

LLYN BRIANNE ACID WATERS PROJECT

Summary of Catchment Characteristics

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## 1. INTRODUCTION

This booklet contains a summary of basic information for the catchments draining in to the Camddwr (CI catchments) and the reservoir (LI catchments) at Llyn Brianne. The data are provided as tables and maps together with summaries of the geology of the area and the experimental land management treatments. At the time of writing, mapping and classification of the semi-natural vegetation of the catchments is incomplete. Vegetation maps and tables of percentage cover will be produced and circulated when available, probably during the autumn of 1990.

The information gathered together in this booklet has come from a variety of sources. The compilers are grateful to the following for providing much of the basic data:

Mr Steve Brown (NRA), Dr Alistair Donald (NRA), Mr Rob Donaldson (Forestry Commission), Mr Graham Heath (Economic Forestry Group), Dr Mike Hornung (ITE Merlewood), Dr Angus Mackie (Cambridge University), Mr Andrew Mclauchlin (ITE Bangor), Dr S Smallwood (Cambridge University), Mr Chris Soulsby (UCW Swansea), Dr Rory Walsh (UCW Swansea).

## 2. SUMMARY OF EXPERIMENTAL LAND MANAGEMENT TREATMENTS

### Catchment CI2

This is a moorland catchment with extensive areas of peat. Eighty tonnes of powdered limestone (Minfil 50; see Table 1) were applied to the stream source areas, which in this case are mainly located in the immediate vicinity of the stream. Approximately 50% of the source area was treated giving a treatment rate of between 15 to 20 t ha<sup>-1</sup> over 5 ha. The lime was applied between 13<sup>th</sup> and 17<sup>th</sup> of June 1988.

### Catchment CI3

A segment of about 20 ha (c. 25%) of this moorland catchment was agriculturally improved following standard practice as recommended by ADAS (Le Grice 1986, pers comm.). The following treatment commenced on the 15<sup>th</sup> May 1986:

1. Ploughing of area followed by harrowing
2. Application of powdered (95% < 1.18mm grain size) agricultural magnesian limestone (containing at least 35% MgCO<sub>3</sub>) at a rate of approximately 10 tonnes per hectare, followed by harrowing (17<sup>th</sup> to 24<sup>th</sup> June 1986)
3. Application of 15 tonnes of 5-20-15 "Sheppy" compound fertilizer and 7.5 tonnes of "Sheppy-Cymru" phosphate (24<sup>th</sup> to 25<sup>th</sup> June 1986)
4. Seeding with Lambhill seed mixture at a rate of 42 kg per hectare

The treatment was completed on the 26<sup>th</sup> June 1986. The compound fertilizer comprised ammonium phosphate, calcium phosphate and potassium chloride. The "Sheppy-Cymru" phosphate contained 31% P<sub>2</sub>O<sub>5</sub> as calcium phosphate and a small quantity of nitrogen (2%) in the ammonium form.

#### Catchment CI4

Forestry-style contour ploughing was undertaken on approximately 8 ha of this moorland catchment in October 1986. The area ploughed consisted of a mixture of deep peats and peaty gley soils.

#### Catchment CI5

The whole area of this moorland catchment was limed with 300 tonnes of Minfil 50 (Table 1) giving a rate of approximately 9 tonnes per hectare. The treatment was performed in September 1987. The lime was spread by tractor and by hand following distribution within the catchment by helicopter.

#### Catchment LI2

Conifers were cleared from the stream bankside of this catchment by the Forestry Commission and contractors working for the Economic Forestry Group between May and August 1986. The minimum width cleared was 15 m on the main stream and 10 m on each of the principal tributaries. A large section of the south bank was cleared back to 50m at the request of the Forestry Commission. Sixty tonnes of magnesian limestone were applied by helicopter between 18<sup>th</sup> and 23<sup>rd</sup> of September 1986, at a rate of approximately 10 tonnes per hectare, on a 30 m wide strip on the main stream and a 20 m wide strip on the tributaries.

#### Catchment LI3

This catchment was originally used for bankside clearance of conifers without liming in 1983. In November 1989, 100 tonnes of pelletised chalk were applied by helicopter to approximately 4 ha of source area within the forest.

#### Catchment LI4

An area of 4 ha of deep peat and wetland source area, within the unplanted headwaters of this forest catchment, was limed with 100 tonnes of Minfil 50 (Table 1) between 24<sup>th</sup> September and 6<sup>th</sup> October 1987. This was supplemented by a further 20 tonnes applied to a narrow strip of streamside wetland, approximately 0.6 ha in area, between 30<sup>th</sup> November and 4<sup>th</sup> December 1987. The first lime application was spread by tractor and the second by hand.

### 3. SUMMARISED GEOLOGY OF THE LLYN BRIANNE CATCHMENTS

The area consists of Lower Silurian (Llandovery) and Upper Ordovician (Ashgill) sediments. The succession is dominated by mudstones but there are localised bodies of sandstone and conglomerate. During the last phase of ice advance, the area was glaciated and much of the outcrop is now obscured by till.

The material presented here has been summarised from Mackie (1987) and Mackie and Smallwood (1987) which give very detailed information on the geology of the Llyn Brianne area. Only the formations present within the experimental catchments have been described here in order of increasing age.

#### Description of geological formations

##### Pysgotwr Formation (Llandovery)

This formation consists of two interbedded facies. These are (1) coarse-grained, poorly-sorted sandstones containing quartz, some feldspars and lithic fragments comprised of quartzites, greywackes, mudstones and acid volcanics interbedded with (2) a thin-bedded, fine-grained sandstone/mudstone facies very similar to the Hafdre Formation described below. Locally, within the Pysgotwr Formation, a conglomerate facies also occurs.

##### Hafdre Formation (Llandovery)

This consists of massive to graded mudstones with abundant chlorite, interbedded with well-sorted silts and fine sandstones which are quartz dominated. Pale-grey weathering phosphatic concretions are found near the top of the mudstone units.

##### Llyn Brianne Formation (Llandovery)

This formation comprises interbedded mudstones, silts and sandstones. The coarser sandstone units contain quartz clasts and some mudstone clasts in a muddy matrix. The fine units are quartz silts in a muddy chlorite-rich matrix. At the type section, a

coarse sandstone facies is found 50m above the base of the unit. This sandstone is very rich in shelly debris (mainly brachiopods) with a locally developed pervasive calcite cement.

#### Cefn Isaf Formation (Llandovery)

This formation is dominated by medium-dark grey, graded siltstone and mudstone units giving the formation a distinctive banded appearance in outcrop. At the base of the formation, silt layers become locally coarser and sometimes contain shelly debris. Coarse sandstones and conglomerates have been found only near the Brianne dam. The conglomerates contain numerous mud clasts and shelly material (brachiopod, crinoid and coral debris).

#### Trawsnant Formation (Llandovery)

This formation is dominated by finely-laminated, dark/pale mudstones occasionally interbedded with lenticular bodies of siltstone. The pale mudstones are generally massive, whilst the dark muds contain fine laminae of silt and black organic-rich layers.

#### Cefn Ystradffin Formation (Ashgill)

This is a highly complex formation consisting of two members.

##### (a) Nant y Ffin Member (upper member)

This member is dominated by massive, dark blue-grey mudstones often showing rusty weathering due to pyrite content. The mudstones often contain thin, fine-grained sandstone interbeds and phosphatic concretions. Sandstone and conglomerate bodies also occur and are more extensive than in the Cwm Henog member. The sandstone units are generally coarse-grained and near the base of the member contain clusters and nodules of pyrite. Pebbly mudstones and coarse conglomerates are also common, the latter with a matrix of coarse sandstone. Corals and brachiopods have been reported from this member.



(b) Cwm Henog Member (lower member)

This member is a medium-grey mudstone with fine dark/pale laminae (similar to the Trawnant Formation) or extensive mottling (Chondrites). The mottled mudstones contain corals and brachiopods. Isolated lenticular arenite bodies upto 5m thick also occur, consisting of grey, medium to coarse-grained sandstone and conglomerate.

**REFERENCES**

Mackie, A.H. 1987. The Geology of the Llyn Brianne Area, Central Wales. Unpublished PhD Thesis, University of Cambridge.

Mackie, A.H. and Smallwood, S. 1987. A revised stratigraphy and sedimentology of the Abergwesyn-Pumpsaint area, mid-Wales. Geol. Journal, 22, 45-60.

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Table 1. Chemical composition and grain size distribution of 'Minfil 50' powdered limestone.

Compound	Percentage by weight (%)
CaCO <sub>3</sub>	98.7
MgO	0.2
SiO <sub>2</sub>	0.6
Al <sub>2</sub> O <sub>3</sub>	0.1
Fe <sub>2</sub> O <sub>3</sub>	0.04
Loss on ignition	43.1

Particle size ( m)	Percentage by weight (%)
50	98
<30	93
<10	52

Table 2. Catchment areas, mean catchment altitudes and catchment rainfall equations.

Catchment	Catchment Area (ha)	Mean catchment altitude	Catchment rainfall equation
LI1	254.9	441.8	R = 1.1016 AWS
LI2	108.9	432.5	R = 1.0881 AWS
LI3	65.5*	414.9	R = 1.0625 AWS
LI4	31.1+	418.2	R = 1.0673 AWS
LI6	73.5	437.4	R = 1.0952 AWS
LI7	73.5 -	462.0	R = 1.1310 AWS
LI8	65.7	453.8	R = 1.1191 AWS
CI2	53.5	476.3	R = 1.1825 M
CI3	86.1	450.3	R = 1.1456 M
CI4	50.1	442.9	R = 1.1352 M
CI5	33.4	430.7	R = 1.1179 M
CI6	60.7	410.3	R = 1.0890 M

Key: AWS = Automatic Weather Station Trawsnant  
ADJUSTED data (Contact IoH)

M = Maesglas/Camddwr ADJUSTED data (Contact R.Walsh UCS)

\* Includes 'treated' areas of LI4 natural catchment  
draining into LI3  
'Natural' catchment = 62.2 ha

+ 'Natural' catchment area; effective area of LI4 may be  
as small as 27.8 ha because of headwater areas draining  
into LI3 treated plots.

Altitudinal corrections used were: Camddwr 0.001468 mm/mm/m  
LI Catchments 0.001454 mm/mm/m

Table 3. Legend for soil maps

Map Unit	Dominant soils
1	Humic ranker
2	Brown ranker
3	Brown podzolic soil
4	Brown podzolic soil - ferric stagnopodzol intergrade
5	Ferric stagnopodzol
6	Ironpan stagnopodzol
7	Gleysoil
8	Humic gleysoil
9	Cambic stagnohumic gleysoil
10	Raw peat soil (flushed)
11	Raw peat soil

Complex units designated by a combination of the above numbers, eg. 7/8 indicates a gleysoil/humic gleysoil complex.

Table 4. Areas (ha) of main soil types for the CI catchments

Map Unit	Soil Type	Catchment					
		CI2	CI3	CI4	CI5	CI6	
2	Brown ranker	2.5					
3	Brown Podzolic	3.1			7.4	10.2	
3/4			11.7	9.0			
5	Ferric stagnopodzol	8.4	33.6		4.9	8.1	
6	Ironpan stagnopodzol			1.4		2.2	
8	Humic gleysoil	5.2	15.3		0.7		
9	Cambic stagnohumic gley	8.3	8.3	6.7	12.3	5.6	
10	Raw peat soil (flushed)	0.5	5.9	1.2	3.7	13.0	
11	Raw peat soil	26.0	11.1	27.8	3.2	5.6	
5/9				5.0		15.8	
9/1					1.1		

These data were compiled from digitised soil maps.

Table 5. Percentage cover of main soil types for the CI catchments.

Map Unit	Soil type	Catchment					
		CI2	CI3	CI4	CI5	CI6	
2	Brown ranker	4.7					16.9
3	Brown Podzolic	5.8				22.2	
3/4			13.6	17.6			
5	Ferric stagnopodzol	15.4	39.1		14.7	13.4	
6	Ironpan stagnopodzol			2.7		3.6	
8	Humic gleysoil	10.2	17.8		2.1		
9	Cambic stagnohumic gley	15.3	9.7	13.1	36.9	9.2	
10	Raw peat soil (Flushed)	0.9	6.9	2.3	11.1	21.5	
11	Raw peat soil	47.8	12.9	54.4	9.6	9.2	
5/9				9.8		26.2	
9/1					3.3		

These data were compiled from digitised soil maps.

Table 6. Areas (ha) of main soil types for the LI catchments.

Map Unit	Soil Type	LI1	LI2	LI3	LI4	LI6	LI7	LI8
2	Brown ranker			1.4	0.5			
3	Brown Podzolic	51.5			3.6	11.7	12.0	9.7
4	BPS/Fs Interggrade	59.3	14.4	21.1	5.8	9.7	5.4	
5	Ferric stagnopodzol	17.2		1.3		11.5		15.1
6	Ironpan stagnopodzol	0.8	1.3	5.4	7.8			0.9
7	Gleysoil					1.3		
8	Humic gley					9.6		2.2
9	Cambic stagnohumic gley	50.4	36.8	29.5	8.1		9.7	2.9
10	Raw peat soil (flushed)			2.9	5.5	3.1		
11	Raw peat soil	61.6	16.1			26.1	25.6	28.3
5/9		13.9					16.7	
7/8			4.8		0.2			6.1
4/5			35.1					
8/10							4.8	

These data were compiled from digitised soil maps.





Table 8. Areas (ha) of main tree species in the LI catchments.

Species	Planting Date	Catchment					
		LI1	LI2	LI3	LI4	LI7	LI8
Sitka Spruce	57						
	58		9.2	8.9	3.1		
	59			14.3	9.3		
	61	145.0 <sup>1</sup>	76.7				
	62	51.4 <sup>1</sup>					
	63	39.2					
	64	18.9					
	71					14.7	24.1
	77						37.8
	?	0.3					
Lodge Pole Pine	57		7.1	1.5			
	58			4.6			
	59			3.8	2.6		
Japanese Larch	57		5.8	6.1	0.3		
	58			1.7	3.7		
	59						3.2
LP/SS <sup>2</sup>	57		10.2	9.4			
Hardwoods							0.6
Unplanted				2.3	12.3	59.7	
TOTAL (ha)		254.8	109.0	62.2	31.3	74.4	65.7

1 Planted in 1962-63

2 Lodgepole pine - Sitka spruce mixture.

Table 9. Percentage cover of main tree species in the LI catchments.

Species	Planting Date	Catchment							
		LI1	LI2	LI3	LI4	LI7	LI8		
Sitka Spruce	57								
	58		8.4	14.3	9.9				
	59			22.9	29.7				
	61	56.9	70.4						
	62	20.2 <sub>1</sub>							
	63	15.4							
	64	7.4							
	71								
	77					19.8	36.7		
	?	0.1					57.5		
Lodge Pole pine	57		6.5	2.4					
	58			7.4					
	59			6.1	8.3				
Japanese Larch	57		5.3	9.8	1.0				
	58								
	59			2.7	11.8			4.9	
LP/SS <sup>2</sup>	57		9.4	15.1					
Hardwoods									0.9
Unplanted				3.7	39.3		80.2		

1 Planted in 1962-63

2 Lodgepole pine - Sitka spruce mixture.

## LIST OF MAPS

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MAP 1 CI2/CI3 REFERENCE  
MAP 2 CI2/CI3 GEOLOGY  
MAP 3 CI2/CI3 SOIL  
MAP 4 CI2/CI3 VEGETATION (TO BE ISSUED)

MAP 5 CI4/CI5/CI6 REFERENCE  
MAP 6 CI4/CI5/CI6 GEOLOGY  
MAP 7 CI4/CI5/CI6 SOIL  
MAP 8 CI4/CI5/CI6 VEGETATION (TO BE ISSUED)

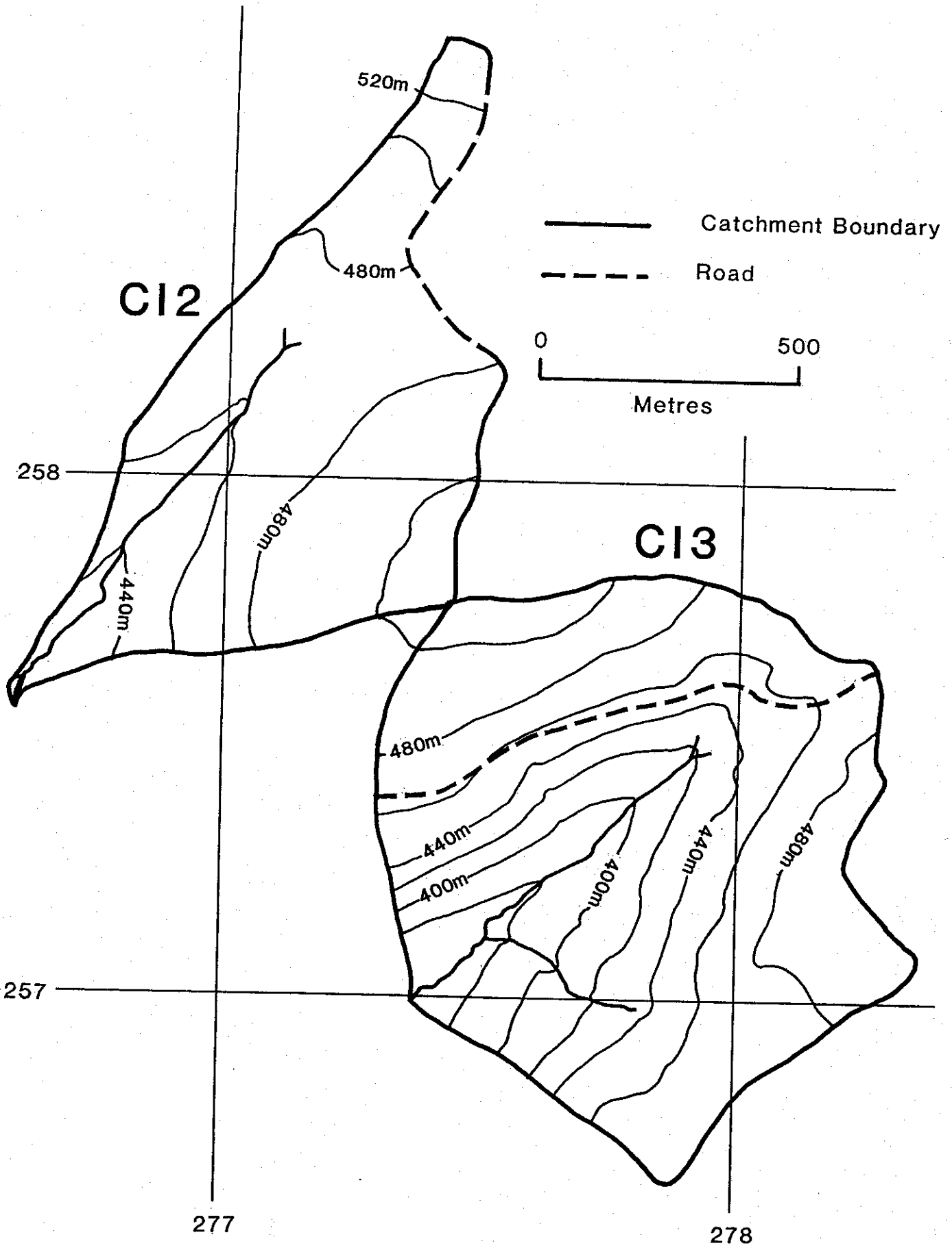
MAP 9 LI1 REFERENCE  
MAP 10 LI1 GEOLOGY  
MAP 11 LI1 SOIL  
MAP 12 LI1 FORESTRY

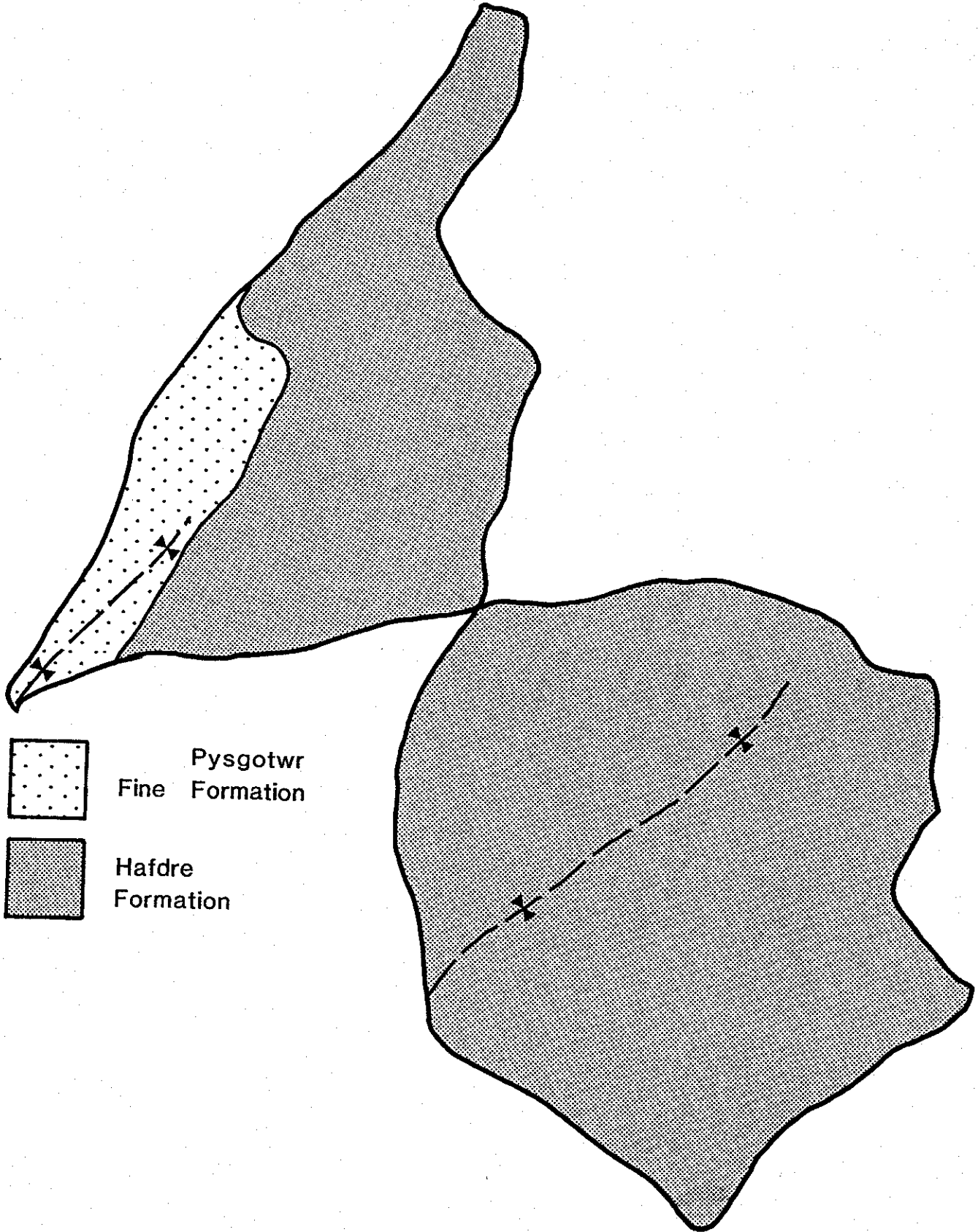
MAP 13 LI2 REFERENCE  
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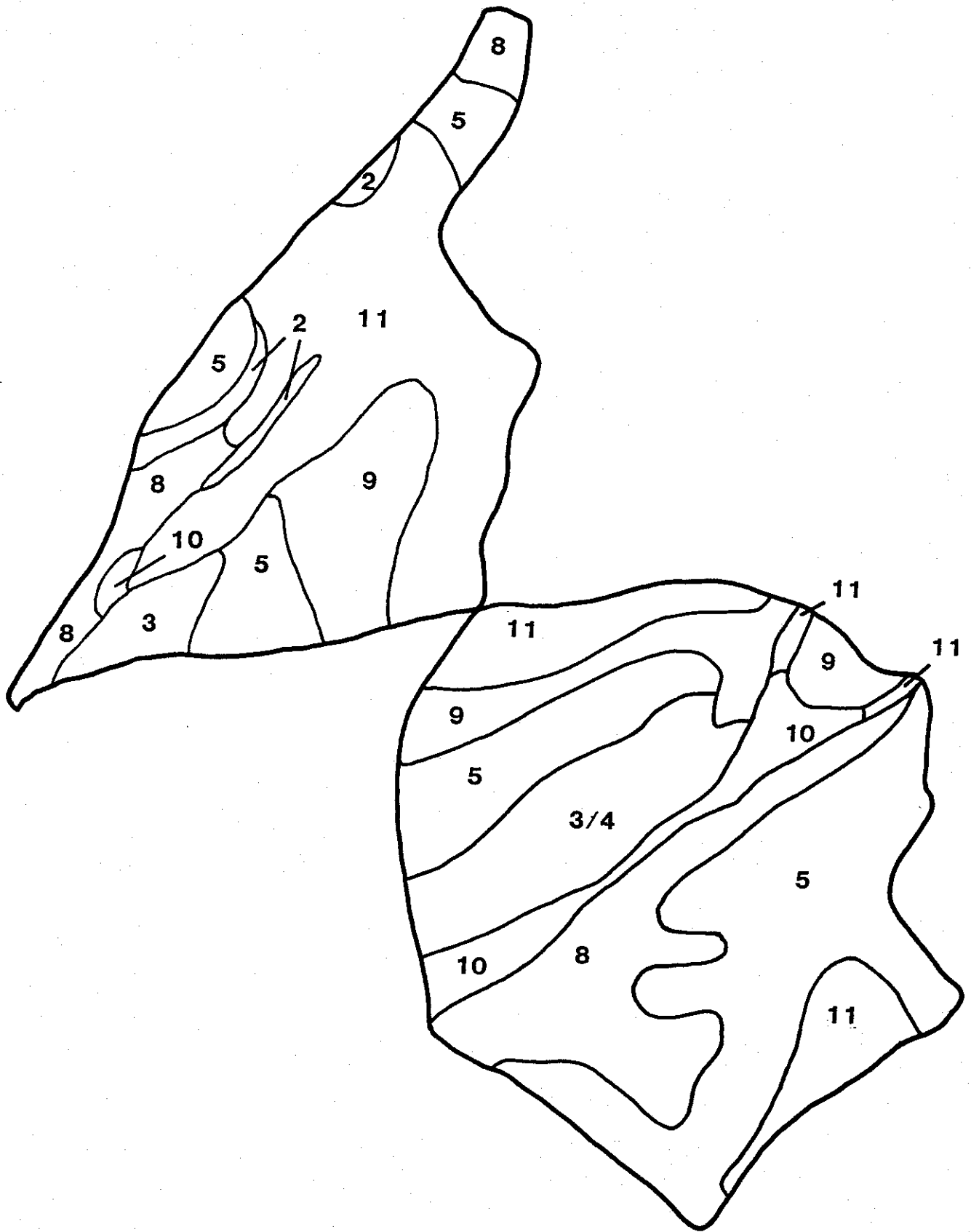
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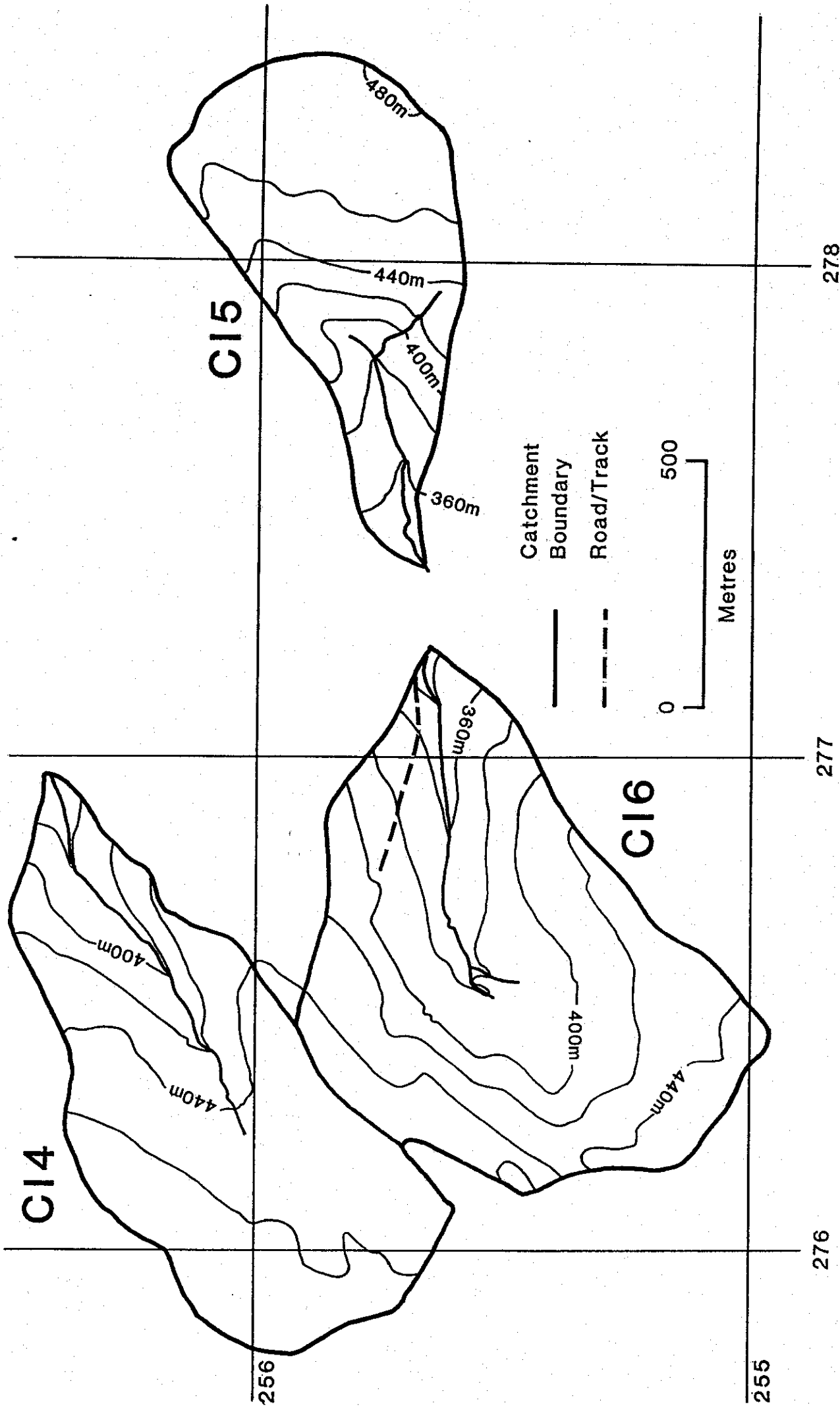
MAP 21 LI6 REFERENCE  
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MAP 25 LI7/LI8 REFERENCE  
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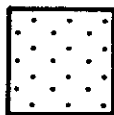




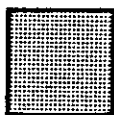




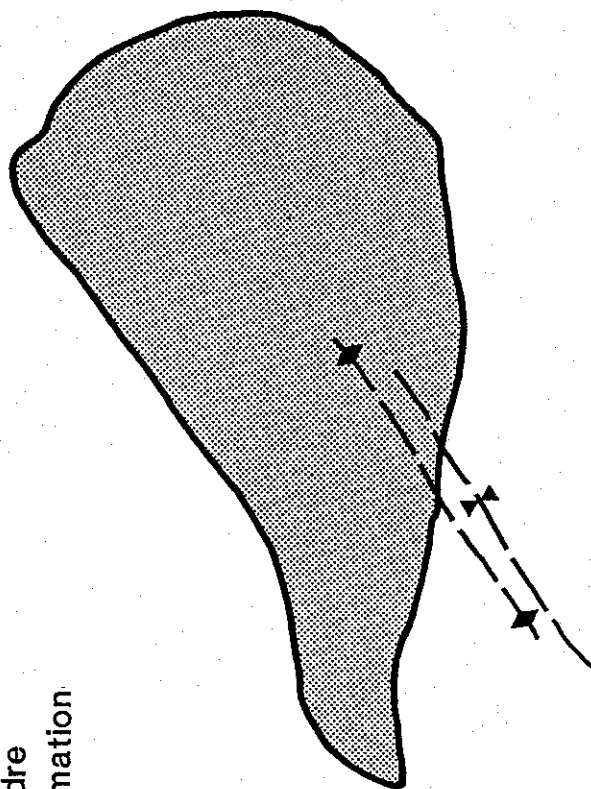
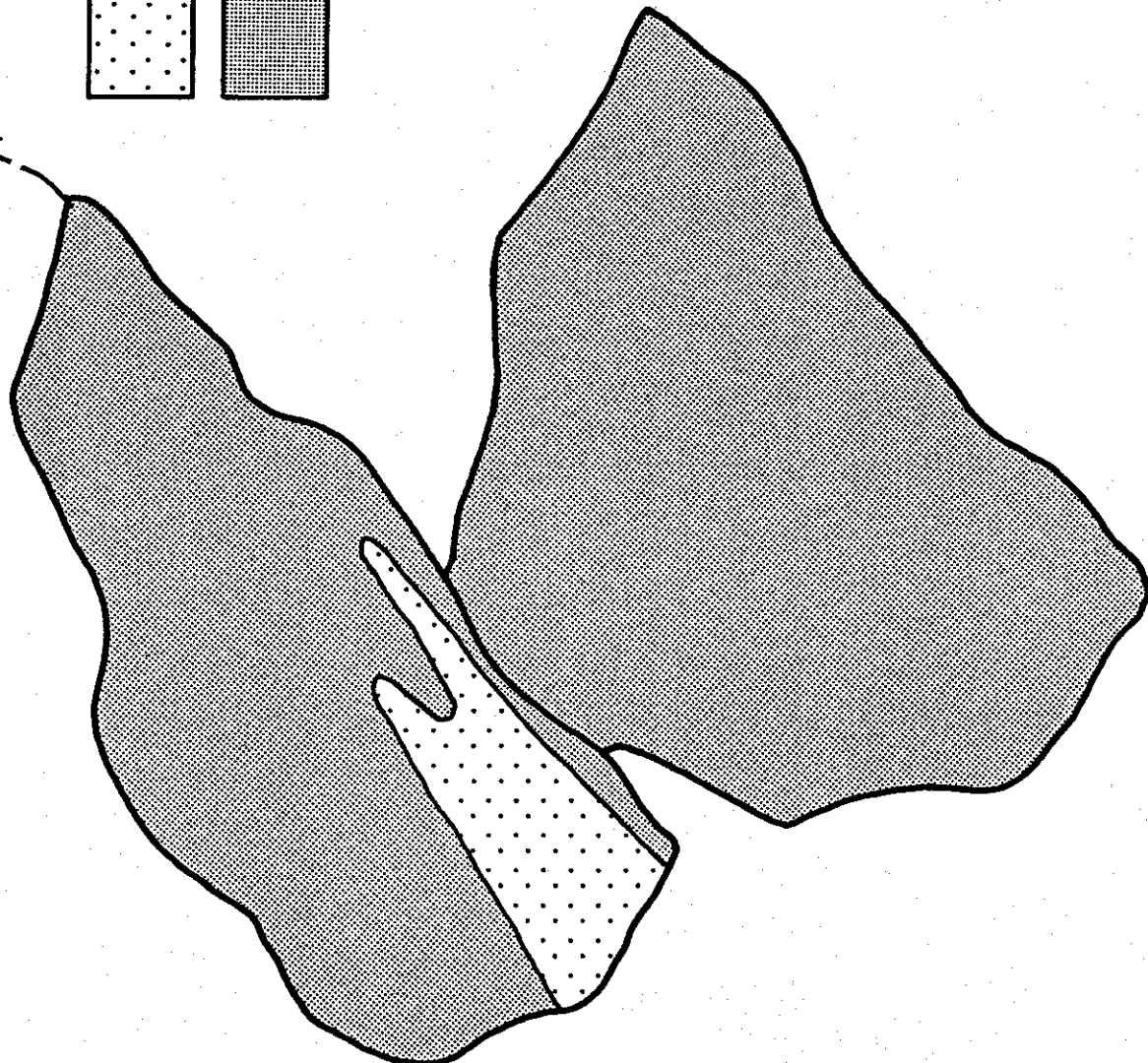




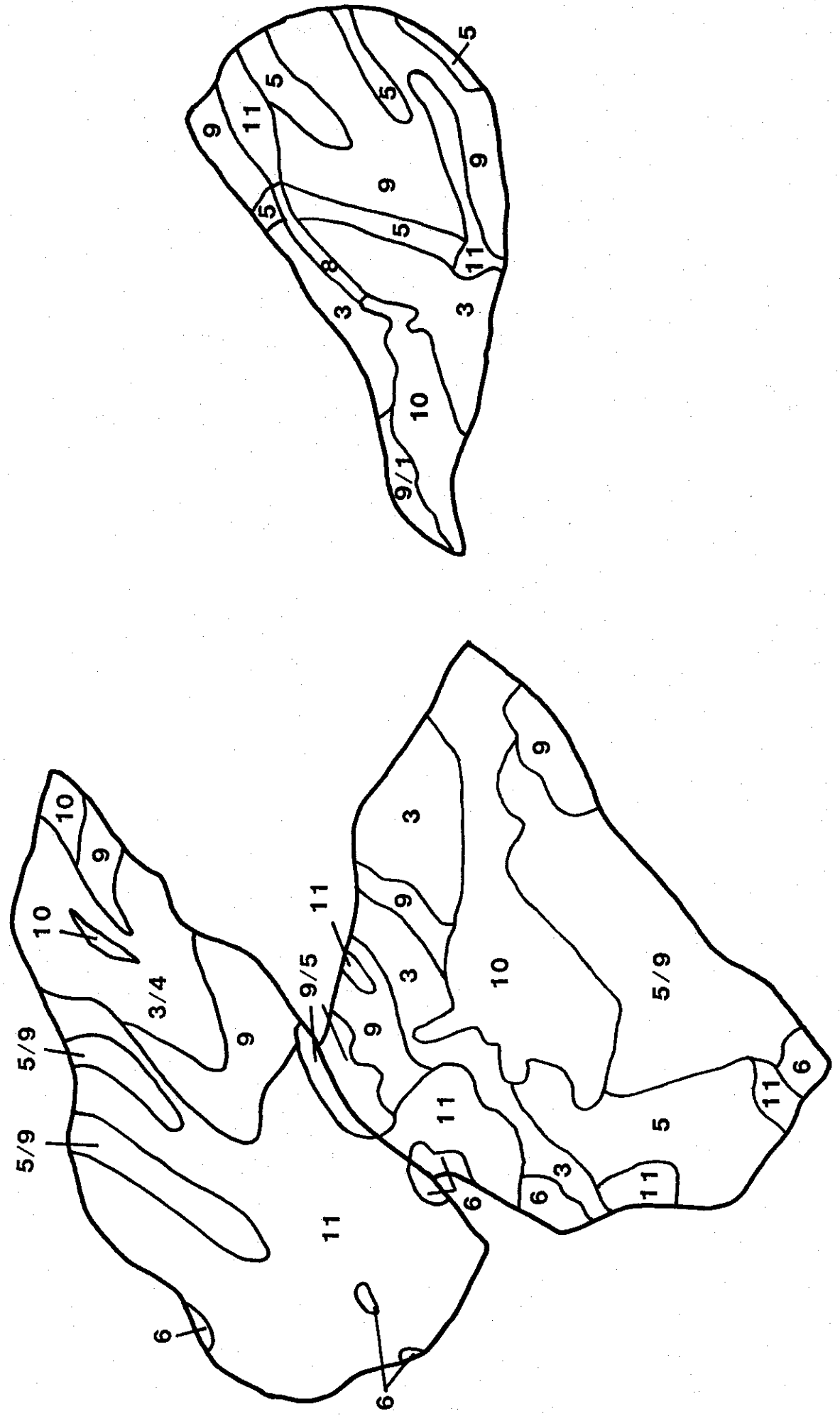
Fine Formation  
Pysgotwr Formation



Hafdre Formation



MAP 7 CI4/CI5/CI6 SOIL



LI1

255

254

253

281

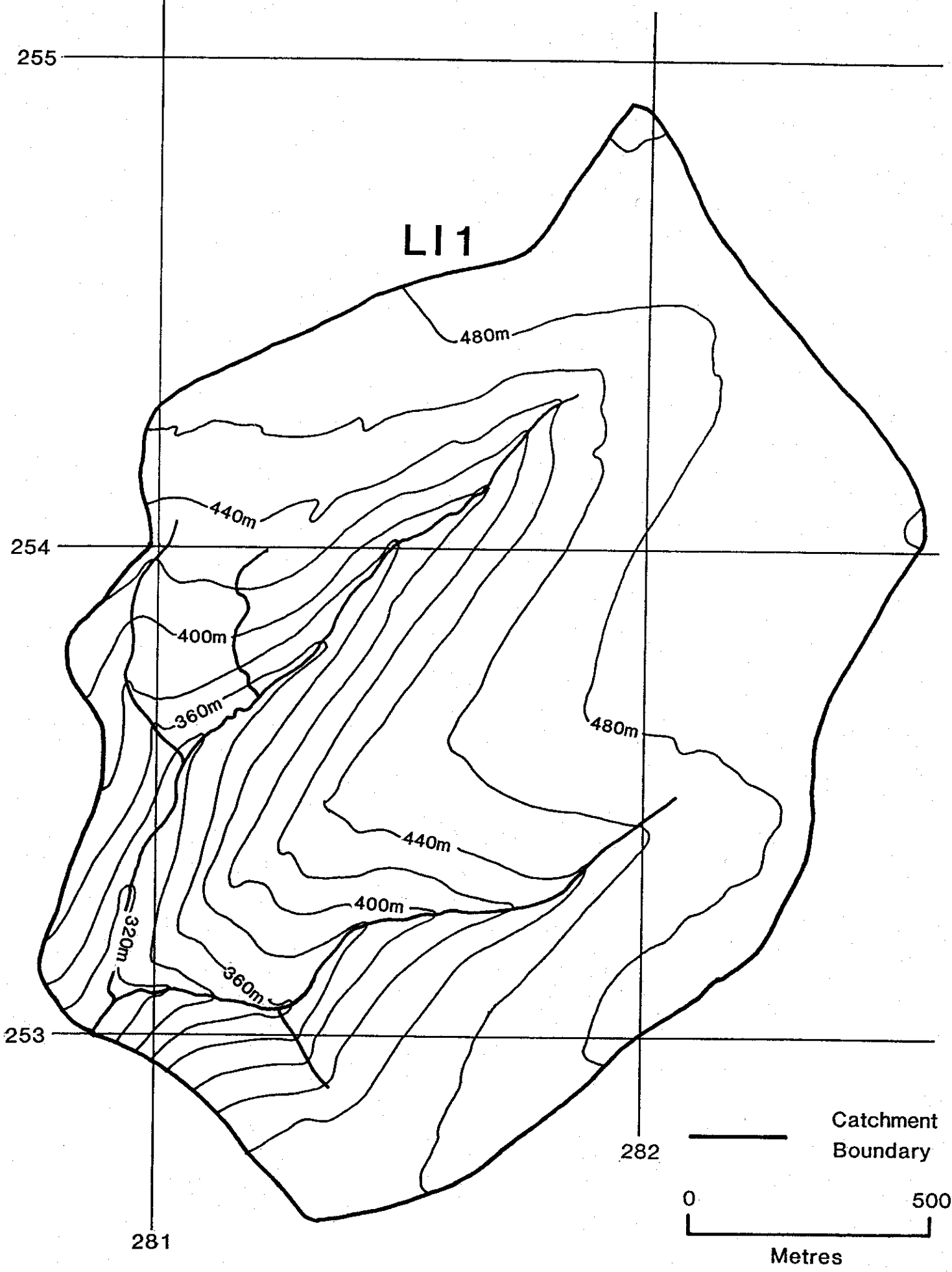
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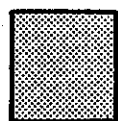
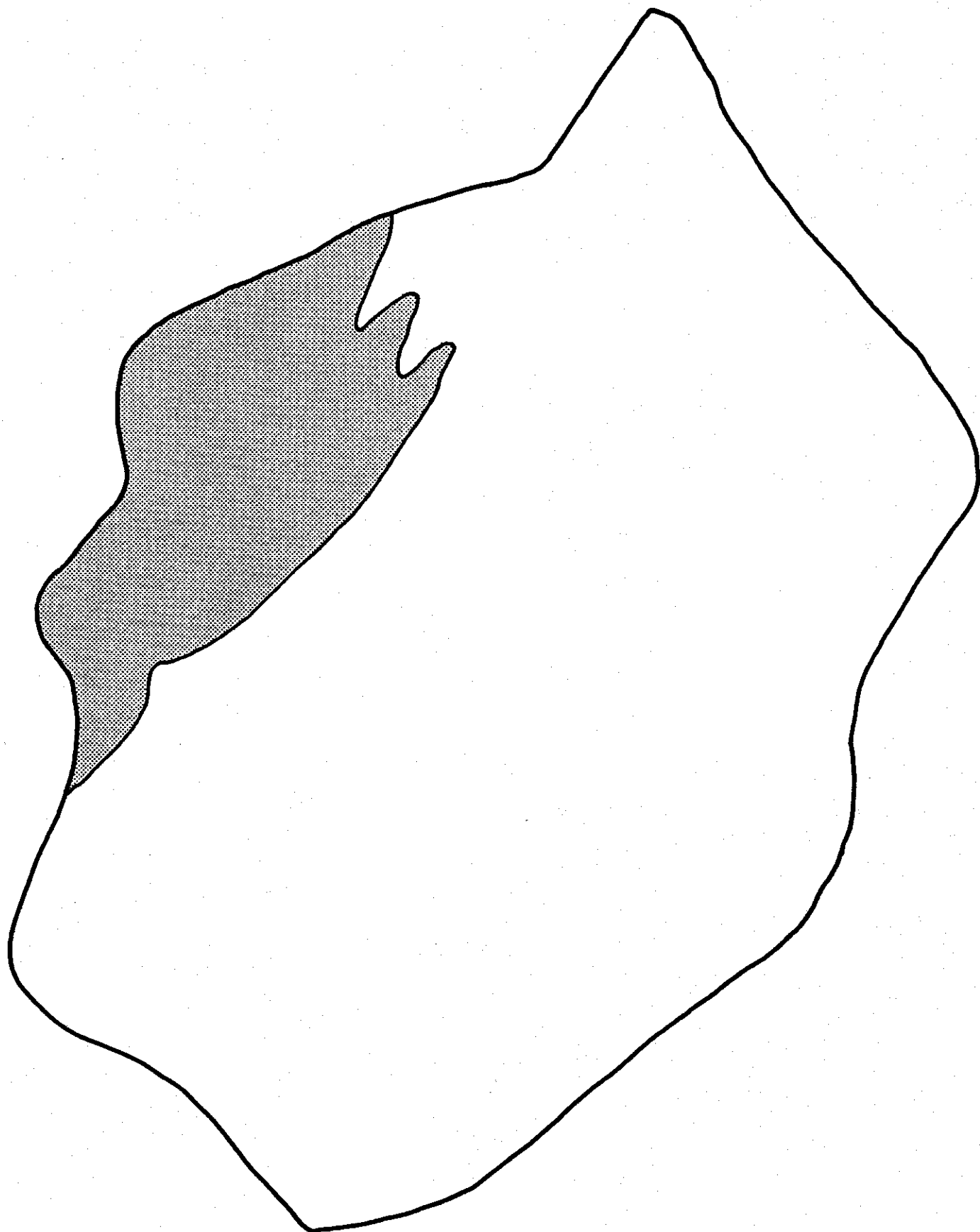
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500

Metres

Catchment  
Boundary

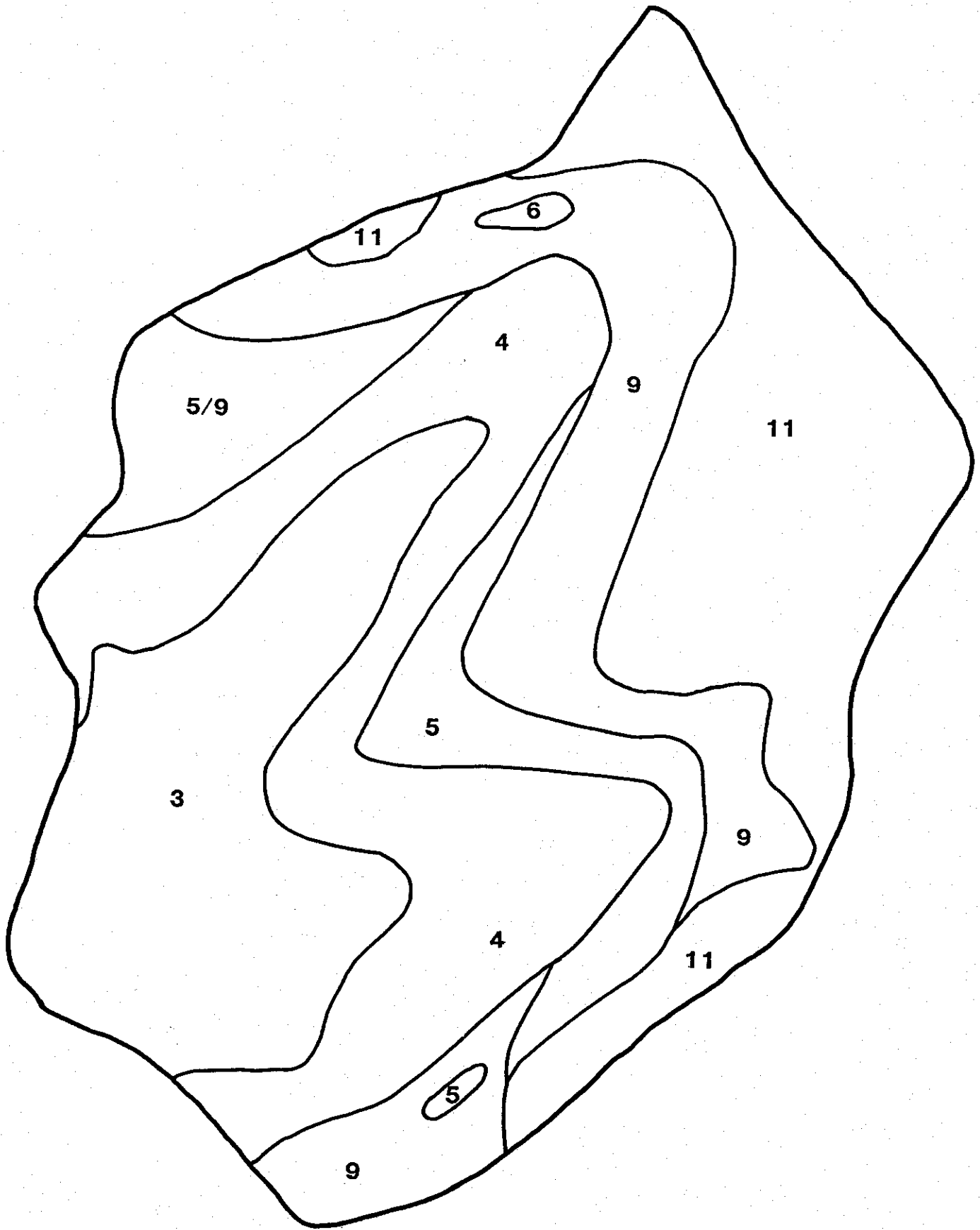


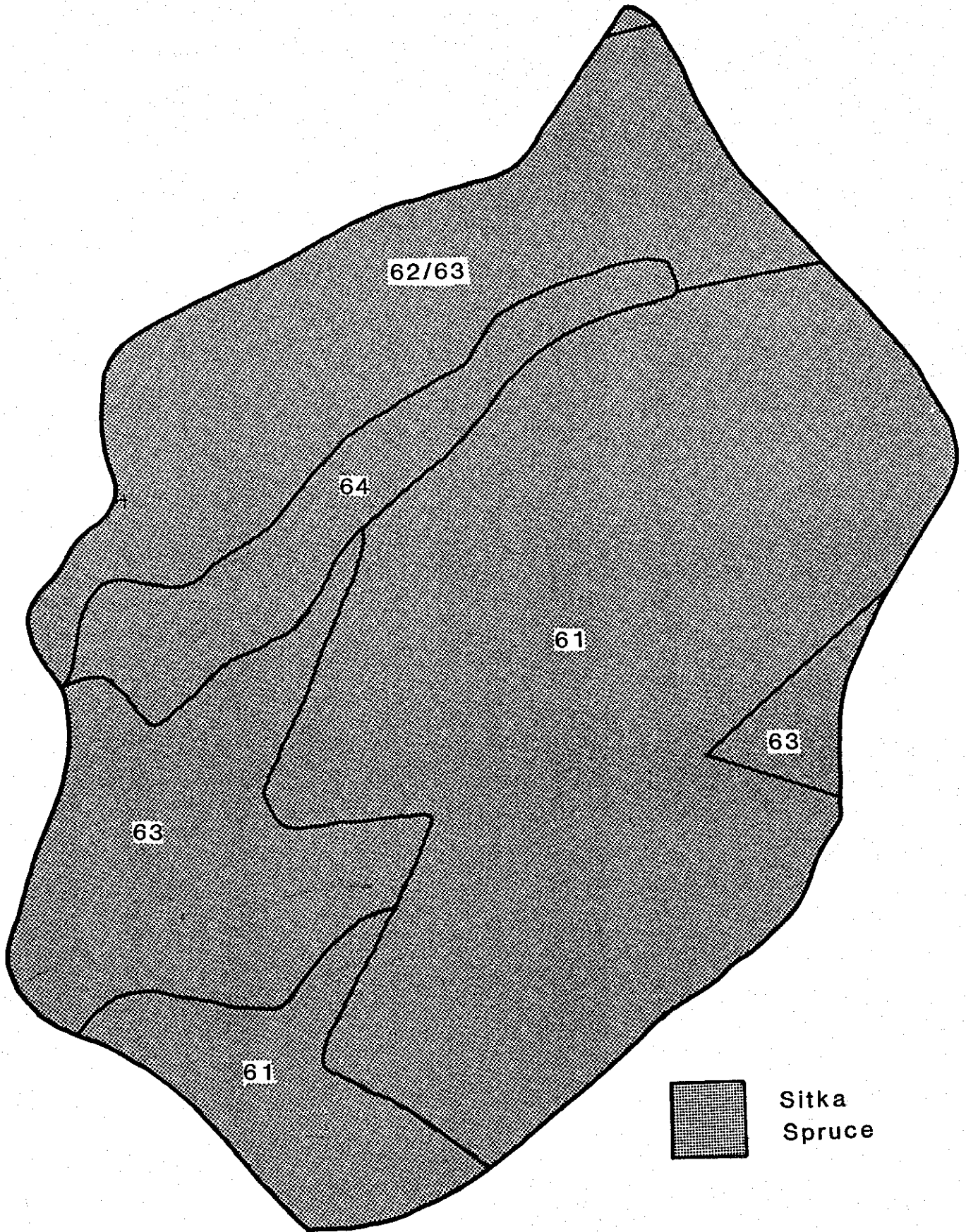


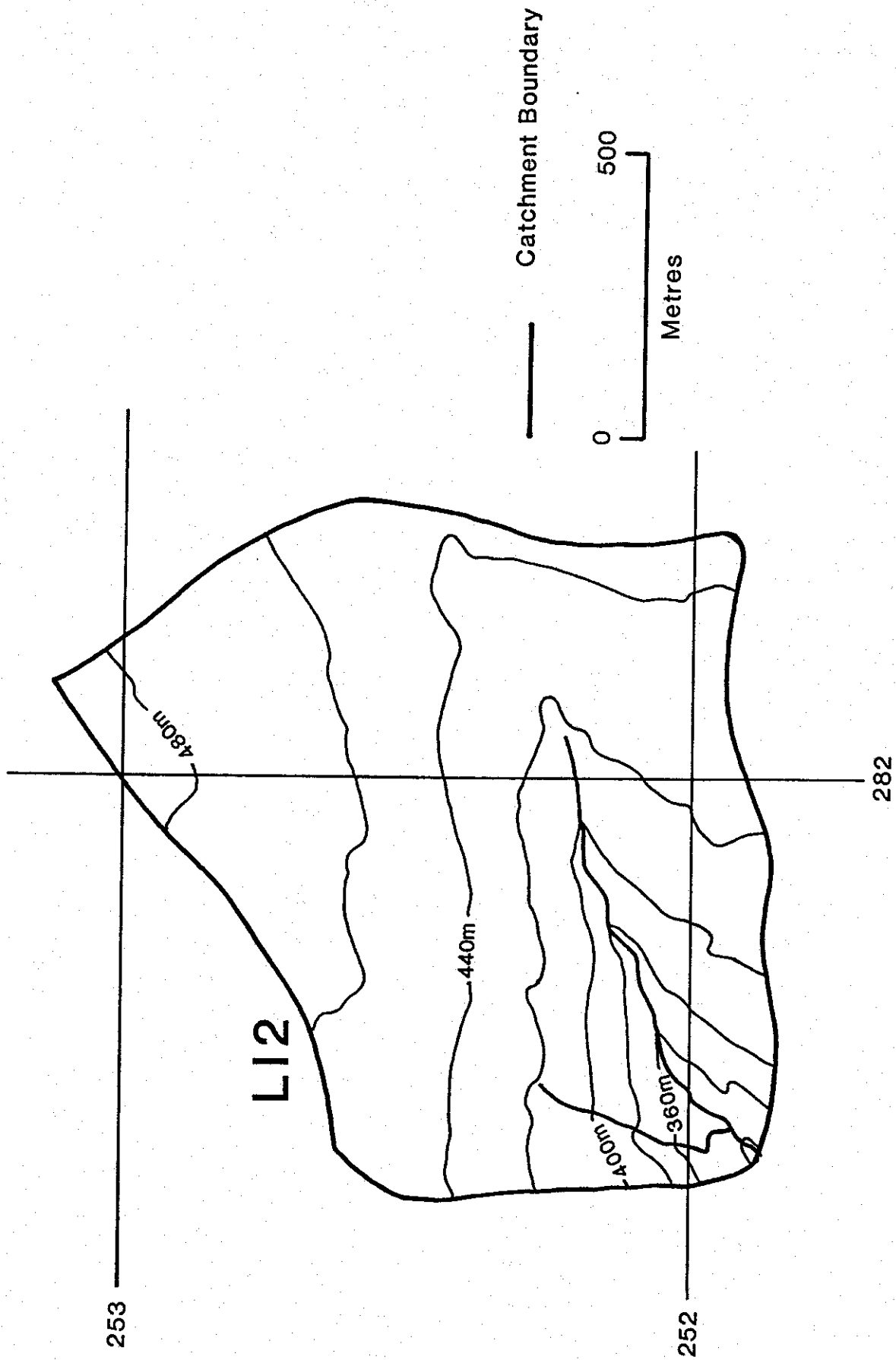
Hafdre  
Formation

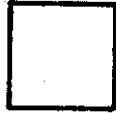
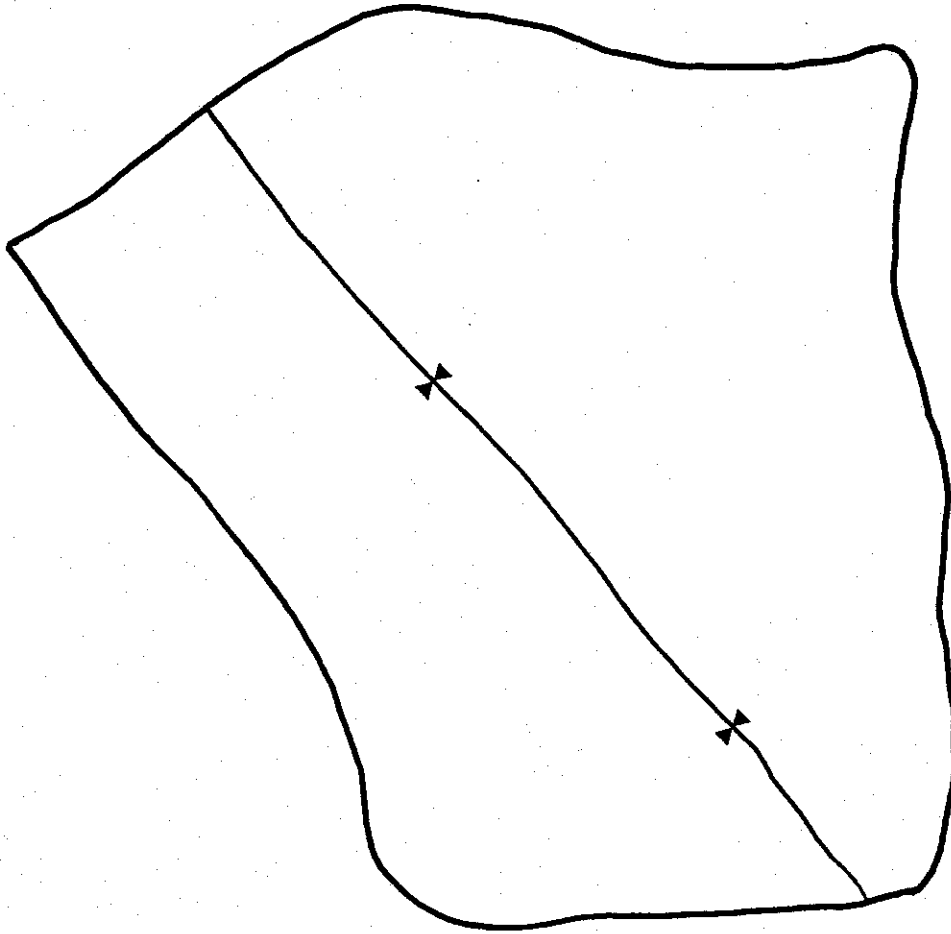


Llyn Brienne  
Formation



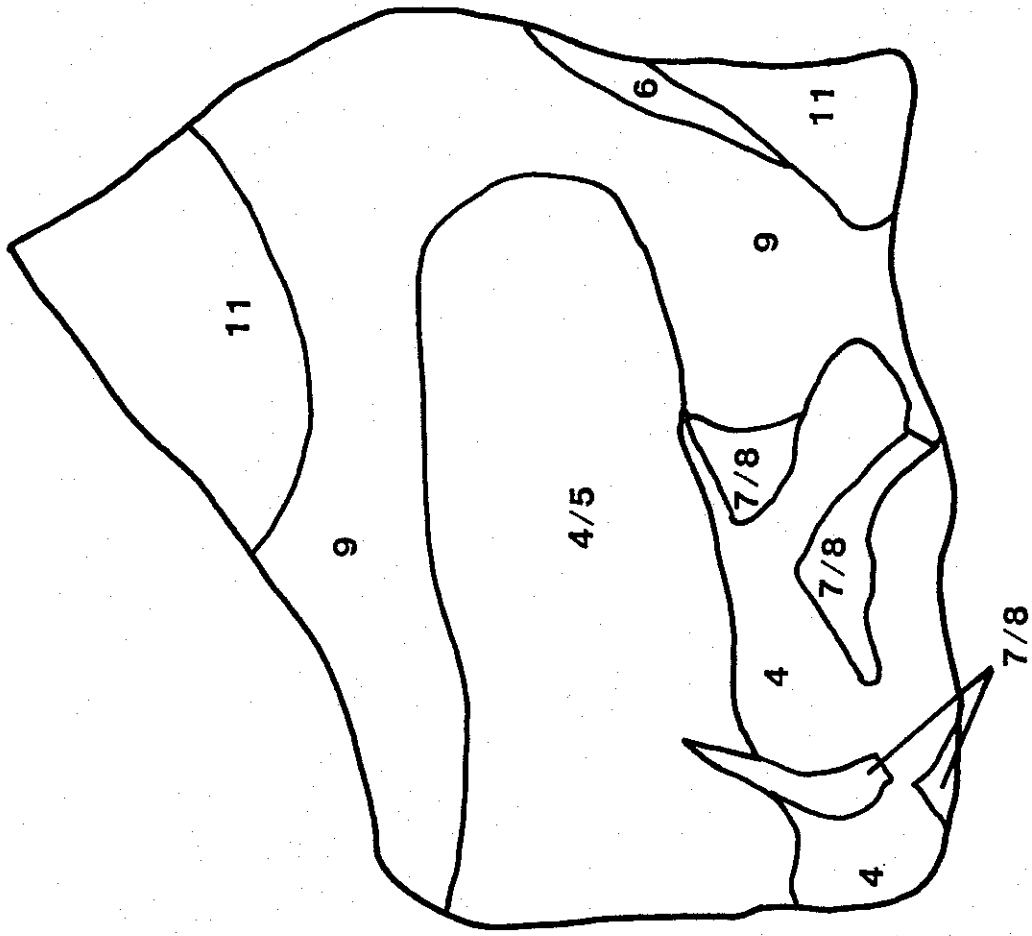


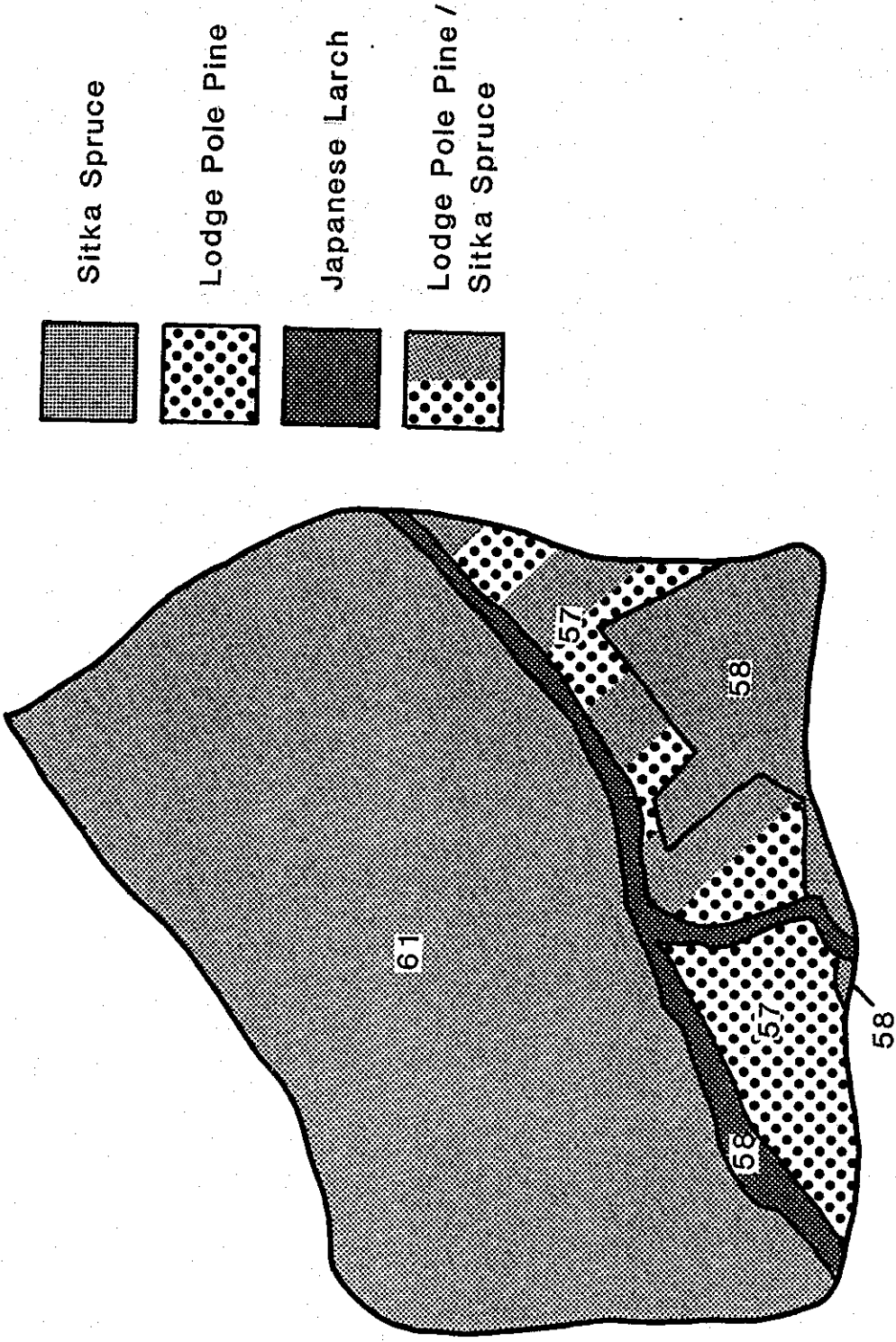


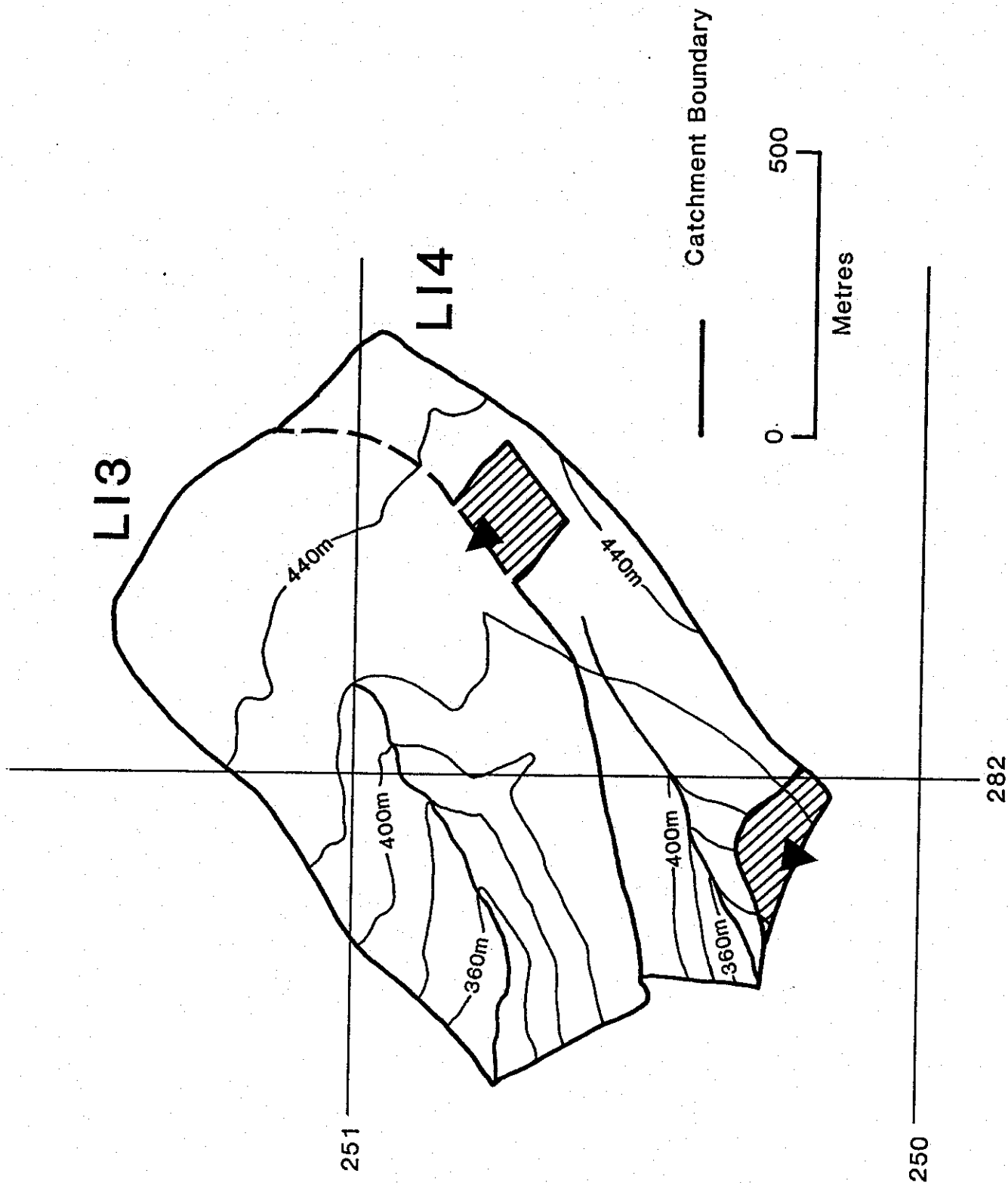


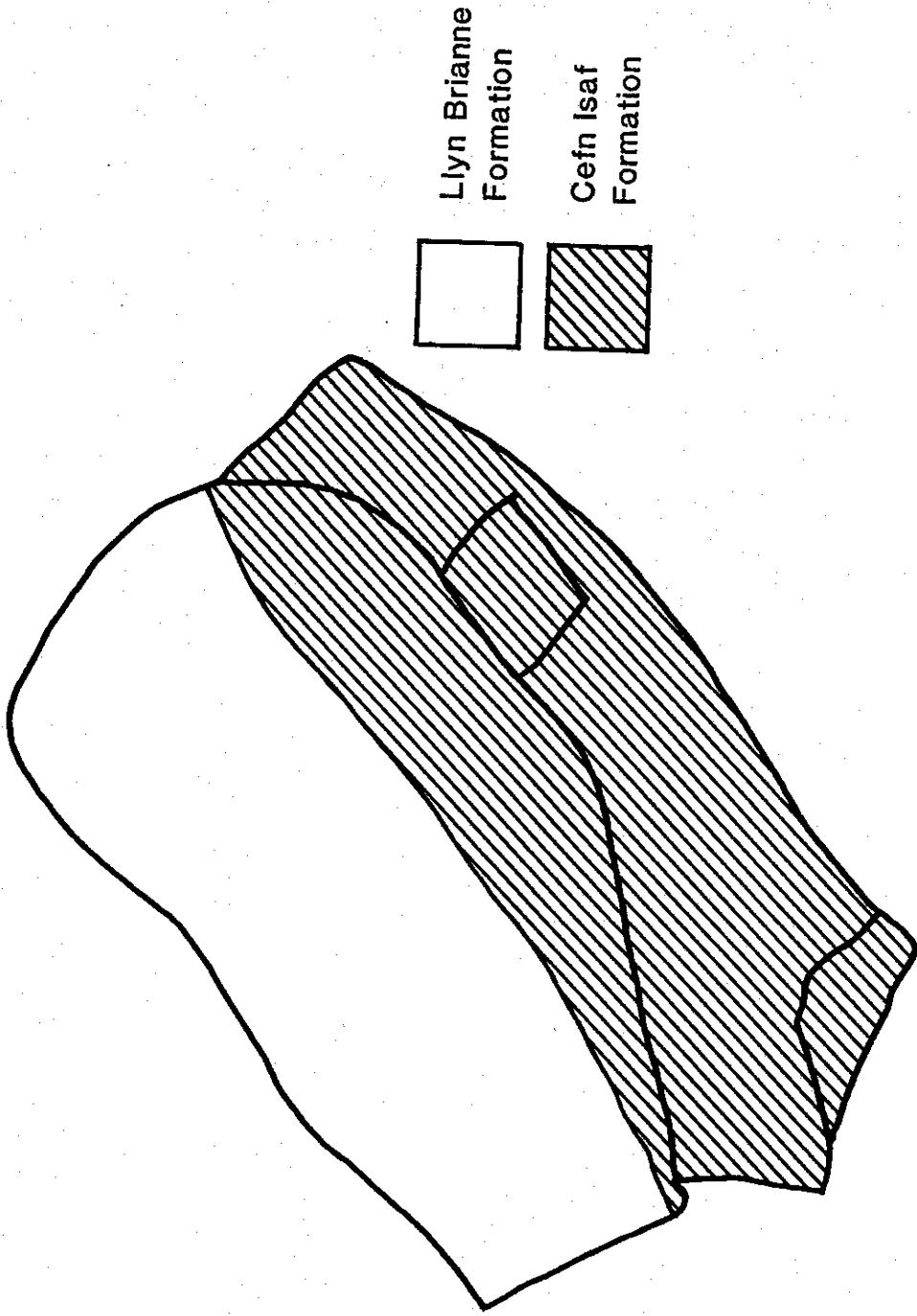
Lyn Brianne  
Formation

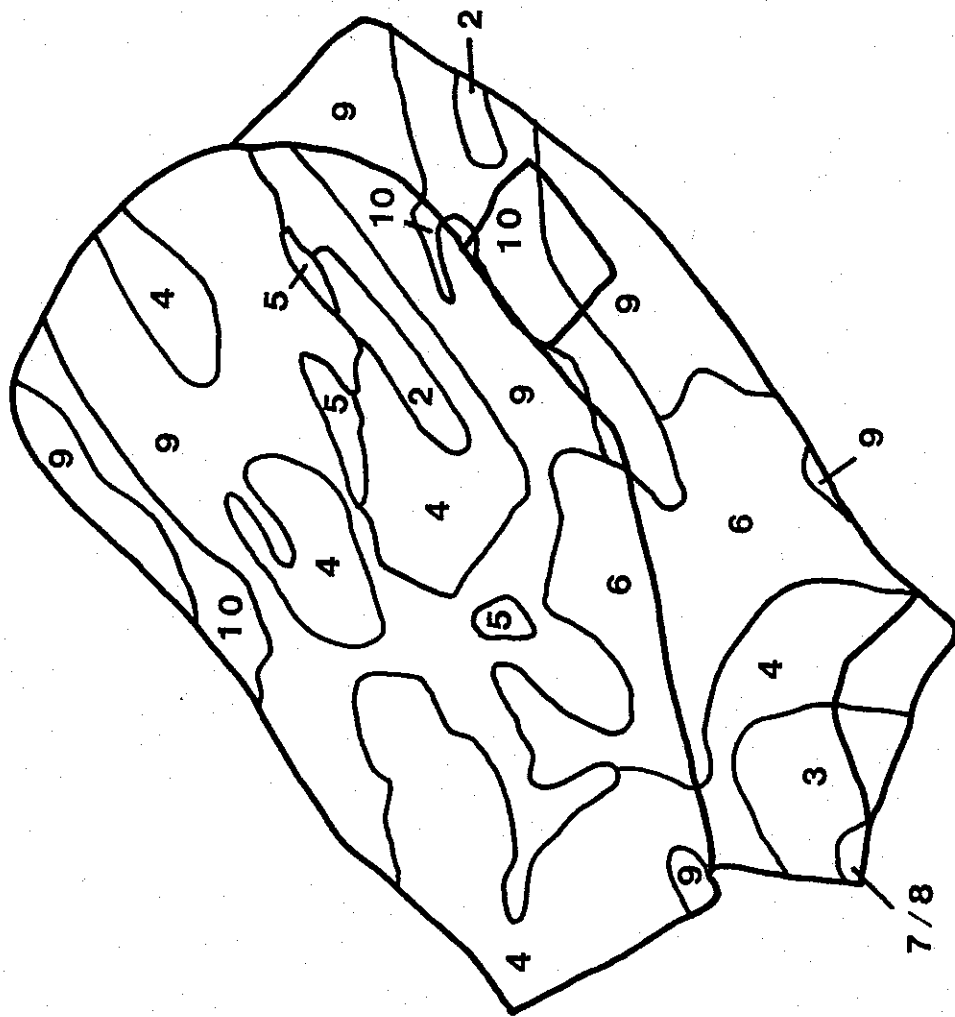




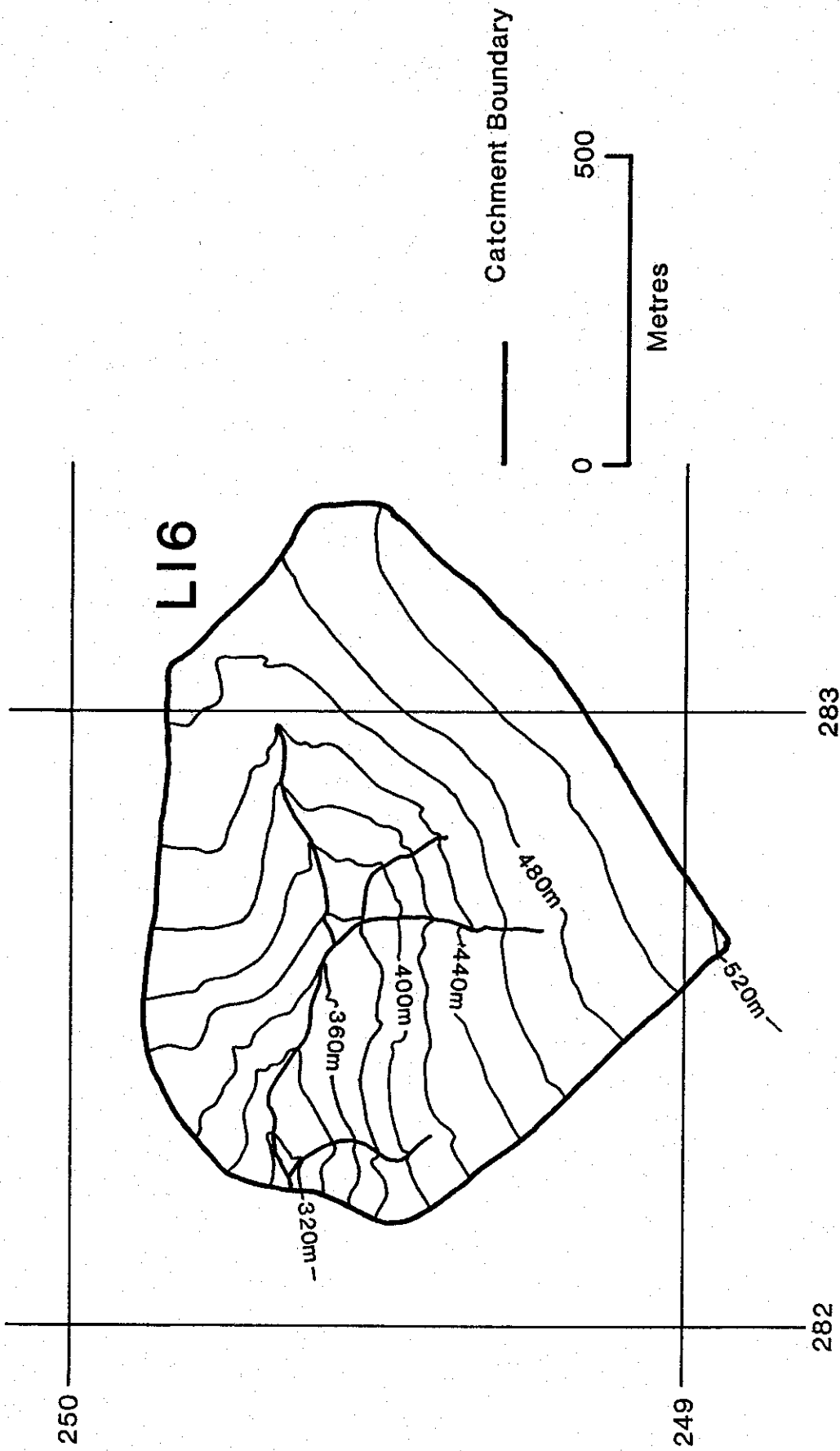


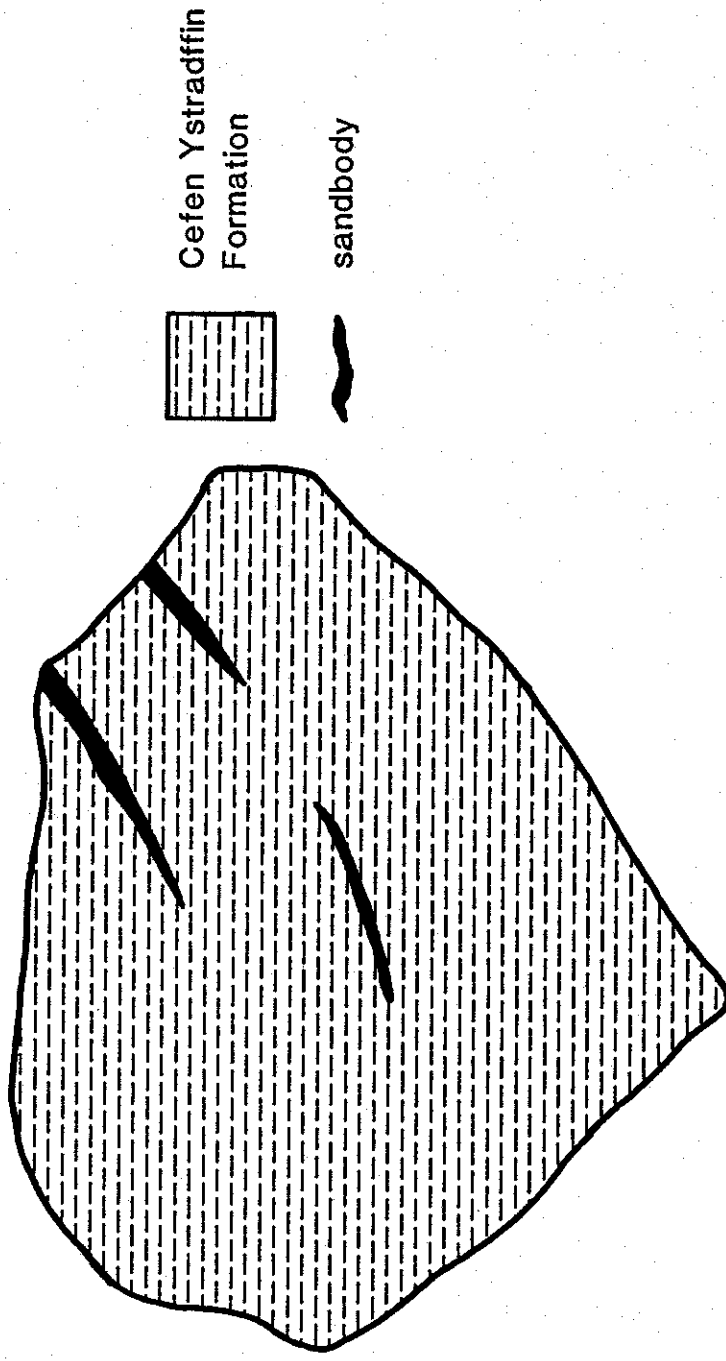














MAP 23 LI6 SOIL

