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Physical Parameters of British Columbia Coastal Lakes Under Study by the Recruitment Assessment Section

D.P. Rankin, F. Winters, J. Candy, and K.D. Hyatt

Biological Sciences Branch
Department of Fisheries and Oceans
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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PHYSICAL PARAMETERS OF BRITISH COLUMBIA COASTAL LAKES UNDER STUDY BY THE RECRUITMENT ASSESSMENT SECTION

by

D.P. Rankin*, F. Winters[1], J. Candy, and K.D. Hyatt*

Salmon Recruitment Assessment Program
Biological Sciences Branch
Department of Fisheries and Oceans
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

[1]M.C. Wright and Associates
2231 Neil Dr., R.R. #3
Nanaimo, B.C. V9R 5K3

*Authors from whom copies of the report may be obtained

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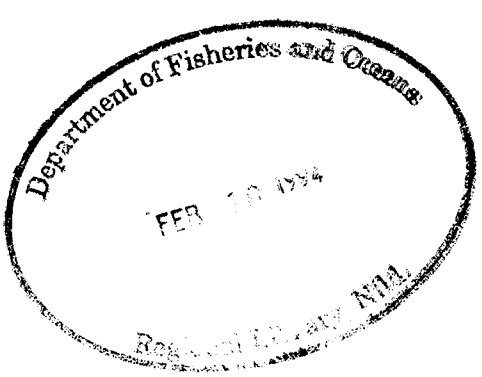

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Rankin, D.P., F. Winters, J. Candy, and K.D. Hyatt. 1993. Physical parameters of British Columbia coastal lakes under study by the Recruitment Assessment Section. Can. Manuscr. Rep. Fish. Aquat. Sci. 2197: 107 p.

Standardized physical parameters and a selection of maps are presented for a series of Vancouver Island and coastal mainland lakes surveyed by the Recruitment Assessment Section since 1983. The data are used not only to assess lake enrichment but to study other factors affecting salmonid growth, recruitment and survival in lakes. Data presented include: lake area, maximum measured depth, mean depth, elevation, shoreline development (DL), mean annual precipitation, watershed area, lake coordinates, shoreline length and lake volume. Transect lengths and lake areas at depth, used to produce fish abundance estimates, are presented in tabular form. Maps show watershed boundaries, topography, bathymetry and hydroacoustic transect locations.

RÉSUMÉ

Rankin, D.P., F. Winters, J. Candy, and K.D. Hyatt. 1992. Physical parameters of British Columbia coastal lakes under study by the Recruitment Assessment Section. Can. Manuscr. Rep. Fish. Aquat. Sci. 2197: 107 p.

Les auteurs présentent des paramètres physiques normalisés et une collection de cartes pour un ensemble de lacs sur l'île de Vancouver et sur la côte de la partie continentale évalués depuis 1983 par la Section de l'évaluation du recrutement. Les données ne servent pas seulement à évaluer l'enrichissement des lacs, mais à étudier d'autres facteurs touchant la croissance, le recrutement et la survie des salmonidés dans les lacs. Les données portent sur la superficie du lac, la profondeur maximale mesurée, la profondeur moyenne, l'altitude, l'aménagement du littoral, les précipitations annuelles moyennes, la superficie du bassin hydrographique, les coordonnées du lac, la longueur du rivage et le volume du lac. Les longueurs de transect et la superficie des lacs en fonction de la profondeur, utilisées pour estimer l'abondance du poisson, sont présentées sous forme de tableau. Les cartes illustrent les limites du bassin hydrographique, les données topographiques, bathymétriques et les emplacements des transects hydroacoustiques.

INTRODUCTION

The first edition of this report (Rutherford et al. 1986) dealt with 22 sockeye salmon (*Oncorhynchus nerka*) nursery lakes surveyed along the B.C. coast over a 10 year period between 1976 and 1986. Since that time the focus of the group has changed somewhat (e.g. the name has changed from the Enhancement Assessment Unit to the Recruitment Assessment Section). In addition to evaluating fish community responses to lake enrichment, the group now has a number of other functions such as: assessing other factors controlling variation in fish production; studying egg-to-fry and marine survival variations; providing in-season advice to fisheries managers concerning numbers of returning adult sockeye; and advising SEP, community and native groups on various enhancement options for salmonids in lakes. These assessments have involved surveys to 21 lakes on Vancouver Island and the coastal mainland, in addition to those mentioned in the first report, that serve as rearing areas for either sockeye salmon or kokanee (*O. nerka*), coho salmon (*O. kisutch*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*) and Dolly Varden char (*Salvelinus malma*).

This report brings together relevant physical and environmental data on these lakes and their corresponding maps into an additional reference document to be used by program personnel and other interested investigators. The physical and environmental data include lake area, maximum recorded depth, mean depth, elevation, shoreline development(DL), mean annual precipitation, watershed area, lake coordinates, shoreline length, and lake volume. For each lake there is a set of four maps that show: 1) watershed boundary, 2) topography, 3) bathymetry, and 4) transect locations used for hydroacoustic surveys. The bathymetric map of Cowichan Lake was taken from Rutherford et al. 1988.

METHODS

Lake area (ha), watershed areas (km^2), elevation (m) and lake coordinates (Table 1 & 2) are taken from 1:50,000 or 1:250,000 topographic maps from the National Topographic Series (Province of British Columbia, Ministry of Lands and Parks, Surveys and Mapping Branch). Lake and watershed areas were measured 3 times using a high resolution digitizing table and the means are reported here.

Shoreline development (Table 2) is the ratio of the length of the shoreline (L) to the length of the circumference of a circle with an area equal to that of the lake:

$$DL = L/2*(3.142*A_o)^{1/2}$$

where

DL = shoreline development
L = length of shoreline (m)
A_o = surface area of lake (ha)

Shoreline length (L) was measured 3 times on a 1:50,000 topographic map using a high resolution digitizing table. The mean was used in the shoreline development calculation.

Precipitation data (Environment Canada, Atmospheric Environment Service) are from the weather station in closest proximity to a given study lake. Only years with complete precipitation data (between 1970 and 1982) were used in calculating mean annual precipitation (MAP, Tables 2 and 3).

Maximum recorded depth (Table 2) and lake bathymetry were determined from echosoundings taken by Department of Fisheries and Oceans personnel (or persons contracted to the department) using a Simrad EY-M echo-sounder in accordance with procedures in Hyatt et al. (1984). The number of transect lines used to determine lake bathymetry is based on lake size and basin complexity and consequently varies substantially between lakes (Table 4). Echo soundings along transects used for the hydroacoustic assessment of fish abundance were occasionally supplemented with soundings initiated specifically for the purpose of determining lake bathymetry.

Bathymetric maps were prepared as follows. Echo sounding transects, with start and end points, were drawn over lake outlines taken from the 1:50,000 topographic maps. If necessary, the lake outline was enlarged using a photocopying machine (distortion was minimal). For each transect, the surface distance was measured on the echogram. Vertical lines were then drawn on the echogram from the bottom contour up to the surface at 5m intervals. Depth contours on the echogram were scaled and transferred to the corresponding transect on the enlarged map. Because the 5m contours were so close together, only the 10m contours are presented.

The distance to each depth contour along the transect on the map was calculated by:

$$DM = DE * TDM/TDE$$

where

DE = distance to depth interval on echogram
DM = distance to depth contour on map
TDE = echogram surface distance
TDM = transect surface distance on map

Bathymetric contours were fitted by eye starting with the deepest contour.

Stratum area (Table 5) was taken at the mid-point of the depth interval and was calculated by averaging the areas corresponding to the stratum's upper and lower contours.

Actual transect lengths at depth (Table 5) were calculated from the echograms and 1:50,000 topographic maps. The actual length of the transect at the surface were measured on the 1:50,000 topographic map and using a General Oceanics flowmeter[1]. Transect length at depth was measured on the echogram at the midpoint of the depth interval and converted to actual length using the surface length on the echogram and the actual surface length from the map and flowmeter.

$$TLD = TLDE * TLS/TLSE$$

where

TLD = actual transect length at depth (m)
TLS = actual transect surface distance (m)
TLSE = echogram surface distance (mm)
TLDE = transect distance at depth on echogram (mm)

Lake volume (Table 2) was calculated by summing the strata volumes and the volume of the lake below the deepest measured stratum for that lake. Stratum volume (V_i) was calculated using the formula from Wetzel(1975) by:

$$V_i = H/3(A1 + A2 + (A1 * A2)^{1/2}) * 10000$$

where

H = vertical distance between stratum points (m)
A_1 = area of upper stratum (ha)
A_2 = area of lower stratum (ha)

The lake volume below the deepest measured stratum was calculated by letting the area of the lower stratum equal zero, the area of the upper stratum equal that of the deepest measured stratum, and the vertical distance equal the difference between maximum depth and the vertical depth to the midpoint of the deepest measured stratum.

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[1]General Oceanics, Inc.
1295 N.W. 163 Street
Miami, Florida 33169

Mean depth (Table 2) was calculated using Wetzel (1975) by dividing lake volume by lake surface area:

$$Z = V/(A_0 * 10{,}000)$$

where

Z = mean depth (m)
V = lake volume (m3)
A_0 = lake surface area (ha)

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Table 1. Lake areas used in previous reports.

Lake	Reported area(ha) Facchin and King[2]	This report[3]
Brannen	109	100
Cowichan	6200	6360
Fulmore	---	860
Georgie	472	589
Glendale	---	144
Grant	55	52
Hesquiat	420	408
Heydon	---	885
Maggie	243	243
Megin	165	166
Middle Quinsam	71	67
Mohun	624	657
Nahmint	710	827
Nahwitti	262	190
Nanaimo(2nd)	172	185
Phillips	---	326
Power	66	65
Quatse	160	145
Schoen	242	260
Uchuck	118	108
Vernon	780	837

[2]Facchin and King (1981)

[3]The difference between the areas reported here and earlier reports may be "operator" or "equipment" induced.

Table 2. Physical and environmental parameters of RAS study lakes.

Lake	Lake area (ha)	Maximum measured depth (m)	Mean depth (m)	Elevation (m)	DL[4]	Map[5] (mm)	Watershed area (km^2)	Coordinates (north) (south)	Shoreline length (km)	Lake volume (m^3.106)
Brannen	100	21	10	78	1.1	1120	50	49°13'124°03'	4	10
Cowichan[6]	6360	160	58	163	3.3	2109	617	48°50'124°15'	90	3666
Fulmore	860	57	28	33	2.2	1552	88	50°35'125°57'	23	239
Georgie	589	42	12	218	3.0	3039	87	50°45'127°40'	20	71
Glendale	144	25	16	74	1.2	1552	14	50°37'125°38'	5	24
Grant	52	40	18	224	1.6	1058	6	48°37'123°46'	4	9
Hesquiat	408	142	65	20	1.8	3019	59	49°30'126°24'	13	266
Heydon	885	136	64	30	2.2	1552	50	50°33'125°40'	23	568
Maggie	243	48	27	30	1.8	3280	60	49°01'125°26'	10	66
Megin	166	46	24	19	1.8	3019	141	49°29'126°04'	8	40
Middle Quinsam	67	15	6	259	2.1	1328	107	49°56'125°29'	6	4
Mohun	657	43	14	198	3.0	1328	50	50°07'125°30'	27	89
Nahmint	827	142	69	105	2.2	2633	146	49°09'125°00'	22	568
Nahwitti	190	52	27	201	1.8	1787	51	50°43'127°51'	9	52
Nanaimo(2^{nd})	185	45	22	198	1.9	1120	9	49°23'122°57'	9	41
Phillips	326	65	39	5	1.6	1552	105	50°35'125°21'	10	127
Power	65	41	22	15	1.8	3019	54	50°12'127°29'	5	14
Quatse	145	20	8	76	1.9	1787	19	50°38'127°34'	8	12
Schoen	260	65	33	421	2.3	1552	89	50°10'126°16'	13	86
Uchuck	108	47	19	32	1.9	2633	8	49°02'125°05'	7	21
Vernon	837	105	51	206	1.8	1552	142	50°62'126°26'	18	427

[4] Shoreline development (Wetzel 1975)
[5] Mean annual precipitation, 1970-1982
[6] Rutherford et al. (1988)

Table 3. Weather stations corresponding to RAS survey lakes.

Lake	Weather station
Brannen	Nanaimo airport
Cowichan	Cowichan Lake Forestry
Fulmore	Alert Bay
Georgie	Holberg
Glendale	Alert Bay
Grant	Duncan Forestry
Hesquiat	Estevan Point
Heydon	Alert Bay
Maggie	Ucluelet (Kennedy Camp)
Megin	Estevan Point
Middle Quinsam	Campbell River airport
Mohun	Campbell River airport
Nahmint	Carnation Creek
Nahwitti	Port Hardy airport
Nanaimo(2^{nd})	Nanaimo airport
Phillips	Alert Bay
Power	Estevan Point
Quatse	Port Hardy airport
Schoen	Alert Bay
Uchuck	Carnation Creek
Vernon	Alert Bay

Table 4. Number of transects used to determine lake bathymetry.

Lake	Number of Transects
Brannen	6
Cowichan	22
Fulmore	6
Georgie	8
Glendale	4
Grant	15
Hesquiat	6
Heydon	6
Maggie	11
Megin	6
Middle Quinsam	6
Mohun	5
Nahmint	8
Nahwitti	5
Nanaimo(2nd)	4
Phillips	9
Power	6
Quatse	5
Schoen	4
Uchuck	10
Vernon	4

Table 5. Transect areas and lengths at depth for RAS survey lakes.

Brannen Lk

Depth stratum (m)	Stratum area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	100	919	924	822	1255	1314	1200
2-5	89	832	843	686	1135	1290	1156
5-10	64	695	684	385	964	1173	1034
10-15	45	551	553	190	538	990	660
15-20	19	0	309	0	0	0	267

Cowichan Lk

Depth Stratum (m)	Stratum area (ha)	Transect #						
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)	7 Len. (m)
Surface	6360	1840	2560	1820	2550	2570	1140	840
2-5	6222	1840	2560	1820	2550	2570	1140	840
5-10	5944	1840	2560	1820	2429	2471	1140	773
10-15	5667	1840	2324	1801	2111	2341	1140	732
15-20	5389	1799	2257	1777	1710	2238	1123	715
20-30	4970	1714	2149	1767	1396	1977	1089	682
30-40	4408	1625	1953	1738	918	1820	1041	640
40-50	3731	1312	1455	1647	749	1694	1003	541
50-60	2937	609	1151	1527	266	1550	951	499

Table 5. (contd)

Fulmore Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	860	1158	632	1182	1525	747	1022
2-5	824	1046	621	1163	1494	690	891
5-10	749	907	605	1125	1481	662	783
10-15	686	614	594	1078	1462	634	681
15-20	618	398	567	1040	1318	600	0
20-30	513	0	540	993	1130	323	0
30-40	431	0	508	889	1048	192	0
40-50	376	0	465	842	941	0	0

Georgie Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #							
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)	7 Len. (m)	8 Len. (m)
Surface	589	485	508	397	629	494	690	1066	462
2-5	557	441	485	313	528	494	645	1012	426
5-10	488	393	465	189	492	446	581	886	318
10-15	403	355	428	142	432	418	523	832	272
15-20	259	304	382	76	0	335	445	747	222
20-30	113	0	232	0	0	0	181	681	154
30-40	36	0	0	0	0	0	0	556	0

Table 5. (contd)

Glendale Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #			
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)
Surface	144	575	505	685	2150
2-5	136	575	490	655	2105
5-10	120	545	470	600	2065
10-15	98	405	420	530	2005
15-20	66	240	370	465	1855
20-30	25	---	---	245	555

Grant Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #								
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)	7 Len. (m)	8 Len. (m)	9 Len. (m)
Surface	52	230	400	310	510	420	440	300	200	120
2-5	48	213	355	298	505	398	418	258	182	98
5-10	39	160	335	259	453	335	388	240	154	30
10-15	31	150	272	236	408	276	331	179	109	0
15-20	25	70	235	194	351	235	283	136	25	0
20-30	17	0	178	118	306	181	204	99	0	0
30-40	6	0	54	74	213	115	0	0	0	0

Table 5. (contd)

Hesquiat Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	408	1080	840	790	1080	1000	550
2-5	401	1070	825	780	1075	995	550
5-10	387	1005	810	760	1065	975	545
10-15	373	950	800	750	1045	955	530
15-20	359	925	785	734	1025	945	500
20-30	339	885	755	710	985	910	470
30-40	310	820	715	685	825	860	440
40-50	282	720	680	650	740	810	405

Heydon Lk

Depth Stratum (m)	Stratum Area (km)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	885	920	1120	1115	1300	1285	1160
2-5	862	890	1120	1100	1260	1255	1160
5-10	818	880	1115	1050	1245	1240	1100
10-15	772	855	1100	1035	1230	1235	865
15-20	728	825	1080	1005	1205	1205	485
20-30	677	785	1045	960	1180	1125	0
30-40	618	700	1000	895	1135	1070	0
40-50	563	630	910	830	1080	1025	0

Table 5. (contd)

Maggie Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	243	2092	1505	609	750	573	653
2-5	219	2070	1476	539	703	533	647
5-10	199	2044	1443	515	682	504	633
10-15	184	2015	1355	487	658	484	607
15-20	169	1961	1325	456	636	470	510
20-30	145	1815	1187	408	591	441	424
30-40	101	1481	1058	250	529	394	0
40-50	44	620	878	0	450	344	0

Megin Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	166	525	600	500	460	350	3335
2-5	152	500	580	500	445	325	3315
5-10	139	430	555	480	420	270	3240
10-15	122	360	535	465	385	220	2955
15-20	106	290	520	440	330	0	2245
20-30	81	201	475	405	245	0	2090
30-40	47	0	380	335	130	0	1520
40-50	15	0	0	135	0	0	570

Table 5. (contd)

Middle Quinsam Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	67	152	102	359	331	345	206
2-5	49	0	68	282	227	248	0
5-10	20	0	0	155	184	184	0
10-15	5	0	0	0	0	92	0

Mohun Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #				
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)
Surface	657	630	850	880	750	400
2-5	598	560	764	822	715	325
5-10	442	490	725	750	605	269
10-15	322	352	616	671	408	131
15-20	188	195	421	548	406	75
20-30	77	0	116	317	310	0
30-40	22	0	0	223	165	0

Table 5. (contd)

Nahmint Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #				
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)
Surface	827	670	819	532	674	592
2-5	815	662	801	525	672	582
5-10	794	649	792	504	653	568
10-15	772	633	781	491	635	546
15-20	750	614	774	477	619	475
20-30	717	590	746	454	593	447
30-40	666	564	706	427	552	411
40-50	648	537	670	395	524	381
50-60	611	516	646	370	483	352

Nahwitti Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #				
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)
Surface	190	750	700	650	375	600
2-5	183	735	685	640	350	565
5-10	171	720	660	625	335	515
10-15	159	700	625	610	300	440
15-20	144	680	605	590	265	390
20-30	119	635	550	600	205	325
30-40	62	160	245	295	100	225
40-50	12	0	130	0	0	70

Table 5. (contd)

Nanaimo 2nd Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #			
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)
Surface	185	700	775	750	550
2-5	171	690	770	745	540
5-10	143	660	755	735	525
10-15	123	630	735	690	510
15-20	109	595	700	645	445
20-30	87	552	650	570	320
30-40	48	460	585	420	0

Phillips Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #								
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)	7 Len. (m)	8 Len. (m)	9 Len. (m)
Surface	326	855	850	880	700	585	1063	1162	1269	978
2-5	318	850	845	870	690	580	1049	1147	1254	969
5-10	302	835	835	865	665	560	1019	1142	1251	937
10-15	287	795	805	840	650	515	980	1125	1205	900
15-20	275	755	775	830	630	495	947	1102	1168	868
20-30	252	695	730	805	595	405	900	1058	1106	828
30-40	215	585	635	775	560	130	770	970	997	784
40-50	180	470	510	740	535	0	573	918	892	727

Table 5. (contd)

Power Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #					
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)	6 Len. (m)
Surface	65	700	350	650	175	500	1925
2-5	61	699	338	650	167	488	1925
5-10	53	660	304	616	153	414	1837
10-15	45	592	239	569	135	333	1742
15-20	38	553	202	540	112	270	1637
20-30	30	504	161	498	62	0	1307
30-40	20	326	108	263	0	0	682

Quatse Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #				
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)
Surface	145	275	575	570	625	630
2-5	119	105	485	470	550	515
5-10	73	50	430	400	460	375
10-15	36	0	275	250	180	0
15-20	10	0	200	75	60	0

Table 5. (contd)

Schoen Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #			
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)
Surface	260	672	945	414	824
2-5	243	643	945	399	805
5-10	224	614	902	399	795
10-15	208	614	807	368	786
15-20	196	595	687	345	776
20-30	172	538	601	322	701
30-40	137	336	472	238	634
40-50	83	0	412	184	549
50-60	32	0	0	138	454

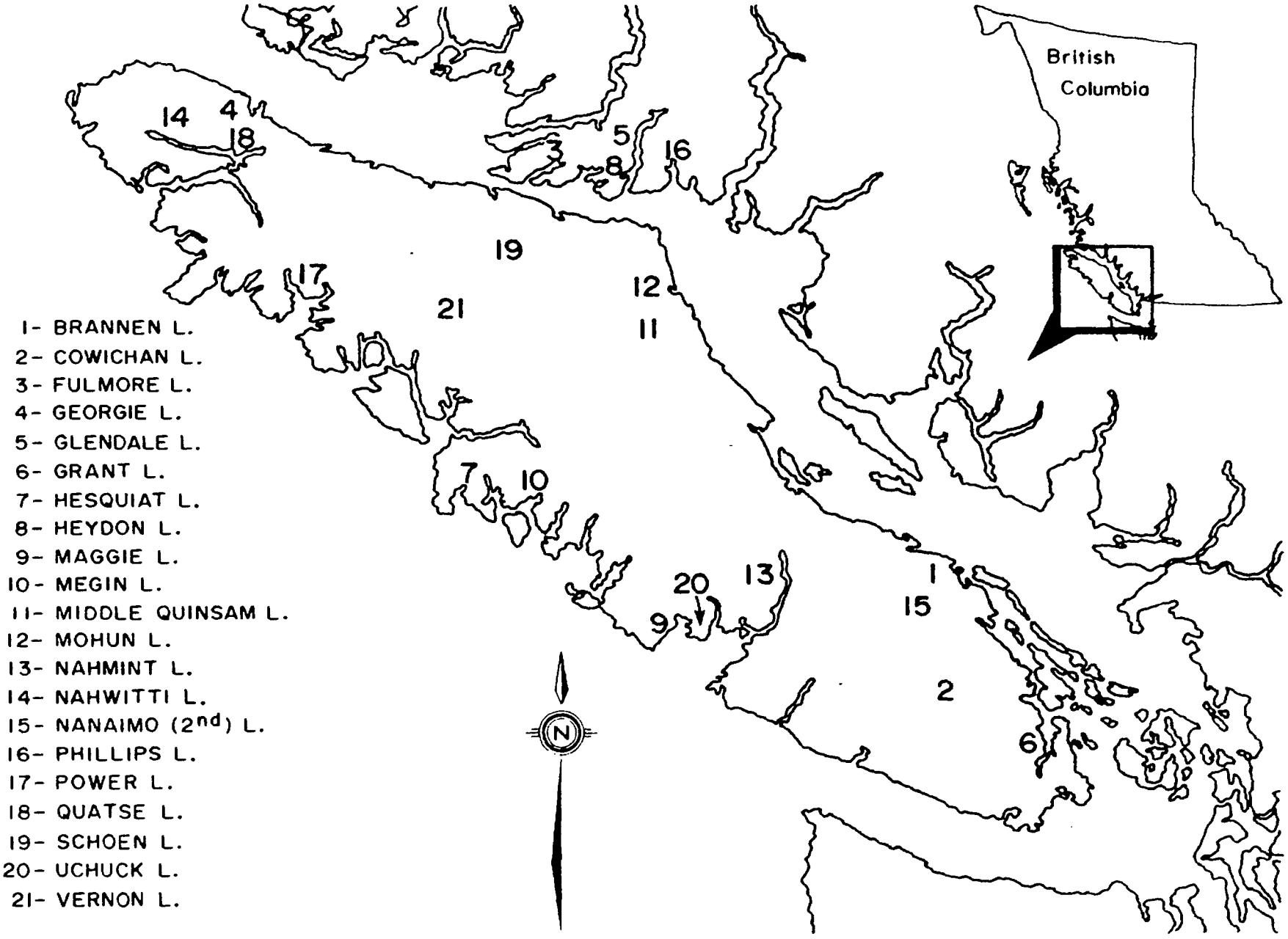
Uchuck Lk

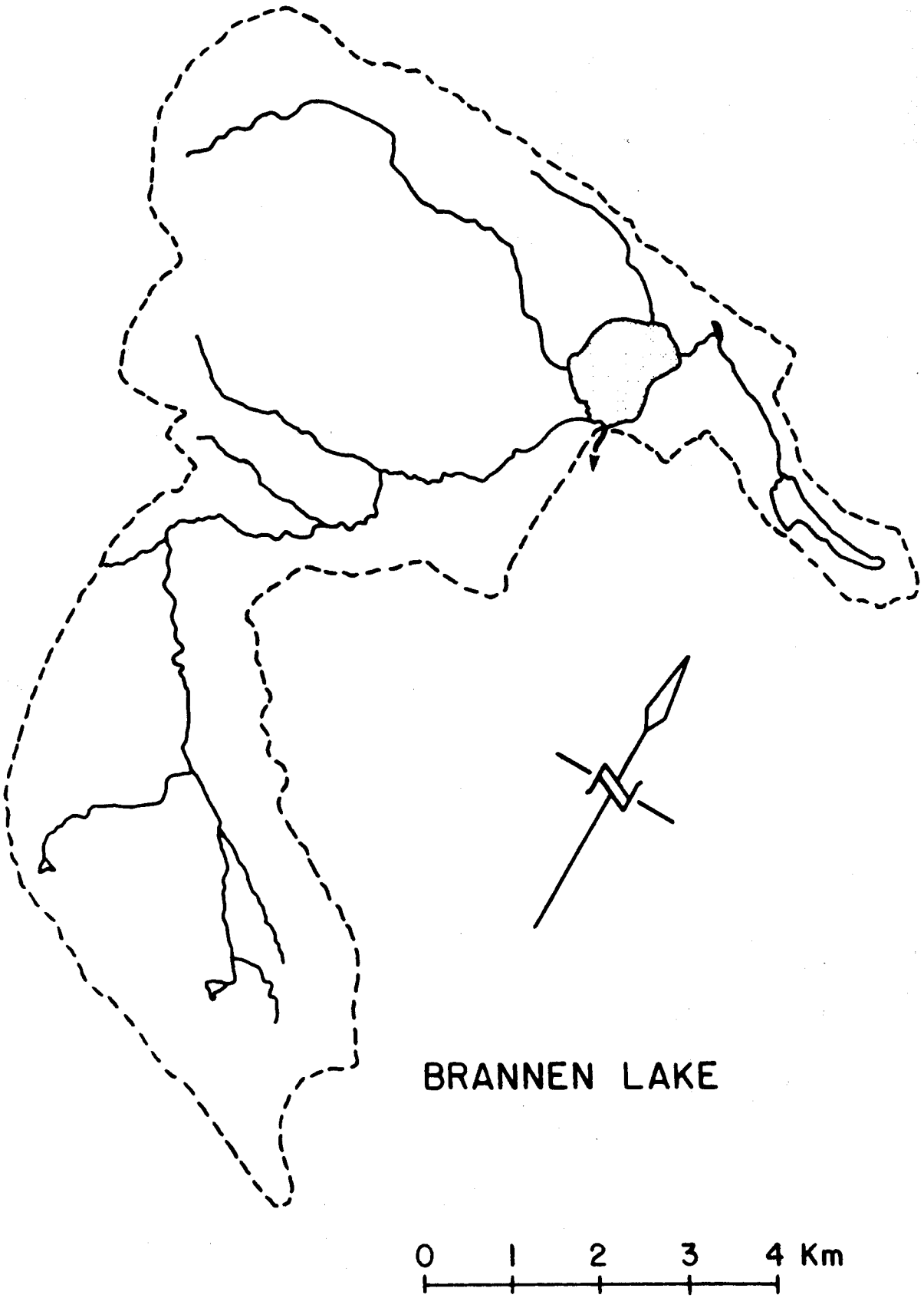
Depth Stratum (m)	Stratum Area (ha)	Transect #				
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)	5 Len. (m)
Surface	108	519	625	483	403	2608
2-5	92	490	617	475	393	2564
5-10	68	425	587	453	379	2384
10-15	57	352	562	435	348	2243
15-20	50	268	537	405	324	2129
20-30	39	123	491	375	143	1992
30-40	26	0	398	271	0	1368
40-50	7	0	252	0	0	0

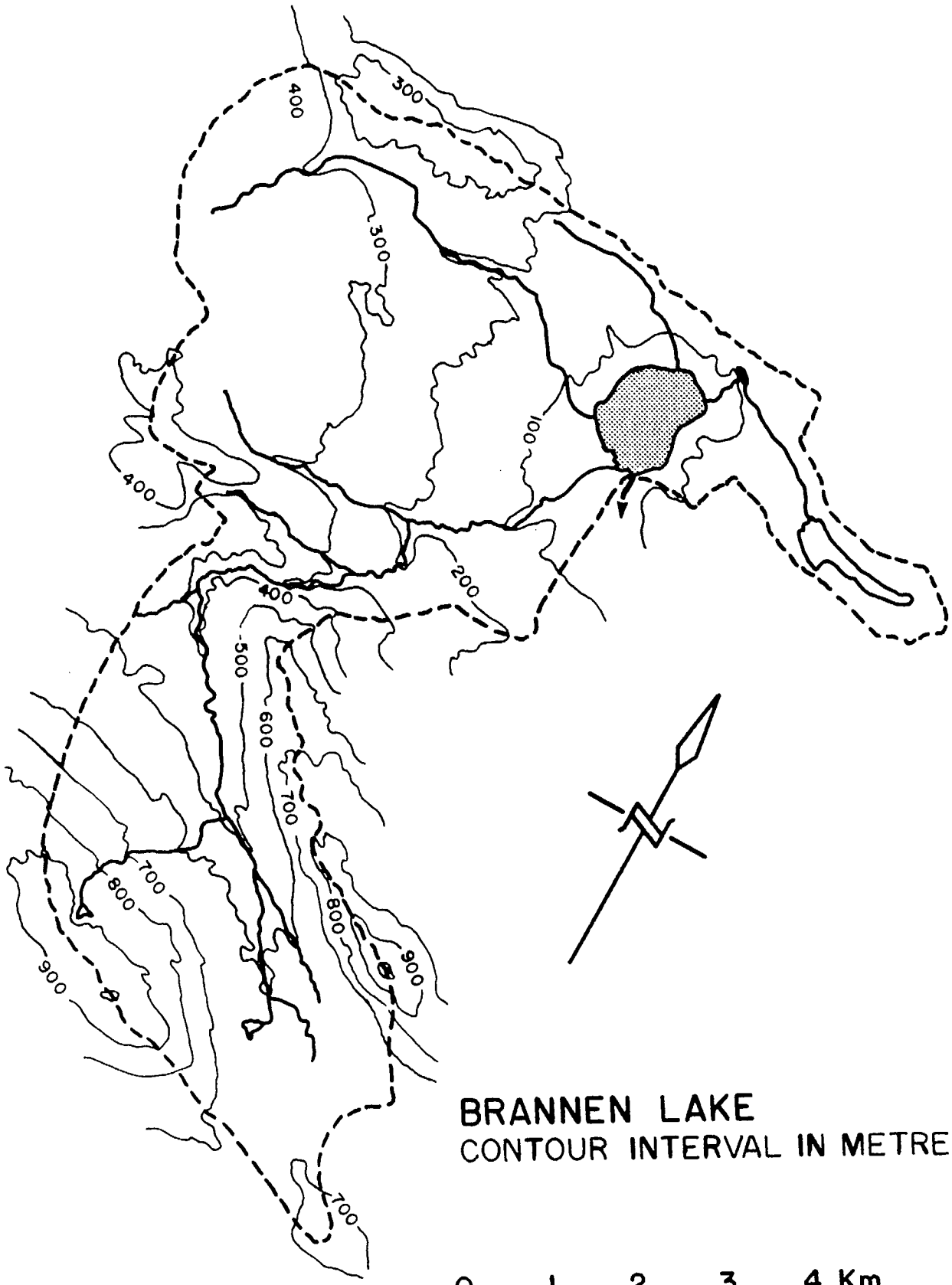
Table 5. (contd)

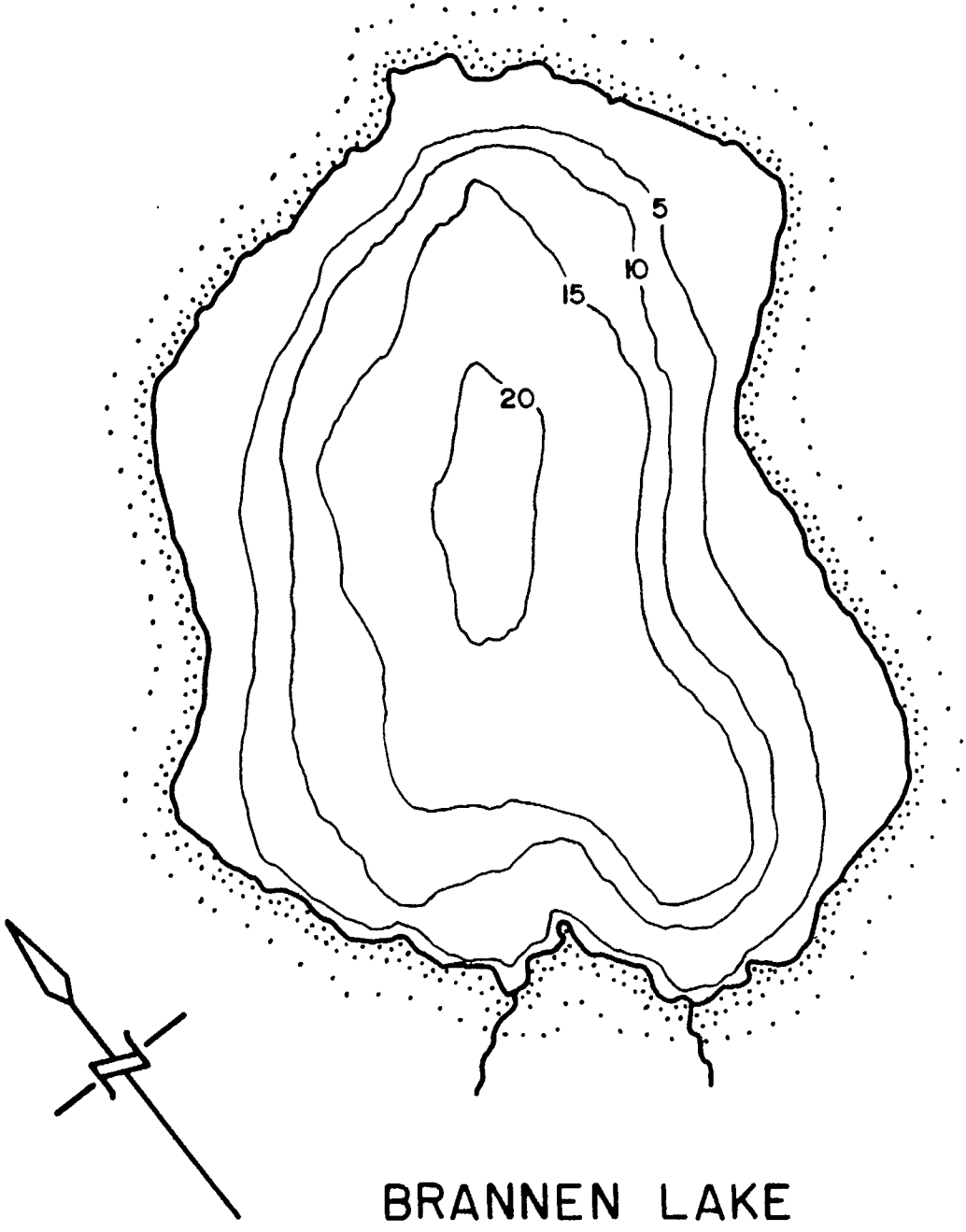
Vernon Lk

Depth Stratum (m)	Stratum Area (ha)	Transect #			
		1 Len. (m)	2 Len. (m)	3 Len. (m)	4 Len. (m)
Surface	837	796	1324	1188	1128
2-5	810	626	1324	1111	1104
5-10	771	612	1313	1091	1066
10-15	726	585	1251	1064	1007
15-20	682	563	1211	1032	1000
20-30	636	533	1170	991	972
30-40	583	472	1111	944	913
40-50	527	404	1049	895	674
50-60	427	288	982	833	601


British
Columbia
1- BRANNEN L.
2- COWICHAN L.
3- FULMORE L.
4- GEORGIE L.
5- GLENDALE L.
6- GRANT L.
7- HESQUIAT L.
8- HEYDON L.
9- MAGGIE L.
10- MEGIN L.
11- MIDDLE QUINSAM L.
12- MOHUN L.
13- NAHMINT L.
14- NAHWITTI L.
15- NANAIMO (2nd) L.
16- PHILLIPS L.
17- POWER L.
18- QUATSE L.
19- SCHOEN L.
20- UCHUCK L.
21- VERNON L.
N


BRANNEN LAKE
0 1 2 3 4 Km

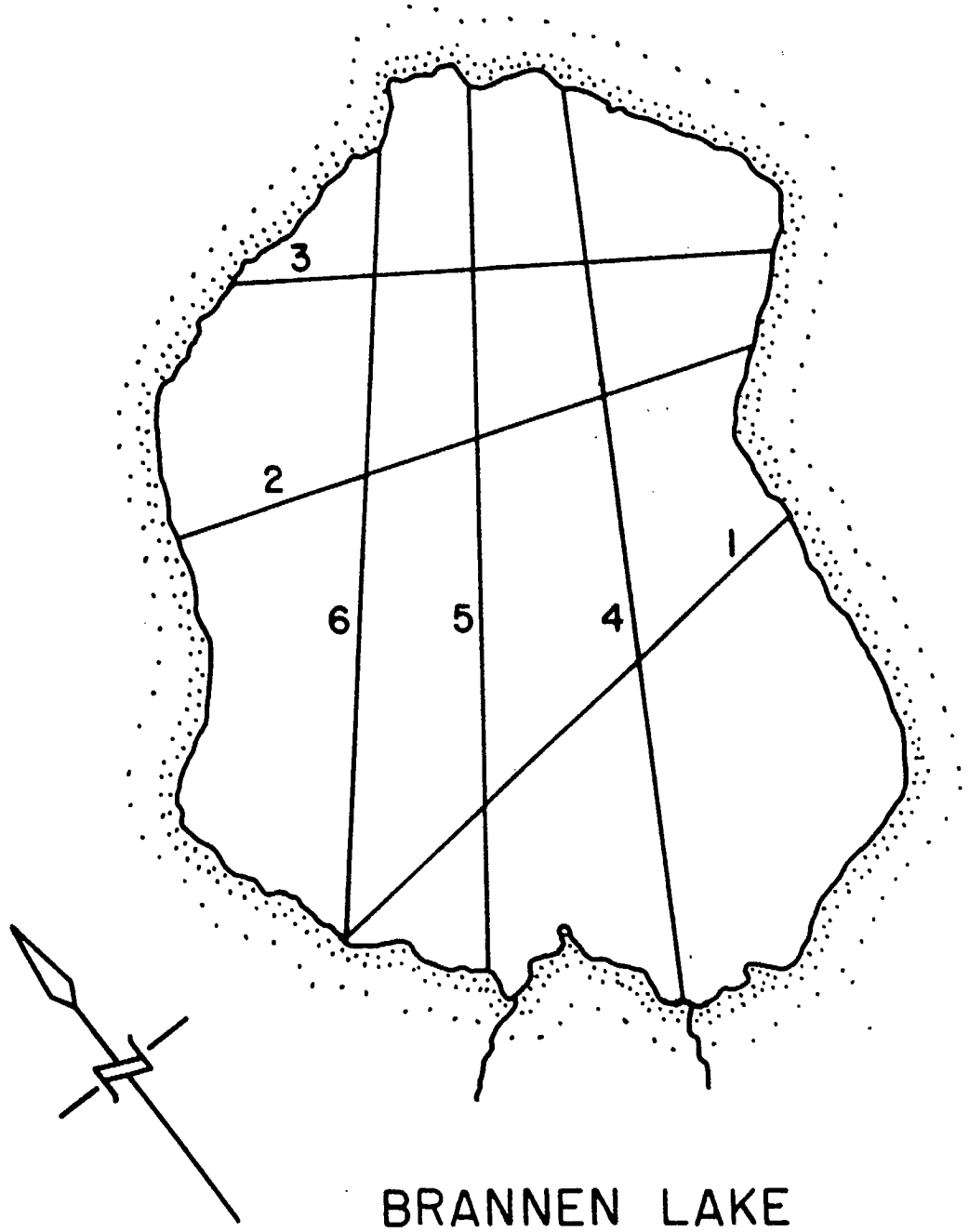

400
300
300
100
400
200
400
500
600
700
700
800
800
900
900
700
BRANNEN LAKE
CONTOUR INTERVAL IN METRES
0 1 2 3 4 Km



BRANNEN LAKE

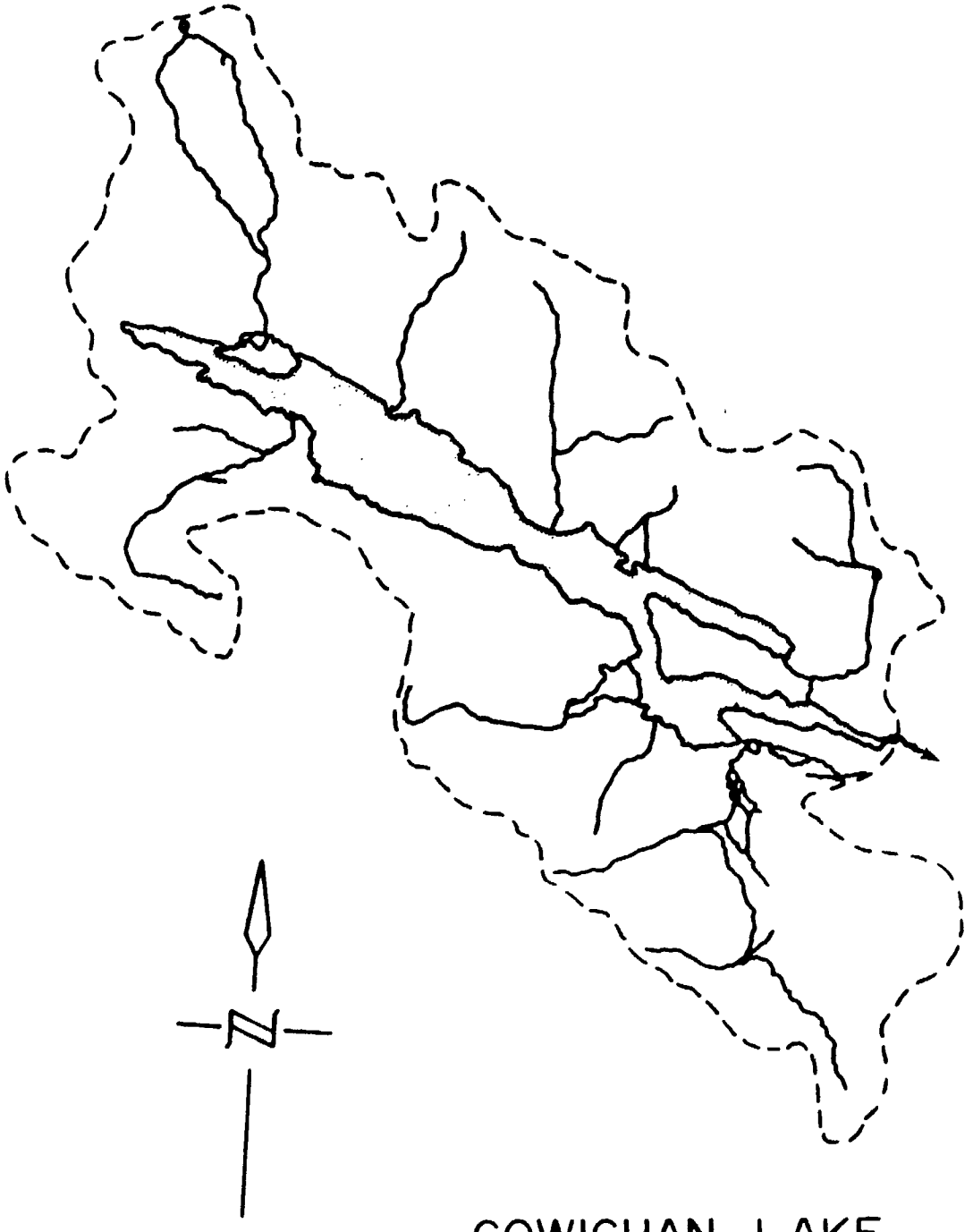
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 21m

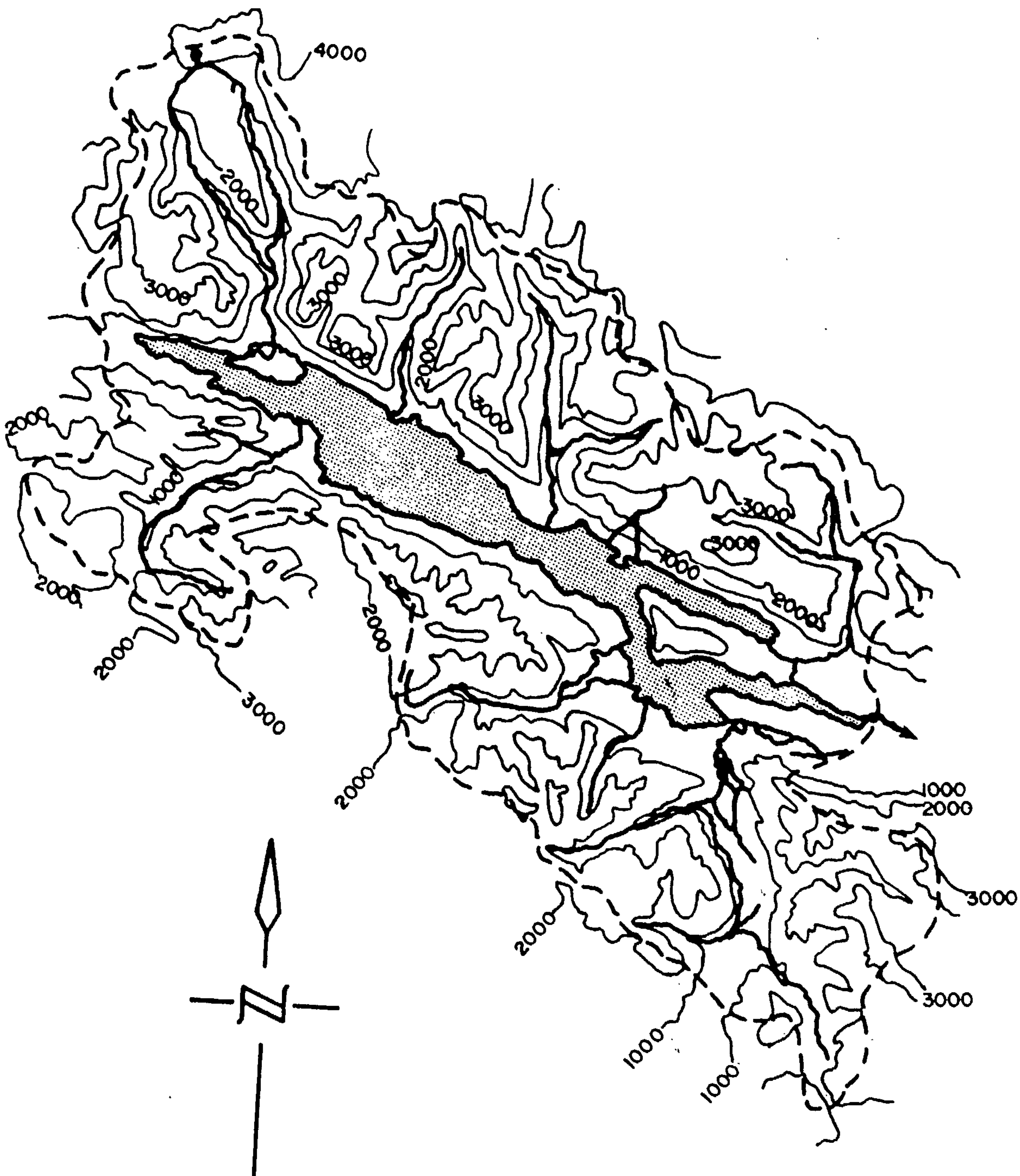
0 1 Km



BRANNEN LAKE

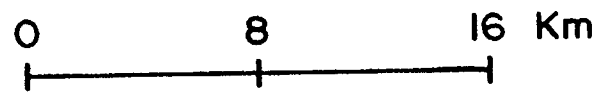
0 1 Km

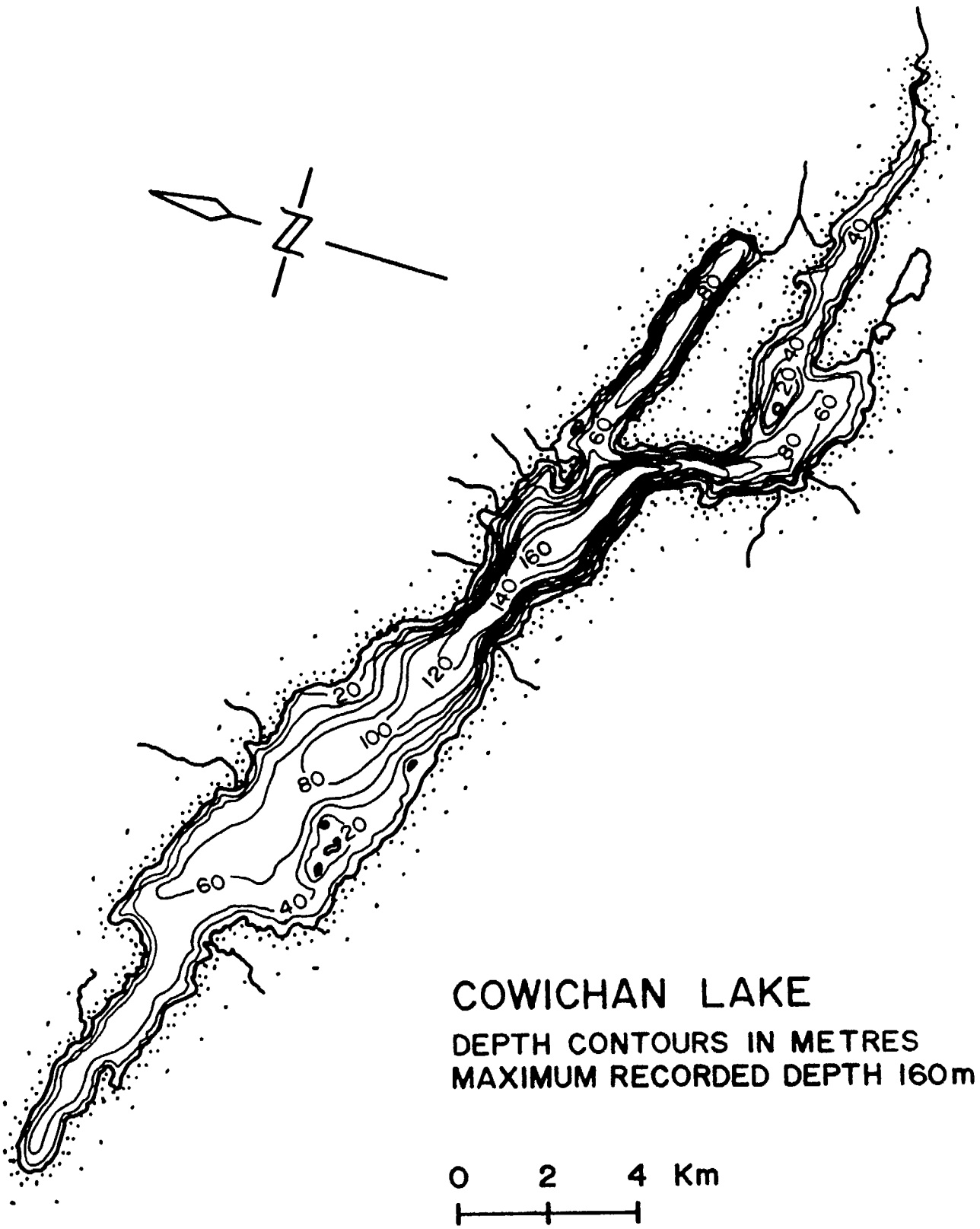

N
COWICHAN LAKE
0
8
16 Km

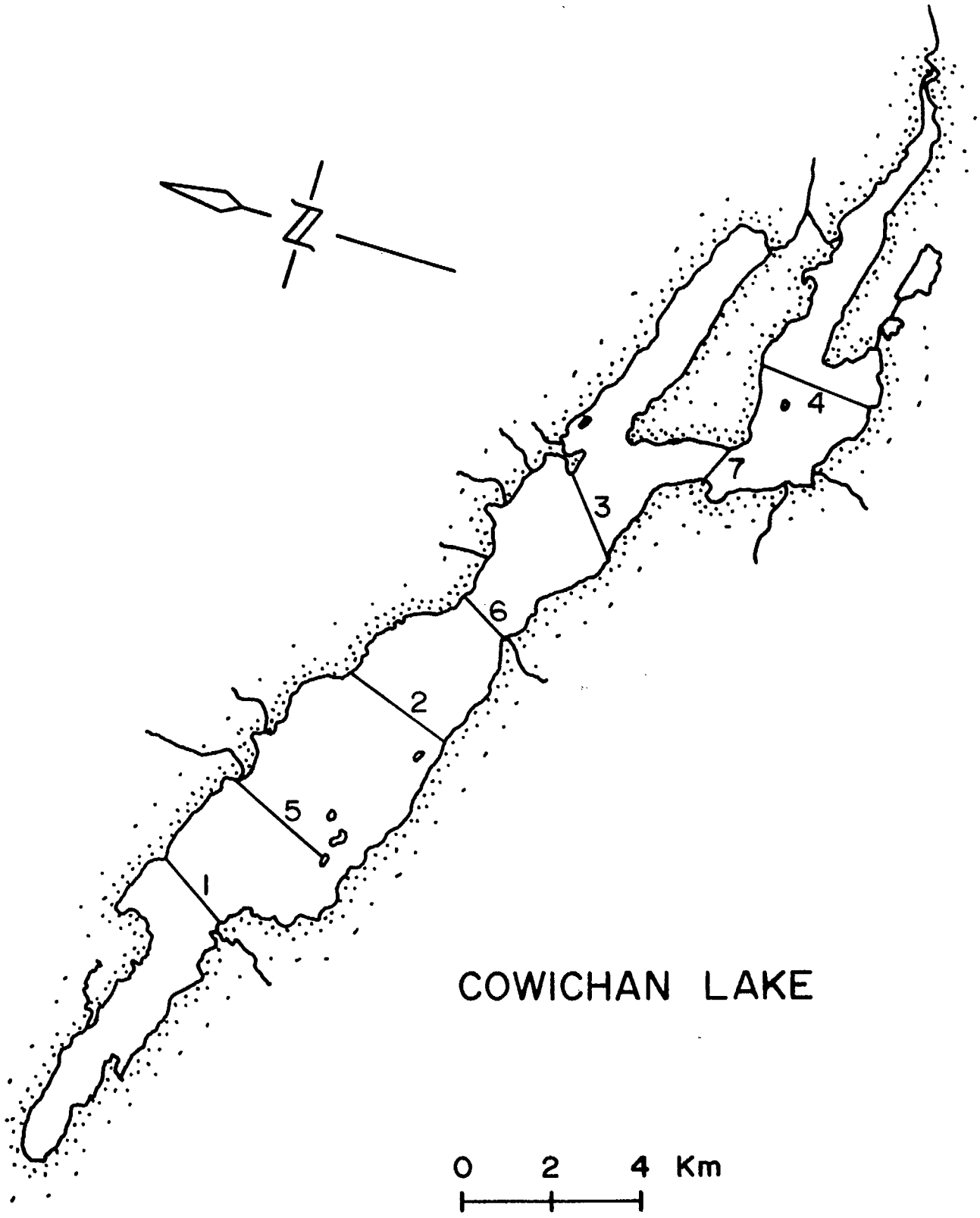


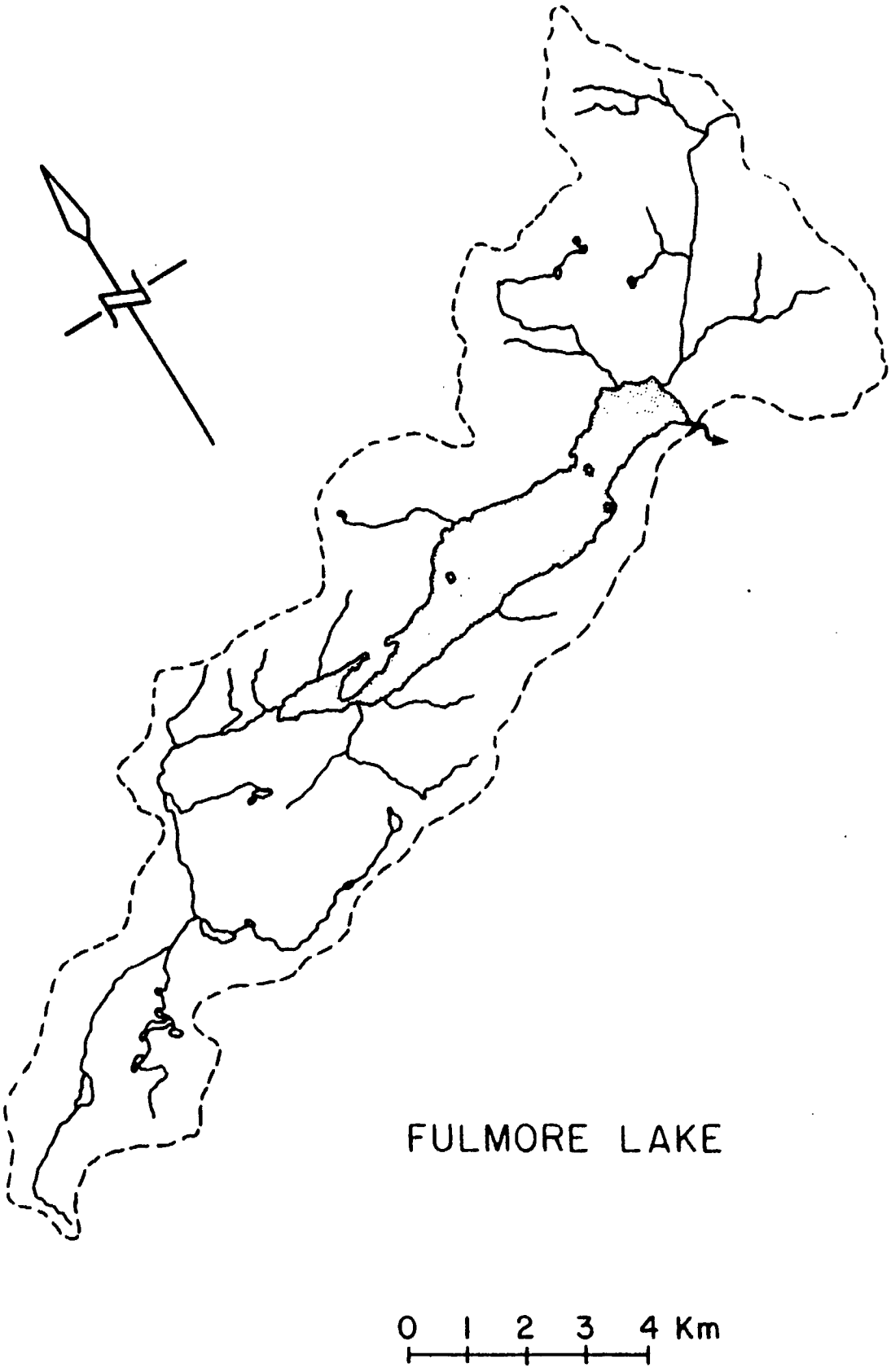
COWICHAN LAKE

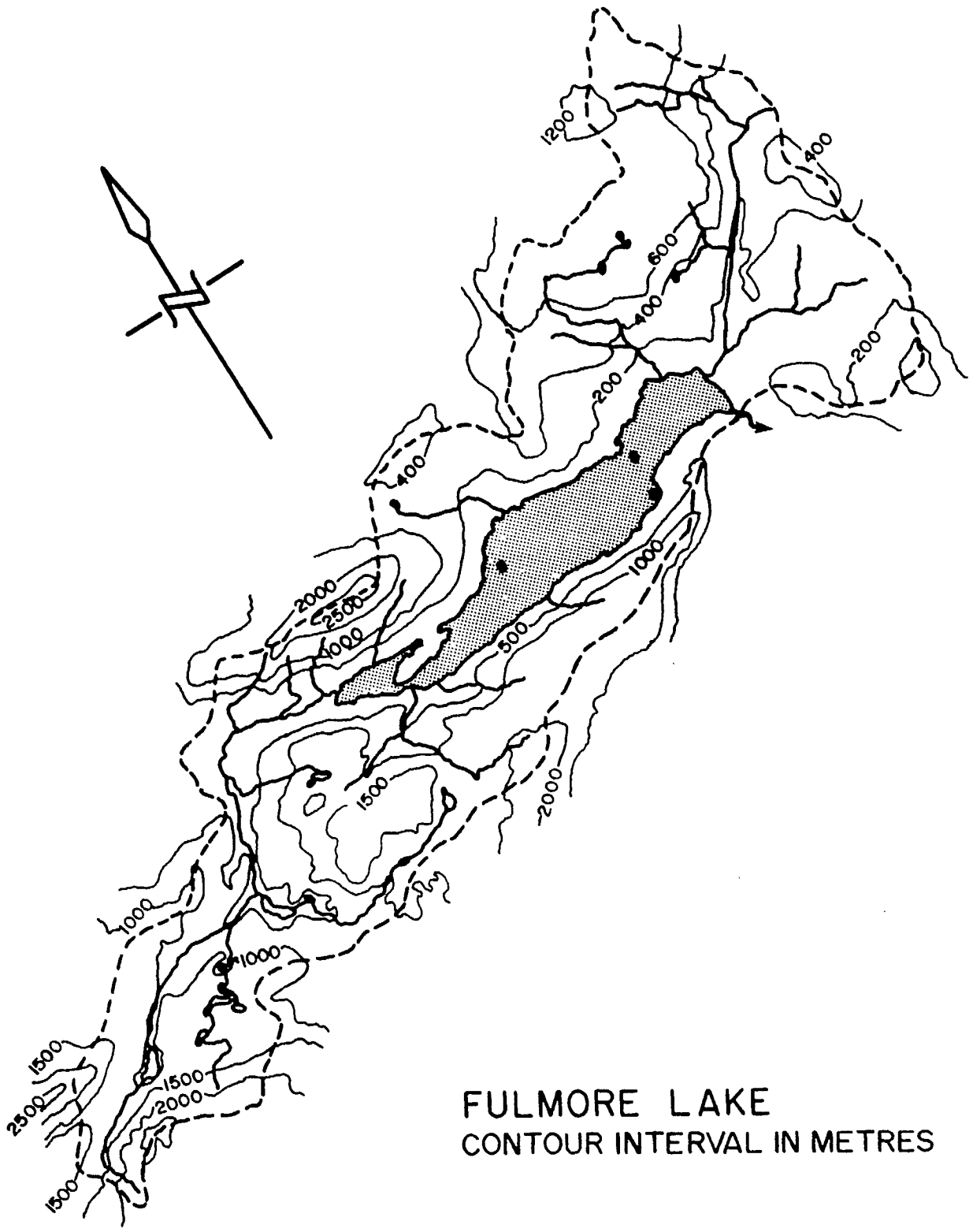
CONTOUR INTERVAL IN FEET




N
20
40
60
80
100
120
140
160
COWICHAN LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 160m
0 2 4 Km

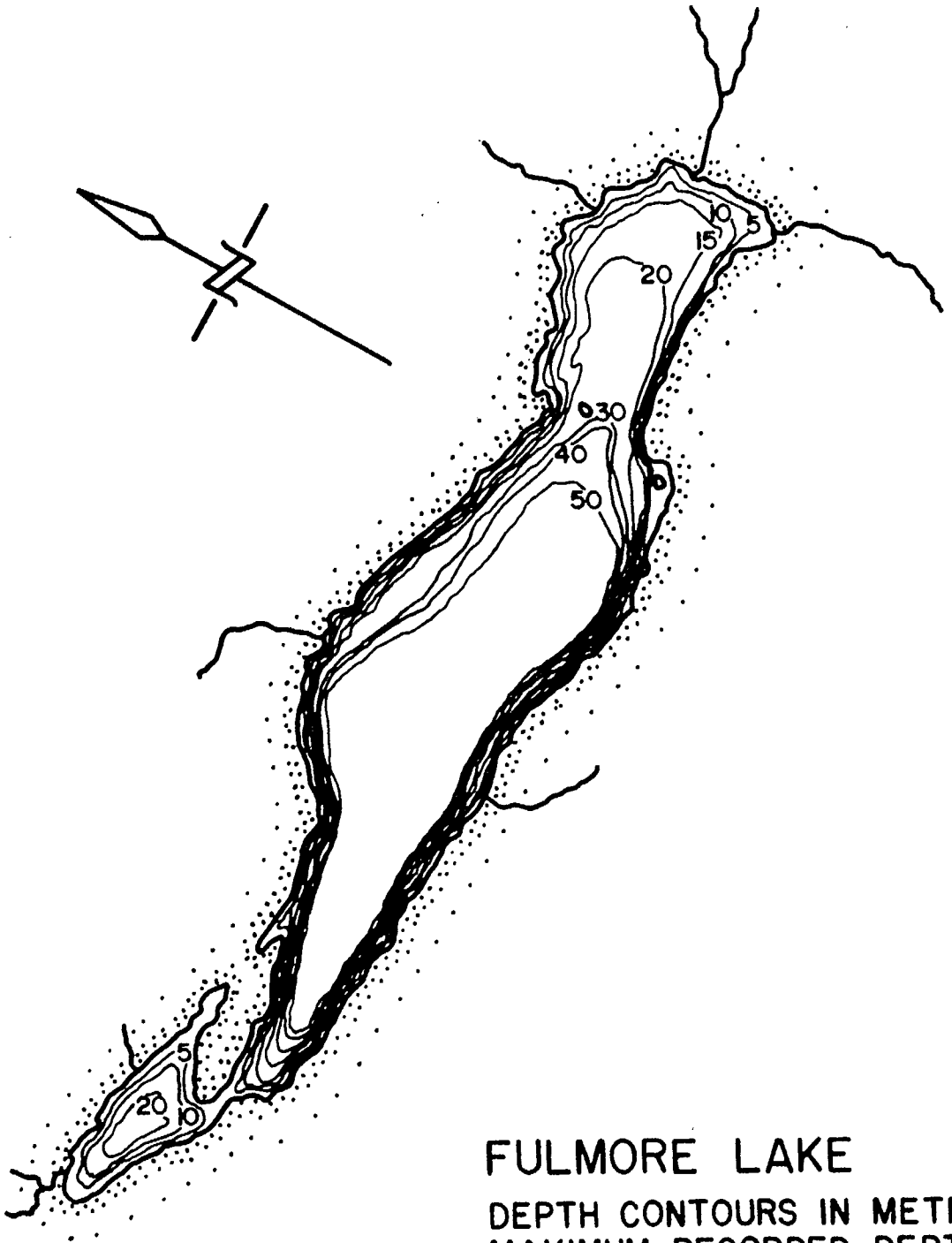

1
2
3
4
5
6
7
COWICHAN LAKE
0 2 4 Km


FULMORE LAKE
0 1 2 3 4 Km



FULMORE LAKE
CONTOUR INTERVAL IN METRES

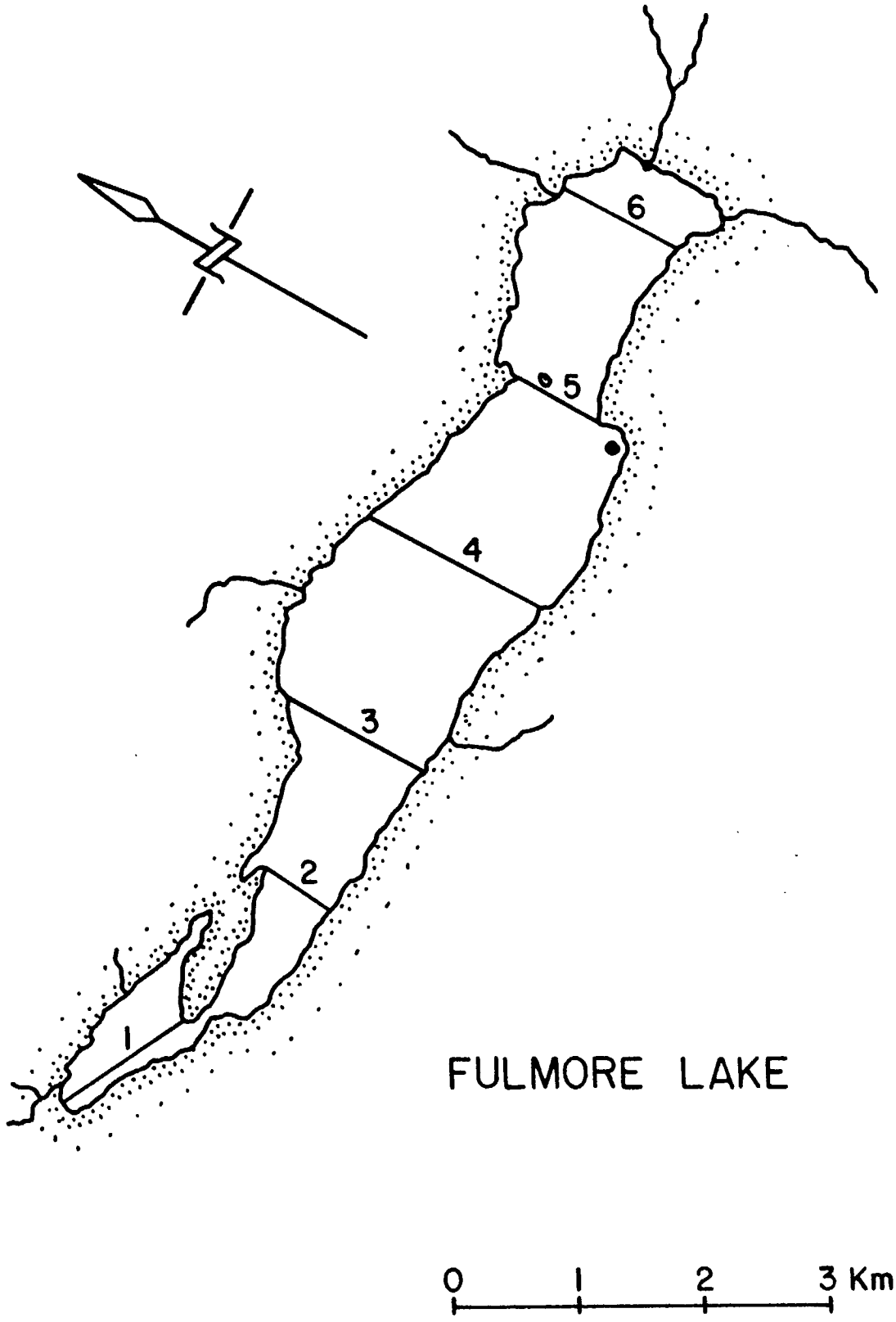
0 1 2 3 4 Km

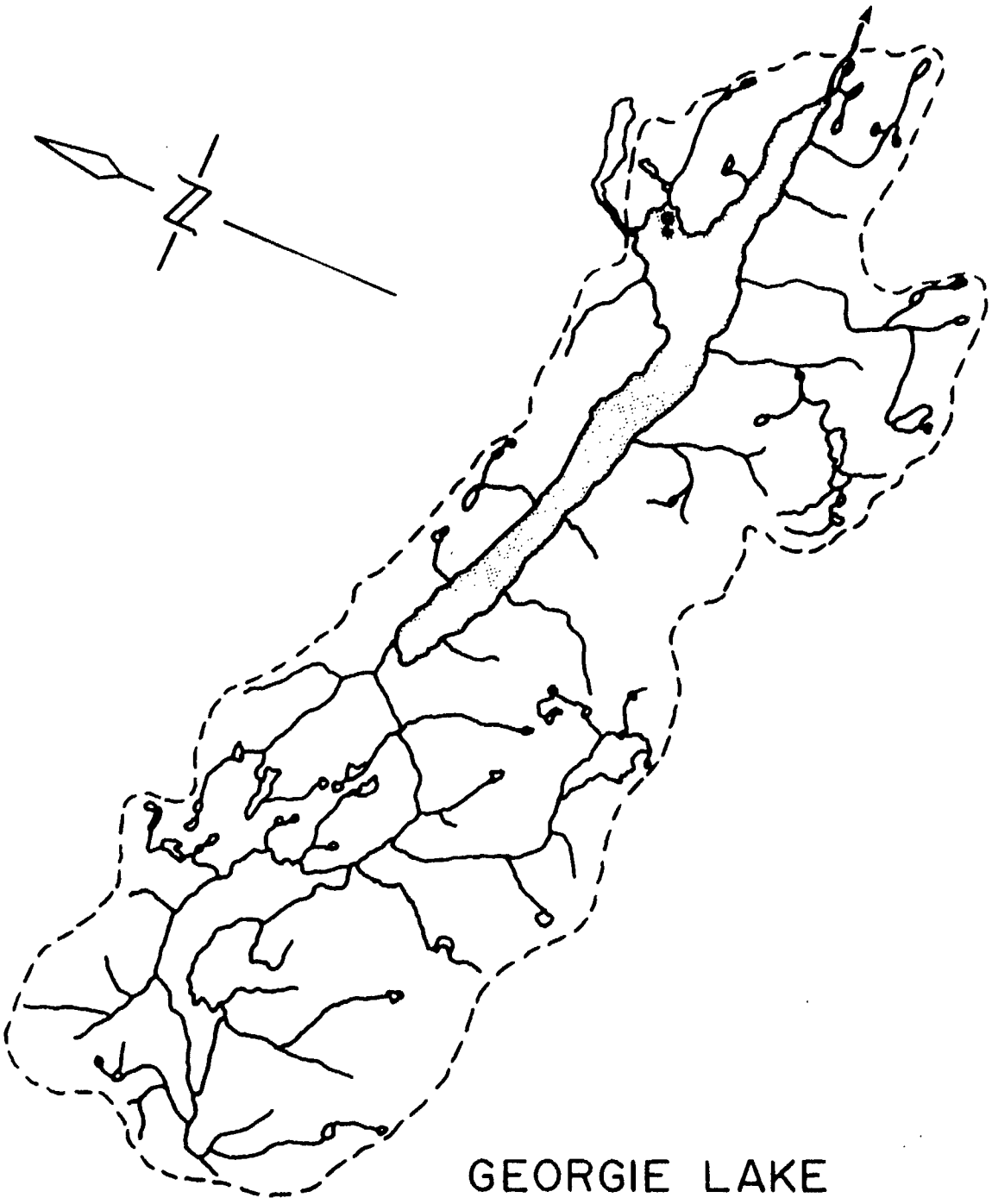


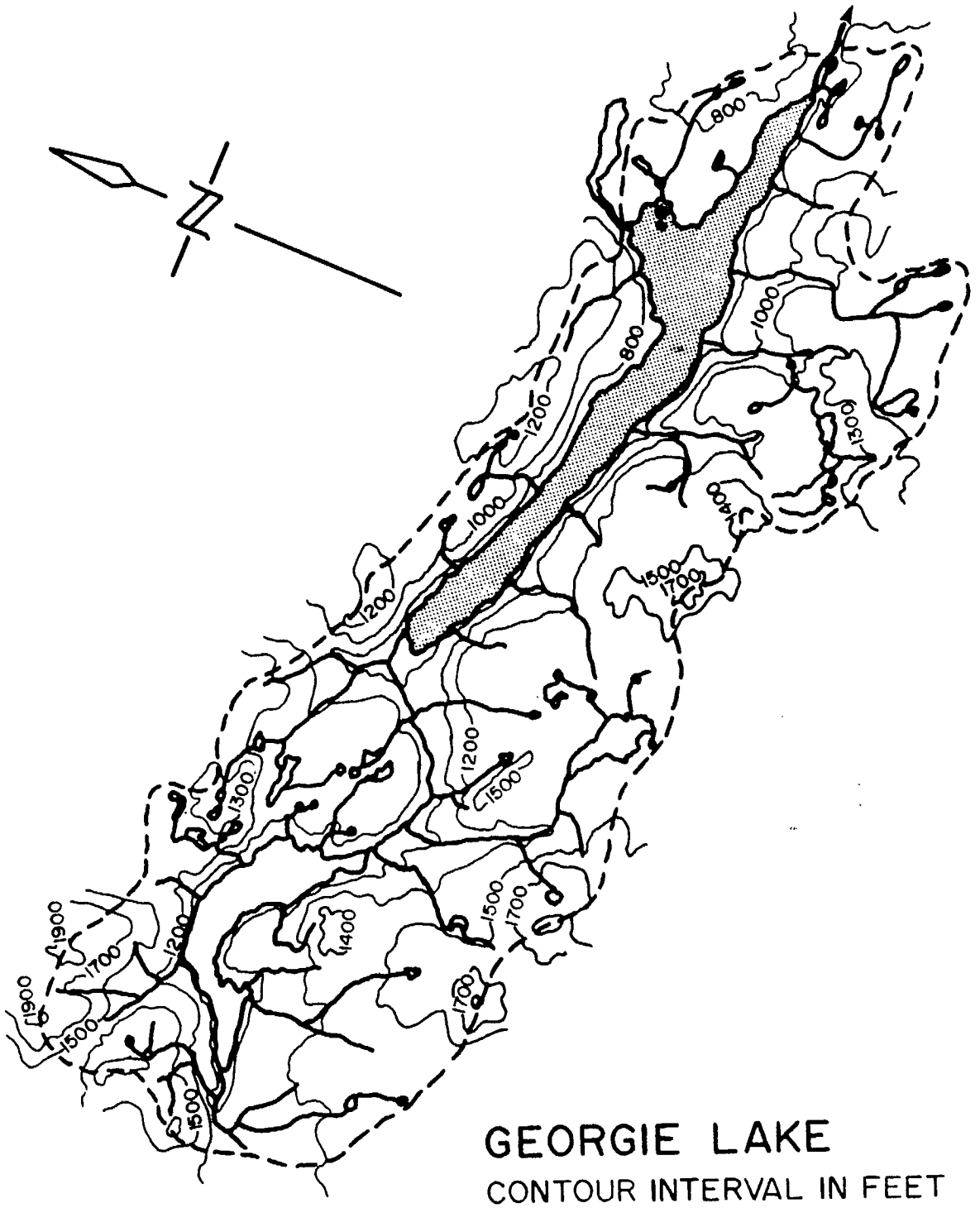
FULMORE LAKE

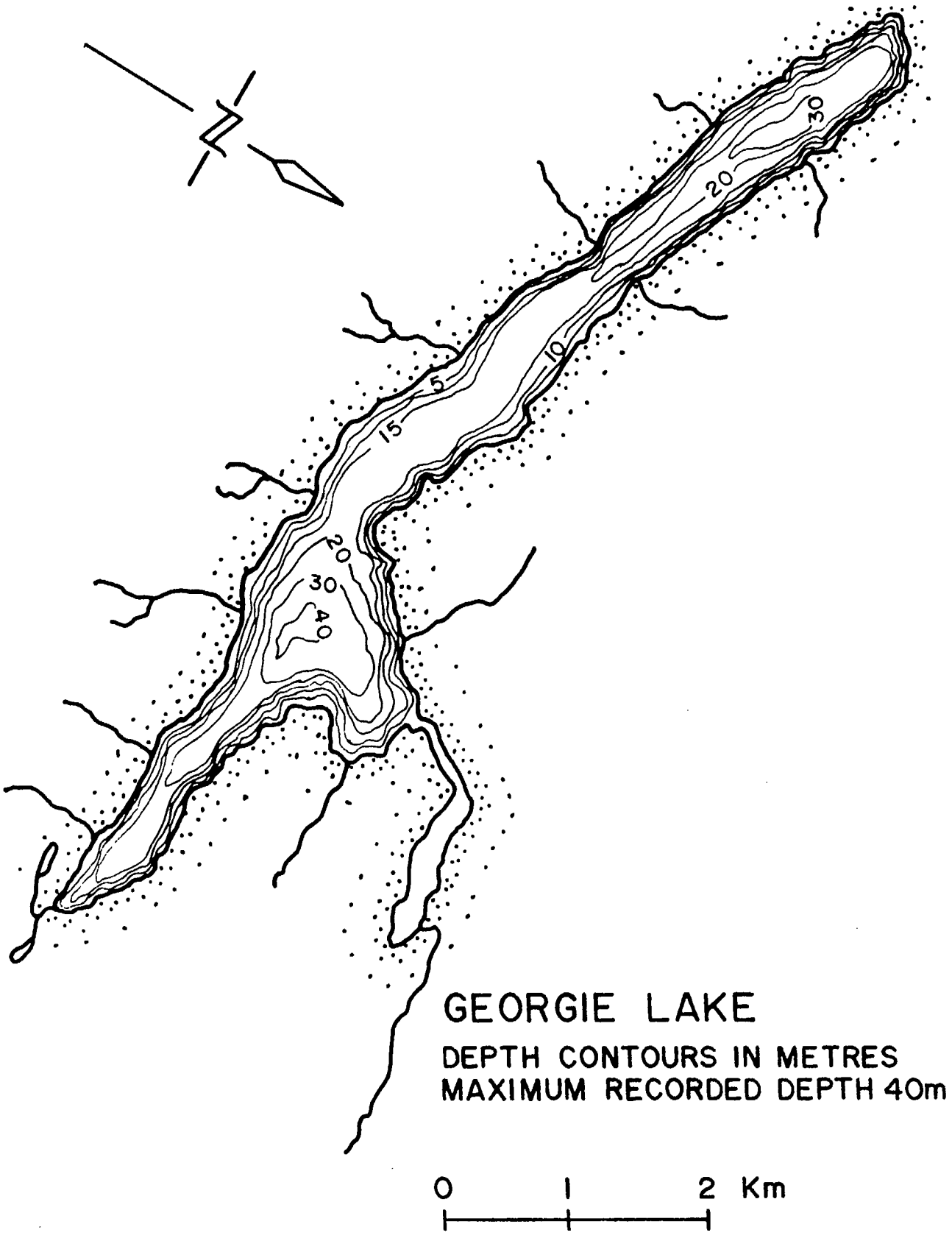
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 57m

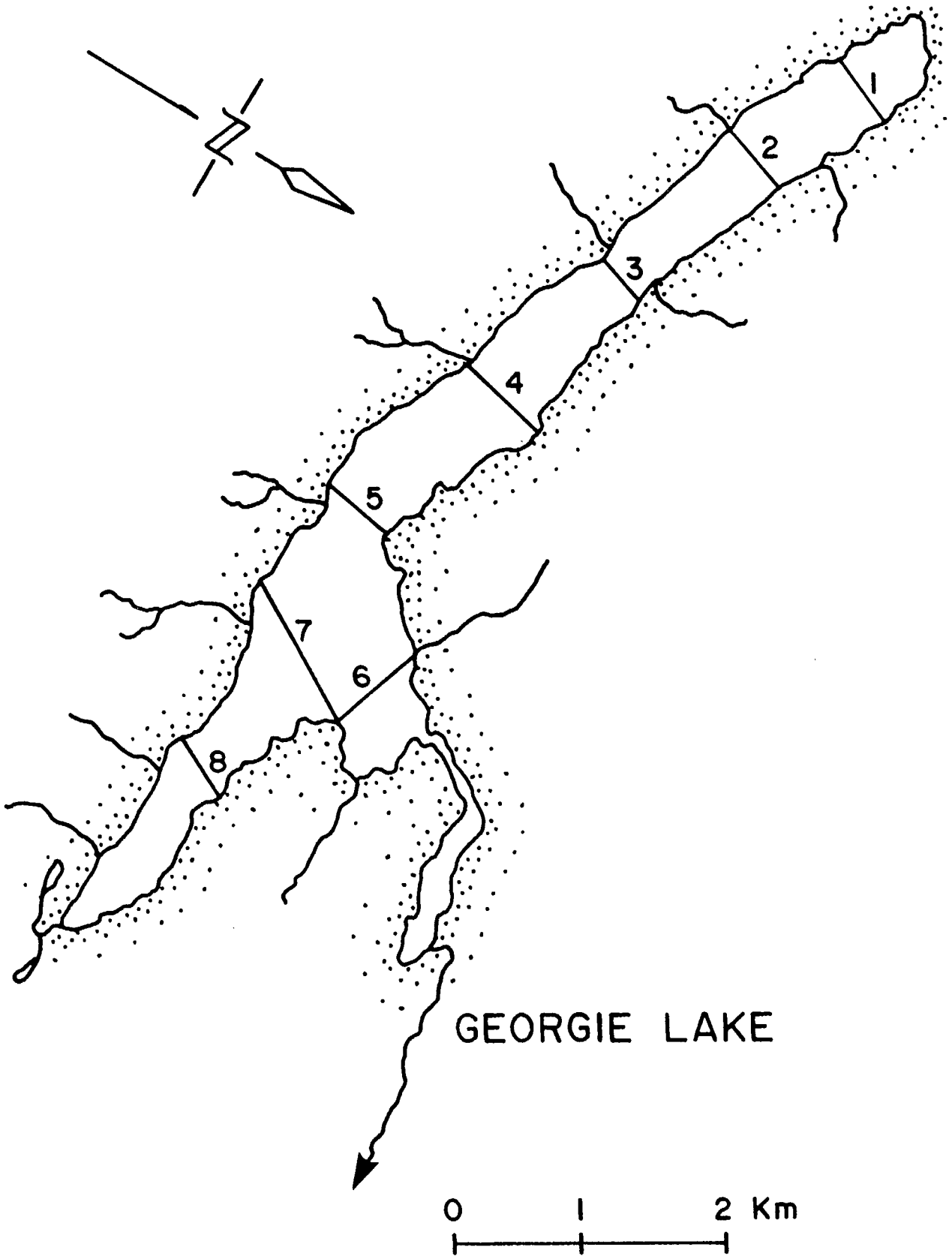
0 1 2 3 Km

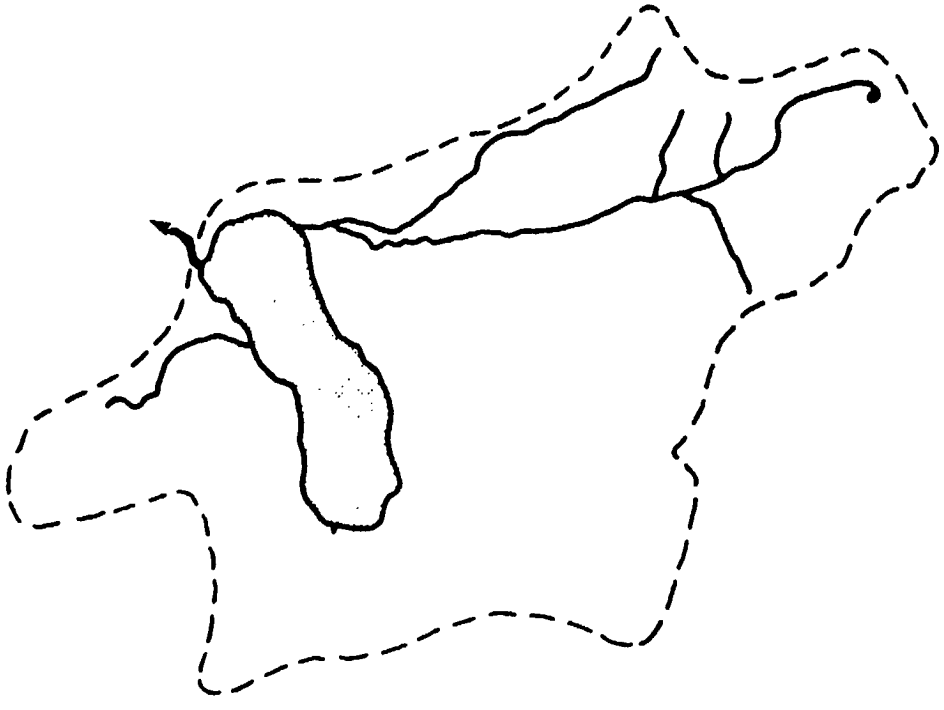

6
5
4
3
2
1
FULMORE LAKE
0
1
2
3 Km


GEORGIE LAKE
0 1 2 3 4 5 Km

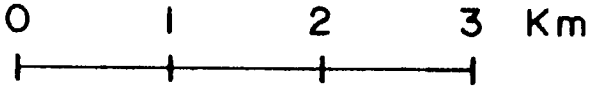

800
1000
1200
1300
1400
1500
1700
1900
GEORGIE LAKE
CONTOUR INTERVAL IN FEET
0 1 2 3 4 5 Km

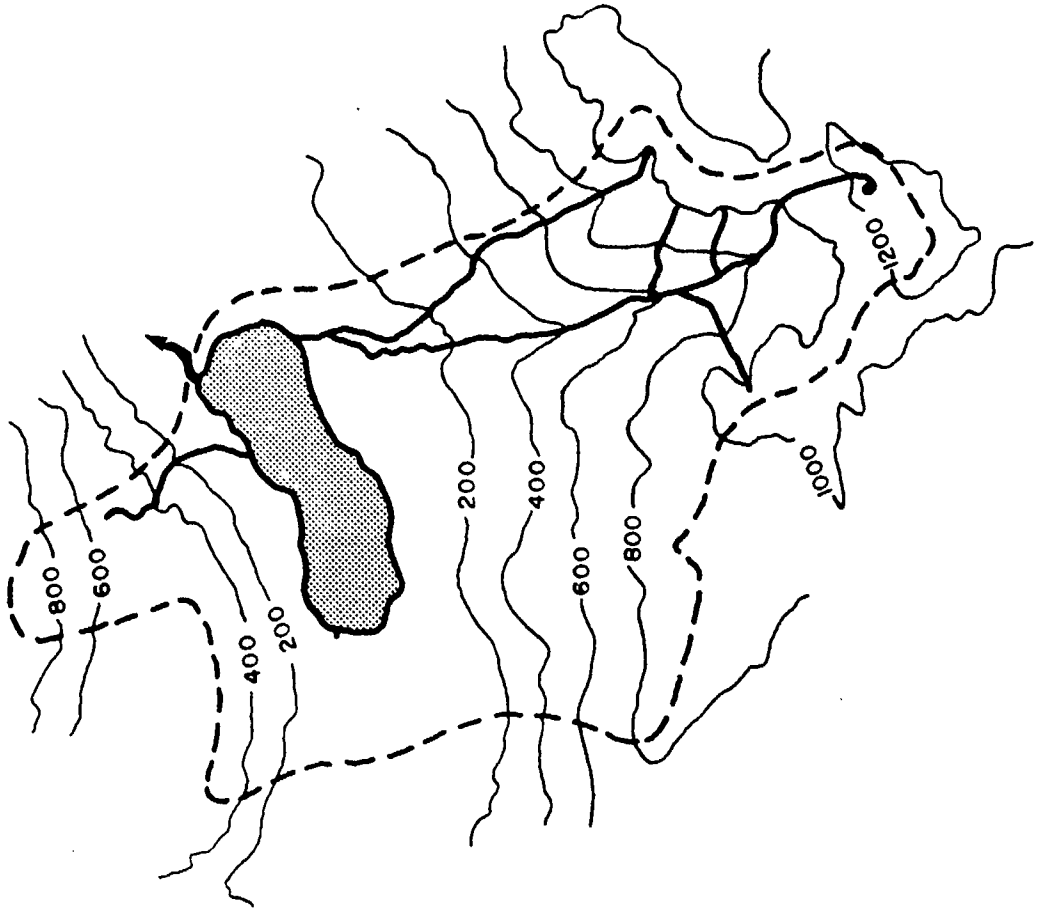

30
20
10
5
15
20
30
40
GEORGIE LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 40m
0
1
2 Km


1
2
3
4
5
6
7
8
GEORGIE LAKE
0
1
2 Km



GLENDALE LAKE

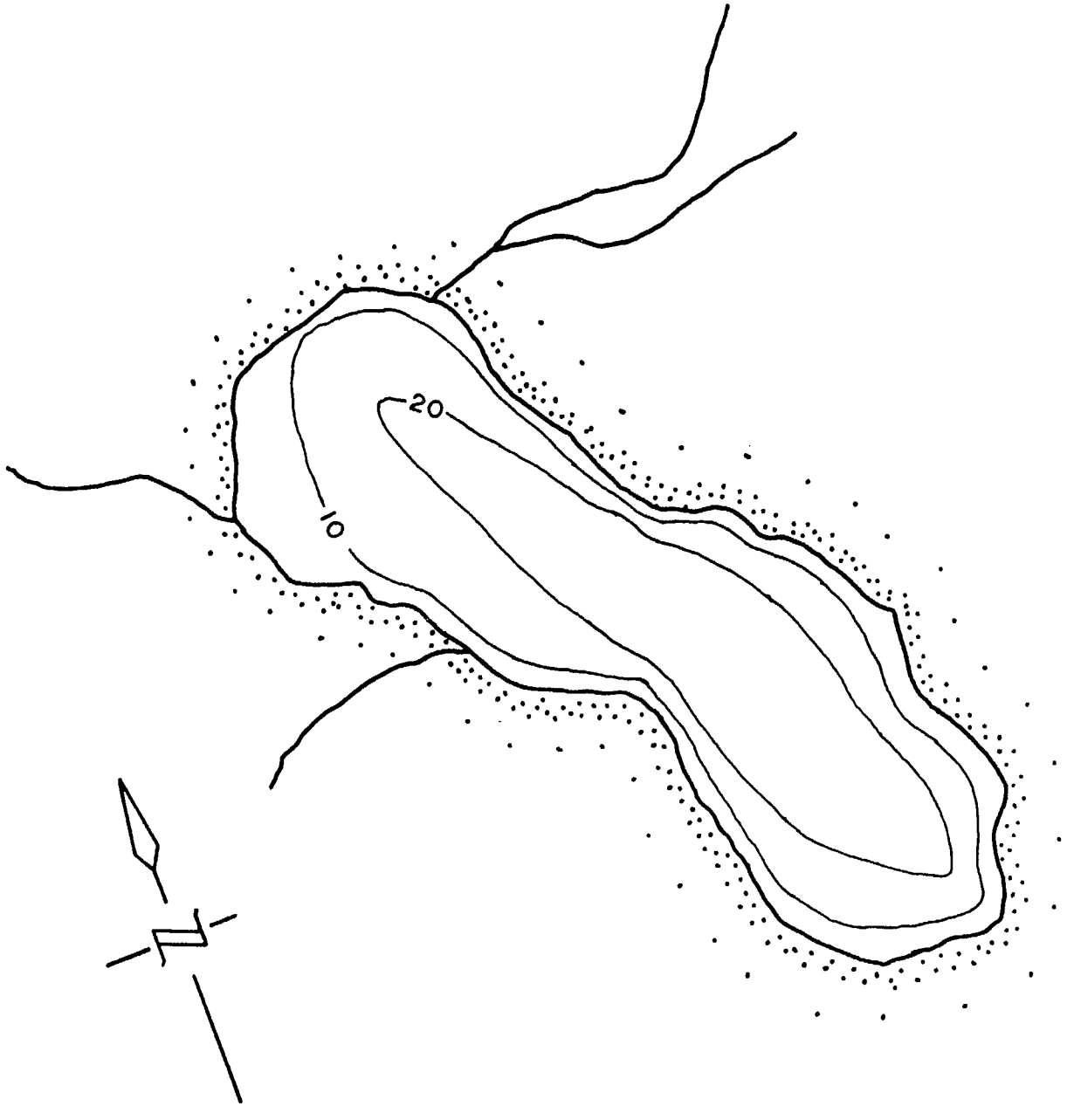




GLENDALE LAKE

CONTOUR INTERVAL IN METRES

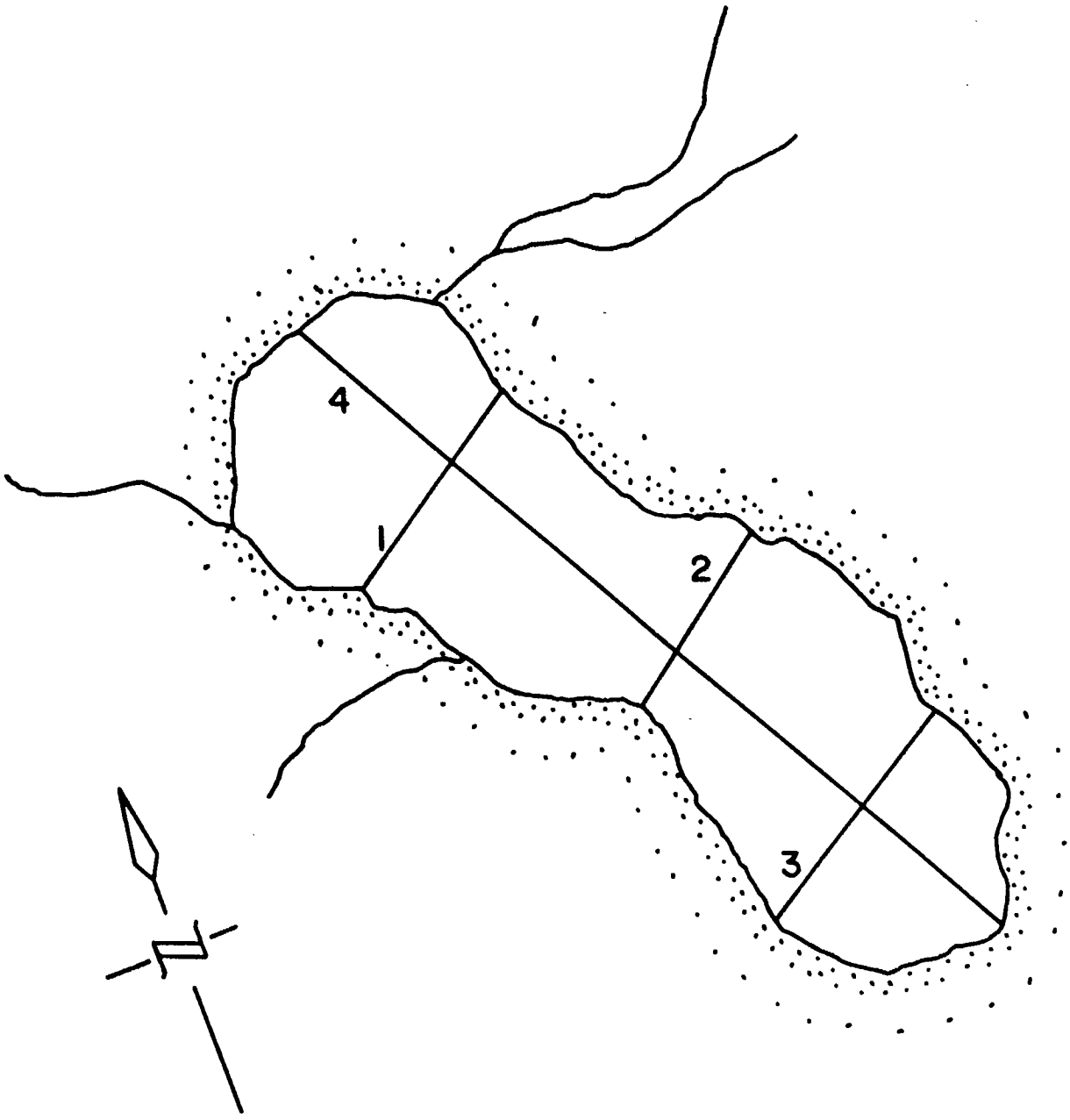
0 1 2 3 Km



GLENDALE LAKE

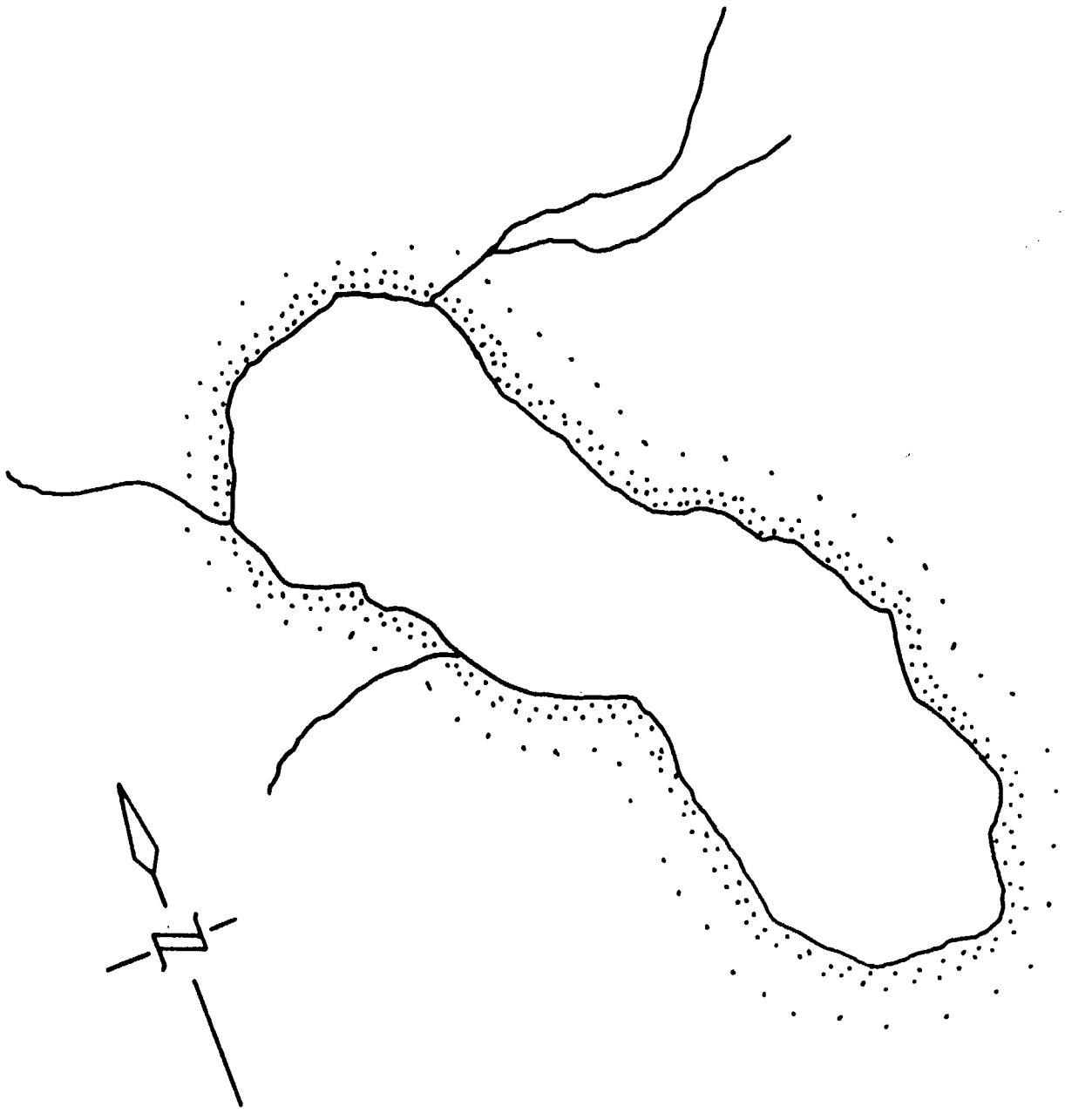
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 25m

0 1 Km



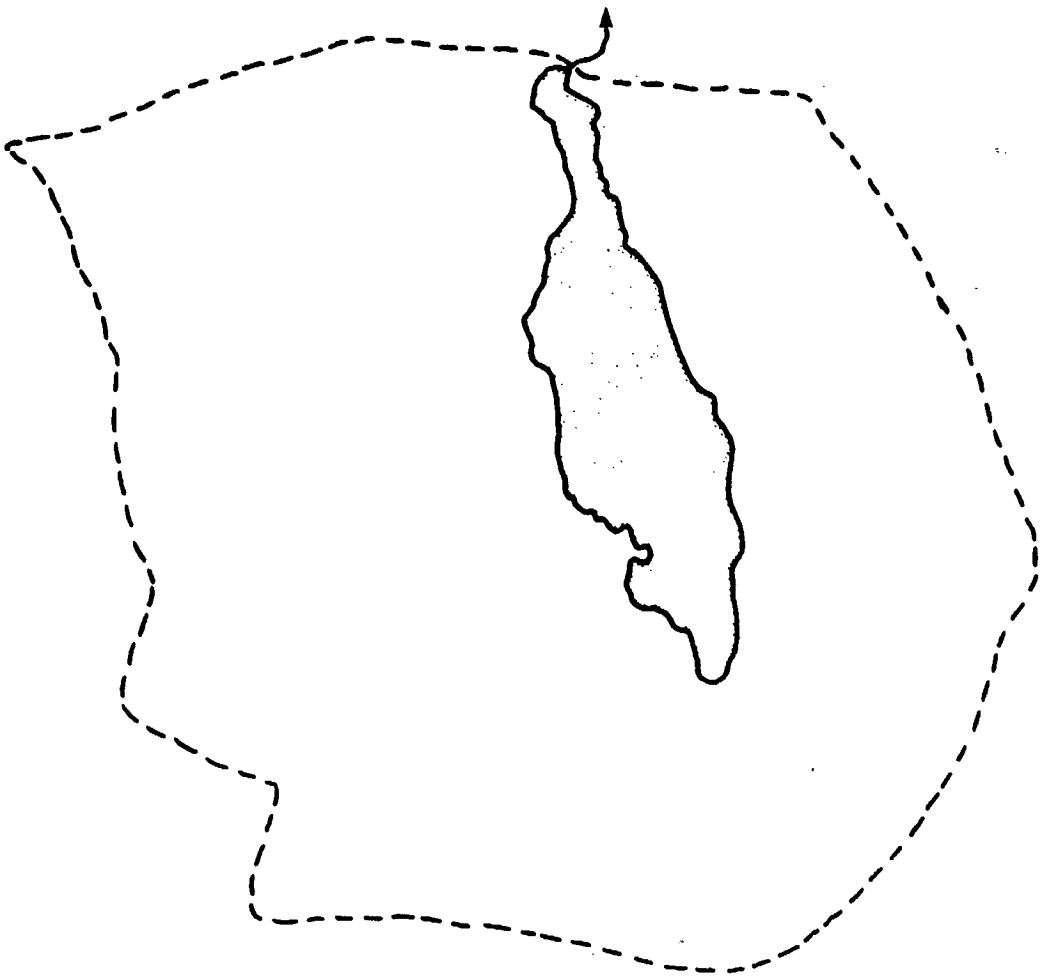
GLENDALE LAKE

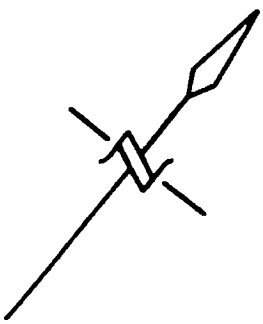
0 1 Km



GLENDALE LAKE

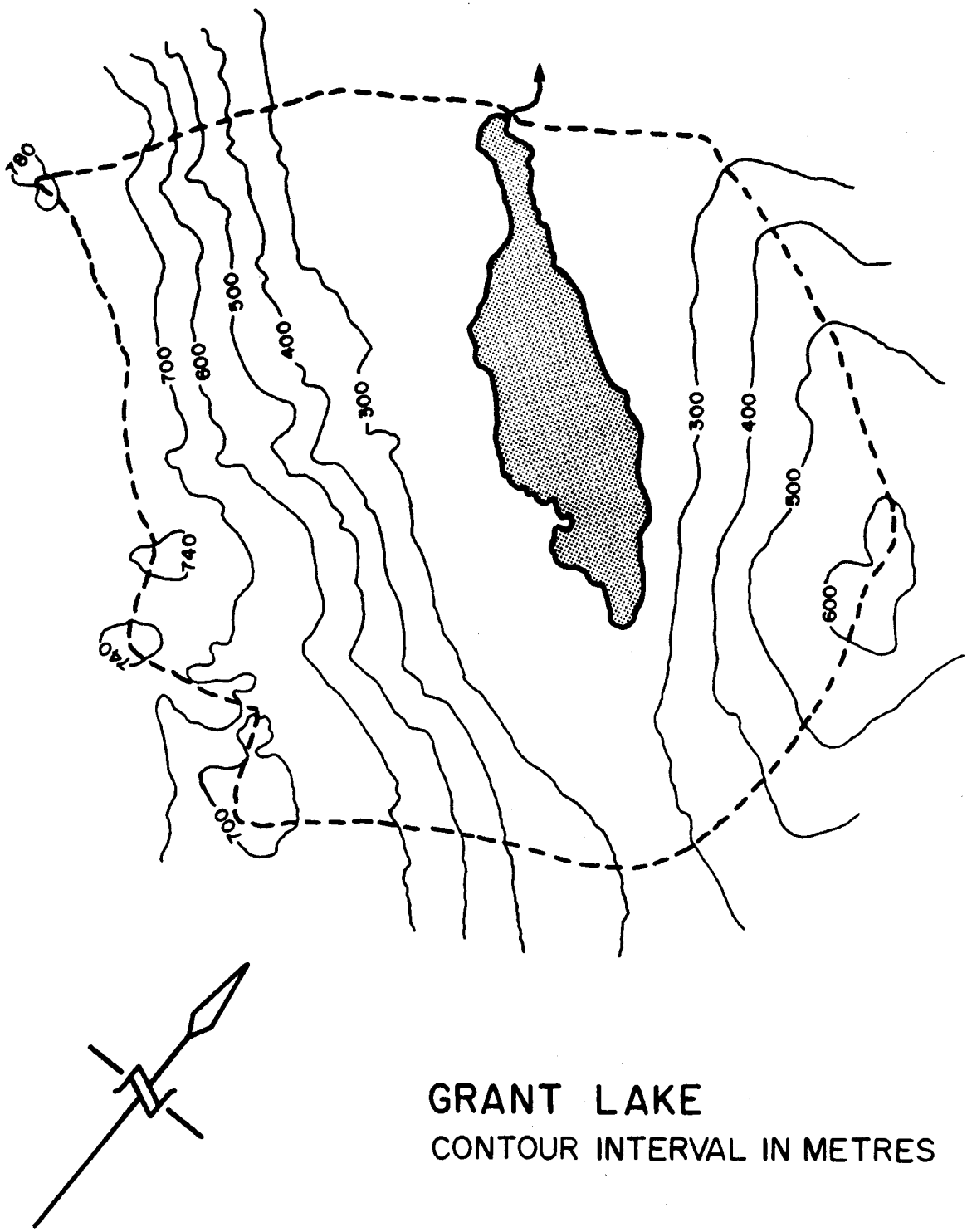
0 1 Km





GRANT LAKE

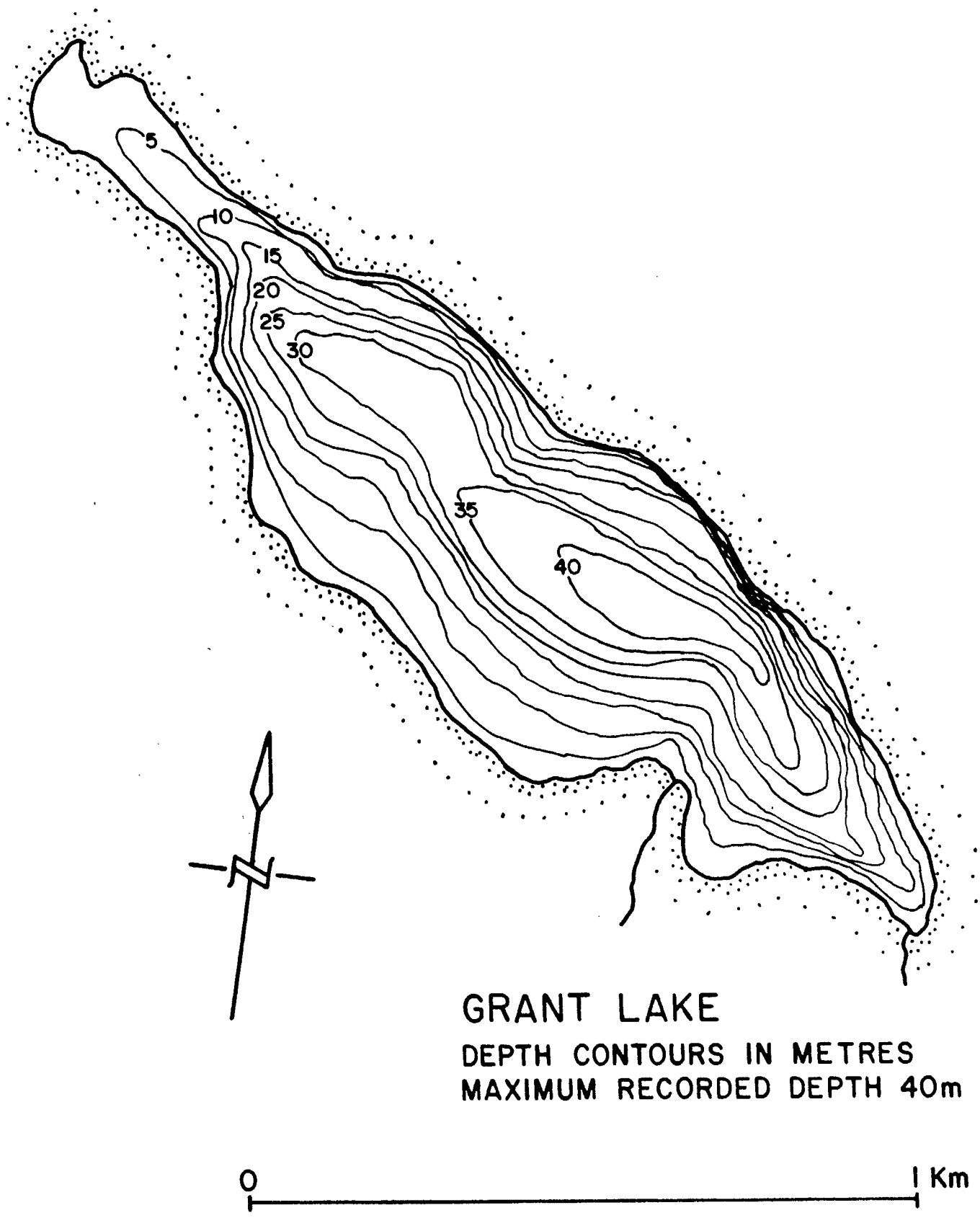
0 1 Km

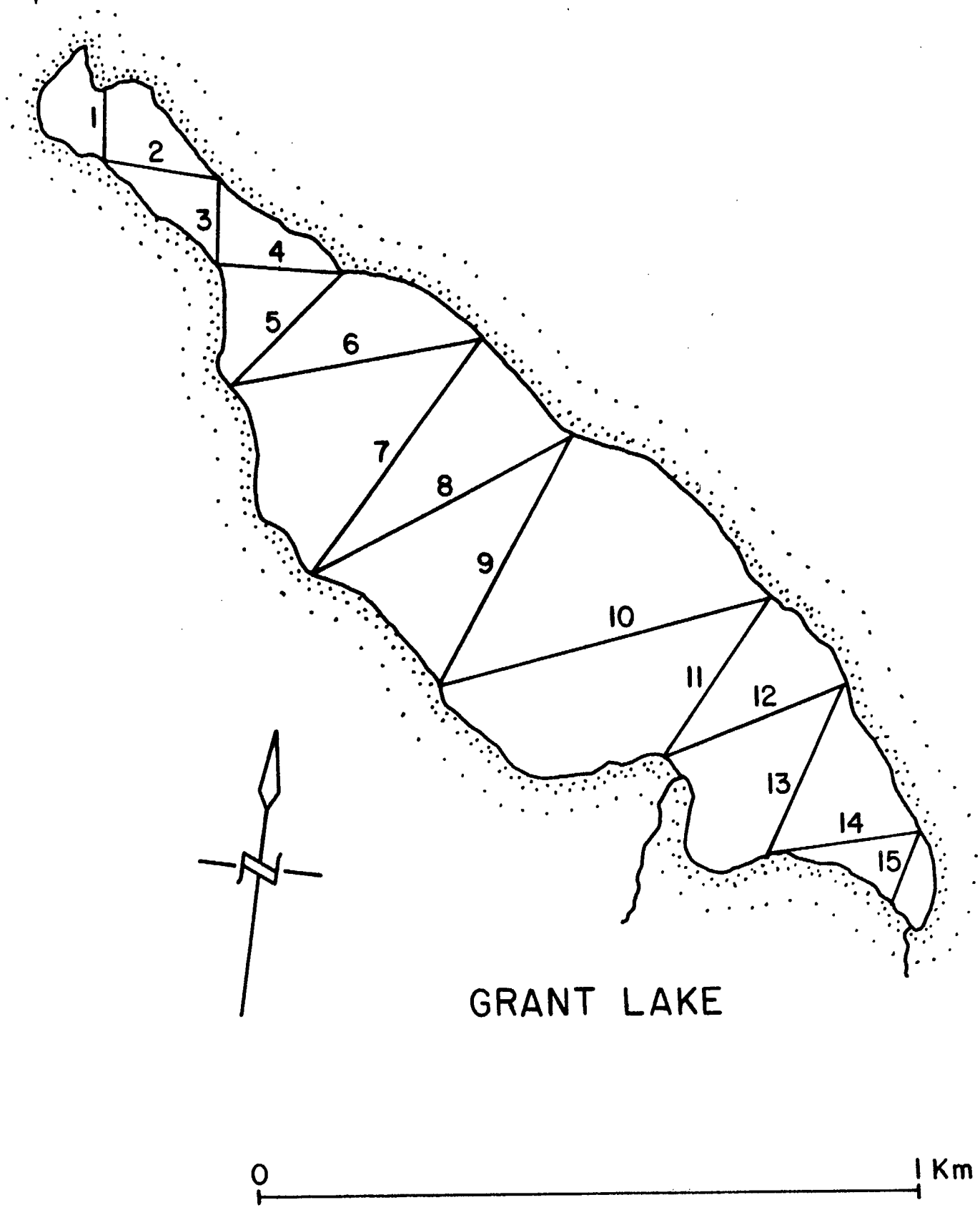


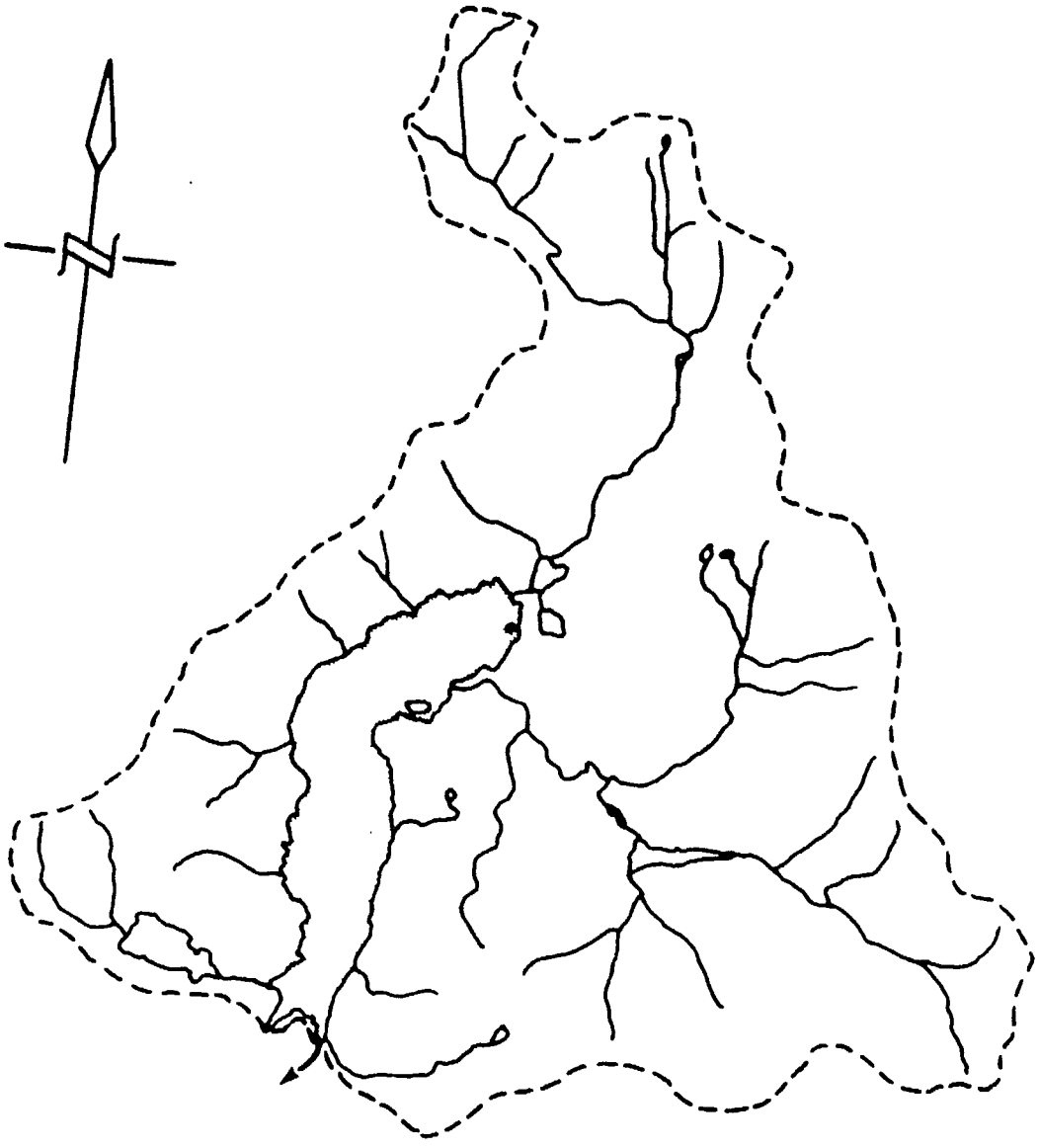
GRANT LAKE

CONTOUR INTERVAL IN METRES

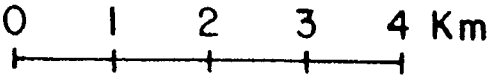
0 1 Km

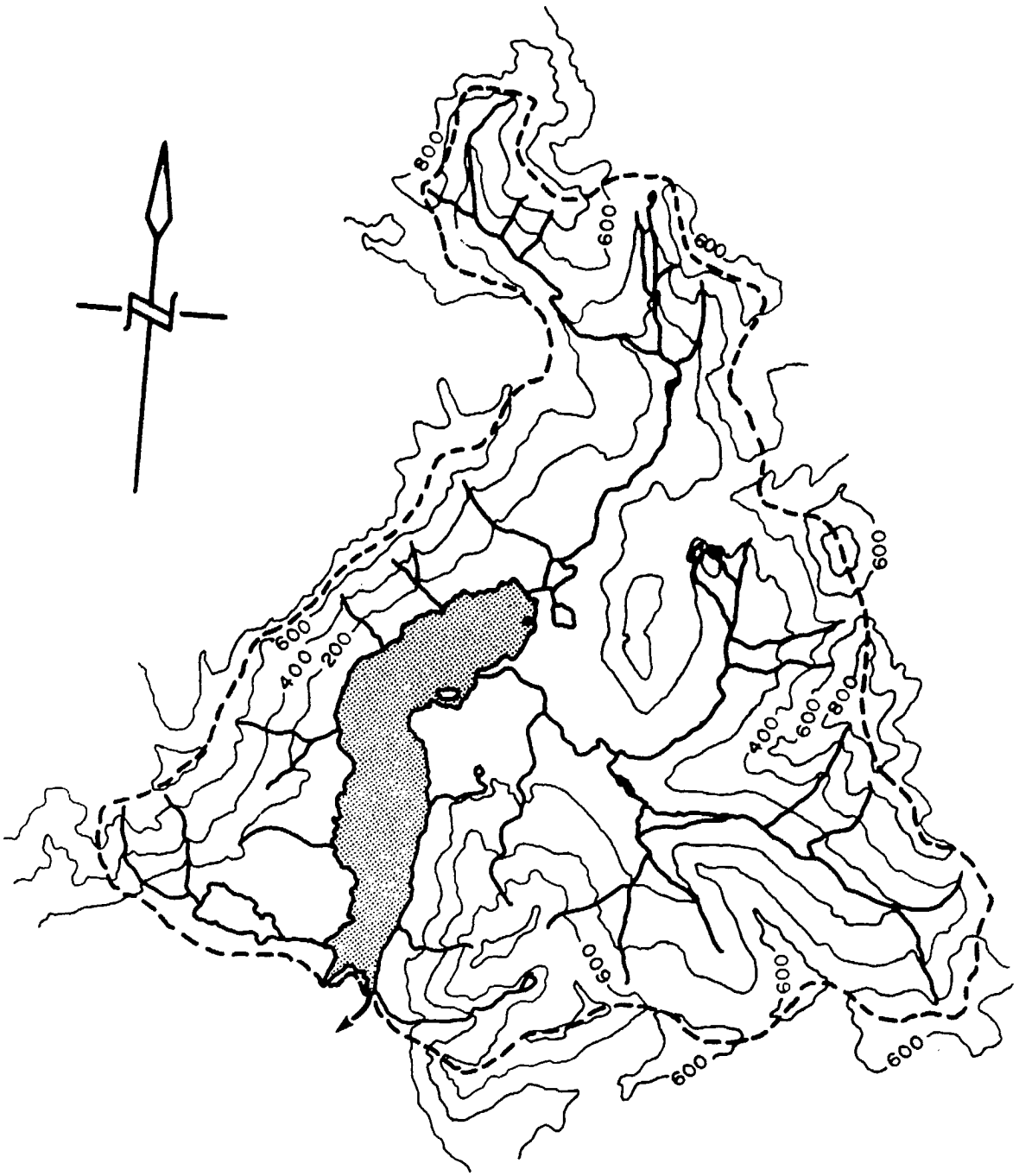

5
10
15
20
25
30
35
40
GRANT LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 40m
0
1 Km


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
GRANT LAKE
0
1 Km



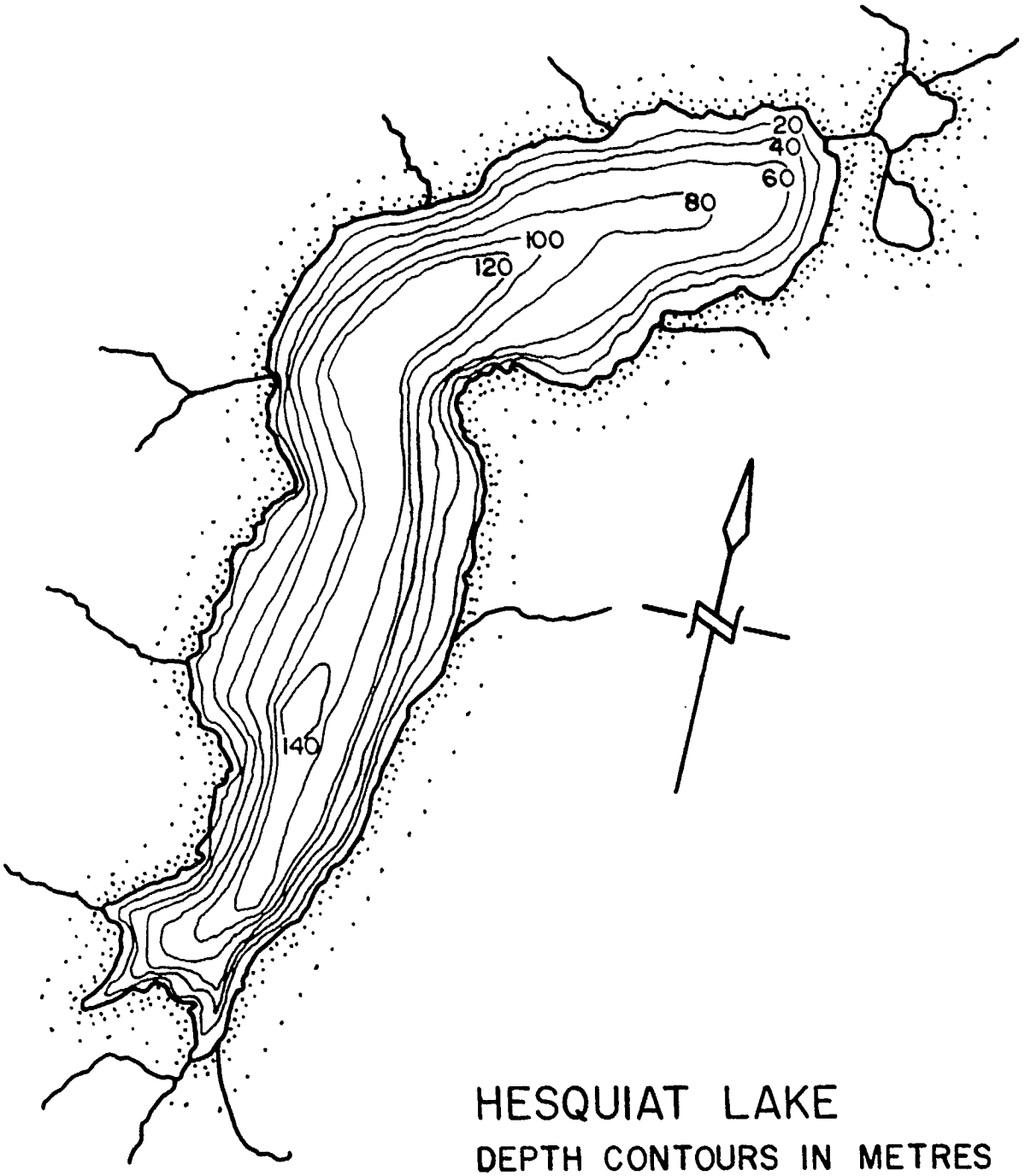
HESQUIAT LAKE





HESQUIAT LAKE
CONTOUR INTERVAL IN METRES

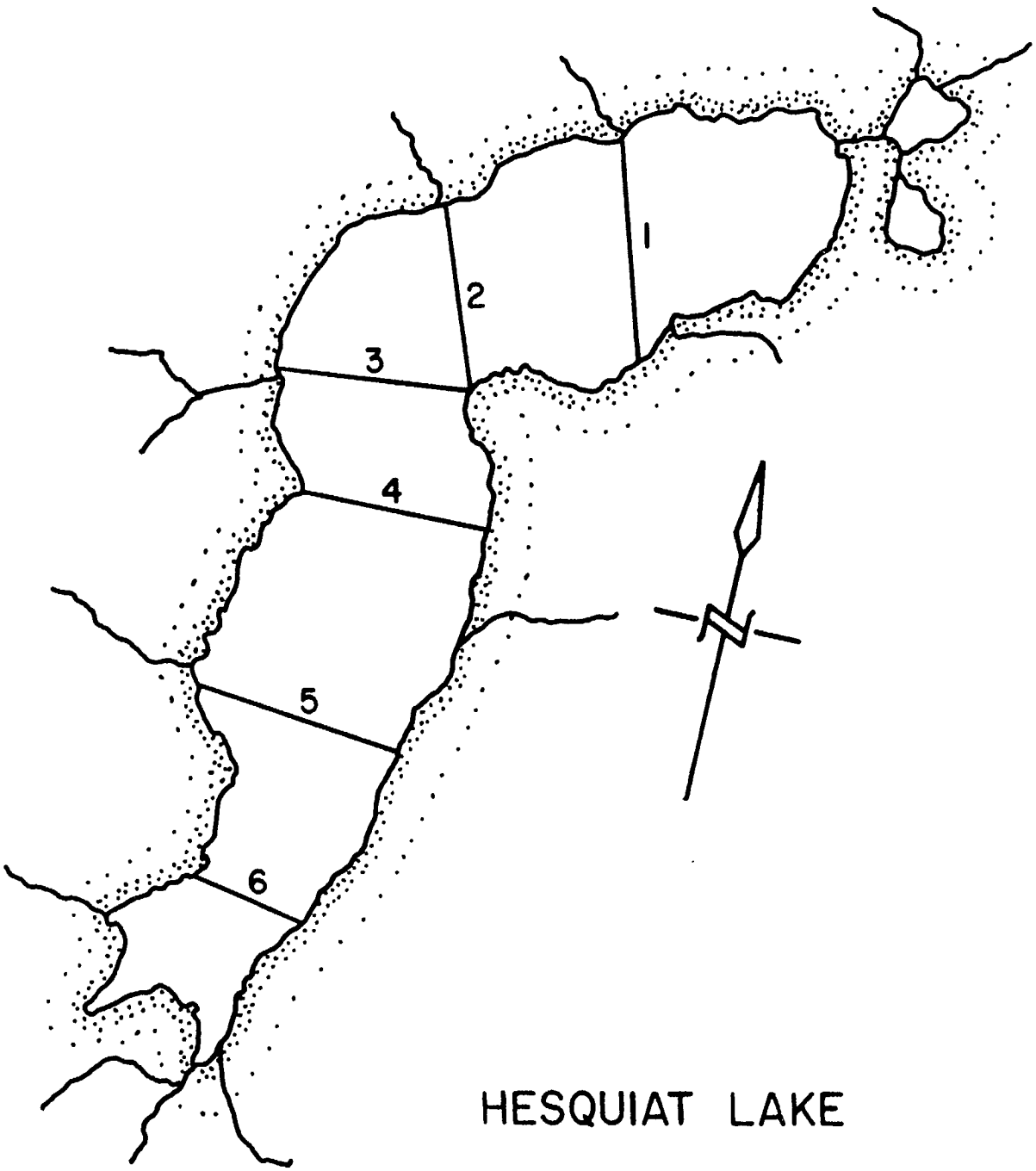
0 1 2 3 4 Km



HESQUIAT LAKE

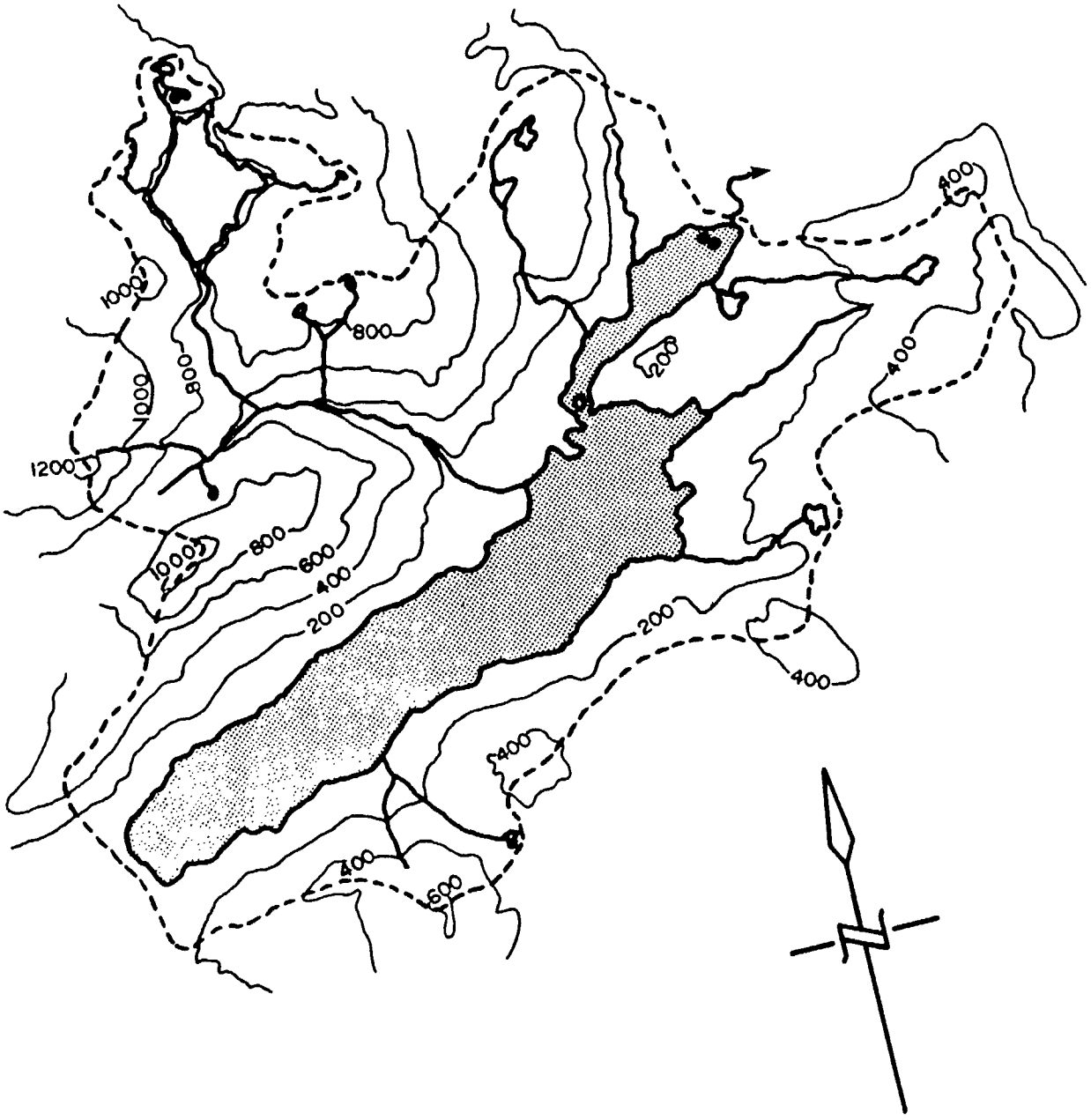
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 142m

0 1 2 Km


1
2
3
4
5
6
HESQUIAT LAKE
0
1
2 Km

HEYDON LAKE

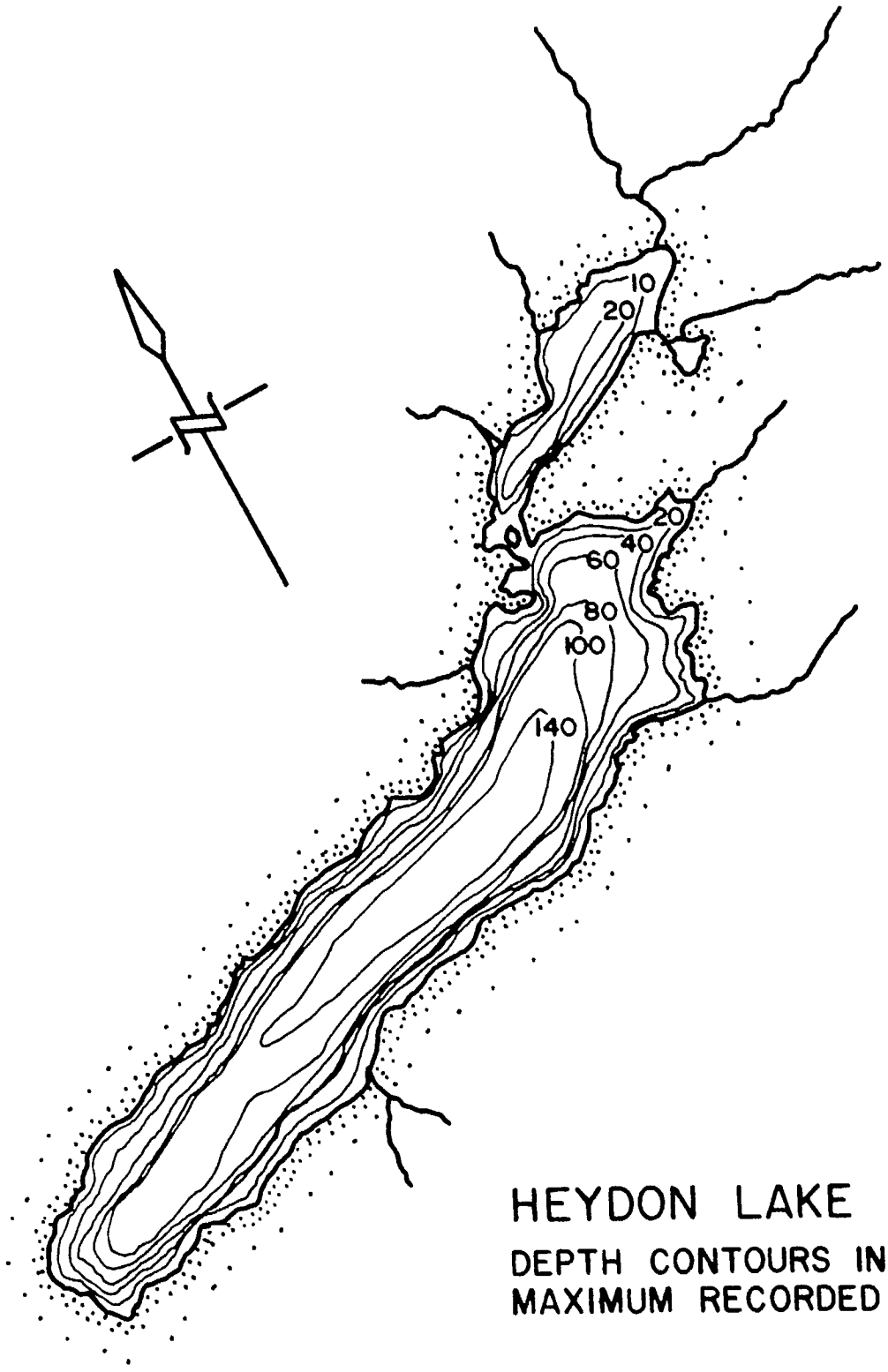
0 1 2 3 4 Km

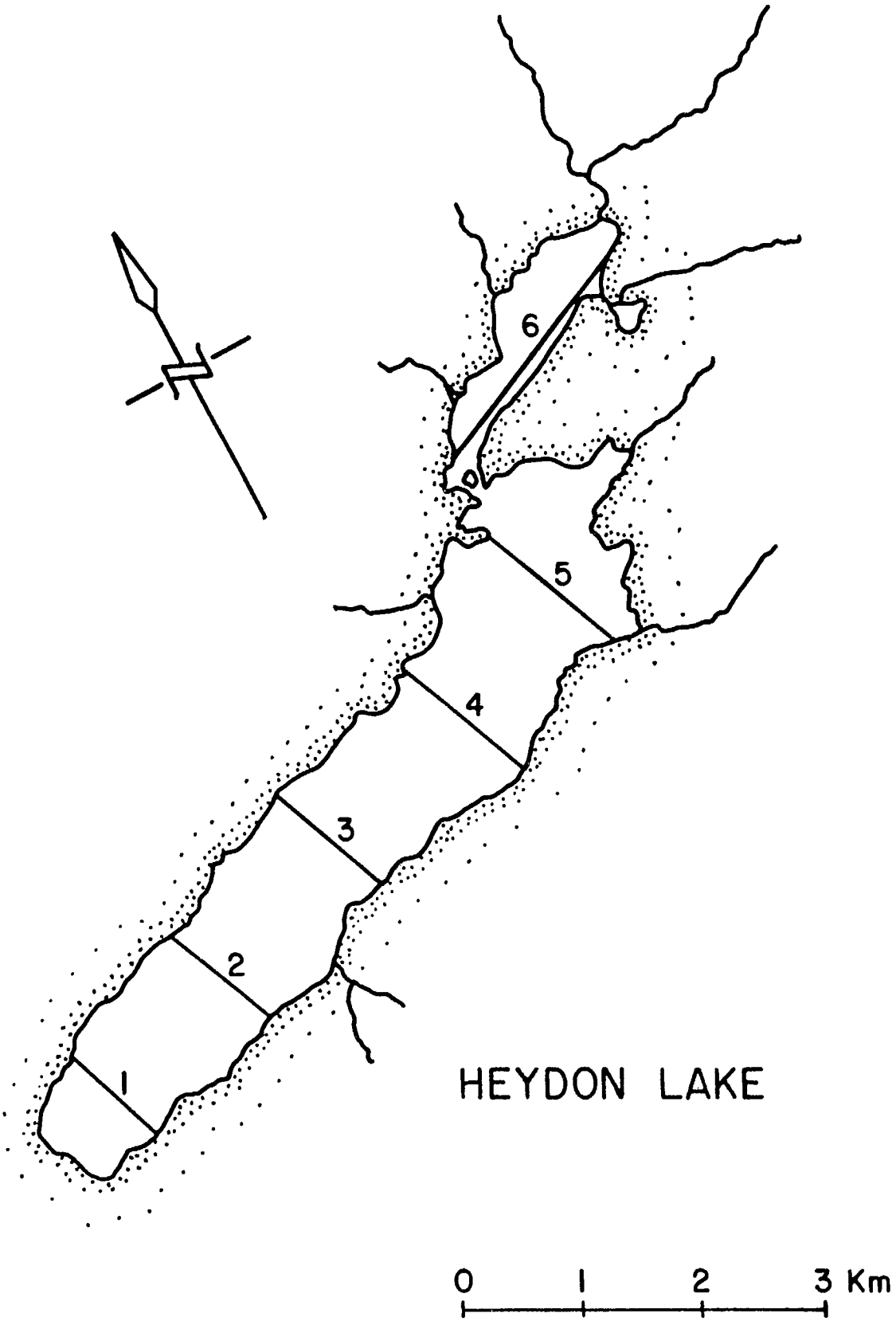


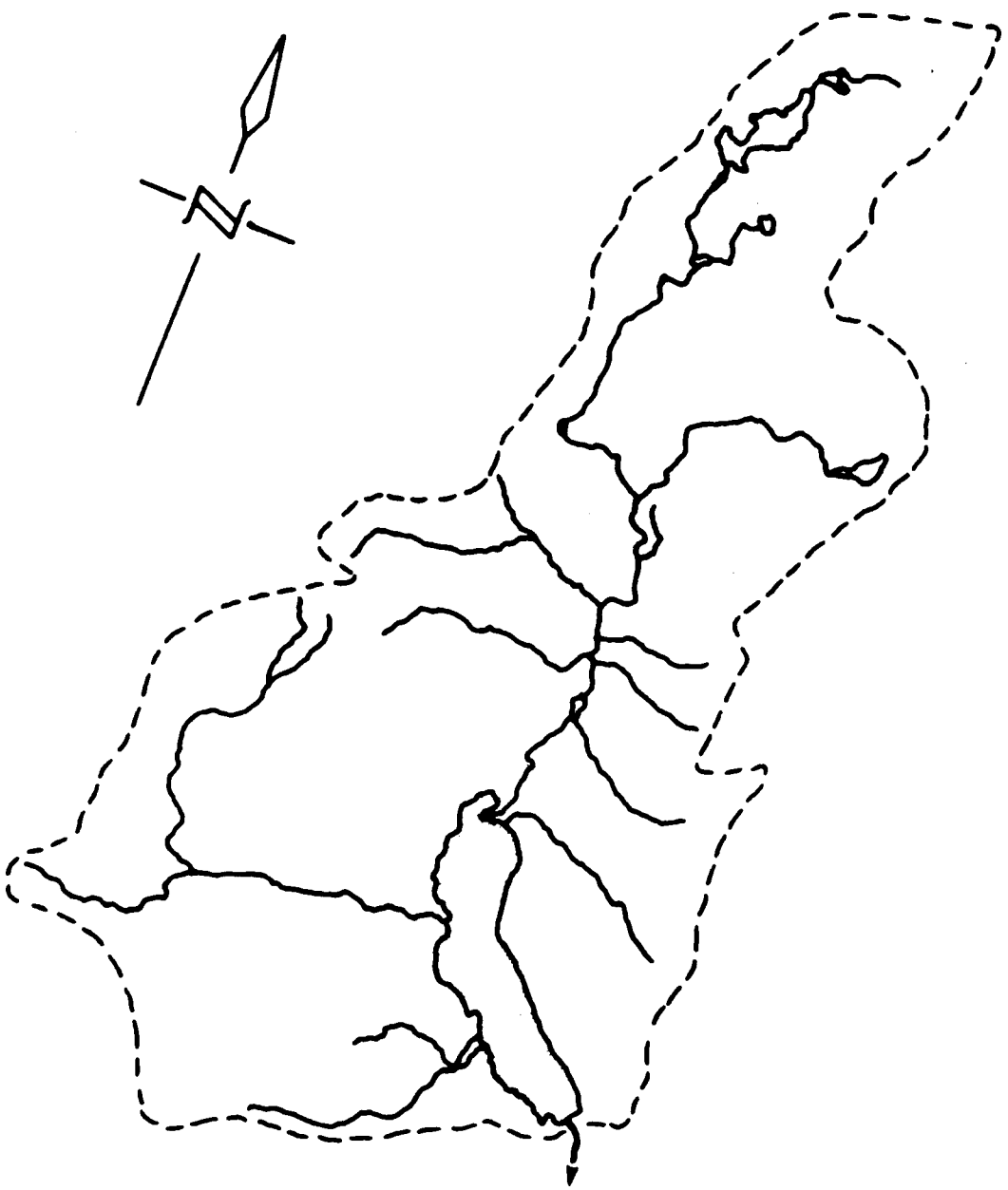
HEYDON LAKE

CONTOUR INTERVAL IN METRES

0 1 2 3 4 Km

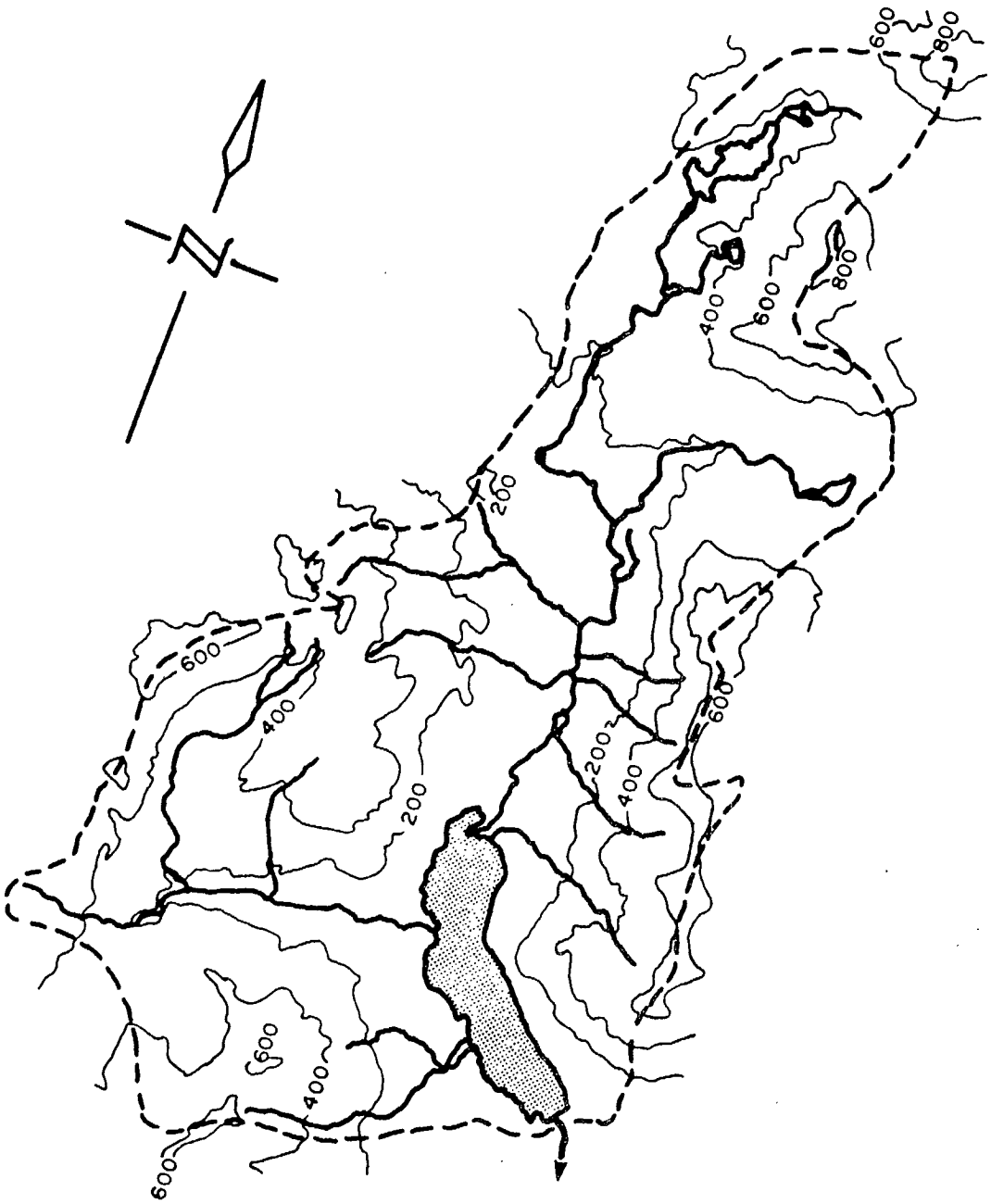

10
20
20
40
60
80
100
140
HEYDON LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 140m
0
1
2
3 Km


6
5
4
3
2
1
HEYDON LAKE
0 1 2 3 Km



MAGGIE LAKE

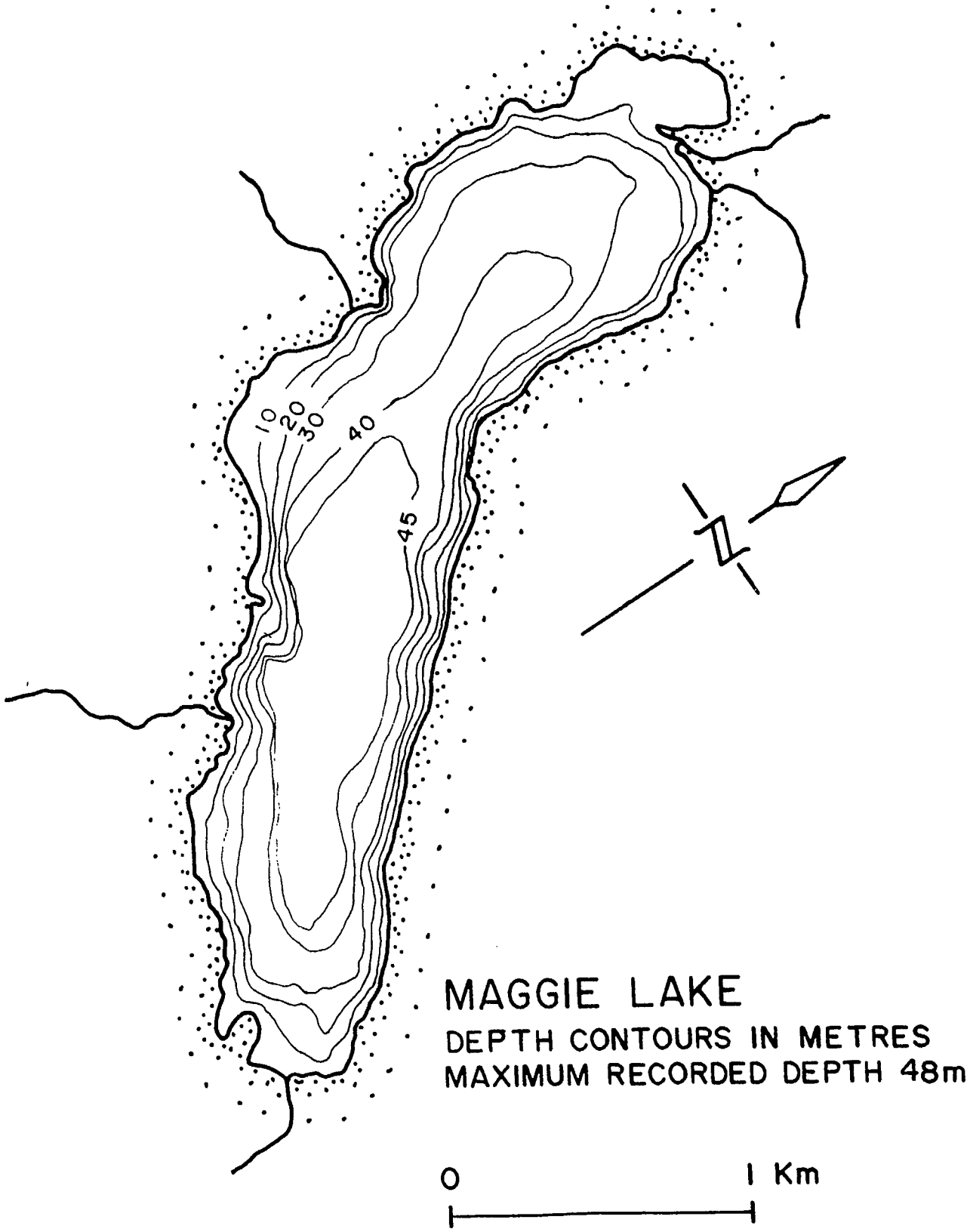
0 1 2 3 4 5 Km

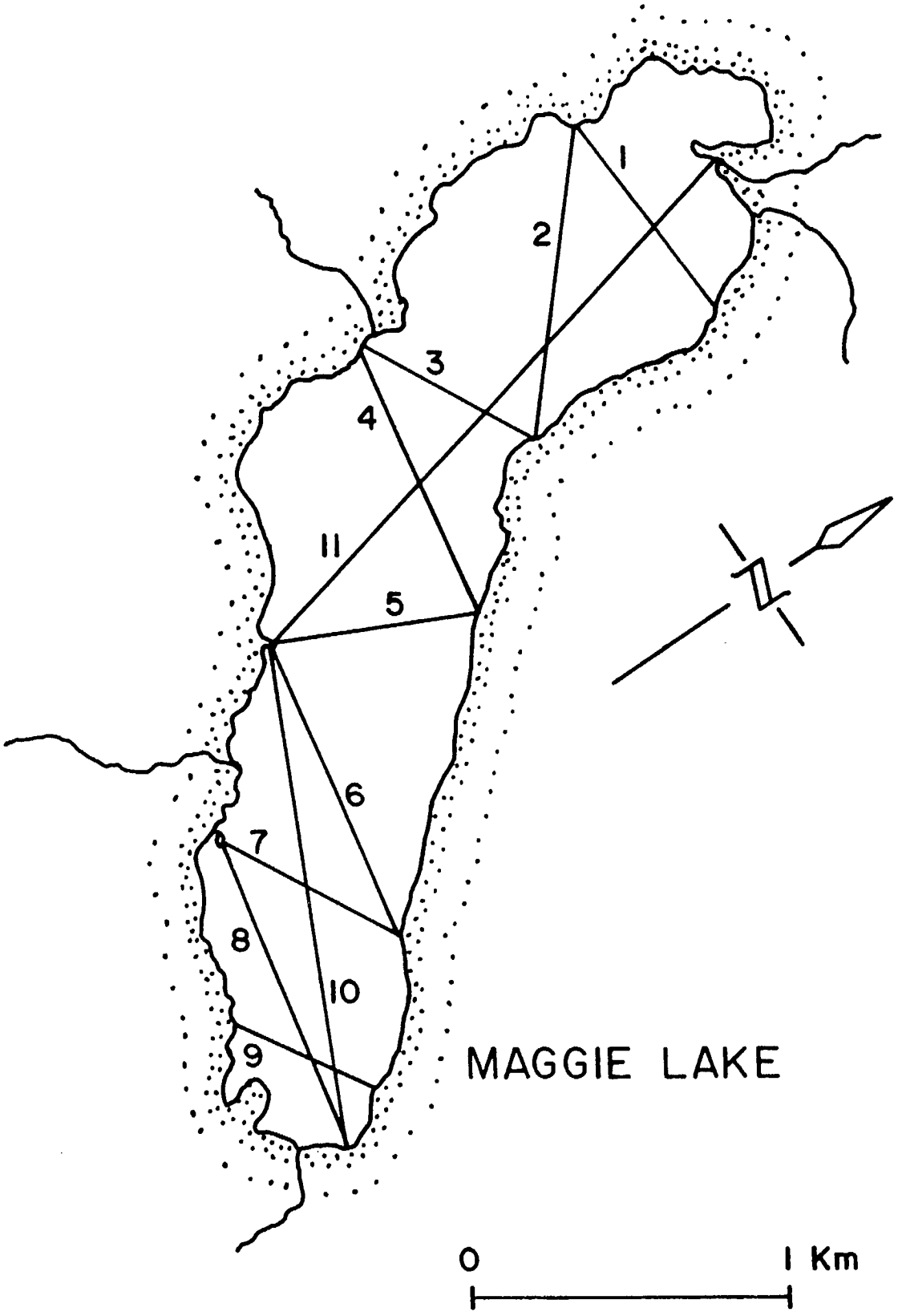


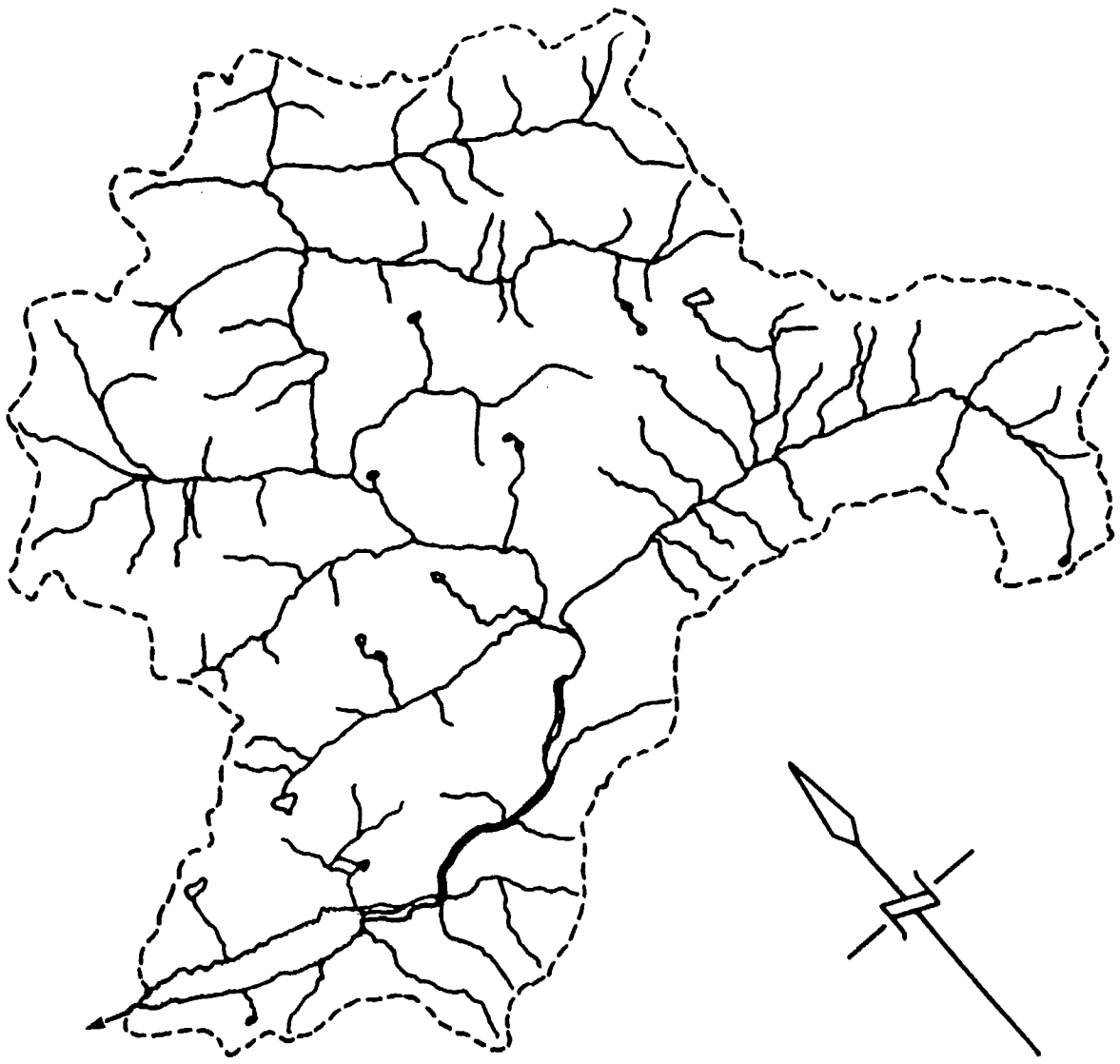
MAGGIE LAKE

CONTOUR INTERVAL IN METRES

0 1 2 3 4 5 Km


10
20
30
40
45
MAGGIE LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 48m
0
1 Km


1
2
3
4
5
6
7
8
9
10
11
MAGGIE LAKE
0
1 Km



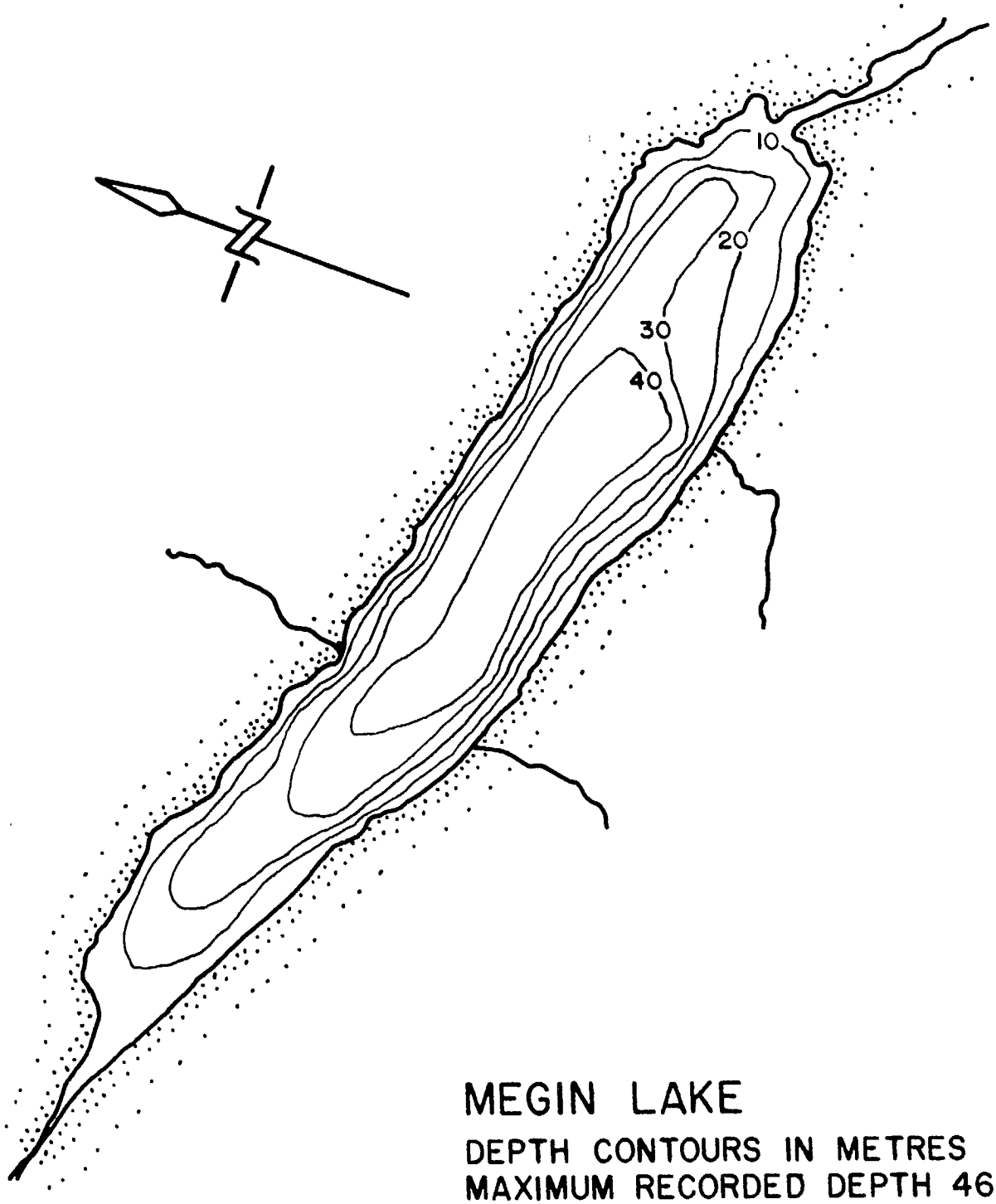
MEGIN LAKE

0 1 2 3 4 5 Km

MEGIN LAKE

CONTOUR INTERVAL IN METRES

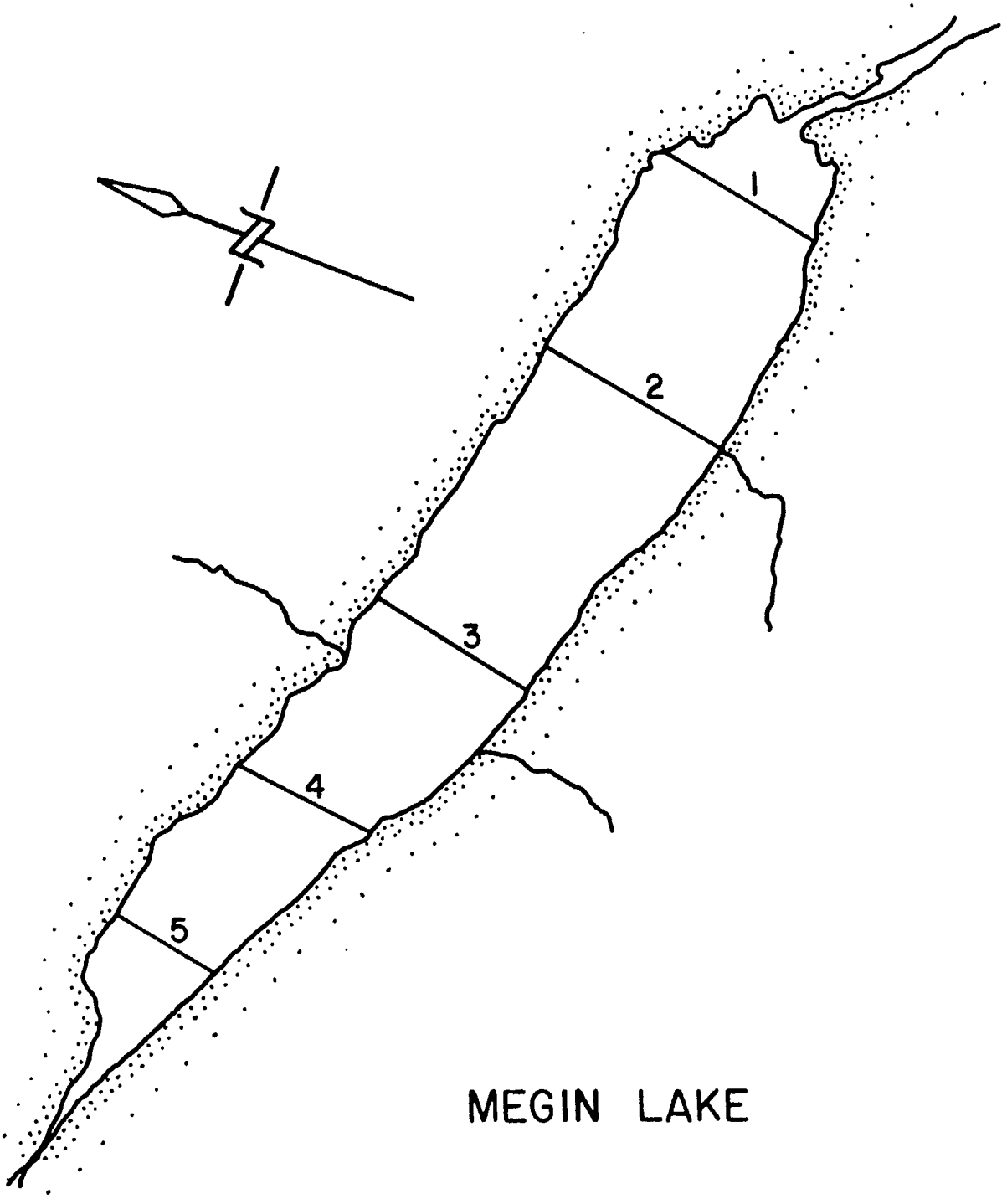
0 1 2 3 4 5 Km

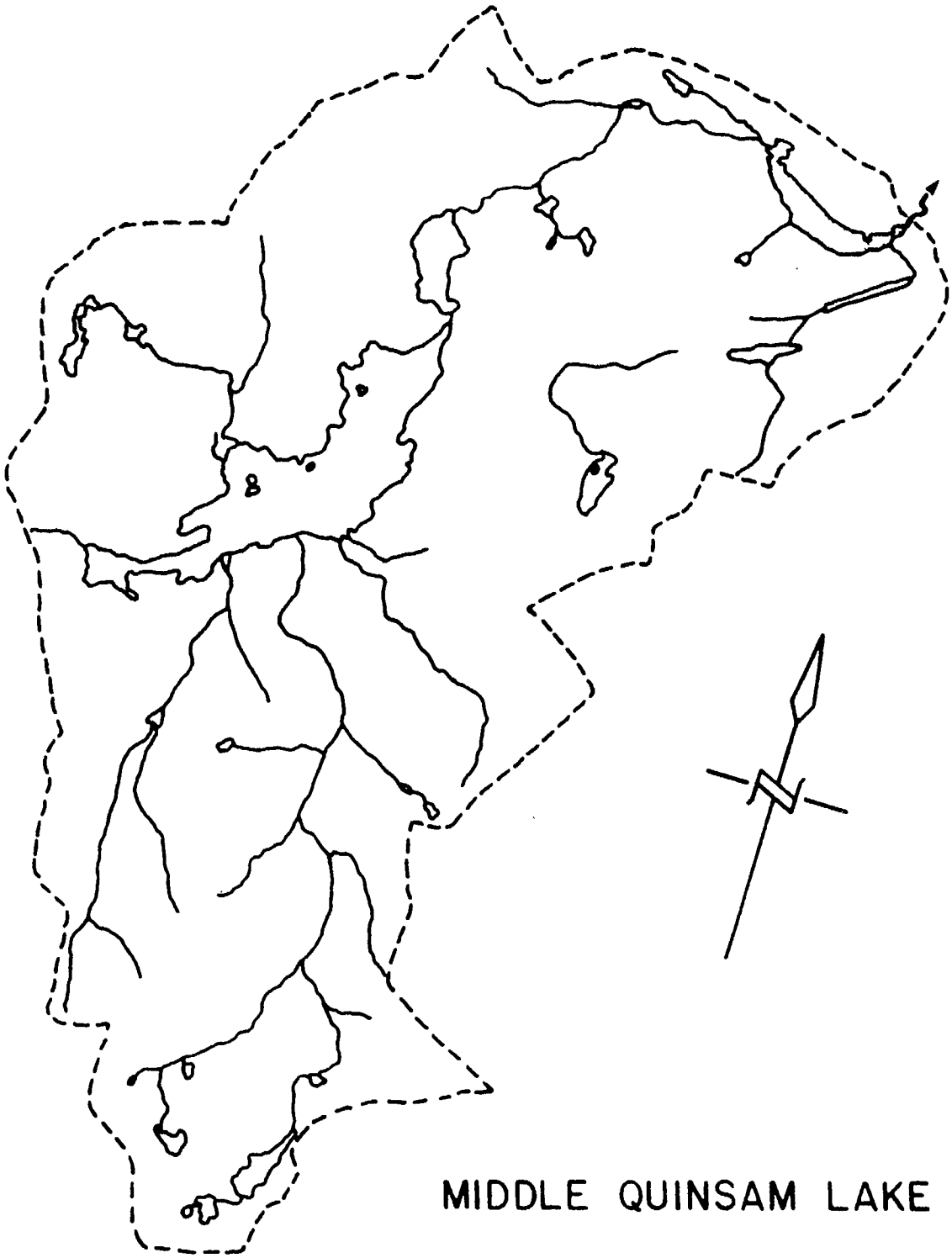


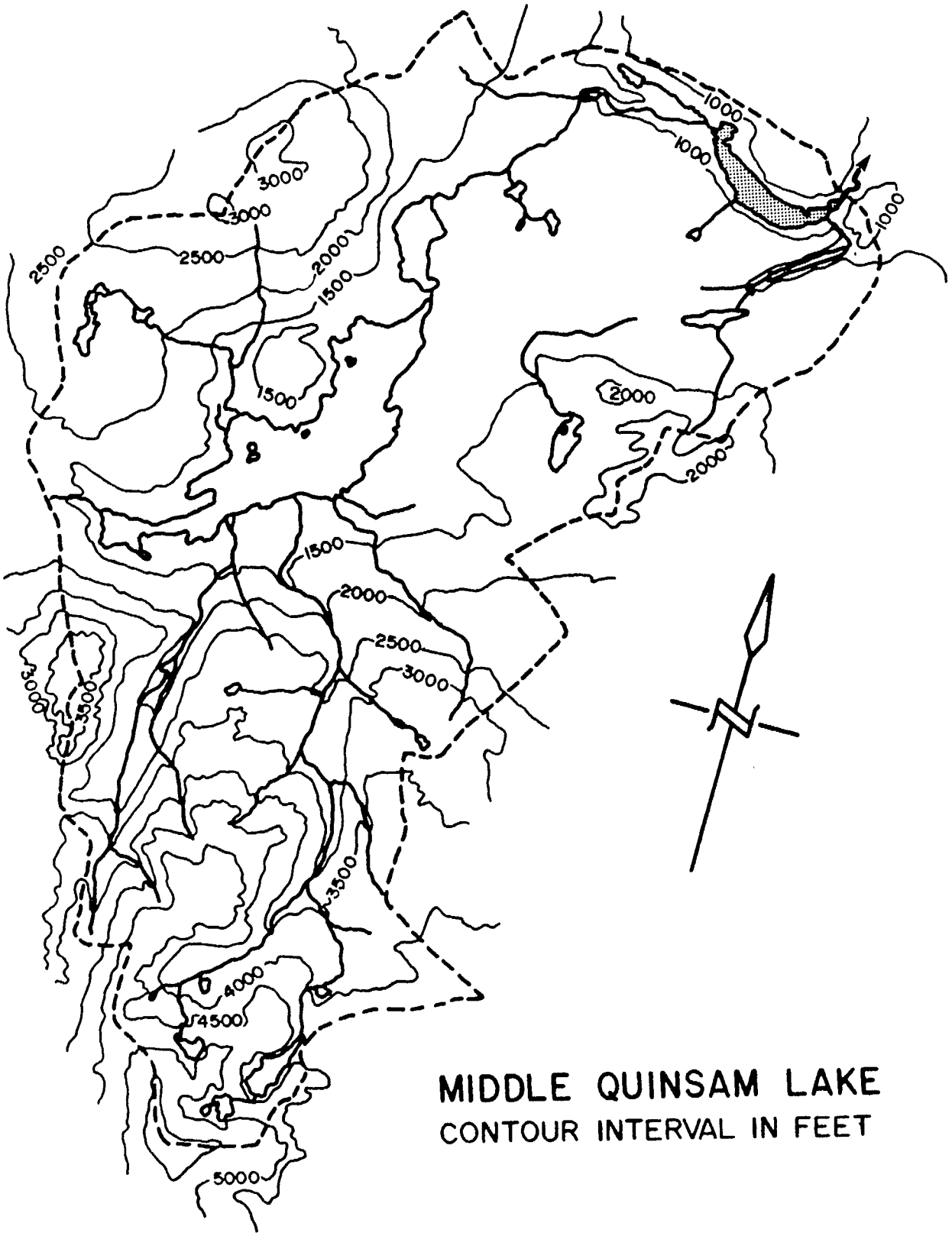
MEGIN LAKE

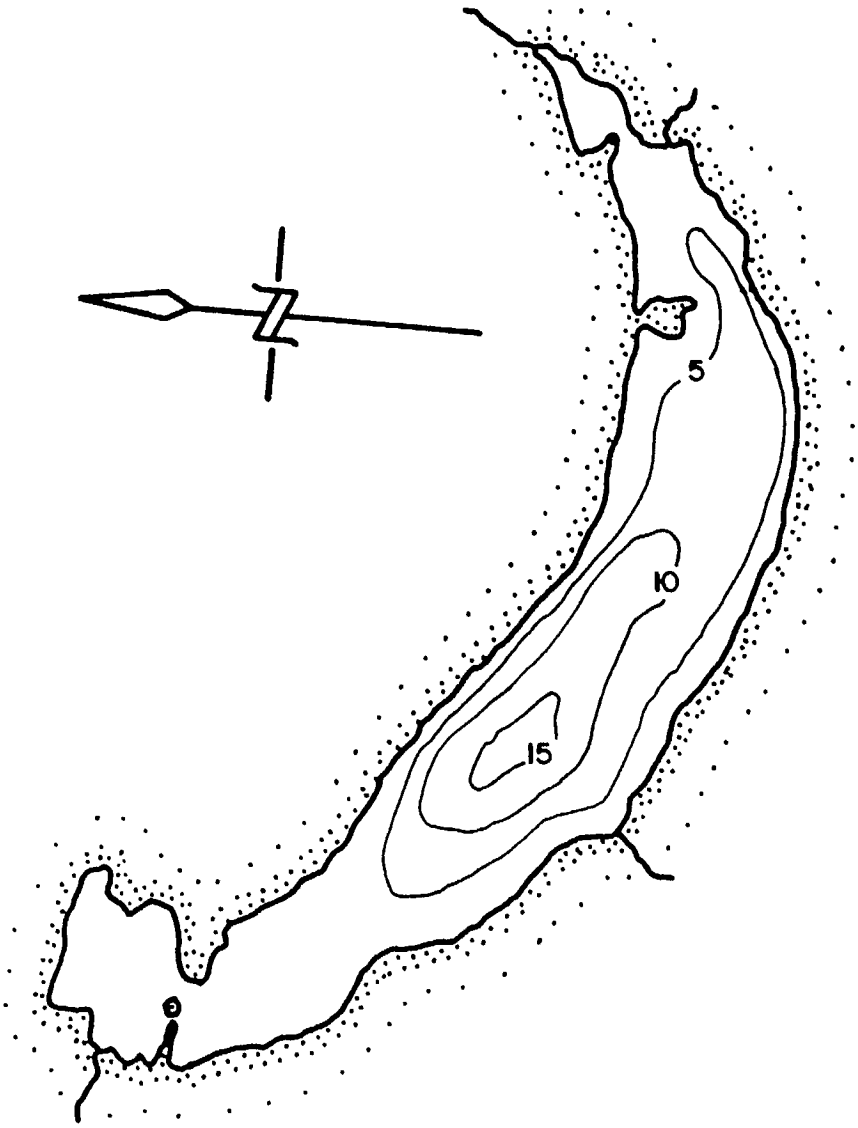
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 46 m

0 1 Km


1
2
3
4
5
MEGIN LAKE
0
1 Km


MIDDLE QUINSAM LAKE
0 1 2 3 4 Km

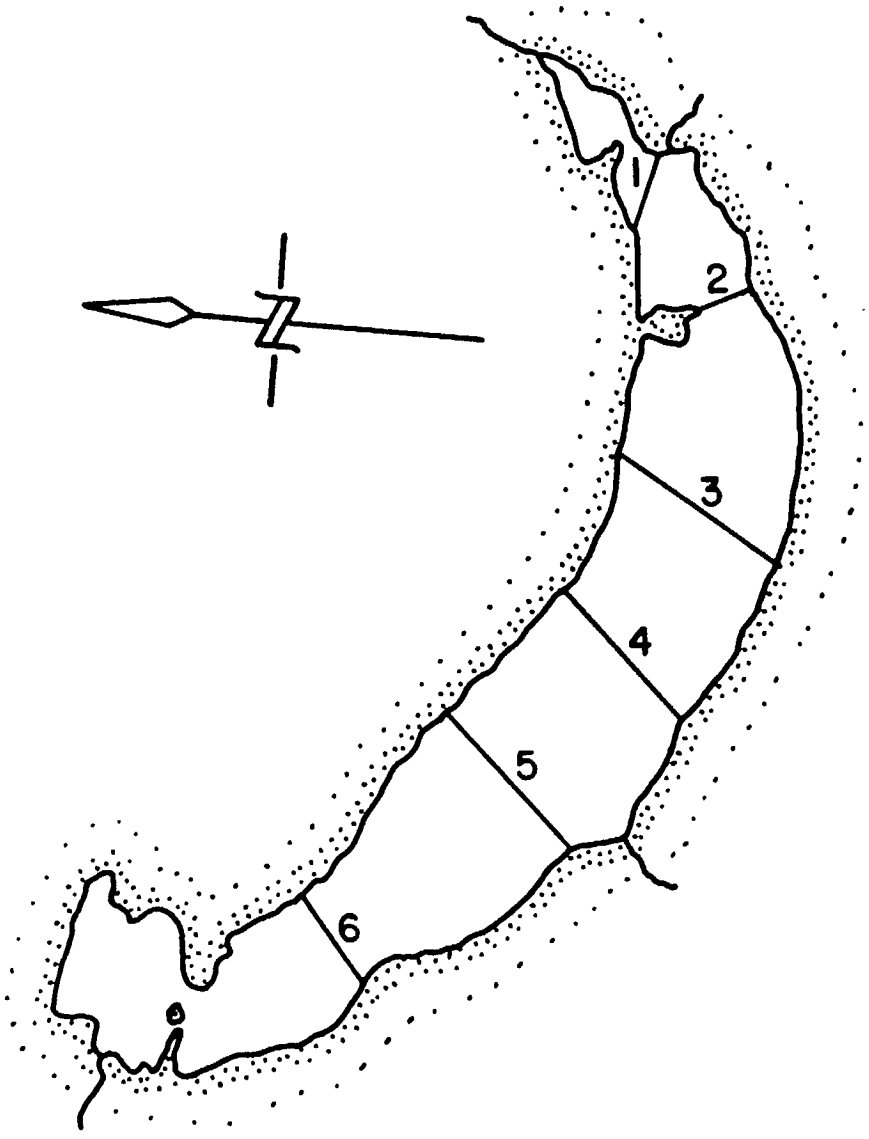

1000
1000
1000
3000
3000
2500
2500
2000
1500
1500
2000
2000
1500
2000
2500
3000
3500
3500
4000
4500
5000
MIDDLE QUINSAM LAKE
CONTOUR INTERVAL IN FEET
0 1 2 3 4 Km



MIDDLE QUINSAM LAKE

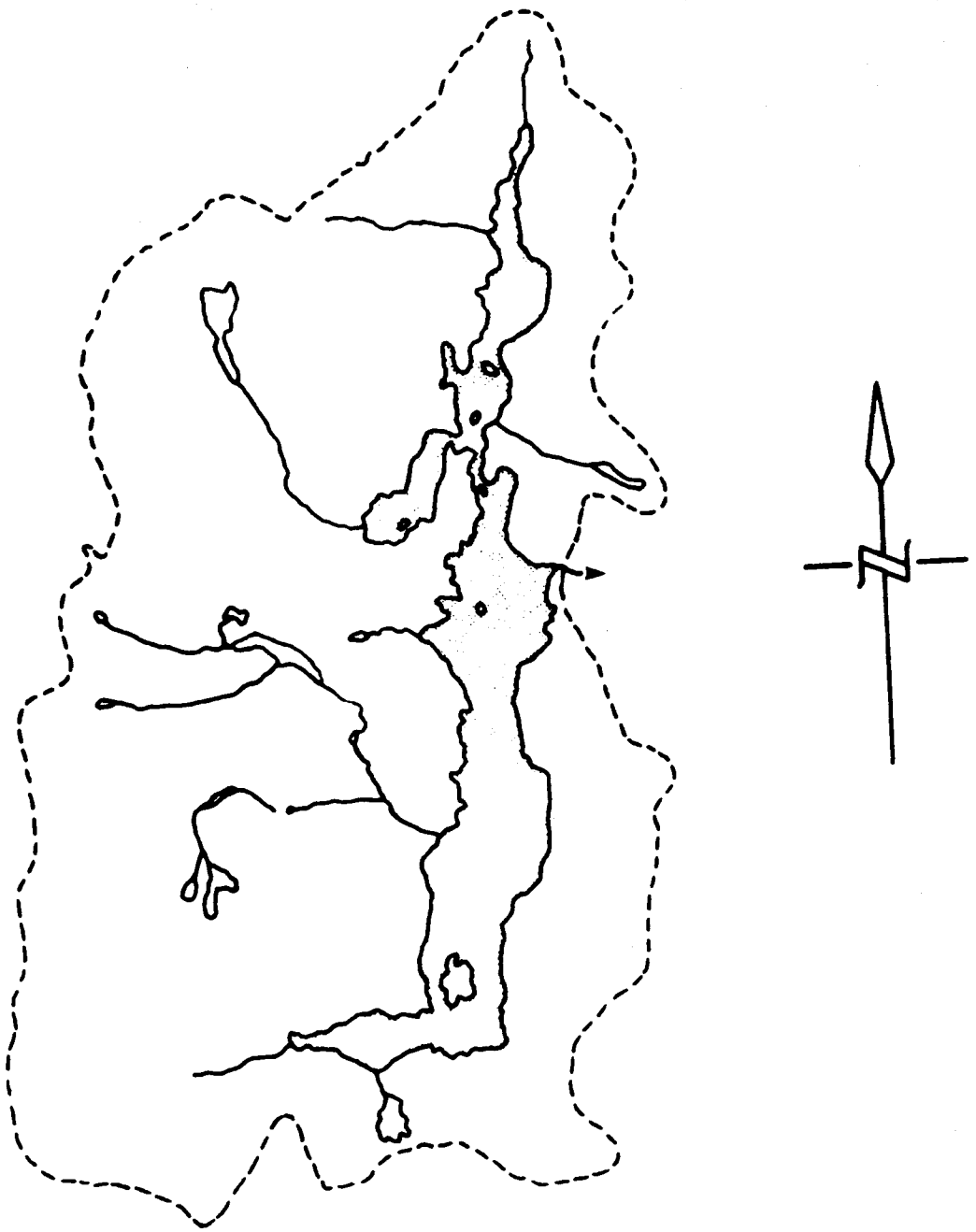
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 16m

0 1 Km



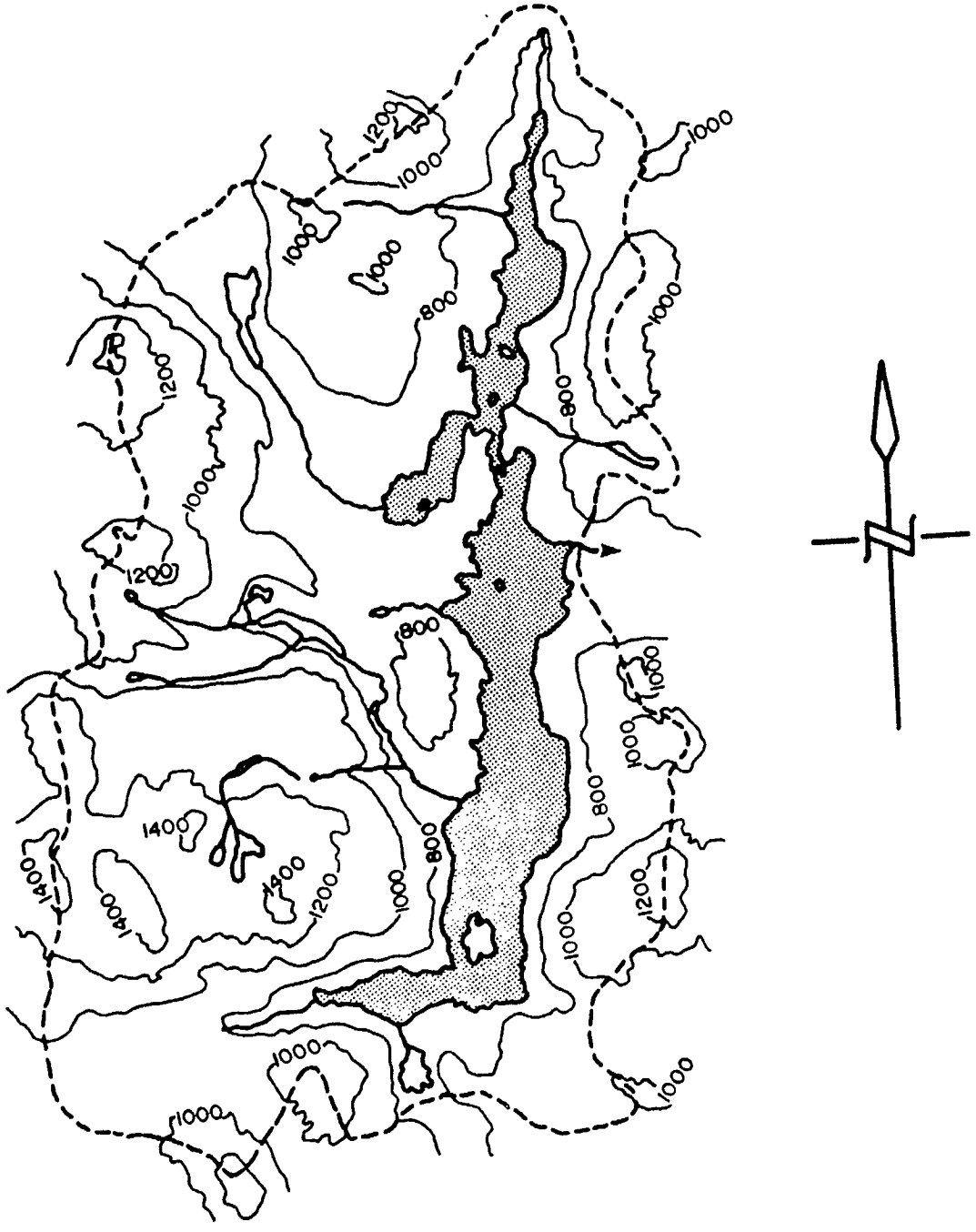
MIDDLE QUINSAM LAKE

0 1 Km



MOHUN LAKE

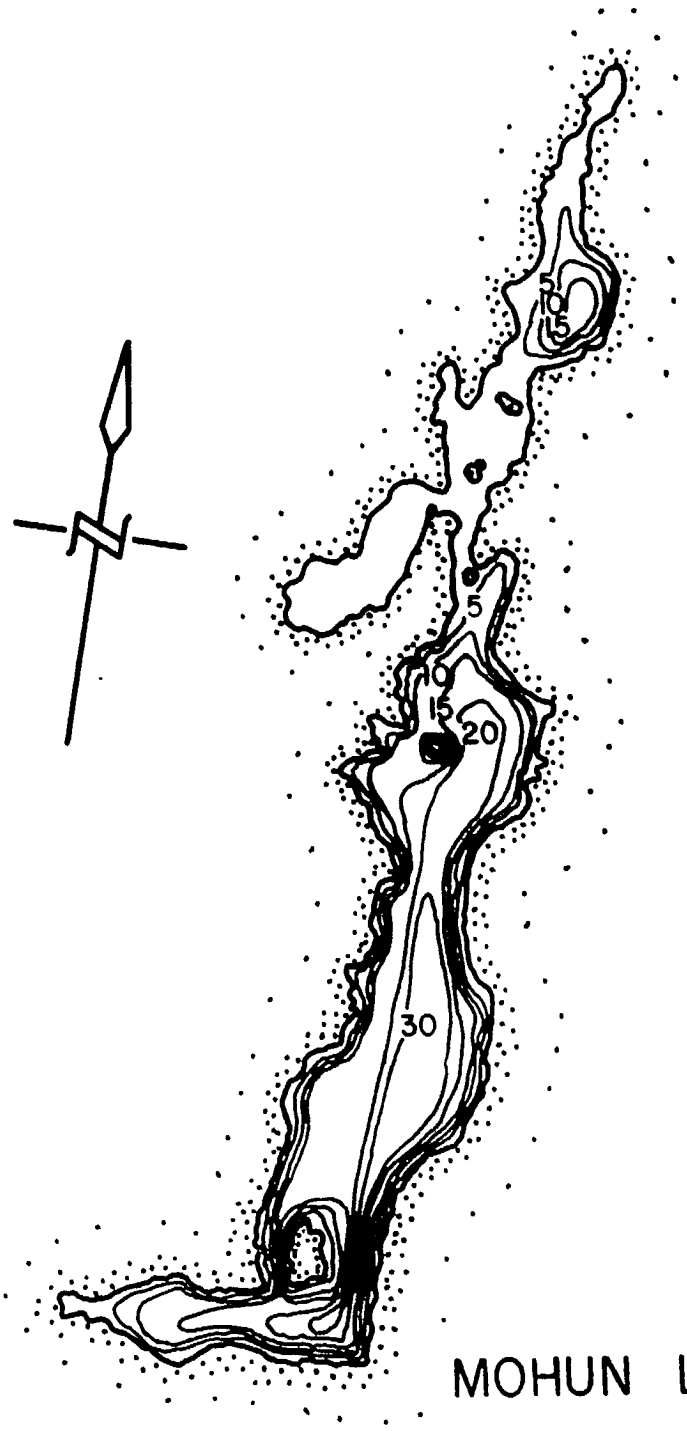
0 1 2 3 Km



MOHUN LAKE

CONTOUR INTERVAL IN FEET

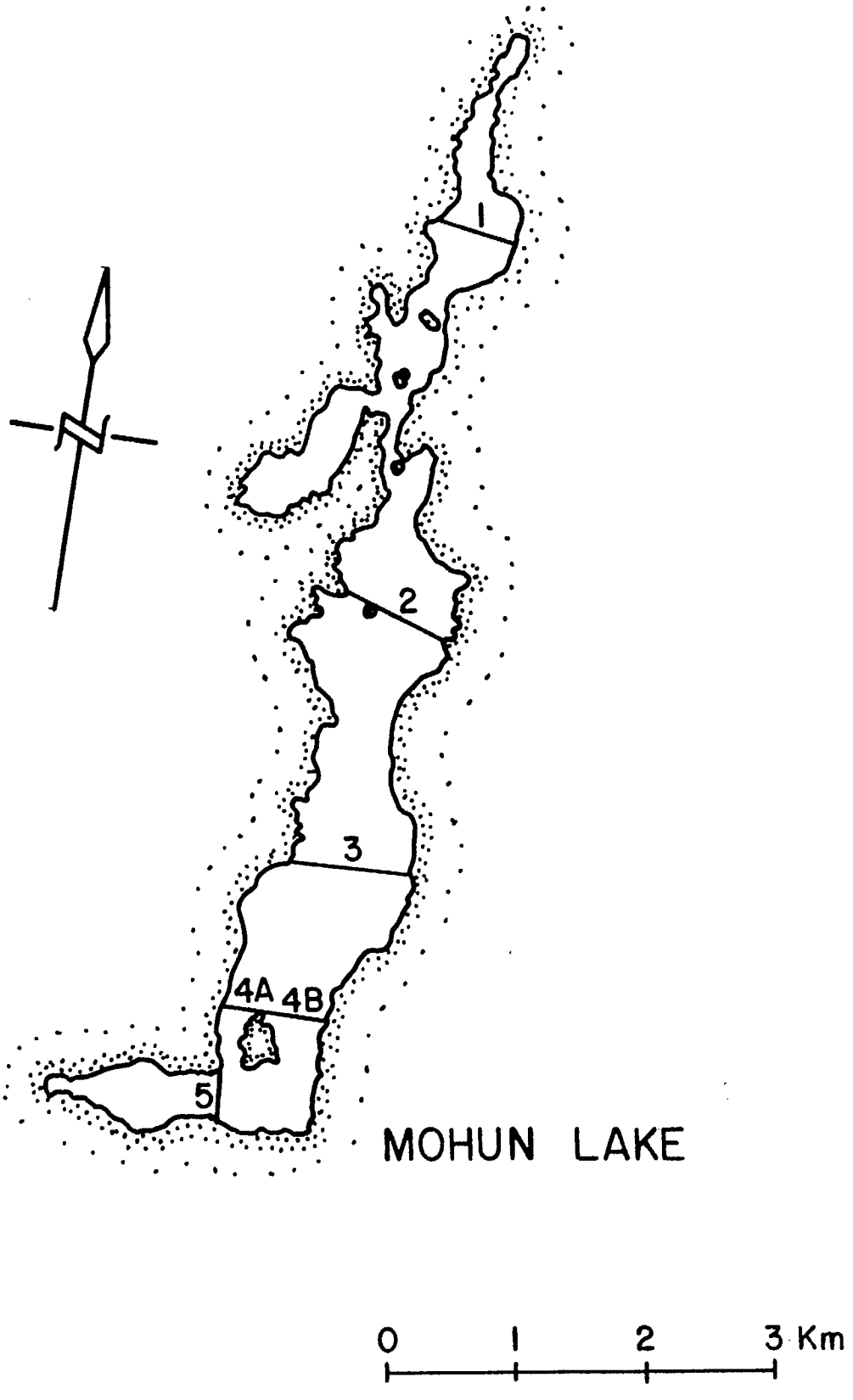
0 1 2 3 Km



MOHUN LAKE

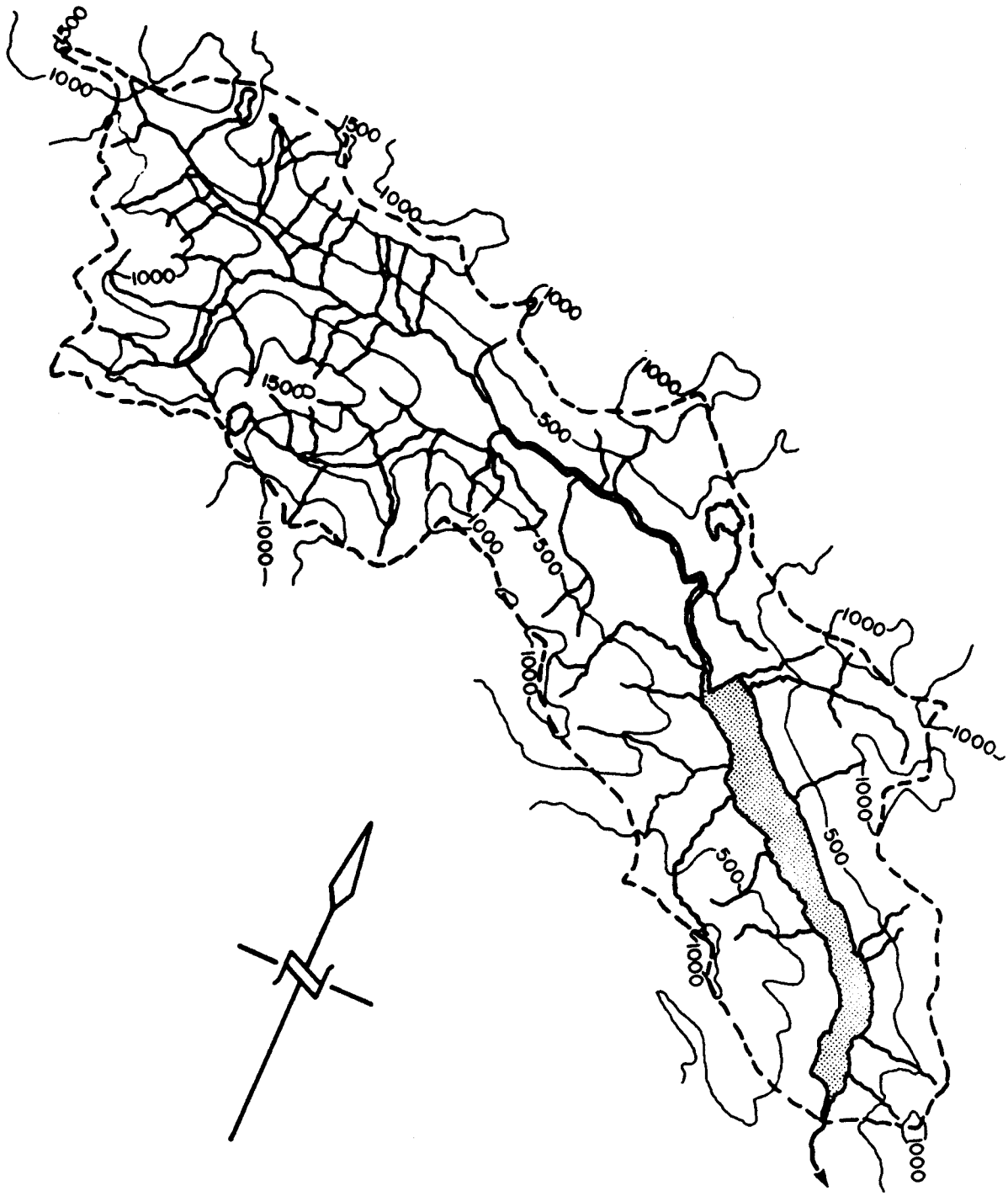
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 43 m

0 1 2 3 Km


1
2
3
4A
4B
5
MOHUN LAKE
0
1
2
3 Km

NAHMINT LAKE

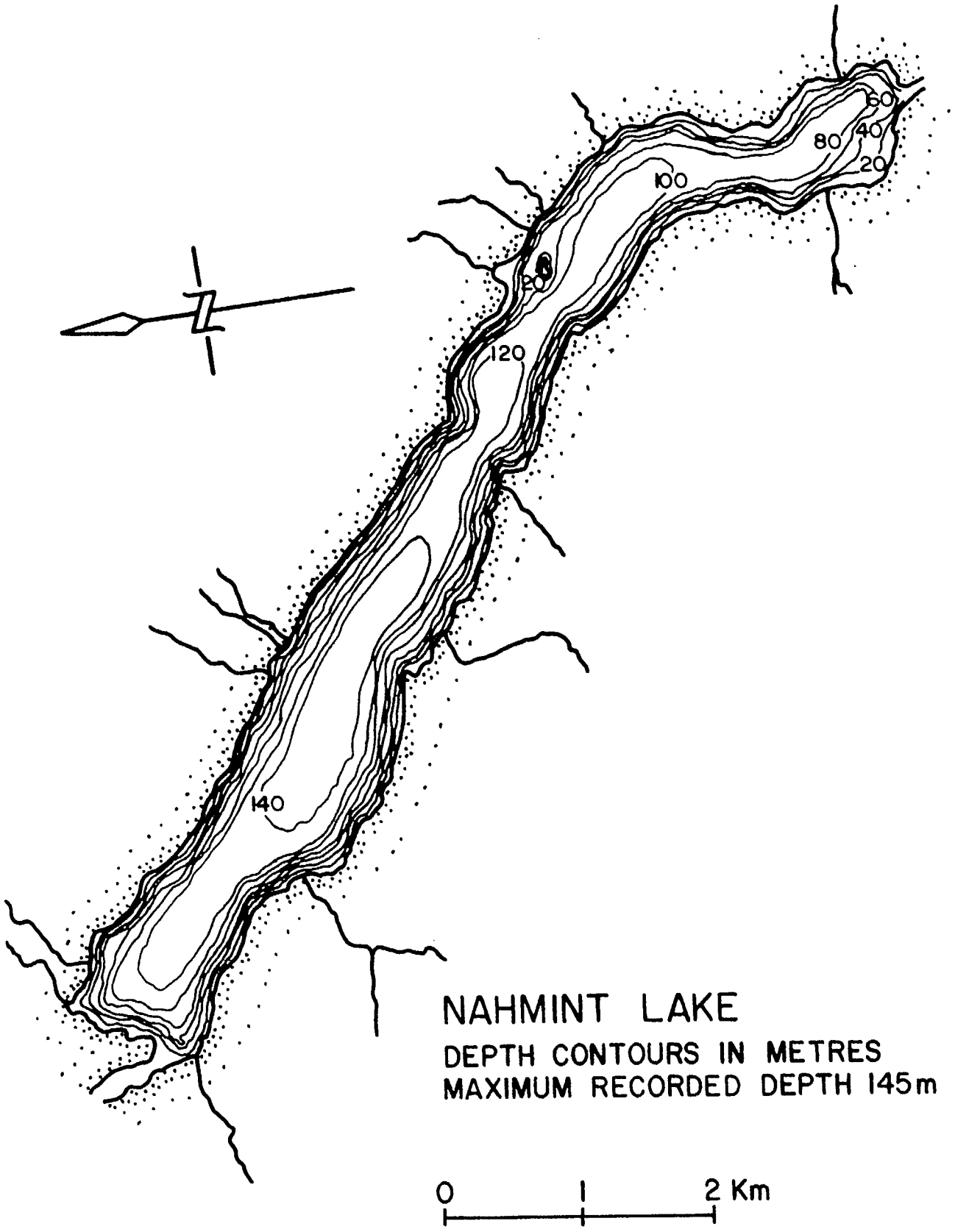
0 2 4 6 8 Km

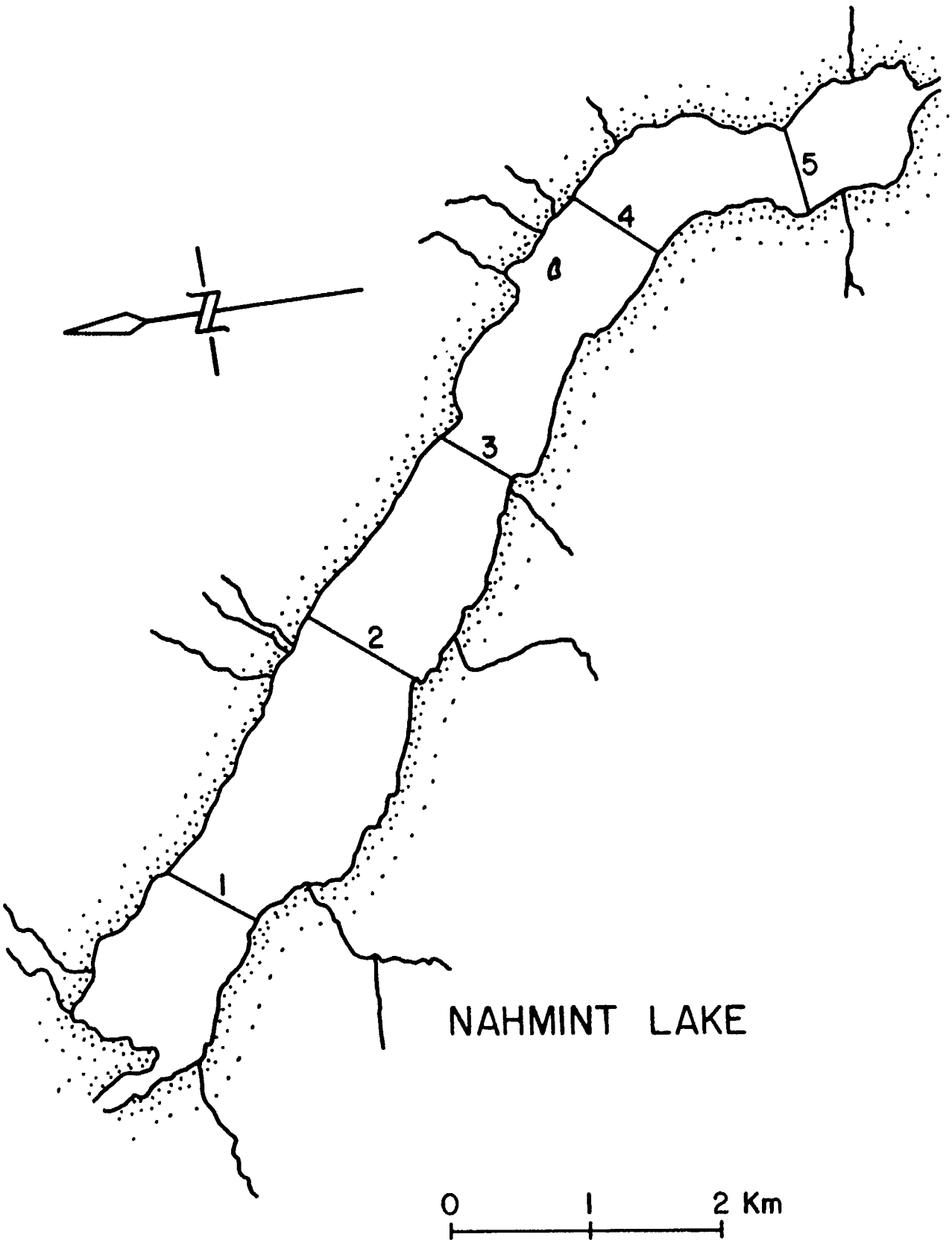


NAHMINT LAKE

CONTOUR INTERVAL IN METRES

0 2 4 6 8 Km


60
40
80
20
100
120
140
NAHMINT LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 145m
0
1
2 Km


5
4
3
2
1
NAHMINT LAKE
0
1
2 Km

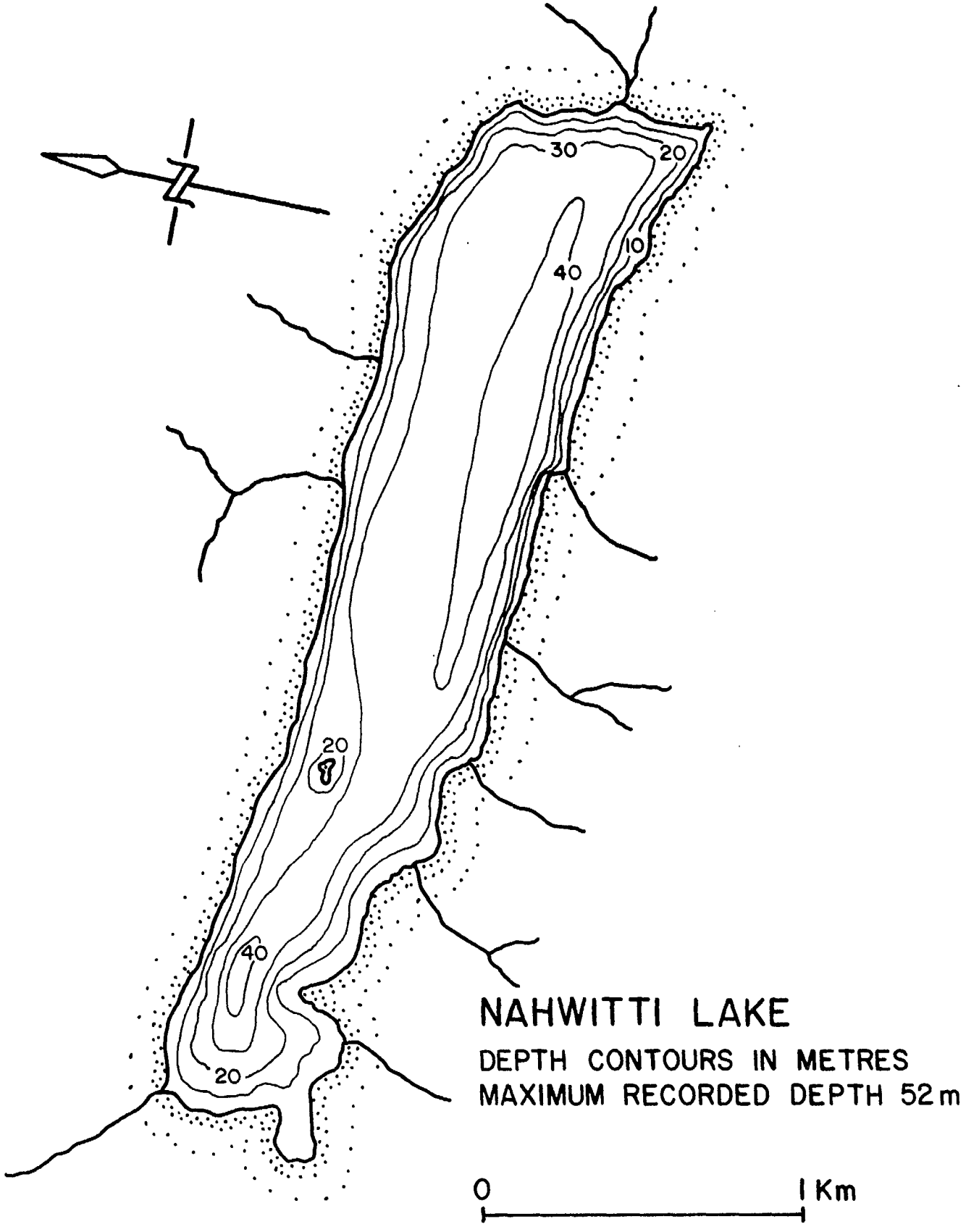
NAHWITTI LAKE

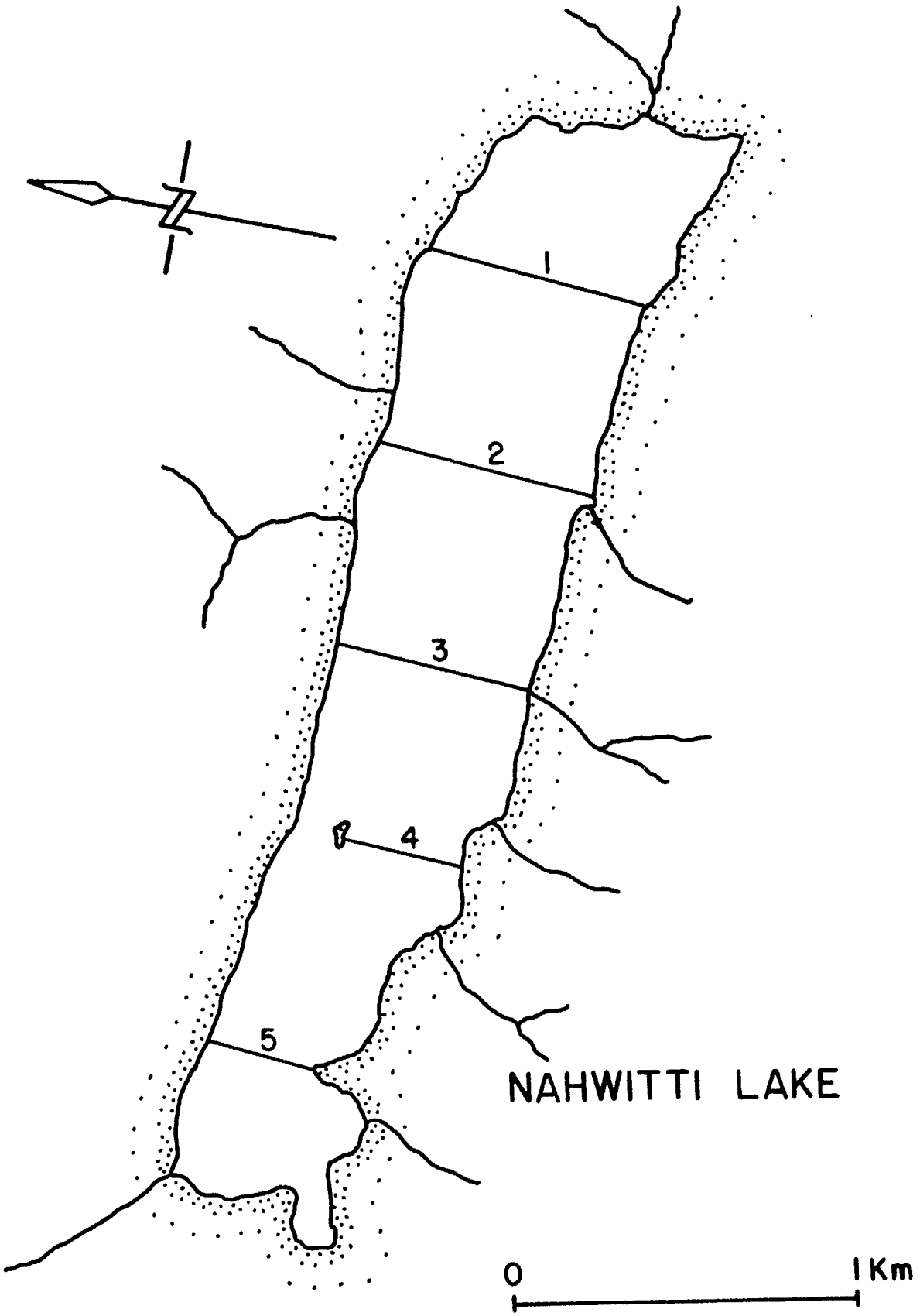
0 1 2 3 4 Km

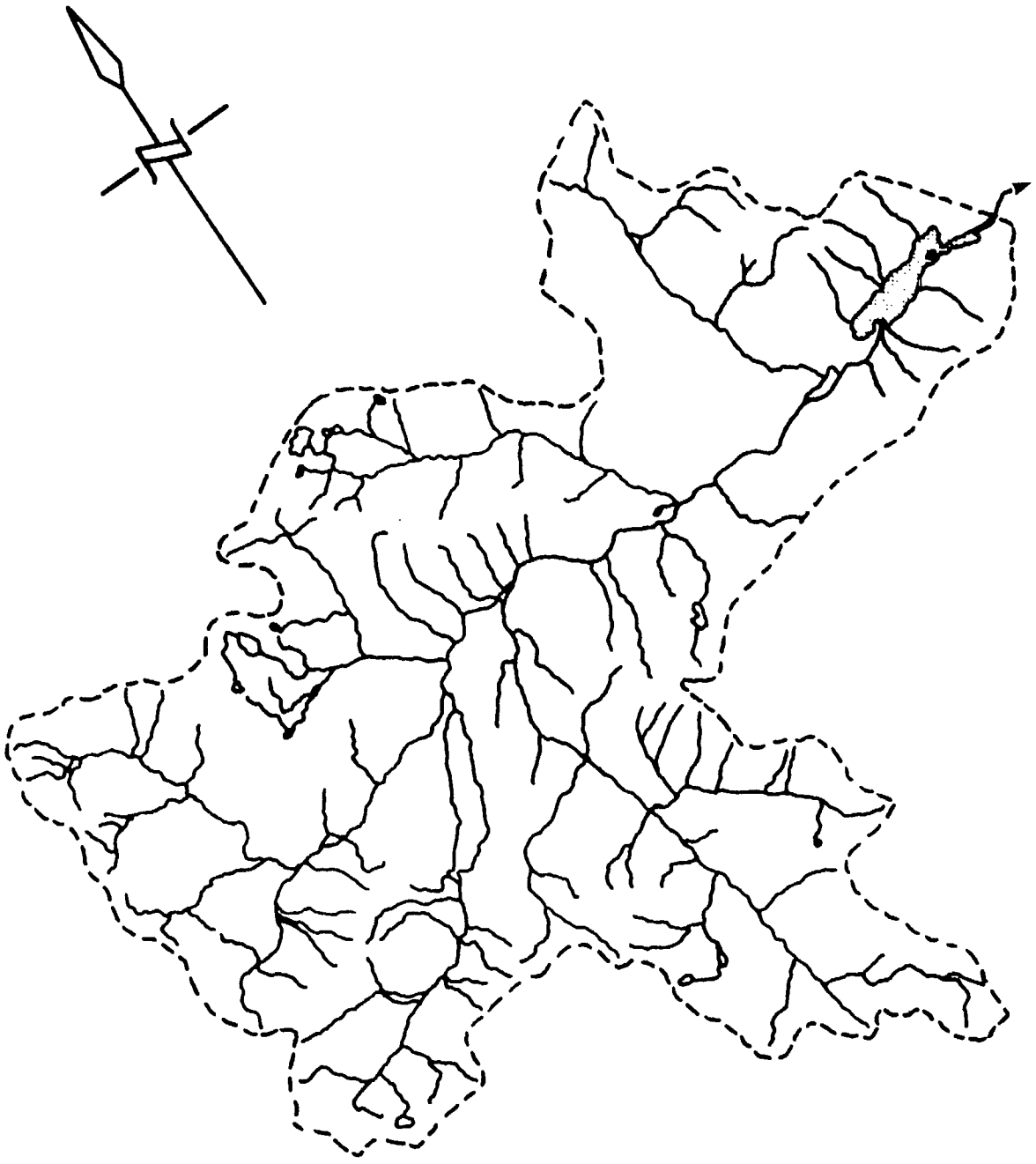
NAHWITTI LAKE

CONTOUR INTERVAL IN FEET

0 1 2 3 4 Km


30
20
10
40
20
40
20
NAHWITTI LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 52 m
0
1 Km


1
2
3
4
5
NAHWITTI LAKE
0
1 Km



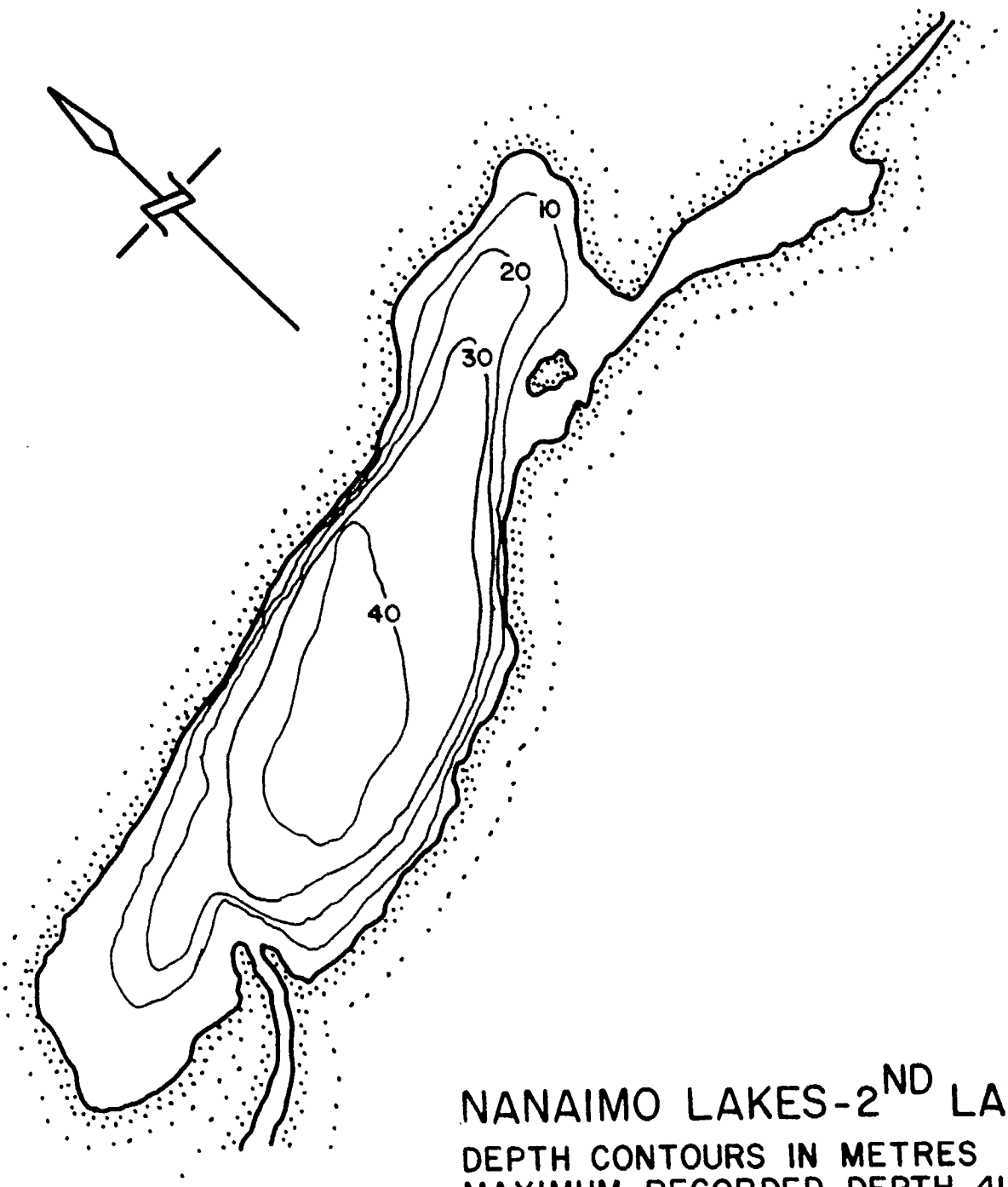
NANAIMO LAKES-2ND LAKE

0 2 4 6 8 Km

NANAIMO LAKES-2ND LAKE

CONTOUR INTERVAL IN METRES

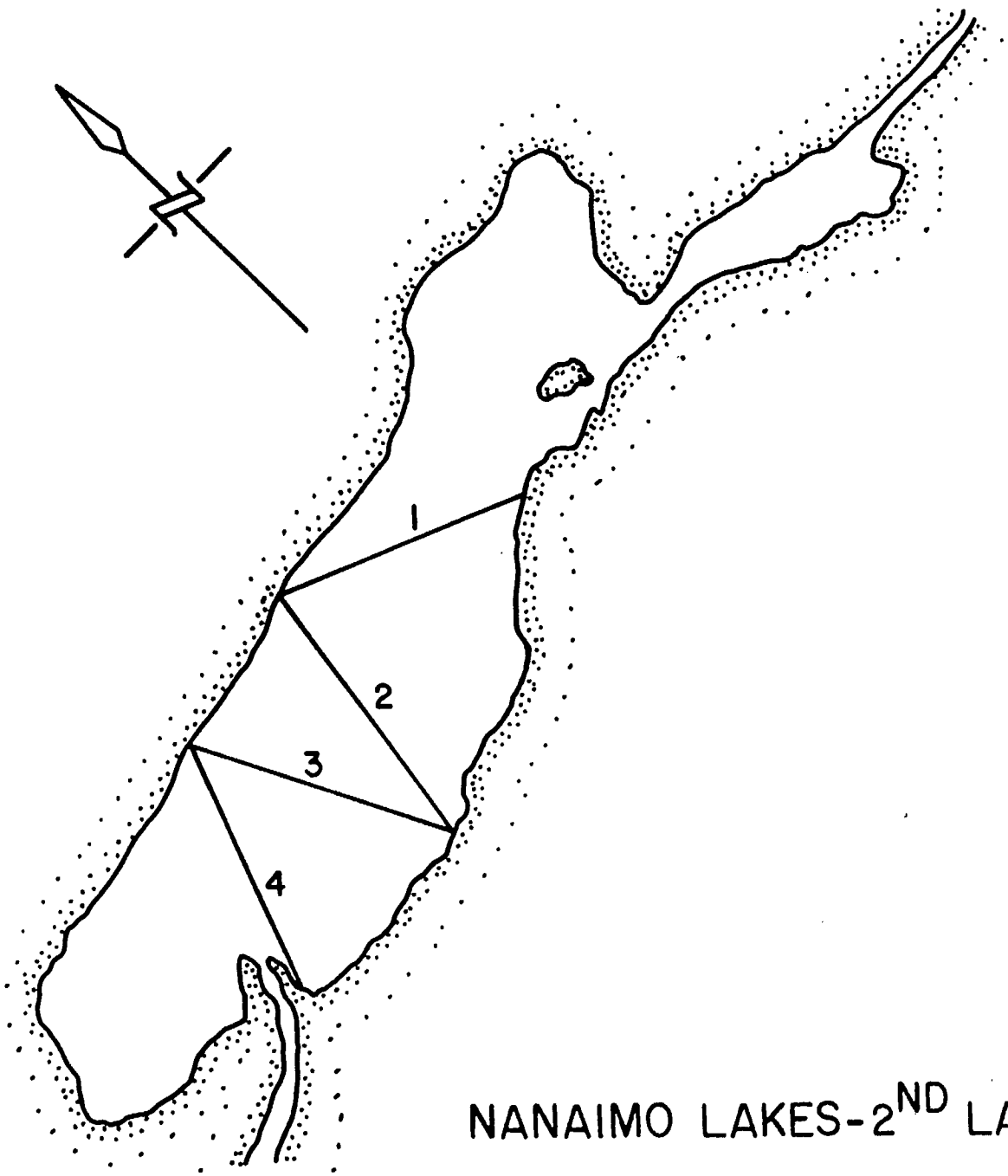
0 2 4 6 8 Km

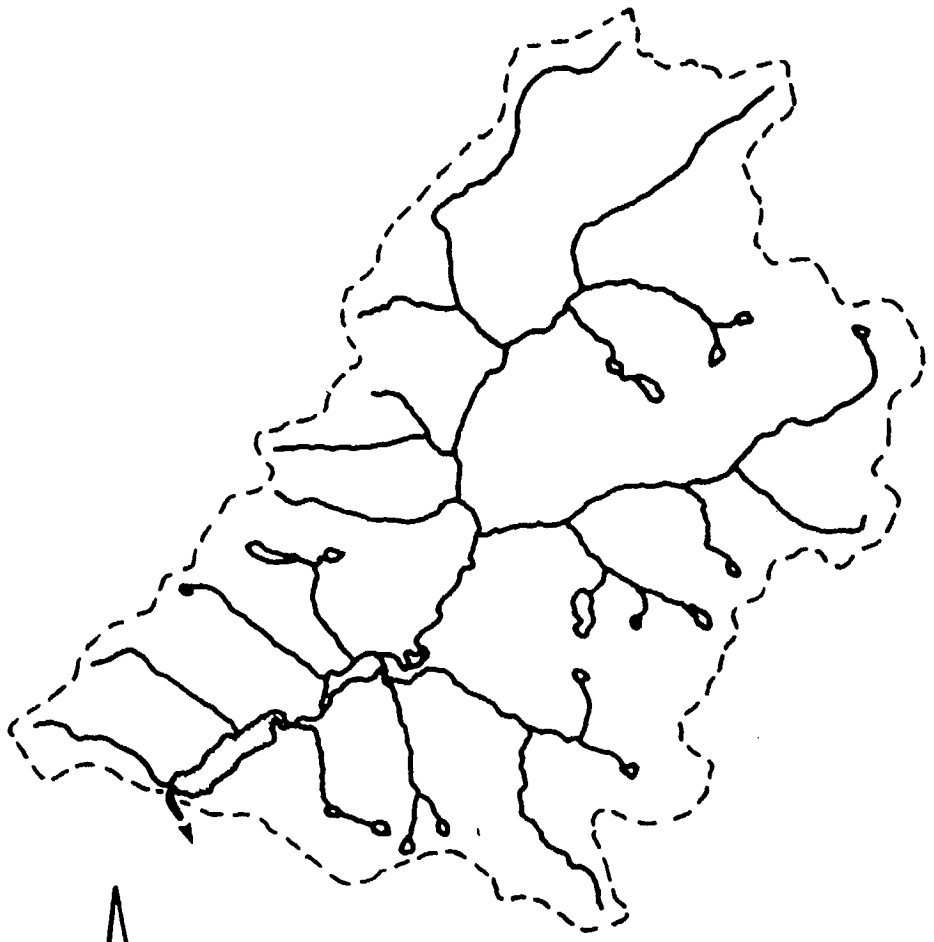


NANAIMO LAKES-2ND LAKE

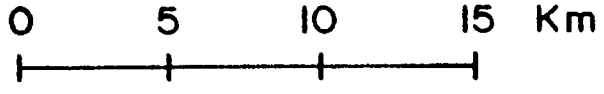
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 41m

0 1Km


1
2
3
4
NANAIMO LAKES-2ND LAKE
0
1 Km



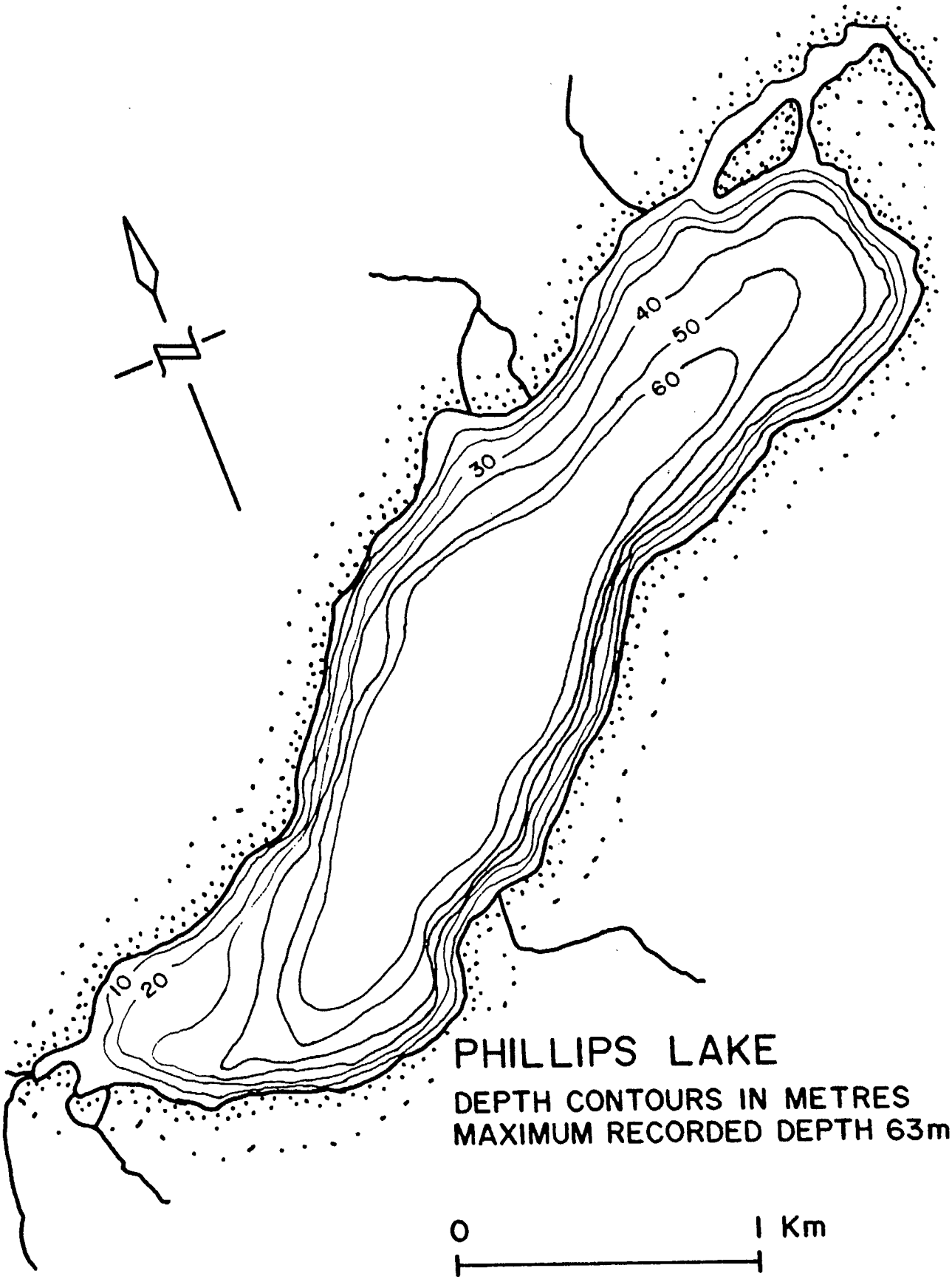
PHILLIPS LAKE

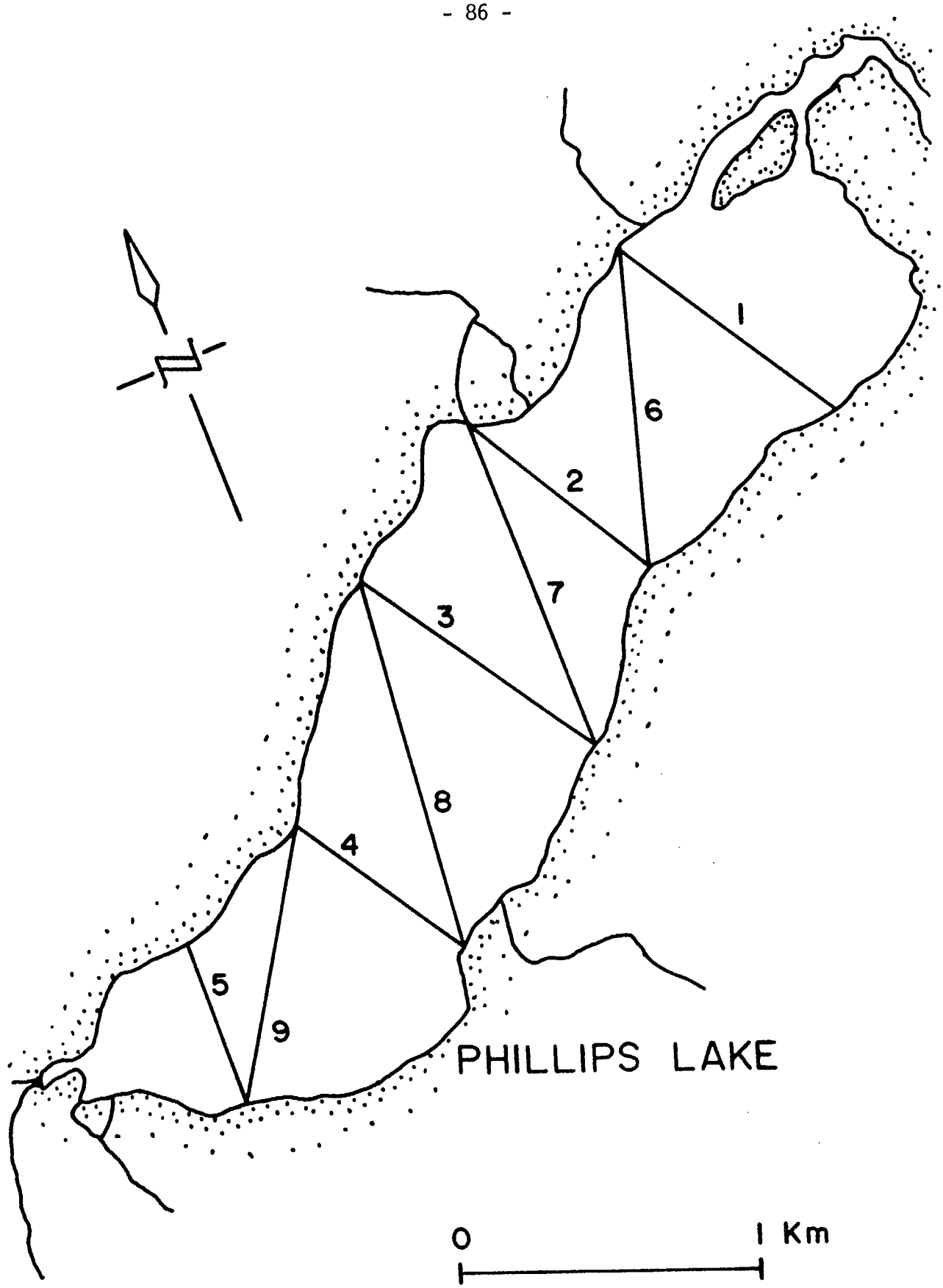


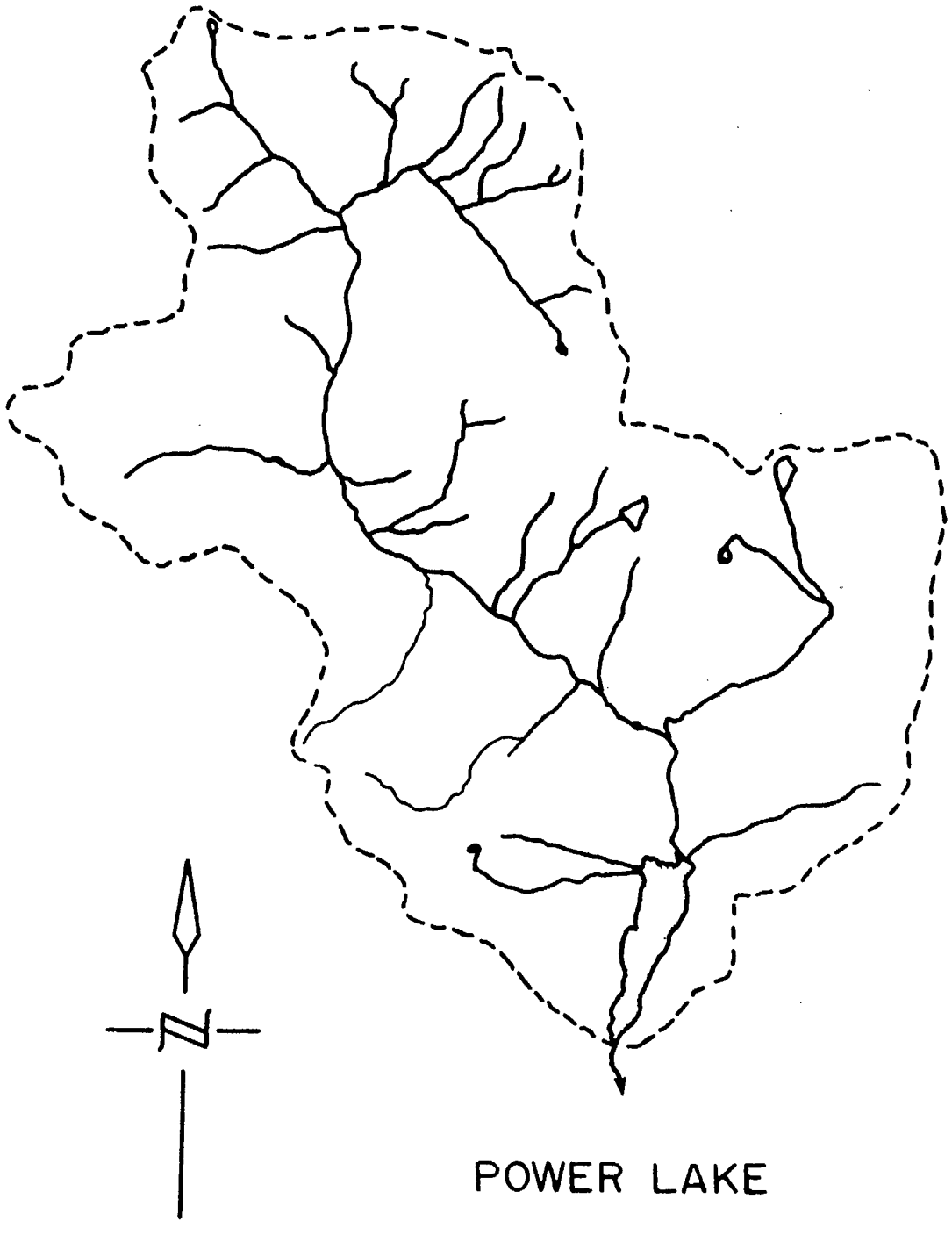
PHILLIPS LAKE

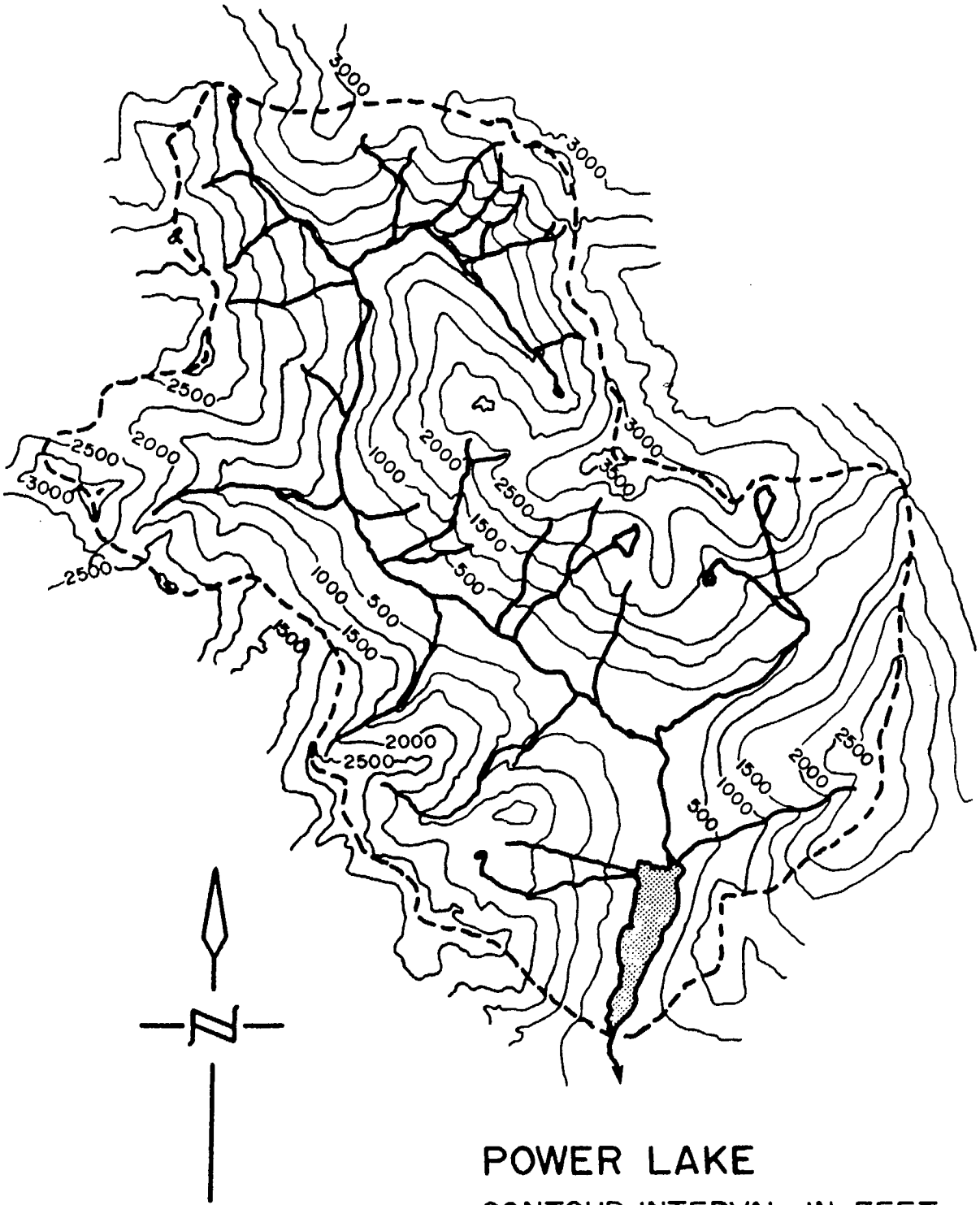
CONTOUR INTERVAL IN FEET

0 5 10 15 Km


N
10
20
30
40
50
60
PHILLIPS LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 63m
0
1 Km


N
1
2
3
4
5
6
7
8
9
PHILLIPS LAKE
0
1 Km

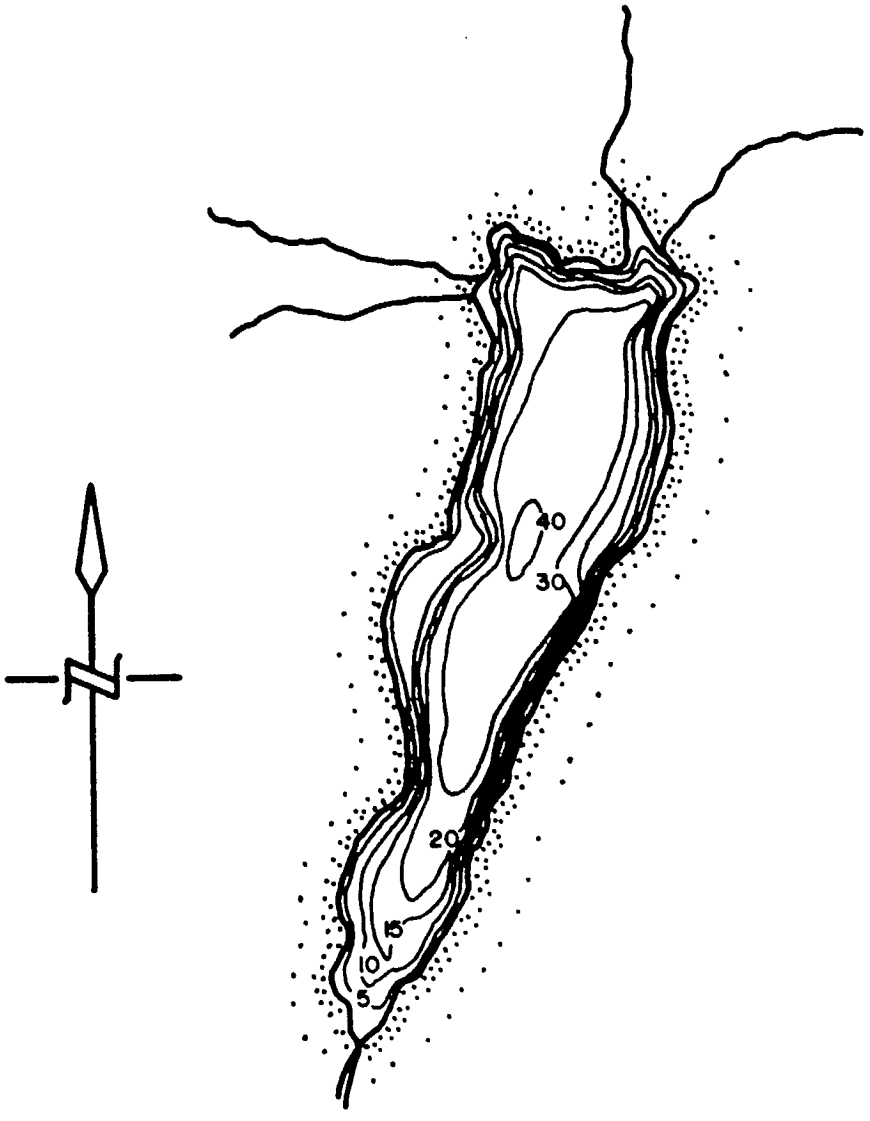

N
POWER LAKE
0 1 2 3 4 Km



POWER LAKE

CONTOUR INTERVAL IN FEET

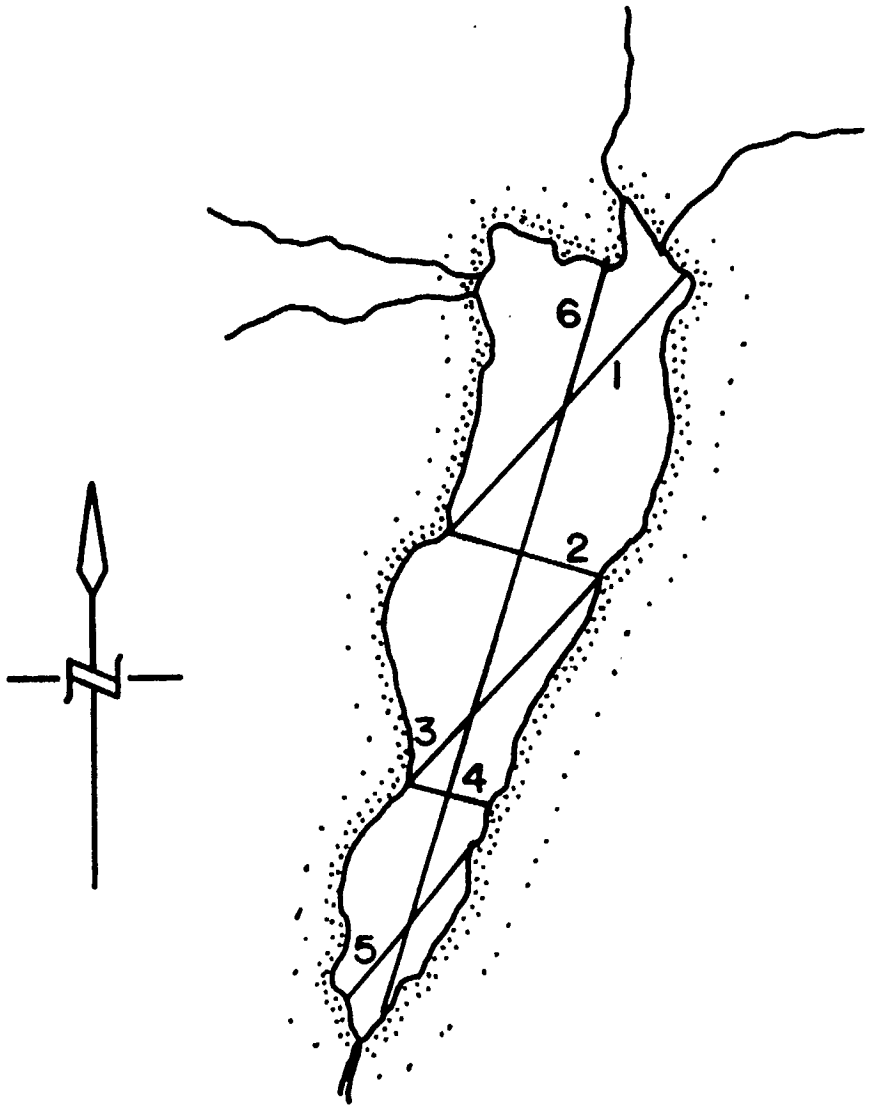
0 1 2 3 4 Km



POWER LAKE

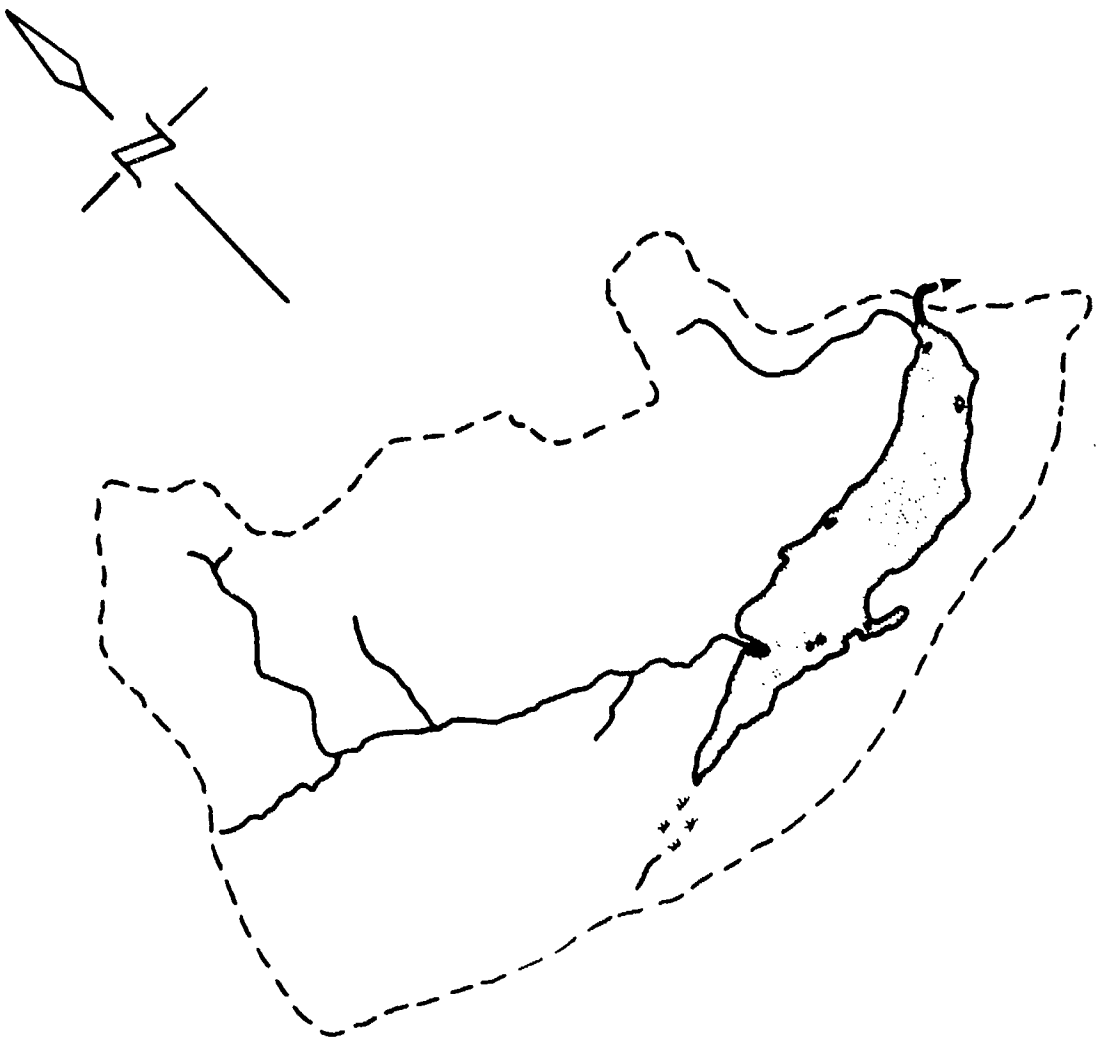
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 41 m

0 1 Km



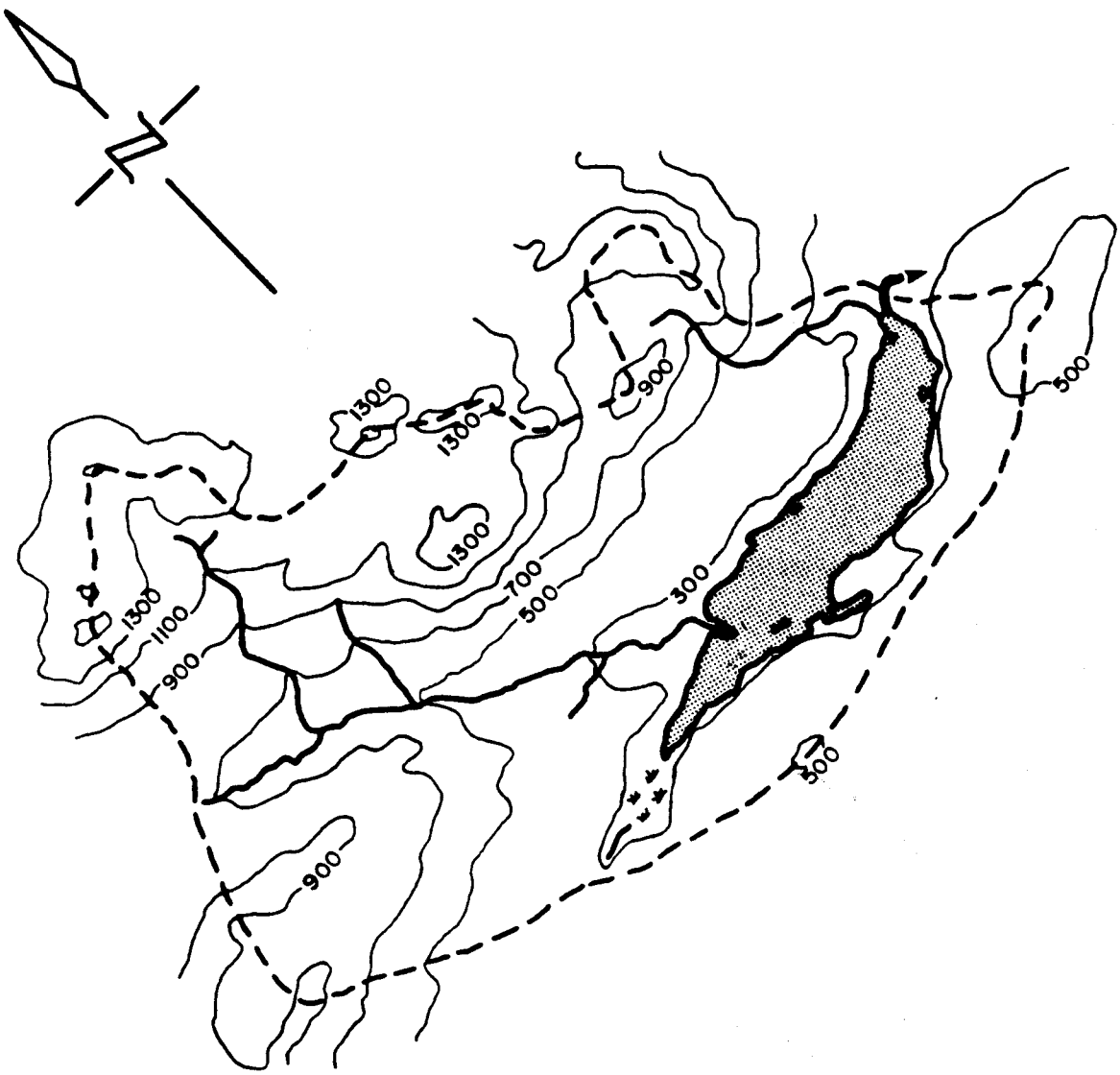
POWER LAKE

0 1 Km



QUATSE LAKE

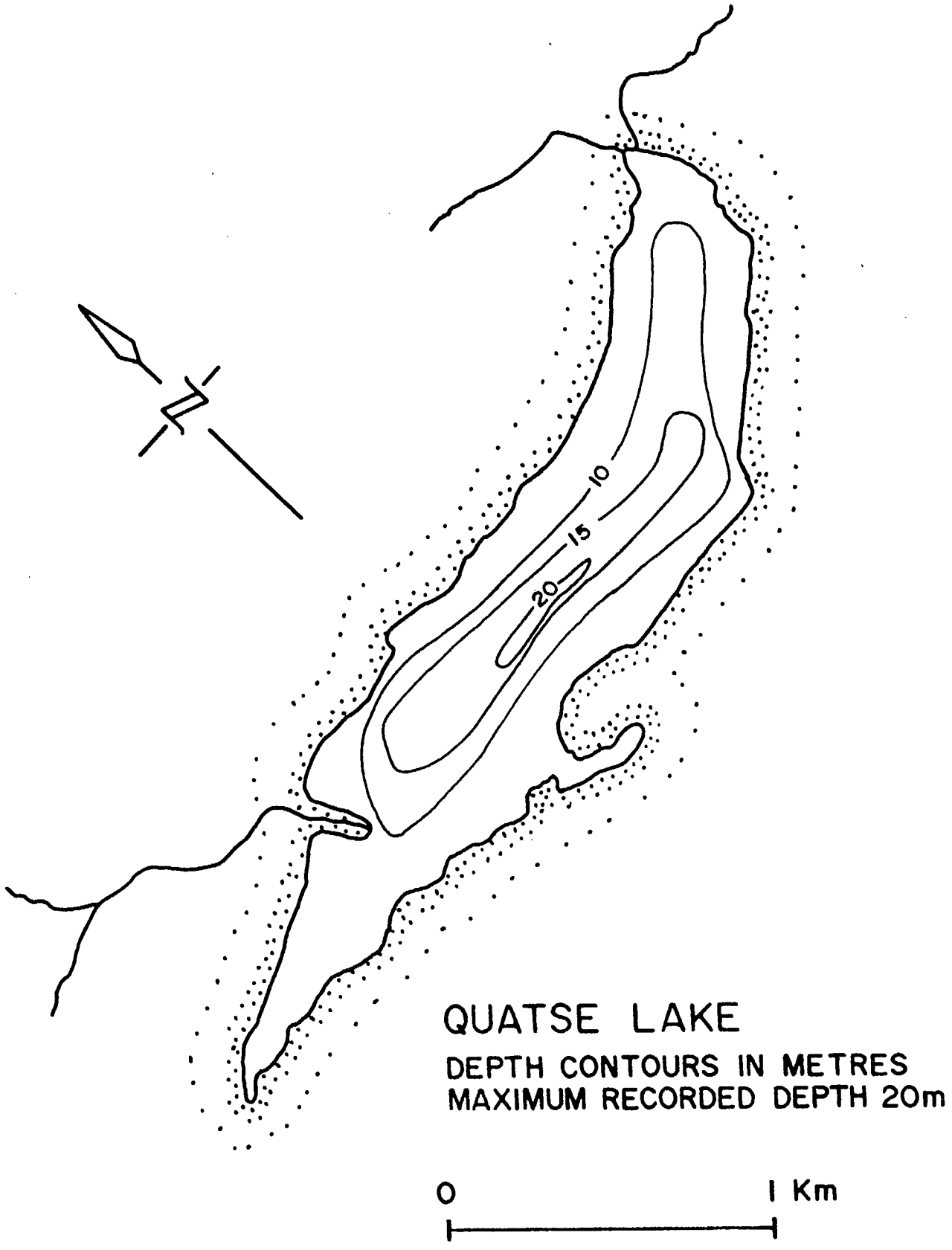
0 1 2 3 Km

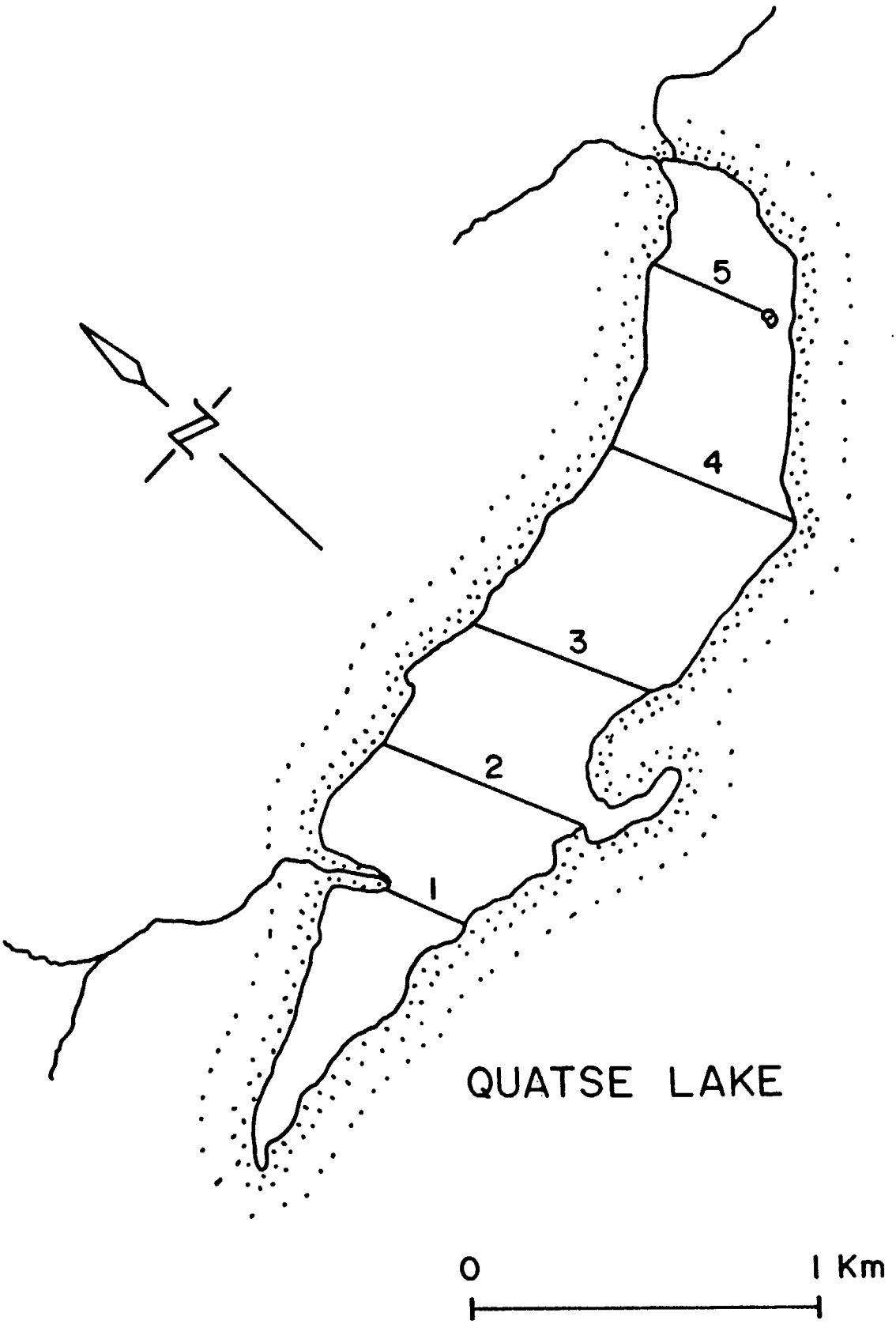


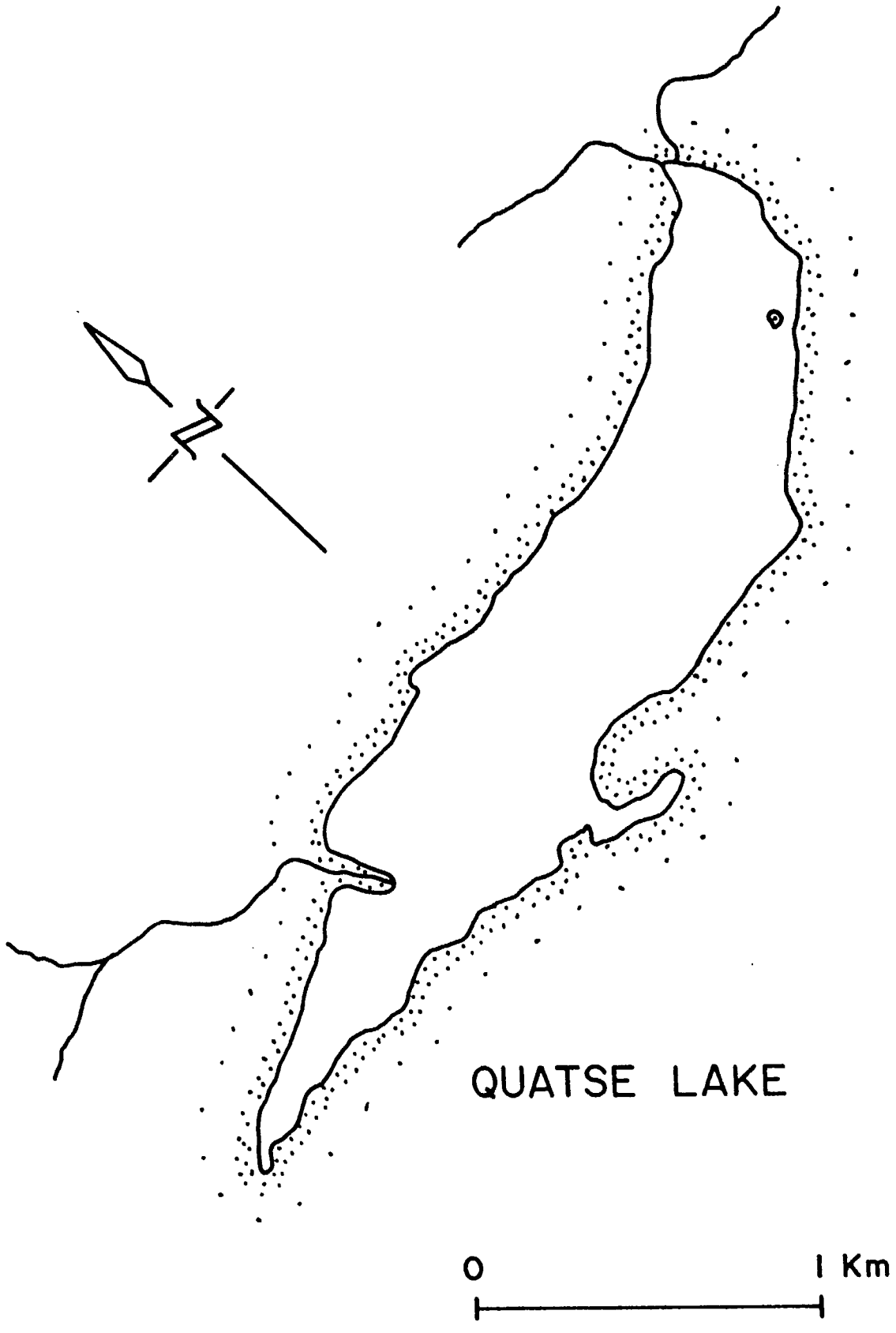
QUATSE LAKE

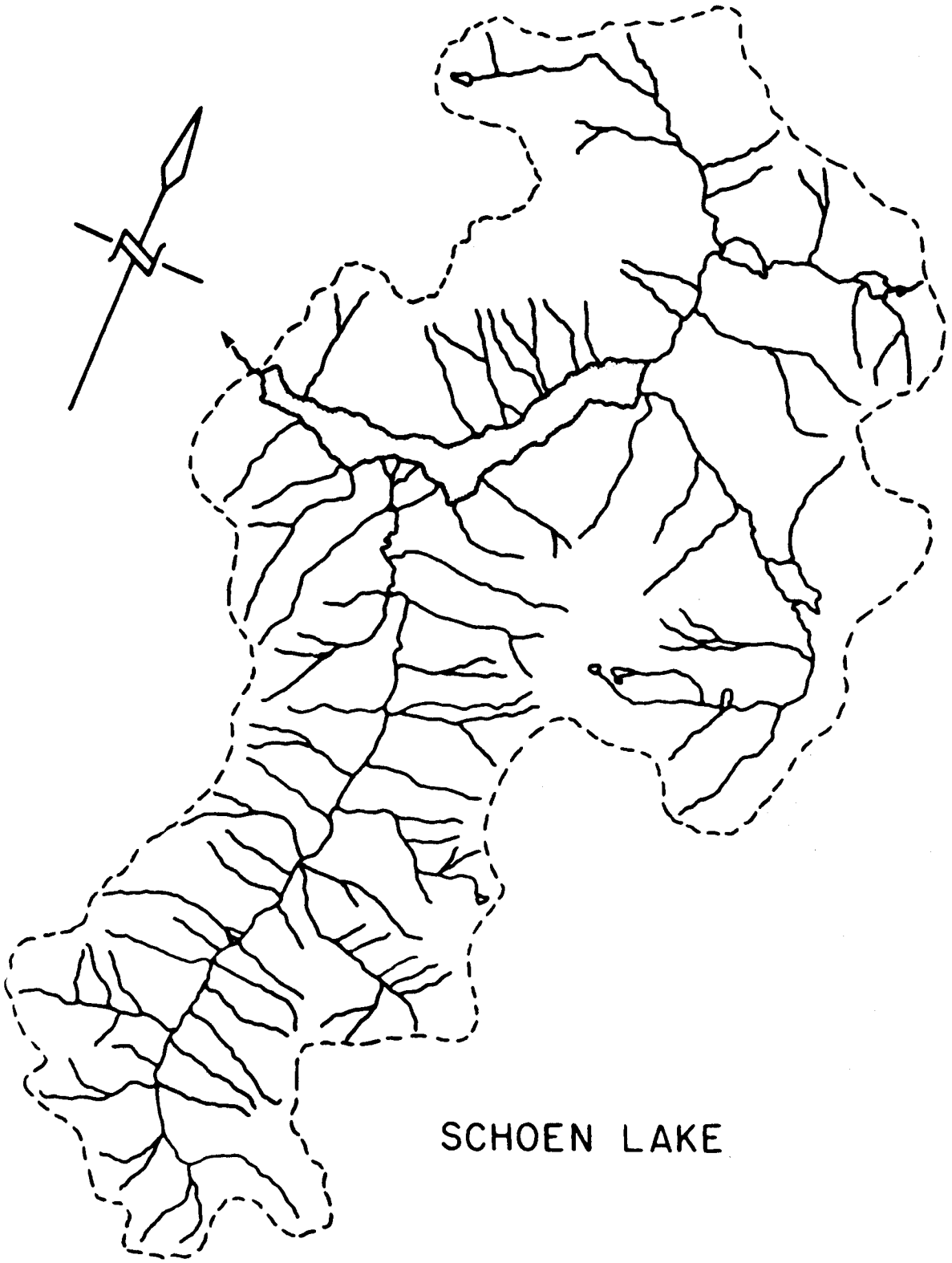
CONTOUR INTERVAL IN FEET

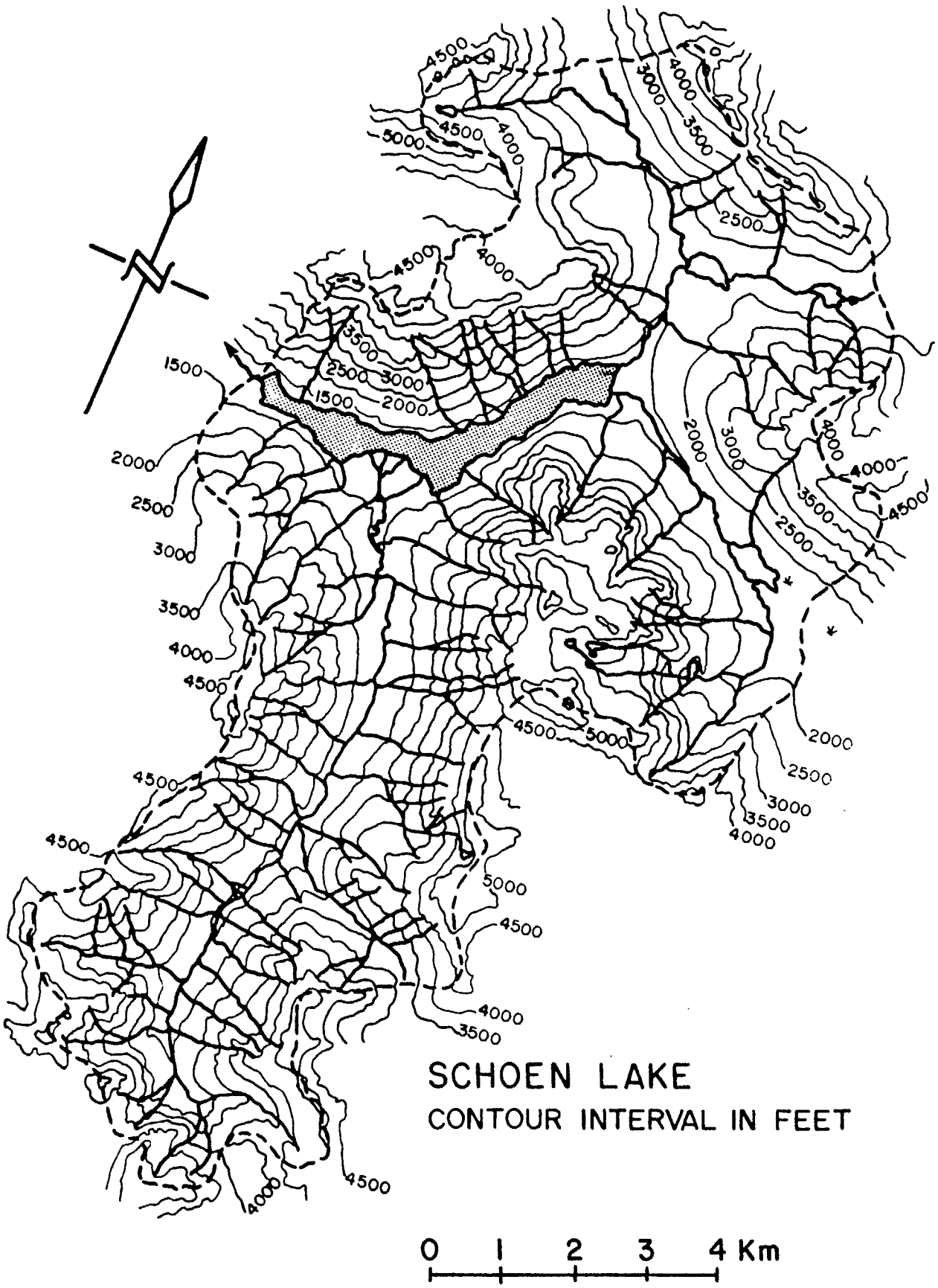
0 1 2 3 Km

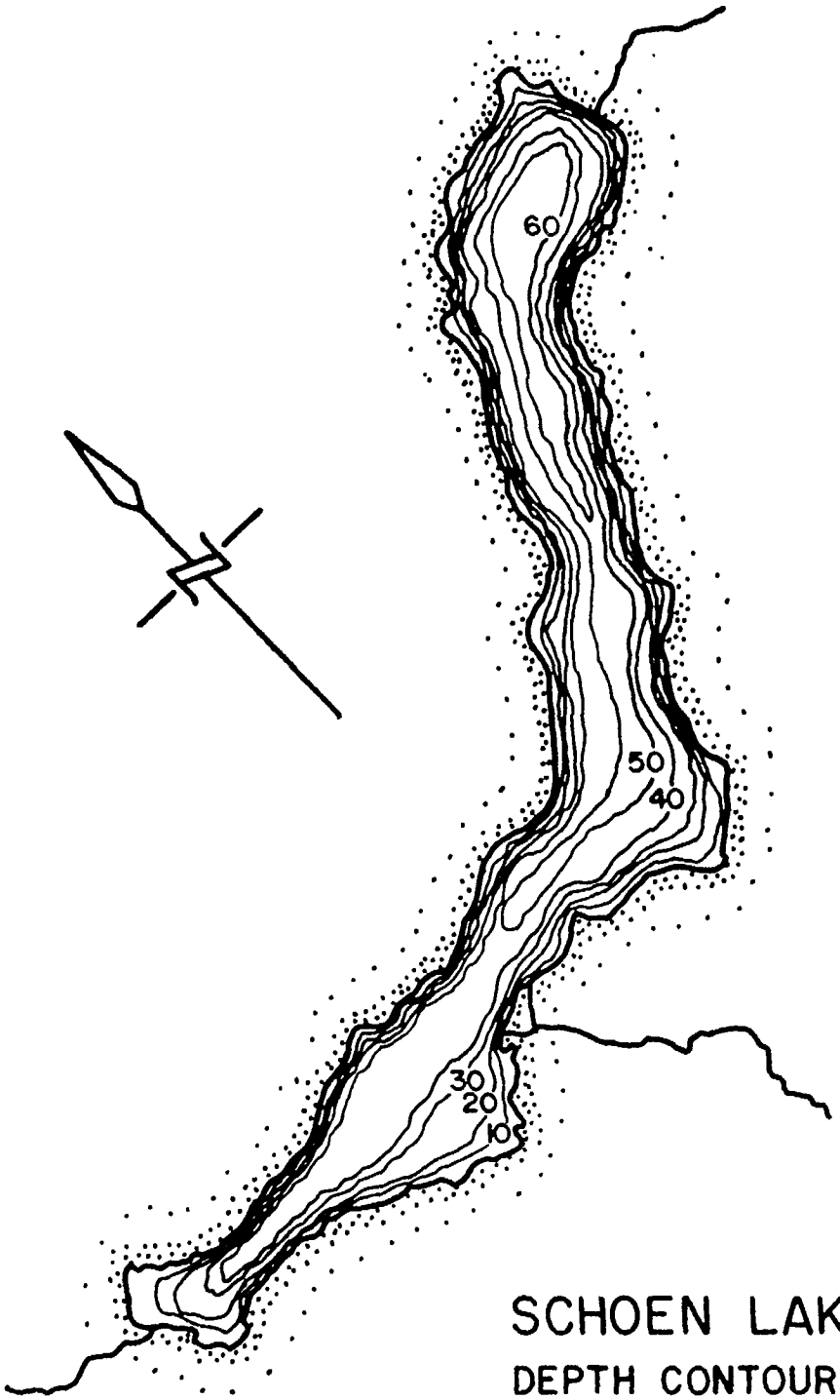

10
15
20
QUATSE LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 20m
0
1 Km


5
4
3
2
1
QUATSE LAKE
0
1 Km


QUATSE LAKE
0
1 Km


SCHOEN LAKE
0 1 2 3 4 Km

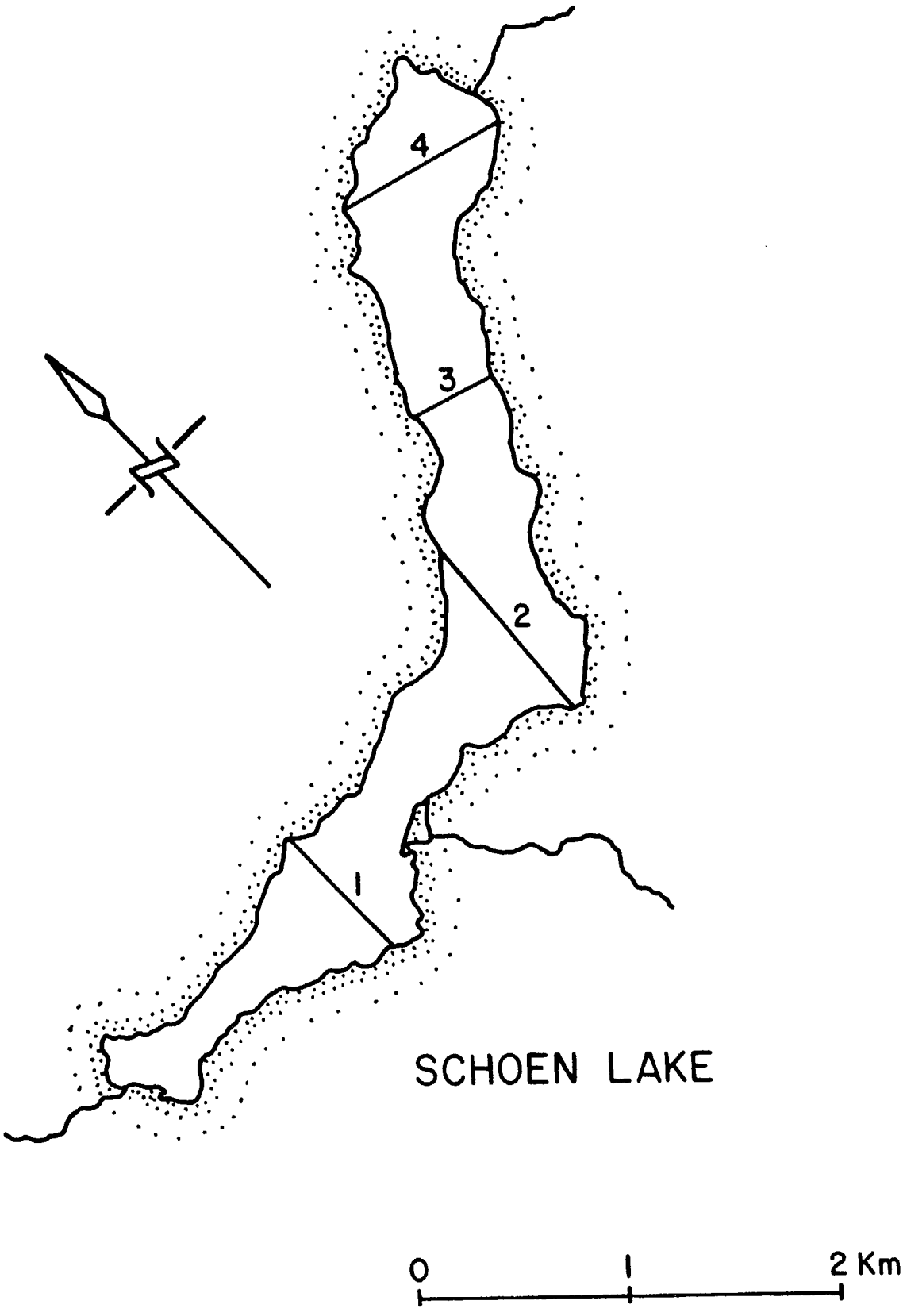

SCHOEN LAKE
CONTOUR INTERVAL IN FEET
0 1 2 3 4 Km

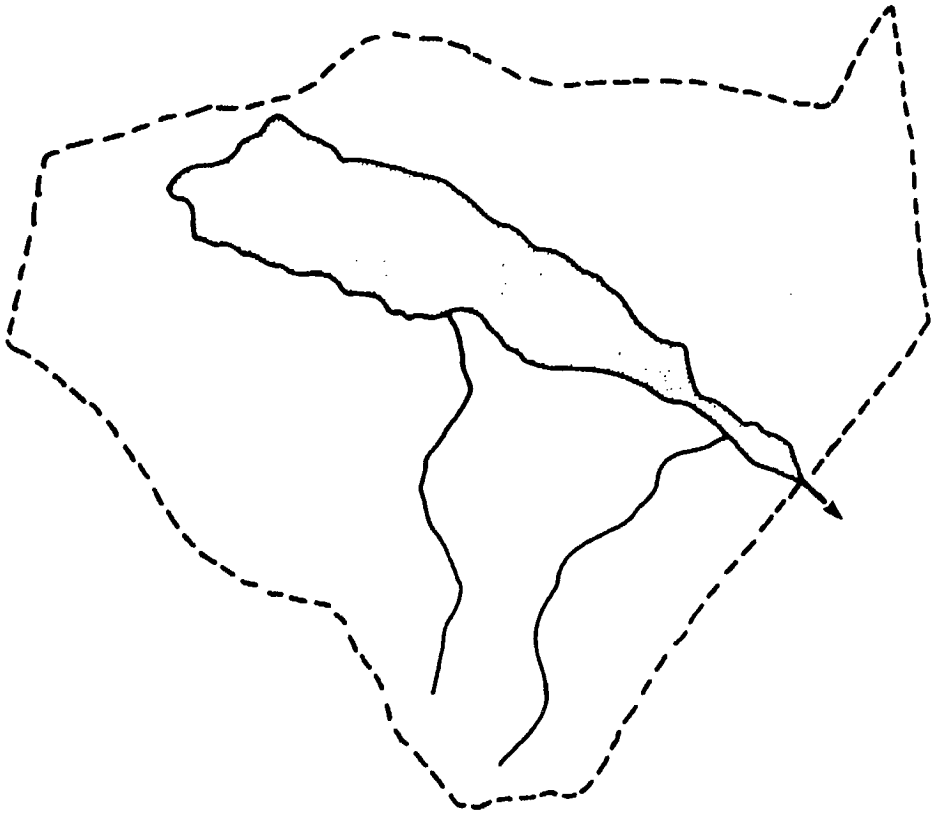


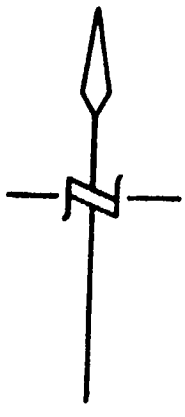
SCHOEN LAKE

DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 70 m

0 1 2 Km

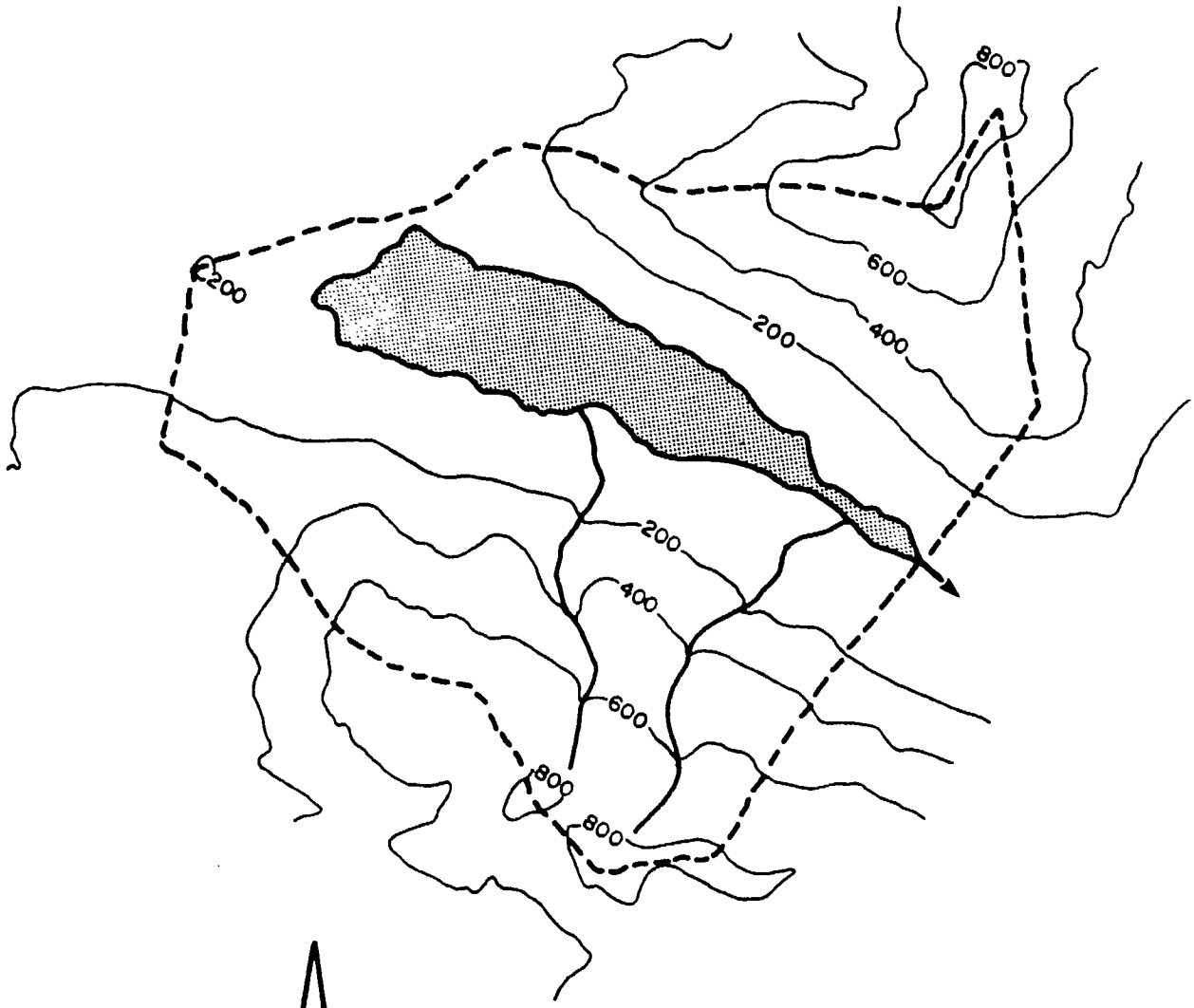

4
3
2
1
SCHOEN LAKE
0
1
2 Km





UCHUCK LAKE

0 1 2 Km



UCHUCK LAKE

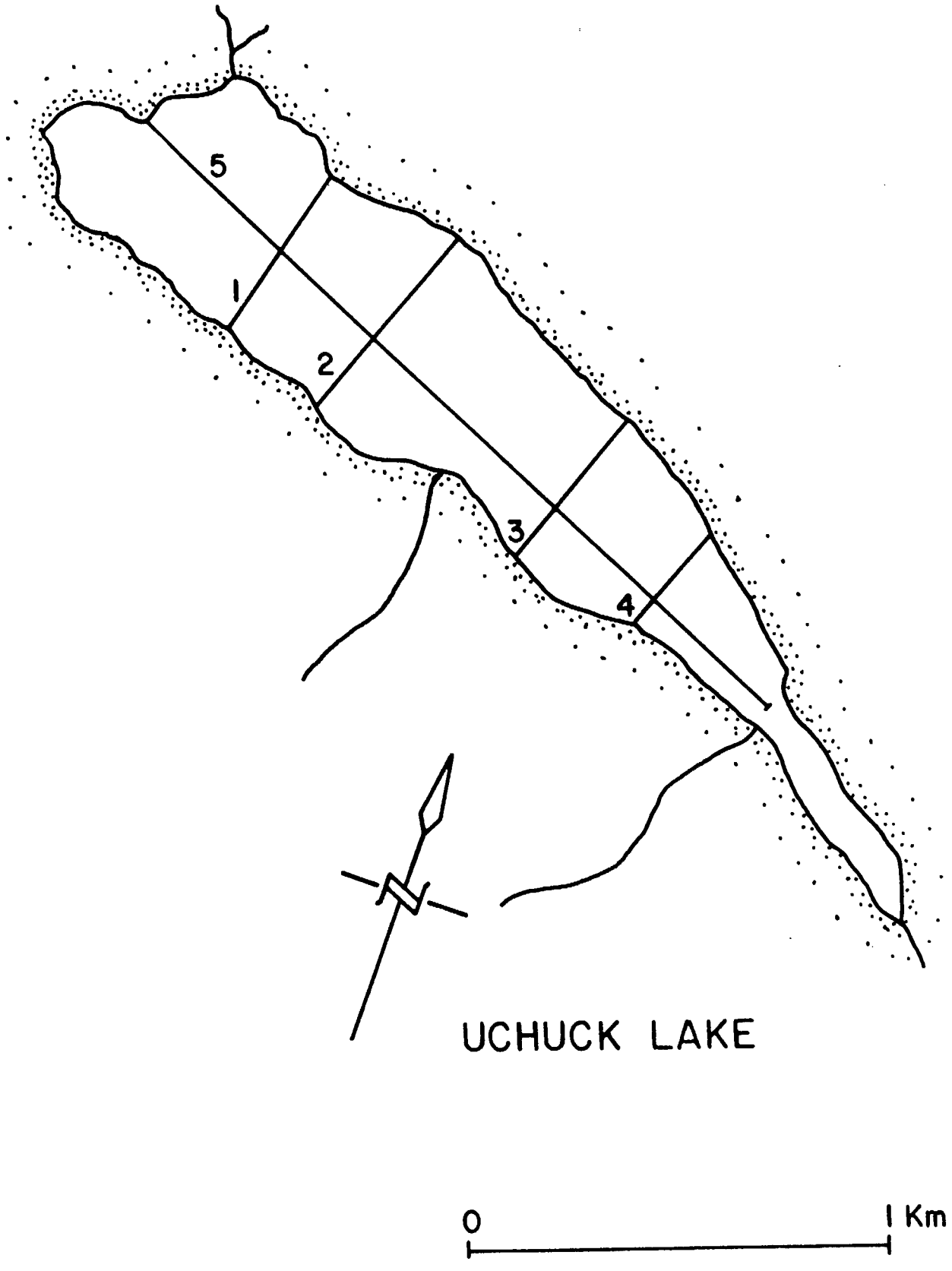
CONTOUR INTERVAL IN METRES

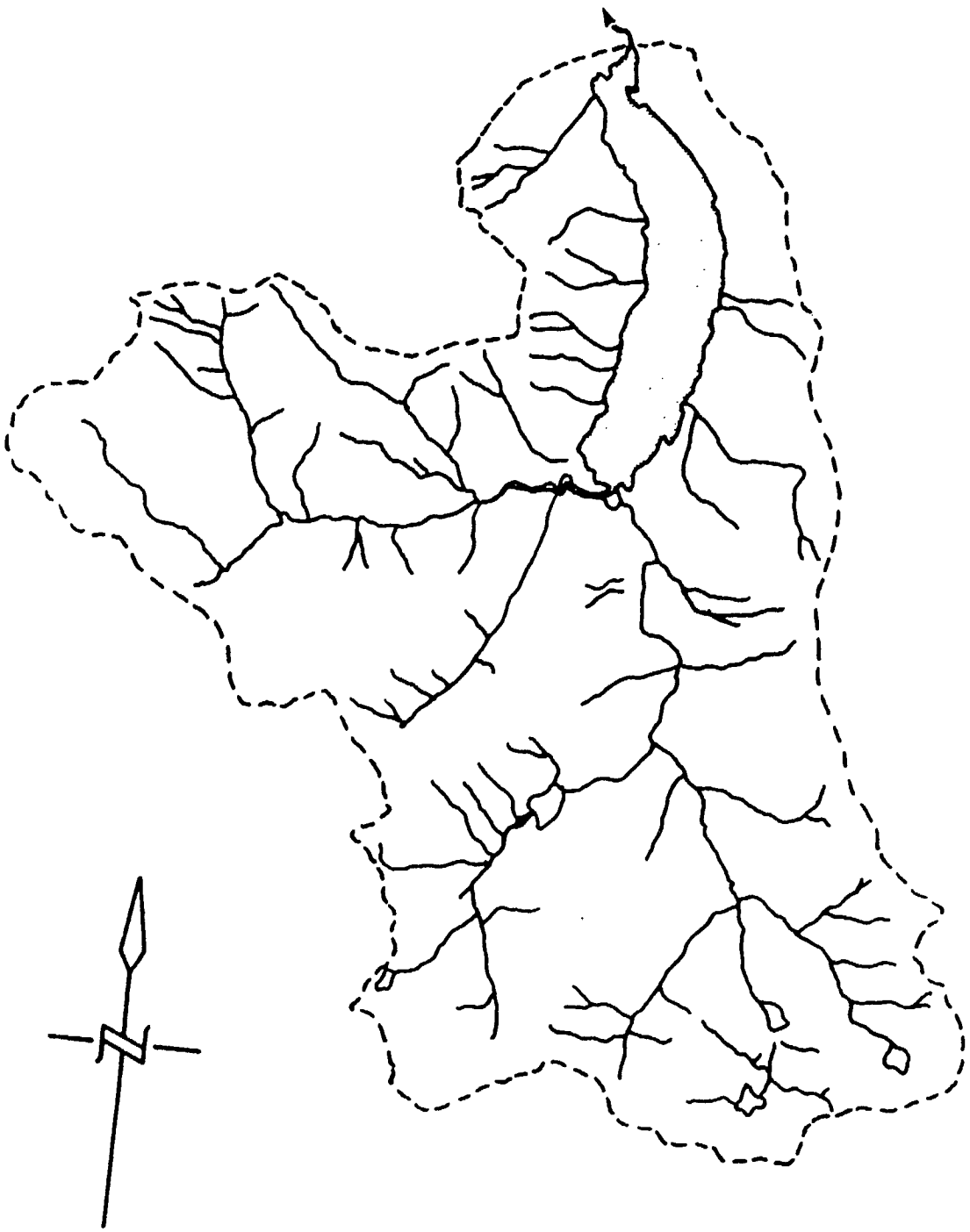
0 1 2 Km

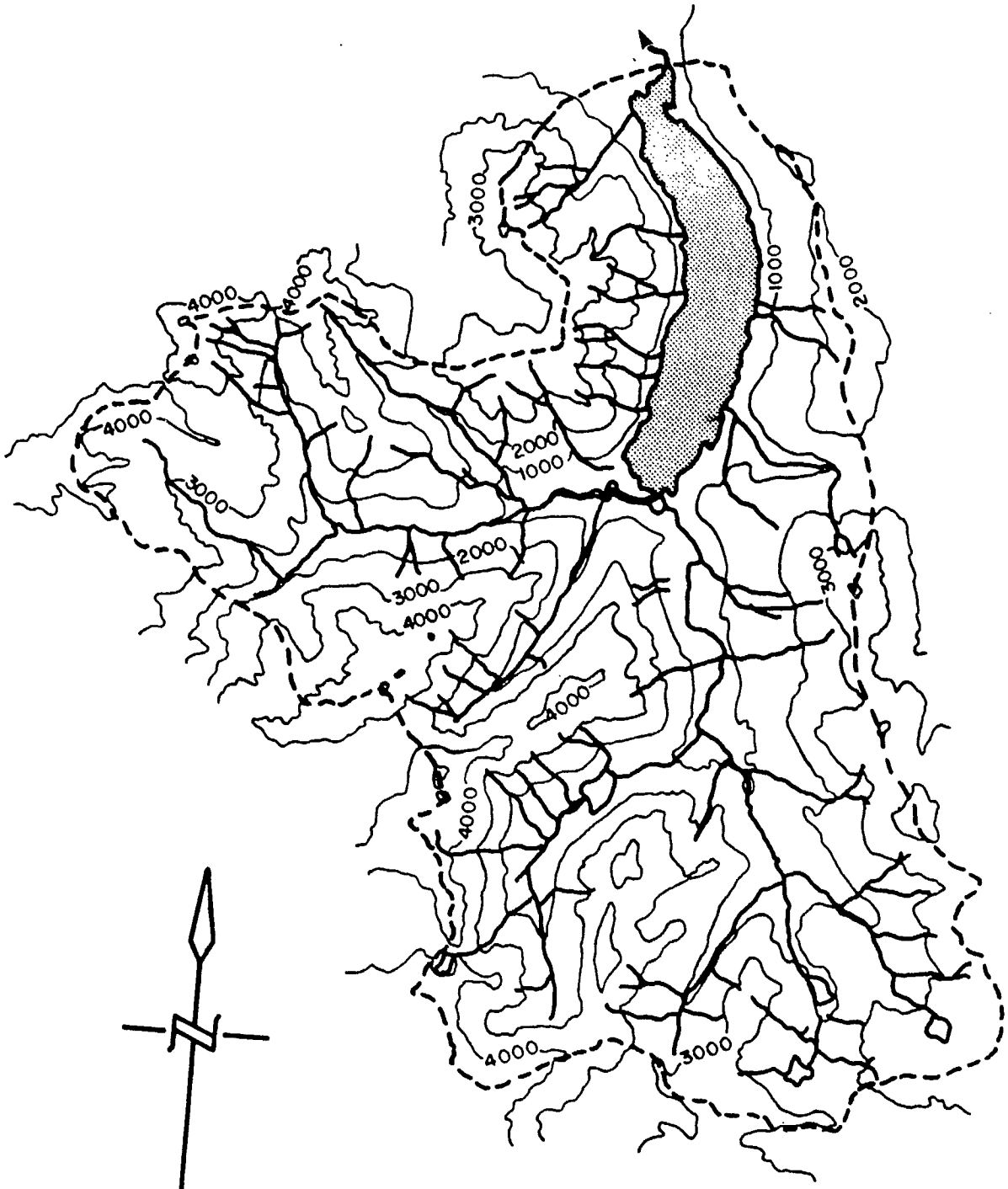
UCHUCK LAKE

DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 47m

0 1 Km

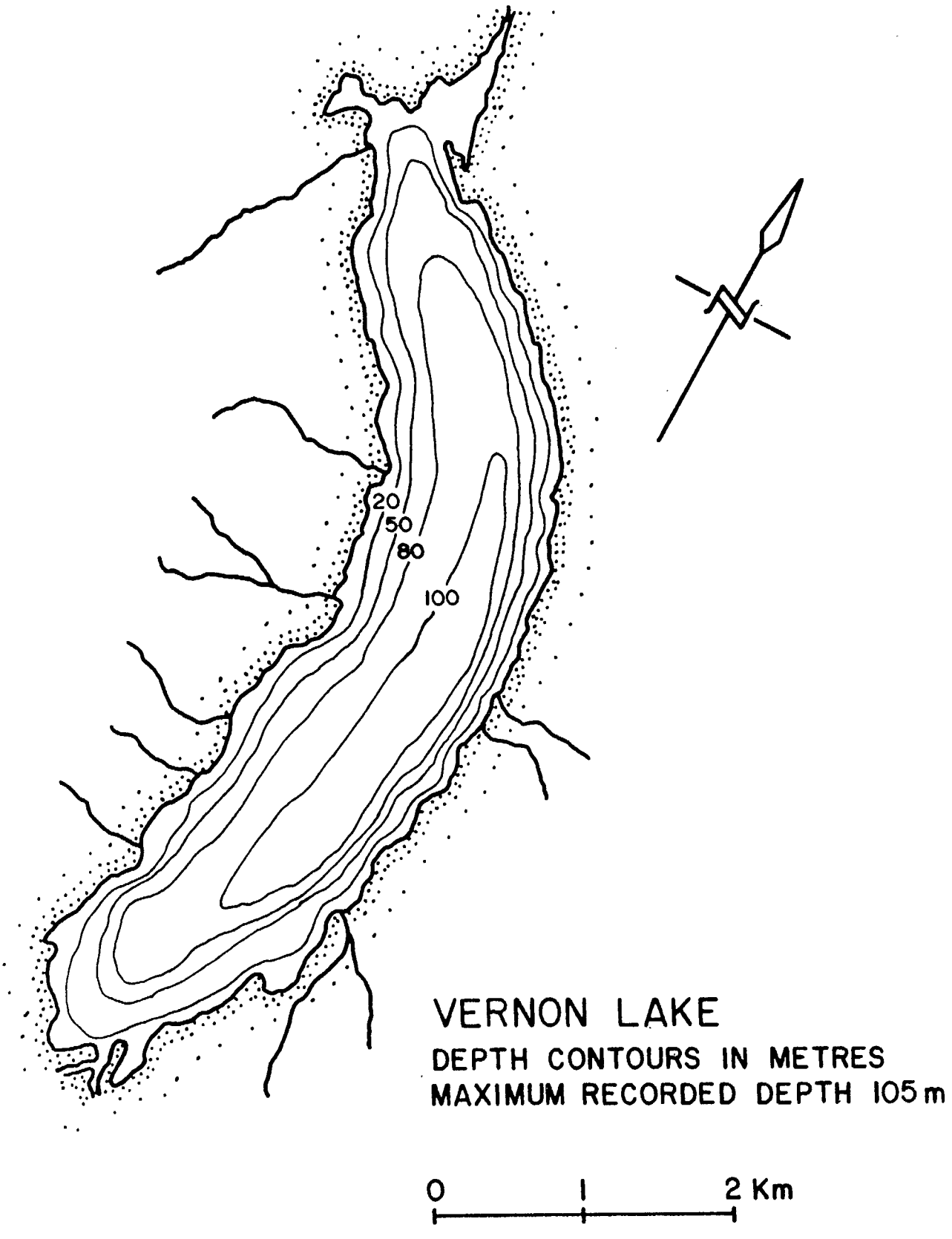

5
1
2
3
4
UCHUCK LAKE
0
1 Km

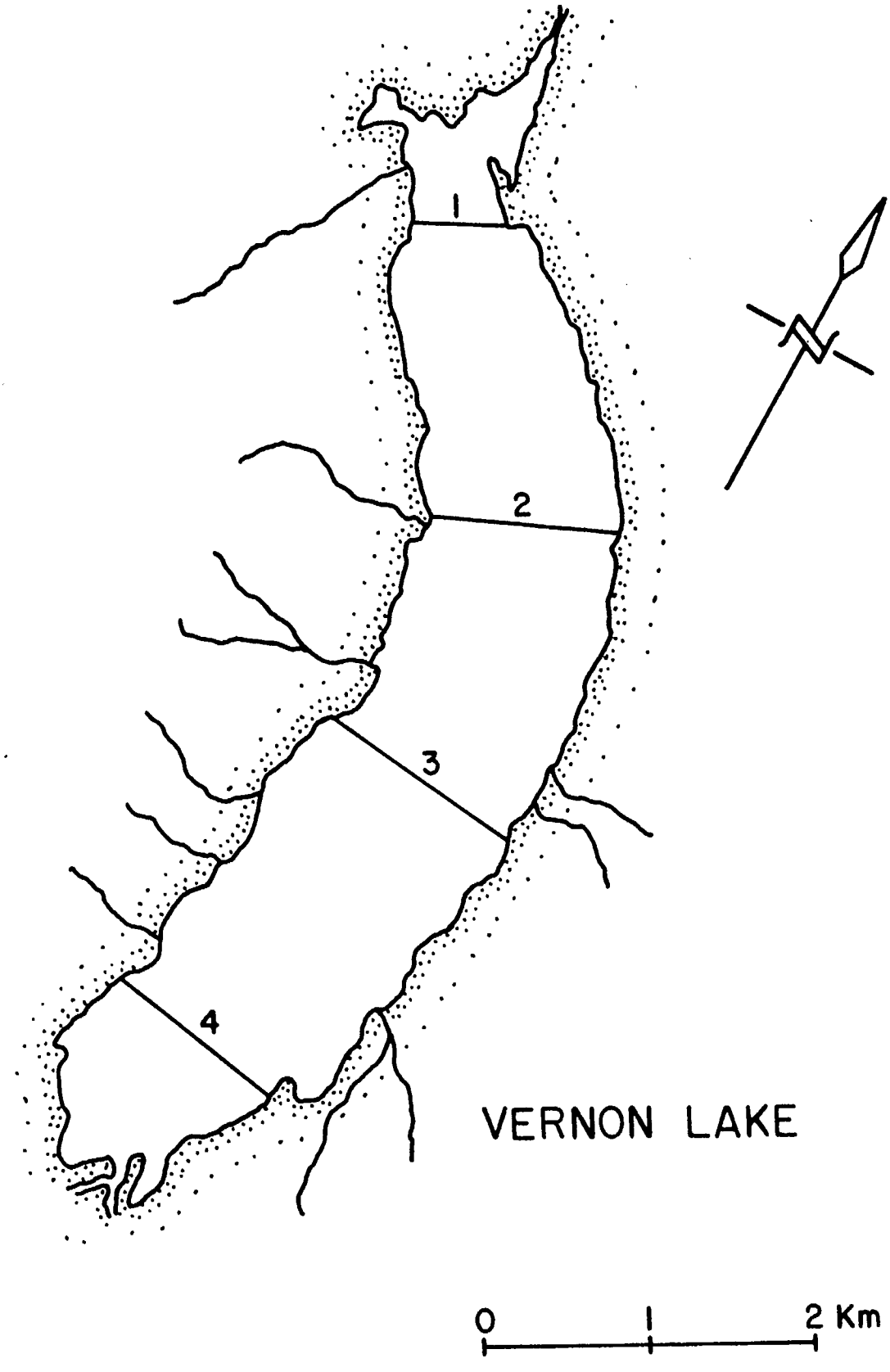

VERNON LAKE
0 1 2 3 4 5 Km



VERNON LAKE

CONTOUR INTERVAL IN FEET


20
50
80
100
VERNON LAKE
DEPTH CONTOURS IN METRES
MAXIMUM RECORDED DEPTH 105 m
0
1
2 Km


1
2
3
4
VERNON LAKE
0
1
2 Km