counties
2	Athabasca area, lesser Slave Lake counties
3	Smoky Lake, Thorhild counties
4	Bonnyville, St. Paul counties
5	Mill-site area, Wandering River area
6	Lakeland county
7	Sturgeon, Strathcona, Lamont, Two Hills, Beaver counties

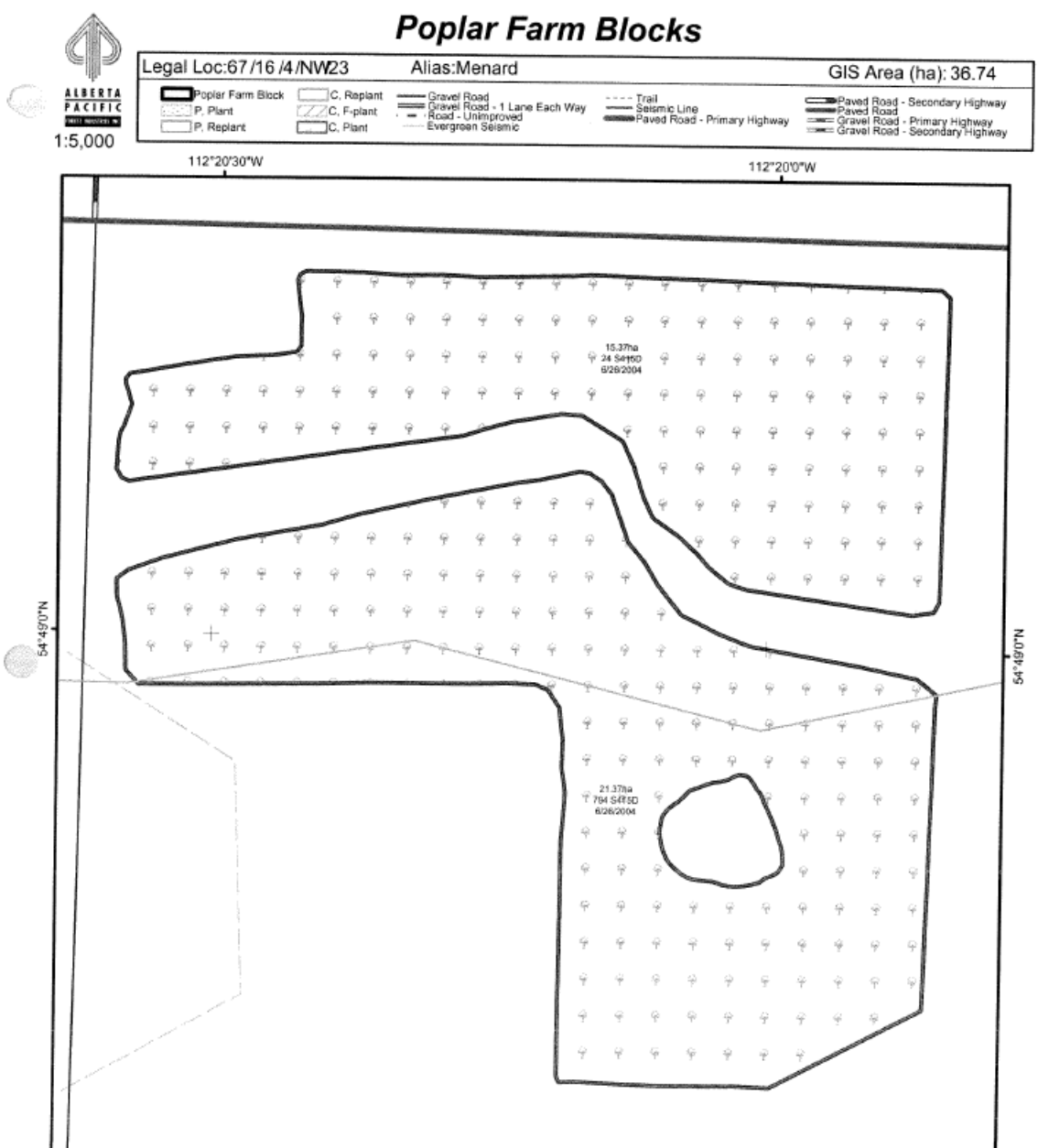


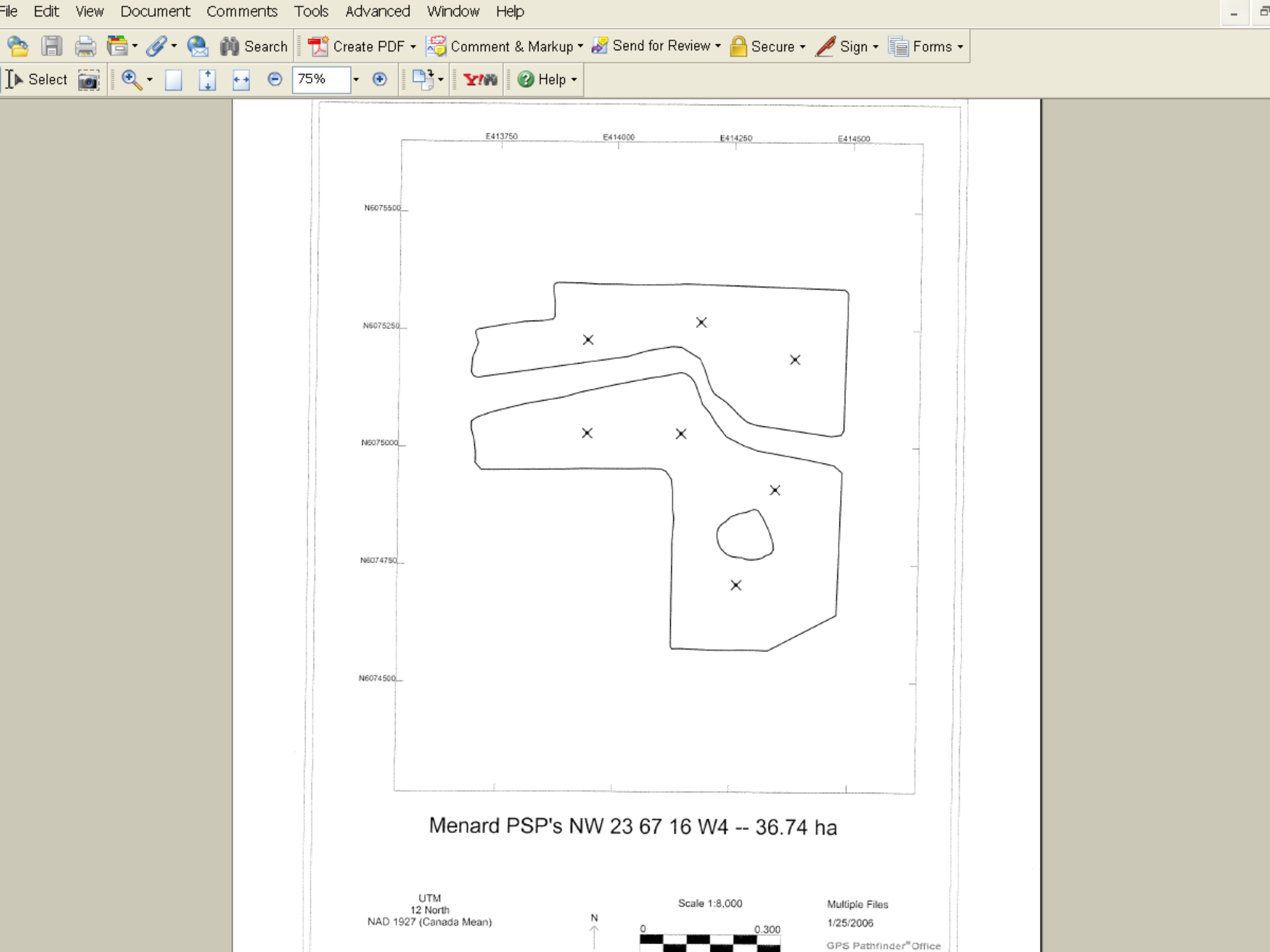
Protocol coding

- Stock Type



Data Code	Stock Type
1	Bareroot
2	OWD (Over-winter dormant)
3	Hot-lifted
4	Cuttings







Tree Measurements

2003 planting



2000 planting



Data recording



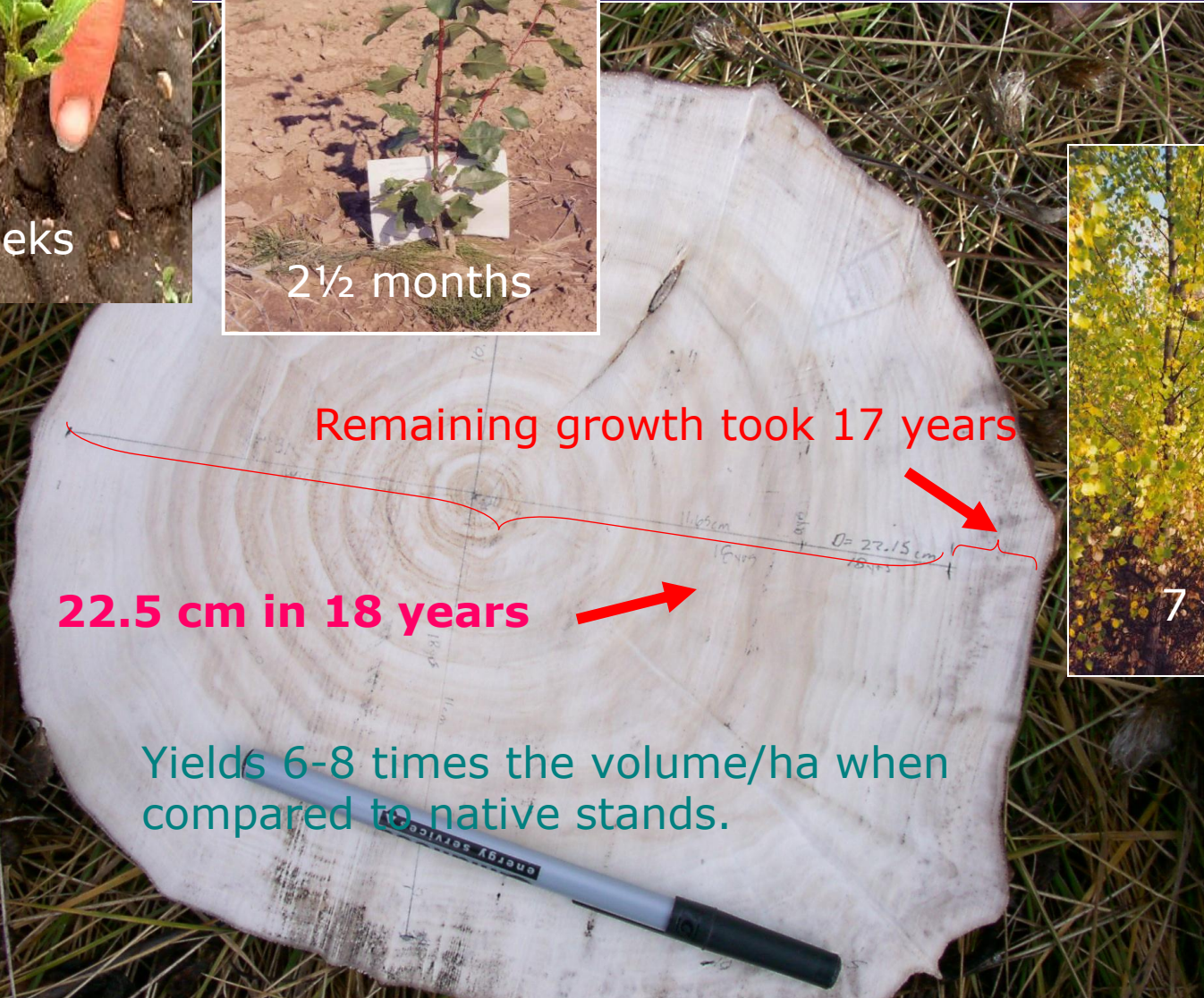
Growth and Yield



2 weeks



2½ months



Remaining growth took 17 years

22.5 cm in 18 years

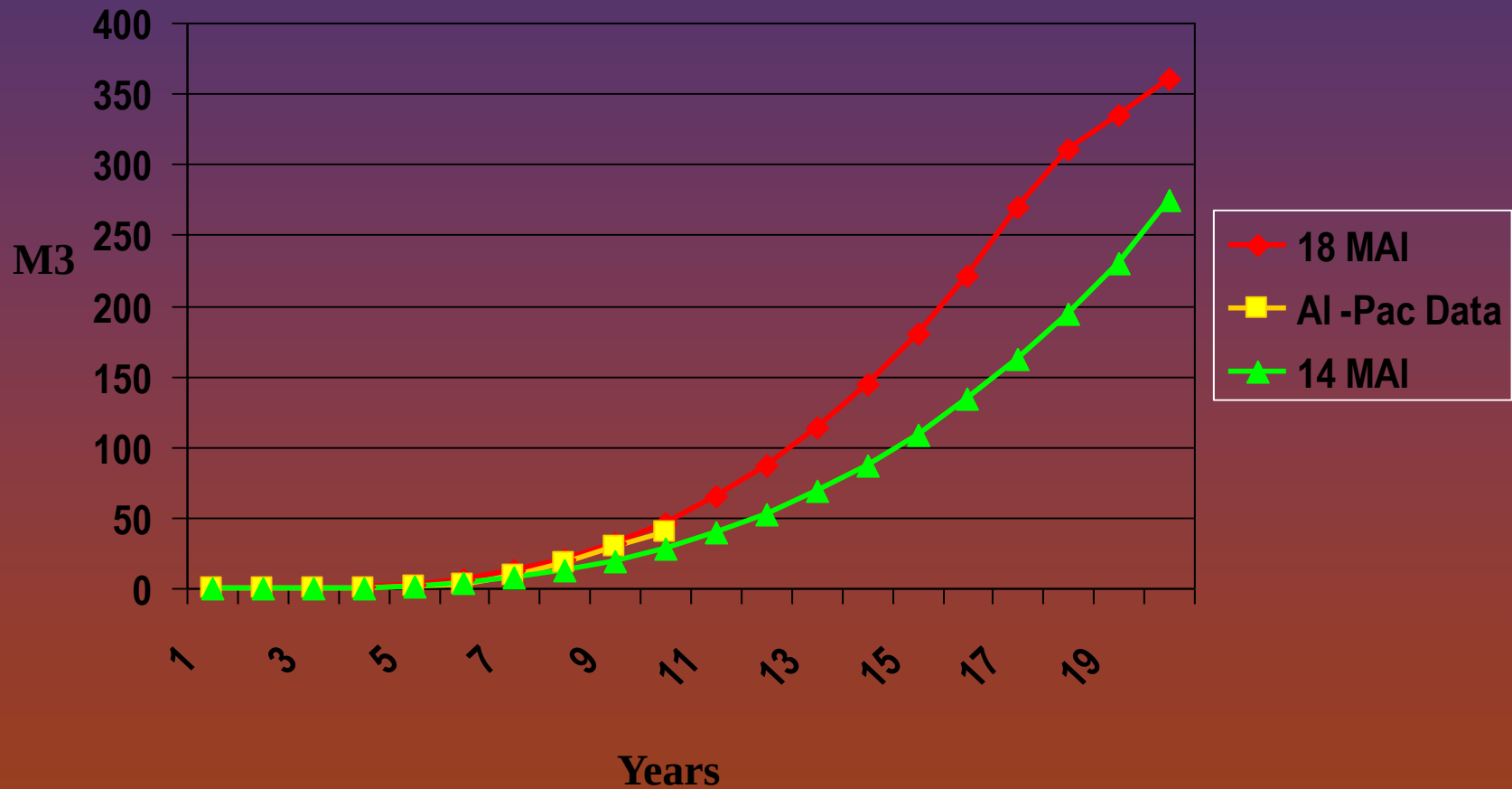
Yields 6-8 times the volume/ha when compared to native stands.



7 years

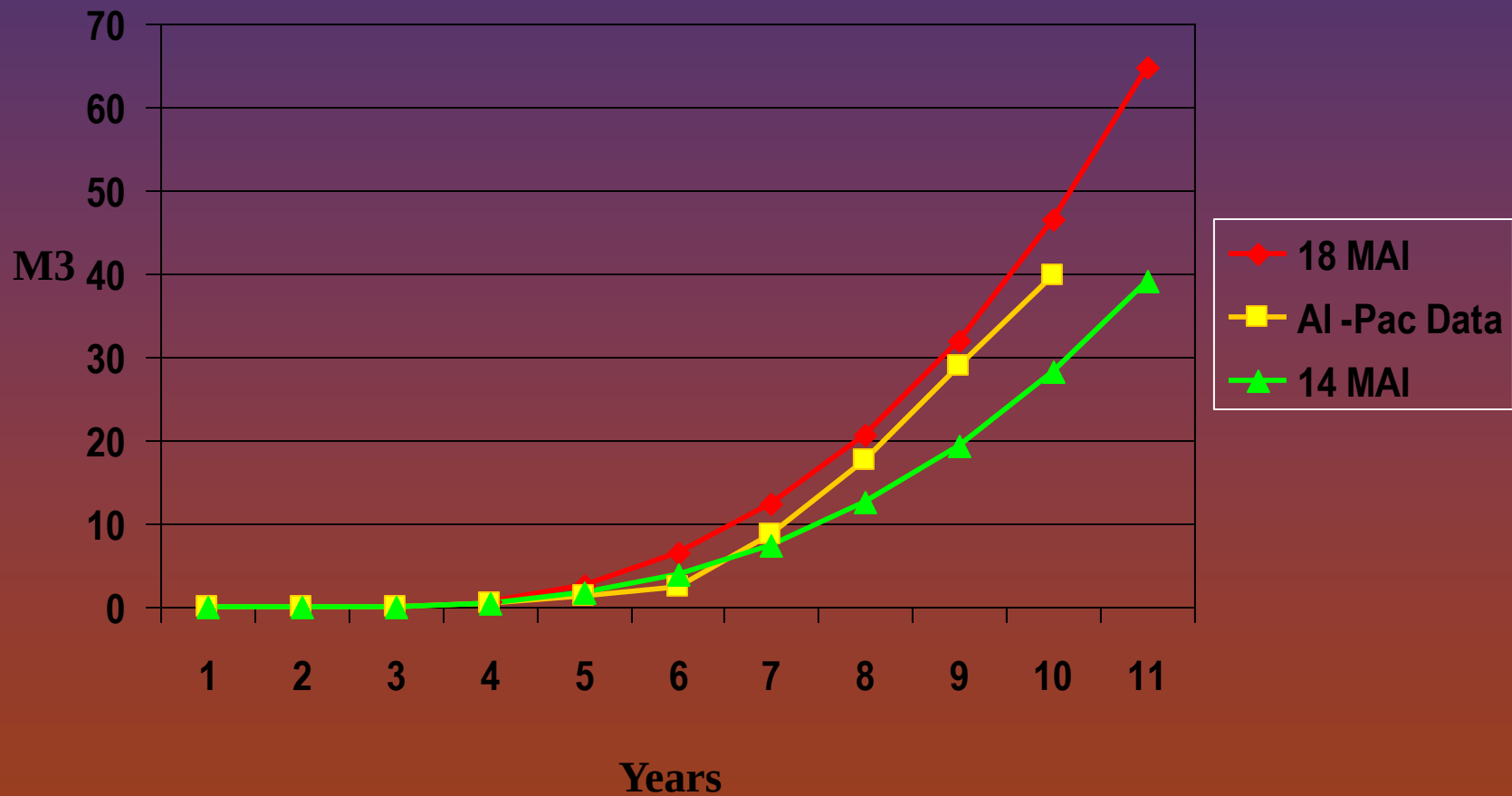


Growth and Yield



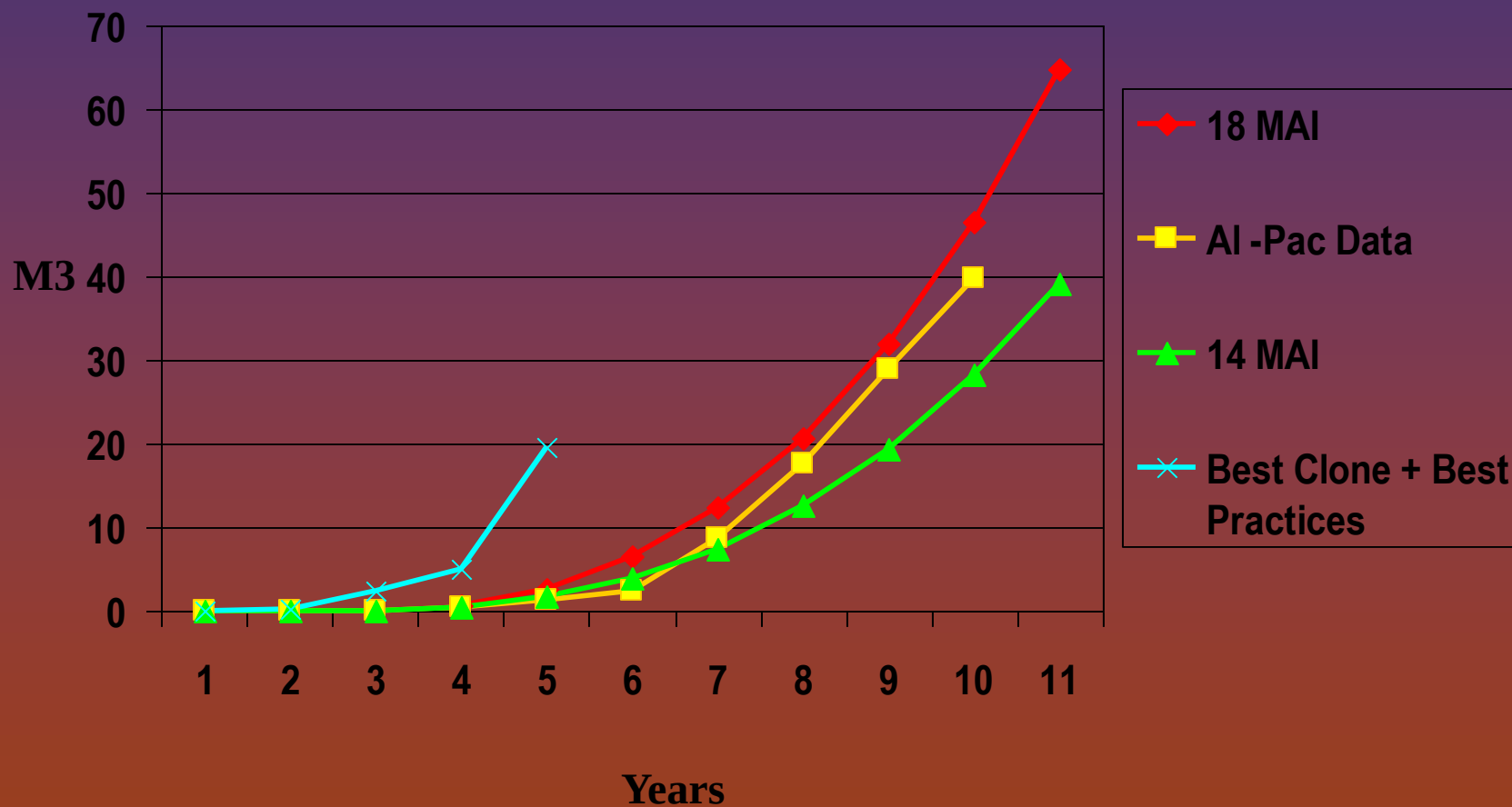


Growth and Yield





Growth and Yield





Volume equation for hybrid poplars

- A Grower's Guide to Hybrid Poplar, MNR Ontario, 1991
- Developed in eastern Ontario
- 407 observations from a range of hybrid poplar clones (mostly *P. deltoides* x *P. nigra* clones)



Volume equation for hybrid poplars

- General individual tree stem volume equation:

$$= \text{EXP}(-1.064079 + 1.562891 * \text{LN}(\text{DBH in cm}) + 0.101423 * (\text{HT in m})) * 1.013689 / 1000$$



Volume equation for hybrid poplars

- Mean annual increment (MAI):

$(\text{Individual volume (m}^3\text{)} \times \text{stems per ha} \times \% \text{ survival}) / \text{age}$

- Current annual increment (CAI):

$\text{Yr 2 volume (m}^3\text{)} \times \text{stems per ha} \times \% \text{ survival} - \text{Yr 1 volume (m}^3\text{)} \times \text{stems per ha} \times \% \text{ survival}$



Volume equation for hybrid poplars

			DBH (cm)				
Walker		5-year	10-year		20yrs	1100t/ha	MAI
	Height (m)	8.6	28		27	m3/ha	
5-year	7.8	0.022278				24.51	4.90
10-year	12.7		0.231704			254.87	25.49
20-year	17				0.338574	372.43	18.62



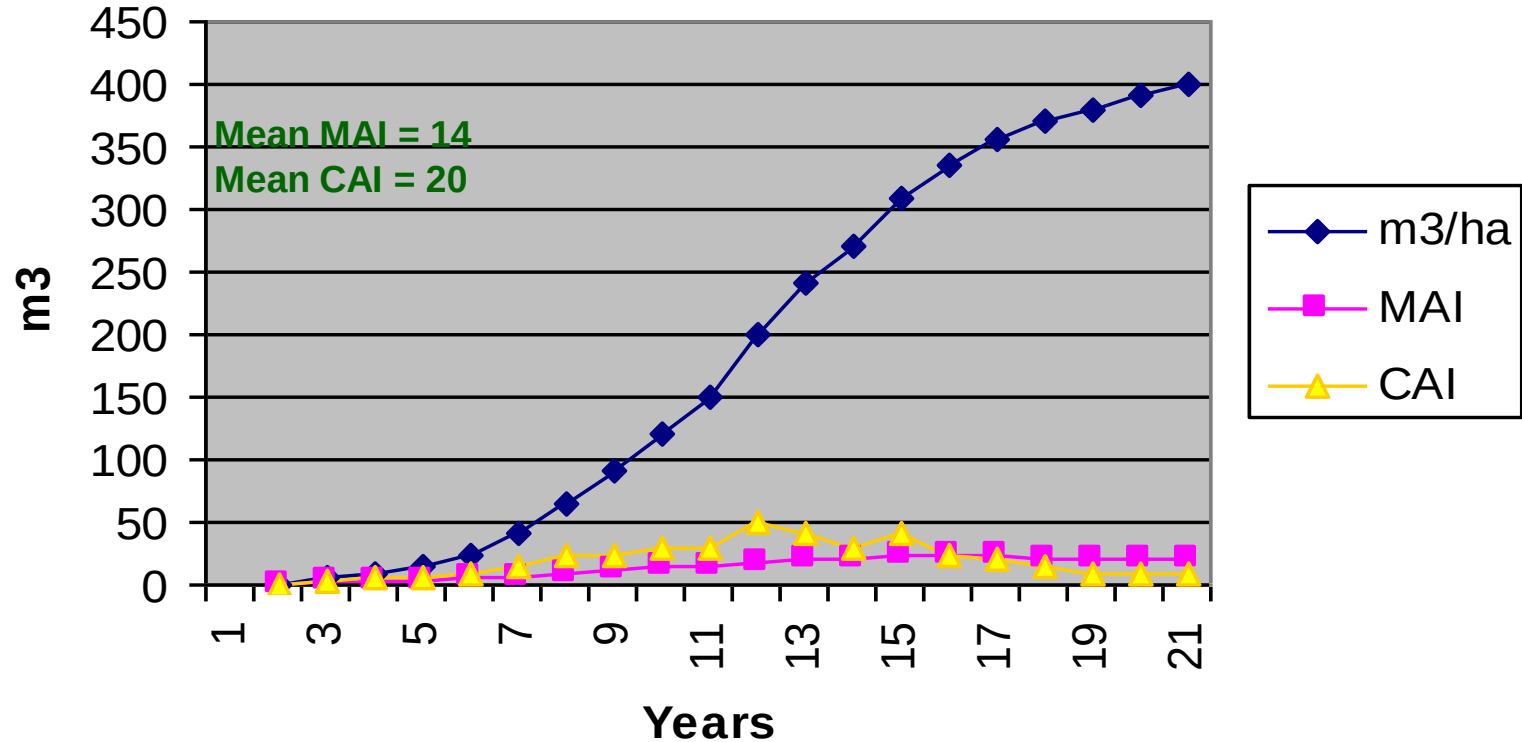
Volume equation for hybrid poplars

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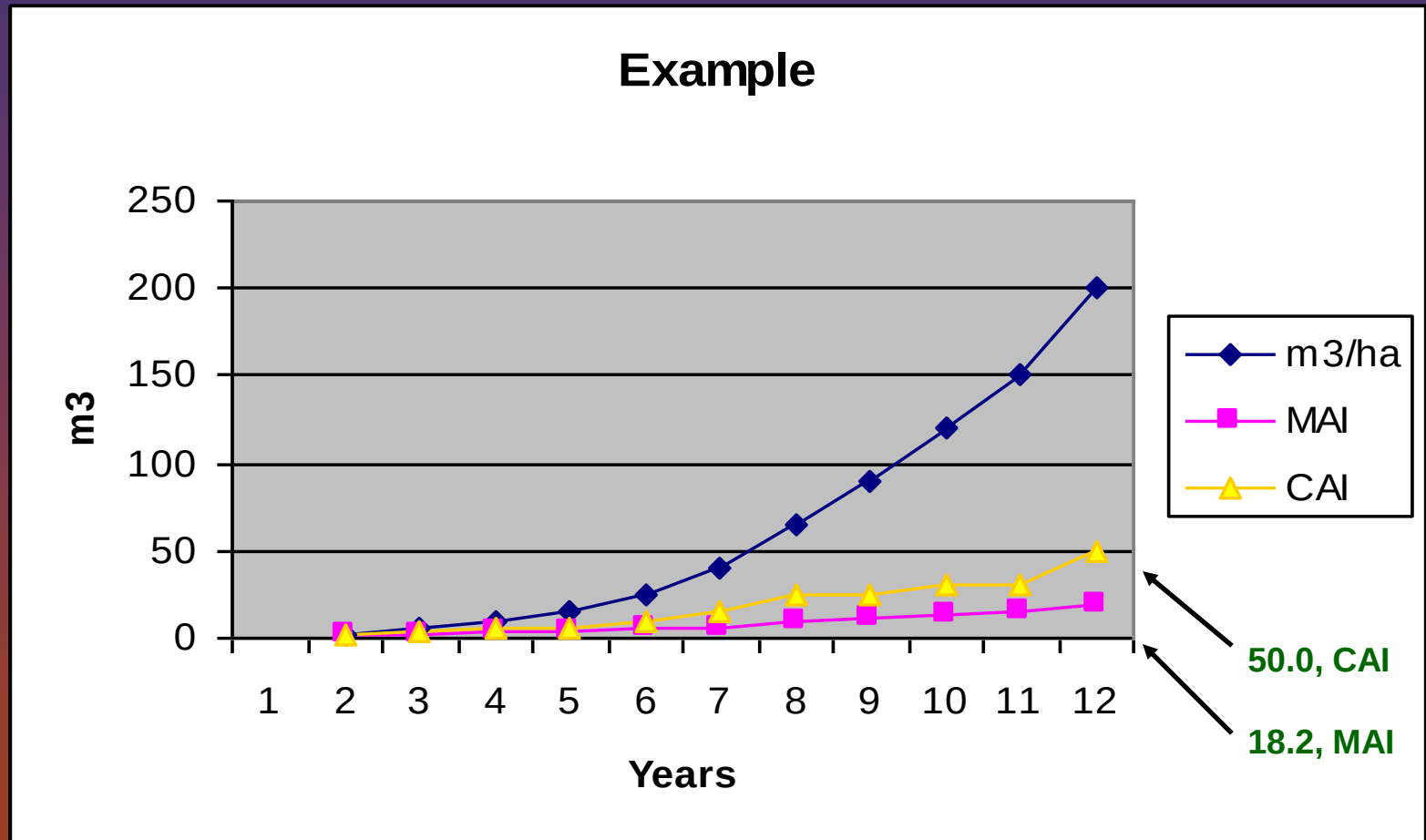
Volume equation for hybrid poplars

Example





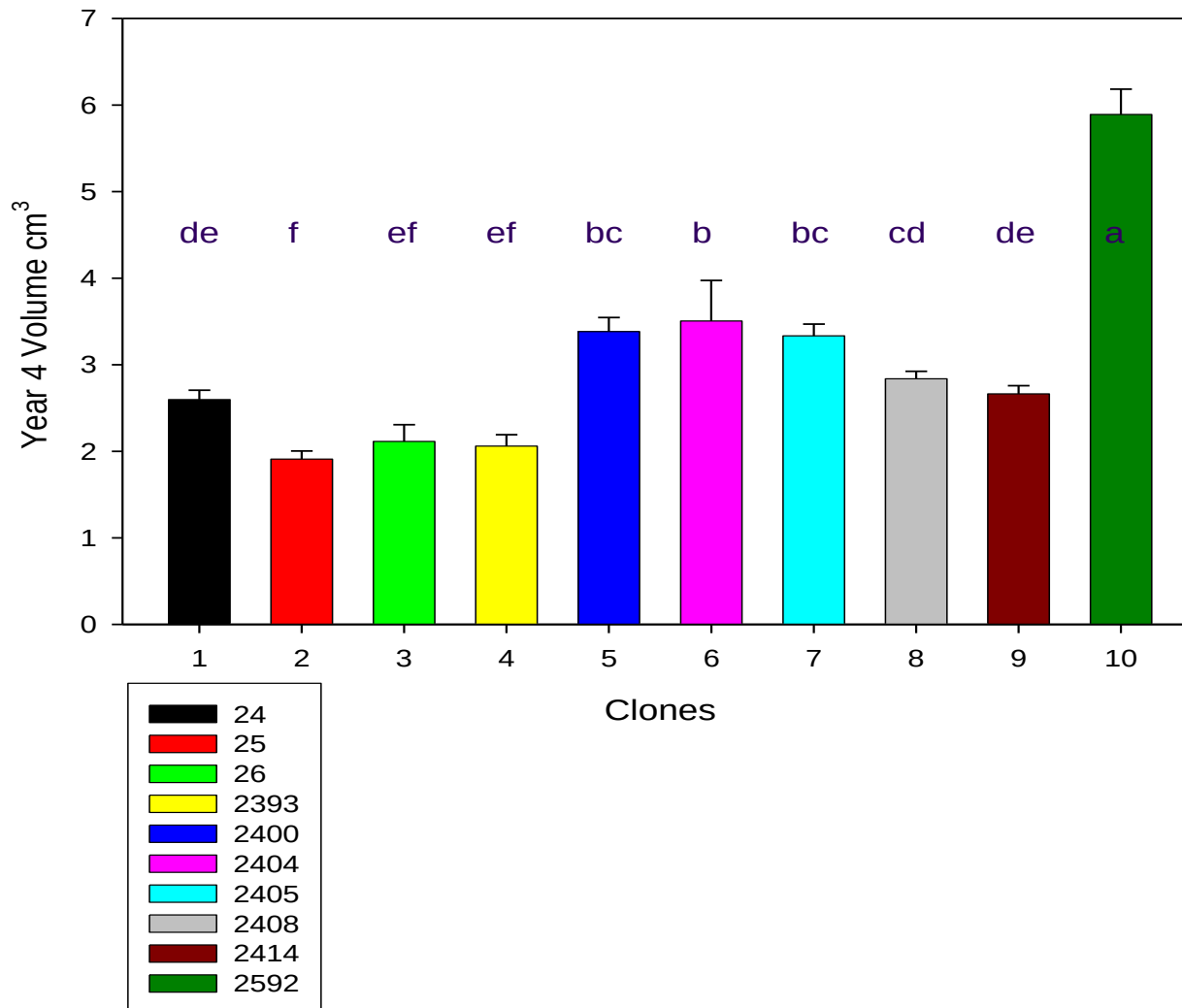
Volume equation for hybrid poplars





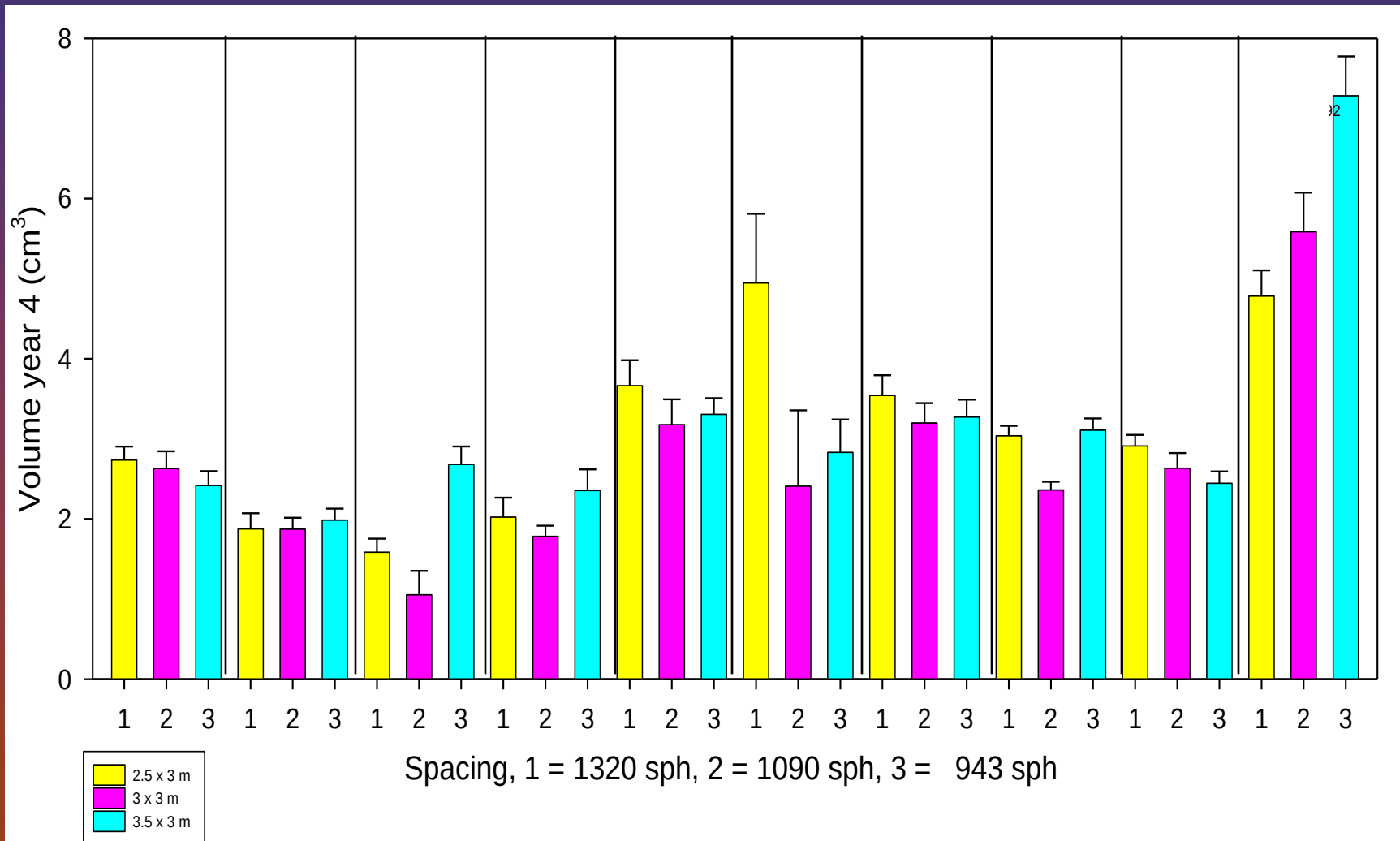
Impact of clone variation

Individual tree volumes in a block planting of 10 hybrid poplar clones



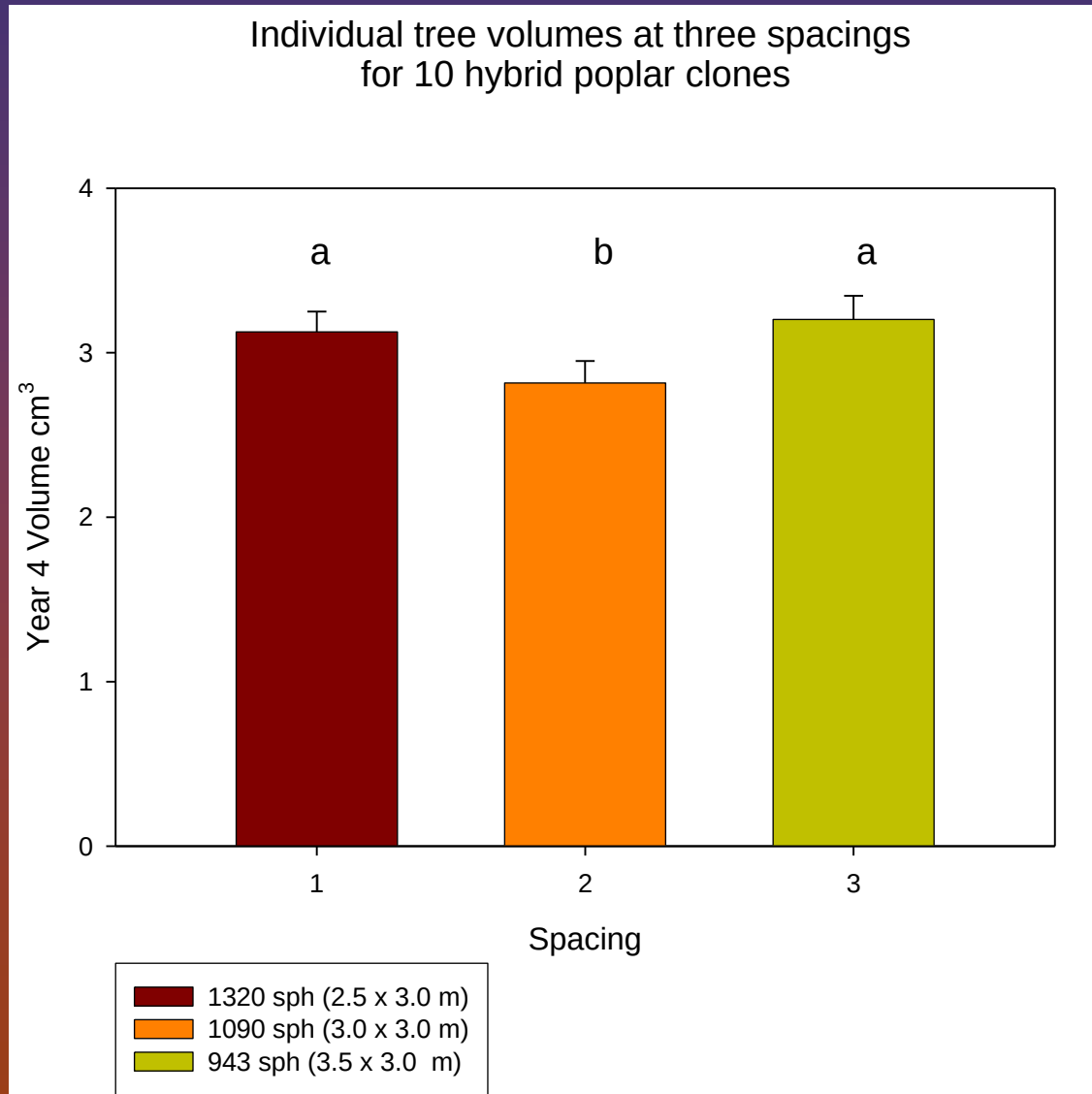


Impact of spacing x clone interaction





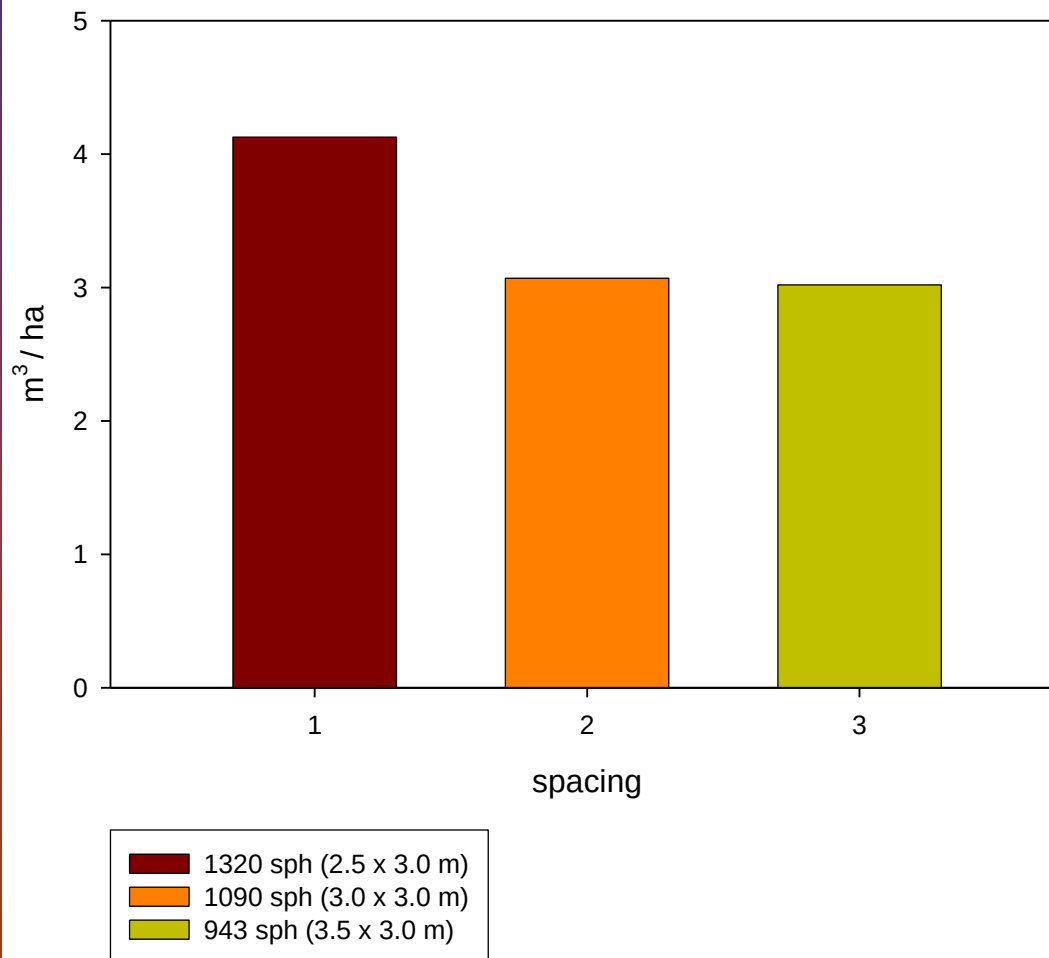
Impact of spacing on individual tree volume





Volume per hectare at three spacings

Year 4 volumes per hectare at three spacings for
10 hybrid poplar clones





Other impacts

- Insect and disease
- Climate changes (extremes)
- Moose
- Weeds





Developing a new model?

- Different hybrid poplars grown in AB vs Ontario
- Different environmental/site factors
- Unknown what impact this might be having on our projected volume estimates
- Dr. Thompson Nunifu joined group in 2003/04



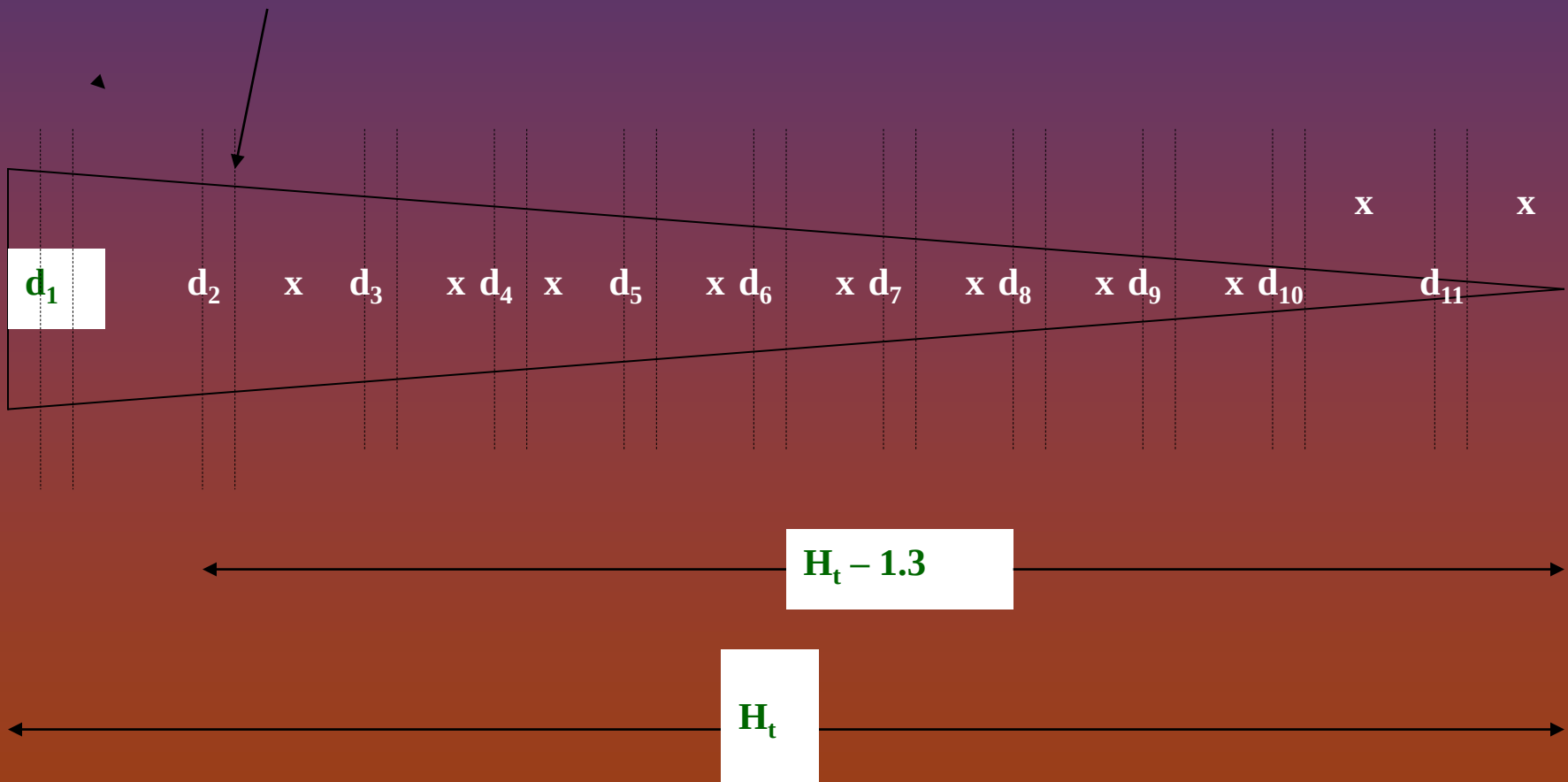
Thompson's work

- Conducted a study with limited samples (10 clones)
- Tested Kozak's (1988) variable-exponent taper equation
- Compared results with Ontario equation



Main stem, showing points where discs cut.
 $d_1 = 0.3\text{m}$, $d_2 = 1.3\text{m}$, remaining discs taken at equal
intervals $x = (H_t - 1.3)/10$.

Breast height
(1.3m)





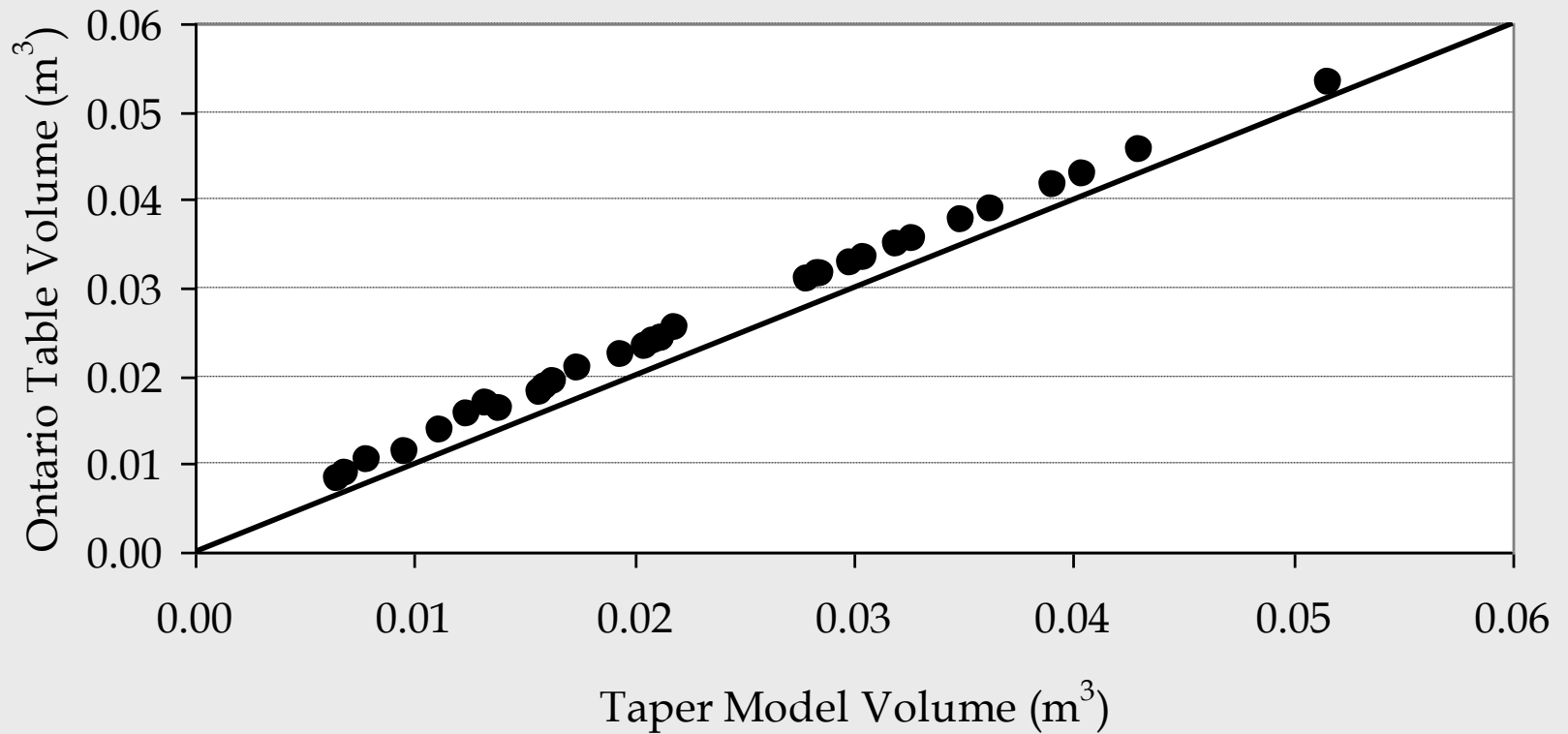


Comparison between Models

Region	Stand Number	PSP Number	Average DBH (cm)	Average Height (m)	Tree Density (stems/ha)	Volume (m ³ /ha)	
						Taper Model	Ontario Volume tables
5.00	1.00	1.00	9.44	8.87	1000.00	28.38	30.87
5.00	1.00	2.00	8.21	7.78	1111.11	20.61	23.90
5.00	1.00	3.00	8.85	8.56	1333.33	31.87	35.44



Model Comparison





Outcome & Next steps

- **Ontario equation appears to over-estimate volumes**
- **Model testing was weak wrt sample size & age of trees**
- **Currently measure ALL trees harvested for any study requiring whole trees (eg: wood quality, carbon, etc.)**
- **Will revisit modified model when sufficient data available to ensure the results are robust**



Acknowledgements

- Poplar Farm Research Team
 - Dave Kamelchuk, Line Blackburn (now in QB)
- Poplar Farm Operations Team
 - In particular Chuck Kaiser,
Al Bertschi, Joanna Ramsum
- Dr. Thompson Nunifu

