

CANADA  
DEPARTMENT OF FORESTRY  
AND RURAL DEVELOPMENT

**PLANTATIONS OF WHITE SPRUCE  
UNDER ASPEN ON DIFFERENT SOILS  
MIXEDWOOD SECTION, ALBERTA**

**THE ATHABASCA PLANTATIONS  
- ESTABLISHMENT REPORT, 1966 -**

**Project - A83**

**by**

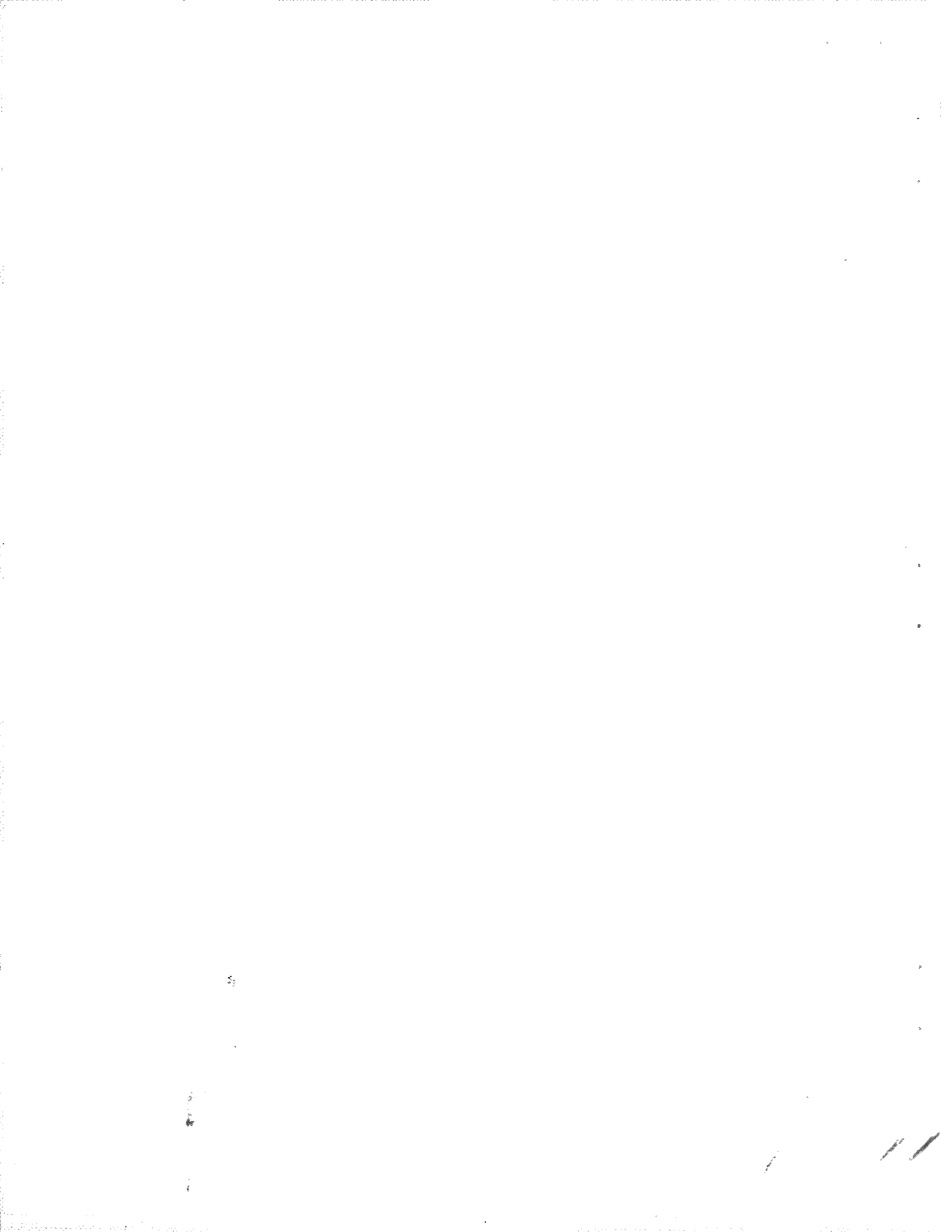
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ESTABLISHMENT REPORT, 1966

Plantations of White Spruce under Aspen on Different Soils,  
Mixedwood Section, Alberta  
The Athabasca Plantations <sup>1</sup>

by

P. J. B. Duffy <sup>2</sup> and Z. Nemeth <sup>2</sup>

INTRODUCTION

Wide portions of the Alberta Foothills and Mixedwood Forests contain stands of pure aspen (Populus tremuloides Michx.), balsam poplar (Populus balsamifera L.) and mixtures of the two. Where these stands have reached the mature and overmature stage the Alberta Forest Service has initiated a planting program aimed at underplanting these stands with white spruce (Picea glauca (Moench) Voss).

To assist this program the Department of Forestry and Rural Development began a series of plantation experiments to determine the effects of site and initial spacing on planting chance, seedling mortality and periodic growth. The first experimental plantation was established on four soils near Marlboro in the Edson Forest. The second was established on three soils near Rocky Mountain House in the Clearwater Rocky Forest. Each plantation consisted of three treatments ( 9 x 9, 12 x 12, and 15 x 15 foot spacings) replicated three times and assigned randomly in each block (Duffy, 1963; Duffy and Nemeth, 1965).

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The experiment was repeated in 1966 on two different soils in the Mixedwood Section (B. 18a) of the Boreal Forest near Smith in the Slave Lake Forest. The plantations were established by the Department of Forestry and Rural Development and the Alberta Department of Lands and Forests. Scarification operations were undertaken in nearby aspen stands on the same soils to test the effect of site pre-treatment on planting chance, survival and young growth in spruce-under-aspen plantations. The scarified blocks will be planted in the spring of 1967. This report describes the establishment of the plantations and the scarification work.

#### EXPERIMENTAL AREA

##### Location

One of the plantations is located north and the other south-east of Smith ( $55^{\circ} 10'$  North latitude and  $114^{\circ} 03'$  West longitude) in the Slave Lake Forest. The locations are shown in Figure 1. and on stereopairs of aerial photographs in Figures 8 and 10. The legal descriptions are as follows:

1. "Fawcett Lake - 1966 Plantation". Southwest quarter of Section 2, Township 72, Range 1, West of the 5th Meridian.
2. "Lawrence Lake - 1966 Plantation". Southeast quarter of Section 10, Township 70, Range 25, West of the 4th Meridian.

##### Soils and Forest Cover

The landscape in the study area is a result of Continental

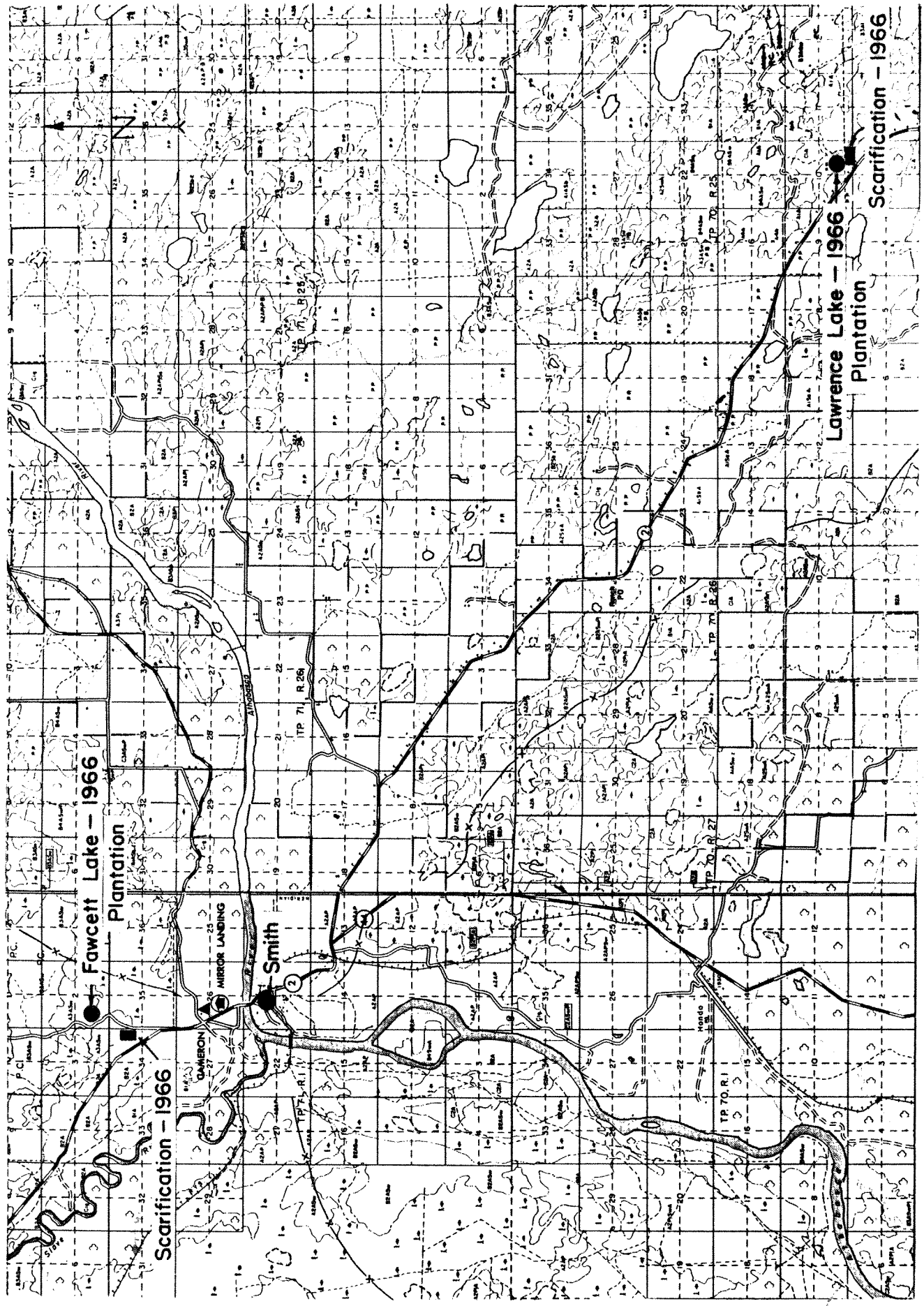


Figure 1. Location of the Athabasca Plantations and Scarifications (1966).

Scale: \_\_\_\_\_ = 2 miles

glaciation and subsequent erosion of the undivided Early Upper Cretaceous bedrock (Anon., 1951) which underlies most of the area and sandstones, shales and conglomerates in some portions (Feniak, 1944). The common landtypes are alluvial lowlands, ponded and lacustrine flats, ground moraines, aeolian deposits and muskegs (Duffy, 1965).

Parent materials vary greatly from the high hills to the riverine sites. Till of varying depth covers the slopes of uplands. The lowlands are filled with lacustrine and fluvial deposits. Aeolian deposits and gravelly and sandy outwash cover large areas. These deposits and soils are described in an Exploratory Soil Survey Report (Wynnyk, Lindsay, Heringa and Odynsky, 1956). In general, Grey Wooded and Biseqa Grey Wooded soils are common.

The typical forest cover on well drained sites is trembling aspen with a few scattered white spruce stems. Ground vegetation offers medium to heavy competition to young trees.

#### Climate

Long cold winters and relatively short warm summers characterize the climate at Smith. Annual precipitation is about 22 inches and the mean annual temperature is 32.7°F. Over 70 per cent of the precipitation falls between April and October inclusive; July and August are the wettest months. The frost-free season at Athabasca is 59 days and at Slave Lake it is 78 days. Frequent invasions of cold, polar continental air together with calm, clear weather bring late spring and early fall frosts.

Table 1. Climatological data for Stations in the Slave Lake - Athabasca Region

Station	Number of years of record used	Mean Annual Temperature (°F)	Mean Annual Precipitation (inches)	Growing Season Precipitation April-October incl. (inches)	Average frost free period (days)
Smith <sup>3</sup>	5	32.7	22.07	16.27	-
Chisholm <sup>3</sup>	7	-	-	15.79	-
Slave Lake <sup>4</sup>	31	33.9	18.30	14.11	78
Athabasca <sup>3</sup>	16	33.8	18.12	13.52	59

<sup>3</sup>Anon. 1950 - 1966.

<sup>4</sup>Lindsay, D. Unpublished data. Alberta Research Council, Soil Survey Section, Edmonton.



## FIELD METHODS

Following an inspection of the forest and soil conditions in October, 1965, two sites were chosen for planting. Department personnel surveyed and referenced the boundaries on the ground, and staked the plantations and the local Alberta Forest Service stand-by crew carried out the planting operations.

### Experimental Design and Layout

To study the optimum spacing level for each soil type, three spacing levels (9 x 9 feet, 12 x 12 feet, 15 x 15 feet) were replicated three times and assigned randomly to one-acre compartments in each plantation. The experimental design is illustrated in Figure 2.

A staff compass and chain were used to lay out a nine-acre block on each of two different soil types and to tie the blocks to a prominent landmark. All bearings were based on true north. One-acre compartments were then delineated with strings and compartment boundaries were marked with spray paint. Trees outside of the block boundary were painted blue, and compartment boundaries were painted orange facing southwest and southeast. A creosoted post was firmly placed at the southwest corner of each 1-acre compartment. To this was attached an aluminum sign showing the compartment number, spacing interval and the year (Figure 3).

The 3-0 white spruce stock was obtained from the Oliver Nursery near Edmonton. The size of the stock was medium (i.e. tops 4-6 inches in length). The stock was transported to Smith in poly-

Figure 2.

Field Layout of the Athabasca White Spruce Under Aspen  
Plantation, Slave Lake Forest, Alberta. Project A-83. 1966.

Note: Each cell is one acre in size.

Soil type I Fawcett Lake			Spacing Levels	
Replication 1.	c	b	a	a. 9 x 9 (3,108 trees) 518 trees/acre)
Replication 2.	b	a	c	b. 12 x 12 (1,812 trees) 302 trees/acre)
Replication 3.	a	b	c	c. 15 x 15 (1,164 trees) 194 trees/acre)
Soil type II Lawrence Lake				
Replication 1.	b	a	c	Total number of trees required <u>6,084</u>
Replication 2.	a	c	b	Total number of acres planted <u>18</u>
Replication 3.	b	c	a	

ethylene bags and was "heeled in" on arrival at each plantation site. The planting stock was in transport from Oliver about 4-5 hours on May 16, 1966.

A one-foot long shingle marker was dipped in red paint and placed at the point where each tree was to be planted. Each plantation was so marked and then a tree was planted one foot south of each marker (Figure 4).

Planting commenced on May 17, 1966, and the slit method and planting bar were employed with no ground preparation. The Lawrence Lake Plantation was established first and then the Fawcett Lake Plantation was planted. The planting job was finished in four days.

On May 26 and 27, 1966, Department personnel planted two rows of white spruce at 12 x 12 spacing around each plantation using the same planting stock. This "surround" of planting stock is to act as a buffer zone as the plantations mature.

#### RECORDS

Stand data were taken as follows:

1. Aspen dominants. Total height, diameter (d.b.h.) and age of ten trees at each plantation. The same data were taken for five white spruce trees at the Fawcett Lake Plantation.
2. Basal area per acre, using a Spiegel relascope (10 factor).

Two samples were taken in each acre compartment; the first at the one-chain mark along the center line and the second at the three-chain mark.

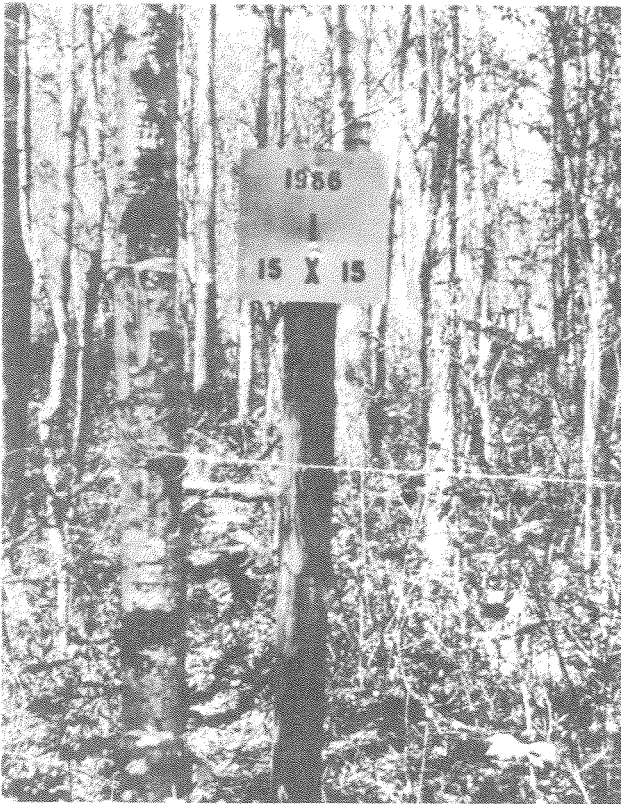


Figure 3. Corner post, compartment 1,  
Fawcett Lake Plantation.

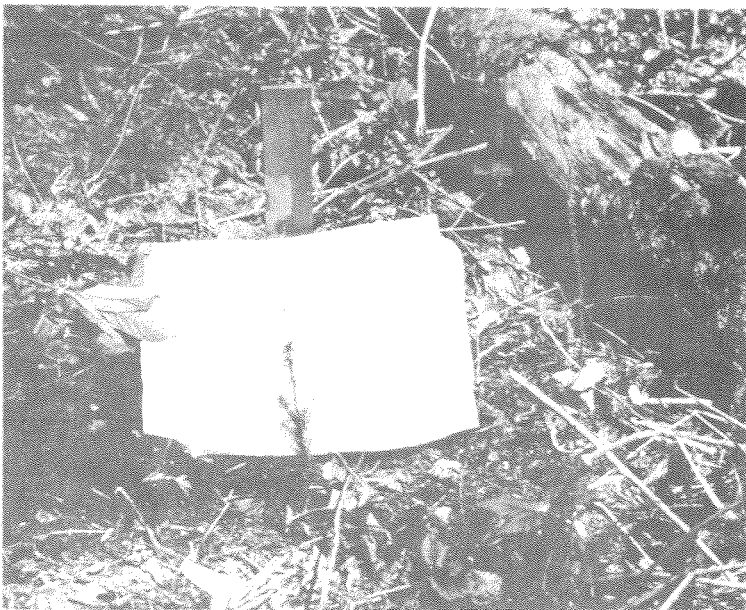


Figure 4. Planted seedling  
with stake.  
Fawcett Lake  
Plantation.

THE PLANTATIONS

Fawcett Lake - 1966

The plantation is located about 2.5 miles north of Smith on the east side of the Fawcett Lake Road. (Figures 5 and 6). The soil is a Grey Wooded on a loamy sand cap overlying sandy clay loam till at depths of one to two feet. The topography is gently rolling and the site is well-drained.

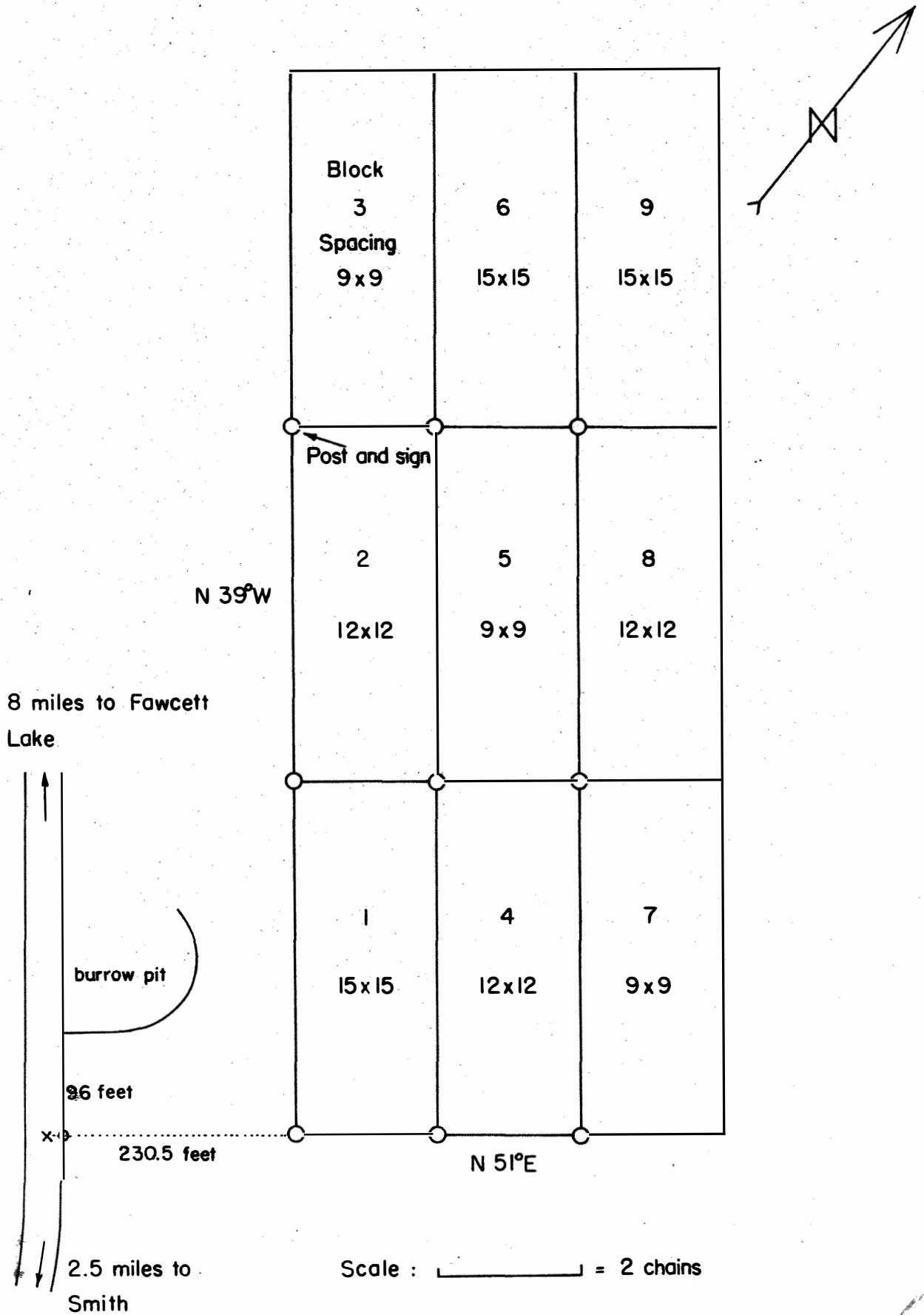
The forest cover is mainly 85-year-old trembling aspen with a few scattered white spruce dominants. The average annual height growth of dominant trees is less than one foot (Table 2). Basal area levels in separate compartments range from 80 to 220 square feet per acre. The average for the plantation is 147 square feet.

Vegetation competition was heavy. Dense underbrush and thick duff layer slowed the staking and planting operation.

Table 2. Growth data for dominants by plantation.

Plantation	Aspen (ten trees)				White Spruce (five trees)		
	Average Age (years)	Average Height (feet)	Average d.b.h. (inches)	Average Basal Area. All species (sq. ft.)	Average Age (years)	Average Height (feet)	Average d.b.h. (inches)
Fawcett Lake	85	65	13.7	147	44	55	12.4
Lawrence Lake	43	54	8.1	148	-	-	-

Figure 5. Fawcett Lake - 1966 Plantation.



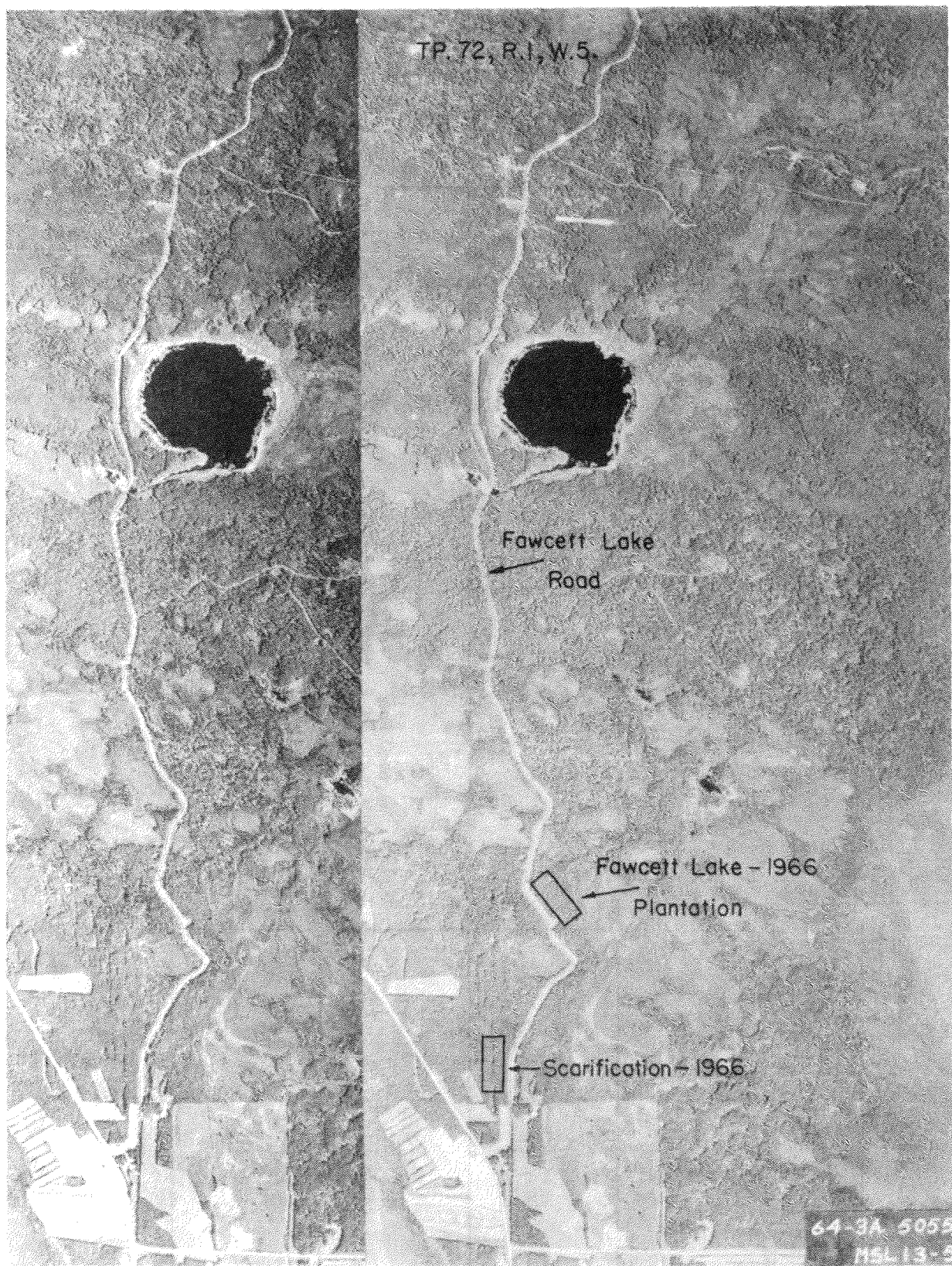


Figure 6. Stereopair of aerial photographs showing the Fawcett Lake Plantation and Scarification sites.

Scale: 1 inch = 2640 feet

### Lawrence Lake - 1966

The plantation is located about 15 miles southeast of Smith on the east side of Highway 2 (Figures 7 and 8). The soil is Grey Wooded on moderately well drained stony sandy clay loam till. The topography is gently rolling.

The forest cover is a pure even-aged 43 year old aspen stand. The height growth of aspen is over one foot per year (Table 2) and the site is more productive in terms of aspen height growth than the Fawcett Lake - 1966 site.

Vegetation competition was classed as medium. Planting and staking conditions were good and no difficulties were experienced.

### THE 1966 SCARIFICATION OPERATIONS

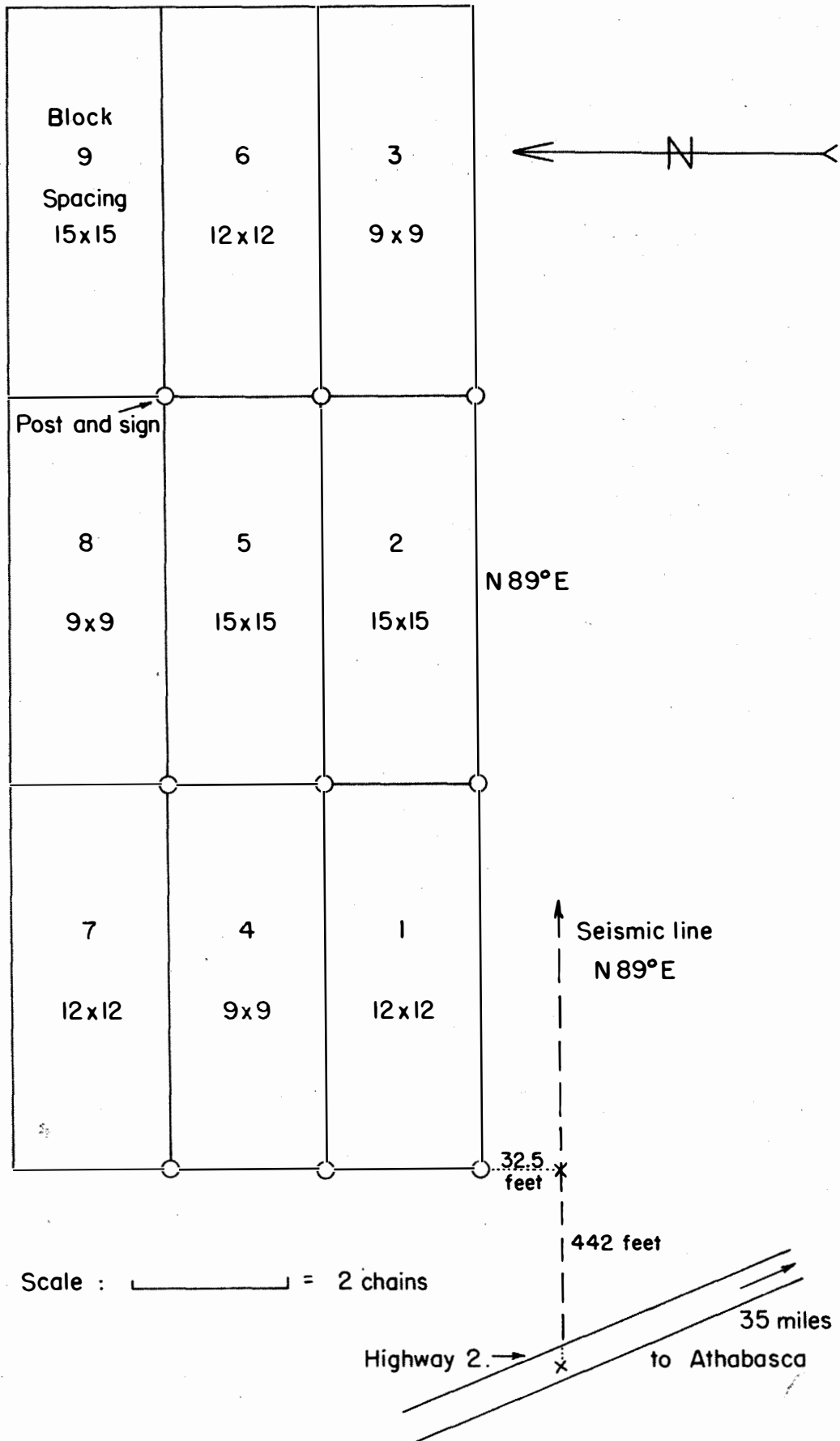
In 1966 scarification was undertaken at sites which are adjacent to the Athabasca Plantations (Figure 1) to test the effect of site pre-treatment on planting chance, survival and young growth of white spruce trees.

Each study area is a 9-acre block. The equipment used for scarification was an International TD-14 with a bulldozer blade (Figure 9.) This machine scarified strips 8-11 feet wide. Mineral soil exposure was about 28% as surveyed on a system of milacre quadrats.

1. The Fawcett Lake Scarification is located in the north-east quarter of Section 34, Township 71, Range 1, West of the 5th Meridian. The scarification was done during August, 1966. The machine scarified 15 strips running across the 6-chain width (Figure 10).



Figure 7. Lawrence Lake - 1966 Plantation.



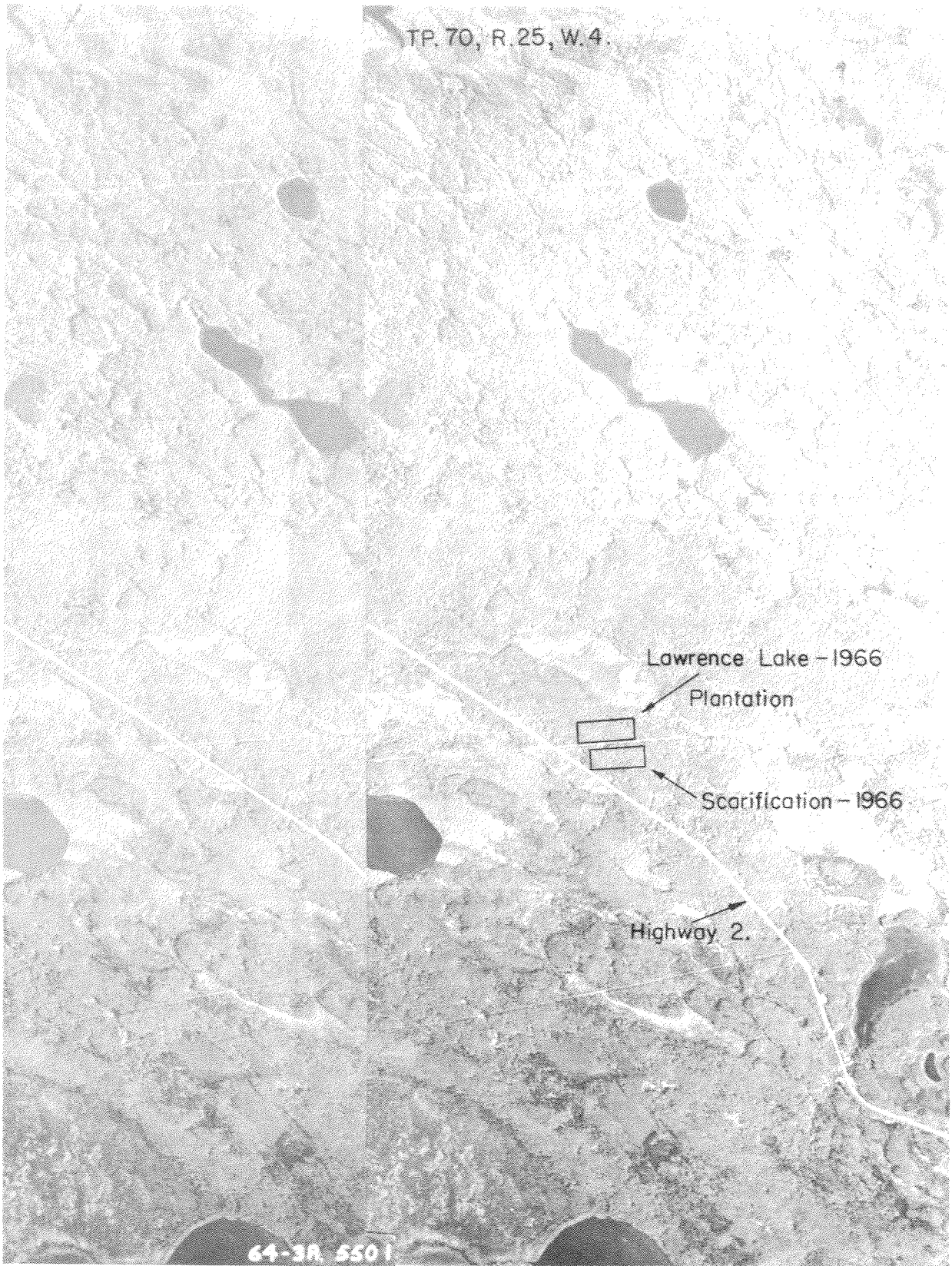


Figure 8. Stereopair of aerial photographs showing the Lawrence Lake Plantation and Scarification. Scale: 1 inch = 2640 feet.



Figure 9. TD-14 Tractor with bulldozer blade.



Figure 10. Scarification produced by the Bulldozer Blade. Fawcett Lake Scarification.

2. The Lawrence Lake Scarification is located in the southeast quarter of Section 10, Township 70, Range 25, West of the 4th Meridian. The scarification was carried out in October, 1966. The machine scarified 16 strips running parallel to the short side of the study area (Figure 11).

#### ANALYSIS OF DATA

Analysis of data will follow that of the Edson and Rocky Mountain House Plantation projects. Data from periodic remeasurement of mortality, young growth and volume growth will be compiled by sites, by spacing levels, and by blocks (replications). These effects will be analyzed using the following analysis of variance table:

<u>Source of variation</u>	Degrees of freedom
Soil type (2)	1
Spacing levels (3)	2
ST x SL	2
Replications (blocks)	1
Error	4
Total	10

Mean values of mortality and growth will be computed for those effects which are shown to be significant and meaningful. It is expected that mortality will vary with parent material and that young growth and periodic yields will vary with parent material and spacing level. As with the other plantations, a significant parent-material - spacing level interaction is expected.

#### FUTURE WORK

A mortality survey will be run in the late summer of 1967 and an appraisal of the results will be the subject of a forthcoming report. In 1971 the dead trees will be replaced and full stocking will be established. At prescribed dates thereafter, height growth



Figure 11. Lawrence Lake  
Scarification.

and volume yields will be measured and the production per acre will be traced through the life of the plantations.

The scarified blocks will be planted to white spruce using different planting methods and stock. Details of these operations are being planned at present. An empirical comparison is being sought since a repeat of the above plantation experiment on a disturbed site would not provide a valid comparison of plantation performance.

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