

Canada

 Saskatchewan

1986/87  
Powered Disc Trencher  
Equipment Trial

**CANADA - SASKATCHEWAN  
FOREST RESOURCE  
DEVELOPMENT  
AGREEMENT**



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**1986/87  
Powered Disc Trencher  
Equipment Trial**

by

**Derek Sidders  
and  
Mark Adamson**

Canadian Forestry Service  
Saskatchewan District Office  
101 - 15th Street East  
Prince Albert, Saskatchewan  
S6V 1G1

## **Abstract**

An equipment trial took place in Saskatchewan utilizing TTS Delta and Donaren 180D powered disc trenchers in the summer of 1986. A total of 380 hectares and 78 hectares were site prepared by the TTS Delta and Donaren 180D respectively. The range of the trial encompassed the commercial forest belt from west to east covering four distinct site conditions, all of which were successfully treated by the two implements. The quality of work completed ranged from a plantability of 68% with a net exposure of 80%, to 93% with a net exposure of 87%. This was based on a prescription of 2 metre by 1.8 metre spacing with net exposure being exposed furrow length versus total furrow length.

## **Acknowledgements**

Our thanks to the following field participants and support staff for their aid in the successful completion of the power disc trencher field trials.

### **Saskatchewan Department of Parks and Renewable Resources:**

Dave Hanline  
Larry Slater  
Meadow Lake Regional staff

### **Saskatchewan Forest Products Corp.:**

John Daisley  
Merl Fitchner  
Ronda Morris  
Gord Moffat

### **Weyerhaeuser Canada Ltd. (formerly Prince Albert Pulpwood):**

Roman Orynik  
Elder Bergen

### **Canadian Forestry Service:**

Jim Johnston	-	Saskatchewan District Office
Kelly Bacon	-	" "
Ron Gorman	-	Northern Forestry Centre
Brad Sutherland	-	Great Lakes Forestry Centre

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Note: The exclusion of certain manufactured products does not necessarily imply disapproval nor does the mention of other products necessarily imply endorsement by the Canadian Forestry Service.

## Introduction

During the winter of 1985/86, discussions took place between various silviculture equipment user groups and the Canadian Forestry Service staff (Sask. District Office), regarding problems and possible solutions to the limited regeneration successes on some of their sites. These sites had limitations such as poor drainage, heavy slash, deep duff, fine soils and advanced growth competition.

With these limitations considered, site preparation using powered disc trenchers was identified as a possible enhancement to present techniques. Powered disc trenchers are among the most recent technological advancements in the mechanized silviculture field and have been proven successful in field applications in the Canadian Boreal Forest. Developed in Finland and Sweden respectively, the TTS Delta and Donaren 180D were identified as the two pieces of equipment to be used in a 1986/87 summer equipment trial in Saskatchewan.

The intent of this report is to make available to Saskatchewan participants, all information and pertinent data pertaining to the power disc trencher trial that was collected by all parties involved during the 1986 operating season. It may be noted that costs are not mentioned in the body of this report. This was due to the inavailability of all cost data incurred through the involvement of a great number of personnel from a number of organizations. Coupled with the complexities of the specifications in the contracts for both machines, costs experienced may be inflated in comparison to a conventional field project. Parties interested in cost comparisons may contact the Canadian Forestry Service (Saskatchewan District) for available information.

### Goals and Objectives

The goals of this equipment trial are to expose the power disc trenchers to a large range of post forest harvest site conditions in Saskatchewan and to involve as many provincial silviculture groups as possible.

The operating goals set down co-operatively between all participants are as follows:

- a) two-metre spacing between furrows;
- b) consistant exposure of mineral soil;
- c) alignment of surface debris.

The objectives of this trial was to create the maximum quantity and quality of plantable microsites in a specific site. The width of the trench created as well as the depth of profile was to be determined by the individual participants on their sites. The assessment of quality was monitored on a daily basis at an approximate sample intensity of 0.5%.

Two of the sites prepared during the field trials were evaluated by the Canadian Forestry Service (Sask. District). Indepth sampling was done on pre-treatment site indices, a time study during operation, and post-treatment disturbances. This information will be evaluated and formulated in a report in the next fiscal year.



### Equipment Descriptions

The Donaren 180D and TTS Delta were made available to Saskatchewan groups through the Canada-Saskatchewan Forest Resource Development Agreement. Companies supplying the equipment were contracted by the Alberta Forest Service (Donaren 180D) and Supply and Services Canada (TTS Delta).

**Table 1. Equipment specialties.**

Description	TTS Delta	Donaren 180D
Fluctuating disc angle--mechanical;	Yes	
Fluctating down loading--hydraulic;	Yes	Yes
Fluctuating powered disc rotation--hydraulic;	Yes	Yes
Fluctuating disc spacing--mechanical/hydraulic;		Yes

The Donaren 180D, supplied by Forest Lease Inc., was mounted on a 210 hp. hydrostatic drive Ardco 4X4 (Model K). The TTS Delta, supplied by Hakmet Ltd., was mounted on a 210 hp. direct drive 740A Turbo John Deere Skidder.

The Appendix contains the specifications for the Donaren 180D and TTS Delta as supplied by their North American distributors.

### Participants

The following table summarizes the involvement of the parties participating in the equipment trial within Saskatchewan.

**Table 2. Summary of participating groups by hours and hectares.**

Participant	TTS Delta		Donaren 180D	
	Operating Hours	Completed Hectares	Operating Hours	Completed Hectares
Saskatchewan Dept. of Parks and Renewable Resources	201	175	-	-
Saskatchewan Forest Products	169	153	44	34
Prince Albert Pulpwood Company (now Weyerhaeuser)	50	51	62	45

### Method

#### **Schedule**

The power disc trencher equipment trial took place in four different sites, from Meadow Lake in the western part of Saskatchewan, to the Sipanok Channel in the east (Figure 1).

The TTS Delta arrived on June 18, 1986, and began operating on the Meadow Lake site on June 19, 1986. The Delta operating sequence traveled east to Dore Mountain, Camp 2 and Sipanok Channel completing its designated contract total of 420 hours on August 5, 1986.

The Donaren 180D arrived on September 2, 1986, in the Dore Mountain area, began operating on September 3, 1986, moved to the Camp 2 site on September 12, 1986, and completed its work on September 21, 1986; a total of 108 production hours. The initial goal of 150 production hours was not met due to time restraints set out in the agreement with Alberta participants of the Donaren trial.

#### **Daily Assessment**

The participants in the equipment trial monitored the quality of work being prepared in their areas in the following manner:

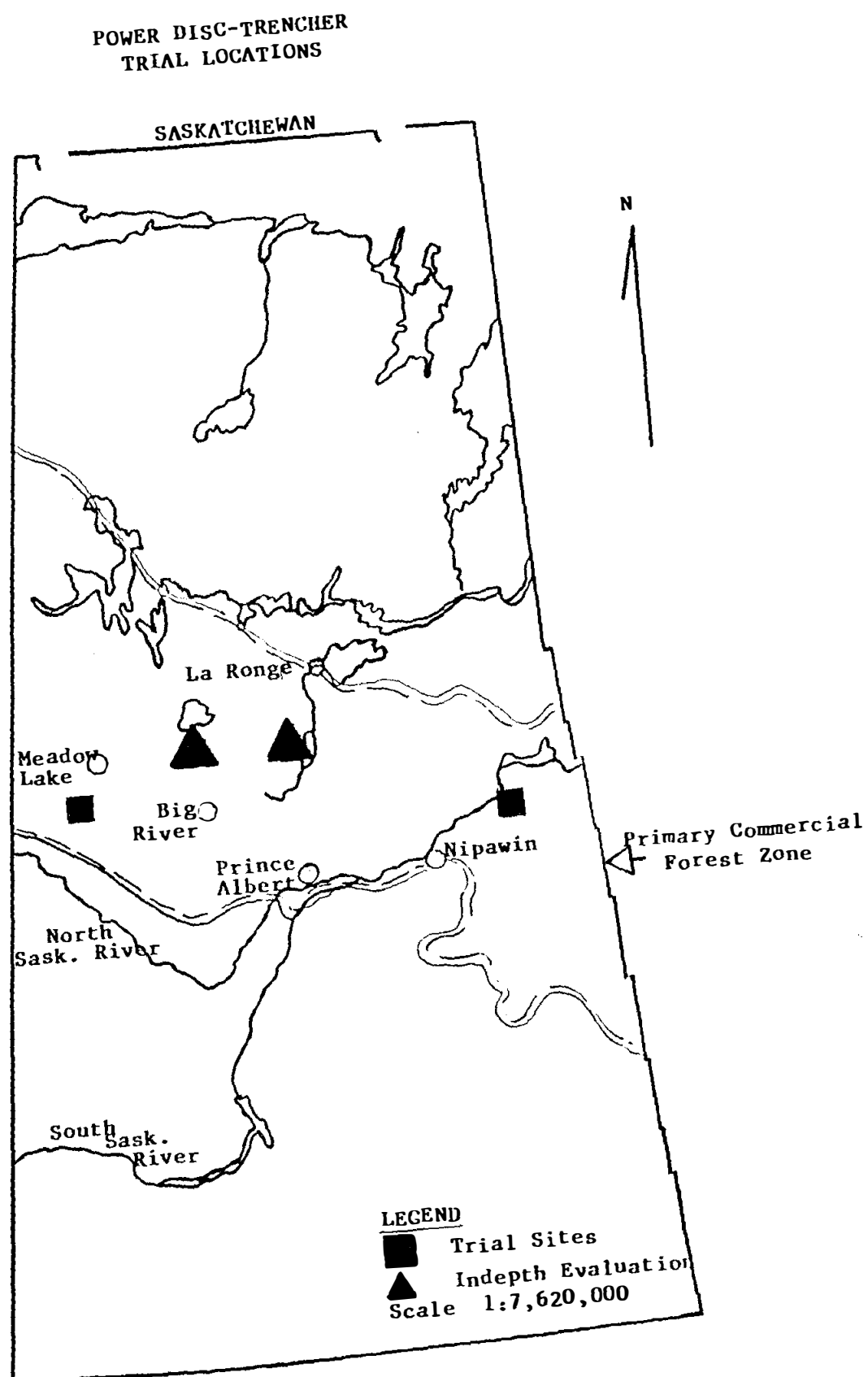


Figure 1.

- i) Transects were laid out perpendicular to furrows across all areas treated on which 50 m<sup>2</sup> circular plots were centered at a spacing to allow a coverage of one plot per hectare.
- ii) Within these 50 m<sup>2</sup> plots, the following furrow profile measurements were taken (Figure 2):
  - a) furrow lengths;
  - b) exposed mineral soil furrow lengths;
  - c) average width of exposed mineral soil/furrow;
  - d) plantable spots.
- iii) The above data is summarized by plot to give net M.S.E. (Mineral Soil Exposure), gross M.S.E. and plantable spots.
- iv) Coverage efficiency of the implements was monitored by the count of furrows on a 200-metre line perpendicular to pass direction.

### **Indepth Evaluation**

An indepth evaluation was done on the Dore Mountain site and the Camp 2 site to compare variations of disc trenchers on similar site conditions. These equipment variations were divided as follows:

<b>Dore Mountain</b>	<b>Camp 2</b>
Donaren 180D	Donaren 180D
TTS Delta with powered discs	TTS Delta without powered discs
TTS Delta without powered discs	
TTS 35 - 2.4 metre	

### **Assessment Procedures**

The data collected for indepth evaluation included the following:

- i) **Pre-treatment Assessment:**
  - intensive measure of all site variables influencing site preparation--slash depth, slash size, duff depth, soil depth, stump height and diameter, species, vegetation present and residual.
- ii) **Time Study:**
  - 100% sample of all time spent operating inside the trial area; broken down by actual production time.

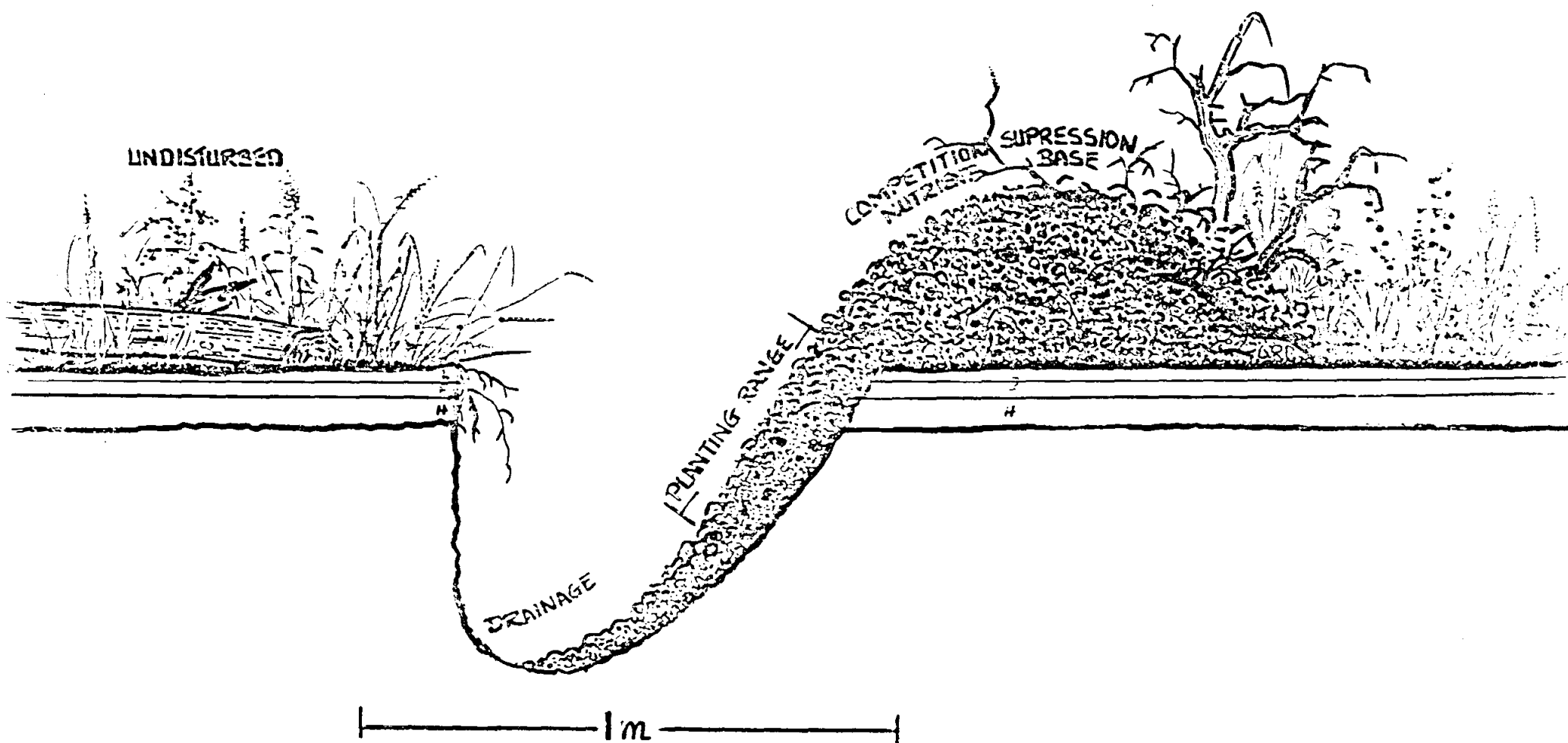


Figure 2. Cross-sectional profile of power trencher furrow.

**iii) Post-treatment Assessment:**

- intensive measurement of all site variables disturbed by site preparation implements and prime movers during the operation;
- plantable spot tally appraisal, tallied using provincial quality standards.

All data collected during this process is presently being evaluated and a summary report of the findings will be produced in 1987. The data was collected using the Standard Assessment Procedures for Evaluating Silviculture Equipment; Sutherland, B.J. 1986.\*

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\* Sutherland, B.J. 1986. Standard Assessment Procedures for Evaluating Silviculture Equipment: A Handbook. Government of Canada.

Copies available from: Communications Services. Great Lakes Forestry Centre. Canadian Forestry Service. Government of Canada. P.O. Box 490, Sault Ste. Marie, Ontario. P6A 5M7.

## Trial Site Summaries

### Meadow Lake

**Participant:** Sask. Department of Parks and Renewable Resources

**Pre-trial Disturbance:** clear cut - 1985/86  
softwood removal - 1980/81

**Slash Loading:** moderate to heavy  
large poplar tops

**Stumps:** moderate spruce and poplar  
range 30-50 cm in diameter  
30 cm in height

**Duff Depth:** 15 cm

**Soil:** silty clay

**Drainage:** imperfect

**Residual:** - patchy  
- some areas of moderate residual  
(up to 400 stems/hectare)

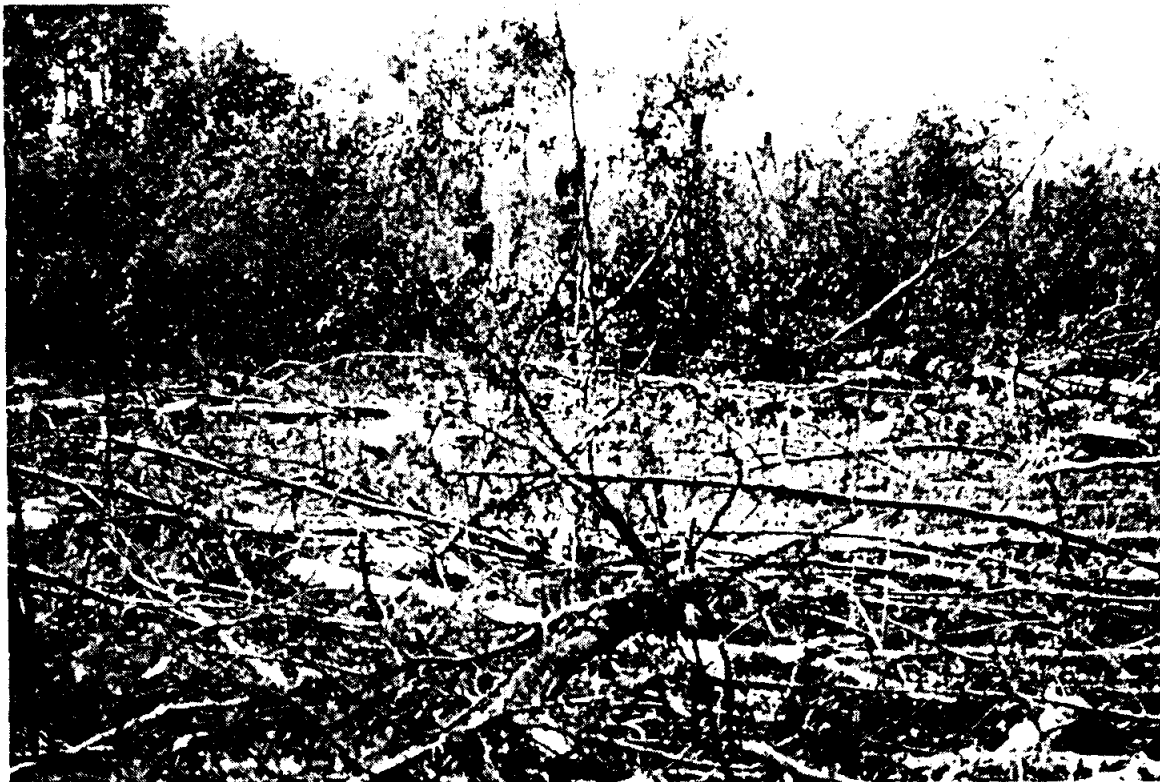


Figure 3. Meadow Lake Site following 1985/86 hardwood harvest.



Figure 4. TTS Delta disc action creating furrows on Meadow Lake Site.

Note: Penetration of independent arm-disc configurations varying directly to ground resistance.



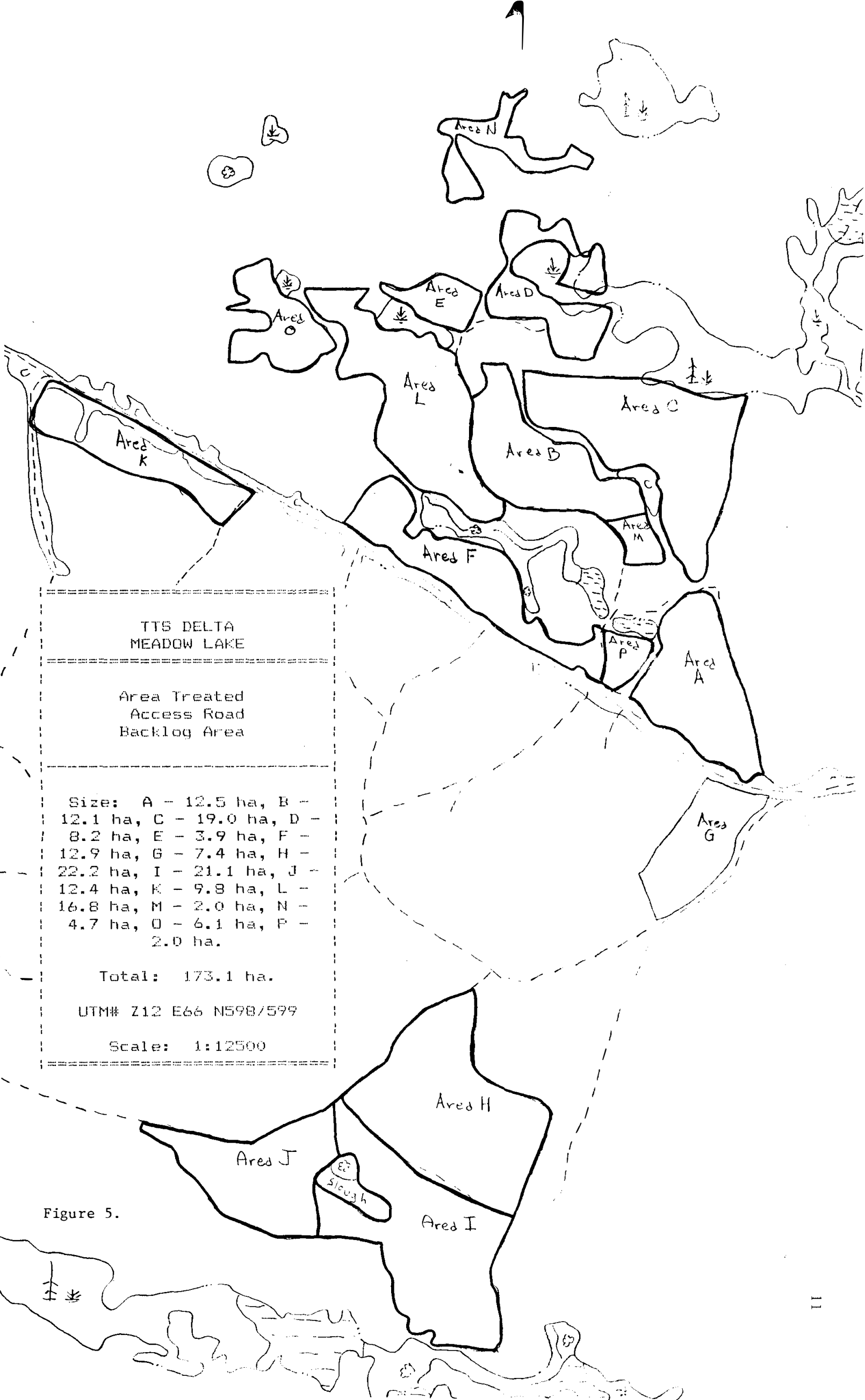


Figure 5.

**Table 3. Meadow Lake - TTS Delta Site Preparation Summary.**

Block	Ha.	Prod. hours	Prod. ha./hr.	Quality			
				Gross exp. %	Net exp. %	Coverage %	Plantable spots/ha.*
A	12.5	14.35		16	87	N/A	
B	12.1	16.20		18	80	N/A	
C	19	22.30		15	76	80	
D	8.2	8.55		19	83	85	
E	3.9	4.45		11	62	N/A	
F, L, M N, O, P	44.5	50.50		16	81	71	
G	8.6	6.5		18	89	71	
H	22.6	23.45		13	75	63	
I	21.8	19		15	81	72	
J	11.7	11.45		14	78	80	
K	9.8	8.1		14	85	80	
Totals	174.7	184.85					
Average			.95	15	80	73	2218

\* Plantable spots per hectare based on 100% coverage of assessment plots - actual operational plantable spots will be approximately 15% lower.

Dore Mountain

**Participant:** Sask. Forest Products Corp.

**Pre-trial Disturbance:** clear cut 1983/84; 1984/85  
white spruce and jack pine

**Slash Loading:** moderate to heavy  
white spruce, jack pine, tops and limbs

**Stumps:** 1914/ha., average height 23 cm, diameter 20 cm

**Duff Depth:** 12 cm

**Soil:** deep sandy clay

**Drainage:** imperfect

**Residual:** scattered trembling aspen

**Topography:** flat to gently rolling



Figure 6. An example of one of the mixedwood blocks of Dore Mountain; John Deere 740A-TTS Delta in background.



Figure 7. Donaren 180D operating on the Dore Mountain Site.

Note: Furrow profile created by downloading and disc rotation.

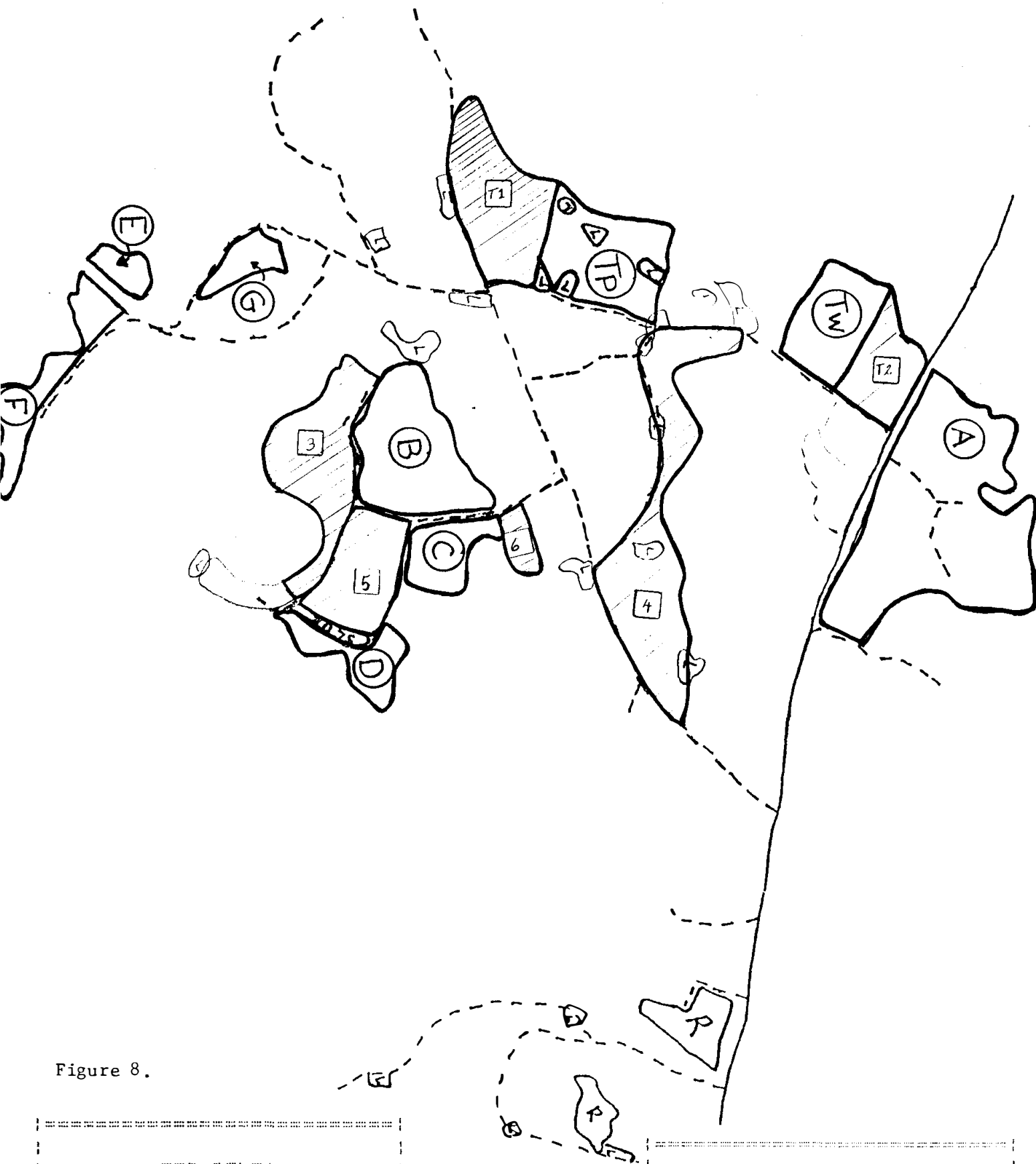


Figure 8.

TTS DELTA DORE MOUNTAIN	
Area Treated	○
Primary Haul Road	—
Access Road	- - -
Size: A - 19.8 ha, B - 8.4 ha, C - 2.8 ha, D - 2.6 ha, E - 1.1 ha, F - 4.4 ha, G - 1.2 ha, Tp - 5.9 ha, Tw - 4.6ha	
Total: 50.8 ha	
UTM# Z13 E36 N605	
Scale: 1:12500	

DONAREN 180 DORE MOUNTAIN	
Area Treated	▨
Primary Haul Road	—
Access Road	- - -
Size: T1 - 3.1 ha, T2 - 5.6 ha, 3 - 8.0 ha, 4 - 11.8 ha, 5 - 5.2 ha, 6 - 1.3 ha.	
Total: 35.0 ha	
UTM# Z13 E36 N605	
Scale: 1:12500	

**Table 4. Dore Mountain - TTS Delta Site Preparation Summary.**

Block	Ha.	Prod. hours	Prod. ha./hr.	Quality			
				Gross exp. %	Net exp. %	Coverage %	Plantable spots/ha.
A	19.8	14.48		N/A	N/A	N/A	
B	8.4	11.17		N/A	N/A	N/A	
C,D	5.4	9.00		21	90	N/A	
E,F	5.5	5.83		20	75	N/A	
G	1.2	1.92		31	88	N/A	
Tp & Tw	10.5	6.08		Indepth	Evaluation	Site	
Total	50.8	48.48					
Average			1.05	22	83		*2612

**Table 5. Dore Mountain - Donaren 180D Site Preparation Summary.**

Block	Ha.	Prod. hours	Prod. ha./hr.	Quality			
				Gross exp. %	Net exp. %	Coverage %	Plantable spots/ha.
All	34	43.55	.78	20	75	N/A	*2742

\* Plantable spots per hectare based on 100% coverage of assessment plots  
 - actual operational plantable spots will be approximately 15% lower.

Camp 2

**Participant:** Prince Albert Pulpwood Company

**Pre-trial disturbance:** clear cut - 1985/86  
mixedwood - primarily trembling aspen

**Slash Loading:** light with moderate patches  
trembling aspen tops and logs

**Stumps:** moderate trembling aspen, some white spruce  
average height - 20 cm, diameter 22 cm

**Duff Depth:** 12 cm

**Soil:** sandy loam

**Drainage:** moderately well

**Residual:** nil

**Topography:** gently rolling to moderate slopes up to 40%



Figure 9. Varying topography on Camp 2 Site.

Note: Pattern of site preparation created by TTS Delta.




Figure 10. John Deere 740A-TTS Delta site preparing Camp 2.

Note: Consistency in coverage and disturbance created by TTS Delta.





TTS DELTA  
CAMP 2

Area Treated   
Primary Haul Road  
Access Road


Size: A - 24.3 ha, B -  
8.8 ha, C - 12.3 ha, Tw  
- 5.9 ha

Total: 51.3 ha

UTM# Z13 E44 N604

Scale: 1:12500

DONAREN 180  
CAMP 2

Area Treated   
Primary Haul Road  
Access Road

Size: TD - 4.6 ha, E -  
10.6 ha, F - 28.0 ha, G -  
1.8 ha.

Total : 45.0 ha.

UTM# Z13 E44 N602

Scale: 1:12500

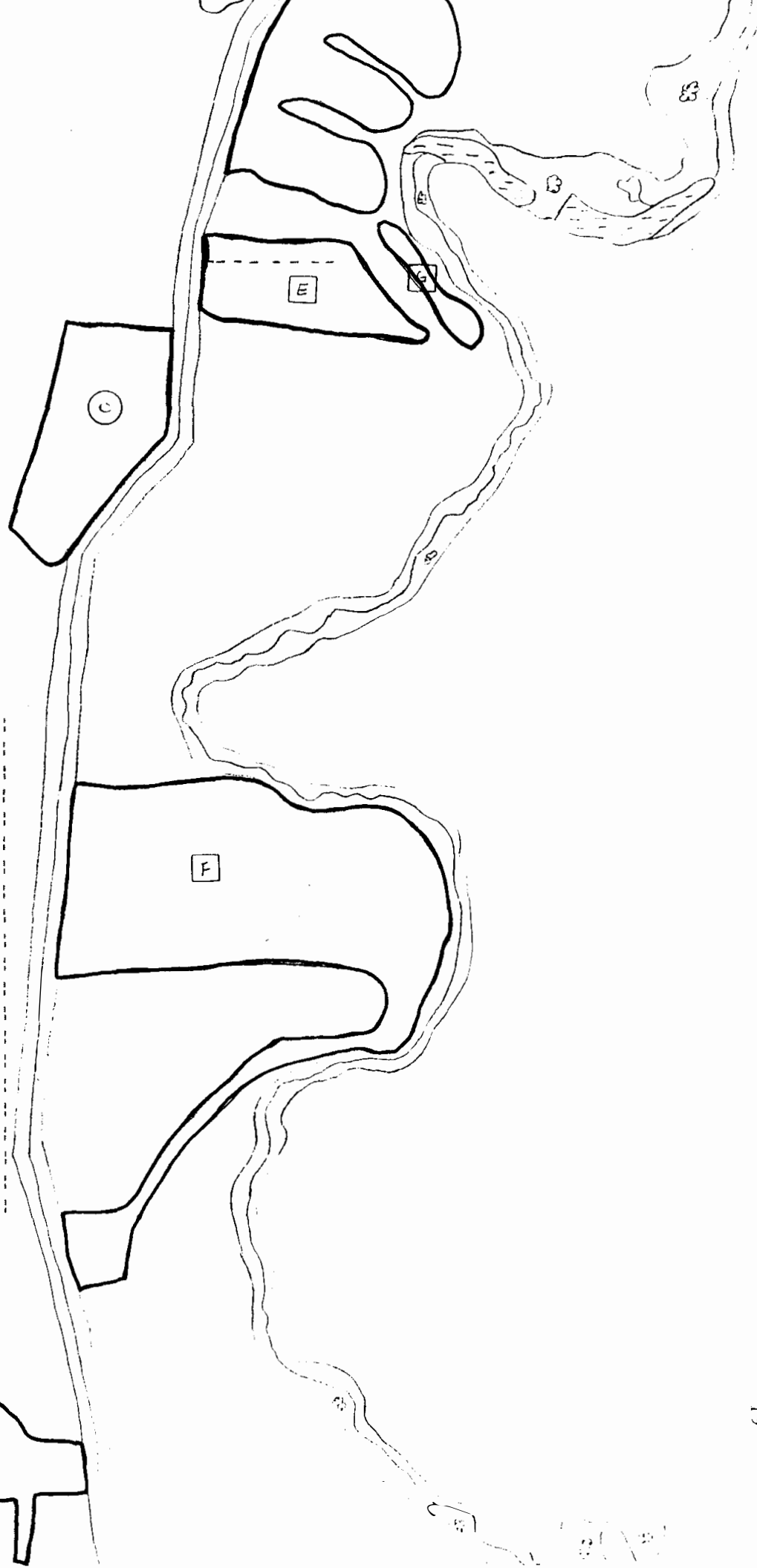


Figure 11.



**Table 6. Camp 2 - TTS Delta Site Preparation Summary.**

Block	Ha.	Prod. hours	Prod. ha./hr.	Quality			
				Gross exp. %	Net exp. %	Coverage %	Plantable spots/ha.*
A	24.3	28.17		29	86	90	
B	8.8	8.00		24	80	92	
C	12.3	9.33		36	93	90	
Trial	5.9	4.58		Indepth Evaluation Site			
Total	51.3	50.08					
Average			1.02	30	87	90	3019*

**Table 7. Camp 2 - Donaren 180D Site Preparation Summary.**

Block	Ha.	Prod. hours	Prod. ha./hr.	Quality			
				Gross exp. %	Net exp. %	Coverage %	Plantable spots/ha.*
All	44	62.25	.71	18	75	N/A	2550

\* Plantable spots per hectare based on 100% coverage of assessment plots  
 - actual operational plantable spots will be approximately 15% lower.

### Sipanok Channel

**Participant:** Saskatchewan Forest Products Corp.

**Pre-trial Disturbance:** clear cut - 1981/82, 1982/83  
white spruce/trembling aspen

**Slash Loading:** light with moderate patches

**Ground Implements:** heavy lower brush vegetation  
raspberry, hazel, poplar, birch

**Stumps:** approximately 600 per hectare  
pre-dominately large white spruce  
average height - 35 cm, diameter - 50 cm

**Duff Depth:** 25 cm

**Soil:** clay

**Drainage:** imperfect

**Residual:** patchy - scattered trembling aspen and white birch

**Topography:** flat

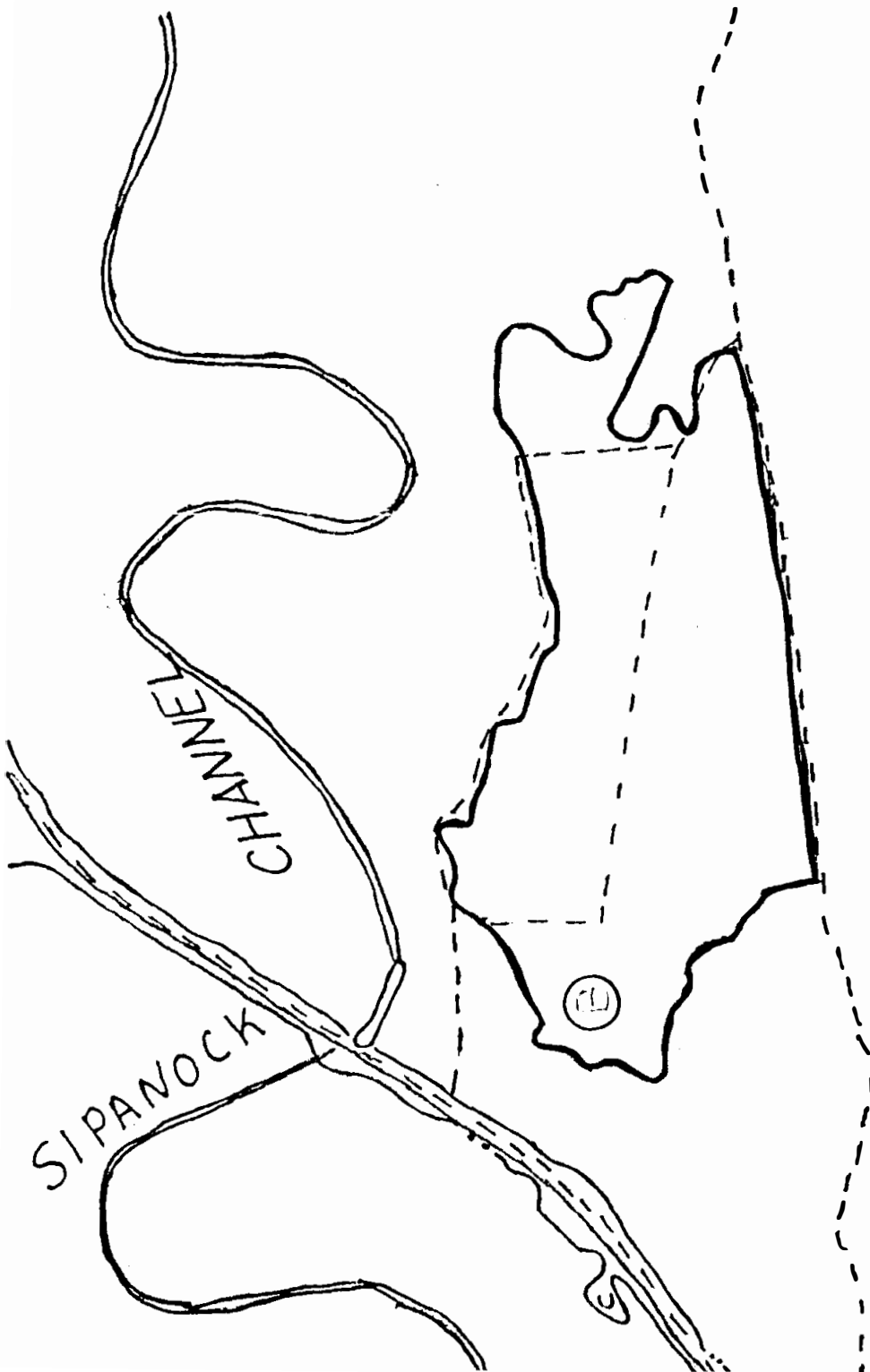


Figure 12. Profile of TTS Delta furrow in Sipanok Channel Site.

**Note:** Narrowing of trencher arms when lifted into transport position.



Figure 13. A TTS Delta furrow penetrating the heavy ground vegetation and deep duff associated with the Sipanok Channel Site.



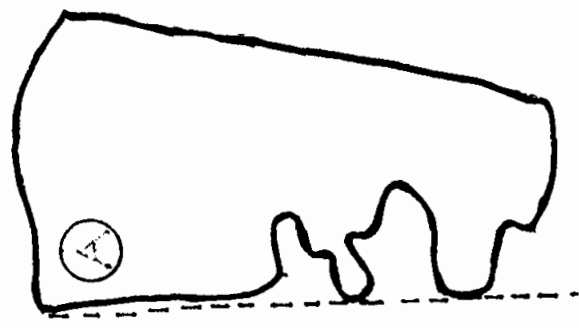
TTS DELTA  
SIPANOCK CHANNEL

Area Treated  
Primary Haul Road  
Access Road

Size: A - 31.1 ha  
B - 71.1 ha  
Total: 102.2 ha

UTM# Z13 E62 N595  
Scale: 1:12500

Figure 14.



**Table 8. Sipanok Channel - TTS Delta Site Preparation Summary.**

Block	Ha.	Prod. hours	Prod. ha./hr.	Quality			
				Gross exp. %	Net exp. %	Coverage %	Plantable spots/ha.*
A	31.7	31.75		24	77	85	
B	71.1	84.50		23	82	76	
Total	102.8	116.25					
Average			.88	23	80	80%	2949

\* Plantable spots per hectare based on 100% coverage of assessment plots  
 - actual operational plantable spots will be approximately 15% lower.

#### **Trial Data Summary**

The following tables summarize all areas site prepared by either the TTS Delta or the Donaren 180D during the 1986/87 equipment trial.

**Table 9. TTS Delta - Summary of all site preparation.**

Site	Total Area Ha.	Prod. Rate Ha./Hr.	Quality			
			Gross Exp. %	Net Exp. %	Coverage %	Plantable Spots/ha.*
Camp 2	51.3	1.02	30	87	90	3019
Dore Mountain	50.8	1.05	22	83	N/A	2612
Sipanok	102.8	.88	23	80	79	2949
Meadow Lake	174.7	.95	15	80	73	2218

**Table 10. Donaren 180D - Summary of all site preparation.**

Site	Total Area Ha.	Prod. Rate Ha./Hr.	Gross Exp. %	Net Exp. %	Coverage %	Plantable Spots/Ha.*
Camp 2	44	.71	18	75	N/A	2550
Dore Mountain	34	.78	20	75	N/A	2472

\* Plantable spots per hectare are based on 100% coverage of assessment plots - actual operational plantable spots will be approximately 15% lower.

### Discussion

Throughout the duration of this equipment trial, the TTS Delta operated on four significantly different sites, with participation by three provincial client groups; the Sask. Dept. of Parks and Renewable Resources, Saskatchewan Forest Products and the Prince Albert Pulp Company (now Weyerhaeuser Canada Ltd.). The second machine, the Donaren 180D operated on two sites with participation by Saskatchewan Forest Products and the Prince Albert Pulpwood Company.

Both the TTS Delta and Donaren 180D were able to successfully create the prescribed microsite on all sites completed during the trial. Through their versatility in power loading, disc rotation and fluctuating disc angling (Delta only), the participating groups were able to try a great variety of combinations to accommodate minor and major site variations.

The Meadow Lake site (Delta only), which contained the most variability in site conditions allowed the Sask. Dept. of Parks and Renewable Resources to operate on wet, deep duffed, heavy advanced growth hardwood and heavy overstoried sites. Through their time and effort, diversity of this implement was tested thoroughly while allowing staff members to get acquainted with the Delta's mechanical and hydraulic abilities. A successful microsite with adequate planting access was produced on all sites. The Meadow Lake site was planted with 332,000 white spruce container stock in september of 1986.

The Saskatchewan Forest Products site at the Sipanok Channel area presented the TTS Delta with deep duff, heavy lower vegetation, extreme stump sizes and an extremely fine textural soil type. Through varying the width of the disc angle and increasing the down loading, a successful microsite for tree planting was prepared on the majority of the area. The stumps imposed an ergonomical problem during the operation with minor influence on the disc operation. Residual white birch, trembling aspen, and balsam fir were also present on this site and although coverage was influenced, the Delta disc action was not significantly impeded.

The site at Camp 2 and Dore Mountain incorporated work by both the TTS Delta and Donaren 180D for a direct comparison. The indepth evaluation was completed on these sites for analysis and final reporting in the next fiscal year. The data summaries will be available for scrutiny by the participants preceeding the final publication on request.

The site preparation by both the Delta and Donaren on the Dore Mountain sites were completed on comparable ground conditions with fairly comparable quality. The major limitations on this site was moderate to heavy slash loading and a stump number range of 1,500 to 2,800 per hectare. Although the Donaren required interpass disc slash-clearing on the heavily slashed



areas, both machines aligned the slash and exposed an adequate amount of mineral soil for a quality planting microsite. The participating staff from Sask. Forest Products found few if any limitations in the ability of both the Donaren and Delta implements themselves. The size of the prime mover required to accommodate a hydraulic disc trencher in comparison to the conventional TTS-35 was questioned in regards to economic limitations. This is of major importance in Saskatchewan as there are few skidders of sufficient horsepower and hydraulic capacity outside of Weyerhaeuser Can. Ltd., for compatibility with the hydraulic trenchers.

The operation of both the TTS Delta and Donaren 180D on the Camp 2 site were influenced mainly by the steepness of the topography. Slopes of up to 35% were traversed by the machines although limitations in speed and coverage were noted. The main objective in operating on these steep sites was to test furrow consistency and production. Although the abilities of the prime mover is the most influential part of site preparation on steep slopes, the powered trenchers play a role in stability on side slopes, and possess an edge over conventional site preparation implements in that loading can be removed while operating to allow ease in upslope operation. The disc rotation in the direction of movement also aids in upslope traction. As noted on the summary tables, the gross and net exposure of the TTS Delta is higher in comparison to the Donaren. The ability of the TTS Delta to adjust its disc angle as well as the different disc tooth configuration allow a wider and more consistent trench in these cases.

The comparison of the two machines' site preparation quality in the Dore Mountain site is less extreme while showing a slight edge to the Delta.

Let it be noted that an operator's ability to manipulate the prime mover/implement configuration in a positive manner will also vary the quality of site preparation. The comparison of the two prime movers in this trial was not taken into consideration as we were advised by the distributors that the site preparation implements were working in an acceptable manner.

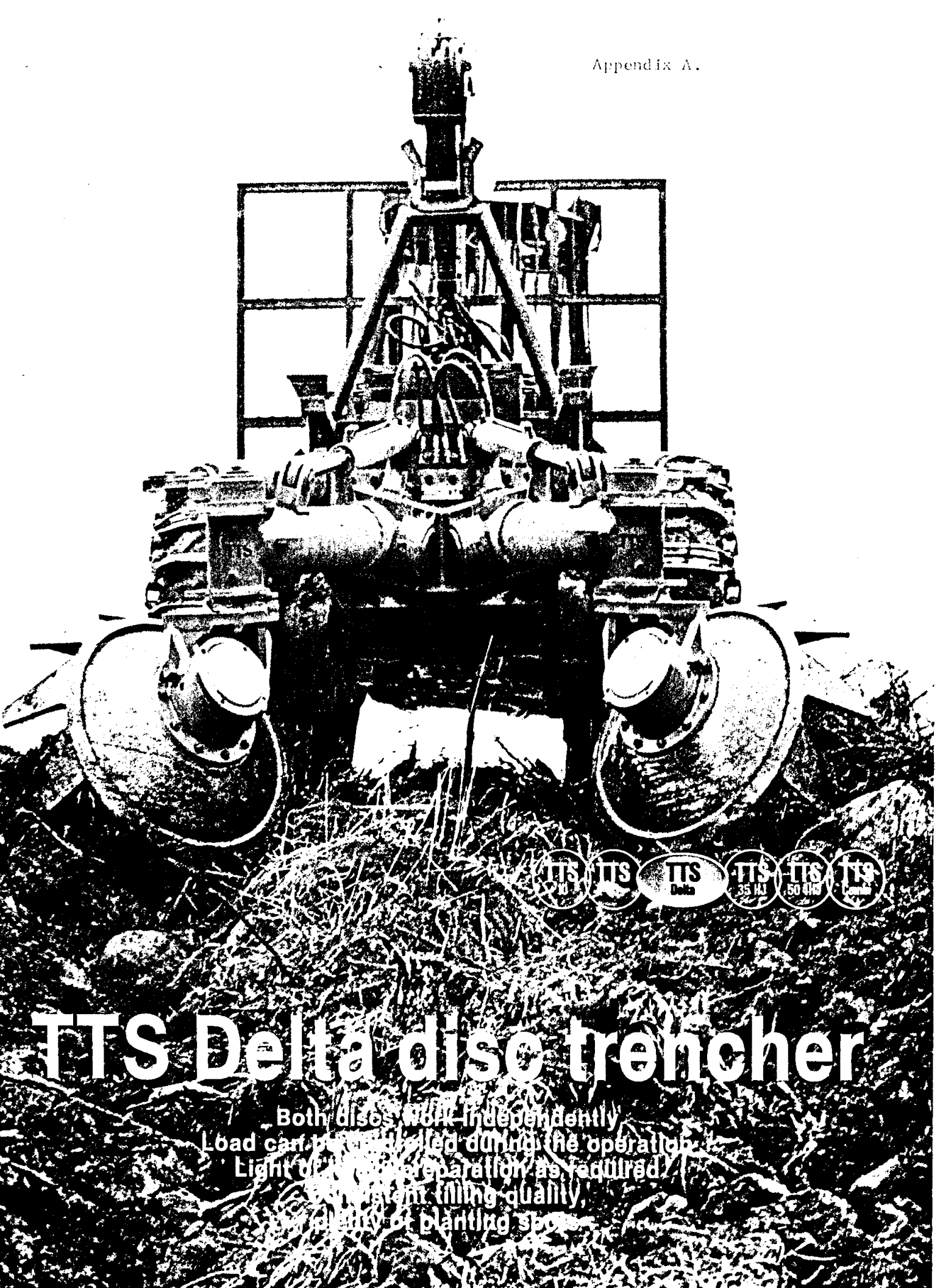
Production on all of the sites was approximately one ha./hr. for the Delta and .8 ha./hr. for the Donaren. This is very significant in that the Donaren was actually slowed down to create the microsite removing doubt that the prime mover was detrimental to the production.

### Summary

Throughout this equipment trial the site preparation quality as well as the operational properties of both the TTS Delta and the Donaren 180D indicate that both machines have a diverse application, favorable to today's needs in Boreal silviculture operations. While problems were encountered with the Donaren's Ardco prime mover, serviceability while in Saskatchewan of both site preparation implements was quite acceptable for field operations of this nature.

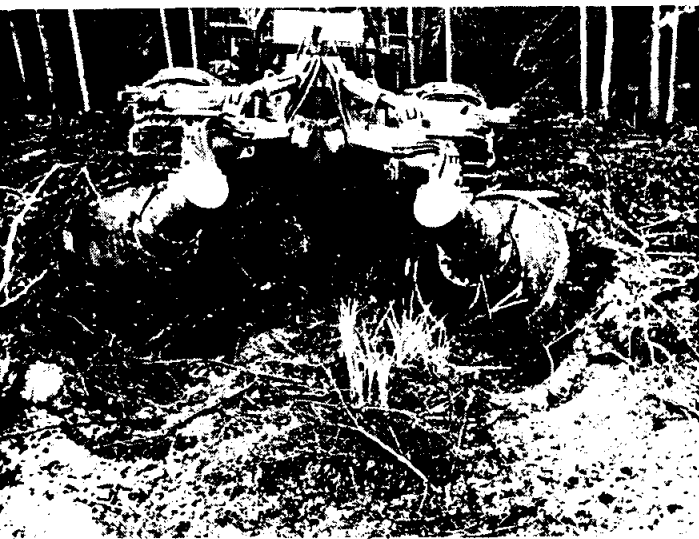
Some limitations which may deter power trencher use in Saskatchewan are lack of maintenance expertise and limitations in prime mover availability. Sites which may inhibit successful applications of the powered disc trenchers are excessive advanced vegetation growth, extremely deep duff and/or sod layers, and sites of extreme wetness requiring a drastic increase in elevated microsite manipulation.

The complete power disc trencher equipment trial has received rave reviews from all parties involved, therefore enticing the idea for co-operative ventures of this type to continue where credible proposals arise.



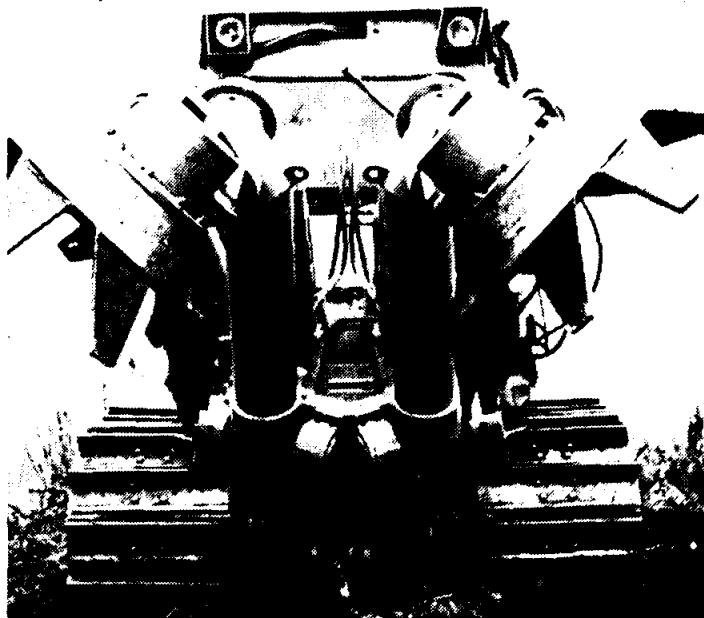
# TTS Delta disc trencher

Both discs work independently  
Load can be controlled during the operation  
Light of work preparation as required  
Consistent tilling quality  
Plenty of planting spots

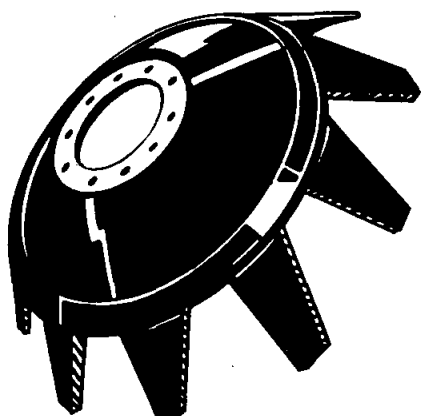


TTS Delta discs can be equipped with a hydraulic motor and a speed reduction gear.

When raised into transport position the TTS DELTA becomes narrower, thus enabling easy and safe transportation on narrow roads. The trencher is raised hydraulically.

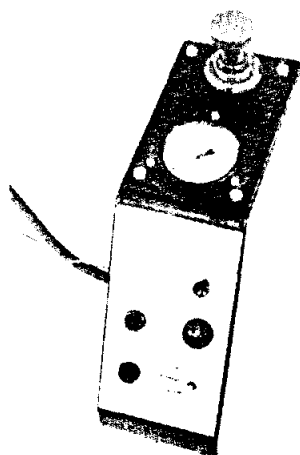


In the picture as a prime mover a crawler.



#### Canaca discs:

- 1200 mm, 9 teeth, teeth length 270 mm
- 1300 mm, 10 teeth, teeth length 270 mm
- 1400 mm, 8 teeth, teeth length 390 mm



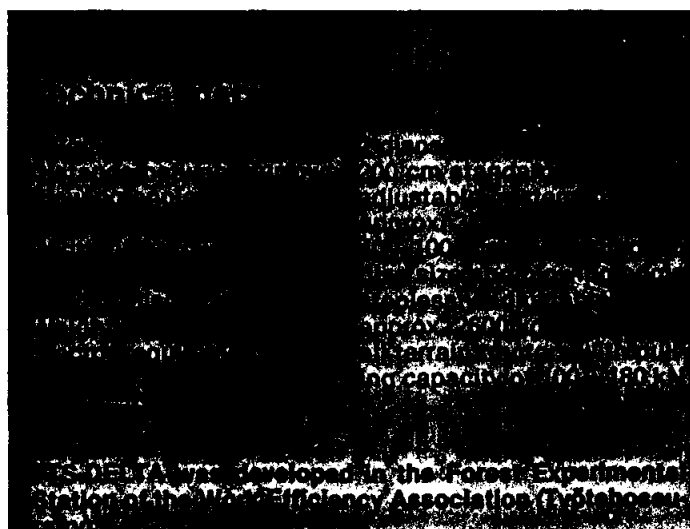
The hydraulic control panel is in the cabin. The operator may adjust the load according to tilling conditions during the operation.



A suitable tractor for the TTS disc trencher is a skidder, forwarder or crawler.

## ADVANTAGES OF THE TTS-35 H DELTA

- Automatic hydraulic loading
- Load can be controlled from the cabin during the operation. When the area is difficult to till, the load is increased and where it is easy, the load is decreased or removed.
- The disc arms work independently and follow the variations of the ground.
- A new arm system eliminates peaks in the pulling resistance. The plowing angle is easily adjustable.





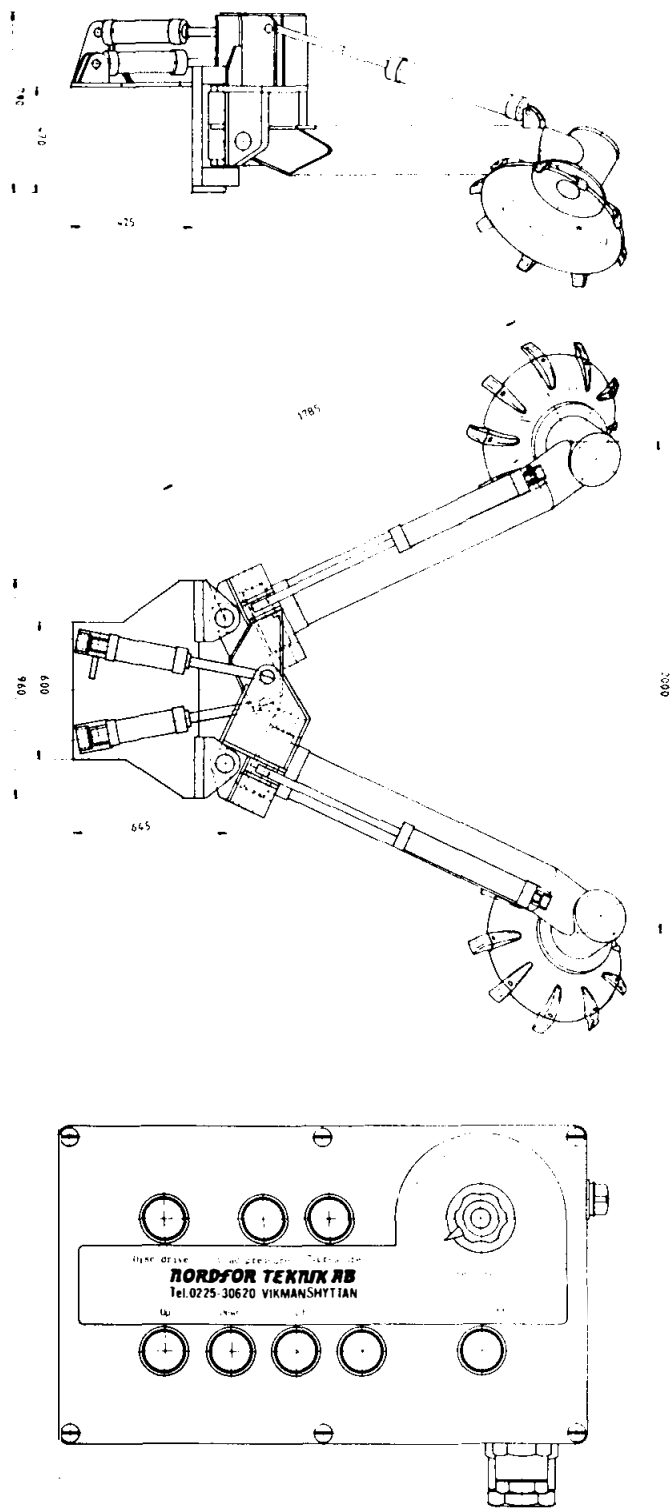
# DONAREN 180

## The Disc Trencher with Unique Combination Features

The hydraulically driven discs combined with stepless, fully adjustable loading pressure on the arms gives the DONAREN 180 better results on all processable areas.

The short, light-weight DONAREN 180 with these new combination features achieves a higher planting level, an improved working result in logging residue and an increased number of good planting or seeding spots.

The **DONAREN 180** with standard equipped arms is prepared for mounting on a hydraulic attachment from which the discs may derive propulsion. From the control panel in the driver's cabin, suitable working positions can be easily selected. The special assembly of the **DONAREN 180** to a vehicle not only gives better accessibility to once hard-to-get areas but also better manoeuvrability. The **DONAREN 180** can be installed on most makes and models of forest machinery. Spare parts, service and installation can be arranged through the general dealer and Nordfor.



**Technical Data:**

<b>Measurement:</b>	
Disc diameter	950 mm (37,4'')
or	1050 mm (41,3'')
Outer measurement, tooth edge	1250 mm (49,2'')
or	1350 mm (53,1'')
Track spacing	1500—2750 mm (59,0'—108,2'')
Track width	600—800 mm (23,6'—31,5'')
Maximum movement up:	1200 mm (47,2'')
above horizontal position	
down:	1250 mm (49,2'')
below horizontal position	

<b>Weight:</b>	
Gross weight:	2300 kgs (5070 lbs.)

<b>Dises:</b>	
Number of replaceable teeth/disc	10
Dises and teeth are designed for automatic slash removal.	

<b>Arms:</b>	
The arms have three (3) work positions:	
- Work position with stepless loading pressure 0—40 bar (0—580 psi)	
- Floating position with 0-pressure.	
- Transport position.	
The arms and disc bearings are strongly built and are designed to give extensive moveability both upwards and to the side.	

<b>Hydraulic System:</b>	
Required hydraulic pressure:	Max. 170 bars (2470 psi)
Required flow	70 l/min. (19 gals)
Variable disc rotation (driven version):	Between 15—30 rpm
Hydraulic motors for the driven discs can be driven in three ways:	
1 directly from the tractor's pump.	
2 from a separate pump mounted on the shaft from the power take-off.	
3 from a separate diesel motor with a pump.	

<b>Electrical System:</b>	
Current - 24 or 12 V	
Electrical control panel conveniently placed in the driver's cab for desired working positions.	

<b>Power Requirement:</b>	
Engine power required is approximately 90—115 kw.	