

**TOPPLING TRIAL ESTABLISHMENT  
REPORT: EVALUATION OF SEVERE  
LATERAL NURSERY ROOT TRIMMING  
AND CONTRASTING GENETIC  
IMPROVEMENT**

**J.A.TURNER, J.D. TOMBLESON & W. BROWN**

**Report No. 44 May 1998**

# **FOREST & FARM PLANTATION MANAGEMENT COOPERATIVE**

## **EXECUTIVE SUMMARY**

### **TOPPLING TRIALS ESTABLISHMENT REPORT: EVALUATION OF SEVERE LATERAL NURSERY ROOT TRIMMING AND CONTRASTING GENETIC IMPROVEMENT**

**J.A. TURNER, J.D. TOMBLESON, W. BROWN**

**Report No. 44**

**May 1998**

Toppling, the wind throw of age two and three-year tree stocks is becoming a significant problem in new plantings of radiata pine seedlings, particularly on fertile farm sites. Several factors have been identified as increasing the likelihood of toppling, including, poor planting technique, poor nursery root architecture, crown architecture, and releasing. Trials have been established in 1996 and 1997 to quantify three factors which potentially influence the incidence of toppling, including root trimming, topping and improved genetic material. The production of seedlings which have a well defined tap root coupled with severe trimming of the nursery root laterals has been proposed as a treatment which eliminates the possibility of root distortion at planting and results in a rooting habit and tree stability similar to that found in naturally regenerated radiata pine. The possible imbalance of root growth to shoot growth has been implicated as a further cause of toppling which will also be evaluated.

Eight trials to compare the incidence of toppling between conventionally root trimmed seedlings and severe lateral root trimmed seedlings with strong tap roots were established on fertile, wind prone sites throughout New Zealand in September 1996 and June 1997 by members of the Forest and Farm Plantation Management Cooperative. Three trials to compare differences in toppling between seedlings with contrasting levels of genetic improvement (GF 10 and GF 30) were established at Stratford in September 1996, and Wairoa and Takapau in June 1997, also by Cooperative members. A further trial was established in Palmerston North in June 1997 to evaluate seedlings which were topped six weeks prior to being lifted from the nursery.

These trials will be re-measured annually for height and diameter growth, and any incidence of toppling, including degree of lean, following the occurrence of any damaging wind events. On sites where toppling occurs, trees will be measured for straightness of the butt log following the final pruning lift and will be re-measured for tree growth throughout the rotation.

## 1. OBJECTIVE

To evaluate the effect of severe lateral nursery root trimming on incidence of toppling, tree growth and butt log straightness of seedlings planted on fertile farm and toppling prone sites.

## 2. INTRODUCTION

"Toppling" (the wind throw of trees aged 2 to 3 years) can have serious economic implications for forest and woodlot growers throughout New Zealand. Toppling results in more stems having butt sweep so reducing potential volume recovery of valuable clearwood, a reduced selection ratio at time of thinning, and a reduced possibility of achieving an acceptable final crop stocking (Menzies 1975). For example, a stand in which 80% of trees toppled more than 15° at age two years could suffer a 31% loss in clearwood production (Mason & Trewin 1987). A further cost of toppling is the increased susceptibility of trees to subsequent wind throw due to poor root architecture (Burdett *et al.* 1986). The incidence of toppling in new plantings may be increasing due to the high rate of new land planting, particularly on fertile farm sites and the forestry move to fertile farm sites (Ray *et al.* 1994).

In 1995/96 members of the Forest & Farm Plantation Management Cooperative awarded the highest ranking to a project proposal to evaluate three treatments aimed at reducing the incidence of toppling. Treatments to be evaluated included; crown lightening, severe lateral root trimming and topping on subsequent stability, tree growth, and stem straightness of seedlings. It was also proposed that a sample of the trial sites would be quantified in terms of their risk to toppling using computer-based air flow models.

There are several ways to avoid, mitigate or remedy the incidence of toppling (Mason 1985):

1. Nursery practice eg. minimum root conditioning, topping, improved root trimming
2. Good site preparation eg. ripping, cultivation, and weed control
3. Improved planting techniques
4. Choice of planting stock. Seedlings, juvenile cuttings and physiologically-aged cuttings.
5. Crown lightening
6. Choice of planting site - exposure to wind.

Considerable research has been carried out in the areas of; site preparation, improved planting techniques and choice of planting stock. The work carried out in this trial series primarily focuses on evaluating; crown lightening, nursery techniques, and site factors.

This report should be read in conjunction with Forest and Farm Plantation Management Cooperative Report No.43 (Turner *et al.* 1997) which describes the installation of trials in June 1996 and May 1997 to evaluate crown lightening as a treatment for reducing the incidence of toppling.

### **3. TRIAL LOCATIONS**

In order to effectively evaluate the influence of the treatments being assessed on the incidence of toppling, the trials need to be situated in locations which have the greatest possibility of being toppled. To increase this likelihood fertile farm sites were selected which are historically subject to strong winds and have a history of toppling (Table 1 and Figure 1). Trials were established over two years, 1996 and 1997, to further increase the likelihood of the trials experiencing wind events that could cause toppling.

#### **Severe Lateral Root Trimming**

The severe lateral root trimming treatment could have the effect of reducing growth in the first year, which may not be of concern on fertile farm sites, but with the compensatory benefit that the root system can not be distorted at planting and as such subsequent root development in particular regeneration of the tap root is likely to be close to that of naturally regenerated seedlings, thus reducing the incidence of toppling. Eight severe lateral root trimming trials were established throughout New Zealand at the following locations: Waihi, Elgood Forest (Ngarawahia), Hautu Forest (Turangi), Fielding, Pukemahoe Station (Stratford) and Berwick Forest in September 1996, and Massey University (Palmerston North) and Takapu Farm Forest (Tawa) in June 1997 (Table 1 and Figure 1).

#### **Contrasting Levels of Genetic Improvement**

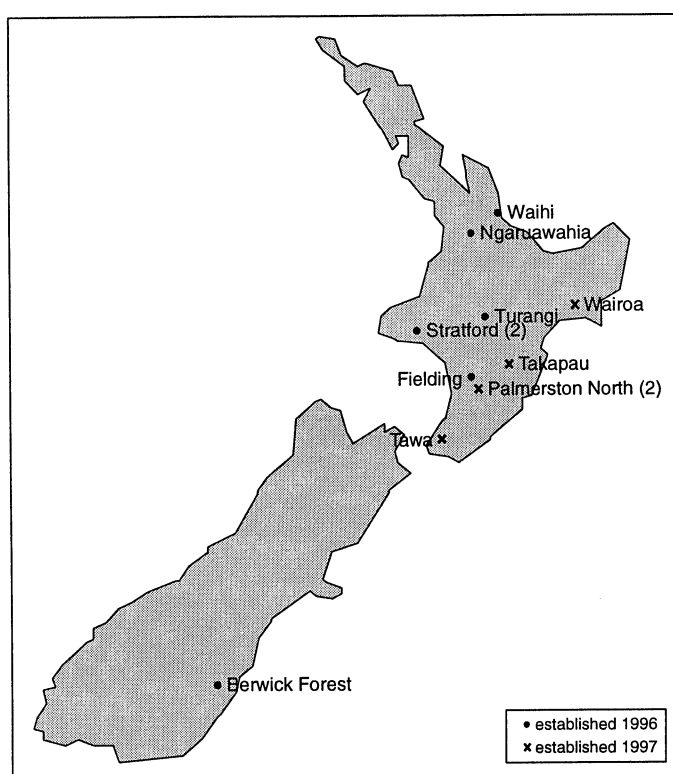
There is anecdotal evidence to suggest that the increased incidence of toppling could be accentuated by any increased growth rate associated with genetically improved tree stocks. Three trials to compare the incidence of toppling for contrasting levels of genetic improvement (GF 10 and GF 30) were established at Stratford (September 1996), Wairoa (June 1997) and Takapau (June 1997) (Table 1 and Figure 1).

#### **Topping**

The potential benefit of this treatment is that early top growth is slower to establish thus creating a more stable tree. One topping trial was established in 1997 at Massey University to assess the topping treatment (Table 1 and Figure 1).

**Table 1: TRIAL SUMMARY:** Location, year established, treatment, owner, contact and experiment number.

	Trial	Year Established	Treatment	Owner	Contact	Experiment Number
1	Waihi	1996	root trim	Neil & Esla Worker	Roger Allen Graham Hardisty	FR310/2
2	Ngaruawahia	1996	root trim	Peter Dillon		FR310/1
3	Wairoa	1997	contrasting GF	Juken Nissho Ltd		FR310/11
4	Turangi	1996	root trim	Justice Dept		FR310/3
5	Stratford	1996	root trim	Jeremy Thomson		FR310/8
6	Stratford	1996	contrasting GF	Don & Eila Hopkirk	Neil Faulknor Blair Haggitt James Millner James Millner Tony Smith	FR310/9
7	Takapau	1997	contrasting GF	N.J.C. Kynoch		FR310/12
8	Fielding	1996	root trim	Dean & Cushla Williamson		FR310/6
9	Palmerston North	1997	root trim	Massey University		FR310/4
	Palmerston North	1997	topping	Massey University		FR310/5
10	Tawa	1997	root trim	Forme Consulting Group Ltd	Max Smith	FR310/10
11	Berwick Forest	1996	root trim	Wenita Forest Products Ltd		FR310/7



**Figure 1:** Location of topping trials established in 1996 and 1997 to investigate the effect of severe lateral root trimming, genetic improvement and topping on the incidence of topping.

Detailed information on each trial including site characteristics is contained in Appendix II and Appendix III.

## 4. PLANT MATERIAL AND NURSERY TREATMENTS

### 1996 Trials

Plant material used in the trials established in 1996 were GF19 seedlings which were raised in the *Forest Research* Nursery, Rotorua. The following nursery regime was applied:

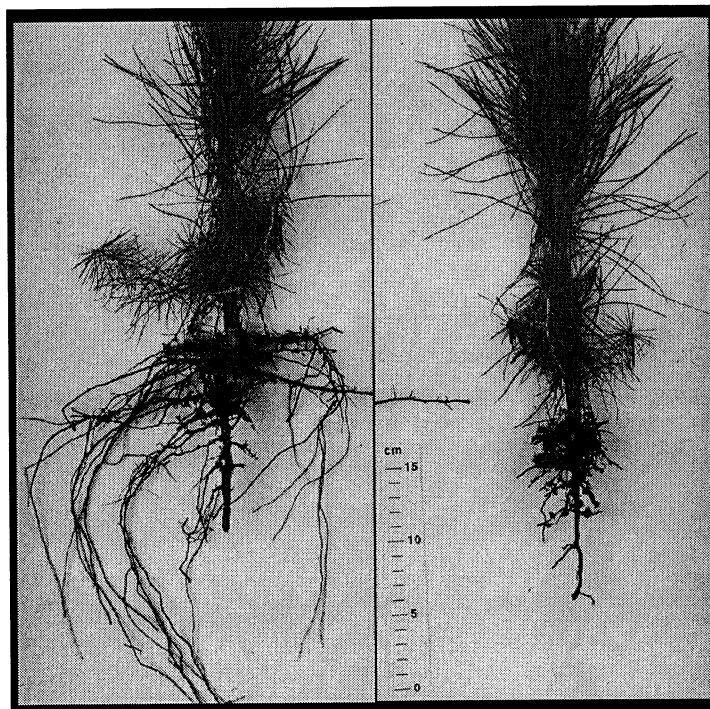
#### Treatment:

- a late and deep undercut to promote the formation of a long single tap root carried out when the seedlings were just over 30 cm tall;
- seedlings lifted on 1 September;
- seedlings were trimmed individually to a maximum width of 4 cm using hand shears on 2 September;
- seedlings were cool stored at *Forest Research* until dispatched in planting boxes and planted between 5 and 20 September 1996.

The effect of the late, deep undercut in terms of producing a well defined tap root is shown in Figure 2. The Control seed stocks used in the trials received the following conventional nursery root conditioning treatment:

#### Control:

- undercut when the seedlings were 20 cm tall to leave a 6 to 8 cm tap root;
- 5 weeks later seedlings were lateral pruned;
- every 2 to 4 weeks after lateral pruning, wrenching was carried out depending on the weather. During dry periods wrenching was delayed.



**Figure 2:** Root characteristics of the treatment showing deep undercut with well defined tap root. The seedling on the left is untrimmed, versus the seedling on the right which is trimmed.

### 1997 Trials

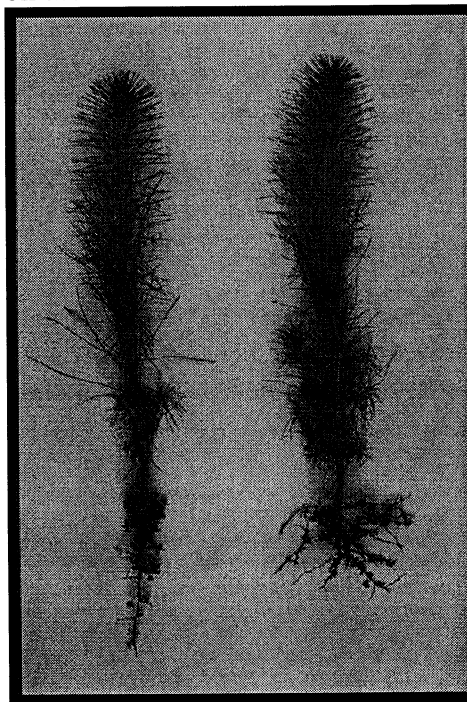
Plant material used in the trials established in 1997 were GF19 seedlings (see Appendix I for seedlot details) which were raised in the *Forest Research* Nursery, Rotorua. The following nursery regime was applied:

- **Treatment:** 3<sup>rd</sup> March seedlings for lateral pruning treatment received a late, deep undercut applied when seedlings had an average height of 12 cm to promote the formation of a long single tap root;
- 3<sup>rd</sup> April seedlings received a lateral prune;
- 6<sup>th</sup> May seedlings for topping treatment were topped by removing the top third of the foliage;
- seedlings lifted on 15<sup>th</sup> June;
- seedlings were trimmed individually to a maximum width of the laterals of 4 cm using hand shears on 16<sup>th</sup> June;
- seedlings were cool stored at *Forest Research* until sent in planting boxes.

The Control used in the trials received the following conventional nursery root conditioning:

#### Control:

- 18<sup>th</sup> March seedlings undercut when 20 cm tall to leave an 8 cm tap root;
- 3<sup>rd</sup> April seedlings were lateral pruned;
- every 2 to 4 weeks after lateral pruning wrenching was carried out depending on the weather.



**Figure 3:** Treatment seedling (on left) which has received an undercut at 20 cm height, lateral prune and wrenching. Root characteristics of radiata pine seedlings which have received a conventional nursery root conditioning (right).

## 5. TRIAL DESIGN

### Severe Lateral Root Trimming

The eight severe lateral root trimming trials comprised the following:

- 98 paired plots (each plot being two trees), laid out in a block comprising 14 x 14 trees (as shown in Figure 4);
- each plot comprises a conventionally root conditioned seedling (Control) and a severe lateral root trimmed seedling (Treatment);
- an initial spacing of 4.0 x 4.0m = 625 stems/ ha;
- two surround rows planted at the same spacing as the trial.

**Figure 4:** Layout for severe lateral root trimming trial.

X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

#### KEY

**C** = Control seedling (conventionally root conditioned)

**T** = Treatment seedling (severe lateral root trimmed)

**X** = Surround seedling

The corners of the inner block are marked with labelled pegs as shown in Figure 4.



### **Comparison of GF 10 and GF 30 Seedlings For Incidence of Toppling**

Three trials were installed in which seedlings of GF 10 and GF 30 will be compared using the same trial design as shown in Figure 4 above except for the following change to the treatment and control.

#### **KEY**

**C** = Control, GF 10

**T** = Treatment GF 30

**X** = Surround seedling (GF18)

The seedlings used in this contrasting GF evaluation received a conventional nursery root conditioning regime.

#### **Topping**

One trial was established in which topped and non-topped GF16 seedlings will be compared using the same trial design as shown in Figure 4 above except for the following change to the treatment and control.

#### **KEY**

**C** = Control

**T** = Treatment, topped

**X** = Surround seedling (GF18)

The seedlings used in this topping evaluation received a conventional nursery root conditioning regime. A further two topping trials are to be established in mid-1998.

## **6. FUTURE MANAGEMENT**

The anticipated duration of the experiment is up to 10 years. Some of the trials, particularly those that topple are likely to be retained for ongoing growth re-measurements and stem straightness assessment at the end of the rotation. The grazing of livestock amongst the trials for the first three years is strongly discouraged. Grazing during this period is likely to result in browsing of the lower branches which could increase the permeability of the crown and thus may confound the trial results. It is not envisaged that the trials incorporate any thinning which would compromise the experimental design. Pruning will be carried out by the plantation owners, as per the prescriptions applied to the surrounding plantation.

## 7. FUTURE TRIAL ASSESSMENT

Tree heights and diameters will be measured at the time of trial establishment and thereafter on an annual basis. Incidence of toppling and the degree of lean will be measured following any toppling, otherwise incidence of toppling and any differences in butt log straightness between the Controls and Treatment(s) will be quantified at the time of final pruning using a straight edge device. Angle of tree lean is to be measured using a protractor and plumb bob, or Abney level attached to a stake, immediately following any toppling for the purpose of quantifying any subsequent recovery of the stem.

To quantify the level of exposure to wind, the angle to the horizon for the eight points of the compass (TOPEX) is to be measured on each trial site. Description including: soil type, exposure to prevailing wind, and any other factors likely to influence toppling have been noted for each trial site.

### **Data Storage**

All data from the trial measurements, are contained in an Excel spreadsheet "*D:\James Work\Topple Trials and Studies\Root Trimming Trials\Root Trimming Trials Data.xls*" held by James Turner, Forest Research. The trial measurements are also stored on the **Forest Research** PSP system under the experiment number FR310.

## 8. ACKNOWLEDGMENTS

The authors gratefully acknowledge the following members of the Forest and Farm Plantation Management Cooperative who provided land and labour to establish the toppling trials on their own or their clients'/ company properties: Graham Hardisty, Department of Corrections; Peter Dillon; James Millner, Massey University; Jeremy Thomson; Don and Eila Hopkirk; Paul Greaves, Wenita Forest Products Ltd; Blair Haggitt, Wilson and Associates; Dean and Cushla Williamson; and Neil Worker; Neil Faulknor, Hawkes Bay Regional Council; Roger Allen, Juken Nissho Ltd; Tony Smith, Form Consulting Group Ltd. Assistance of the **Forest Research** nursery staff for carrying out the laborious task of root trimming and arranging the couriering of plant material is also acknowledged.

## 9. REFERENCES

- Burdett, A.N., H. Coates, R. Eremko and P.A.F. Martin. 1986. Toppling in British Columbia's Lodgepole pine plantations: Significance, Cause and Prevention. **The Forestry Chronicle** 62(5): 433-439.
- Mason, E.G. 1985. Causes of juvenile instability of *Pinus radiata* in New Zealand. **New Zealand Journal of Forestry Science** 15(3): 263-280.
- Mason, E.G. and A.R.D. Trewin. 1987. Toppling of radiata pine. **What's New in Forest Research No. 147**. New Zealand Forest Research Institute, Rotorua.
- Menzies, M.I. 1975. Remedial action for tree toppling. **Forest Establishment Report No. 65**. New Zealand Forest Research Institute, Rotorua.
- Ray, J., B. Richardson, A. Vanner, N. Davenport and G. Coker. 1994. The effect of compaction, weed competition, fertilisation, and method of planting on the susceptibility of *Pinus radiata* cuttings and seedlings to toppling. **Workplan No. 2358**. New Zealand Forest Research Institute, Rotorua.
- Turner, J.A., J.D. Tomblinson and J.P. Maclaren. 1997. Crown lightening trials: Installation Report. **Forest and Farm Plantation Management Cooperative Report No. 43**. New Zealand Forest Research Institute Ltd., Rotorua.

## **APPENDIX I: SEEDLOT DETAILS**

# APPLICATION FOR SEED CERTIFICATION



NAME AND ADDRESS OF PERSON OR AGENCY REQUESTING CERTIFICATION	PROSEED NZ LTD PRIVATE BAG 3020 ROTORUA	<b>A</b>
SPECIES <u>PINUS RADIATA</u> YEAR OF COLLECTION AND COLLECTION No. <u>95/11</u> QUANTITY COLLECTED, OR QUANTITY OF SEED EXTRACTED ..... kg NATURAL STAND, OR YEAR ESTABLISHED <u>1974-85</u>		INTENDED PURPOSE PROPOSED BREED OR SEED REGION ..... DETAILED LOCATION OF SEED SOURCE <u>KAINGAROA CPT. 1111,1112</u> <u>RA6 1974-75</u> <u>RA8 1976-85, EXCLUDING 1977 and 1978</u> LOCATION NAME <u>KAINGAROA</u>

<b>B</b>	USE THIS BOX FOR:	<b>NATIVE SPECIES                  OR NON-ORCHARD LOTS</b>
PARENT STAND SEEDLOT No. REGISTERED SEED STAND No. or PARENTAGE ..... No. OF TREES FROM WHICH SEED WAS COLLECTED ..... (Under 20 state number, Over 20 estimate) No. OF TREES IN PARENT STAND ..... SIZE OF COLLECTION AREA ..... ha SPECIES NEIGHBOURING SEED COLLECTION AREA ARE ..... MIXED OR PURE STAND ..... IF MIXED SPECIES STATE OTHER SPECIES OR FOREST ASSOCIATION ..... ALTITUDE ..... m LATITUDE ..... ° ..... ' LONGITUDE ..... ° ..... ' Supply a map of the seed collection area and surrounds with this application if this would aid certification.		

<b>C</b>	USE THIS BOX FOR:	<b>CLONAL SEED ORCHARDS                  OR CONTROL-POLLINATED SEED</b>
CLONAL SERIES <u>268</u> No. OF CLONES PLANTED ..... No. OF CLONES REMAINING AFTER THINNING OR ROGUEING ..... No. OF CLONES FROM WHICH SEED WAS COLLECTED <u>130+</u> DATE ORCHARD WAS LAST ROGUEED ..... DISTANCE FROM EXTERNAL POLLEN SOURCE ..... m OPEN-POLLINATED OR CONTROL-POLLINATED <u>OP</u> SEED PARENTAGE DESCRIPTION OR CLONE NUMBERS OF PARENT TREES ..... ..... ..... ..... ..... ..... List both female and male parents for control-pollinated seedlots (Female First)		

<b>D</b>	HAS SEED FROM THIS SOURCE PREVIOUSLY BEEN CERTIFIED? ..... IF YES, SHOW THE CLASSIFICATION AND SEEDLOT No. PREVIOUSLY CERTIFIED ..... HAS ANYTHING BEEN DONE TO THE SEED SOURCE THAT WARRANTS A CHANGE IN CLASSIFICATION? ..... IF YES, STATE CHANGES ..... ..... ..... ..... THE FOREGOING INFORMATION GIVES A CORRECT DESCRIPTION OF THE SEEDLOT COLLECTED  <div style="display: flex; justify-content: space-around; width: 100%;"> <span>Signed</span> <span>Designation</span> </div>
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<b>E</b>	CERTIFIED BY THE SEED CERTIFICATION SERVICE AS: SPECIES: <u>PINUS RADIATA</u> CODE: <u>GF 16</u> COLLECTION No.: <u>95/11</u> PROVENANCE OR CLONE NAME: ..... <div style="text-align: center; margin: 20px 0;"> </div> SPECIAL COMMENTS ..... ..... <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="text-align: center;">                           Manager                     </div> <div style="text-align: center;"> <u>21-11-95</u>                          Date                     </div> </div>
Received: ..... Register: .....	

Send Original to:

The Secretary  
 SEED CERTIFICATION SERVICE  
 Forest Research Institute  
 Private Bag  
 Rotorua

BOX E FOR USE BY CERTIFICATION SERVICE ONLY

# APPLICATION FOR SEED CERTIFICATION



NAME AND ADDRESS OF PERSON OR AGENCY REQUESTING CERTIFICATION	PROSEED NZ LTD PRIVATE BAG 3020 ROTORUA	<b>A</b>
SPECIES <u>PINUS RADIATA</u>		INTENDED PURPOSE
YEAR OF COLLECTION AND COLLECTION No. <u>96/30</u>		PROPOSED BREED OR SEED REGION
QUANTITY COLLECTED, OR		DETAILED LOCATION OF SEED SOURCE
QUANTITY OF SEED EXTRACTED ..... kg		<u>AMBERLEY BLOCKS 4B-15G</u> <u>WAIKUKU BLOCKS 4E-10A</u>
NATURAL STAND, OR YEAR ESTABLISHED <u>1986-93</u>		LOCATION NAME <u>AMBERLEY and WAIKUKU</u>

<b>B</b>	USE THIS BOX FOR:	<b>NATIVE SPECIES                  OR NON-ORCHARD LOTS</b>
PARENT STAND SEEDLOT No. REGISTERED SEED STAND No. or PARENTAGE		
No. OF TREES FROM WHICH SEED WAS COLLECTED ..... (Under 20 state number, Over 20 estimate)		
No. OF TREES IN PARENT STAND .....		
SIZE OF COLLECTION AREA ..... ha		
SPECIES NEIGHBOURING SEED COLLECTION AREA ARE		
MIXED OR PURE STAND .....		
IF MIXED SPECIES STATE OTHER SPECIES OR FOREST ASSOCIATION		
ALTITUDE ..... m		
LATITUDE ..... ° LONGITUDE ..... °		
Supply a map of the seed collection area and surrounds with this application if this would aid certification.		

<b>C</b>	USE THIS BOX FOR:	<b>CLONAL SEED ORCHARDS                  OR CONTROL-POLLINATED SEED</b>
CLONAL SERIES <u>268, 850</u> No. OF CLONES PLANTED ..... <u>875, 880</u>		
No. OF CLONES REMAINING AFTER THINNING OR ROGUEING .....		
No. OF CLONES FROM WHICH SEED WAS COLLECTED <u>9</u>		
DATE ORCHARD WAS LAST ROGUEED .....		
DISTANCE FROM EXTERNAL POLLEN SOURCE ..... m		
OPEN-POLLINATED OR CONTROL-POLLINATED <u>CP</u>		
SEED PARENTAGE DESCRIPTION OR CLONE NUMBERS OF PARENT TREES		
<u>MIX OF CP CROSSES INVOLVING</u> <u>15 PARENTS</u>		
List both female and male parents for control-pollinated seedlots (Female First)		

<b>D</b>	HAS SEED FROM THIS SOURCE PREVIOUSLY BEEN CERTIFIED?
IF YES, SHOW THE CLASSIFICATION AND SEEDLOT No. PREVIOUSLY CERTIFIED	
HAS ANYTHING BEEN DONE TO THE SEED SOURCE THAT WARRANTS A CHANGE IN CLASSIFICATION?	
IF YES, STATE CHANGES	
THE FOREGOING INFORMATION GIVES A CORRECT DESCRIPTION OF THE SEEDLOT COLLECTED	
 Signed	Manager Designation

<b>E</b>	CERTIFIED BY THE SEED CERTIFICATION SERVICE AS:
SPECIES: <u>PINUS RADIATA</u>	
CODE: <u>GF 30</u>	
COLLECTION No.: <u>96/30</u>	
PROVENANCE OR CLONE NAME:	
SPECIAL COMMENTS	
 Manager	<u>3-10-96</u> Date
Received: _____ Register: _____	

Send Original to:

The Secretary  
**SEED CERTIFICATION SERVICE**  
 Forest Research Institute  
 Private Bag  
 Rotorua

BOX E FOR USE BY CERTIFICATION SERVICE ONLY

# APPLICATION FOR SEED CERTIFICATION



NAME AND ADDRESS OF PERSON OR AGENCY REQUESTING CERTIFICATION	PROSEED NZ LTD C/- FRI CAMPUS ROTORUA	DATE 6-9-93	<b>A</b>
SPECIES PINUS RADIATA		INTENDED PURPOSE PROPOSED BREED OR SEED REGION	
YEAR OF COLLECTION AND COLLECTION No. 93 305		DETAILED LOCATION OF SEED SOURCE	
QUANTITY COLLECTED, OR QUANTITY OF SEED EXTRACTED ..... kg		YEAR ESTABLISHED 1964 - 1972	
NATURAL STAND, OR YEAR ESTABLISHED 1964 - 1972		LOCATION NAME WAIMIHIA ORCHARD	

<b>B</b>	USE THIS BOX FOR:	<b>NATIVE SPECIES OR NON-ORCHARD LOTS</b>
PARENT STAND SEEDLOT No. REGISTERED SEED STAND No. or PARENTAGE		
No. OF TREES FROM WHICH SEED WAS COLLECTED ..... (Under 20 state number. Over 20 estimate)		
No. OF TREES IN PARENT STAND .....		
SIZE OF COLLECTION AREA ..... ha		
SPECIES NEIGHBOURING SEED COLLECTION AREA ARE		
MIXED OR PURE STAND .....		
IF MIXED SPECIES STATE OTHER SPECIES OR FOREST ASSOCIATION		
ALTITUDE ..... m		
LATITUDE ..... ° LONGITUDE ..... °		
Supply a map of the seed collection area and surrounds with this application if this would aid certification.		

<b>C</b>	USE THIS BOX FOR:	<b>CLONAL SEED ORCHARDS OR CONTROL-POLLINATED SEED</b>
CLONAL SERIES 850..... No. OF CLONES PLANTED .....		
No. OF CLONES REMAINING AFTER THINNING OR ROGUING .....		
No. OF CLONES FROM WHICH SEED WAS COLLECTED 23		
DATE ORCHARD WAS LAST ROGUE .....		
DISTANCE FROM EXTERNAL POLLEN SOURCE ..... m		
OPEN-POLLINATED OR CONTROL-POLLINATED OP		
SEED PARENTAGE DESCRIPTION OR CLONE NUMBERS OF PARENT TREES		
DOES NOT INCLUDE 850, 32, 55, 87, 90, 91, 93, 96, 101, 110, 117, 191, 392 395, 399, 400, 432		
List both female and male parents for control-pollinated seedlots (Female First)		

<b>D</b>	HAS SEED FROM THIS SOURCE PREVIOUSLY BEEN CERTIFIED?
IF YES, SHOW THE CLASSIFICATION AND SEEDLOT No. PREVIOUSLY CERTIFIED	
HAS ANYTHING BEEN DONE TO THE SEED SOURCE THAT WARRANTS A CHANGE IN CLASSIFICATION?	
IF YES, STATE CHANGES	
THE FOREGOING INFORMATION GIVES A CORRECT DESCRIPTION OF THE SEEDLOT COLLECTED	
<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">  Signed                         </div> <div style="text-align: center;">  Designation                         </div> </div>	

Send Original to:

The Secretary  
SEED CERTIFICATION SERVICE  
Forest Research Institute  
Private Bag  
Rotorua

<b>E</b>	CERTIFIED BY THE SEED CERTIFICATION SERVICE AS:
SPECIES: PINUS RADIATA	
CODE: GF10	
COLLECTION No.: 93 305	
PROVENANCE OR CLONE NAME:	
SPECIAL COMMENTS	
<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">  Manager                         </div> <div style="text-align: center;">                         6-9-93 Date                     </div> </div>	
Received: Register:	

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## **APPENDIX II: ROOT TRIMMING TRIALS SUMMARY INFORMATION**

### **1. WAIHI FR310/2 - Severe Lateral Root Trimming**

**General Location:** Neil and Eisla Worker's property,  
Waihi, Bay of Plenty.

#### ***Geographic Location***

NZMS 260 Map Sheet T13 NZMG 6420 2769

Latitude: 37°23.8'S. Longitude: 175°55.5'E

Altitude: 260 m

#### ***Contact***

Neil and Eisla Worker,  
Beard Rd,  
RD,  
WAIHI.

Ph: (07) 863-7645

***Date Established:*** 6 September 1996

#### ***Establishment:***

Land preparation consisted of hard grazing by cattle up until the day of planting. Post-plant Velpar spray 23 September at 3 g/ tree, repeated about 15 December at 3 g/ tree. Velpar applied with a Weed-A-Meter with a wide skirt. A further spray of Velpar applied autumn 1997.

***Dates Measured:*** 9 April 1997, 14 August 1997, 6 April 1998

***Soil Type:*** Waitekauri sandy loam, hill soil (55H) from Waihi Ash on rhyolite and andesite.

***Rainfall:*** 2 500 mm

***Topex:*** 9.65

***Aspect:*** East and west

#### ***Additional Notes***

Trial surround was planted in aged cuttings on 12 September.

Trees form pruned and crown lightened, 30 January 1998.

Trees with extreme topple were sodded.



## **2. NGARUAWAHIA, ELGOOD FOREST FR310/1**

### **- Severe Lateral Root Trimming**

**General Location:** end of Elgood Rd,  
Ngaruawahia, Waikato

#### ***Geographic Location***

NZMS 260 Map Sheet S14 NZMG 6394 2996

Latitude: 37°38.5'S. Longitude: 175°06'E

Altitude: 120 m

#### ***Contact***

Peter R. Dillon,  
Forestry Consultant & Manager,  
42 Huntington Drive,  
HAMILTON.  
Ph/ FAX: (07) 855 0184  
MOBILE: (025) 825 226

***Date Established:*** 10 September 1996

#### ***Establishment:***

Multi-cut during planting and six weeks later the trees were sprayed with Velpar granules at 3 g per tree.

***Date Measured:*** 8 April 1997, 6 April 1998

***Soil Type:*** Clay-based. North-western corner is on coal overburden.  
Waikokowai silt loam and clay loam (61d) from Mairoa ash on Hanilte ash.

***Rainfall:*** 1 250 mm

***Topex:*** unknown

***Aspect:*** south

#### ***Additional Notes:***

On the east side by trial the remaining severe lateral seedlings were topped and planted at 2.5 m spacing.

### **3. WAIROA, MANGAPAHİ FOREST FR310/11**

#### **- Contrasting Genetic Improvement**

**General Location:** Compartment 04 Mangapahi Forest,  
northern Hawkes Bay

#### ***Geographic Location***

NZMS 260 Map Sheet X19 NZMG 6239 2916

Latitude: 38°57'S Longitude: 177°42'E

Altitude: 500 m

#### ***Contact***

Roger Allen,  
Juken Nissho Ltd,  
PO Box 1239,  
Gisborne.

Ph (06) 867-8398

FAX (06) 867-0579

***Date Established:*** 23 August 1997

***Establishment:*** extensive pre-plant grazing and roller crushing of tauhinau

***Date Measured:*** 20 April 1998

***Soil Type:*** Mahoenui silt loam (115) from banded mudstone and sandstone.  
softish pumice type with ash overlay

***Rainfall:*** 2 500 mm MAR

***Topex:*** 12.33

***Aspect:*** North-west

#### **4. TURANGI, HAUTU FOREST *FR310/3* - Severe Lateral Root Trimming**

***General Location:*** Hautu Prison,  
Turangi, Central North Island

##### ***Geographic Location***

NZMS 260 Map Sheet T19 NZMG 6238 2759

Latitude: 39°02'S. Longitude: 175°52.5'E

Altitude: 480 m

##### ***Contact***

Graham Hardisty,  
Corrland,  
Private Bag 900,  
TURANGI.

Ph (07) 386-1712

FAX: (07) 386-0593

***Date Established:*** 11 September 1996

##### ***Establishment:***

Site preparation consisted of ripping and mounding.

***Date Measured:*** 10 April 1997

***Soil Type:*** Rangipo sand (18e) from 2-7 in Ngauruhoe ash on coarsely textured Taupo Ash.

***Rainfall:*** 1 580 mm

***Topex:*** unknown

***Aspect:*** none

***Abandoned:*** 1 April 1998

## **5. STRATFORD, PUKEMAHOE FR310/8 - Severe Lateral Root Trimming**

**General Location:** Pukemahoe Station,  
Stratford, Taranaki.

### ***Geographic Location***

NZMS 260 Map Sheet Q19 NZMG 6224 2643

Latitude: 39°11'S. Longitude: 174°32'E

Altitude: 110 m

### ***Contact***

Jeremy Thomson,  
Saunders & Thomson Ltd,  
Forest & Land Management Consultants,  
Makara R.D.24,  
STRATFORD.

Ph/ FAX: (06) 762-4835

MOBILE: (025) 865-798

***Date Established:*** 14 September 1996

### ***Establishment:***

Gardoprim, 2 m spots, with 4 mL Gardoprim/ spot

Two cut planting method, planted deep.

***Dates Measured:*** 15 April 1997, 7 April 1998

***Soil Type:*** New Plymouth sandy loam (67b) from Stratford Ash on Egmont  
Ash. Waitara River silt over sandstone/ mudstone subsoil

***Rainfall:*** 2 000 mm

***Topex:*** 6.65

***Aspect:*** north-east

## **6. STRATFORD, MAKAHU FR310/9 - Contrasting Genetic Improvement**

**General Location:** Don and Eila Hopkirk's Property,  
Stratford, Taranaki Region.

### ***Geographic Location***

NZMS 260 Map Sheet R20 NZMG 6209 2654

Latitude: 39°18.5'S. Longitude: 174°40'E

Altitude: 320 m

### ***Contact***

Jeremy Thomson,  
Saunders & Thomson Ltd,  
Forest & Land Management Consultants,  
Makara R.D.24,  
STRATFORD.

Ph/ FAX: (06) 762-4835

MOBILE: (025) 865-798

Don & Eila Hopkirk,  
Makahu,  
Murcott Rd R D 22,  
RD 22,  
STRATFORD.

(06) 762-3805

***Date Established:*** 12 September 1996

### ***Establishment:***

Gardoprim, 2 m spots, with 4 mL Gardoprim/ spot  
Two cut planting method, planted deep.

***Dates Measured:*** 15 April 1997, 22 April 1998

***Soil Type:*** Whangamomona complex (116a) from mudstone and sandstone,  
Stratford and Egmont Ash.

***Rainfall:*** unknown

***Topex:*** 9.55

***Aspect:*** west

## **7. TAKAPAU FR310/12 - Contrasting Genetic Improvement**

**General Location:** N.J.C. Kynoch's property,  
Takapau, Hawkes Bay

### ***Geographic Location***

NZMS 260 Map Sheet U22 NZMG 27852 61356

Latitude: 39°57'S. Longitude: 176°13'E

Altitude: 480 m

### ***Contact***

Neil Faulknor,  
Hawkes Bay Regional Council  
PO Box 178,  
Waipukurau.

Ph (06) 858-8636

FAX (06) 858-8636

email: neil@hbrc.govt.nz

***Date Established:*** September 1997

***Establishment:*** planted with an Atlas spade using a 3 cut, pull up method.  
Releasing was done using Gardoprim applied with a knapsack.

***Date Measured:*** 21 April 1998

***Soil Type:*** 37B Makaretu heavy silt loam

***Rainfall:*** 1350 to 1400 mm

***Topex:*** unknown

***Aspect:*** NE

### ***Additional Notes:***

Some rabbit damage.

## **8. FIELDING FR310/6 - Severe Lateral Root Trimming**

**General Location:** Dean & Cushla Williamson's property,  
Fielding, Manawatu.

### ***Geographic Location***

NZMS 260 Map Sheet T23 NZMG 6114 2732

Latitude: 40°08.8'S. Longitude: 175°36'E

Altitude: 200 m

### ***Contact***

Blair Haggitt,  
Wilson and Associates,  
PO Box 217,  
1st Floor Carters Building,  
Rangitikei St.,  
PALMERSTON NORTH.

Ph: (06) 357-6096

MOBILE: (025) 445 646

FAX (06) 356-2517

Dean & Cushla Williamson,  
RD 7,  
FIELDING.

Ph: (06) 323-9408 (home)

(06) 323-7107 (office)

MOBILE: (025) 453-914

***Date Established:*** 20 September 1996

### ***Establishment:***

Land preparation consisted of hard grazing by sheep up until day of planting. Released using Gardoprim on 5 October 1996.

***Dates Measured:*** 14 April 1997, 8 April 1998

***Soil Type:*** Halcombe silt loam (13b) from sandy mudstone

***Rainfall:*** 875 to 1 000 mm

***Topex:*** 10.77

***Aspect:*** North and south

**9. MASSEY UNIVERSITY *FR310/4* and *FR310/5***

- Severe Lateral Root Trimming,**
- Topping**

***General Location:*** Pasture & Crop Research Unit, Massey University,  
Palmerston North, Manawatu

***Geographic Location***

NZMS 260 Map Sheet T24 NZMG 6087 2732

Latitude: 40°23.5'S. Longitude: 175°37'E

Altitude: 60 m

***Contact***

James Millner,  
Plant Science,  
Massey University,  
Private Bag 11-555,  
PALMERSTON NORTH.

Ph: (06) 356-9099, Ext 7782

***Date Established:*** 15 June 1997

***Establishment:*** Roundup and Granstar pre-plant

***Date Measured:*** 7 and 8 April 1998

***Soil Type:*** Tokomaru silt loam (class III) (13) from alluvium.

***Rainfall:*** 1 000 mm

***Topex:*** 8.32

***Aspect:*** North-east

***Additional Notes:*** severe lateral root trimming and contrasting GF trials established in 1996 failed to establish, trials abandoned. Replanted 1997 with severe lateral root trimming and topping trials.



**10. TAWA, TAKAPU FARM FOREST FR310/10**

**- Severe Lateral Root Trimming**

***General Location:*** Tawa, Wellington

***Geographic Location***

NZMS 260 Map Sheet R27 NZMG 6003 2665

Latitude: 41°10'S. Longitude: 174°51'E

Altitude: 200 m

***Contact***

Tony Smith,  
Forme Consulting Group Ltd,  
PO Box 56-030,  
173 Main Rd,  
Tawa  
WELLINGTON.

Ph: (04) 232 7155

FAX (04) 232 8172.

Farm Manager: Gary Jamieson (04) 232-5725

***Date Established:*** late July 1997

***Establishment:*** heavy grazing

***Date Measured:*** 8 April 1998

***Soil Type:*** Korokoro silt loam, hill soil (35bH) from greywacke

***Rainfall:*** unknown

***Topex:*** 11.82

***Aspect:*** none

***Additional Notes:***

Some rabbit damage.

## **12. BERWICK FOREST FR310/7 - Severe Lateral Root Trimming**

**General Location:** Compartment 089/07 Berwick Forest,  
Dunedin, Otago

### ***Geographic Location***

NZMS 260 Map Sheet H45 NZMG 5464 2276  
Latitude: 45°59.8'S. Longitude: 169°58'E  
Altitude: 340 m

### ***Contact***

Max Smith,  
Wenita Forest Products Ltd,  
11 Hartstonge Av.,  
MOSGIEL

Ph: (03) 489-3234  
FAX (03) 489-3303

***Date Established:*** 11 September 1996

### ***Establishment:***

Logged by skidder, then root raked with excavator. Oversown September 1996 with 3 kg/ha of Yorkshire fog. Spot sprayed with Velpar DF 5 kg/ha November 1996

***Date Measured:*** May 1997

***Soil Type:*** Waipori silt loam, stony silt loam

***Rainfall:*** unknown

***Topex:*** unknown

***Aspect:*** unknown

***Abandoned:*** 1 April 1997

### **APPENDIX III: TRIAL LOCATION DETAILS**

## **Neil Worker's Property, Waihi**

9-000 NO. : 047 0837845

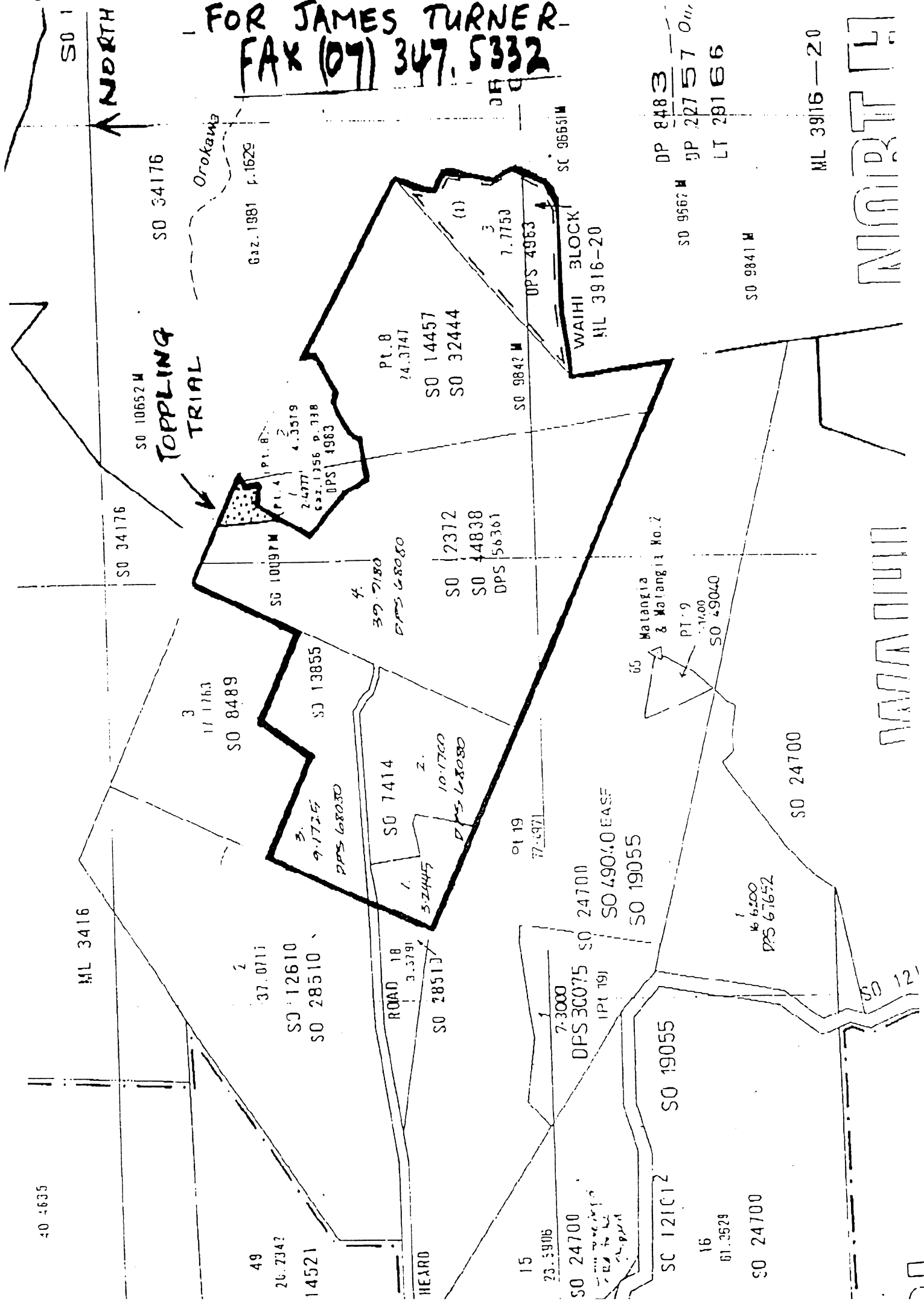
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JP 22757 0"  
LT 29166

ML 3916-20

# FEEL

# WAVES

1



N  
Waihi

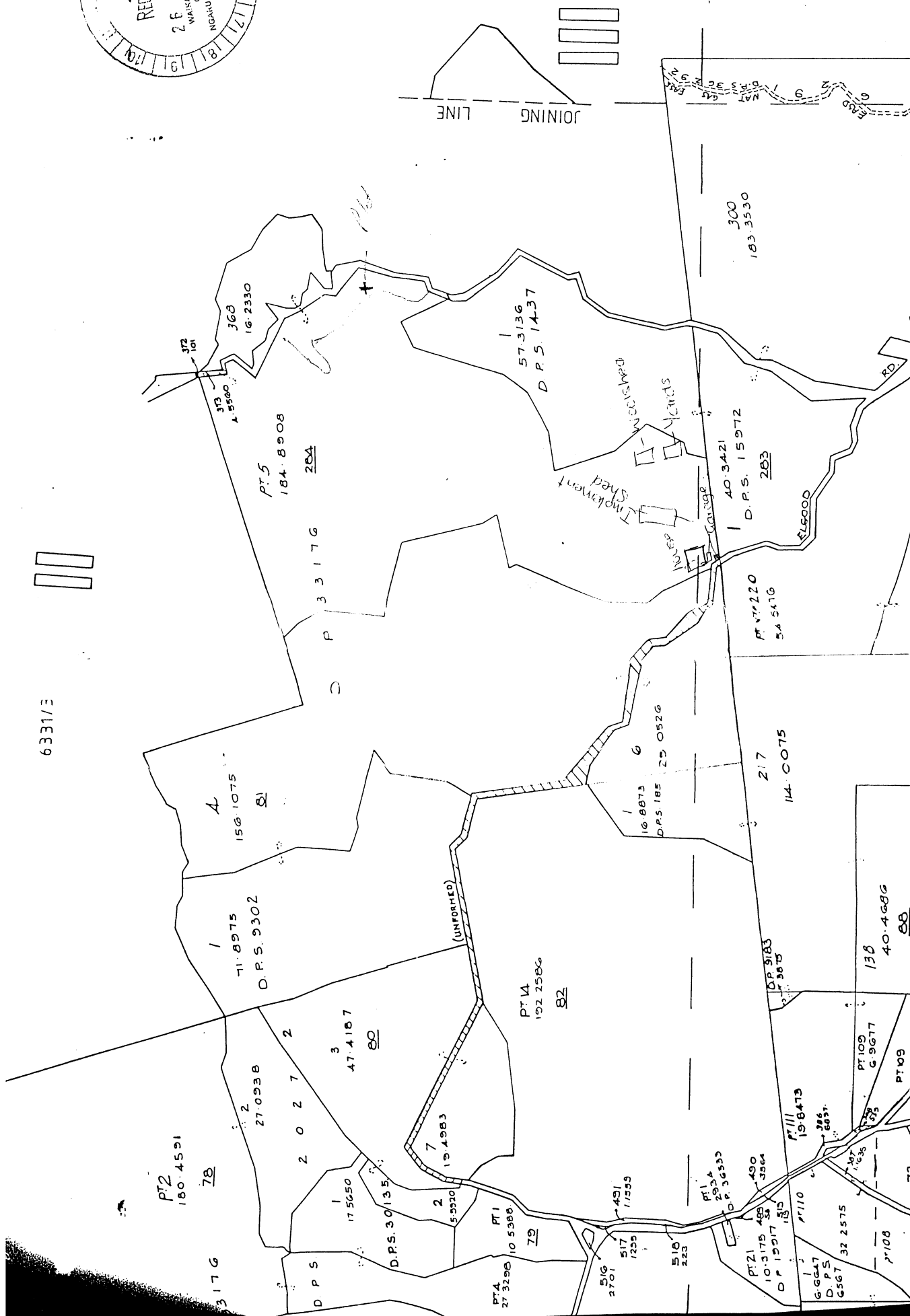
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X	65	X	X	X	X	X	X			X	X	X	X	X	X	57	X
X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X

First tree measured

Direction of measurement

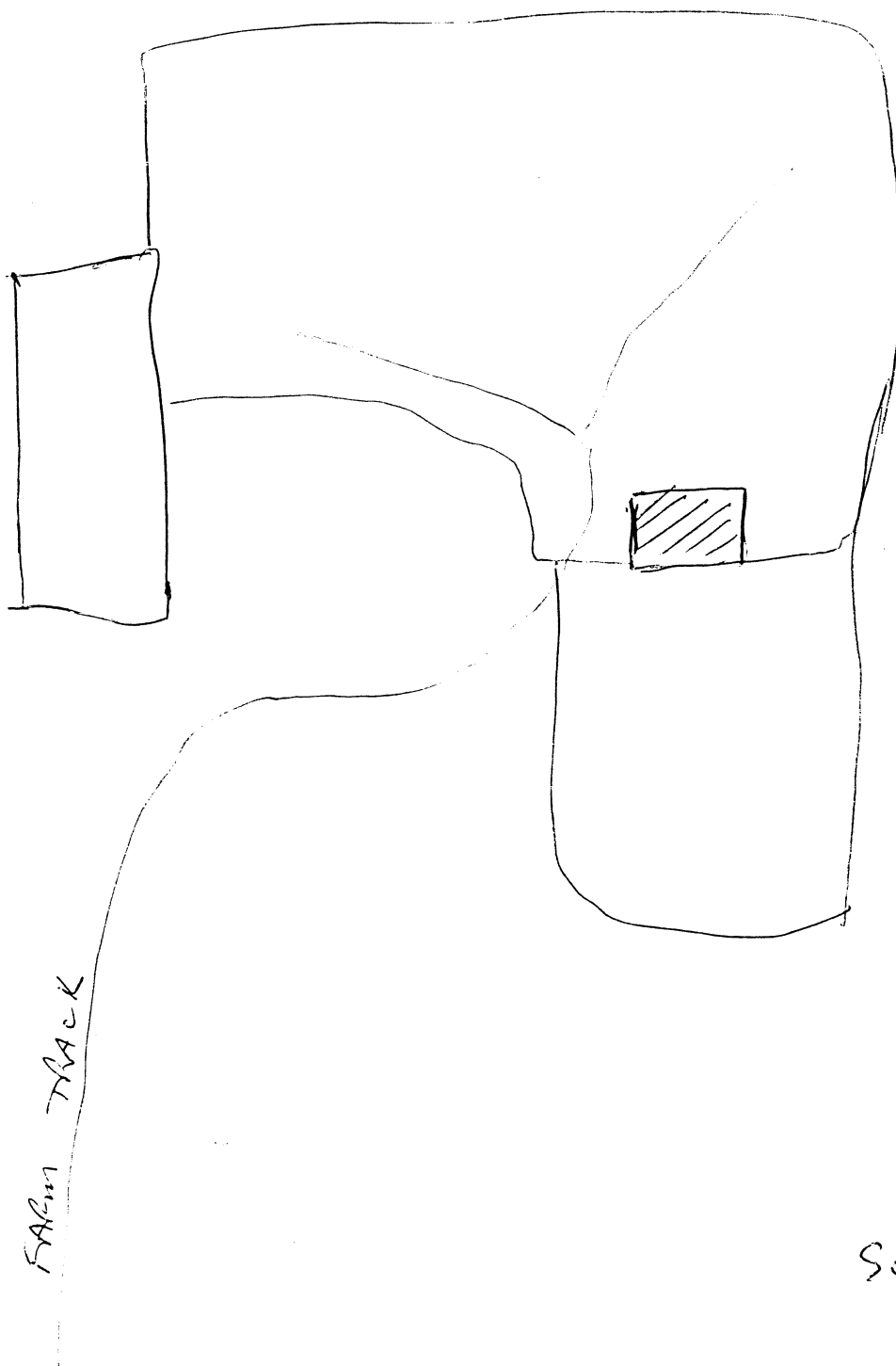
Road into trial

**Elgood Forest, Ngaruawahia**





North



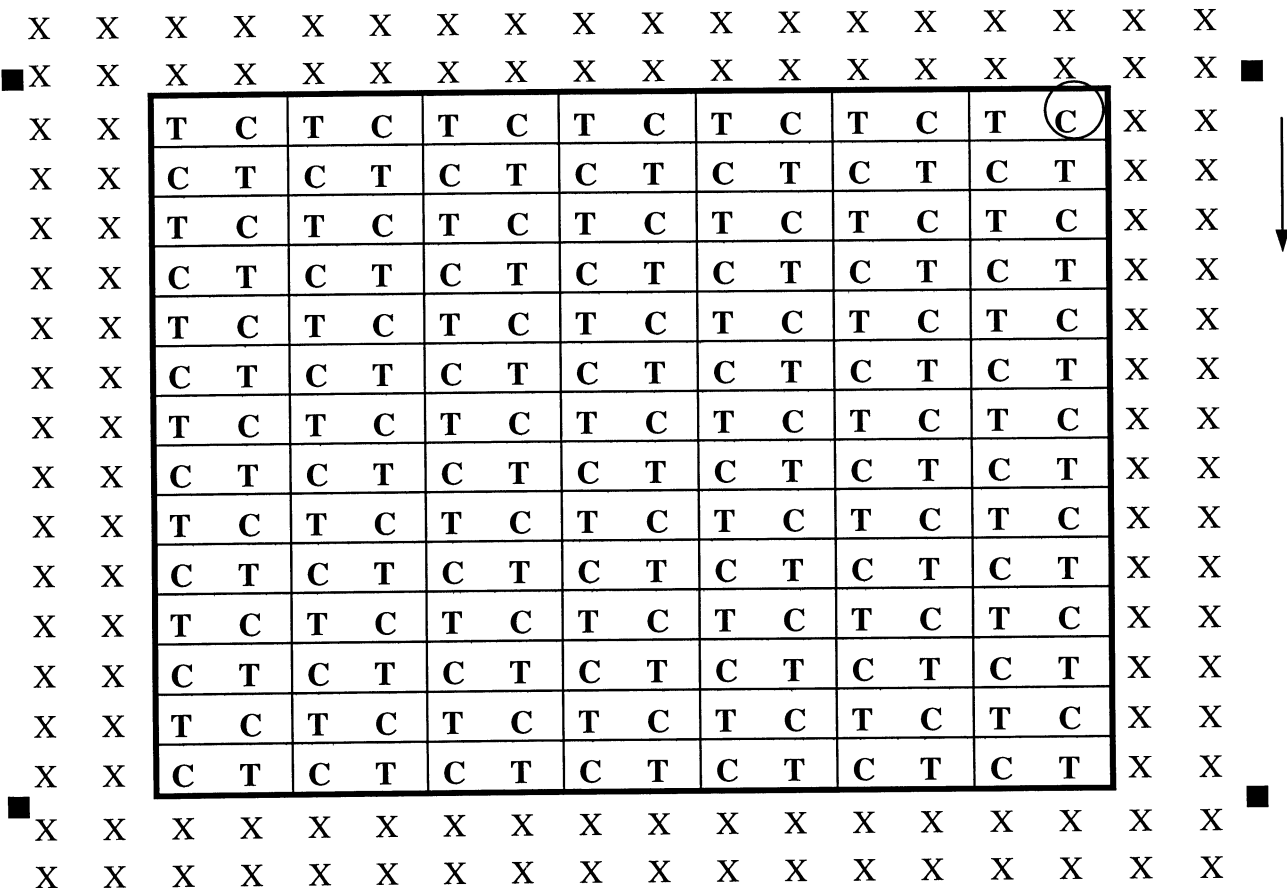
F.R.I.  
Plot



South

ELGOOD FOREST - NEAR UWAHIA

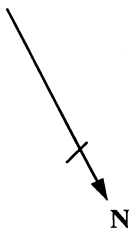
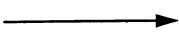
Elgood Forest



First tree measured



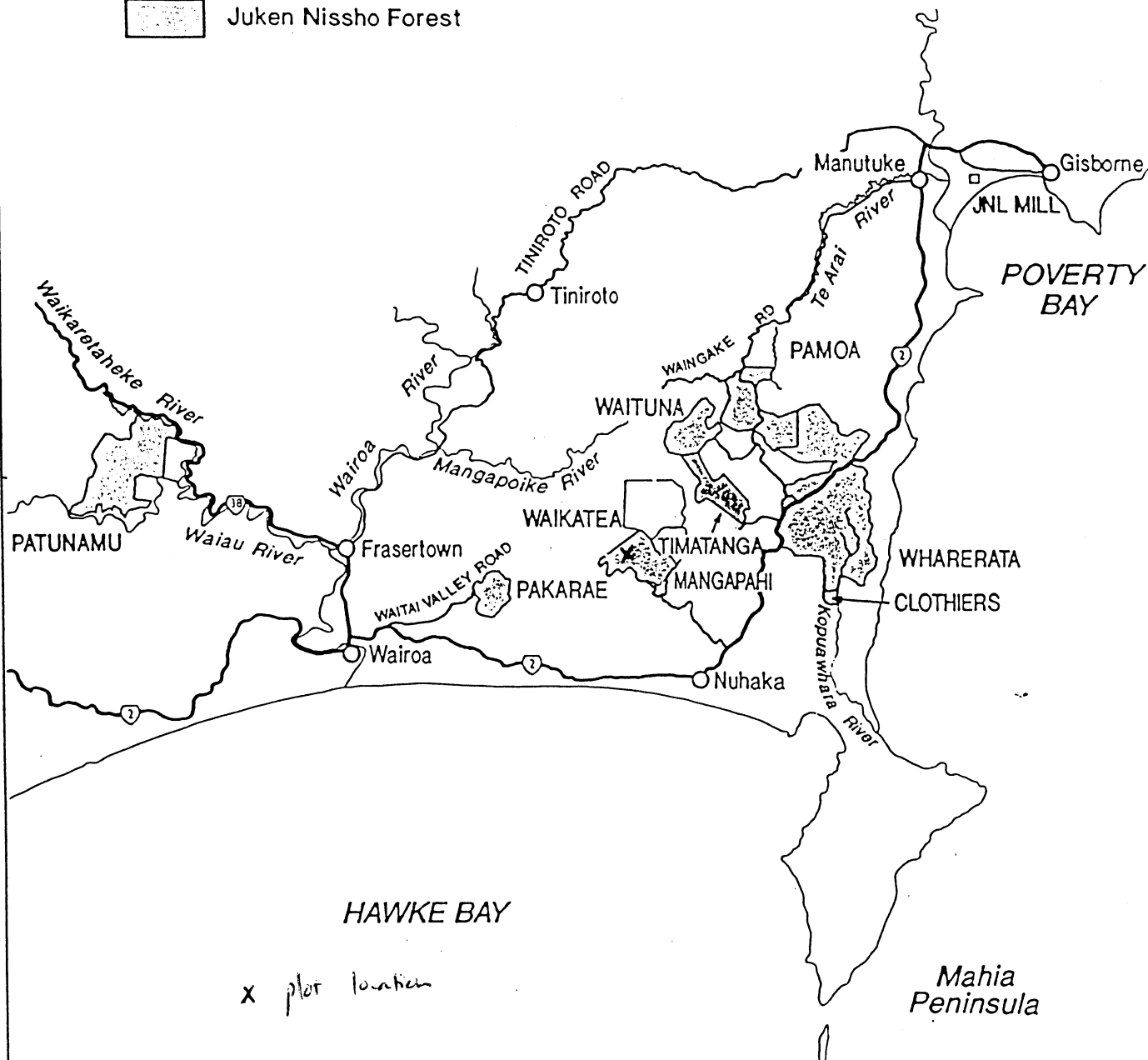
Direction of measurement



## **Mangapahi Forest, Hawkes Bay**

# LEGEND

- Town/City
- (2)— State Highway
- Minor Road
- ▨ Juken Nissho Forest



PROPERTY NAME

## FOREST MANAGEMENT AREAS

SCALE

1:500 000

MAP TYPE

LOCALITY MAP



Prepared by Terralink NZ Ltd

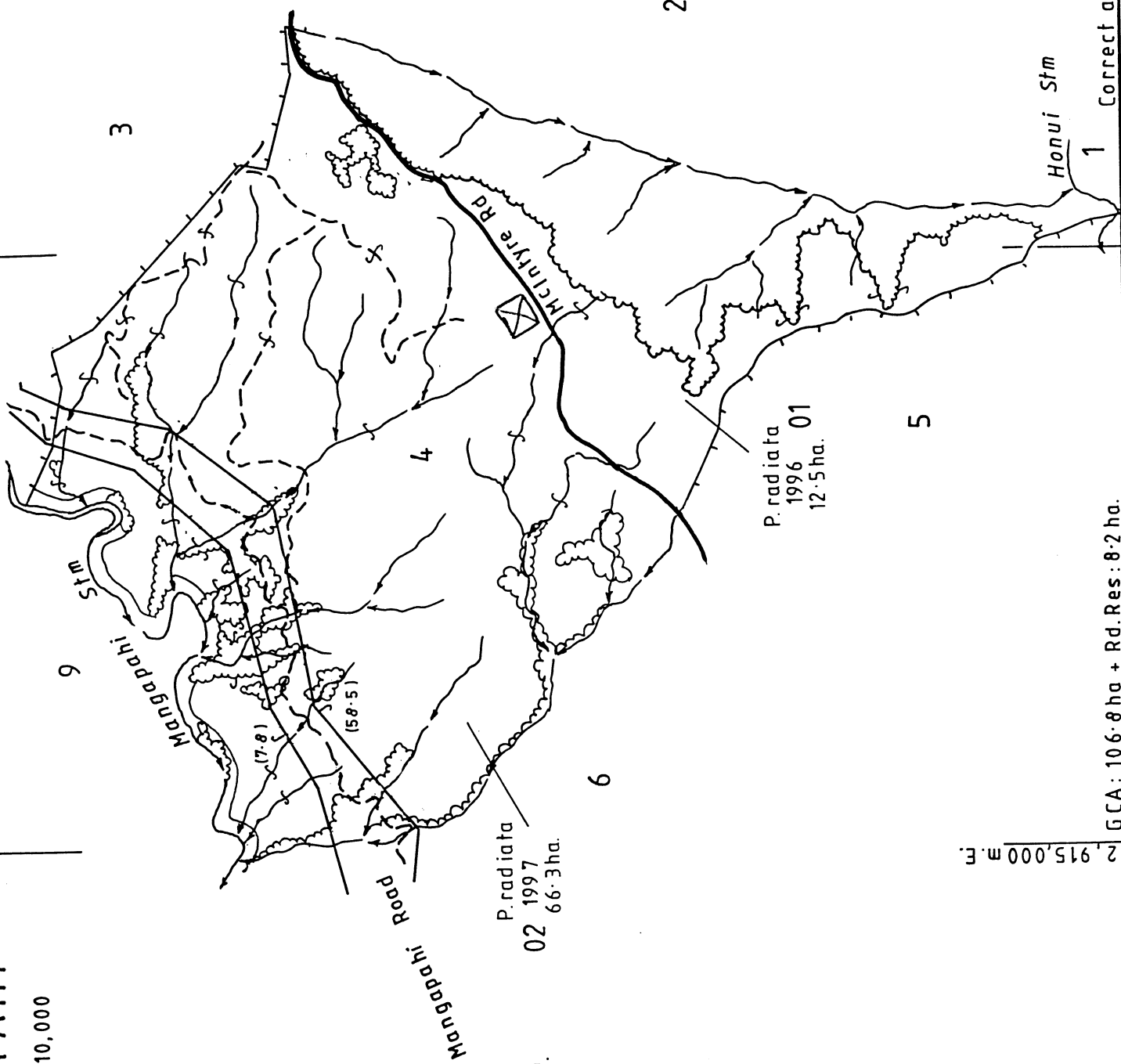
MAP/PHOTO REF.

NZMS 262 SHT 5 & 7



# MANGAPAHİ

Scale 1 : 10,000



6,239,000 m. N.

P. radiata  
1997 02  
66.3ha.

P. radiata  
1996 01  
12.5ha.

2,915,000 m. E.

GCA: 106.8 ha + Rd. Res: 8.2 ha.

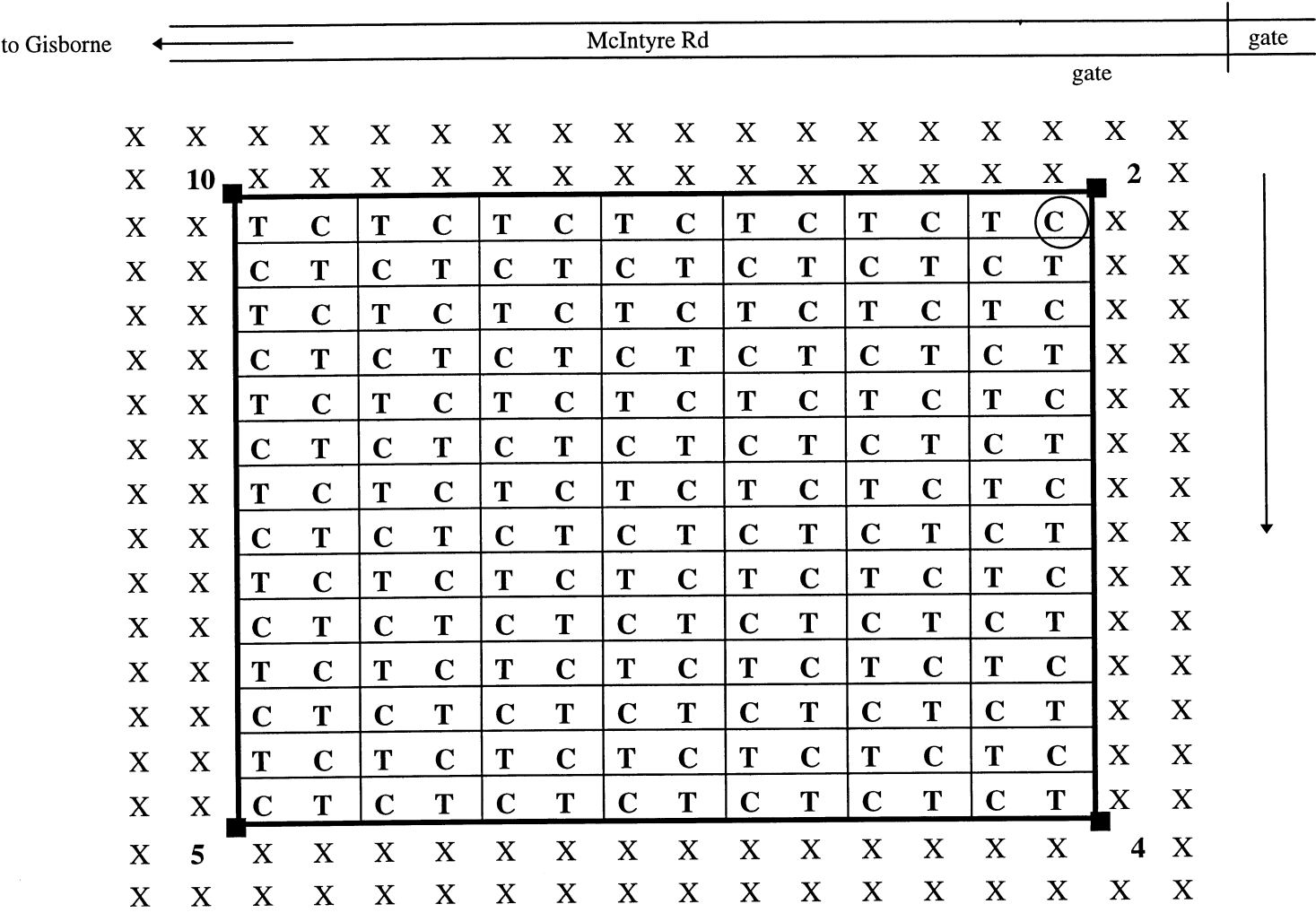
Honui Stm

1 Correct as at:

2,917,000 m. E.

plot location

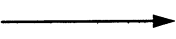
**Mangapahi Forest**



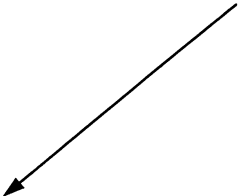
First tree measured



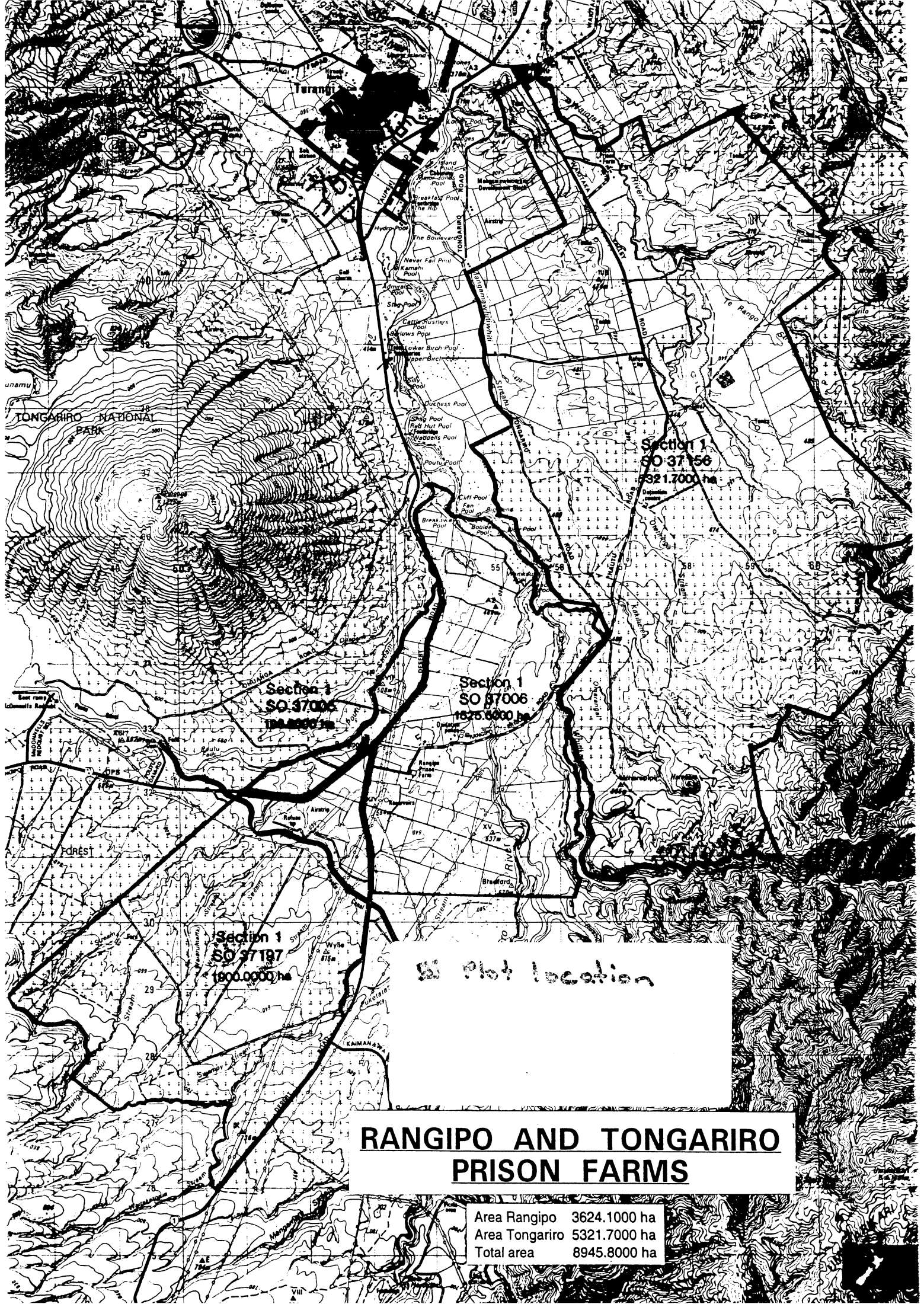
Direction of measurement



N



**Hautu Forest, Turangi**



Section 1  
SO 37005  
184.8000 ha

Section 1  
SO 37006  
1825.6000 ha

Section 1  
SO 37156  
5321.7000 ha

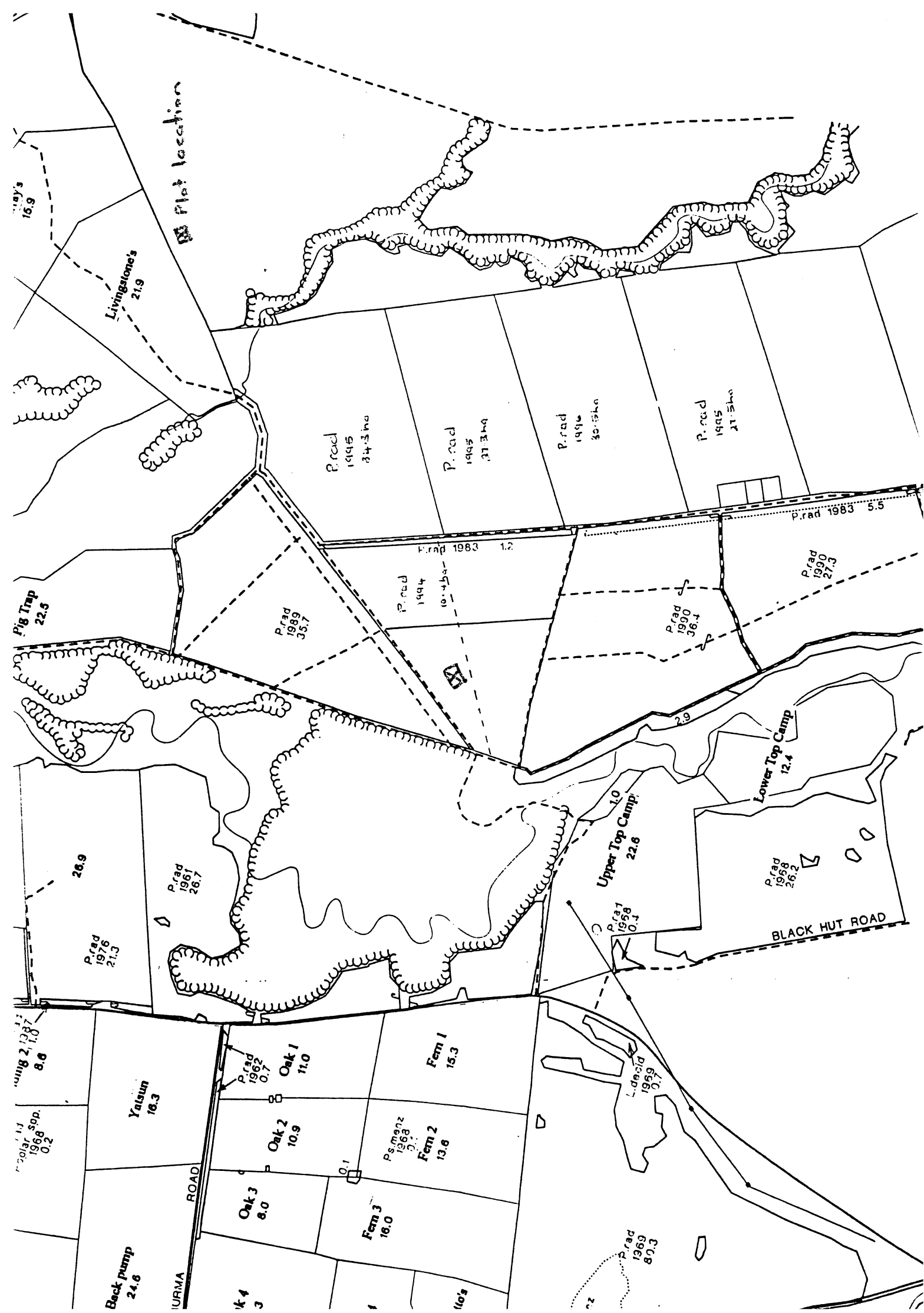
Section 1  
SO 37197  
1900.0000 ha

Plot location

## RANGIPO AND TONGARIRO PRISON FARMS

Area Rangipo	3624.1000 ha
Area Tongariro	5321.7000 ha
Total area	8945.8000 ha



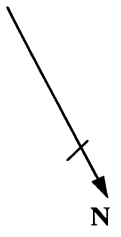


Hautu Forest

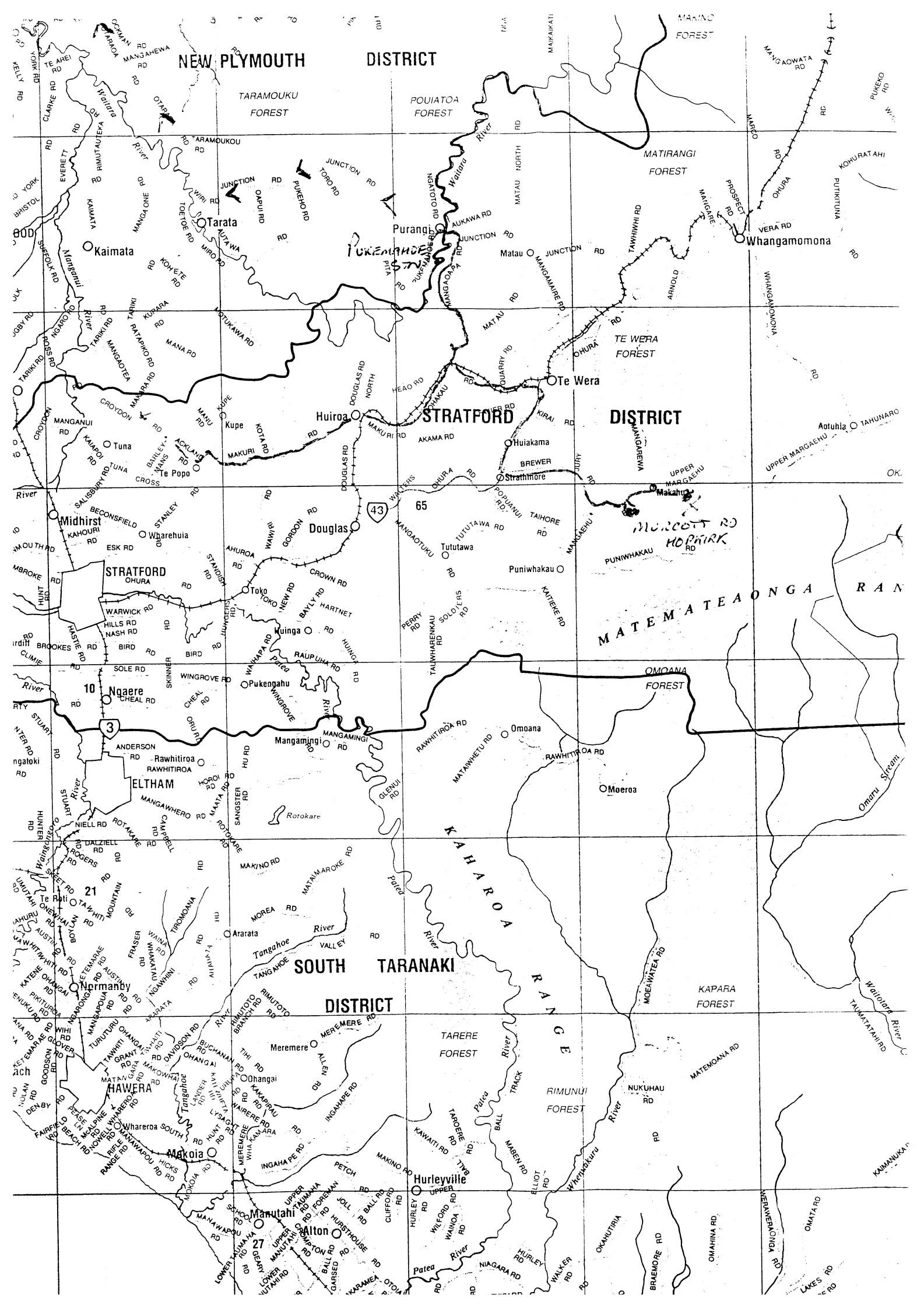
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First tree measured ○

Direction of measurement →



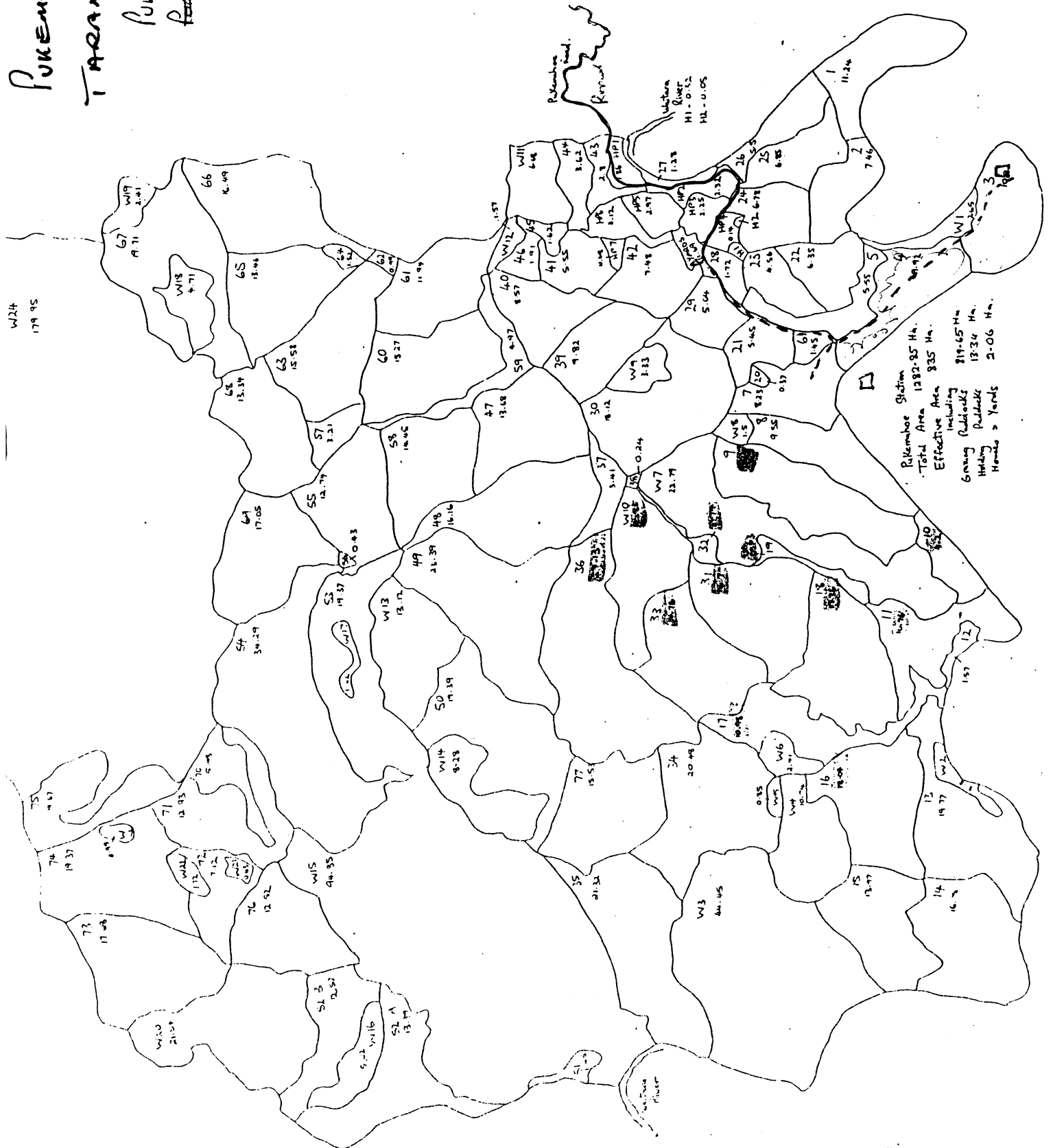
## **Pukemahoe Station, Waitara**



ПУКЕМАНОЕ FOREST

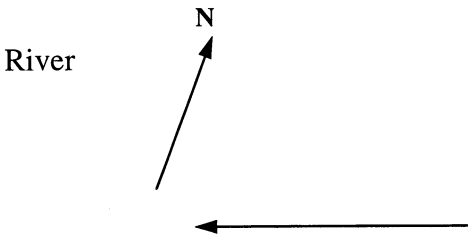
ТАРАНАКИ SAWMILLS LTD

ПУКЕМАНОЕ ROAD - PUKEMANO  
~~FOREST~~ - INKEDWOOD.



W24  
 179.95

**Pukemahoe Station**



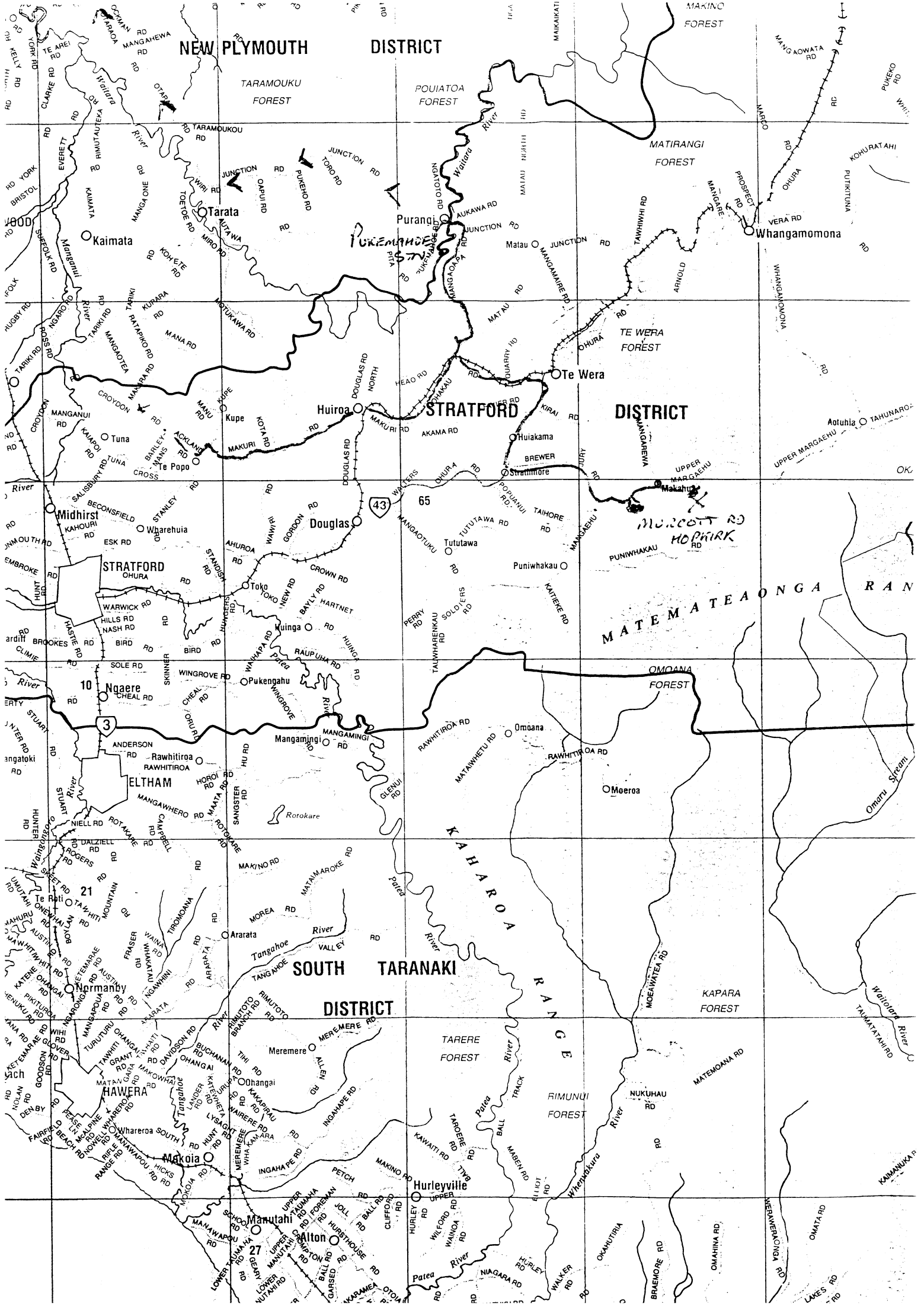
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Access road

First tree measured 

Direction of measurement 

## **Don and Eila Hopkirk's Property, Makahu**





## Makahu

fence

fence

[illegible]

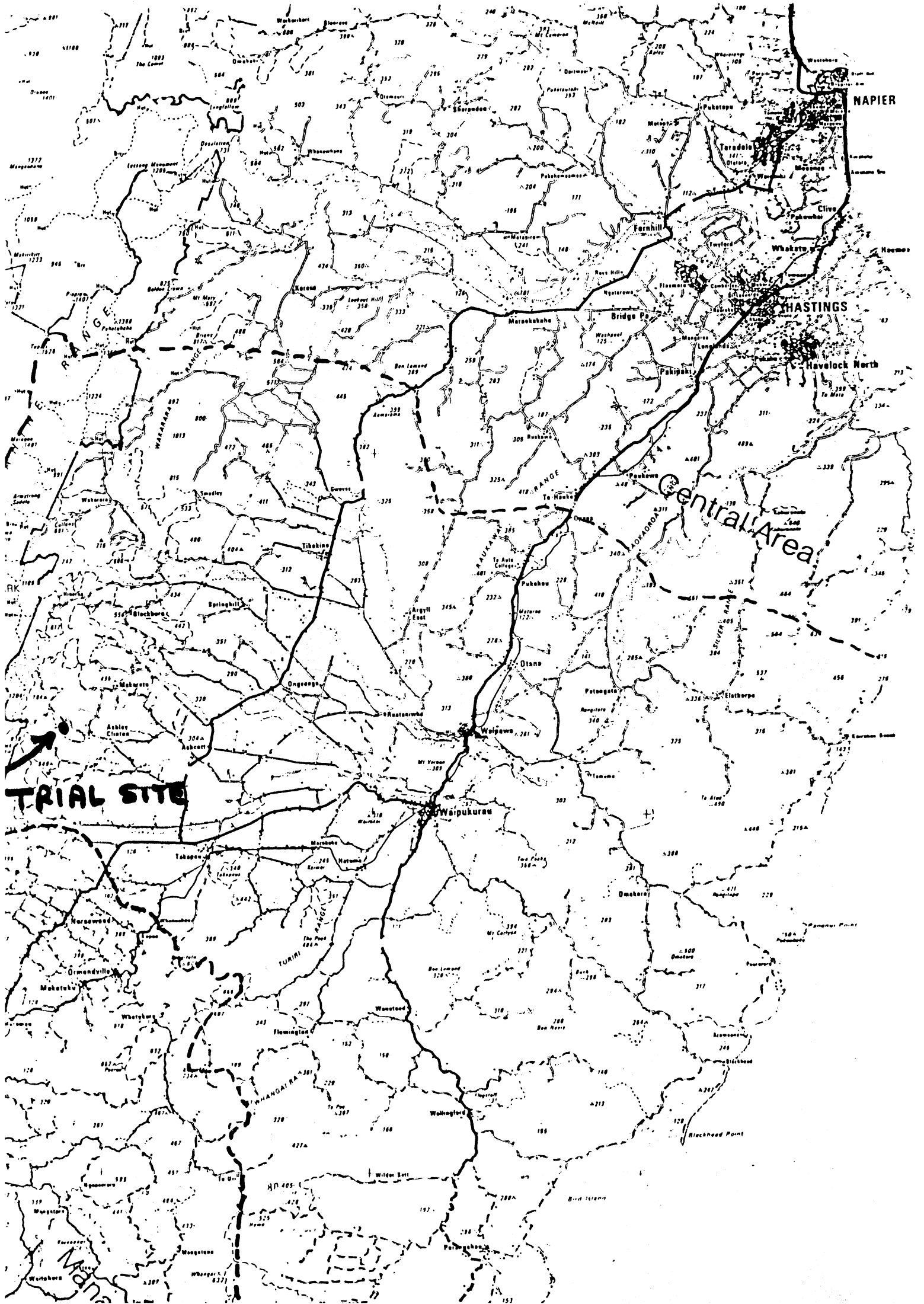
Direction of slope

### First tree measured

### Direction of measurement

**N**

## **N.J.C. Kynoch's Property, Takapau**



TRIAL SITE



LEGEND

≡ R ≡ Retirement fencing

++++ Gully planting

Q Q Open planting

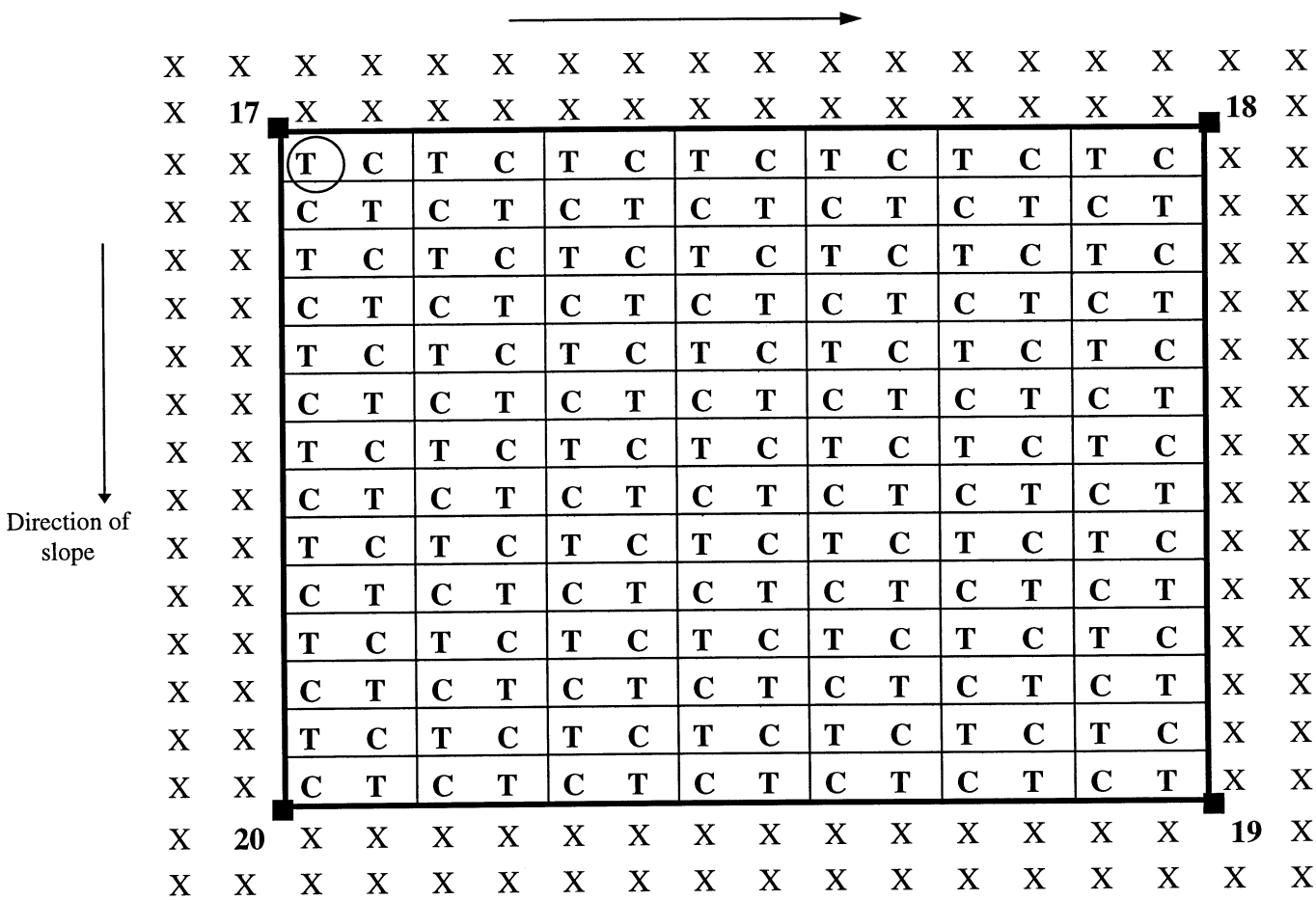
— Fences

150 Units required

Scale 1:25 000

**N.J.C. Kynoch's Property, Takapau**

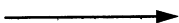
fence



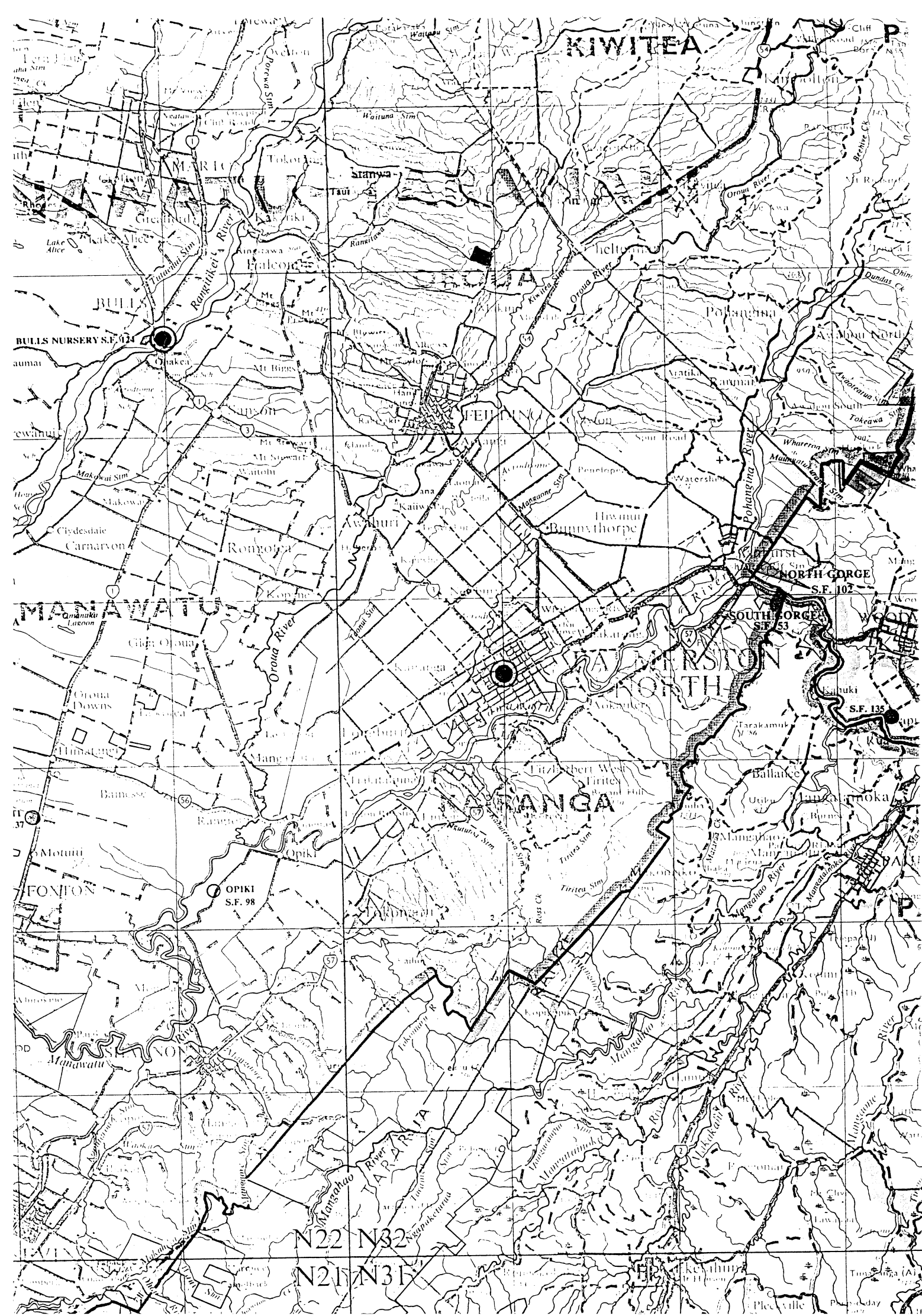
First tree measured



Direction of measurement



## **Dean and Cushla Williamson's Property, Fielding**



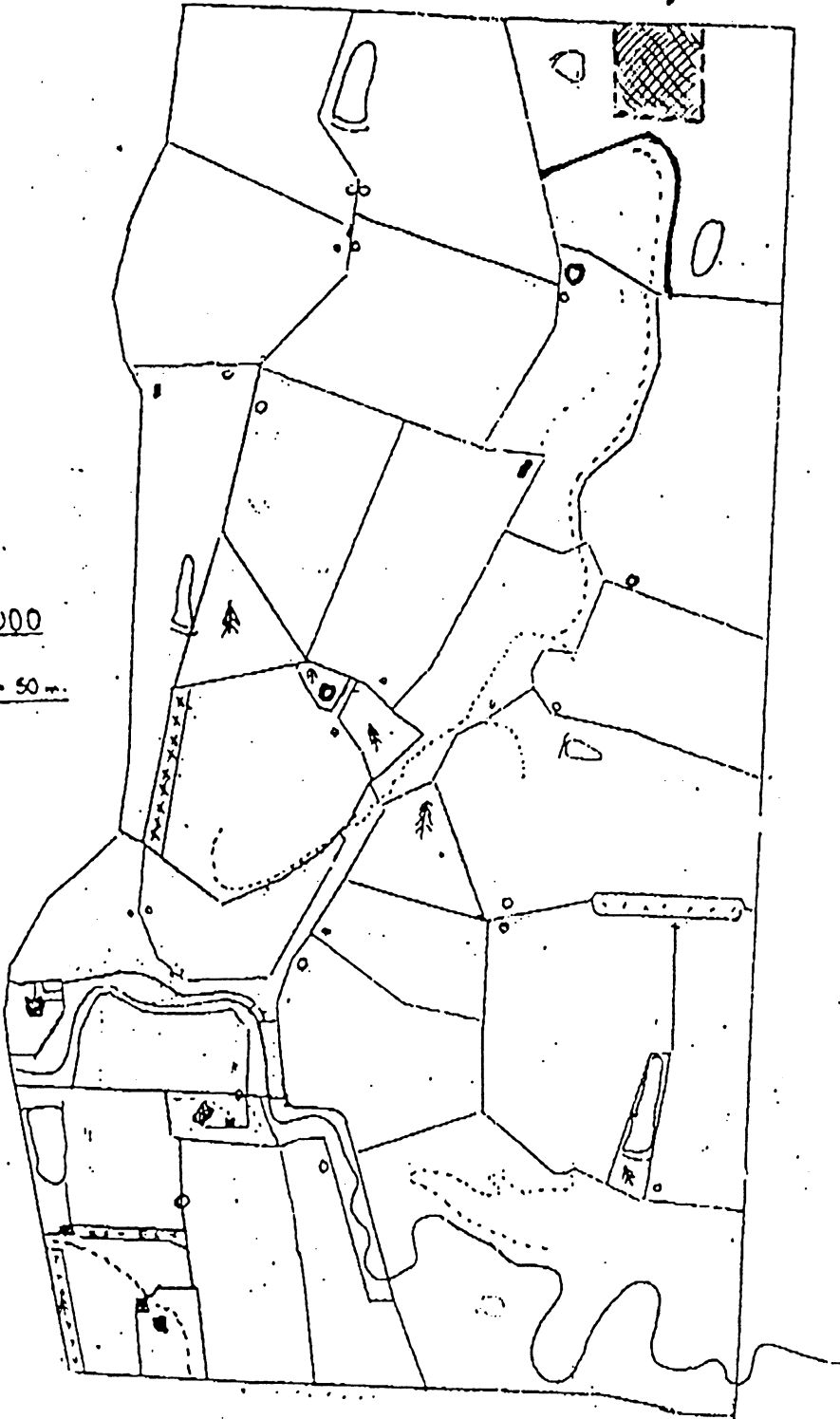
FRI Trial Block.

Planted 20/9/96

Released 5/10/96

1:5000

1 cm. = 50 m.



Dean & Cynthia Williamson

Car Makins & Junction Rd

R.D.7, Feilding.

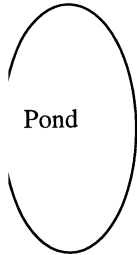
M/Fax 06 323 9408.

025 453 914



Williamson's Property

fence



X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

First tree measured

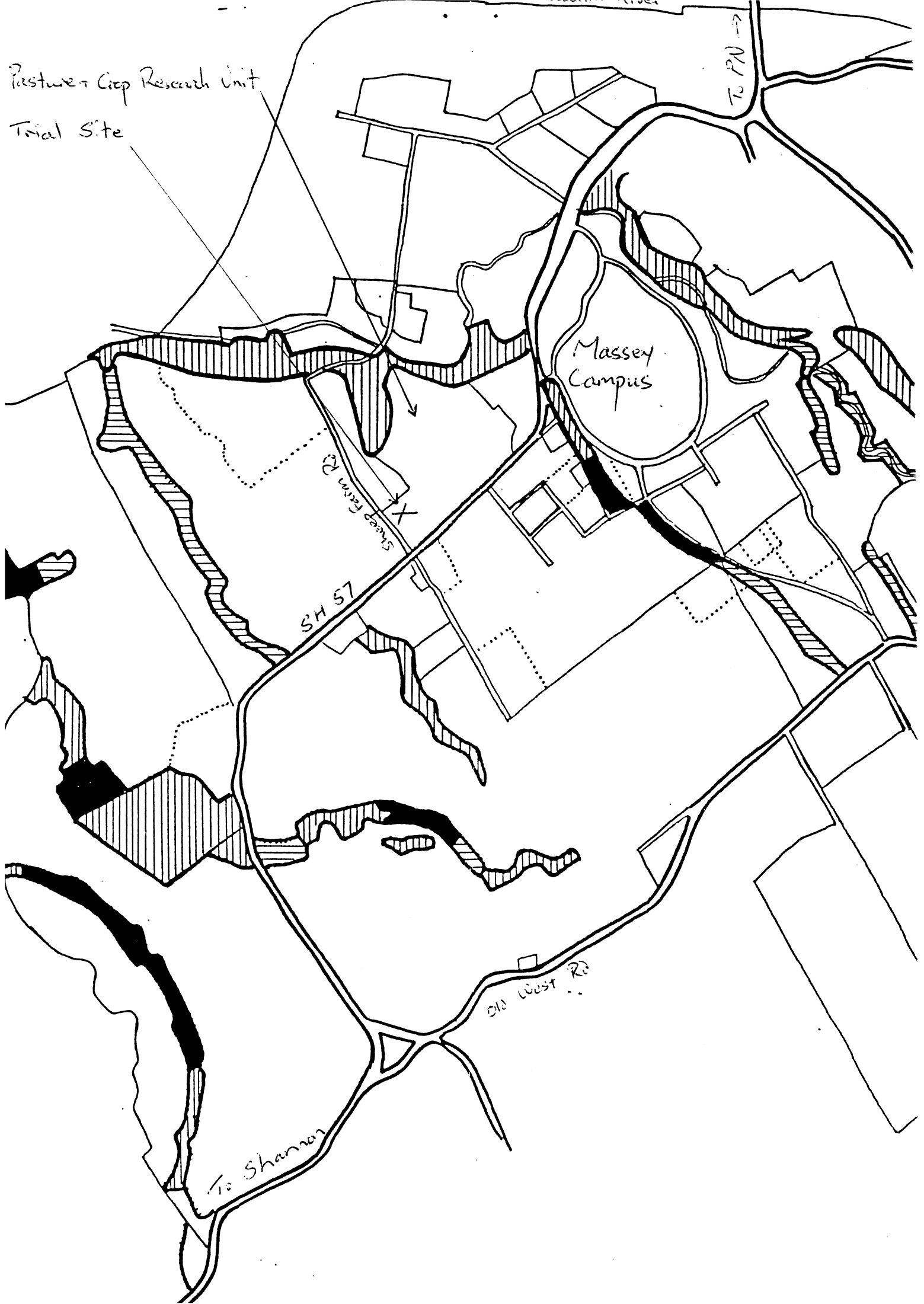


Direction of measurement



**Massey University, Palmerston North**

Pasture + Crop Research Unit  
Trial Site



Shannon →

State Highway 57

← Massey

Sheep Farm Road

House

Rain shelter

C = Conventional  
SF 19  
  
T = Topped

C = Conventional  
root cond.  
SF 19

T = Severe lateral  
root trim  
SF 19

DAM

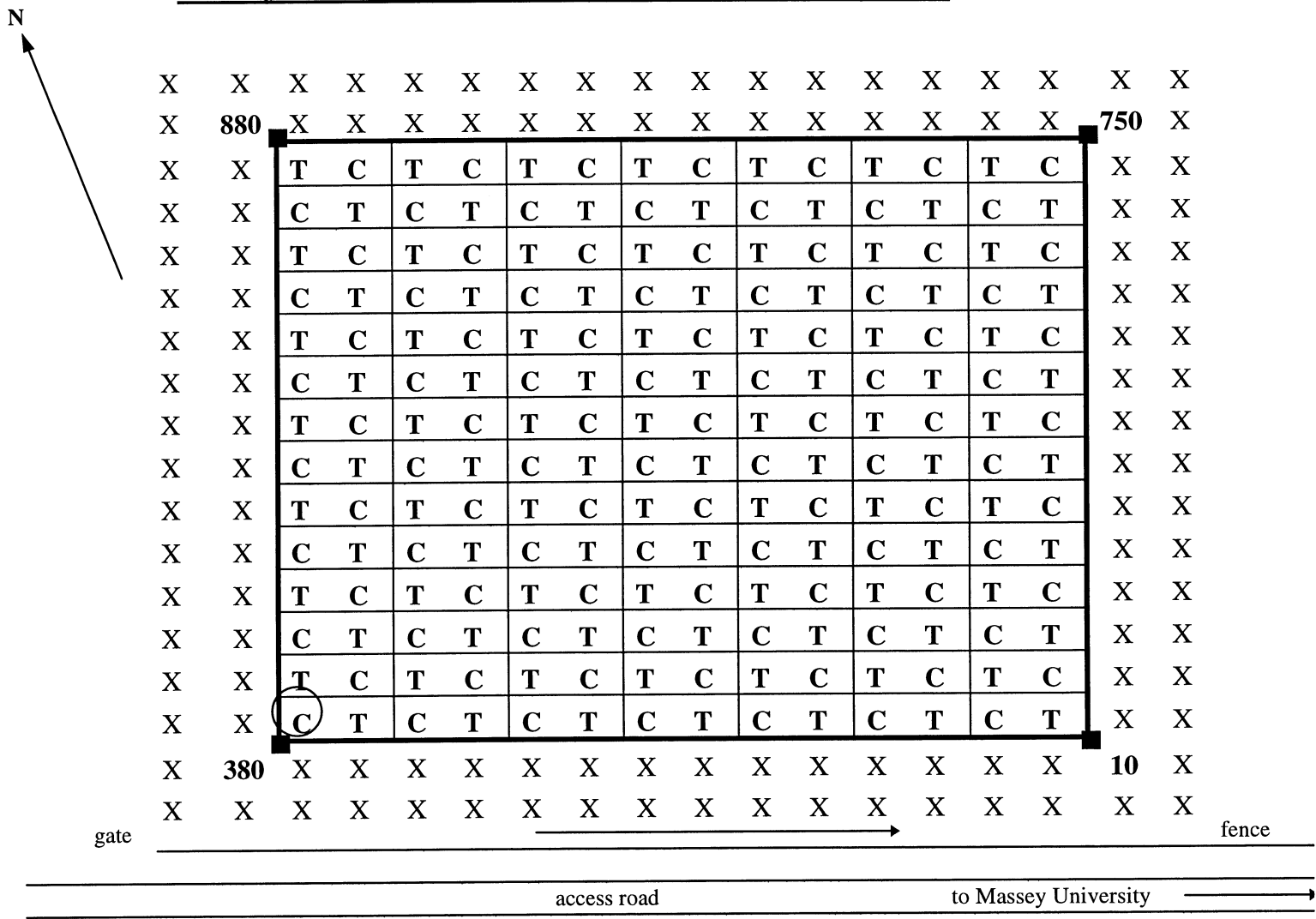
Magnetic

North (Grid)

Pasture & Crop Research Unit

Race

Massey University, Severe Lateral Root Trimming Trial



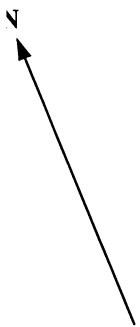
First tree measured



Direction of measurement



Massey University, Topping Trial

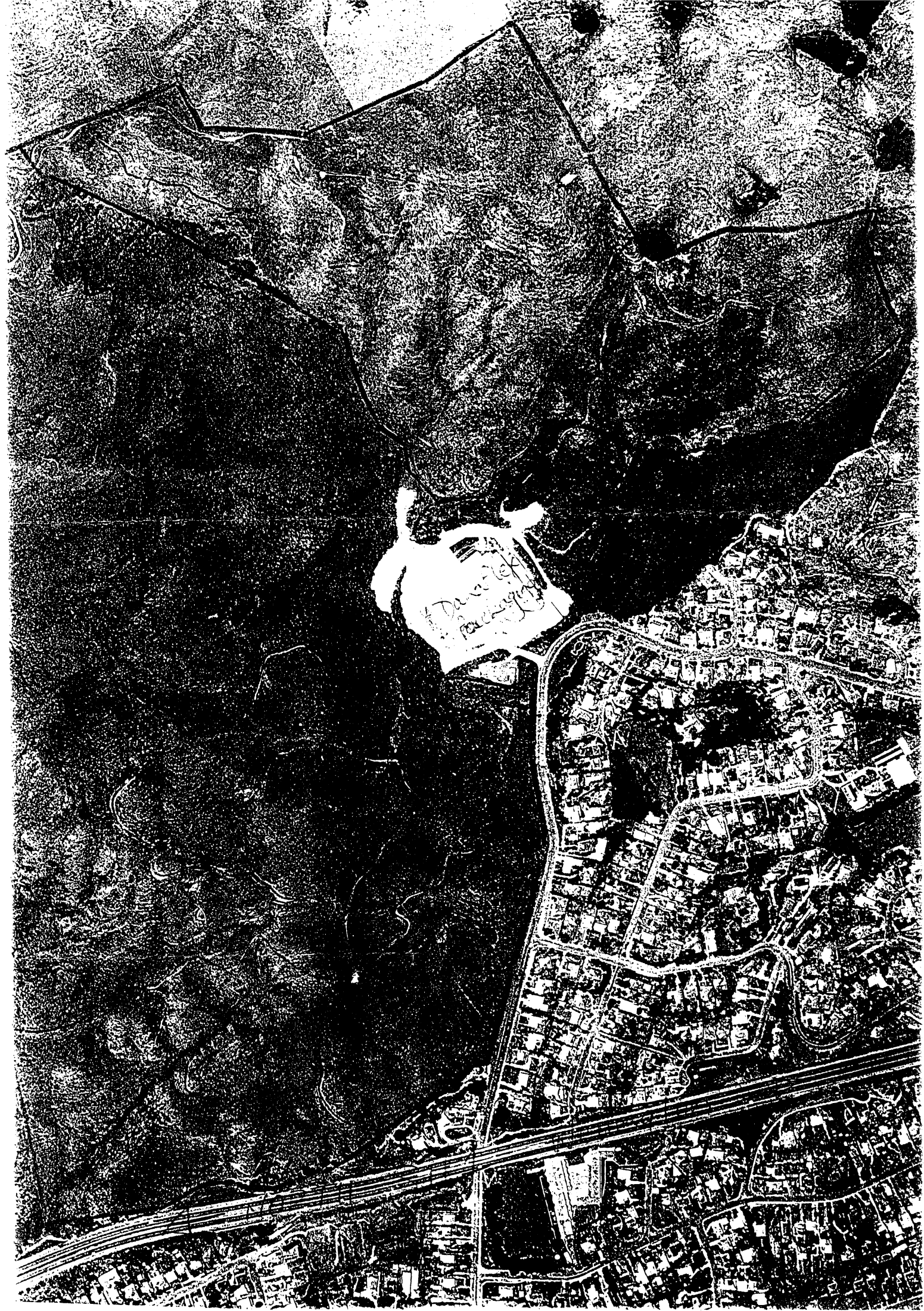


X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	690	X	X	X	X	X	X	X	X	X	X	X	X	X	X	470	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X	X
X	X	T	C	T	C	T	C	T	C	T	C	T	C	T	C	X	X	X
X	X	C	T	C	T	C	T	C	T	C	T	C	T	C	T	X	X	X
X	670	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1430	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

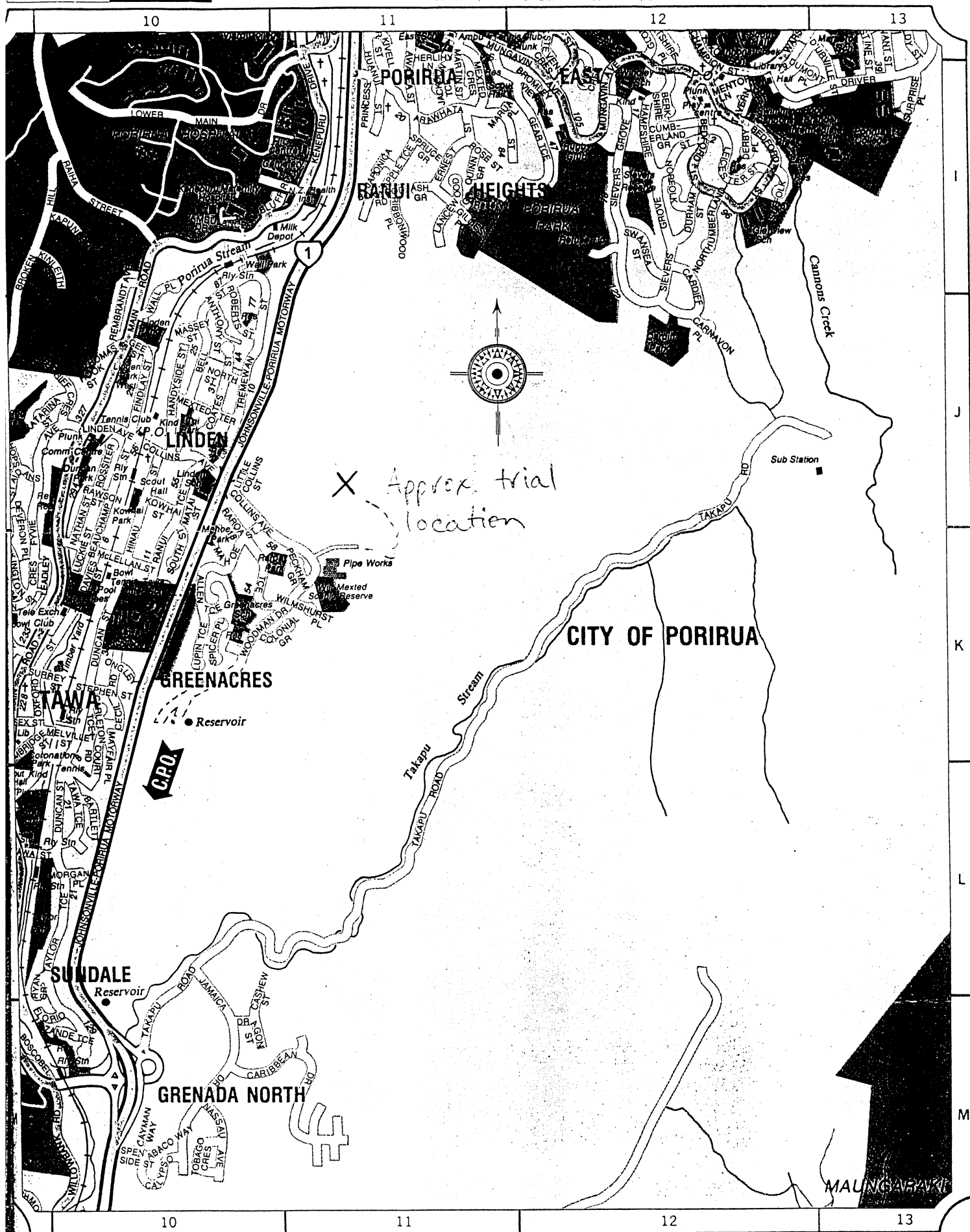
First tree measured

Direction of measurement

## **Takapu Farm Forest, Tawa**





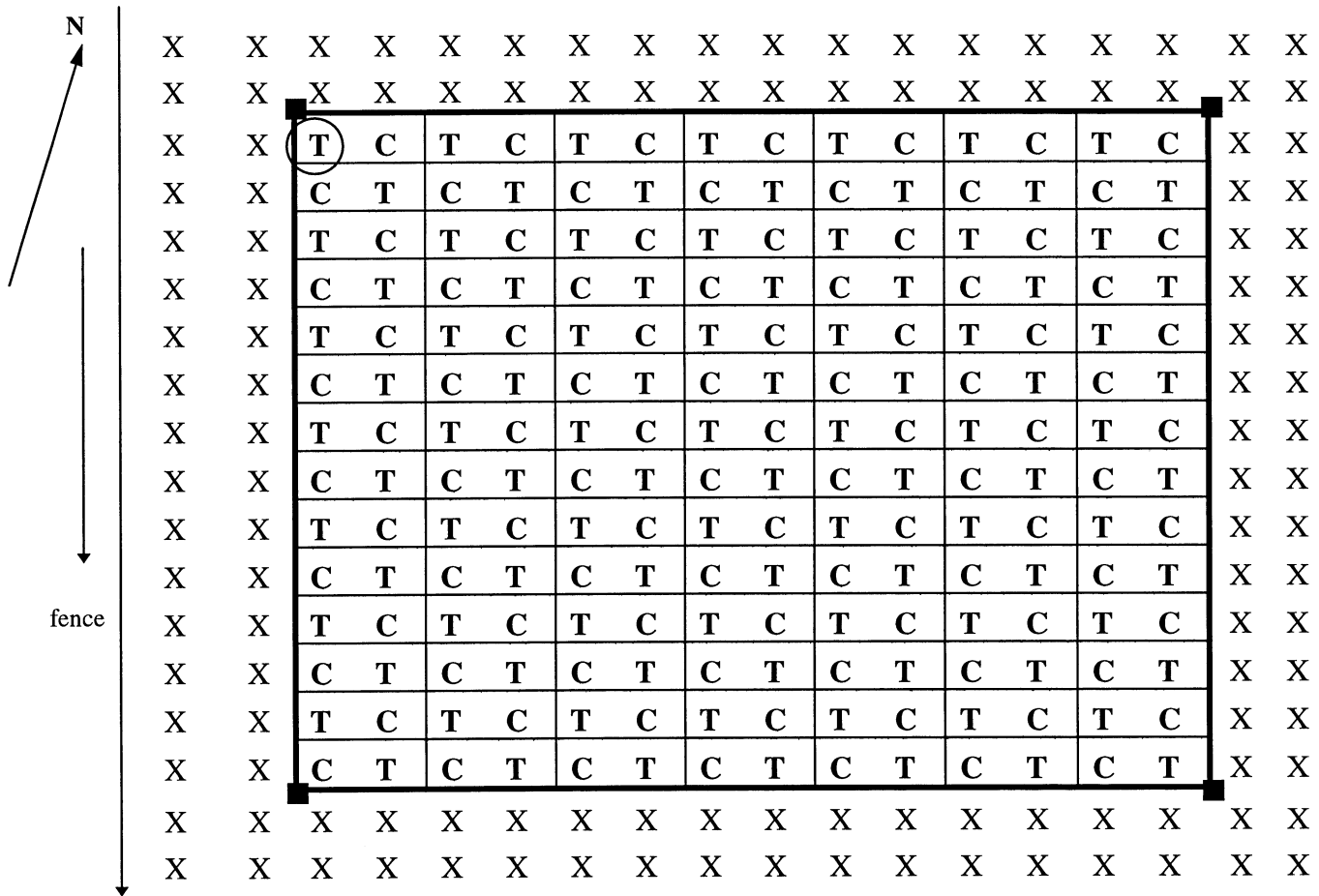


X Approx. trial location

CITY OF PORIRUA

CRO

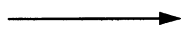
# Tawa, Takapu Farm Forest



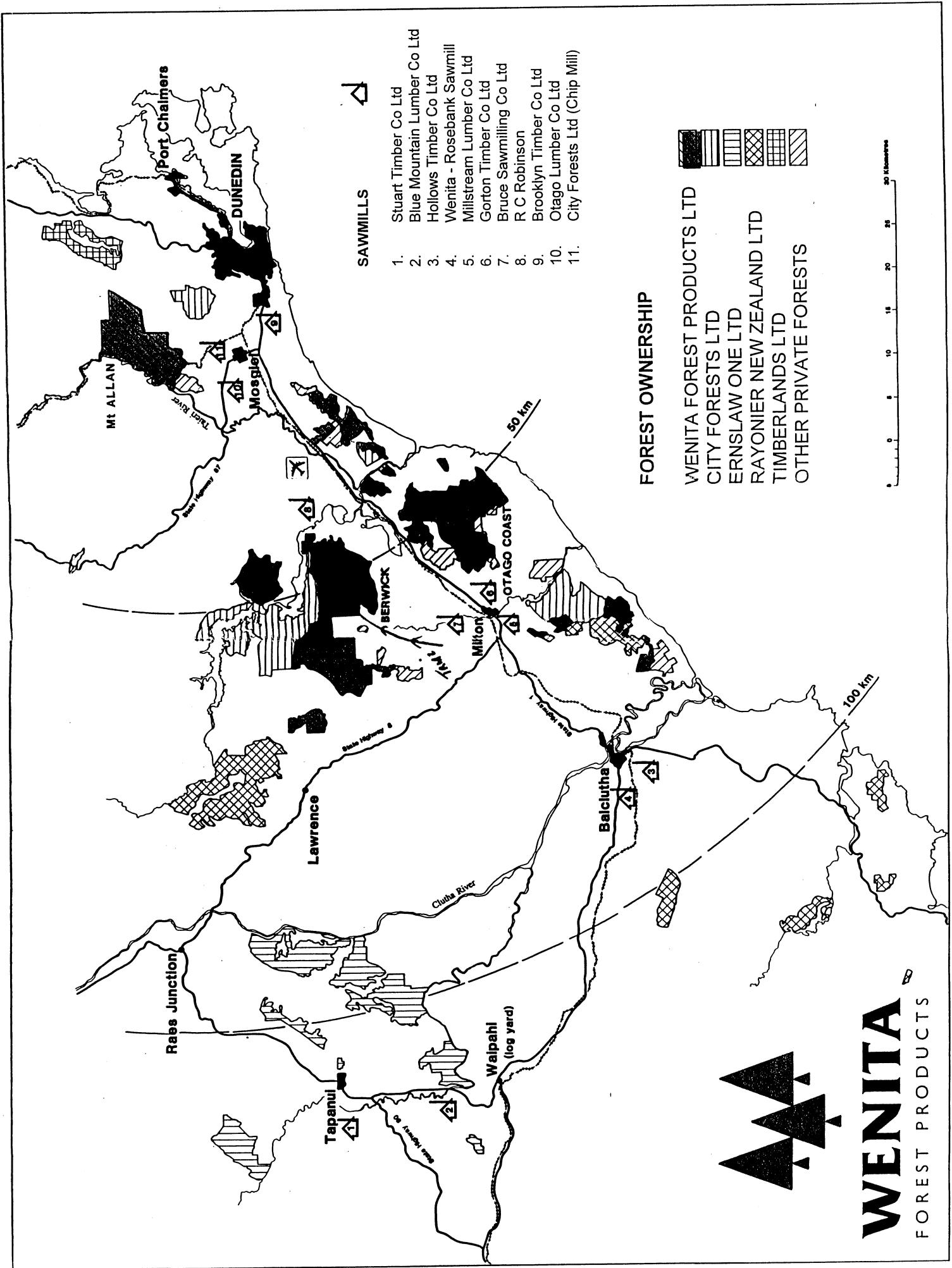
First tree measured



Direction of measurement



## **Berwick Forest, Dunedin**

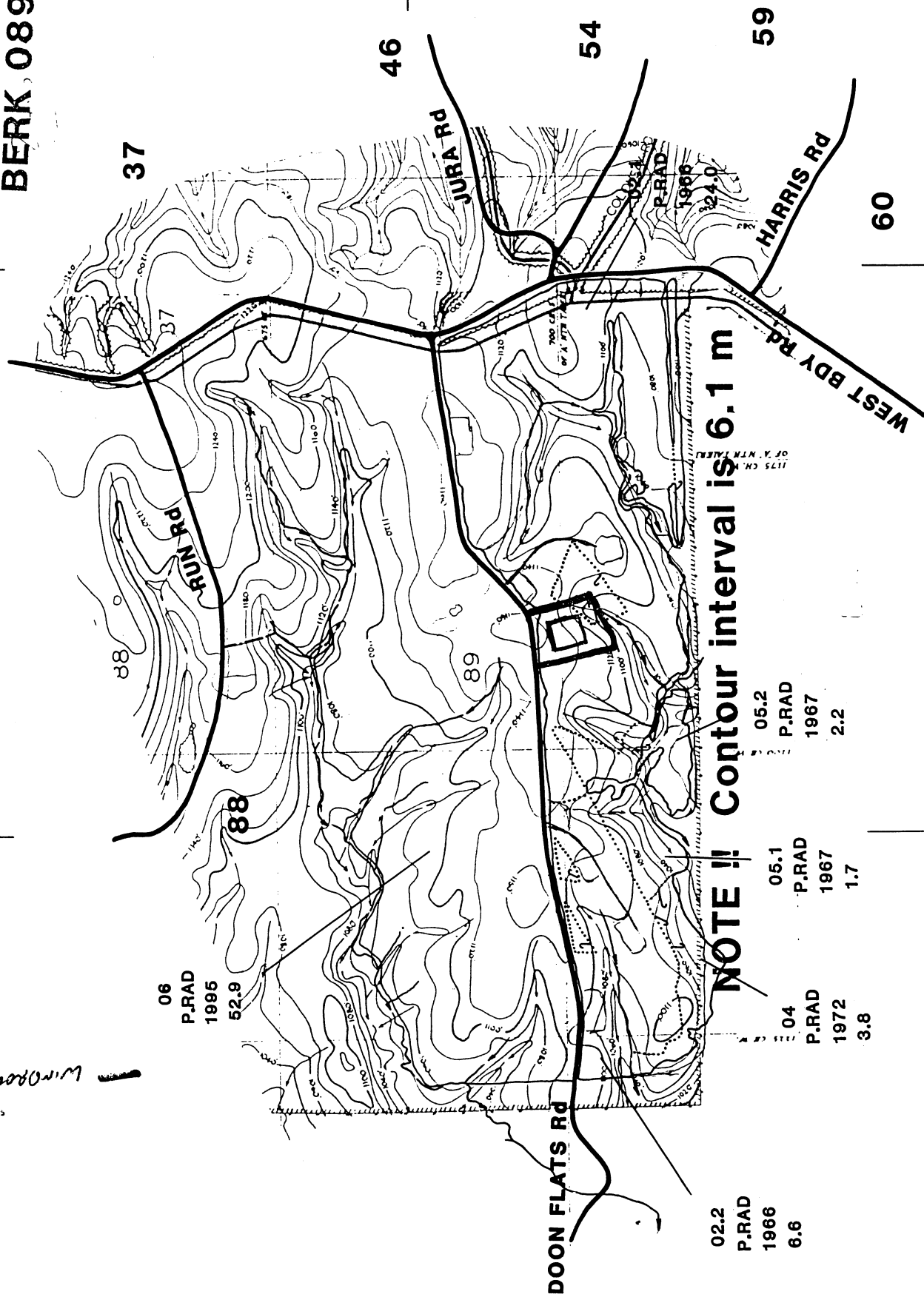


BERWICK

BERK 089

BERK 089

WINDROW



089