

# Intensive Forest Management Science Partnership: NEBIE Plot Network

## Timmins Installation Set

The Timmins installation set is one of eight study sites of the *Intensive Forest Management Science Partnership: NEBIE Plot Network* research project. Established in 2001, this site provides research partners (see partner list – pg.6) with the opportunity to understand how various silviculture intensities affect fibre production, biodiversity, soil properties, and coarse wood components of a poplar–white spruce mixedwood forest type on deep soils with silty very fine sand to silty clay textures.

The NEBIE framework (i.e., N-natural disturbance and Ex-extensive, B-basic, I-intensive, and EI-elite silviculture) has been applied on 4 blocks of five 2 ha plots (see Figure 1).

### Site description

- Location: Lake Abitibi ecoregion, Foleyet ecodistrict (3E-5)
- Climate: Daily average January temperature: -17.5°C; daily average July temperature: 17.4°C; average rainfall: 558.1 mm; average snowfall: 313.4 cm; days with minimum temperature above 0°C: 154.8<sup>1</sup>
- Pre-harvest stand: Dominated by trembling aspen (Po), white spruce (Sw), and balsam fir (Bf) with smaller amounts of black spruce (Sb) and white birch (Bw) (Table 1)
- Pre-harvest growth and yield: Average basal area of 31.8 m<sup>2</sup> ha<sup>-1</sup> and average volume of 274 m<sup>3</sup> ha<sup>-1</sup> (Table 1)
- Northeastern Ontario forest ecosystem classification<sup>2</sup>:
  - Ecosite: ES 6m – trembling aspen – black spruce – balsam fir – medium soil and ES 7f – trembling aspen – white spruce – white birch – fine soil
  - Vegetation type: V10 – trembling aspen – balsam fir – speckled alder
  - Soil type: Ranges from S7 to S13

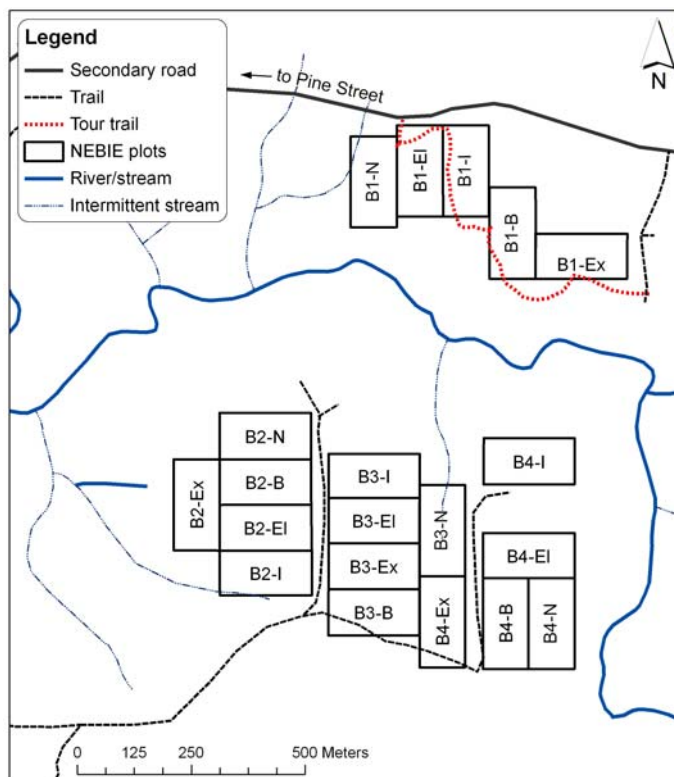


Figure 1. Layout of the blocks (B1-B4) and treatment plots at the Timmins installation set (48°21'N, 81°18'W).

Table 1. Pre-harvest stand and site description for the Timmins installation set of the NEBIE plot network. (Percents indicate the portion of the block that is the specified stand, example Block 2 is 60% Po4Sw2Bf2Sb1Bw1)

	Species composition <sup>a</sup>	Site class <sup>a</sup>	Stocking <sup>a</sup>	Age <sup>a</sup> (years in 2002)	Soil texture <sup>b</sup>	Gross total volume <sup>c</sup> (m <sup>3</sup> ha <sup>-1</sup> )
<b>Block 1</b>	Po4Sw2Bf2Sb1Bw1	2	0.7	90	silt / silty clay	237
<b>Block 2</b>	Po4Sw2Bf2Sb1Bw1 (60%)	2	0.6	85	silt / silty very fine sand	311
	Po6Sw1Sb1Bw1Bf1 (40%)	2	0.8	90		
<b>Block 3</b>	Po6Sw1Sb1Bw1Bf1 (85%)	2	0.8	90	silty clay	296
	Po4Sw2Bf2Sb1Bw1 (15%)	2	0.6	85		
<b>Block 4</b>	Po6Sw1Sb1Bw1Bf2	2	0.8	90	silt	254

<sup>a</sup> Forest resource inventory, 1991 photography, 1992 interpretation; <sup>b</sup> Pre-harvest soil samples (21 samples/site); <sup>c</sup> Pre-harvest growth and yield (20 plots/block)

<sup>1</sup> Environment Canada climate normals 1971-2000, Timmins Airport, <http://www.climate.weatheroffice.ec.gc.ca>

<sup>2</sup> Taylor, K.C., Arnup, R.W., Merchant, B.G., Parton, W.J. and Nieppola, J. 2000. A field guide to forest ecosystems of northeastern Ontario. Ont. Min. Nat. Resour., Northeast Sci. Technol., Timmins, ON. NEST Field Guide FG-001.

## NEBIE treatments

Silvicultural work at this site began in 2002 with the development of roads and subsequent harvest. The objective of each silvicultural intensity treatment level and associated silvicultural activities are described in Table 2 and illustrated in the graphic below. The natural treatment was not harvested and was left to undergo natural succession.

Table 2. Objectives and silvicultural activities at the Timmins installation set of the NEBIE plot network by treatment.

	<i>Extensive</i>	<i>Basic</i>	<i>Intensive</i>	<i>Elite</i>
<b>Objectives</b>	stocking >40% of Po and Sw free of major insect pests	stocking >60% of Sw free of interspecific competition and major insect pests	stocking >80% of Sw and Po free of intra- and interspecific competition and major insect pests	stocking >80% of Sw and Po free of nutrient deficiencies, intra- and interspecific competition and major insect pests
<b>Harvest</b>	Fall 2002: full tree logging to roadside (block 1), cut to length (blocks 2-4), leaving 25 residual trees per hectare			
<b>Site preparation</b>	none	Sept. 2003: power disc trencher	Sept. 2003: power disc trencher with second trench pass at 90° to the first pass	
<b>Tree plant</b>	none	Spring 2004: 1800 white spruce ha <sup>-1</sup>	Spring 2004: 2200 white spruce ha <sup>-1</sup>	
<b>Vegetation management I</b>	none	Sept. 2005: back pack application of glyphosate to control all broad leaved trees and shrubs	Sept. 2005: back pack application of glyphosate with 3 - 6 m wide no spray strips 27 m apart	Sept. 2005: back pack application of glyphosate leaving a quality aspen every 5 m
<b>Vegetation management II</b>	none	none	Aug. 2007: back pack application of glyphosate with 3 - 6 m wide no spray strips 27 m apart	Aug. 2007: back pack application of glyphosate leaving a quality aspen every 5 m
<b>Re-fill tree plant</b>	none	May 2008: 583 white spruce ha <sup>-1</sup> , only block 2	May 2008: 730 white spruce ha <sup>-1</sup>	May 2008: 1020 white spruce ha <sup>-1</sup>
<b>Future options</b>	none	none	commercial thinning	pruning dead branches, commercial thinning

Po = poplar, Sb = black spruce, Sw = white spruce

### Natural



### Extensive



### Basic



### Intensive



### Elite



## Sample plots and data collection

- **Growth and yield** information was collected in 2002, 2004, and 2007 to represent the pre-harvest, year 2, and year 5 conditions (G&Y plots in Figure 2). These data are collected to assess fibre production, tree quality, and fate of residual trees  $\geq 2.5$  cm diameter at breast height (DBH).
- Trees  $< 2.5$  cm DBH are also assessed in the G&Y plots. Stem counts, average height, and % foliar cover are assessed in ten 2 m x 2 m **stocking** quadrats, which are also used to estimate **tree and shrub diversity**.
- **Diversity of herbaceous, grass, sedge, fern and fern ally, lichen and bryophyte species** was assessed in 2002, 2004, and 2007 (FEC plots in Figure 2).
- **Coarse woody debris** was measured in 2003-04 in the natural, intensive, and elite treatments to assess its abundance and the distribution of carbon.
- **Fine woody debris, organic matter, and mineral soil** samples were collected in 2002, 2003-04 (intensive and elite treatments), and 2007 (natural, extensive, and intensive treatments) to assess the distribution of carbon, nitrogen, and base cations.
- Other data collected at this site includes: post-harvest microsite descriptions, pathology of harvested trees; litter composition, abundance, and decomposition rates; photographs from specific points; height:diameter ratios for each tree species; and weather parameters.

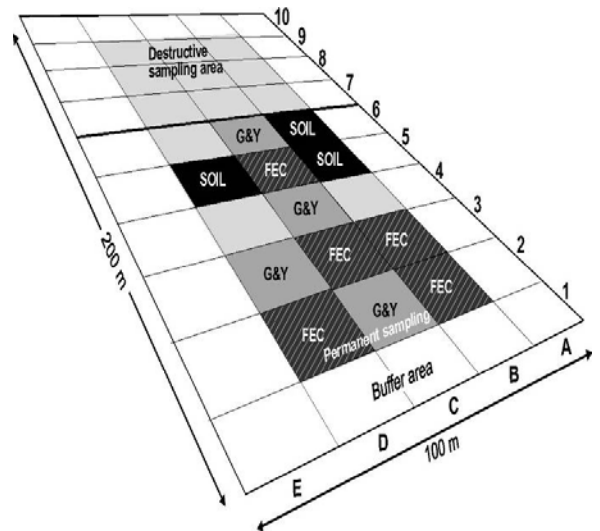


Figure 2. Standard two hectare experimental plot showing alpha-numeric grid and an example of a random layout of sample plots.

## Current site conditions

### Growth and yield volume and density by diameter class

Fifth year re-measurement of the growth and yield plots (trees  $\geq 2.5$  cm DBH) was completed in 2007. The extensive treatment had a larger number of stems in the small diameter classes (mainly trembling aspen) due to the herbicide application in the basic, intensive, and elite treatments (Figure 3). In the natural treatment plots, the small diameter classes were dominated by balsam fir. The mid-diameter classes included white spruce, balsam fir, trembling aspen, white birch, and black spruce. Trembling aspen dominated the large diameter classes. Note the 2 cm diameter class ranges from 2.5 to 3.0 while all other diameter classes represent a full 2 cm interval.

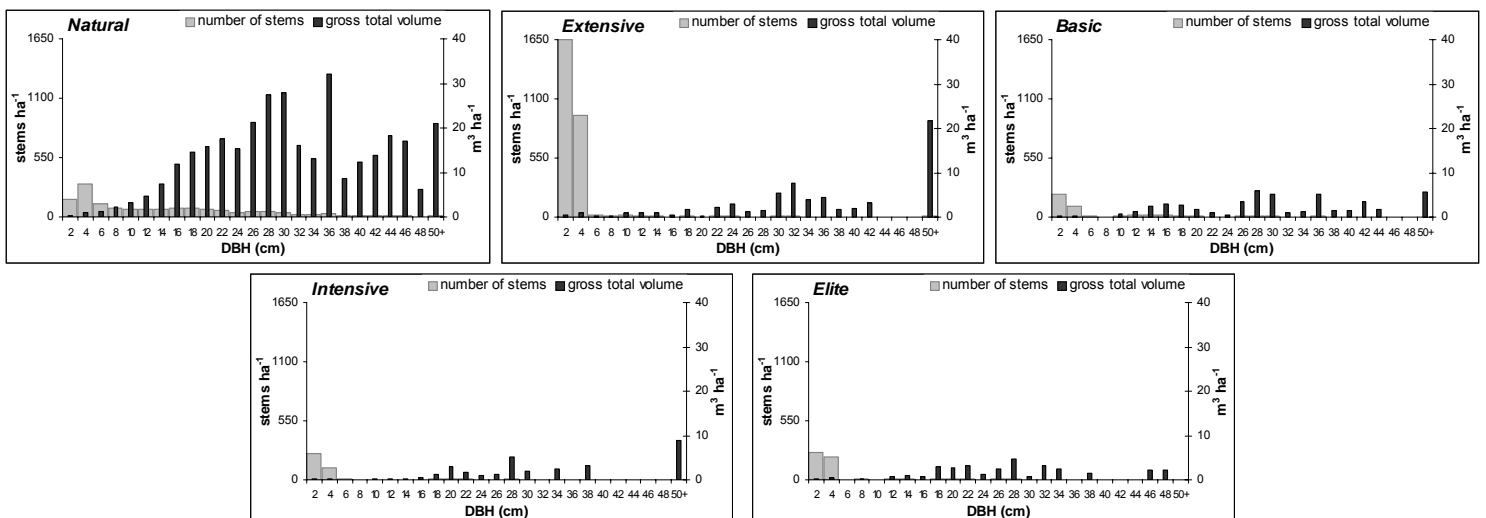


Figure 3. Number of stems and gross total volume by diameter class – 2007 data by treatment.

## Stocking

Stocking provides a measure of regeneration success. In all treatments, 5<sup>th</sup> year stocking (2007) was high but spruce stocking was much higher in the basic, intensive, and elite treatments (Figure 4; Table 3). When all stems were included, however, spruce was a small component of the stand in all treatments (Figure 5). These levels did not meet the silvicultural objectives therefore a refill plant was required in 2008. Trembling aspen was the dominant tree species in 2004 and maintained a strong presence after one herbicide application (Table 3; Table 4).

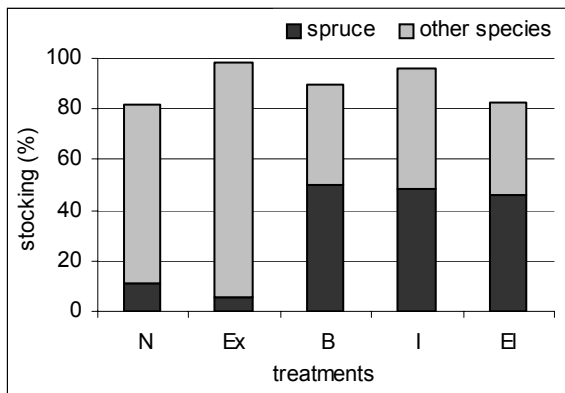


Figure 4. Percent of 2 m x 2 m quadrats stocked with stems <2.5 cm DBH in 2007 by treatment.

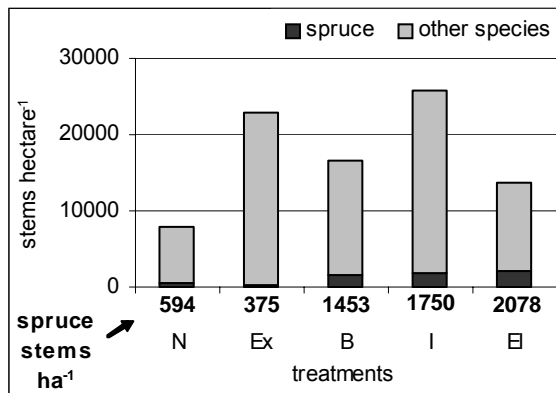


Figure 5. Total stems <2.5 cm DBH per hectare in 2007 by treatment.

Table 3. Stocking of trees <2.5 cm DBH by treatment in 2004 and 2007 on the Timmins installation set.

Treatment	Year	No. of filled quadrats <sup>1</sup>	Stocking (%) <sup>2</sup>	Stocking by species (%) <sup>2</sup>									
				balsam fir	red maple	white birch	red pine	white spruce	black spruce	total spruce <sup>3</sup>	balsam poplar	trembling aspen	pin cherry
Natural	2004	not assessed											
	2007	131	82	58	1	4	0	11	1	11	15	34	4
Extensive	2004	158	99	22	0	7	0	4	0	4	14	94	31
	2007	157	98	18	0	7	1	6	0	6	11	93	25
Basic	2004	154	96	21	0	9	0	59	0	59	11	73	34
	2007	144	90	16	0	13	0	50	0	50	6	61	27
Intensive	2004	160	100	9	0	6	0	59	0	59	21	99	55
	2007	154	96	8	0	13	0	45	5	49	8	78	26
Elite	2004	156	98	9	0	15	0	52	0	52	18	77	41
	2007	132	83	9	0	14	0	40	7	46	4	56	14

<sup>1</sup> # of filled quadrates refers to the number of 2 m x 2 m plots (of 160) that contain a tree (regardless of how many)

<sup>2</sup> stocking refers to the percent of assessed 2 m x 2 m plots containing a tree

<sup>3</sup> total spruce includes black and white spruce

Table 4. Density of trees <2.5 cm DBH by treatment in 2004 and 2007 on the Timmins installation set.

Treatment	Year	total density (stems ha <sup>-1</sup> )	Density by species (stems ha <sup>-1</sup> )										
			balsam fir	red maple	white birch	red pine	white spruce	black spruce	total spruce*	balsam poplar	trembling aspen	pin cherry	
Natural	2004	not assessed											
	2007	7875	4063	16	250	0	578	16	594	688	2047	219	
Extensive	2004	44641	813	0	531	0	109	0	0	2359	36578	4250	
	2007	22969	1344	0	438	31	375	0	375	1078	17438	2266	
Basic	2004	44766	609	0	1063	0	1672	0	0	1078	34313	6031	
	2007	16578	656	0	2000	0	1453	0	1453	516	8297	3656	
Intensive	2004	57969	250	0	156	0	1781	0	0	2672	44250	8859	
	2007	25875	313	0	12078	0	1609	125	1750	516	10078	1141	
Elite	2004	33625	344	0	1094	0	1719	0	0	1734	24438	4297	
	2007	13594	297	0	4516	0	1891	172	2078	188	4484	2031	

\*total spruce includes black and white spruce

## Number of species encountered by life form

Regardless of treatment intensity, 5 years post-harvest, species diversity remained similar with the exception of trees, bryophytes, and lichens (Table 5).

Table 5. Total number of species by life form for each treatment and all treatments combined – 2007 data.

Species group	Treatment					Total on site
	Natural	Extensive	Basic	Intensive	Elite	
Trees	10	7	7	7	7	11
Shrubs	27	25	24	23	22	30
Herbs (non-woody plants)	37	32	48	42	53	73
Grasses	8	10	9	11	8	13
Sedges	4	6	12	13	8	14
Ferns and fern allies (pteridophytes)	13	11	11	7	12	16
Mosses and liverworts (bryophytes)	61	45	47	45	46	69
Lichens	7	2	1	1	1	7
<b>Total number</b>	<b>167</b>	<b>138</b>	<b>159</b>	<b>149</b>	<b>157</b>	<b>233</b>

## Most abundant species by treatment

- Abundance of a species was assessed using foliar cover
  - Percent cover (%C) represents the average cover of a species across all plots in a treatment
  - Percent occurrence (%O) indicates the percentage of plots in which a species was found
- The ten most abundant species in each treatment are listed in Table 6.

Table 6. Most abundant species by treatment. (Data collected in 2007; %C = percent cover, %O = percent occurrence)

Natural		Extensive		Basic		Intensive		Elite						
species	% C	% O	species	% C	% O	species	% C	% O	species	% C	% O	species	% C	% O
large-leaved aster	30	95	trembling aspen	40	93	wild red raspberry	27	94	wild red raspberry	36	99	wild red raspberry	37	99
balsam fir	17	68	wild red raspberry	28	84	fringed black knotweed	14	60	trembling aspen	17	81	skunk currant	11	76
beaked hazel	15	77	beaked hazel	25	69	trembling aspen	14	62	rough goldenrod	10	95	trembling aspen	10	64
bush honeysuckle	12	53	large-leaved aster	9	68	skunk currant	9	63	large-leaved aster	9	95	fringed black knotweed	9	83
mountain maple	11	41	bush honeysuckle	8	40	bush honeysuckle	6	23	skunk currant	7	61	rough goldenrod	6	83
speckled alder	7	23	speckled alder	6	29	large-leaved aster	5	78	fringed black knotweed	6	50	large-leaved aster	5	75
wild sarsaparilla	4	93	serviceberry	5	28	rough goldenrod	4	73	beaked hazel	4	28	common haircap moss	4	95
dwarf raspberry	4	66	bluebead-lily	4	83	dwarf raspberry	4	65	broad-leaved reed-grass	4	88	fireweed	4	83
wild red raspberry	3	34	skunk currant	4	58	beaked hazel	4	31	dwarf raspberry	4	53	spotted touch-me-not	4	40
prickly tree club-moss	3	73	dwarf raspberry	4	58	speckled alder	3	13	speckled alder	3	17	dwarf raspberry	3	72

**Active Research Partners**

- Ontario Ministry of Natural Resources
- University of Guelph
- Tembec Industries Inc.
- Forest Ecosystem Science Co-op
- Lakehead University

**Additional Sponsors**

- Forestry Futures Trust
- Living Legacy Trust
- Natural Sciences and Engineering Research Council of Canada (NSERC)

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