

**SURVEY OF TOMETOSUS ROOT ROT
AND LAYOUT FOR RESISTANCE TRIAL
NEAR TERCER LAKE, BURNS LAKE, B.C.**

by

Dave Daust, B.S.F.
Silvicon Services Inc.
Smithers, British Columbia

British Columbia Ministry of Forests
Victoria, British Columbia
Forest Service Internal Report

PM-PB-59

Submitted September 1986

Not for Publication

March 1991

FOREWORD

This report is one of a series of internal reports distributed by Forest Protection Branch, B.C. Ministry of Forests, to record accomplishments and interim or provisional results for the information of staff, colleagues, and others.

In the Canada-British Columbia Forest Resources Development Agreement (FRDA) 1985 to 1990, over 100 pest control projects were directly funded by the province and administered by protection staff. To facilitate application of the results, and development of improved forest health management strategies, the contractors reports have been edited and distributed as internal reports. Accordingly, any opinions and recommendations expressed are those of the contractor, and not necessarily those of the ministry or the FRDA management committee.

For details or more information about the report or project, please contact forest health staff at Protection Branch or at the forest region offices.

J. Muir, RPF
Acting Manager
Forest Health
Forest Protection Branch

The guidelines for internal reports outlined in the Protection Manual were adhered to as closely as possible. All manuscripts were altered to comply with a common format, but entire reports were not rewritten to conform to a standardized outline.

Most Executive Summaries were the work of Graham Hawkins of MoF Inventory Branch (formerly with Pacific Coast Forest Biology). All word processing was accomplished by Catriona Kaufman of Top Kat Services. Will Gordon of R. White Woods inc. prepared all maps and figures.

R. White, editor
R. White Woods inc.

EXECUTIVE SUMMARY

The objectives of the project were to:

1. establish permanent sample plots (PSP's) to monitor *tomentosus* root rot-induced mortality and disease spread from infected stumps to young hybrid spruce, lodgepole pine and Douglas-fir;
2. assess the effectiveness of stumping in controlling disease spread.

Five locations which had potentially high levels of *tomentosus* root rot were surveyed post-harvest near Tercer Lake and Burns Lake, Prince Rupert Forest Region. Transects were run at 60m intervals and all stumps were checked for three metres either side of line. In this manner, total coverage was five percent of each block. Stumps were examined with pulaskis for evidence of *tomentosus* root rot. Two control methods were proposed: uprooting of infected stumps or establishment of alternate species with possible resistance to the disease.

Results of the survey indicated that all sites were too wet wherever suitable disease incidence was encountered to allow reasonably cost-effective and non-disruptive stumping trials. Thus, nine two-hectare treatment blocks were delineated for species resistance trials utilizing Douglas-fir, lodgepole pine and hybrid spruce. These treatment blocks were located over areas exhibiting relatively uniform and high levels of *Inonotus tomentosus* (16 to 18%). Three 30m by 30m PSP's were established in each block to obtain long-term data disease incidence and spread.

The following recommendations resulted from the survey work and establishment of a treatment area. Although there was some difficulty with pathogen identification and slash, the post-harvest survey method was generally found to be productive and practical, with coverage of 184m/hour. Similar procedures were recommended for future studies with the provision that disease centres be located and marked prior to harvest to ensure complete delineation of infection centres. A combination of pre- and post-harvest surveys might be particularly useful for completely locating *tomentosus* root rot in pure spruce stands since symptoms are often seen in spruce stumps whereas crown indicators are frequently absent. However, this method would be much less useful in spruce-pine mixes or pure pine stands because stump symptomology is far less reliable in this species. In addition, sites should be stratified since this disease was more common in moist to wet areas than dry. This observation is in agreement with trends seen on other projects, where moist, well-drained soils seemed to support greater disease development.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	ii
1 INTRODUCTION	1
2 METHODS	
2.1 <u>Strip Sampling for <i>I. tomentosus</i></u>	2
2.1.1 Problems faced during sampling	2
2.1.2 Results	2
2.2 <u>Establishment of Permanent Plots</u>	
2.2.1 Stumping trial	3
2.2.2 Species resistance trial	3
2.2.3 Design	4
2.2.4 Layout	4
2.3 <u>Soil and Ecological Data</u>	4
3 RECOMMENDATIONS	
3.1 <u>Continuation of This Study</u>	5
3.2 <u>Future Studies</u>	5
APPENDICES	
A General Location of Study Area	6
B Location of the Five Sample Areas	7
C Productivity Data (Strip Sampling for <i>I. tomentosus</i>)	8
D Soil Pit Data for Blocks 1, 2 and 3	9
E Ecological Data for Blocks 1, 2 and 3	10

TABLES

	Page
1 <i>I. tomentosus</i> Infection in Areas 1-4	3

FIGURES

1 Location on Sample Strips and Infected Stumps in Area 1	11
2 Location of Sample Strips and Infected Stumps in Area 2	12
3 Location of Sample Strips and Infected Stumps in Area 3	13
4 Location of Sample Strips and Infected Stumps in Area 4	14
5 Location of Block Boundaries in Relation to <i>I.</i> <i>tomentosus</i> Incidence in Area 1	15
6 Location of Block Boundaries in Relation to <i>I.</i> <i>tomentosus</i> Incidence in Area 2	16
7 Location of Block Boundaries in Relation to <i>I.</i> <i>tomentosus</i> Incidence in Area 3	17
8 Location of Block 1, Plots A, B, and C	18
9 Location of Block 2, Plots D, E, and F	19
10 Location of Block 3, Plots G, H, and I	20
11 Location of Blocks 1, 2, and 3	21

1 INTRODUCTION

Inonotus tomentosus (previously *Polyporus tomentosus*) is a root disease which causes a red discoloration in the roots and butts of living trees. Tree mortality, as a result of this disease, is not uncommon. In advanced stages, the red discoloration gives way to elliptical white pockets. *I. tomentosus* is widespread in North America and primarily affects spruce and pine. Spruce (*Picea glauca* x *engelmannii*) is considered to be more susceptible than lodgepole pine (*Pinus contorta*) (MoF Protection Manual, 1985). In an effort to reduce the spread of *I. tomentosus* between successive rotations, two experiments were proposed: the first to test the resistance of various tree species to *I. tomentosus* infection, and the second to test stump removal as a way of eradicating *I. tomentosus* from a site.

The Tercer Lake area (Appendix A) was indicated as a good area to establish these long-term experiments. To choose the exact location to establish permanent test plots, a strip sampling technique was used to estimate the level of *I. tomentosus*.

Significant levels were found in several areas; consequently, boundaries were established for a species resistance trial.

2 METHODS

2.1 Strip Sampling for *I. tomentosus*

Strip line sampling was conducted in five locations indicated as having potential *I. tomentosus* infections (Appendix B). Data on sampling productivity is presented in Appendix C. In each of the five areas, a baseline was established (blue ribbon). From the baseline, perpendicular (except in Block 2) strips were begun at 60m intervals with the length of the strip corresponding to the width of the cutblock. The strips were set at three metres wide after field testing 6m and 4.5m strips. The three metre wide strip produced a 5% sample of the area and a reasonable number of stumps in each strip.

Strips were established in the field (blue ribbon) using a hip chain and a compass. Along each strip, any stump with its centre within 1.5m of the strip centre was sampled. Sampling was done by chopping into the root collar, or preferably, into exposed roots, on either side of the stump. Sharp pulaskis, useful for both digging and chopping, were used. A 2-4cm deep wedge was removed and the exposed wood was examined for signs of *I. tomentosus* (red stain and/or white elliptical pockets). *I. tomentosus* was also found by examining the centre of stumps and root ends of up-rooted stumps. Often, a sample wedge showed only vague signs of *I. tomentosus*. Verification required sectioning and examining a deeper root. In many cases, positive identification remained uncertain.

Infected stumps were spray painted orange.

For each strip, stump location, tree species and *I. tomentosus* infection was recorded on a F.S. 375 tally card. From these records, maps and tables were produced showing the level of *I. tomentosus* infection in each area.

2.1.1 Problems faced during samples

Positive identification of *I. tomentosus* was difficult. *I. tomentosus* can be easily confused with *Fomes pini*. Stumps were occasionally buried in slash and difficult to sample. Lodgepole pine and spruce stumps were often difficult to distinguish apart.

2.1.2 Results

In the four areas sampled, *I. tomentosus* infections ranged from 5.8% to 15.3% (Table 1).

TABLE 1 I. TOMENTOSUS INFECTION IN AREAS 1-4

Area	1	2	3	4
Metres of strip	3 123	900	3 600	1 760
Total stumps sampled	528	144	540	291
Total stumps infected	48	22	65	17
Percentage infected	9.1%	15.3%	12.0%	5.8%

Data for Area 5 is not presented because sampling was stopped when the remaining area became insufficient to establish permanent sample plots.

The percentage of stumps infected varied considerably between strips within areas (Figures 1-4). Drier regions, comprised primarily of lodgepole pine stumps, showed little or no *I. tomentosus* infection. This distribution agrees with current knowledge, suggesting *I. tomentosus* is found more often in spruce than in lodgepole pine. The majority of infection was found in areas which had been primarily spruce/aspen stands. These areas had mesic to subhygric moisture regimes.

2.2 Establishment of Permanent Plots

2.2.1 Stumping trial

The stumping trial was cancelled for the following reasons: (1) the overall area with a high incidence of *I. tomentosus* was considerably less than 60 hectares originally estimated; (2) the sample strips with high *I. tomentosus* incidence (> 10%) were located on the wetter ecosystems; (3) machine operability was thought to be poor in these wetter areas; and (4) the presence of aspen could lead to a brush problem after the stumping operation and general disturbance.

2.2.2 Species resistance trial

The species resistance trial does not require as large an infected area and has no machine operability constraints. The root disease survey indicated that three 6ha blocks could be established within areas of relatively high *I. tomentosus* incidence.

Area 4 has a high *I. tomentosus* level in some strips but lacks a uniformly high *I. tomentosus* level over a large enough area to establish plots. Area 5 became too small to establish permanent plots after initial sampling. Portions of Areas 1, 2 and 3 are suitable for permanent plots and will be labelled as Blocks 1, 2 and 3.

With the three chosen areas, the aim was to design and lay out three 6ha blocks, each containing three 2ha plots. Prior to design, a rough traverse was done of the local road system to establish a base map of the area and control points for block boundaries.

2.2.3 Design

Blocks were designed (Figures 5-7) using maps of *I. tomentosus* infection. Block boundaries were located to encompass ground with uniformly high *I. tomentosus* levels, but some anomalies do exist. The average *I. tomentosus* infection level is approximately 16-18% in each of the three blocks. Roads and landings, being non-productive, were removed from area calculations.

Similar procedures were used to partition blocks into plots. Any areas with low *I. tomentosus* infection were spread evenly between plots where possible.

2.2.4 Layout

A compass and a hip chain were used to establish block and plot boundaries in the field. Pink ribbon was used to mark boundaries, except where natural boundaries existed. Four corner posts in the form of stakes or blazed trees were established in each block. Corner posts indicate block number; one of NE, NW, SE or SW, bearing of boundary and date. As well, plots within blocks were separated with pink ribbon. Block number and plot location were placed on plot posts.

Figures 8, 9 and 10 show the final results after layout. Figure 11 shows how the three blocks are located in relation to the road system.

2.3 Soil and Ecological Data

After layout, soil and ecological data was collected for each of the three blocks (Appendices 4 and 5). Based on the Canadian Soil Classification System, soil in Block 1 is a Brunisol, soil in Block 2 is a Gleyed Gray Luvisol, and soil in Block 3 is a Brunisolic Gray Luvisol.

Blocks 1, 2 and 3 are all part of the Sub-boreal Spruce Zone, subzone "d." All blocks appear to contain both the Associations "01" and "07." However, accurate separation of associations was difficult because the areas were clearcut.

3 RECOMMENDATIONS

3.1 Continuation of This Study

To ensure that block boundaries become permanent, we suggest that tree species be used to delineate them. That is, if species "A" is planted in a particular plot, species "B" or "C" should be planted around the edge of that plot.

3.2 Future Studies

The methods used for this survey seemed practical and efficient. We suggest that similar procedures be used in any future surveys. The pulaski is the best tool for sampling, as sampling involves removing debris from around the roots and then chopping into the wood. Sampling the root collar is faster than sampling the roots; however, we obtained no indication as to the reliability of root collar samples relative to root samples. The difficulty of positively identifying *I. tomentosus* was the major concern identified during sampling. Distinguishing features of *I. tomentosus* should be stressed in any future projects.

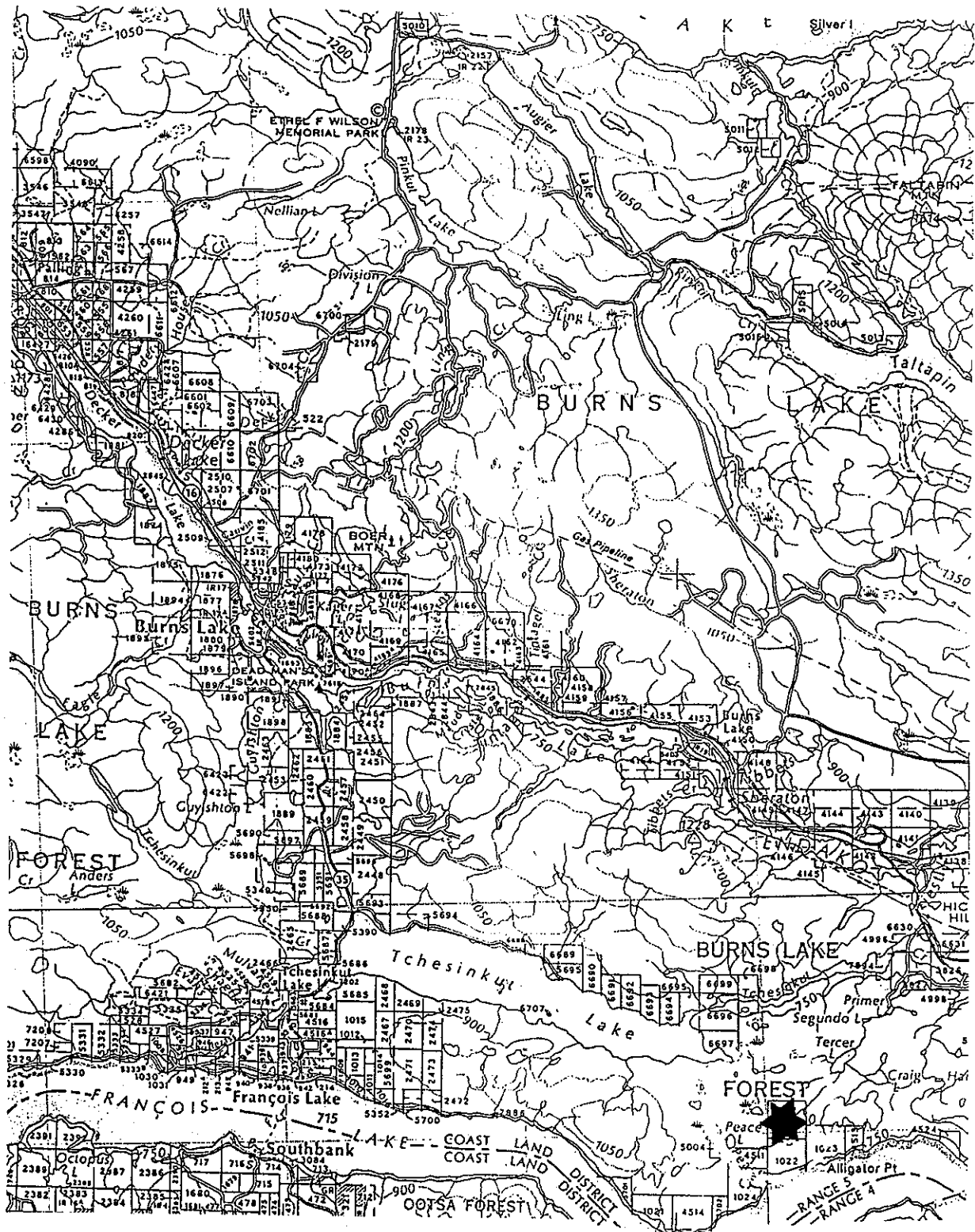
As a general procedure for locating diseased areas to sample, we suggest the following practices be considered.

Suspect areas should be noted during the cruise, if possible, rather than after logging. Dead standing spruce, showing no signs of bark beetle or conks, could indicate *I. tomentosus* activity, and thus a possible study site.

In logged areas where *I. tomentosus* is suspected, aerial photographs should be used to locate ground which is highly susceptible to *I. tomentosus*. Based on our sampling experience, we feel that lower slope areas of spruce and aspen, which are recognizable on aerial photographs, are highly susceptible.

A rough reconnaissance of the identified susceptible areas should then be carried out. Large homogeneous areas showing signs of *I. tomentosus* should be noted as potential study sites. Finally, an intensive survey should be performed to estimate the incidence of rot and to determine the exact location of study plots.

APPENDIX A GENERAL LOCATION OF STUDY AREA

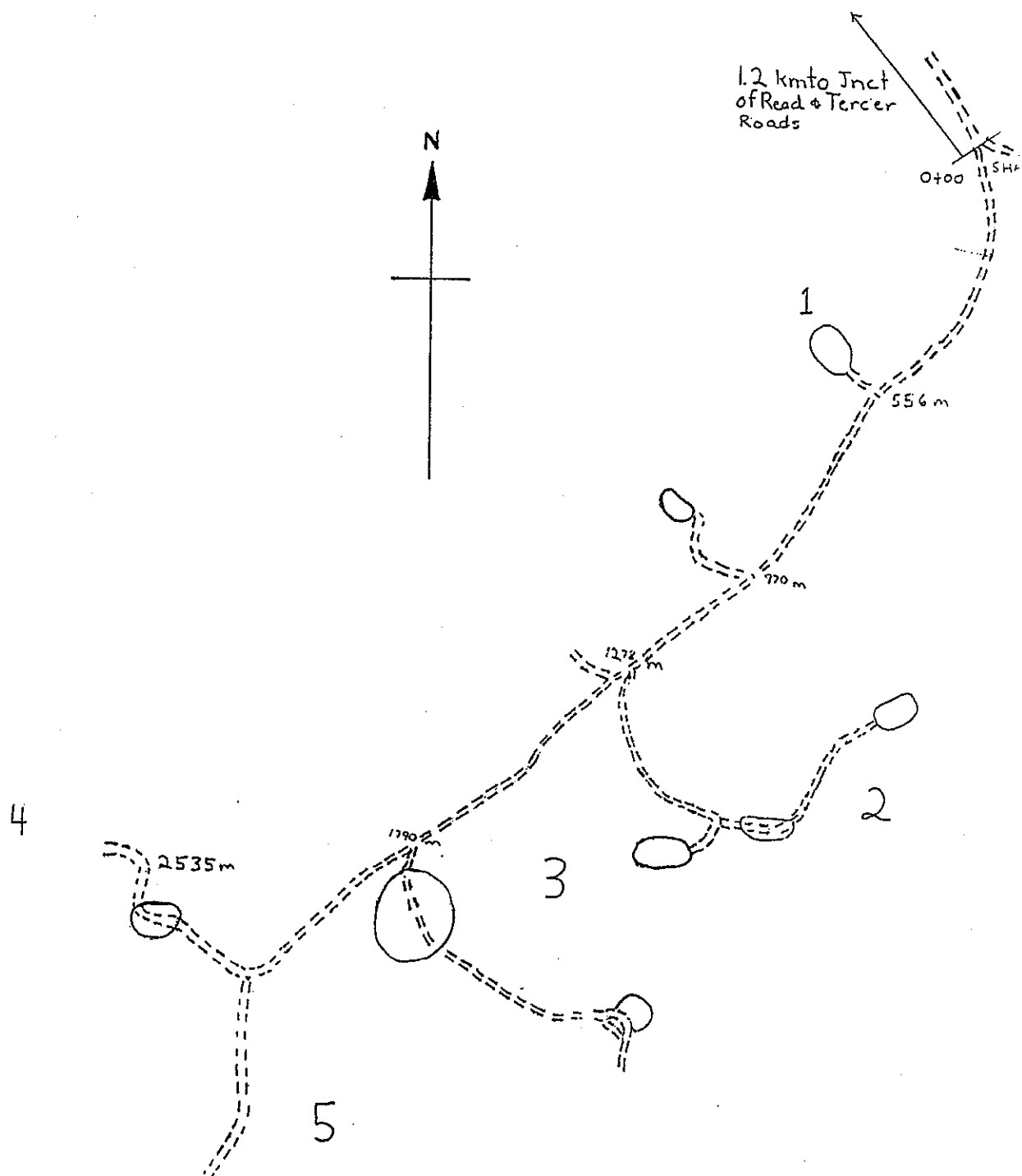


Study Site



Scale 1:250 000

APPENDIX B LOCATION OF THE FIVE SAMPLE AREAS



SCALE 1:10000

APPENDIX C PRODUCTIVITY DATA
(Strip Sampling for *I. tomentosus*)

Since strip sampling of root rot is new in this area, productivity data is presented here. Nine thousand six hundred metres of sample strip were covered in approximately 12 man-days; hence, the strip can be sampled at a rate of approximately 100m/hour. This figure includes travel time (one hour/day) and familiarization time. A larger sampling project would likely show an increase in the sampling productivity, since proportionally less time would be spent with familiarization.

Prior to the project, sampling time for one stump was estimated to be two minutes. At an estimated 10 stumps/100m, therefore, 300m should be sampled in one hour. We found, during sampling, that two minutes per stump was a close estimate; however, we found an average of 16.3 stumps/100m. This would result in a sampling rate of 184m/hour for each hour strictly allotted to sampling.

APPENDIX D SOIL PIT DATA FOR BLOCKS 1, 2 AND 3

SOIL DESCRIPTION SHEET PROJECT CODE 303d 01a/07

LOCATION _____ DATE AUG 28/86 SITE NO. 1

PHOTO _____ PHOTO CO-ORDINATES X _____ SURVEYOR GP/1,2,3

AGENCY _____ LONGITUDE _____ LATITUDE _____

BEDROCK _____

TERRAIN CLASSIF. MORAINAL SOIL DRAINAGE* 1 VERY RAPID 1 PERADIC 1 AQUE 1 SUBAQUE 1 POORLAND 1 MUD 1 SUB MUD 1 SUB ARID 1 ARID 1 XERIC

SOIL NAME BRUNISOL SOIL CLASSIF. BRUNISOL SOIL PHASE 1 WELL 1 SUPERFECT 1 POOR 1 VERY POOR

SLOPE LENGTH _____ ELEVATION _____ SLOPE *OR % _____ SLOPE POSITION* 1 CREST 1 UPPER 1 MIDDLE 1 LOWER 1 TOE 1 DEPRESSION

ASPECT _____ PERVIOUSNESS* 1 RAPID 1 MODERATE 1 SLOW 1 ABSENT 1 PRESENT

HORIZON	DEPTH	TEXTURE	STRUCTURE	COLOR	COMMENTS
LFH	5	SL	GR		Hemimons
Ahe	5-13	L	FW SBK		coarse fragments
Bm	13+	SL	SBK		finer fragments

LAB NO.	HOR. SAMPLED	% C	pH(CaCl ₂)	Fe	Al	COMMENTS

1 CANADIAN SYSTEM OF CLASSIFICATION
2 CANADA SOIL INFORMATION SYSTEM MANUAL FOR DESCRIPTIONS IN THE FIELD 1975

SOIL DESCRIPTION SHEET PROJECT CODE 303d 01b

LOCATION _____ DATE AUG 28/86 SITE NO. 2

PHOTO _____ PHOTO CO-ORDINATES X _____ SURVEYOR GP/1,2,3

AGENCY _____ LONGITUDE _____ LATITUDE _____

BEDROCK _____

TERRAIN CLASSIF. MORAINAL SOIL DRAINAGE* 1 VERY RAPID 1 PERADIC 1 AQUE 1 SUBAQUE 1 POORLAND 1 MUD 1 SUB MUD 1 SUB ARID 1 ARID 1 XERIC

SOIL NAME GLAYED GRAY LUVISOL SOIL CLASSIF. GLAYED GRAY LUVISOL SOIL PHASE 1 WELL 1 SUPERFECT 1 POOR 1 VERY POOR

SLOPE LENGTH _____ ELEVATION _____ SLOPE *OR % _____ SLOPE POSITION* 1 CREST 1 UPPER 1 MIDDLE 1 LOWER 1 TOE 1 DEPRESSION

ASPECT _____ PERVIOUSNESS* 1 RAPID 1 MODERATE 1 SLOW 1 ABSENT 1 PRESENT

HORIZON	DEPTH	TEXTURE	STRUCTURE	COLOR	COMMENTS
LFH	8	CL	SBK		Hemimons
Ae	4	CL	SBK		
Bm	4-9	SL	SBK		
Ba	8-9	SL	SBK		
Btg	9+	L	SBK		

LAB NO.	HOR. SAMPLED	% C	pH(CaCl ₂)	Fe	Al	COMMENTS

1 CANADIAN SYSTEM OF CLASSIFICATION
2 CANADA SOIL INFORMATION SYSTEM MANUAL FOR DESCRIPTIONS IN THE FIELD 1975

SOIL DESCRIPTION SHEET PROJECT CODE 303d 01c

LOCATION _____ DATE AUG 28/86 SITE NO. 3

PHOTO _____ PHOTO CO-ORDINATES X _____ SURVEYOR GP/1,2,3

AGENCY _____ LONGITUDE _____ LATITUDE _____

BEDROCK _____

TERRAIN CLASSIF. MORAINAL SOIL DRAINAGE* 1 VERY RAPID 1 PERADIC 1 AQUE 1 SUBAQUE 1 POORLAND 1 MUD 1 SUB MUD 1 SUB ARID 1 ARID 1 XERIC

SOIL NAME BRUNISOL SOIL CLASSIF. BRUNISOL SOIL PHASE 1 WELL 1 SUPERFECT 1 POOR 1 VERY POOR

SLOPE LENGTH _____ ELEVATION _____ SLOPE *OR % _____ SLOPE POSITION* 1 CREST 1 UPPER 1 MIDDLE 1 LOWER 1 TOE 1 DEPRESSION

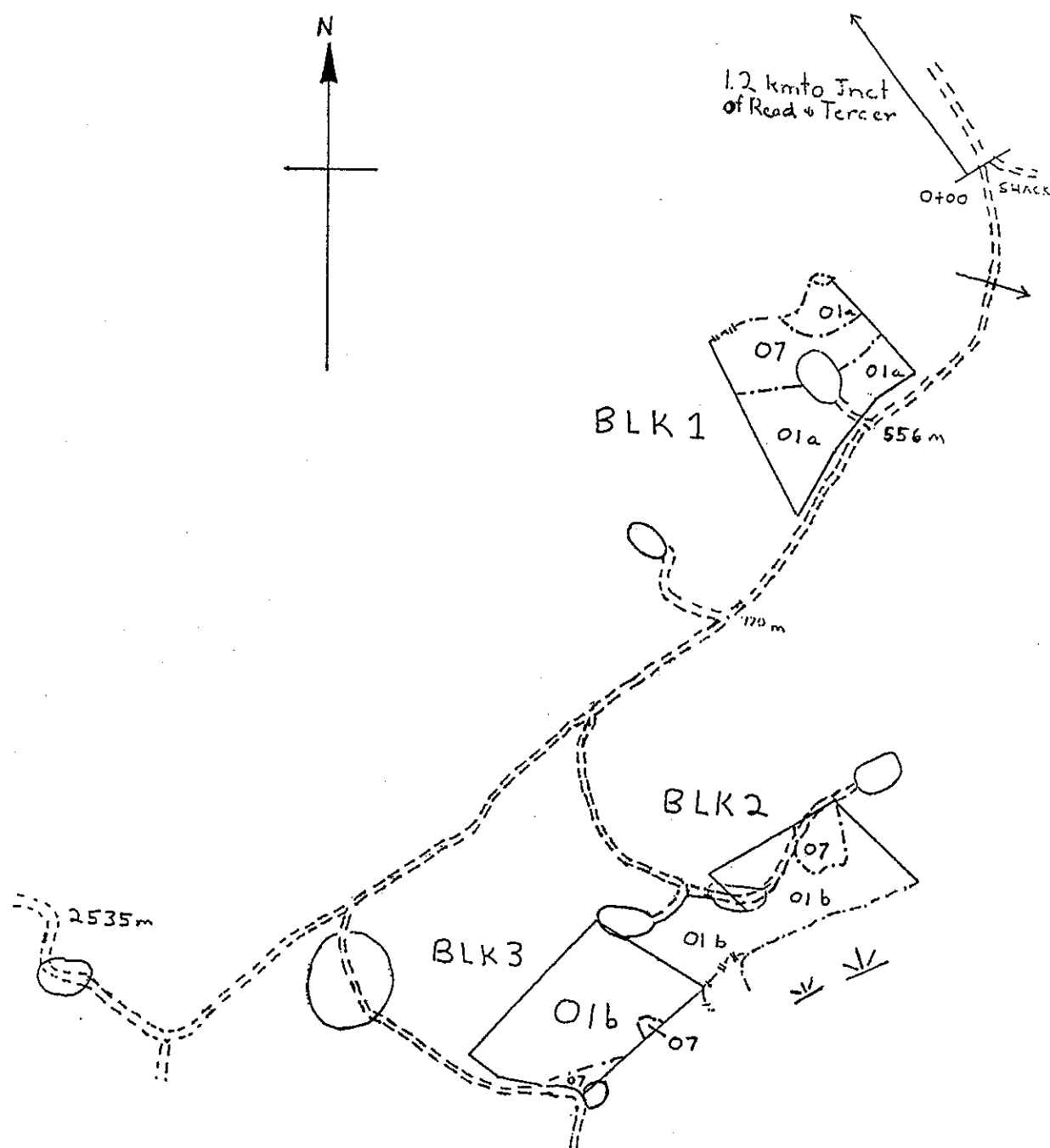
ASPECT _____ PERVIOUSNESS* 1 RAPID 1 MODERATE 1 SLOW 1 ABSENT 1 PRESENT

HORIZON	DEPTH	TEXTURE	STRUCTURE	COLOR	COMMENTS
LFH	8	L	SBK		Hemimons
Aa	4	L	SBK		light gray brown
Bm	4-8	CL	SBK		dark brown
Bt	8-9	C	SBK		gray brown
Btg	9+	C	SBK		

LAB NO.	HOR. SAMPLED	% C	pH(CaCl ₂)	Fe	Al	COMMENTS

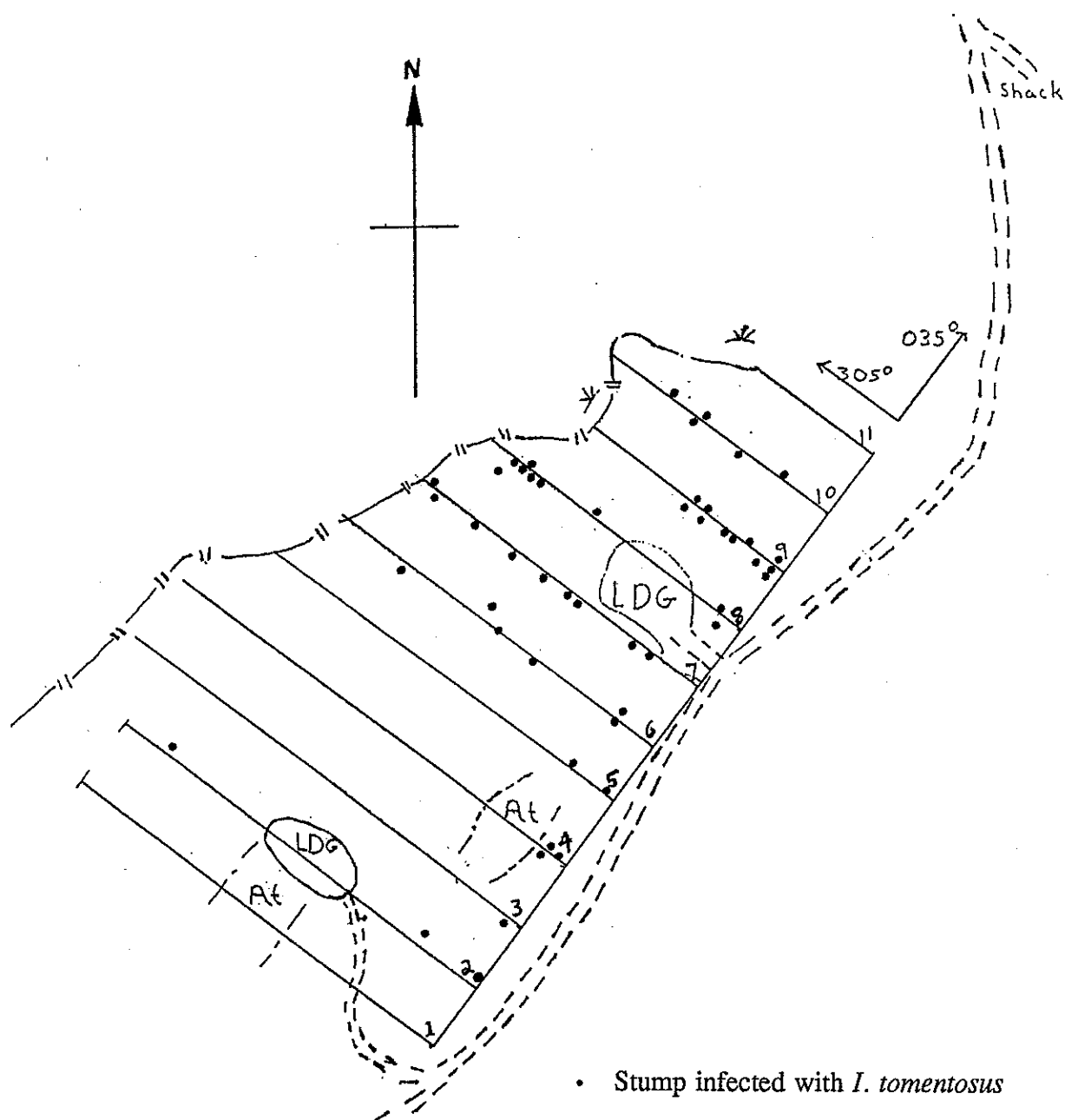
1 CANADIAN SYSTEM OF CLASSIFICATION
2 CANADA SOIL INFORMATION SYSTEM MANUAL FOR DESCRIPTIONS IN THE FIELD 1975

APPENDIX E ECOLOGICAL DATA FOR BLOCKS 1, 2 AND 3



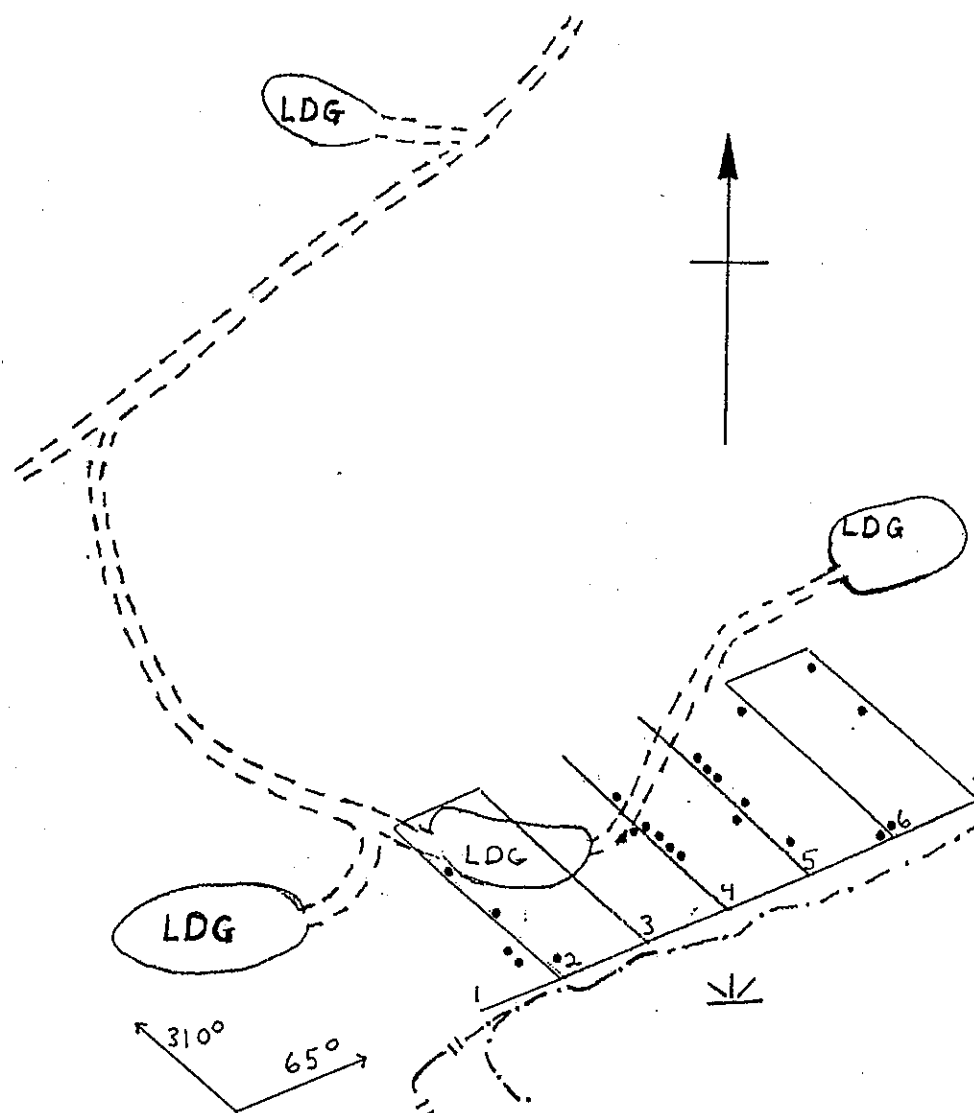
All blocks located in the "SBSd"
Ecological associations shown on Block

FIGURE 1 **LOCATION OF SAMPLE STRIPS AND**
INFECTED STUMPS IN AREA 1



Strip	1	2	3	4	5	6	7	8	9	10	11
# Trees	38	36	65	56	71	51	35	36	66	41	33
% Infected	0.0	11.1	1.5	5.4	4.2	7.8	25.7	22.2	16.7	12.2	0.0

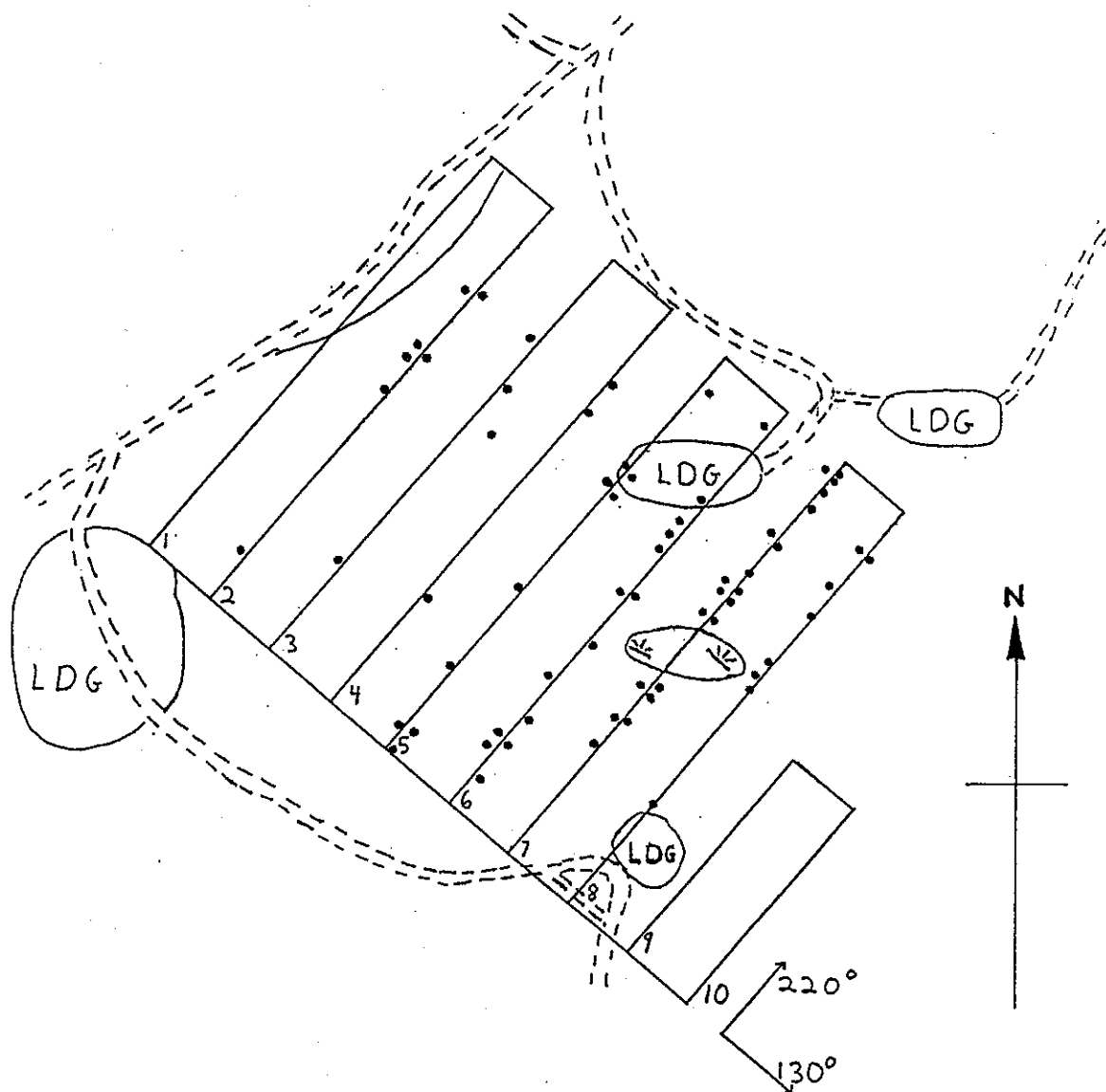
FIGURE 2 **LOCATION OF SAMPLE STRIPS AND
INFECTED STUMPS IN AREA 2**



• Stump infected with *I. tomentosus*

Strip	2	3	4	5	6	7
# Trees	24	9	22	31	33	25
% Infected	20.8	0.0	27.3	19.4	9.1	8.0

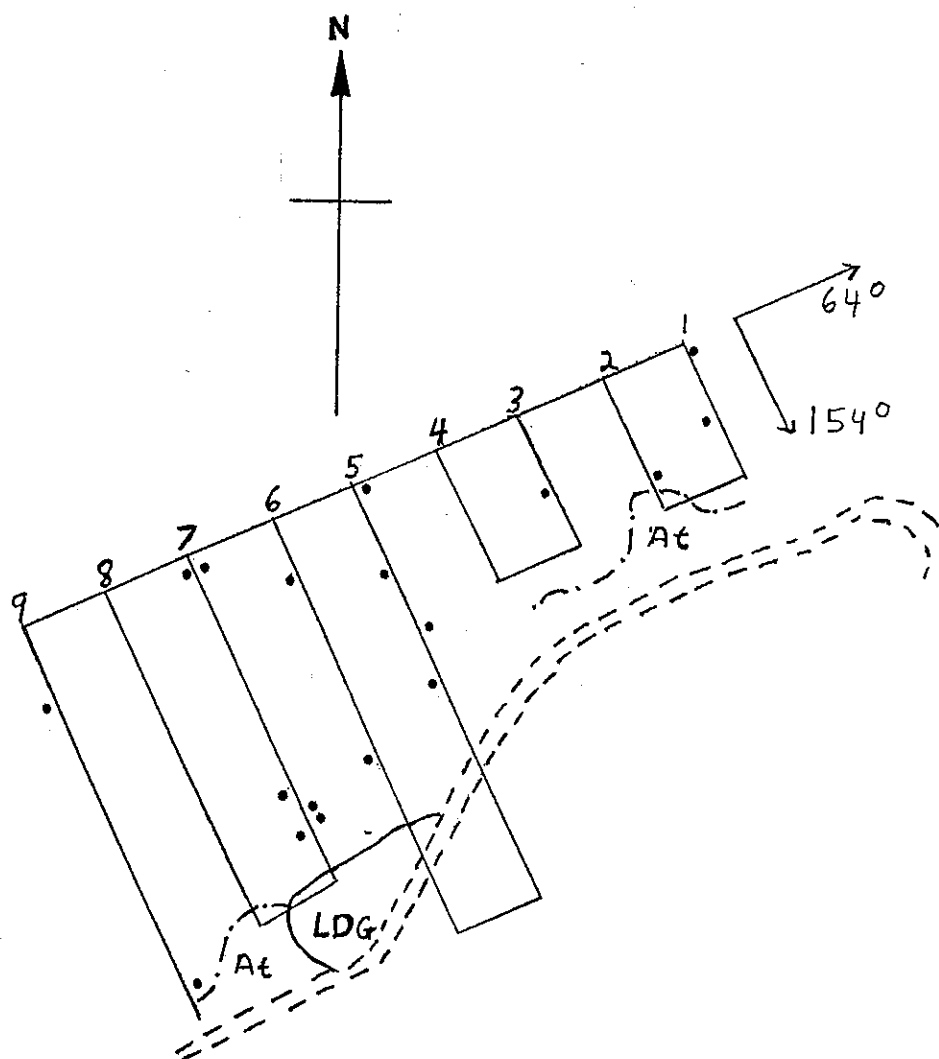
FIGURE 3 **LOCATION OF SAMPLE STRIPS AND
INFECTED STUMPS IN AREA 3**



• Stump infected with *I. tomentosus*

Strip	1	2	3	4	5	6	7	8	9	10
# Trees	26	44	72	82	82	68	73	69	18	6
% Infected	0.0	15.9	4.2	3.7	9.8	23.5	27.4	11.6	0.0	0.0

FIGURE 4 **LOCATION OF SAMPLE STRIPS AND**
INFECTED STUMPS IN AREA 4



• Stump infected with *I. tomentosus*

Strip	1	2	3	4	5	6	7	8	9
# Trees	11	8	9	16	57	70	34	47	39
% Infected	18.2	12.5	11.1	0.0	5.3	2.9	17.6	0.0	5.1

FIGURE 5 LOCATION OF BLOCK BOUNDARIES IN RELATION
TO *I. TOMENTOSUS* INCIDENCE IN AREA 1

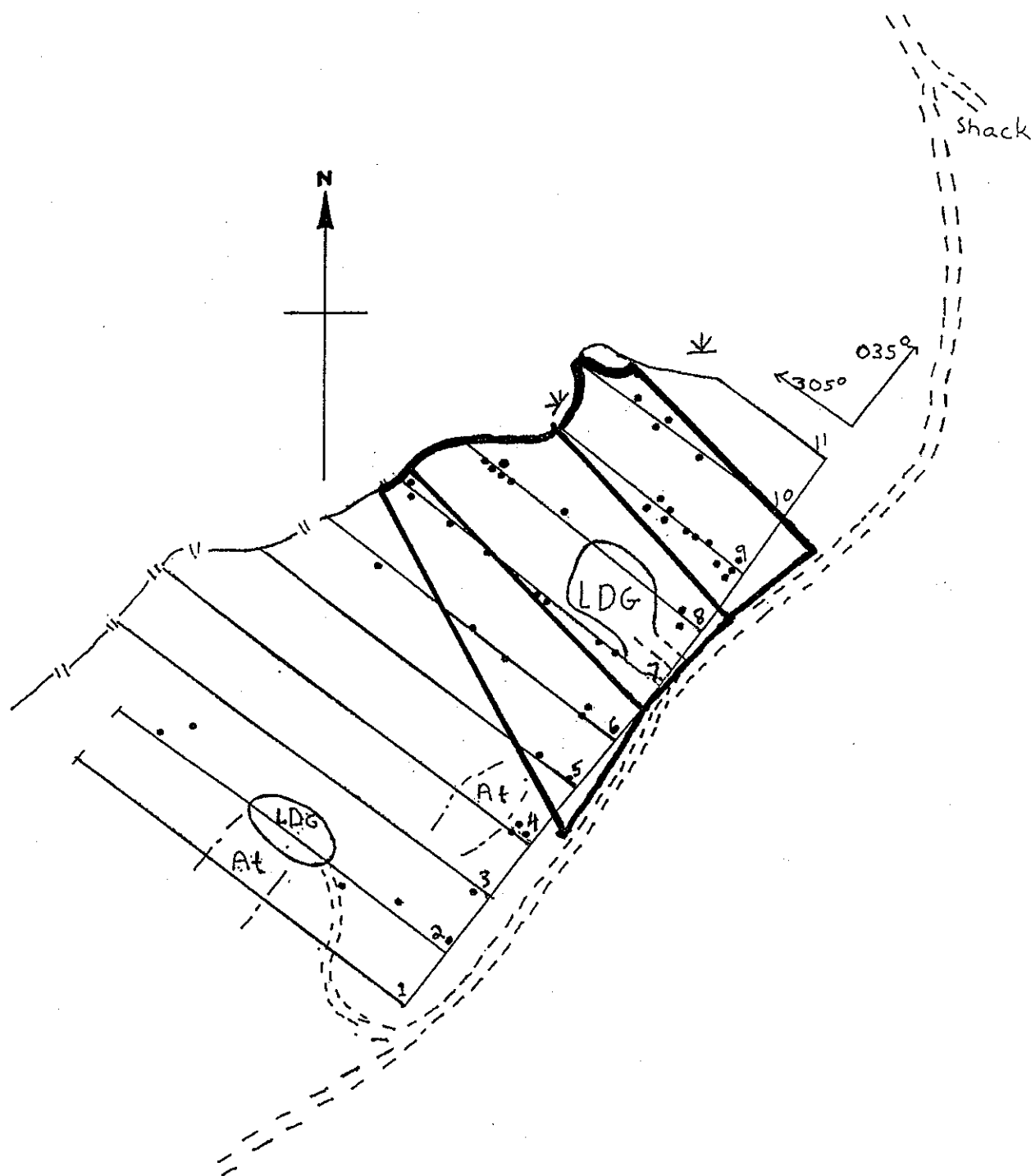


FIGURE 6 **LOCATION OF BLOCK BOUNDARIES IN RELATION**
TO I. TOMENTOSUS INCIDENCE IN AREA 2

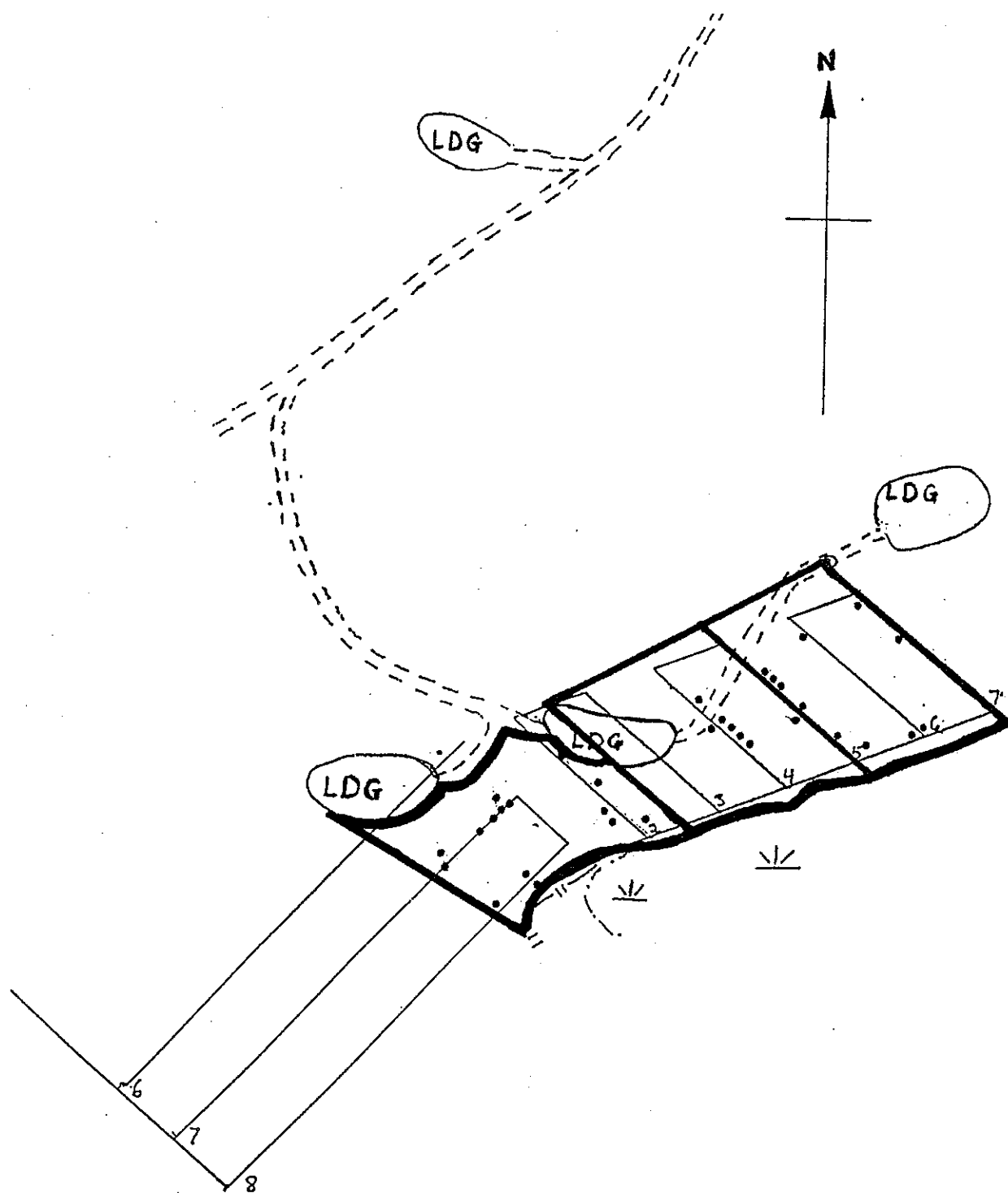


FIGURE 7 LOCATION OF BLOCK BOUNDARIES IN RELATION
TO *I. TOMENTOSUS* INCIDENCE IN AREA 3

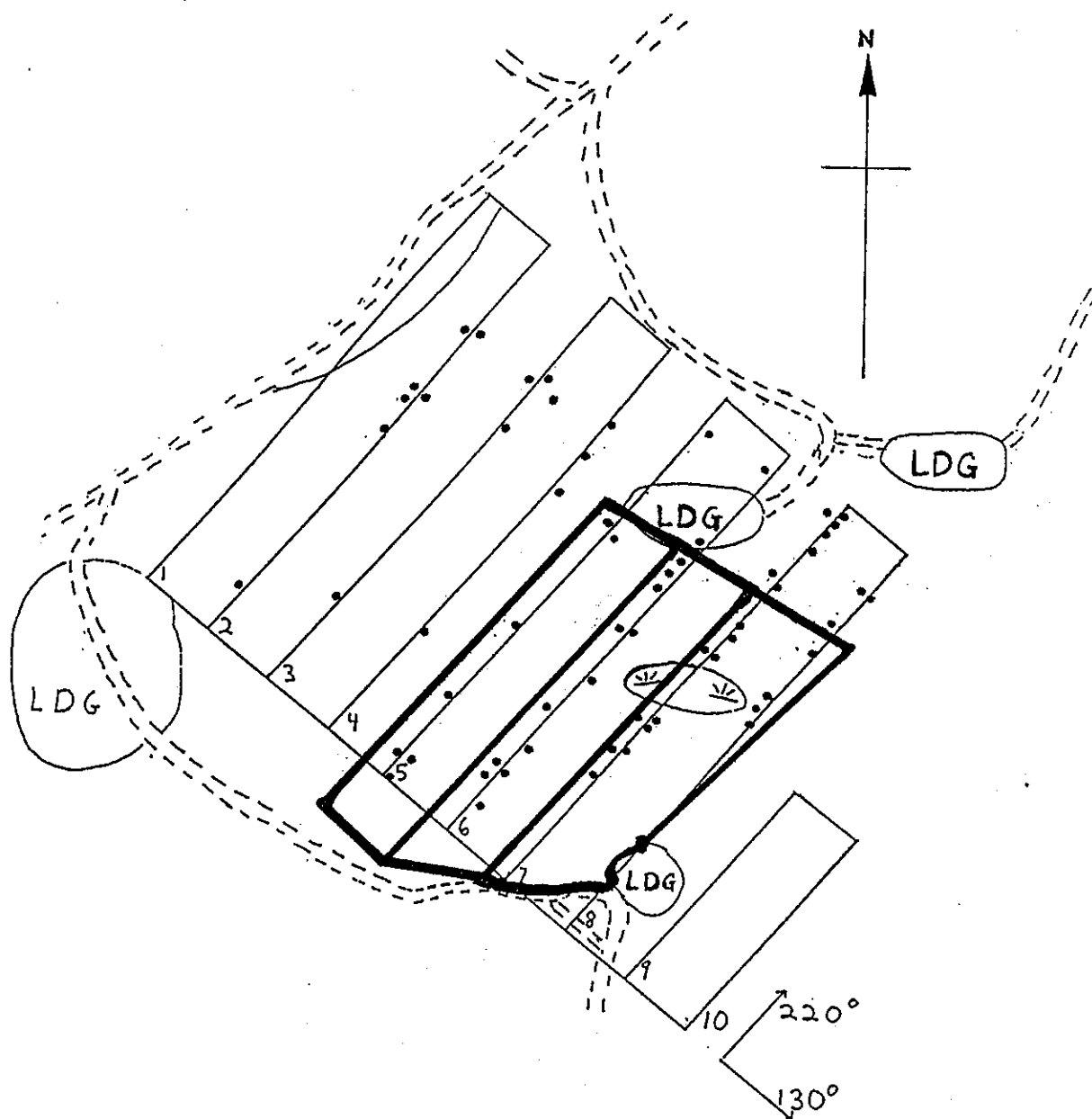


FIGURE 8 **LOCATION OF BLOCK 1, PLOTS A, B AND C**

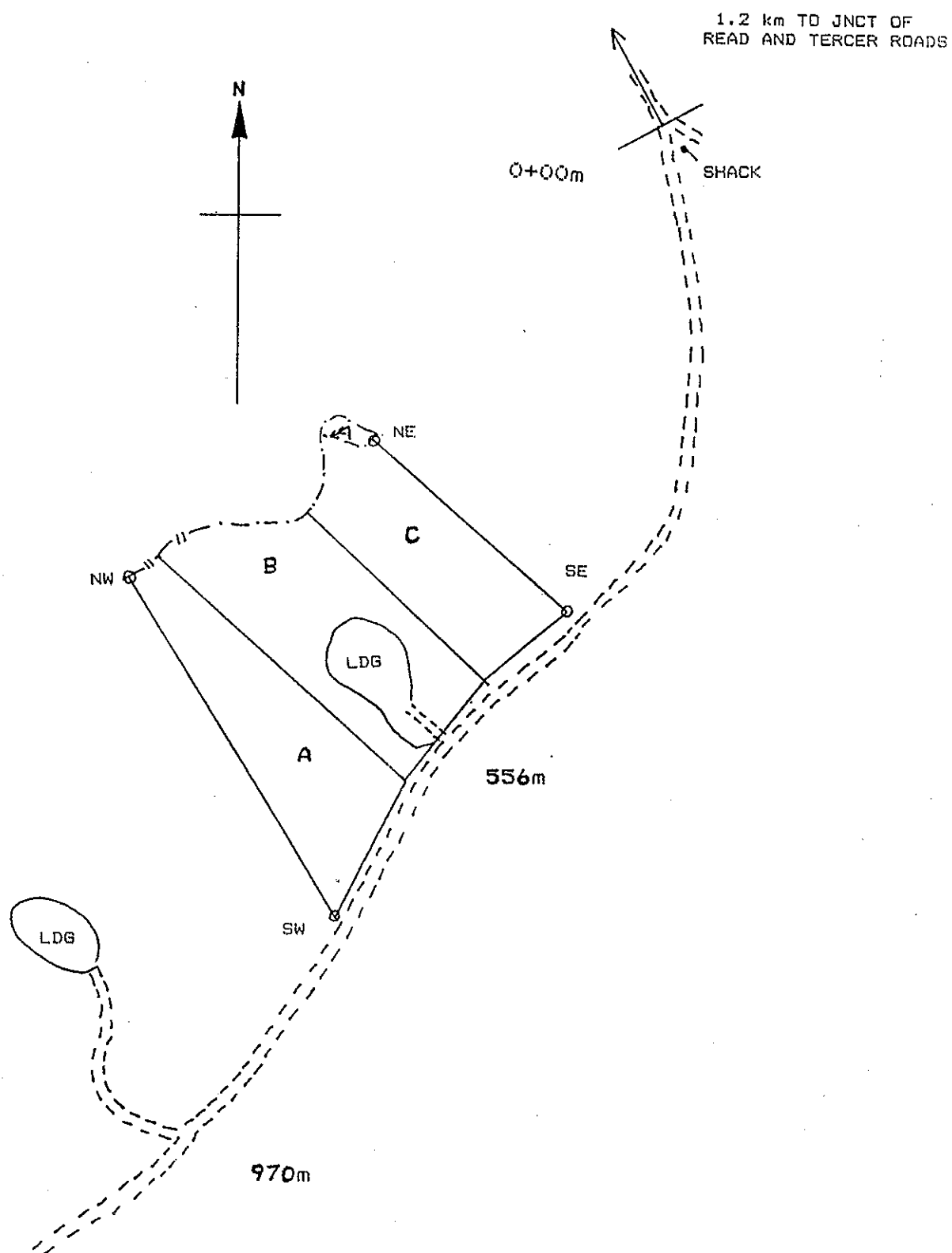
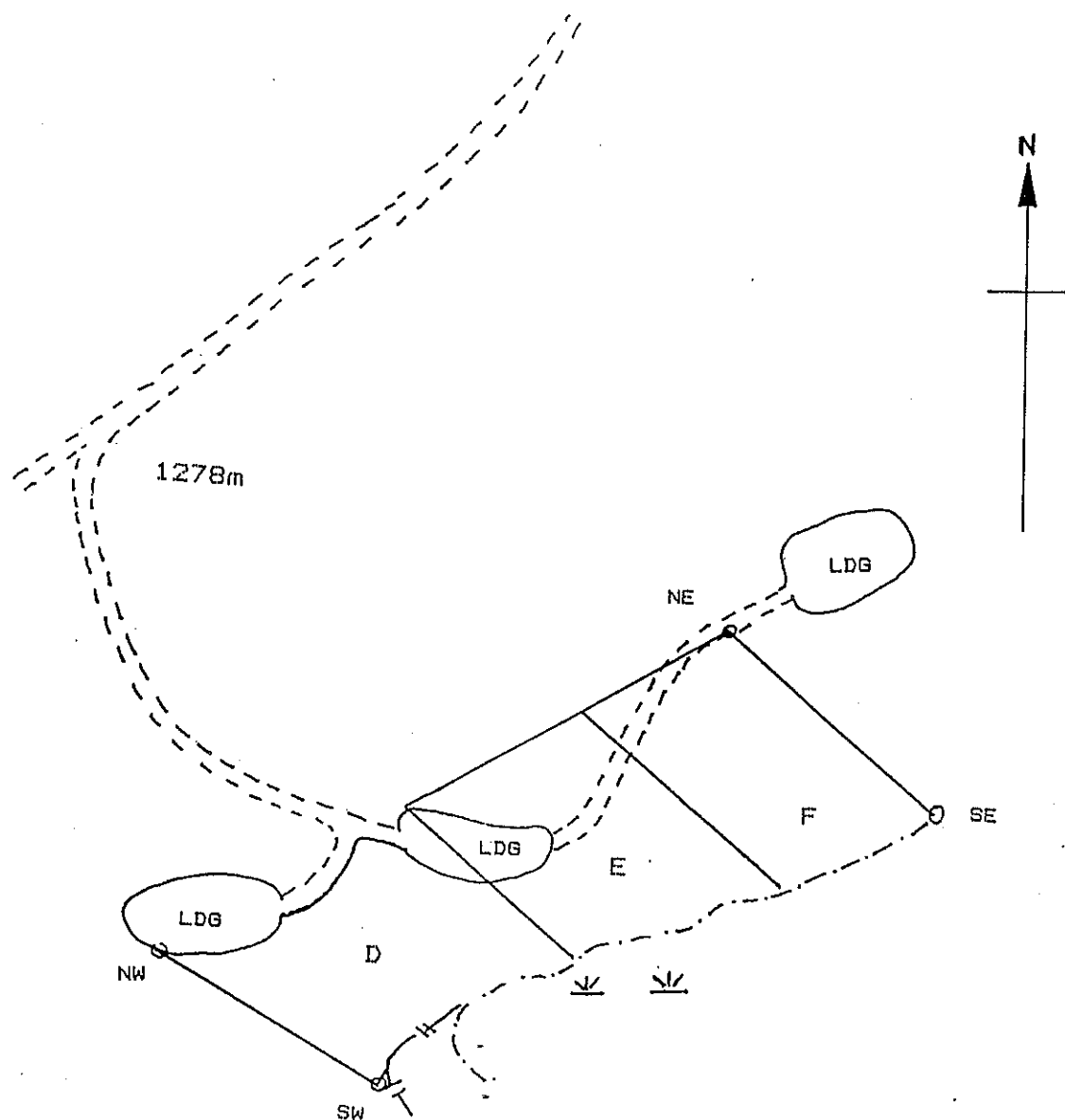
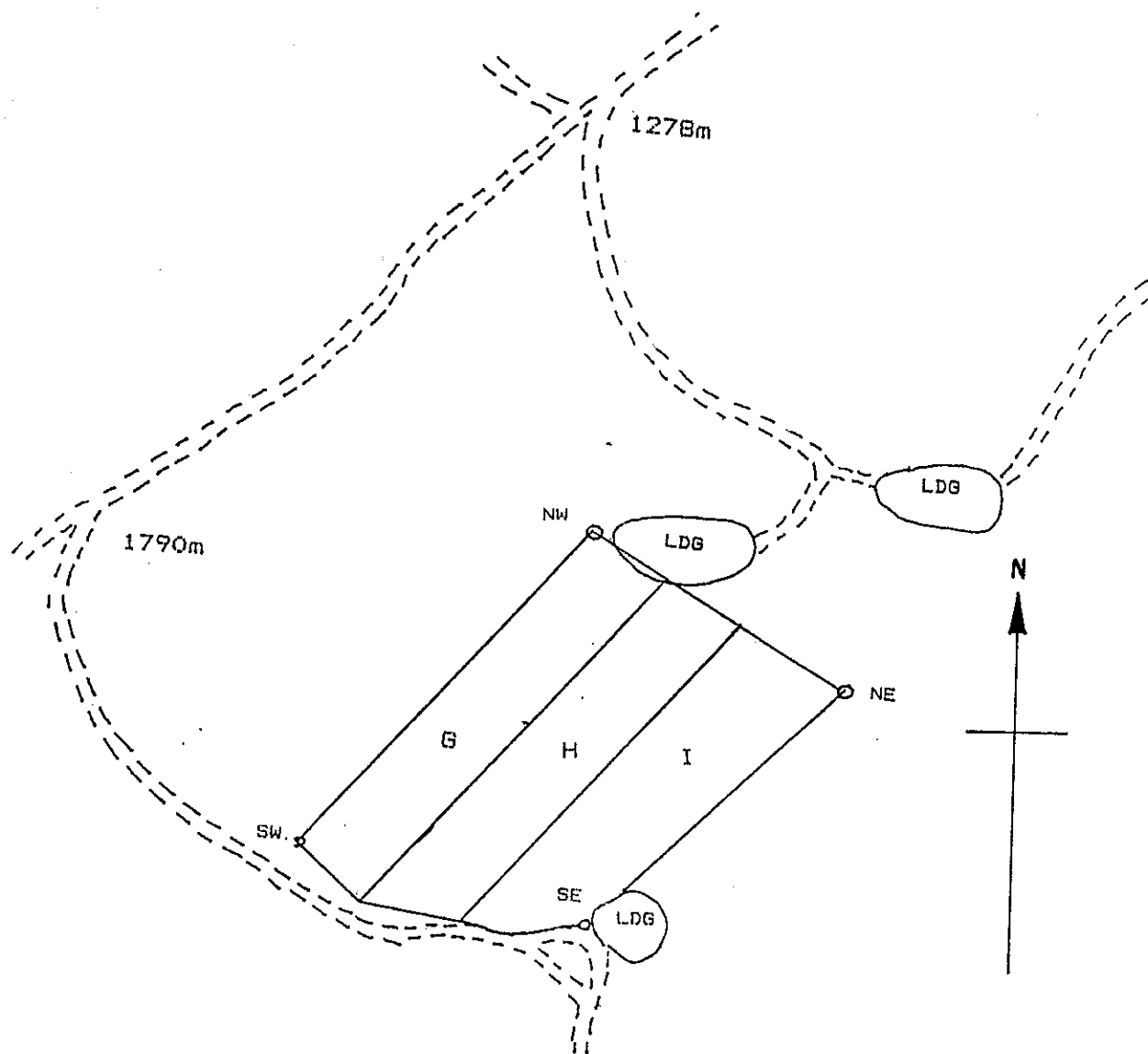


FIGURE 9 **LOCATION OF BLOCK 2, PLOTS D, E AND F**



Block and plot boundaries marked with pink ribbon

FIGURE 10 **LOCATION OF BLOCK 3, PLOTS G, H AND I**



Block and plot boundaries marked with pink ribbon

FIGURE 11 **LOCATION OF BLOCKS 1, 2 AND 3**

