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PHYSICAL PARAMETERS OF NASS RIVER SALMONID NURSERY LAKES UNDER STUDY BY THE INTERIM MEASURES FISHERIES PROGRAM

S.P. Murdoch, M.R.S. Johannes, D.K. McCreight,
K.D. Hyatt, and D.P. Rankin

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

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PHYSICAL PARAMETERS OF NASS RIVER SALMONID NURSERY LAKES UNDER STUDY BY THE INTERIM MEASURES FISHERIES PROGRAM

by

S.P. Murdoch[1], M.R.S. Johannes[1*], D.K. McCreight[1], K.D. Hyatt[*] and D.P. Rankin[*]

[*]Salmon-Recruitment Assessment Program
Biological Sciences Branch
Department of Fisheries and Oceans
Pacific Biological Station
Nanaimo, B.C. V9R 5K6

[1]Triton Environmental Consultants Ltd.
#120-13511 Commerce Pkwy.,
Richmond, B.C., V6V 2L1.

[*]Authors from whom copies of report may be obtained

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ABSTRACT

Murdoch, S.P., M.R.S. Johannes, D.K. McCreight, K.D. Hyatt, and D.P. Rankin. 1993. Physical parameters of Nass River salmonid nursery lakes under study by the Interim Measures Fisheries Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 2192: 113p.

A series of maps and tables are presented for salmonid nursery lakes surveyed (1991-1992) in the Nass River System by the Salmon Recruitment Assessment Program (Canadian Department of Fisheries and Oceans) in cooperation with biologists and technicians from the Nisga'a Tribal Council. The information presented provides essential standardized physical parameters in support of salmon production assessment in freshwater lakes. Physical parameters 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. Hydroacoustic transect lengths and lake areas at depth are presented in tables. Maps show watershed boundaries, topography, bathymetry and hydroacoustic transect locations.

RÉSUMÉ

Murdoch, S.P., M.R.S. Johannes, D.K. McCreight, K.D. Hyatt, and D.P. Rankin. 1993. Physical parameters of Nass River salmonid nursery lakes under study by the Interim Measures Fisheries Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 2192: 113p.

Nous présentons une série de cartes et de tableaux sur des lacs servant de nourriceries aux salmonidés, dans le réseau de la rivière Nass, qui ont été examinés (1991-1992) dans le cadre du Programme d'évaluation du recrutement des salmonidés (ministère des Pêches et des Océans du Canada) en collaboration avec des biologistes et des techniciens du Conseil de la tribu Nisga'a. L'information présentée fournit les paramètres physiques essentiels étalonnés sur lesquels se fonde l'évaluation de la production de saumons dans les lacs d'eau douce. Ces paramètres sont: la superficie du lac, la profondeur maximale mesurée, la profondeur moyenne, l'altitude, l'aménagement du rivage, la moyenne annuelle de précipitations, la superficie du bassin versant, les coordonnées du lac, la longueur du rivage et le volume du lac. Les tableaux présentent la longueur des transects hydroacoustiques et la superficie du lac à une profondeur donnée. Les cartes indiquent les limites du bassin versant, la topographie et la bathymétrie, ainsi que la localisation des transects hydroacoustiques.

INTRODUCTION

The Nass River system has historically supported moderate to high sockeye salmon (Oncorhynchus nerka) production relative to other areas of British Columbia. Preliminary biological surveys (Stockner and Shortreed 1978, Graham et al. 1979, Shortreed and Stockner 1981, Simpson et al. 1981) of Nass River sockeye nursery lakes provided some information on fish populations and nursery lake characteristics. Recent assessments of annual salmon production have focused efforts to establish current and potential sockeye production in lakes of the Nass system in order to address uncertainties that have arisen during the process of ongoing land claim negotiations.

To aid the appraisal of actual and potential salmon production by various species populations in the Nass River system, an Interim Measures Fisheries Program was established collaboratively among the Canadian Department of Fisheries and Oceans (DFO), the Province of British Columbia (BC) and the Nisga'a Tribal Council (NTC). During 1991/92 personnel from DFO and the NTC initiated a number of salmon stock assessment studies including sockeye studies in the freshwater lakes of the Nass.

The physical and environmental data collected from each lake are used to evaluate lake nutrient status, primary and secondary production, fish abundance and species composition. This report contains baseline physical data that are essential to subsequent estimates of fish abundance and production potential.

This report includes information on: (1) lake basin morphology characterized by maximum and mean lake depth, lake volume, shoreline length, shoreline development and bathymetric maps; (2) watershed area and topography; (3) mean annual precipitation; (4) lake coordinates (Lat/Long); (5) lake elevation above sea level; (6) hydroacoustic transect lengths; and (7) lake area at specific depth strata across hydroacoustic transects. Lake specific parameters including hydroacoustic transect length and lake area at depth are used by Recruitment Assessment Program (RAP) personnel in calculation of fish population estimates. Computer programs have been developed to use lake physical parameters, in the format presented in this report, in conjunction with data derived from hydroacoustic and trawl surveys (Hyatt et al. 1984) to calculate fish population size and biomass by species.

This report follows the format of physical parameter information presented from other lakes by Rutherford et al. (1986) and established for survey use by Hyatt et al. (1984). Four maps and a table are presented for each lake: (1) watershed boundary map; (2) watershed topography map; (3) bathymetric map; (4) hydroacoustic transect location and plankton sampling station map; and (5) transect length and depth strata area tables.

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 6 times using a high resolution digitizing table and the mean of these areas is reported here for each lake.

Shoreline length (L) was measured 6 times on a 1:50,000 topographic map by using a high resolution digitizing table. The mean shoreline length was used to calculate shoreline development. 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:

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

where

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

Precipitation data (Environment Canada, Atmospheric Environment Service) were compiled from two weather stations (New Aiyansh, Stewart) in proximity to the study lakes. Only years with complete annual precipitation data (1970 to 1982) were used to calculate mean annual precipitation (MAP, Table 2).

Maximum recorded depth (Table 2) and lake bathymetry data were obtained from the B.C. Environment Ministry records for Bonney, Dragon, Fred Wright, Kwinageese, Kwinamuck, Lava, Meziadin and Niska West lakes and referenced against bathymetric data collected from surveys during 1991-1992. In the remaining lakes, maximum recorded depth and lake bathymetry were determined from hydroacoustic surveys (Hyatt et al 1984). Bathymetric data were insufficient to produce reliable maps for Bowser, IMP, Niska East, Oweegee and Yellen lakes.

The number of transect lines used to determine lake bathymetry is based on lake size and basin complexity and varies among lakes (Table 3). Supplemental transects were added to routine hydroacoustic surveys to compile additional data for lake bathymetry (Figure 2d).

Bathymetric maps were prepared from hydroacoustic surveys using the following methods. Acoustic transects were drawn onto lake outlines taken from 1:50,000 topographic maps. Vertical lines were then drawn on the echogram from the surface to the bottom (60m in deep lakes) at 5m intervals. For each transect, a relative surface distance was measured

from the echogram. Relative depth contours (isobaths) on the echogram were scaled and transferred to the corresponding transect on the lake outline map.

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 contour lines were then sketched onto the map by connecting depth contour reference marks for all transects. Stratum area (Table 4) 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.

Transect lengths at depth (Table 4) were calculated from the echograms and 1:50,000 topographic maps. The transect length at the lake surface was measured on a 1:50,000 topographic map. Transect length at depth was measured on the echogram at the midpoint of the depth interval and converted to a transect length using the following formula:

$$TLD = TLDE * TLS/TLSE$$

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 according to Wetzel (1975) as :

$$V_i = H/3(A_1+A_2+(A_1*A_2)^{1/2})*10,000$$

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 the deepest measured stratum and maximum depth. Mean depth (Table 2) was calculated by dividing lake volume by lake surface area (Wetzel 1975):

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

where

Z = mean depth (m)
V = lake volume (m^3)
A_0 = lake surface area (ha).

RESULTS

The results are presented in the following tables and figures.

ACKNOWLEDGEMENTS

We wish to thank the Nisga'a Tribal Council for their cooperation in this study, particularly George Gosnel Sr., Ben Gonu, Vincent Johnson and Leonard Squires for their input and assistance in carrying out this study. We appreciate the assistance of Alan Hirst for his involvement on lake surveys. We are grateful to the Province of British Columbia, Fish and Wildlife Branch for lake survey information. We also wish to thank Bob Bocking (LGL) for his cooperation and assistance.

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Table 1. Lake areas used in previous reports.

Lake	Reported Area (ha)				
	B.C. Fish and Wildlife Branch (1972)	Stockner and Shortreed (1978)	Shortreed and Stockner (1981)	B.C. Environment Fisheries Branch (1988)	This Report
Bonney	429				400
Bowser			3400	3610	3443
Damdochax		200	200		146
Dragon	531				222
Fred Wright	397	450	390		390
Halfway					45
IMP					122
Kwinageese					257
Kwinamuck				180	188
Lava	563				537
Meziadin	3323	3110	3600		3606
Niska East					157
Niska West				230	229
Oweegee					50
Yellen					23

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

Lake	Lake Area (ha)	Maximum Measured Depth (m)	Mean Depth (m)	Elevation (m)	Shoreline Development	Mean Annual Precipitation (mm)	Watershed Area (km^2)	Latitude (North)	Longitude (South)	Shoreline Length (km)	Lake Volume ($10^6 \cdot m^3$)
Bonney	400	86	21	762	4.09	1862[b]	70.5	55°57'	128°50'	29.5	84.5
Bowser	3443	NA	NA	368	3.20	1862[b]	1359	53°31'	129°30'	66.5	NA
Damdochax	146	22	10	580	1.45	1862[b]	115.9	56°30'	128°08'	6.3	14.9
Dragon	222	9.4	5	244	1.18	893[a]	16.5	55°19'	128°57'	6.3	11.5
Fred Wright	390	41	18	579	2.67	1862[b]	215.7	55°58'	128°47'	18.7	71.5
Halfway	45	19	8	564	2.10	1862[b]	222.1	56°00'	128°45'	5.1	3.6
IMP	122	NA	NA	445	2.02	1862[b]	18.0	56°10'	128°45'	7.9	NA
Kwinageese	257	50	19	615	3.24	1862[b]	13.9	56°03'	128°48'	18.9	49.8
Kwinamuck	188	6.0	3.5	144	1.46	893[a]	40.8	55°58'	129°48'	7.1	6.1
Lava	537	56	17	172	3.58	893[a]	322.1	55°03'	129°00'	29.4	92.9
Meziadin	3606	134	57	246	2.29	1862[b]	661.2	56°02'	129°15'	48.8	2059.6
Niska (E)	157	NA	NA	549	1.45	893[a]	8.4	55°47'	129°07'	6.4	NA
Niska (W)	229	33	17	527	1.52	893[a]	34.7	55°47'	129°10'	8.2	38.3
Oweegee	50	NA	NA	512	2.59	1862[b]	53.0	56°39'	129°43'	6.5	NA
Yellen	23	NA	NA	450	1.87	1862[b]	13.6	56°10'	128°44'	3.2	NA

[a] Weather Station New Aiyansh B.C. 1975-1982 (omitted 1976 and 1978 due to missing data)
[b] Weather Station Stewart B.C. 1975-1982 (omitted 1977 due to missing data)
NA Currently Not Available

Table 3. Number of transects used to determine lake bathymetry.

Lake	Number of transects used.
Bonney	92[a]
Bowser	NA
Damdochax	7[b]
Dragon	9[a]
Fred Wright	34[a]
Halfway	3[b]
IMP	NA
Kwinageese	5[b]
Kwinamuck	7[a]
Lava	46[a]
Meziadin	39[a]
Niska East	NA
Niska West	12[a]
Oweegee	NA
Yellen	NA

[a] Data from B.C. Environment (1972 and 1988)
[b] Department of Fisheries and Oceans Survey (1991-92).

Table 4. Transect lengths and area at depth for Nass study lakes.

Bonney Lake

		Transect				
		1	2	3	4	5
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)						
Surface	400	338	445	468	695	500
2 - 5	340	300	409	440	610	410
5 -10	311	255	378	420	518	290
10-15	250	217	335	370	424	147
15-20	195	183	299	345	360	30
20-30	151	132	233	106	286	
30-40	108	58	96	14	117	
40-50	74					
50-60	50					

	Transect			
	6	7	8	9
	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)				
Surface	820	775	923	838
2 - 5	794	758	859	763
5 -10	760	741	807	734
10-15	703	696	738	715
15-20	632	659	692	643
20-30	423	606	639	538
30-40	165	542	506	418
40-50	16	423	446	344
50-60		344	350	233

Table 4. (Cont'd).

Damdochax Lake

		Transect			
		1	2	3	4
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)					
Surface	146	394	609	627	690
3 - 5	140	370	587	614	677
5 -10	127	188	402	591	640
10-15	78			534	385
15-20	33			199	

Dragon Lake

		Transect			
		1	2	3	4
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)					
Surface	222	1225	1240	1250	870
3 - 5	204	1145	1210	1207	799
5 -10	145	1058	1133	1131	465

Table 4. (Cont'd).

Fred Wright Lake

		Transect			
		1	2	3	4
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)					
Surface	390	955	2374	445	520
3 - 5	371	925	2350	407	512
5 -10	320	848	2147	285	504
10-15	256	794	2028		429
15-20	201	748	1873		379
20-30	164	663	1575		248
30-40	90	331	1276		
40-50	30		298		

Halfway Lake

		Transect		
		1	2	3
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)				
Surface	45	503	255	845
2 - 5	38	222	215	729
5 -10	27	180	161	326
10-15	18	127	111	246
15-20	8			124

Table 4. (Cont'd).

Kwinageese Lake

		Transect				
		1	2	3	4	5
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)						
Surface	257	198	483	967	496	707
2 - 5	244	198	455	960	487	697
5 -10	221	198	426	954	455	693
10-15	184	198	409	929	445	662
15-20	148	176	307	728	424	610
20-30	117	118	98	399	350	493
30-40	60			280	286	250
40-50	20			27	124	88

Lava Lake

		Transect						
		1	2	3	4	5	6	7
	Stratum Area (ha)	Length (m)	Length (m)	Length (m)	Length (m)	Length (m)	Length (m)	Length (m)
Depth Stratum (m)								
Surface	537	400	515	485	467	398	455	713
2 - 5	484	383	308	454	441	364	440	686
5 -10	410	123	10	383	411	331	428	651
10-15	297				372	297	417	648
15-20	239				343	278	399	626
20-30	192					69	351	602
30-40	131						246	554
40-50	76							427

Table 4. (Cont'd).

Meziadin Lake

		Transect					
		1	2	3	4	5	6
	Stratum Area (ha)	Length	Length	Length	Length	Length	Length
Depth Stratum (m)							
Surface	3606	1725	1640	1800	2050	2585	1490
2 - 5	3571	1669	1824	1775	2019	2561	1475
5 -10	3544	1604	1802	1741	1978	2544	1429
10-15	3418	1595	1770	1715	1948	2308	1300
15-20	3212	1577	1760	1699	1927	1990	1216
20-30	3012	1549	1717	1673	1896	1944	1163
30-40	2688	1493	1685	1623	1784	1753	857
40-50	2451	1438	1621	1563	1743	1615	
50-60	2278	1298	1578	1513	1671	1060	

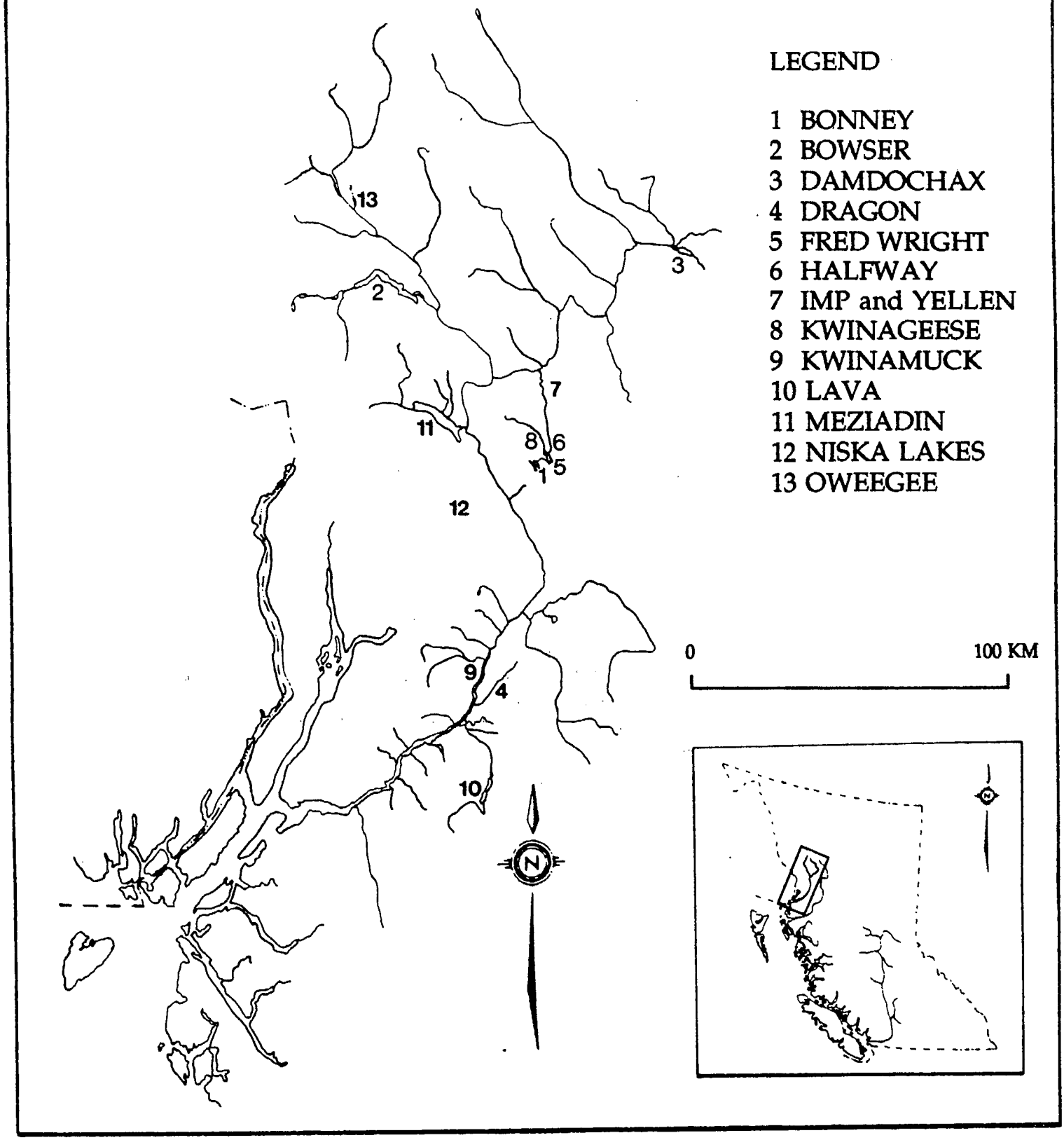
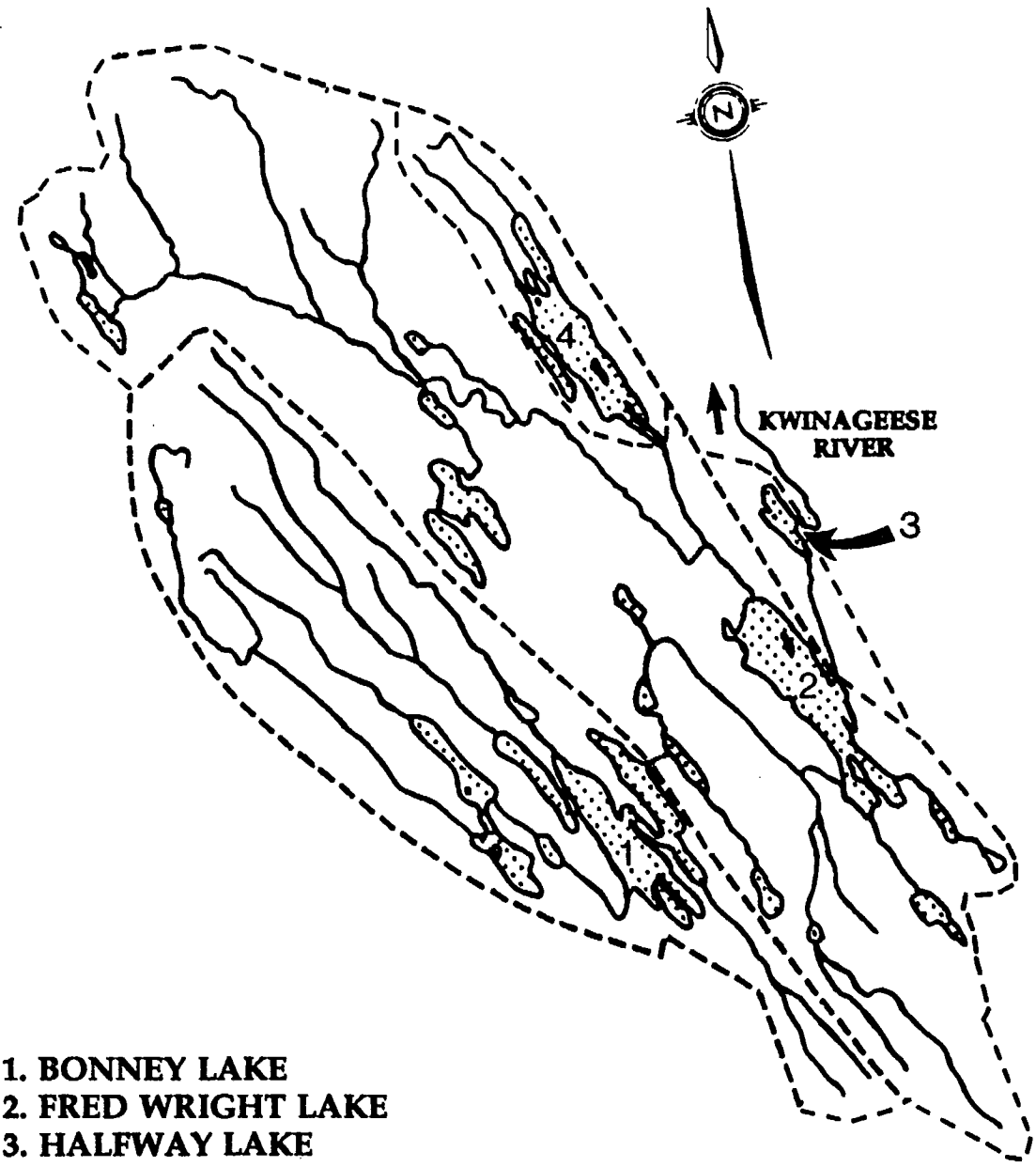


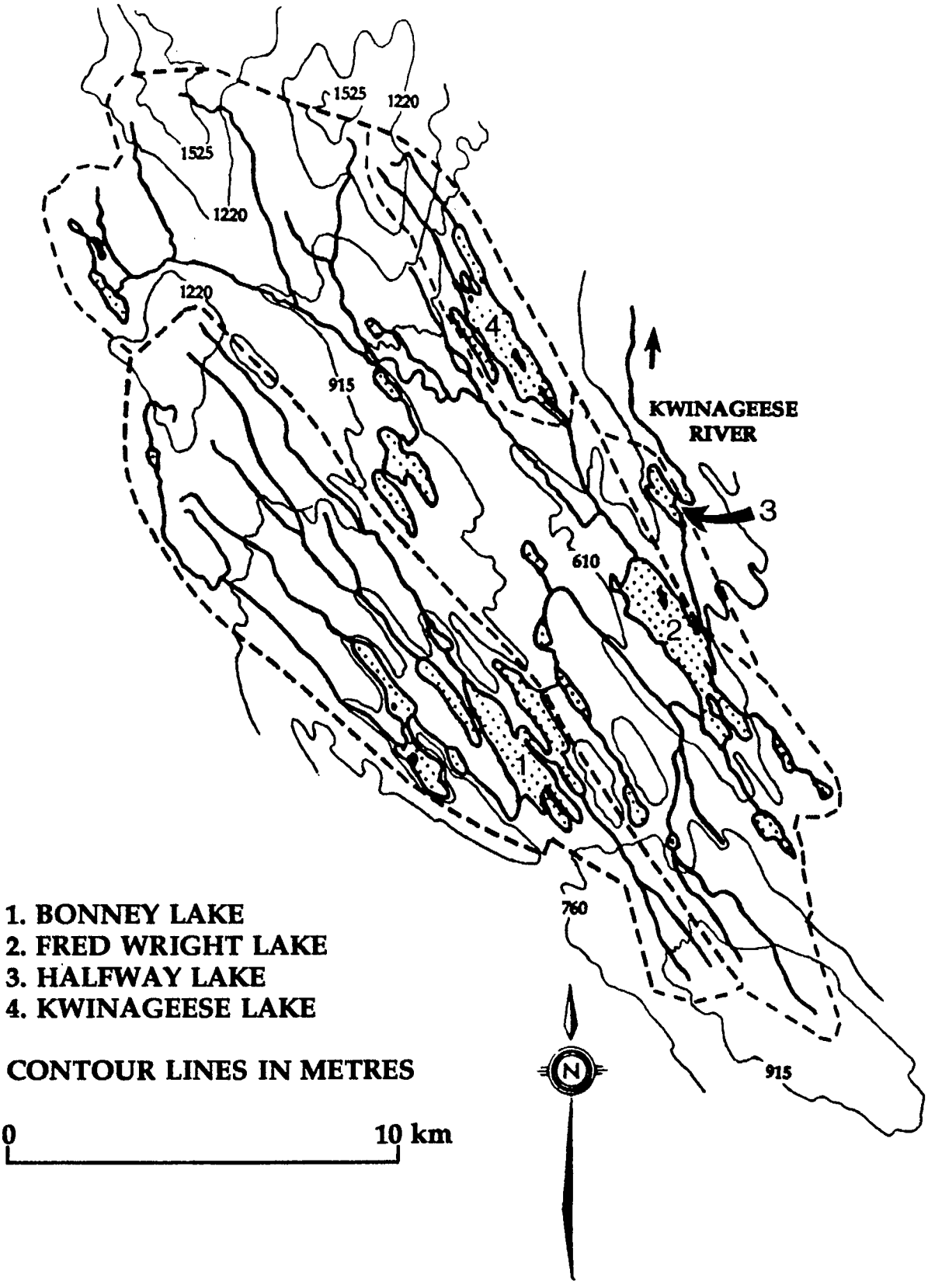
Figure 1. Map of Nass River watershed showing salmonid nursery lakes.

Figure 2. Separate maps of (a) watershed boundary, (b) topography, (c) bathymetry and (d) hydroacoustic transects for Bonney, Damdochax, Dragon, Fred Wright, Halfway, Kwinageese, Kwinamuck, Lava, Meziadin and Niska West lakes (insufficient data for Bowser, IMP, Niska East, Oweegee and Yellen Bathymetry maps)



1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE

0 10 km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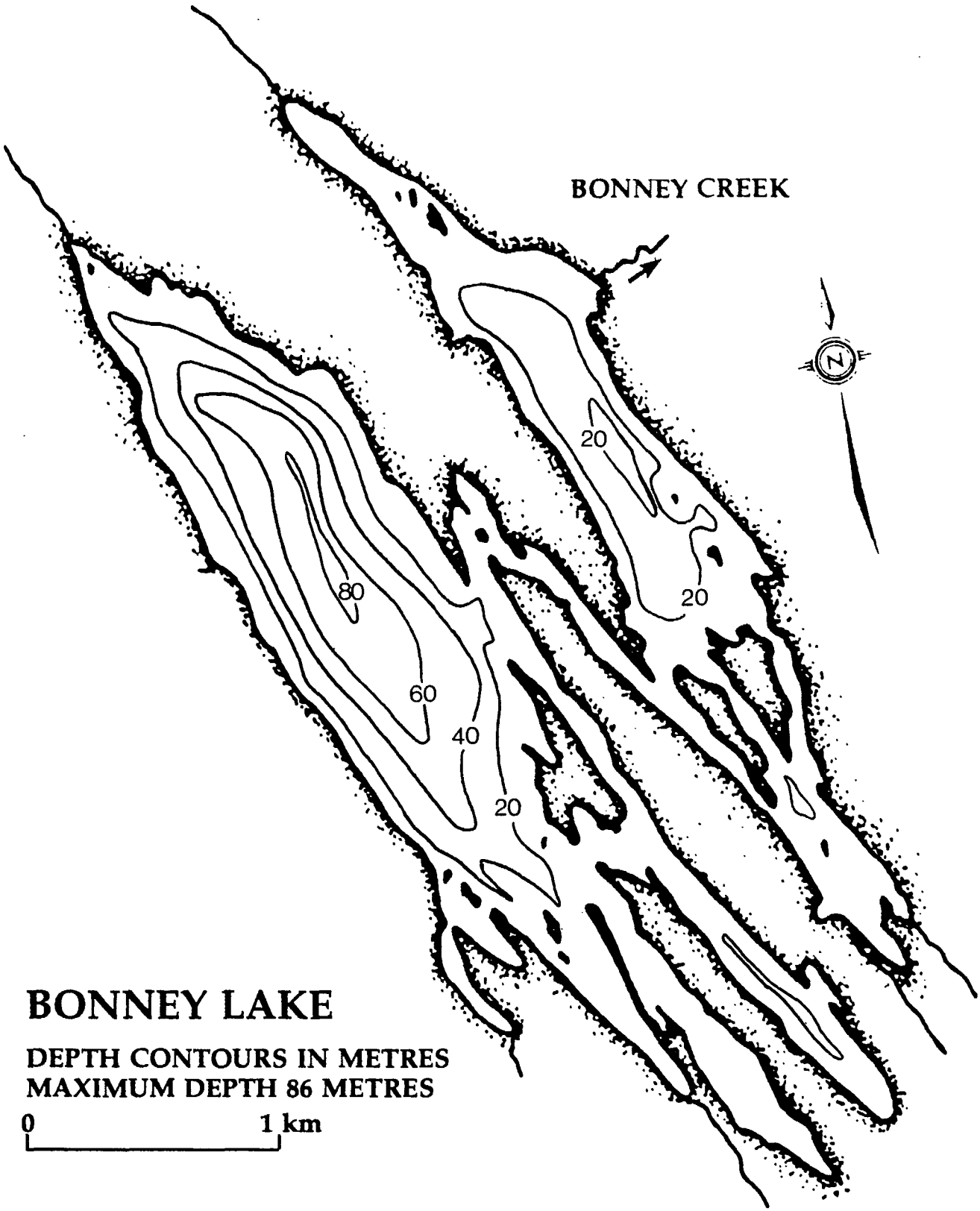
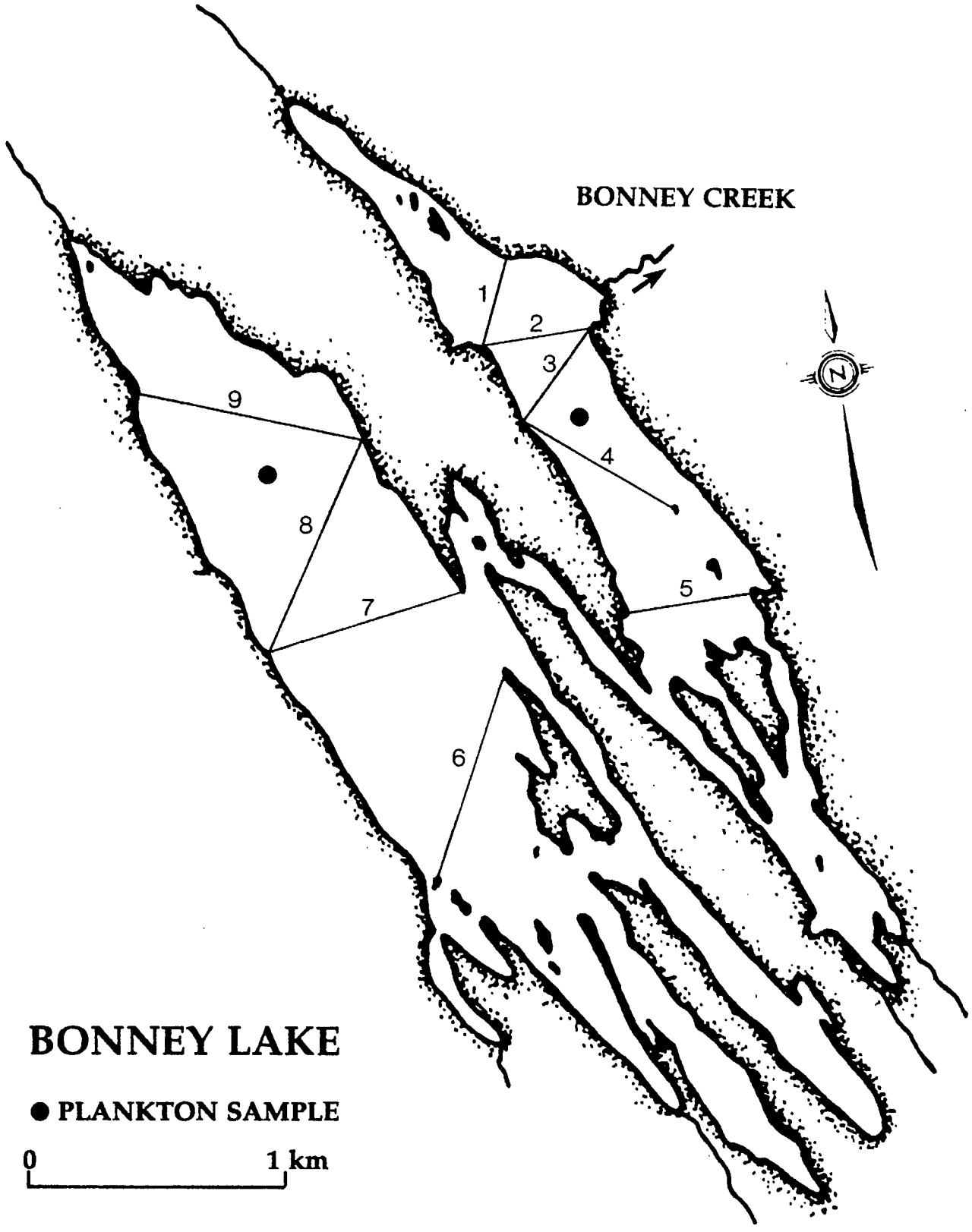
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE
CONTOUR LINES IN METRES
0
10 km
N

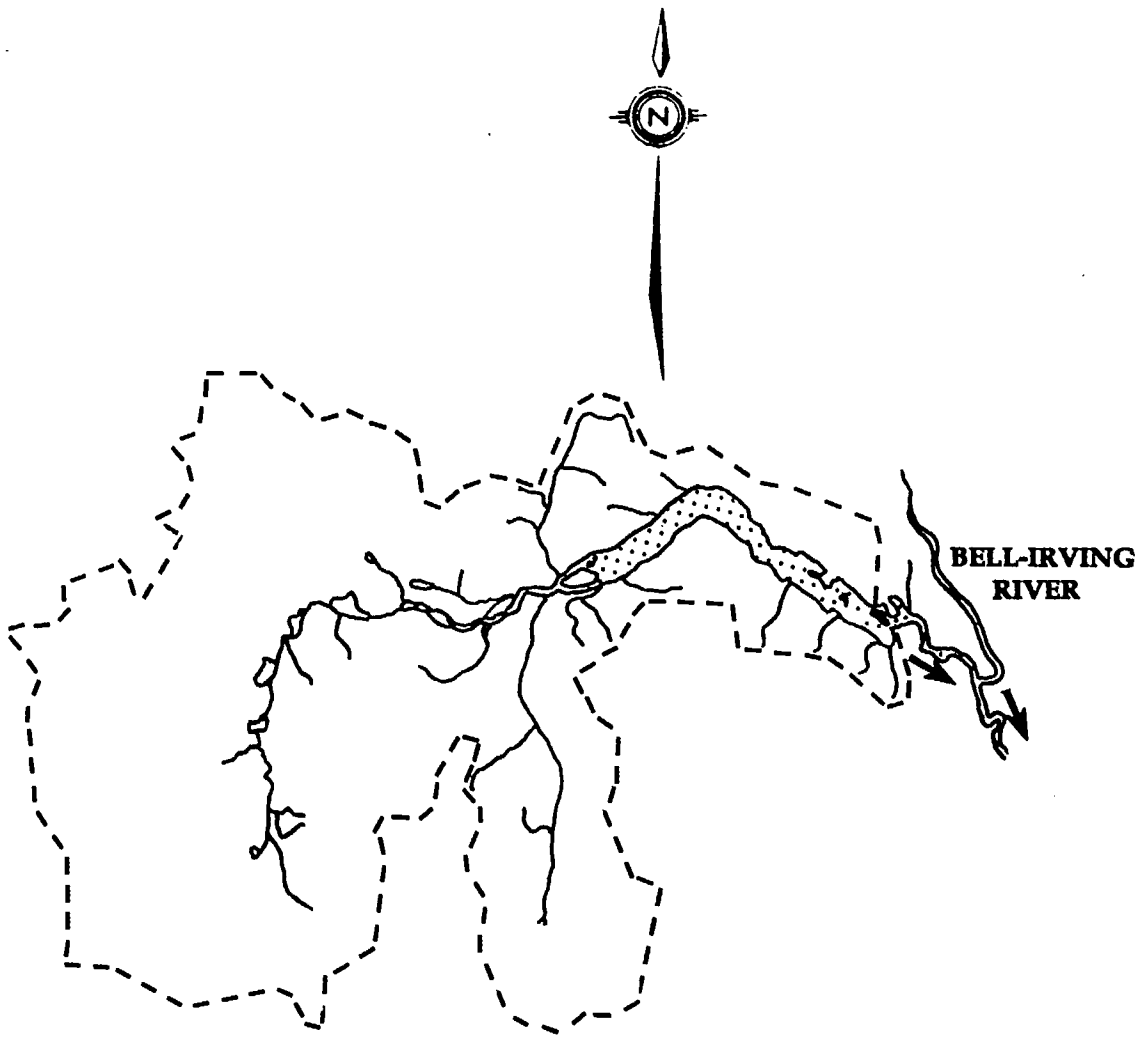


BONNEY LAKE

DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 86 METRES

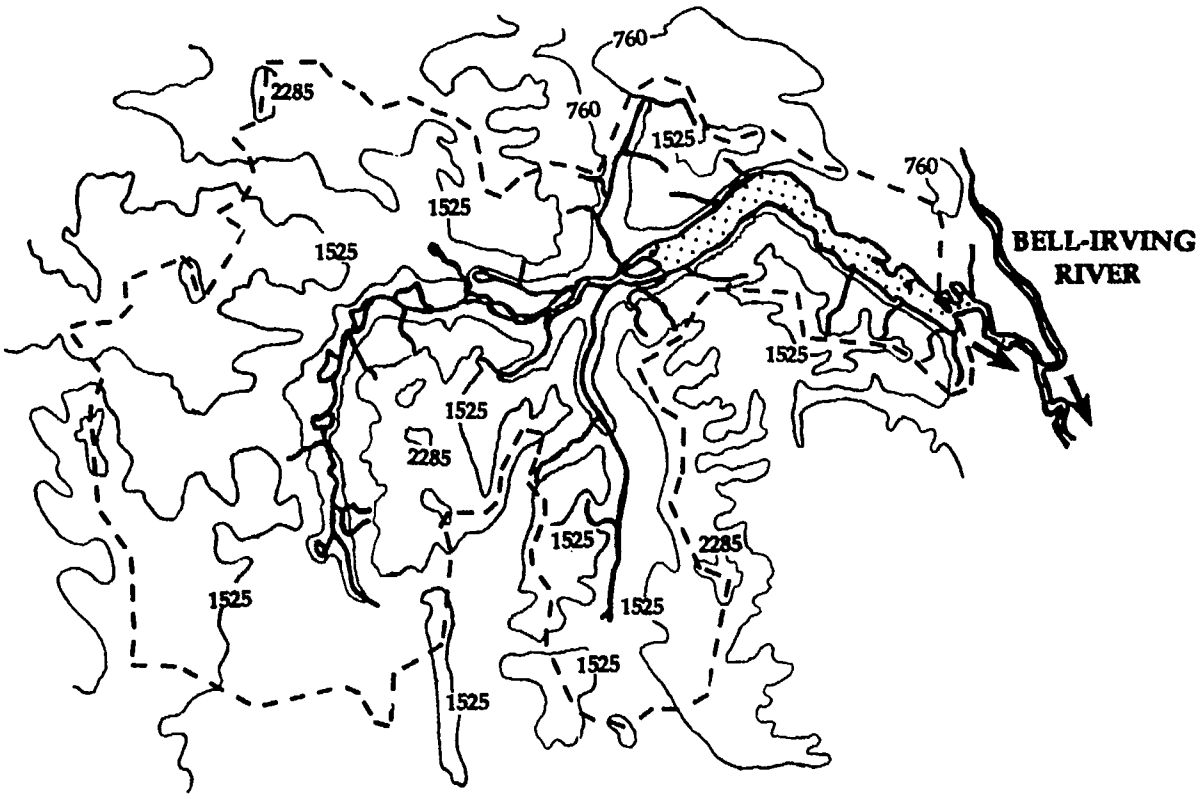
0 1 km


BONNEY CREEK
1
2
3
4
5
6
7
8
9
N
BONNEY LAKE
● PLANKTON SAMPLE
0
1 km



BOWSER LAKE

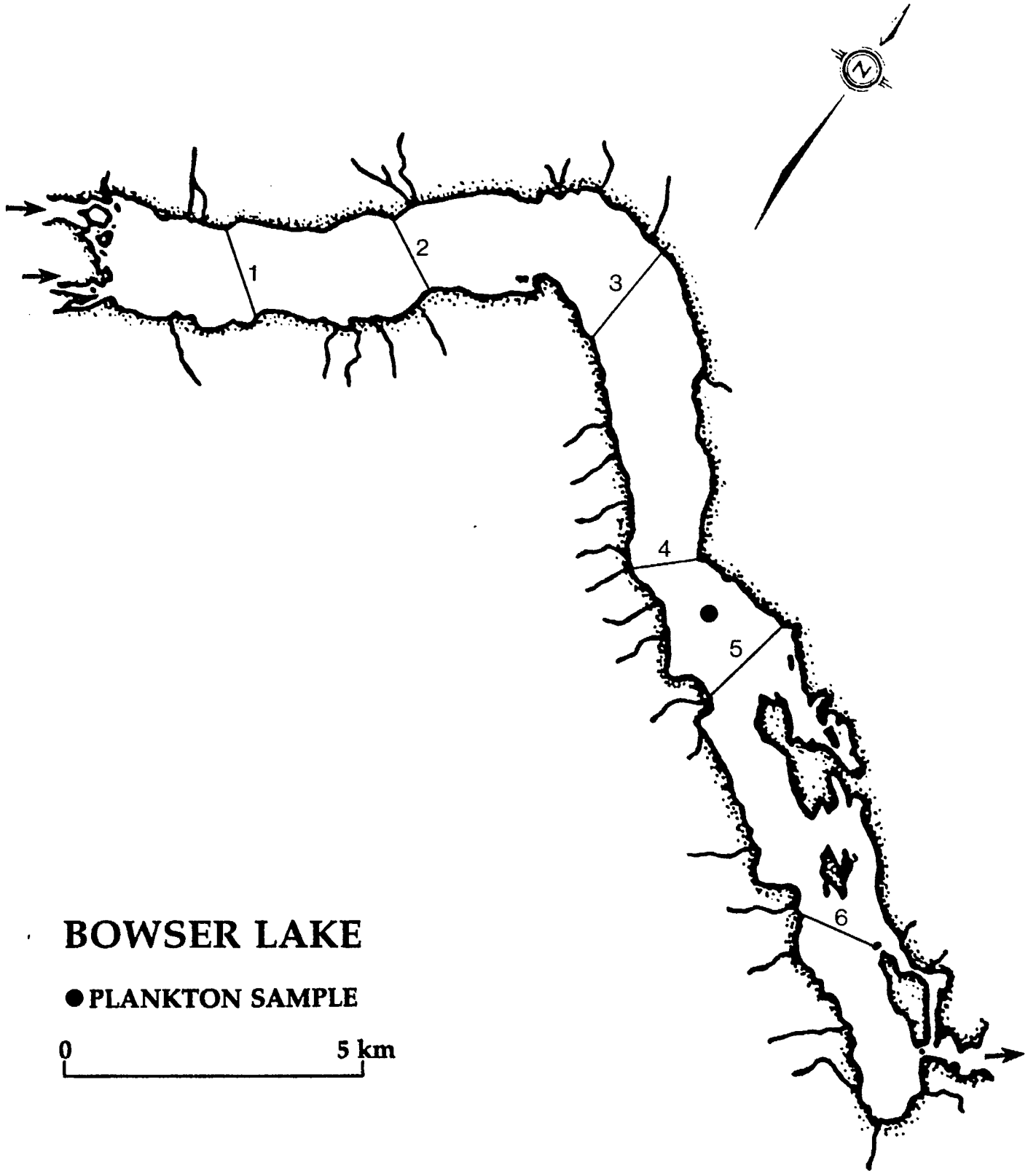
0 30 km

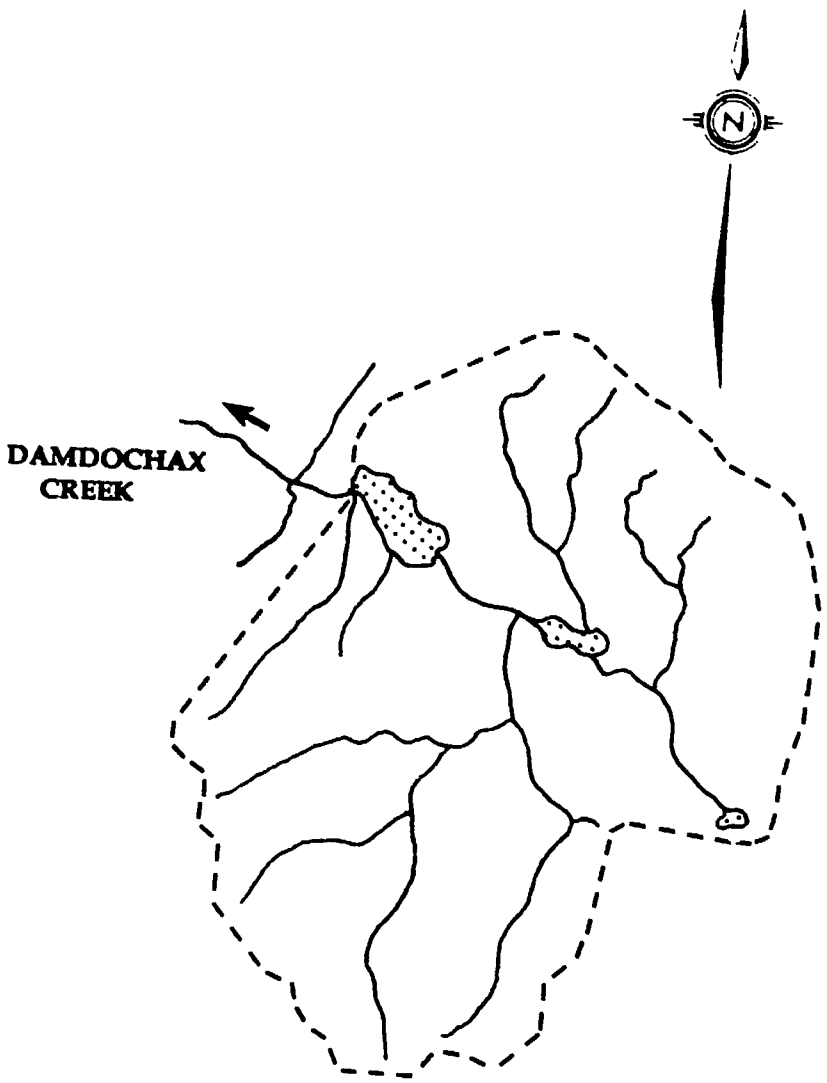


BOWSER LAKE

CONTOUR LINES IN METRES

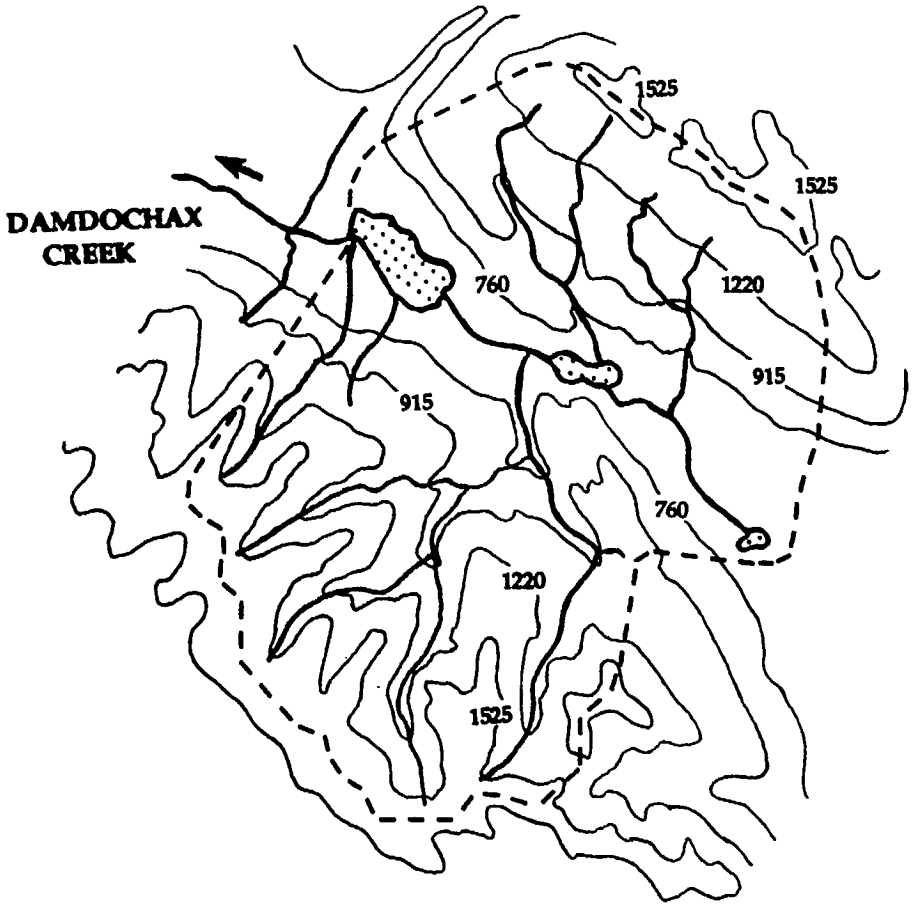
0 ——— **30 km**


N
1
2
3
4
5
6
BOWSER LAKE
● PLANKTON SAMPLE
0
5 km



DAMDOCHAX LAKE

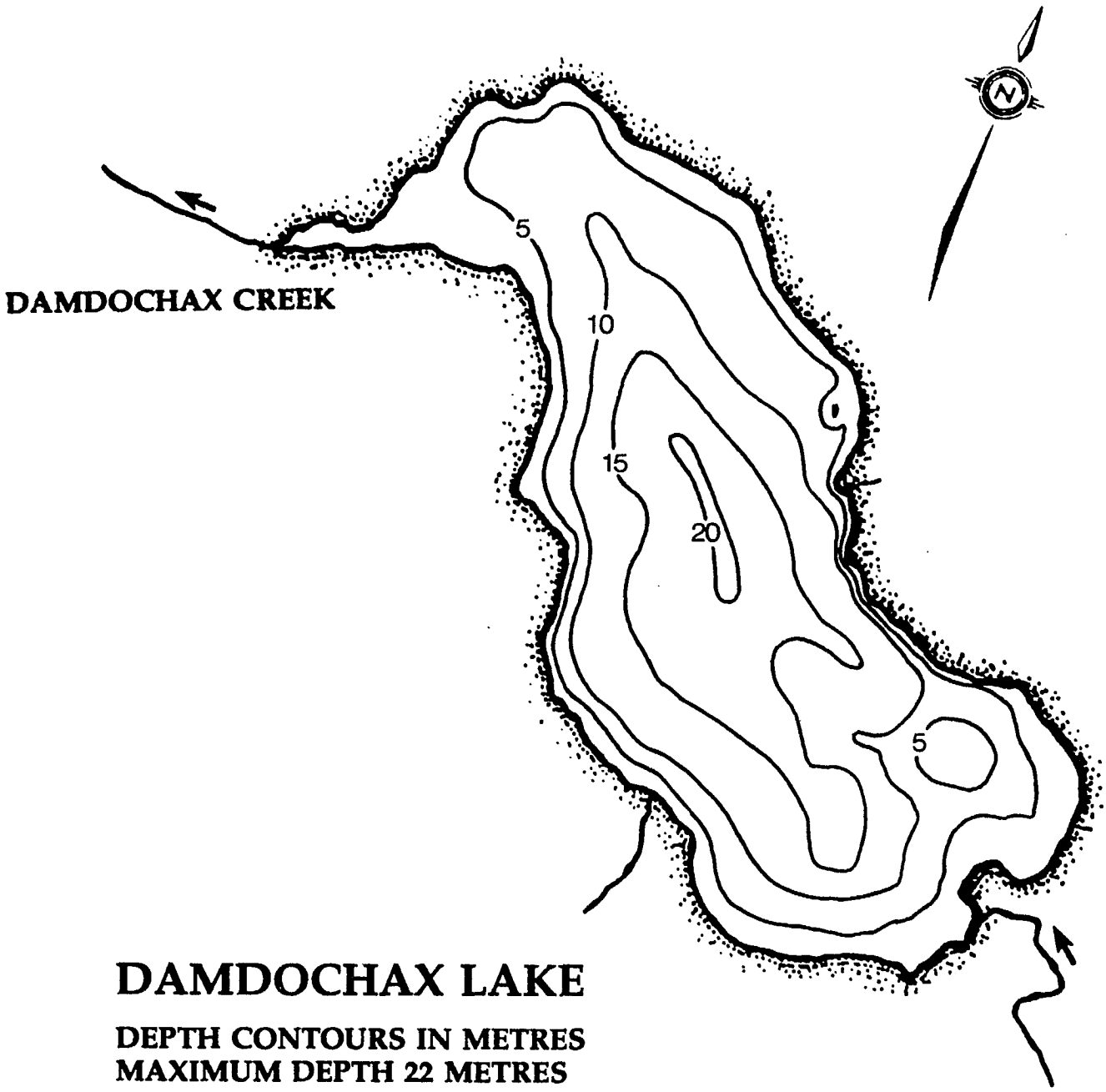
0 **10 km**



DAMDOCHAX LAKE

CONTOUR LINES IN METRES

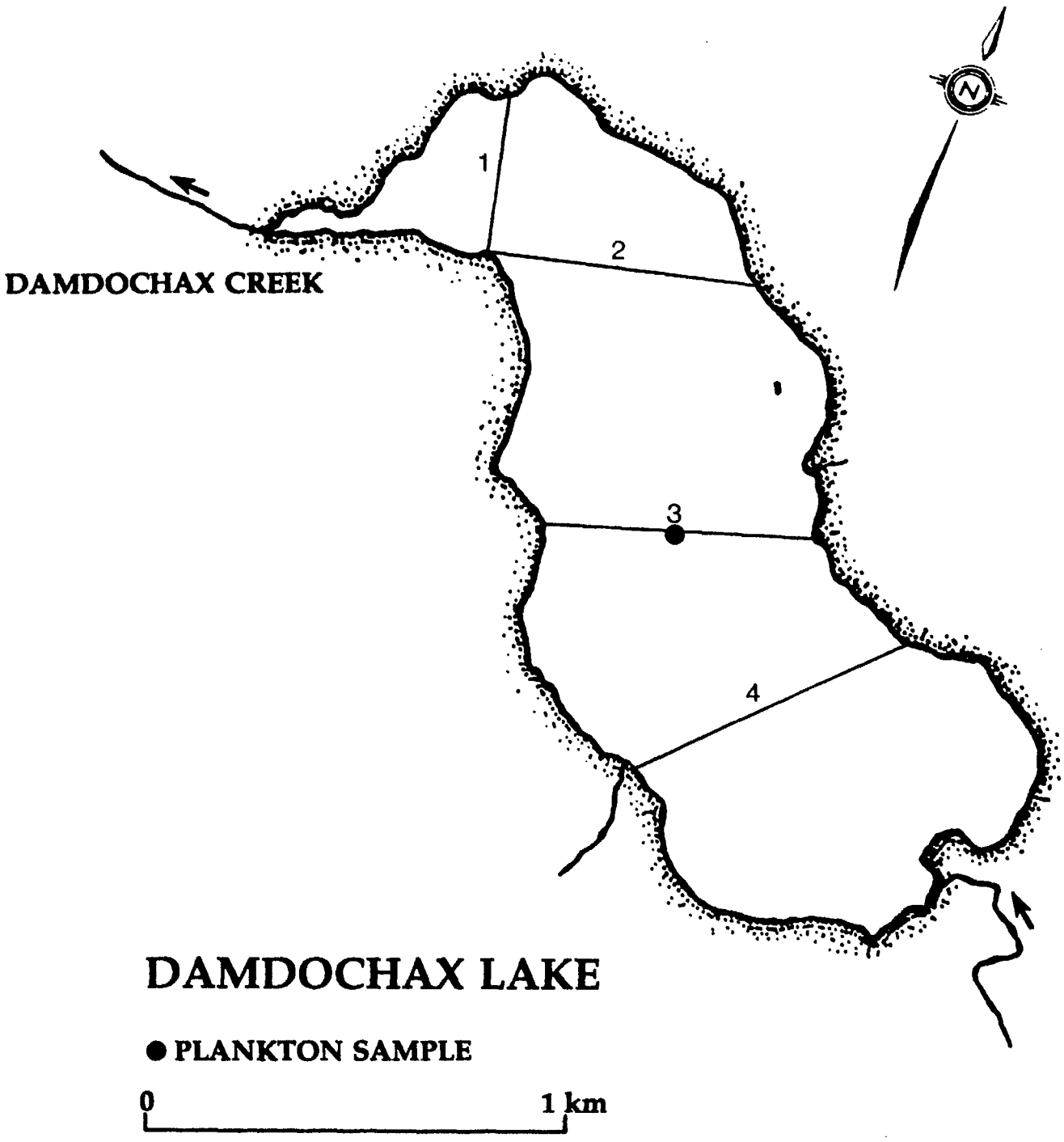
0 **10 km**

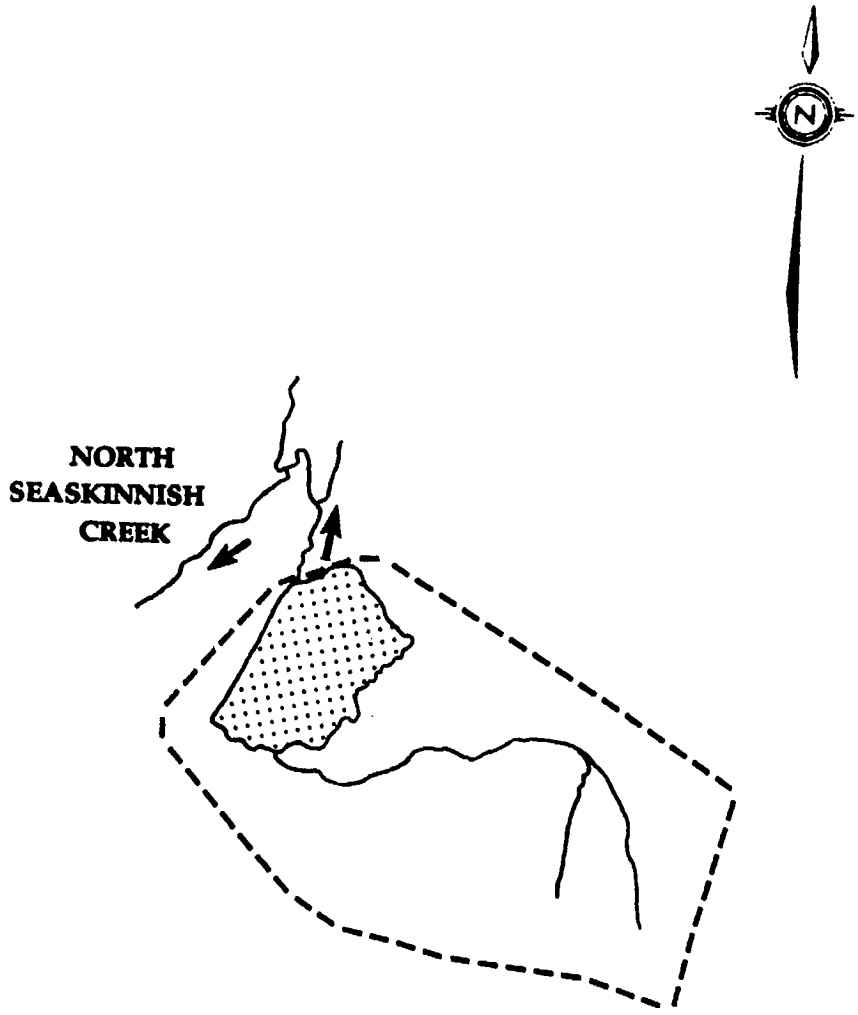


DAMDOCHAX LAKE

DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 22 METRES

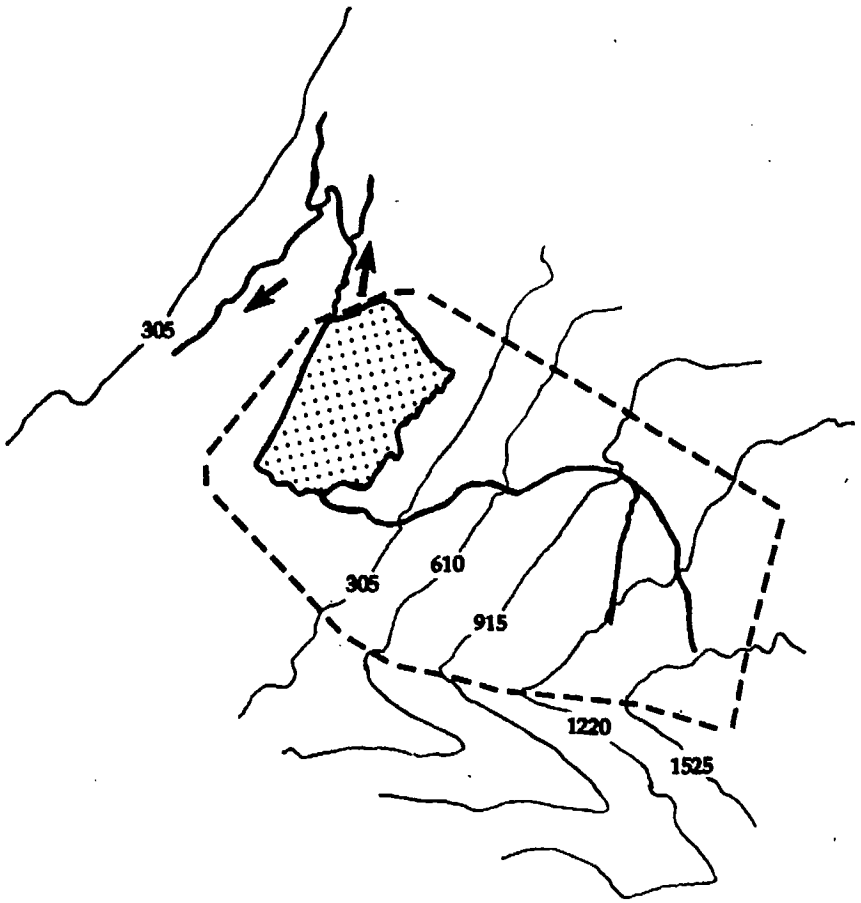
0 1 km


1
2
3
4
DAMDOCHAX CREEK
DAMDOCHAX LAKE
● PLANKTON SAMPLE
0
1 km



DRAGON LAKE

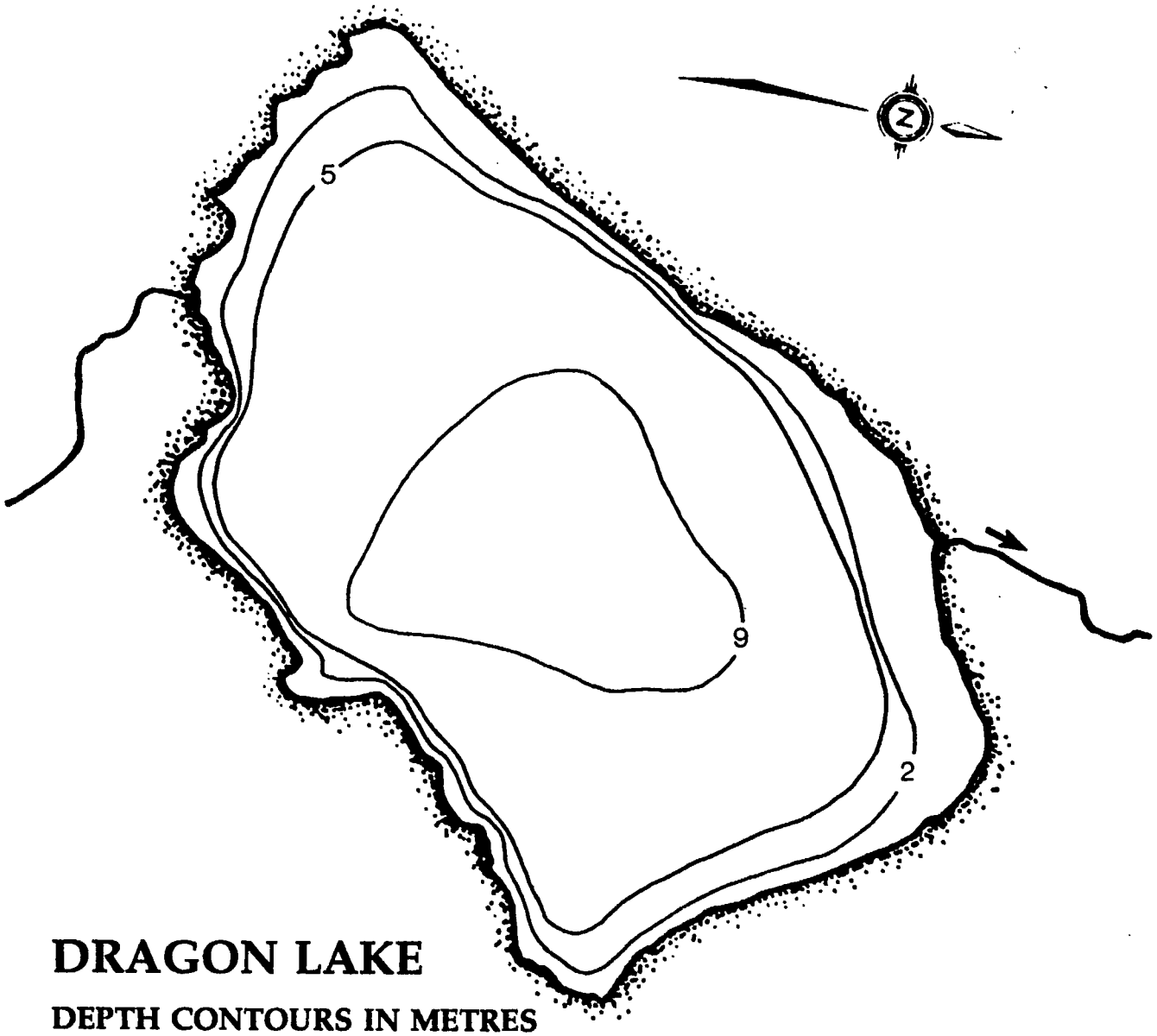
0 **5 km**



DRAGON LAKE

CONTOUR LINES IN METRES

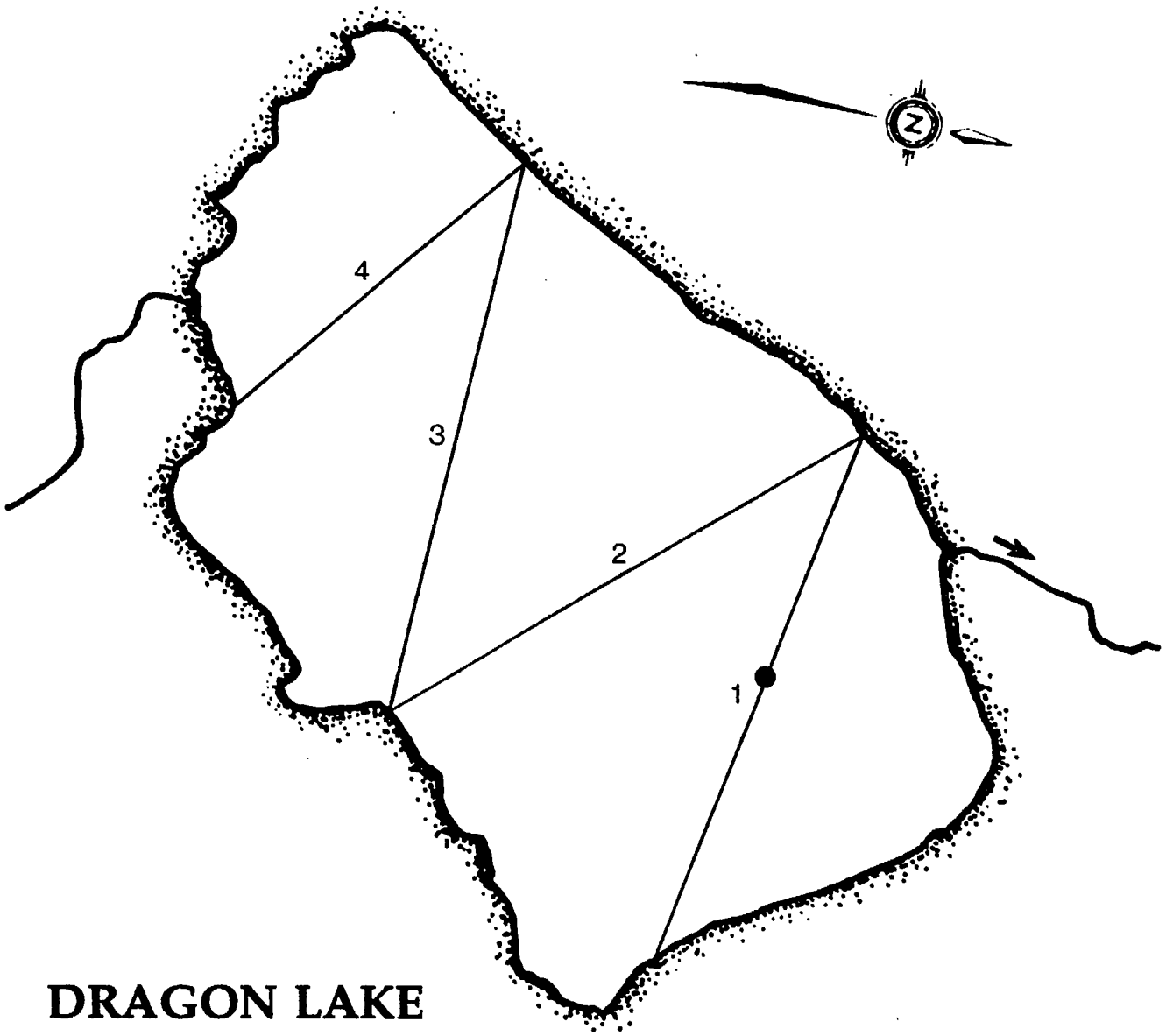
0 **5 km**



DRAGON LAKE

DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 9.4 METRES

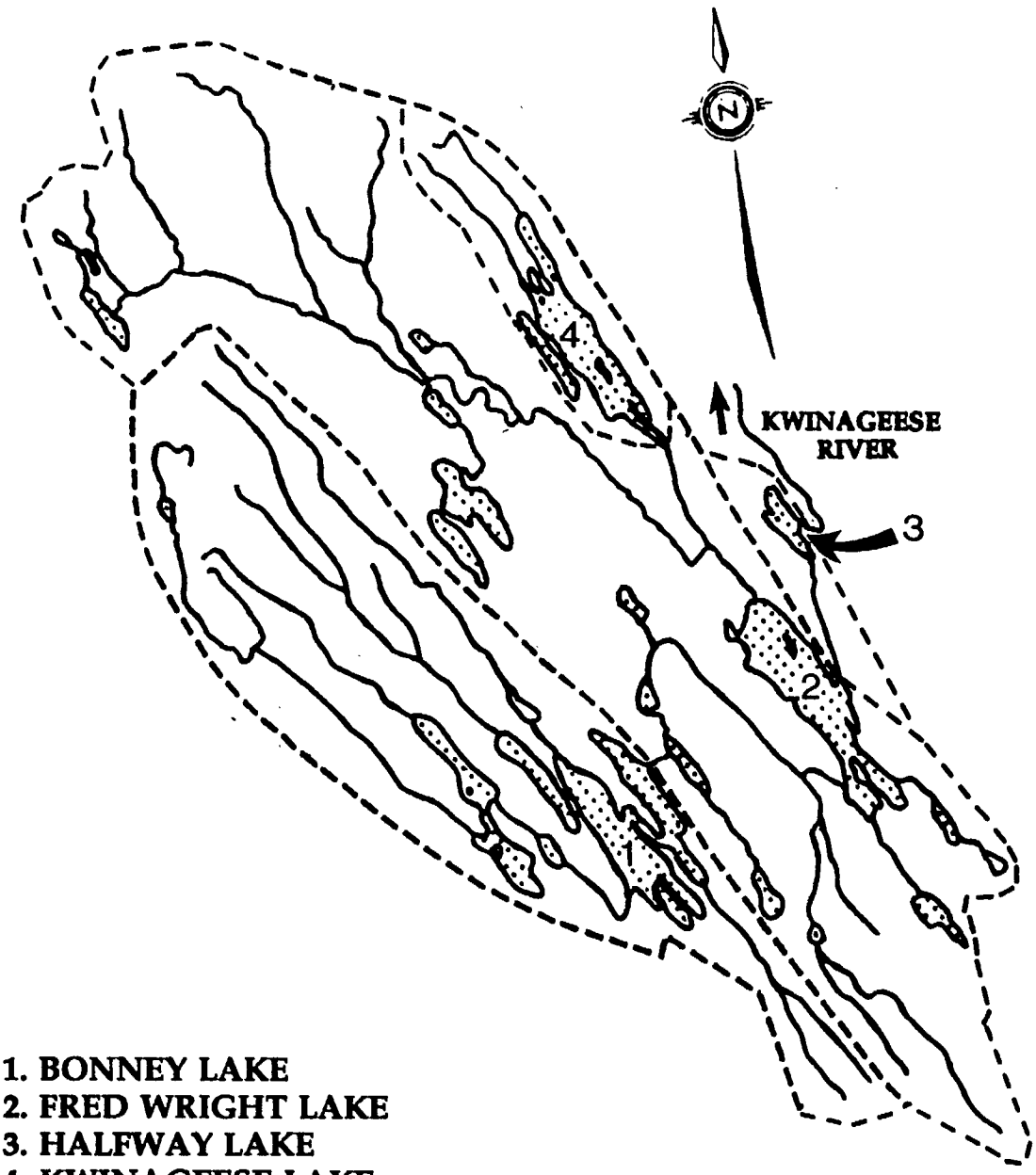
0 1 km



DRAGON LAKE

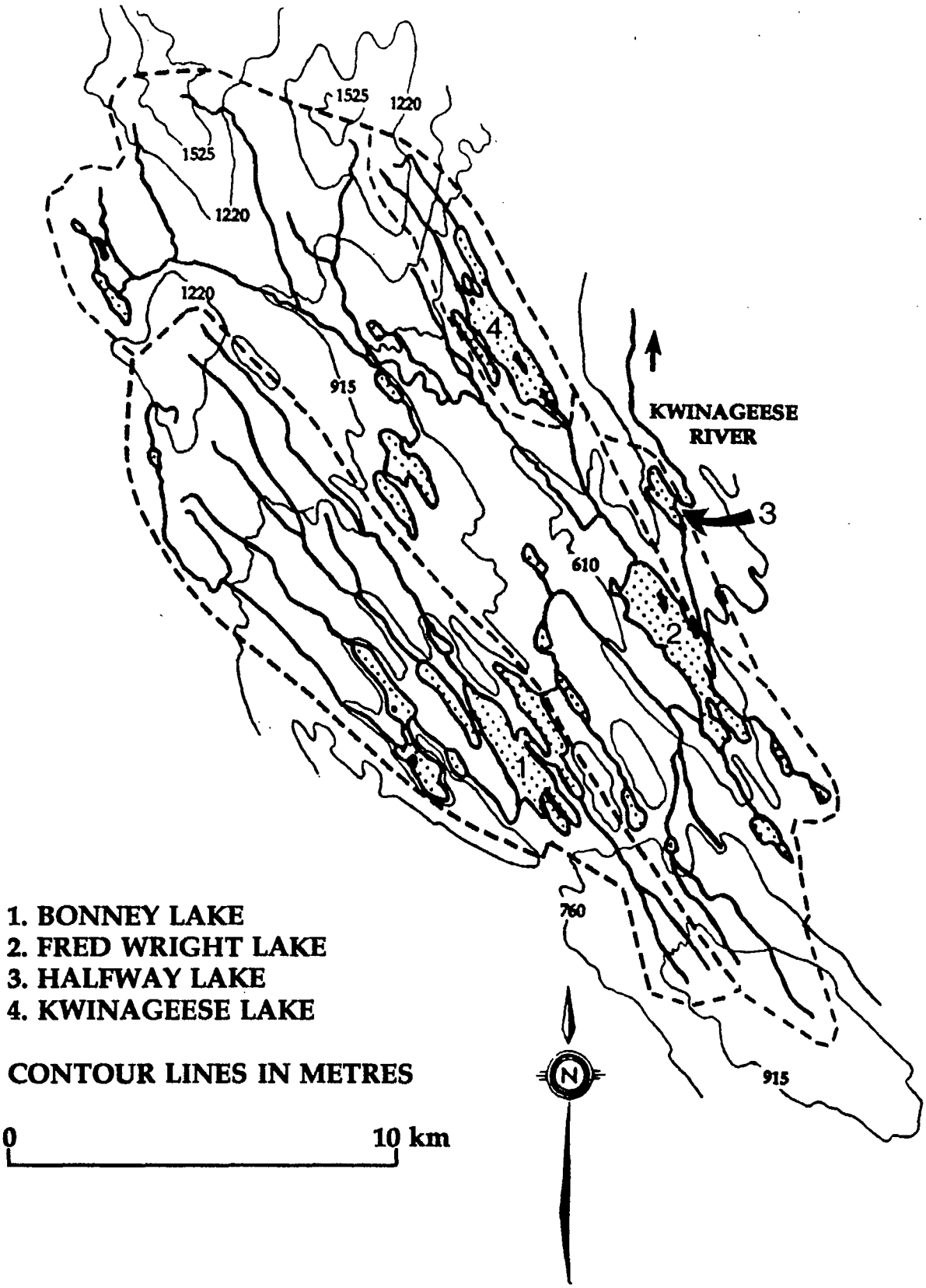
● PLANKTON SAMPLE

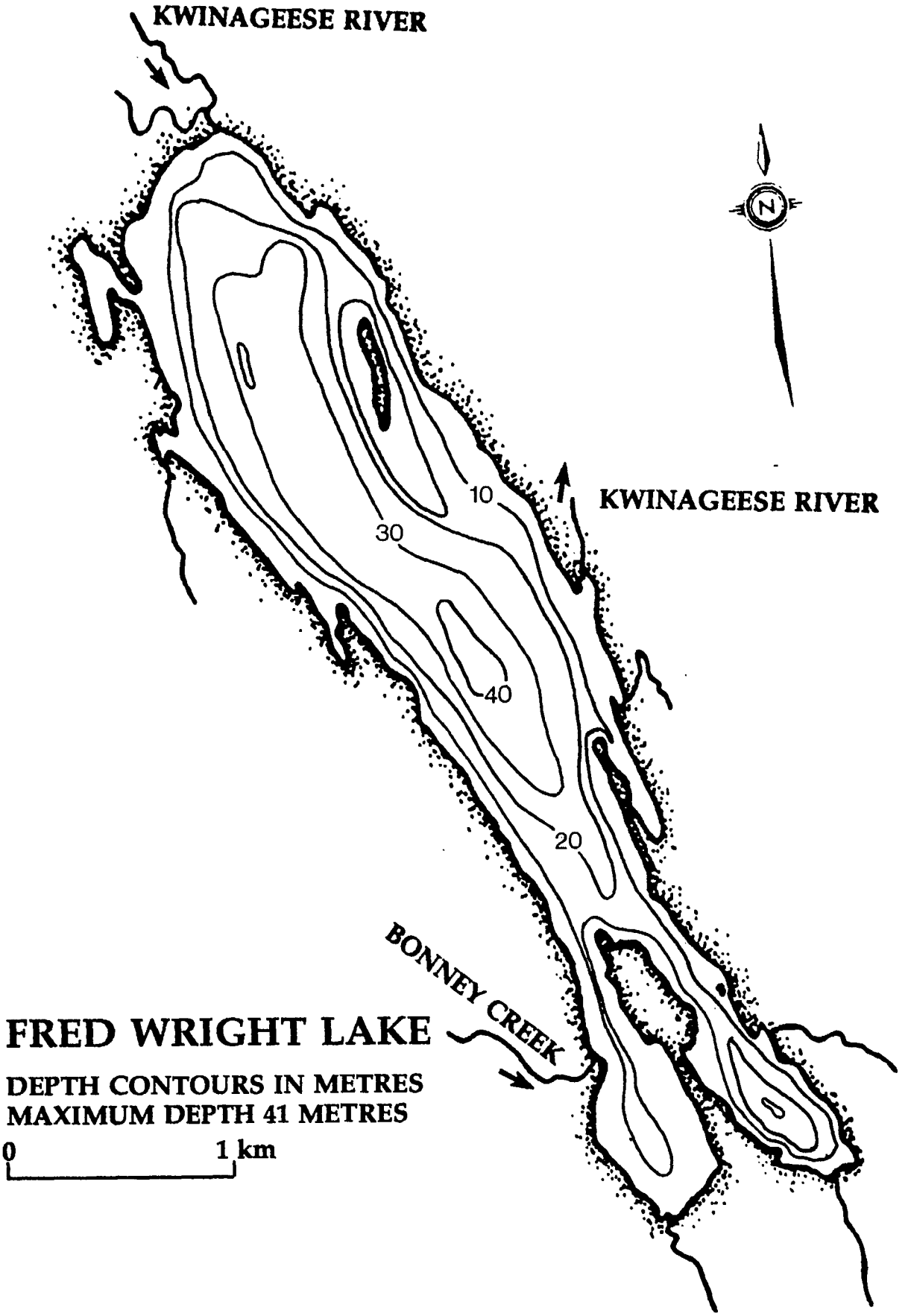
0 1 km

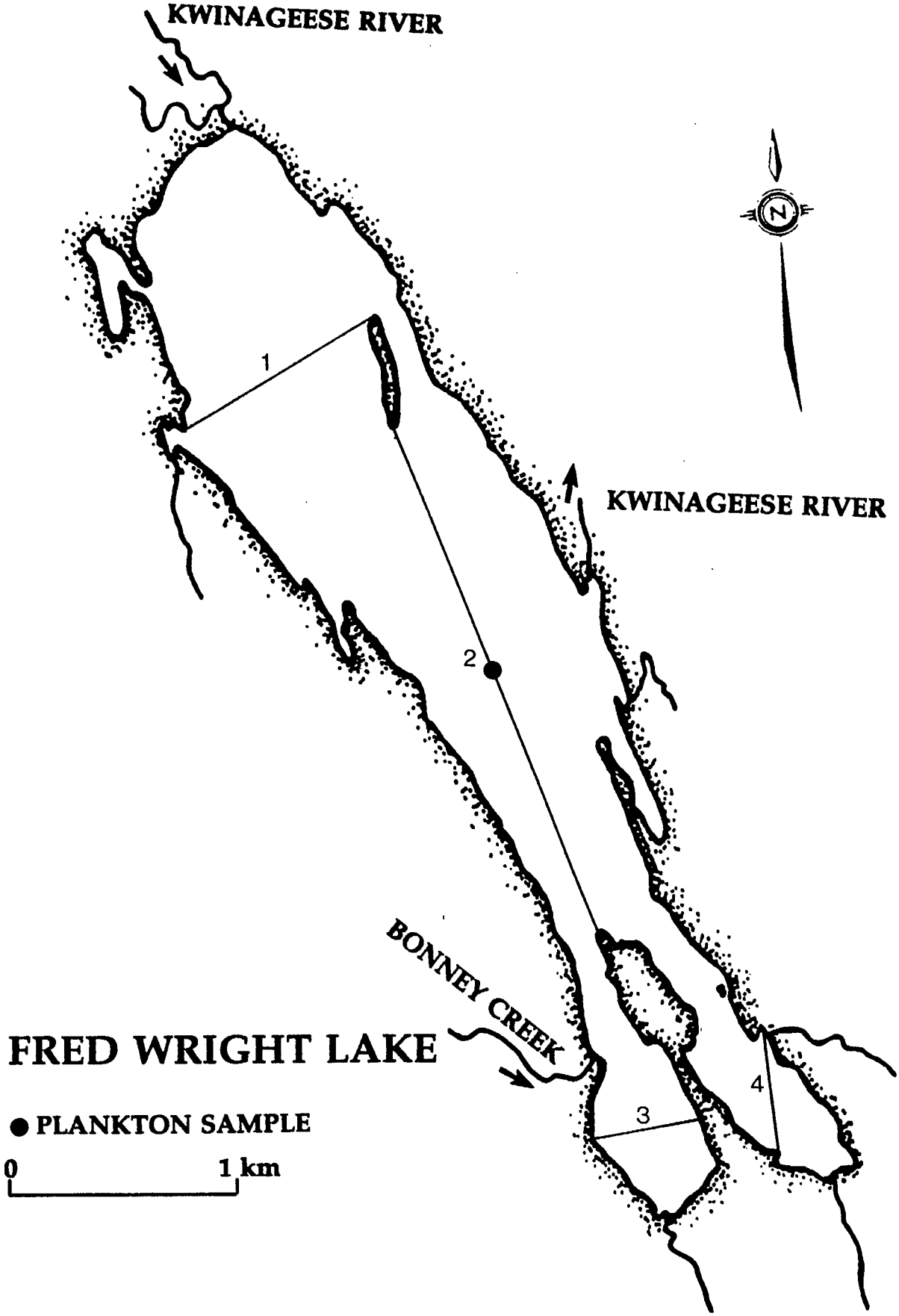


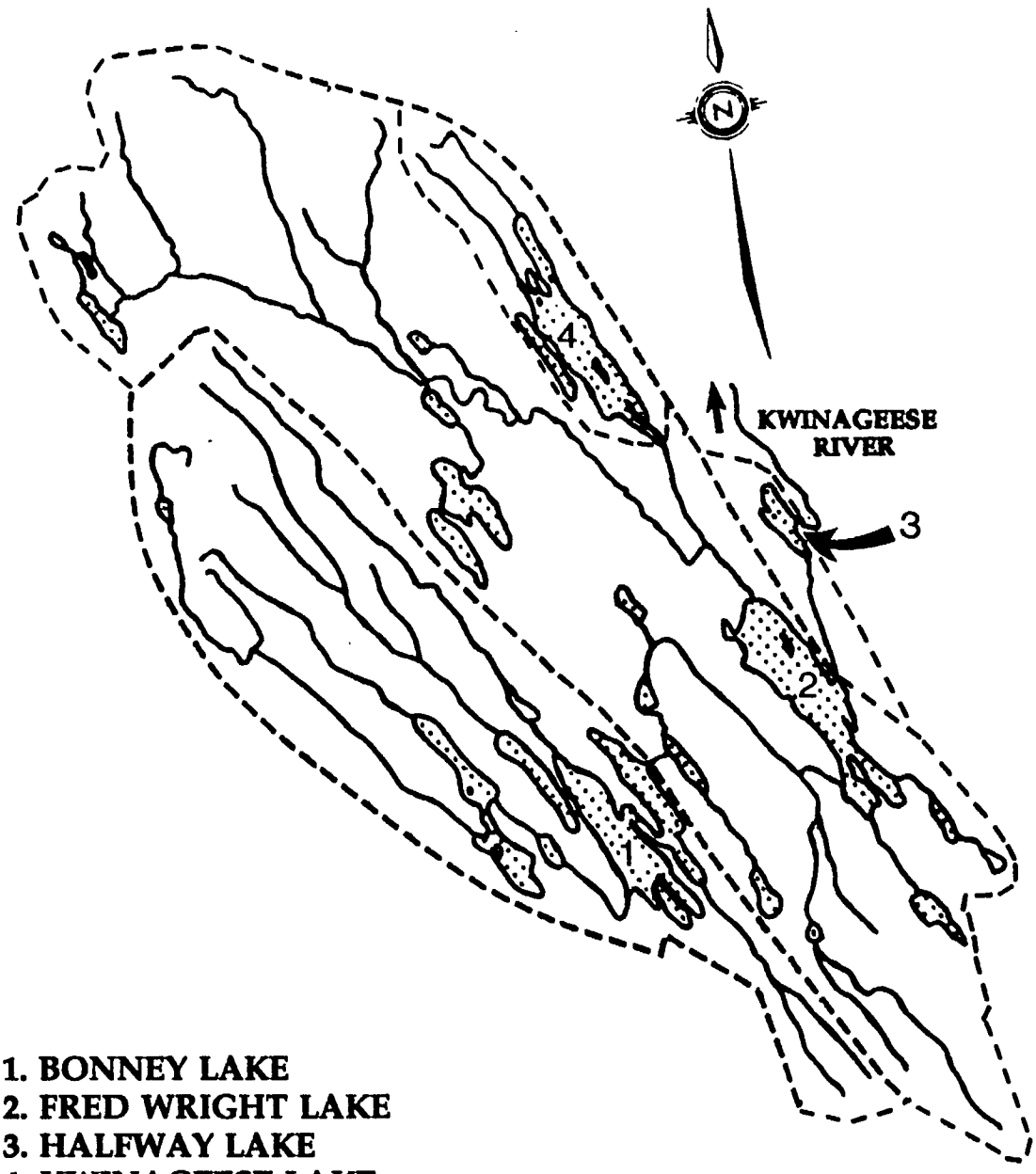
1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE

0 10 km


1525
1220
1525
1220
1220
915
4
KWINAGEESE
RIVER
3
610
2
1
760
915
1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE
CONTOUR LINES IN METRES
0
10 km
N

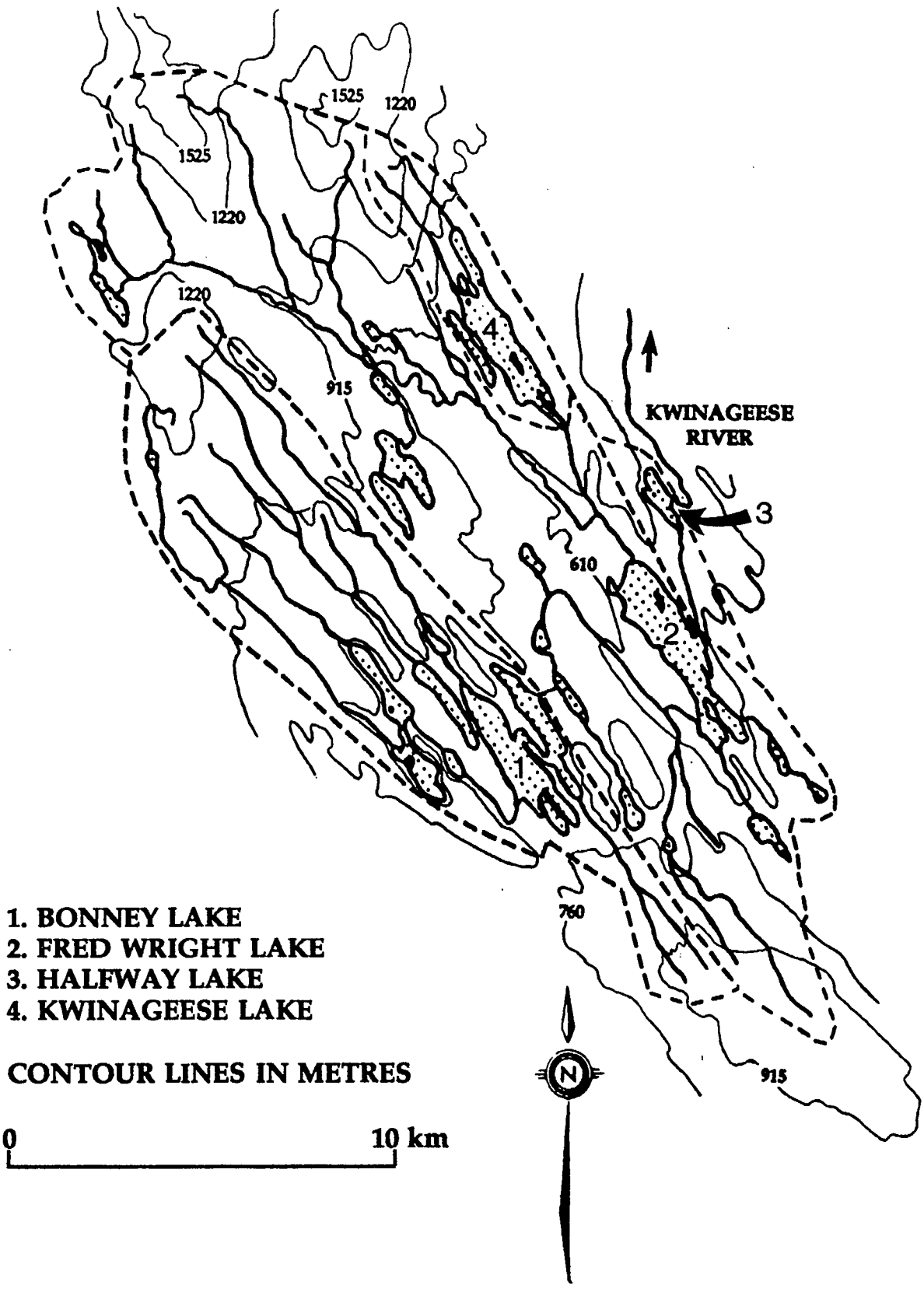

KWINAGEESE RIVER
10
30
40
20
KWINAGEESE RIVER
BONNEY CREEK
FRED WRIGHT LAKE
DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 41 METRES
0
1 km

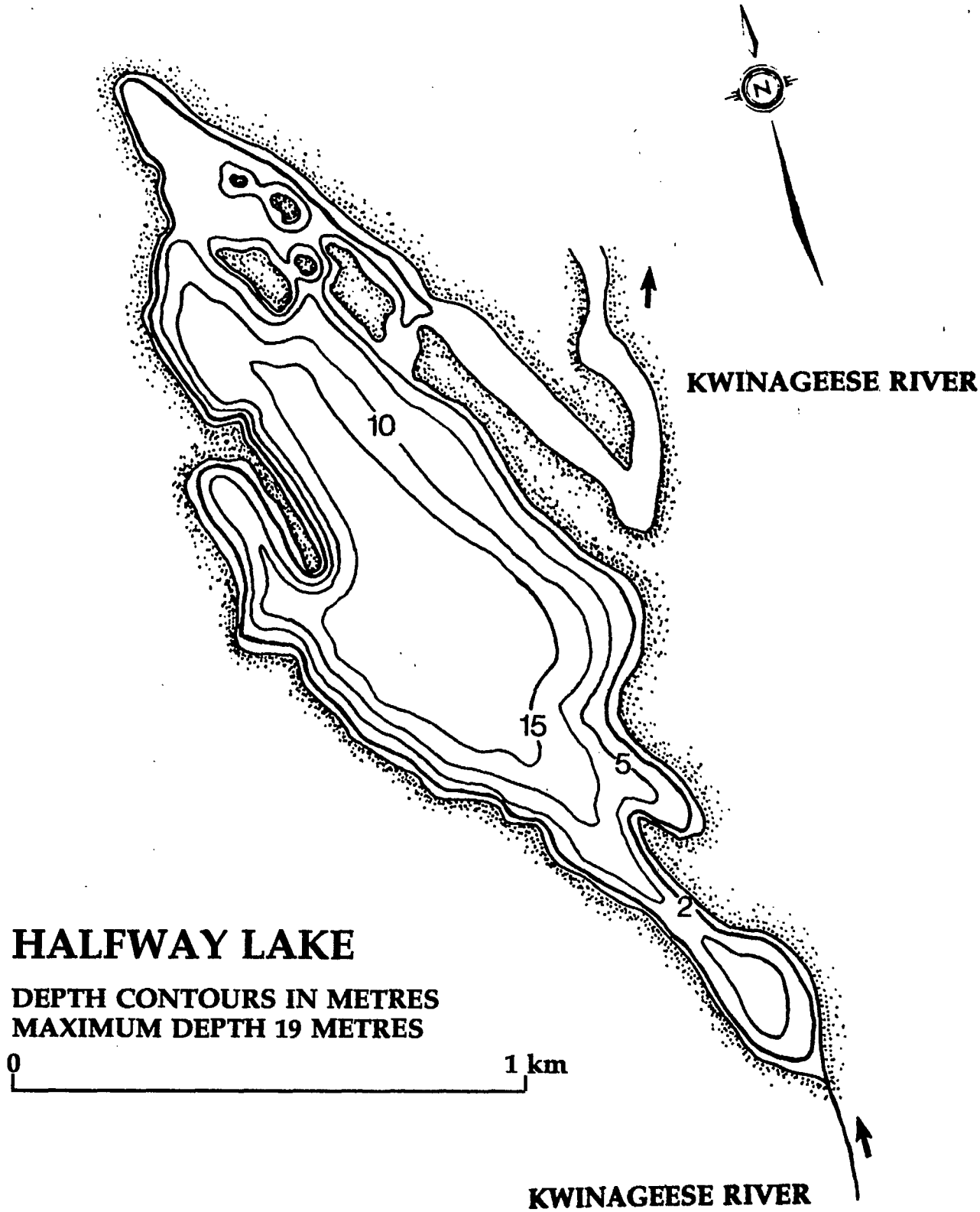

KWINAGEESE RIVER
N
1
KWINAGEESE RIVER
2
BONNEY CREEK
FRED WRIGHT LAKE
3
4
● PLANKTON SAMPLE
0
1 km

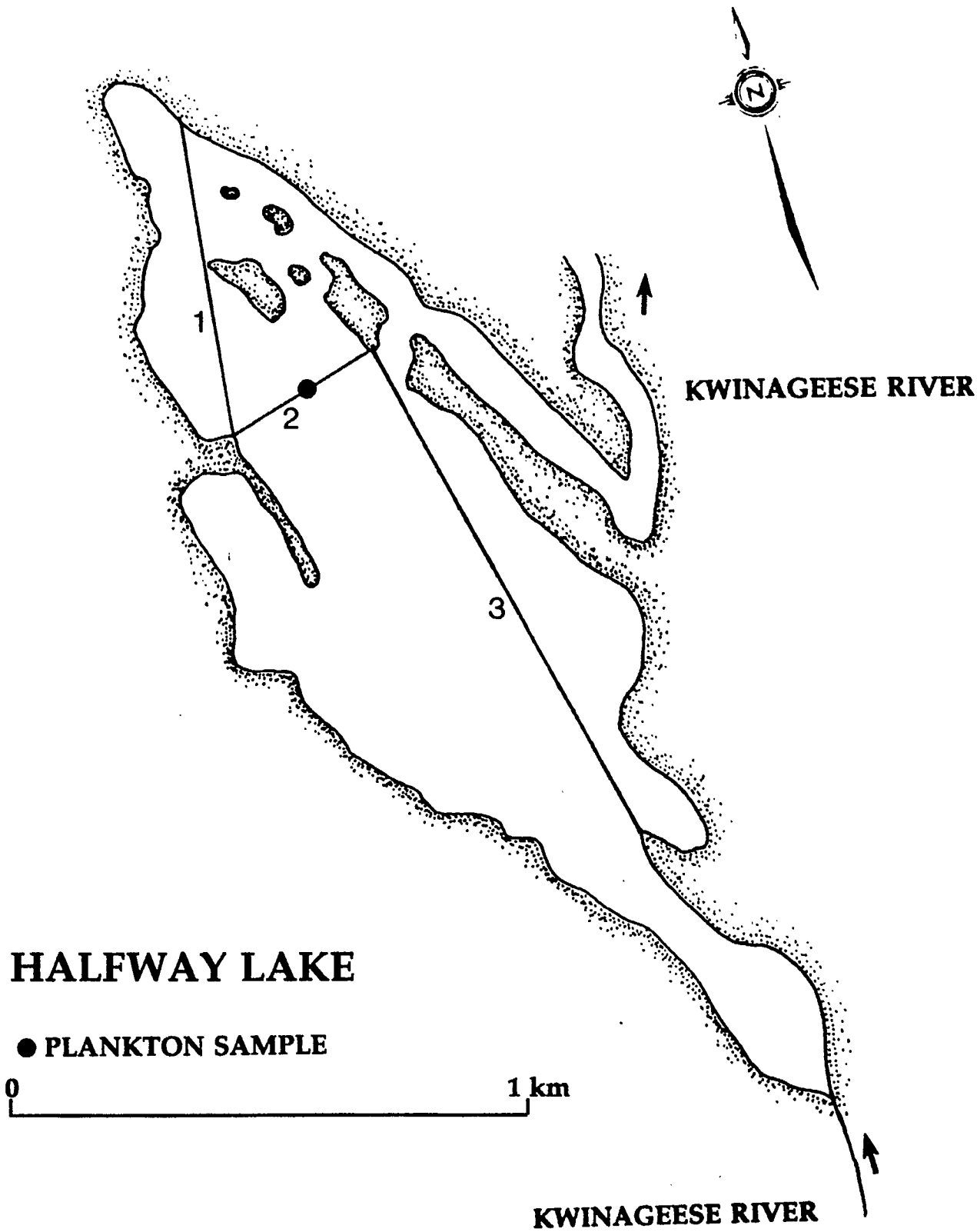


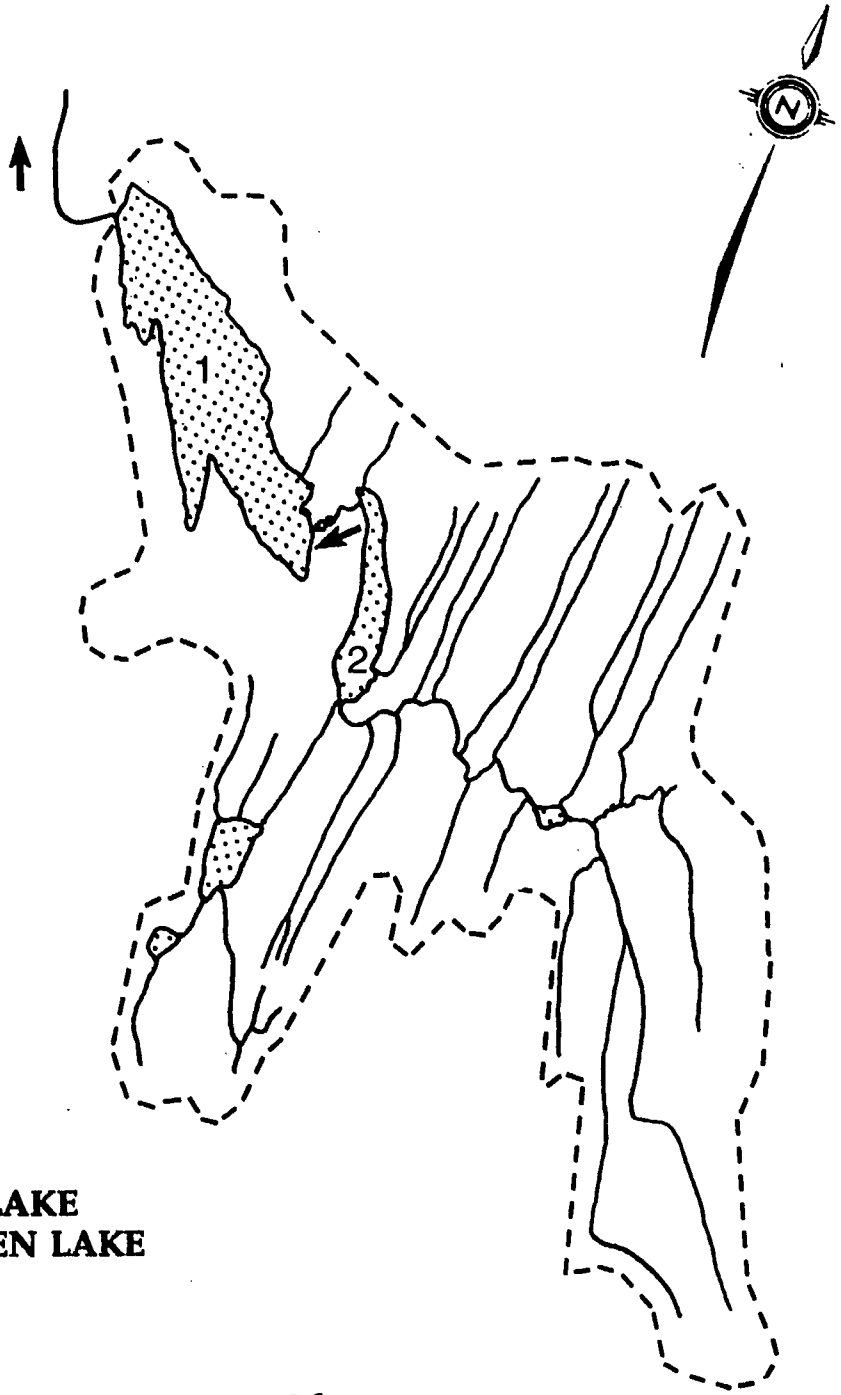
1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE

0 10 km

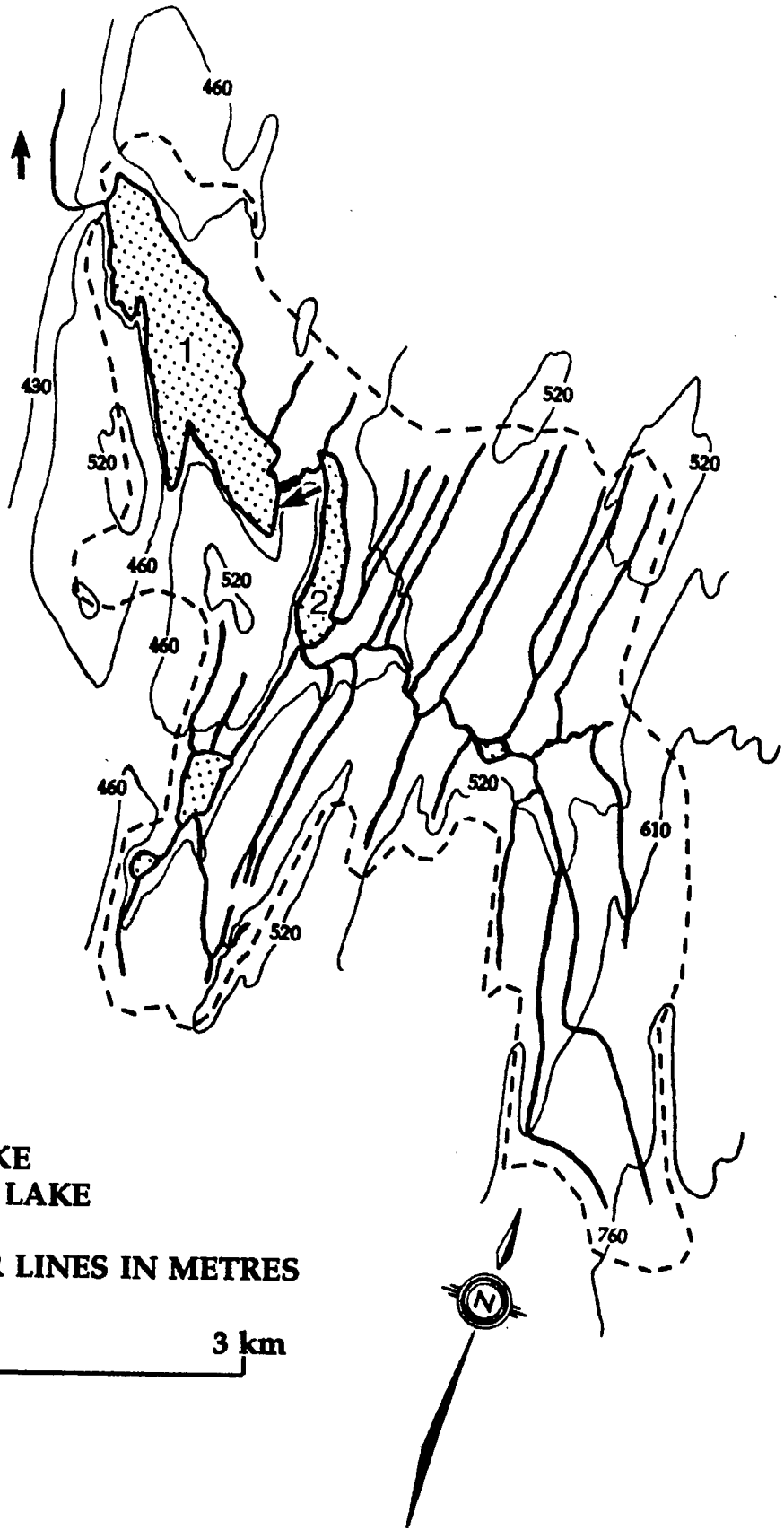

1525
1220
1525
1220
1220
915
4
KWINAGEESE
RIVER
3
610
2
1
760
915
1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE
CONTOUR LINES IN METRES
0
10 km
N


N
KWINAGEESE RIVER
10
15
5
2
HALFWAY LAKE
DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 19 METRES
0
1 km
KWINAGEESE RIVER


N
1
2
3
KWINAGEESE RIVER
HALFWAY LAKE
● PLANKTON SAMPLE
0
1 km
KWINAGEESE RIVER



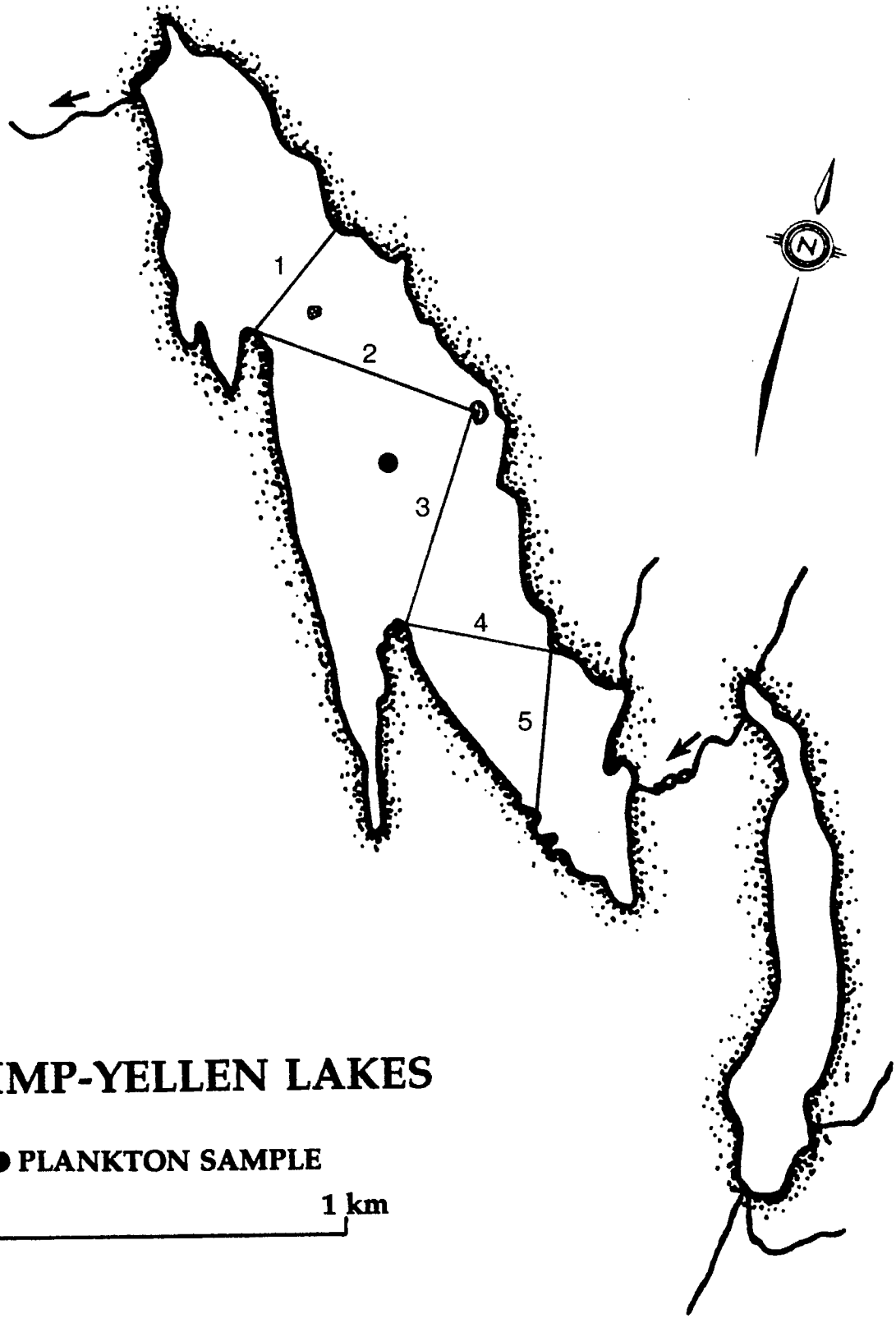
1. IMP LAKE
2. YELLEN LAKE



1. IMP LAKE
2. YELLEN LAKE

CONTOUR LINES IN METRES

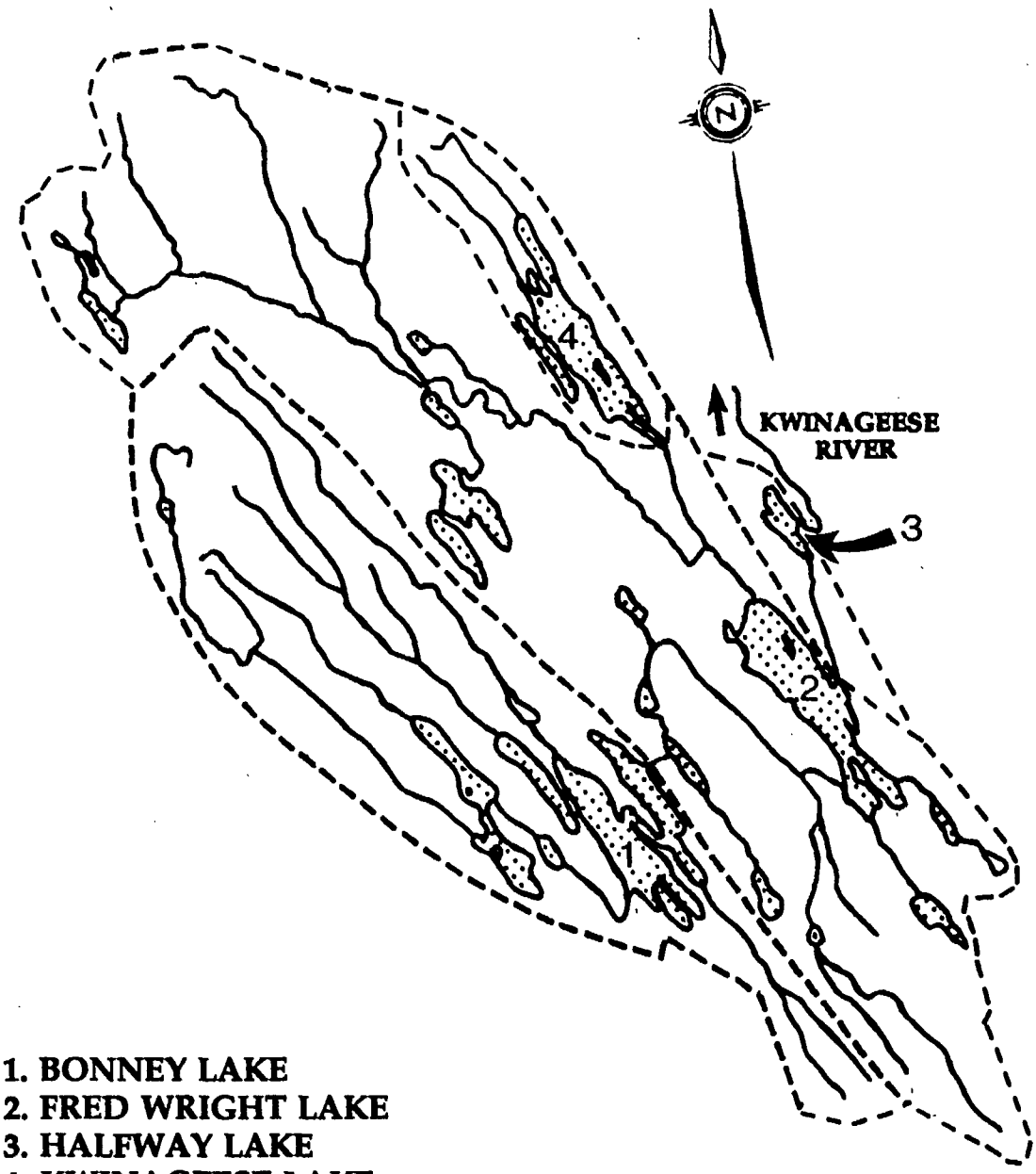
0 ——— **3 km**



IMP-YELLEN LAKES

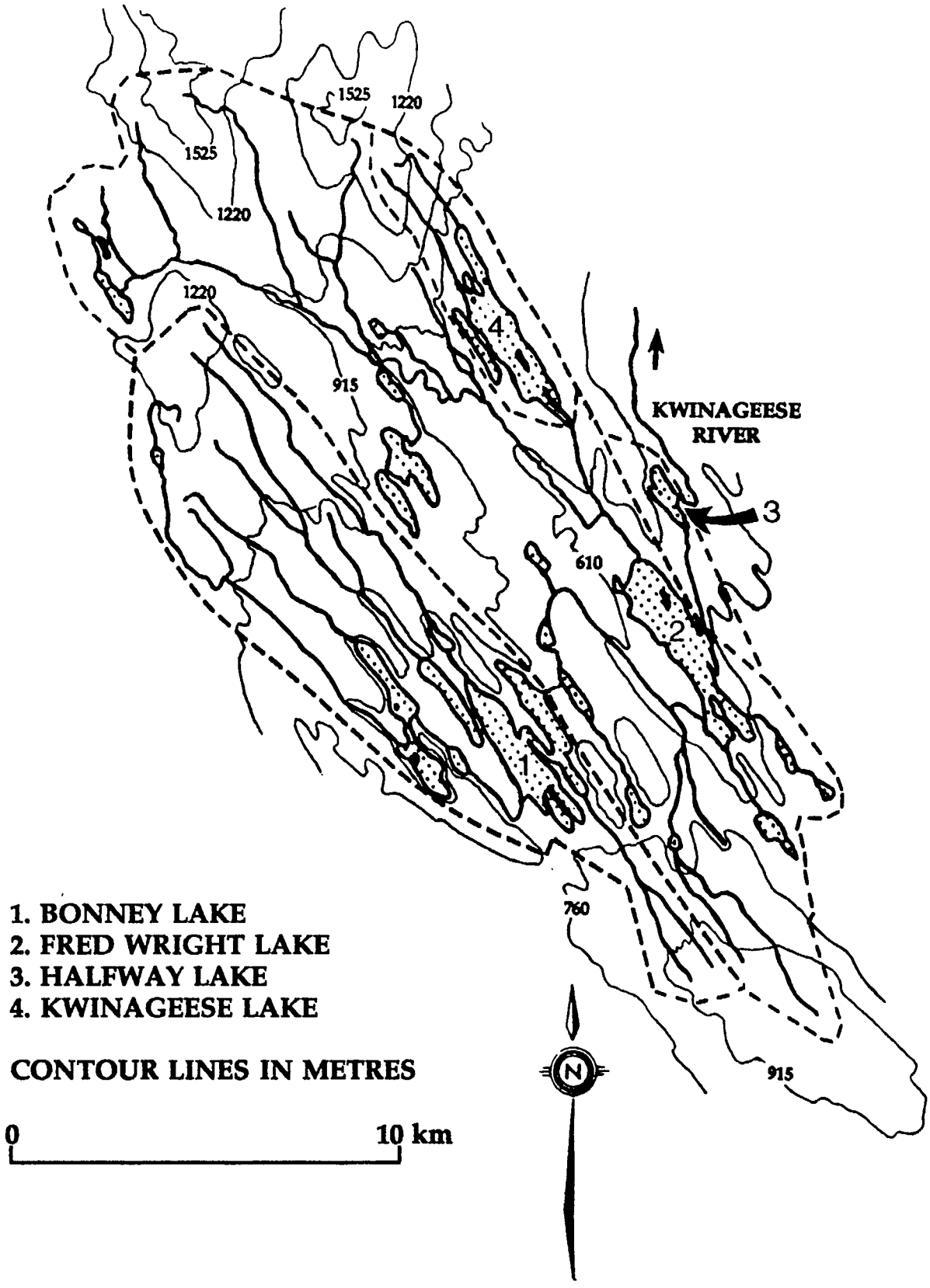
● PLANKTON SAMPLE

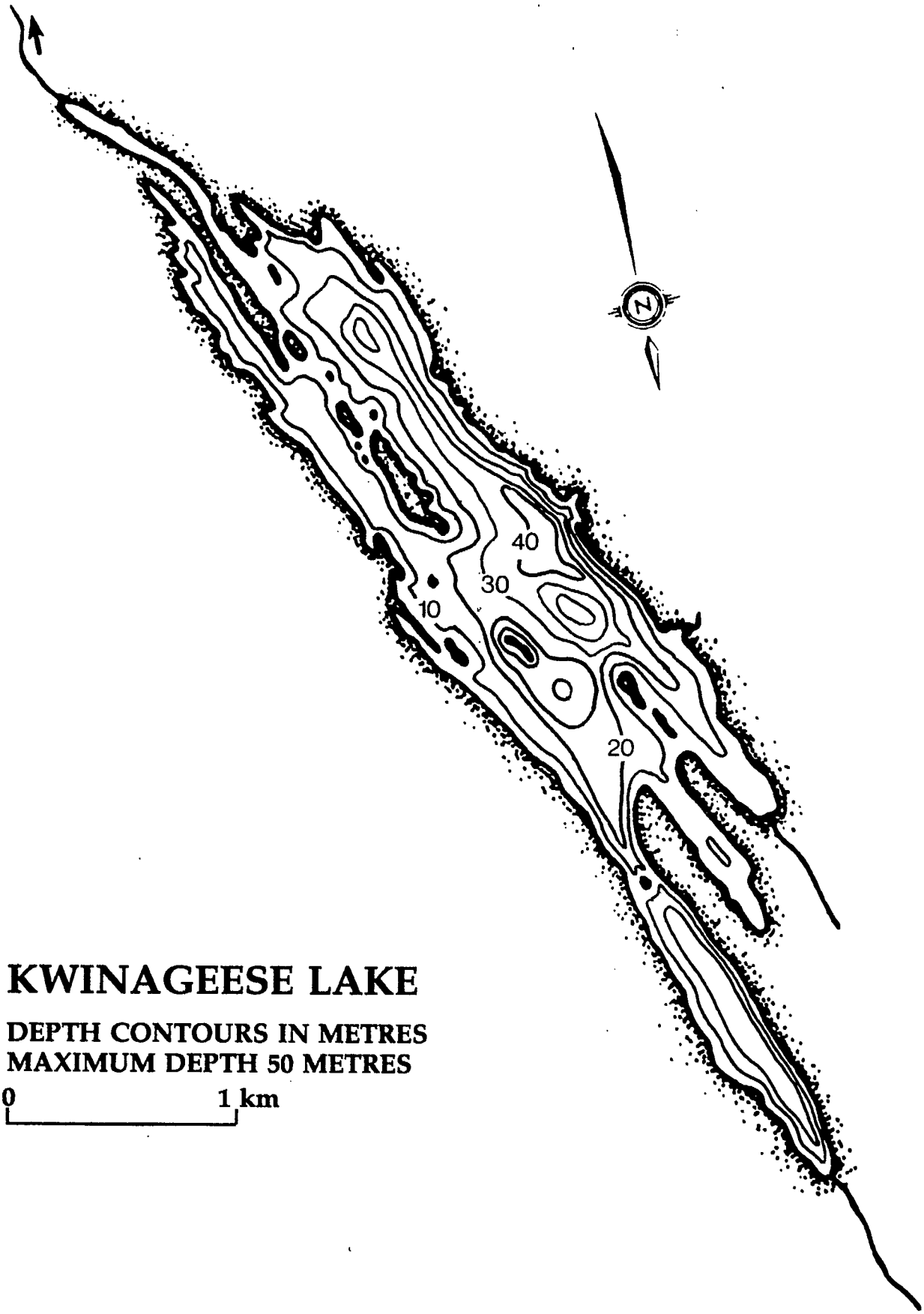
0 1 km



1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE

0 10 km

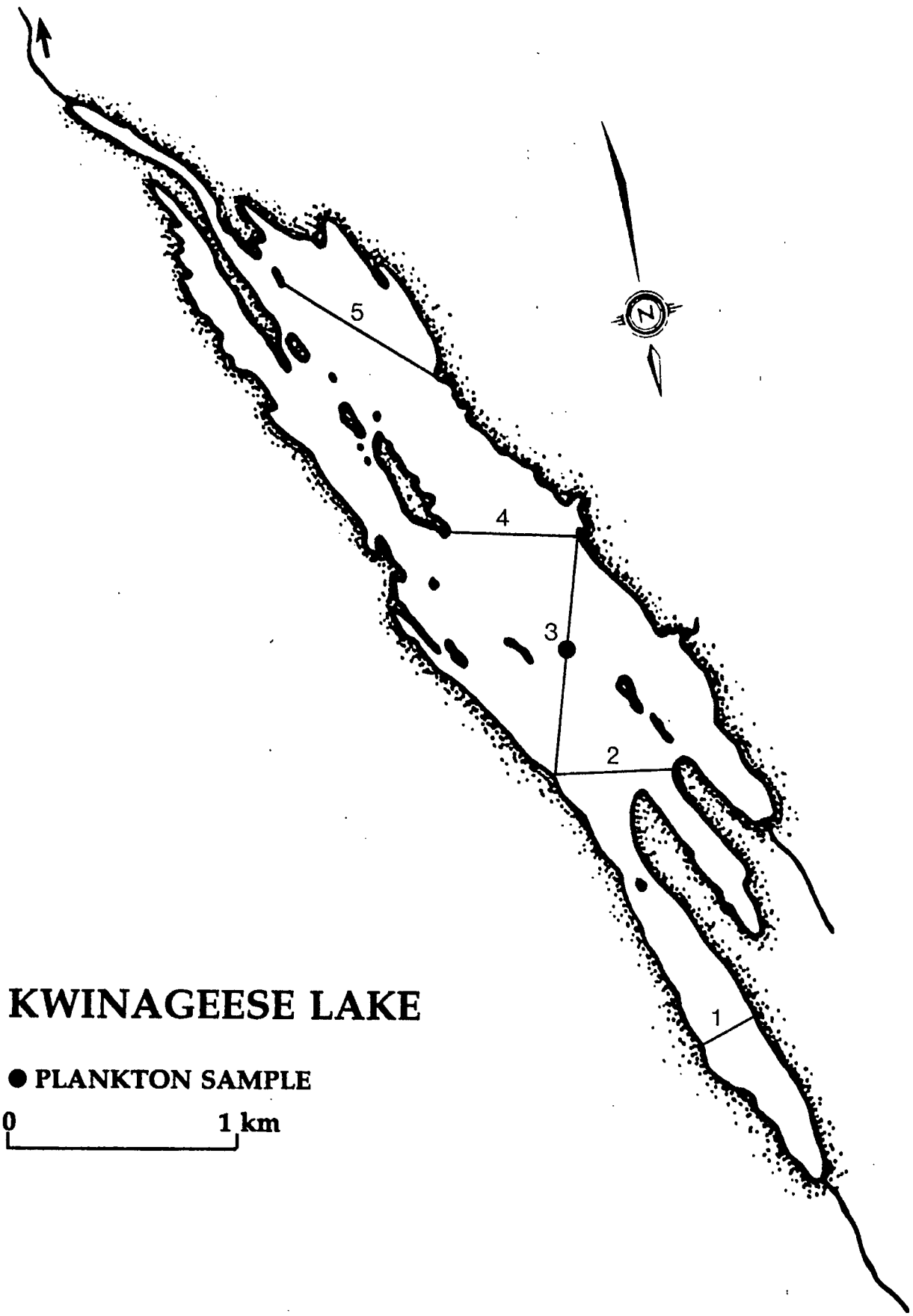

1525
1220
1525
1220
1220
915
4
KWINAGEESE
RIVER
3
610
2
1
760
915
1. BONNEY LAKE
2. FRED WRIGHT LAKE
3. HALFWAY LAKE
4. KWINAGEESE LAKE
CONTOUR LINES IN METRES
0
10 km
N

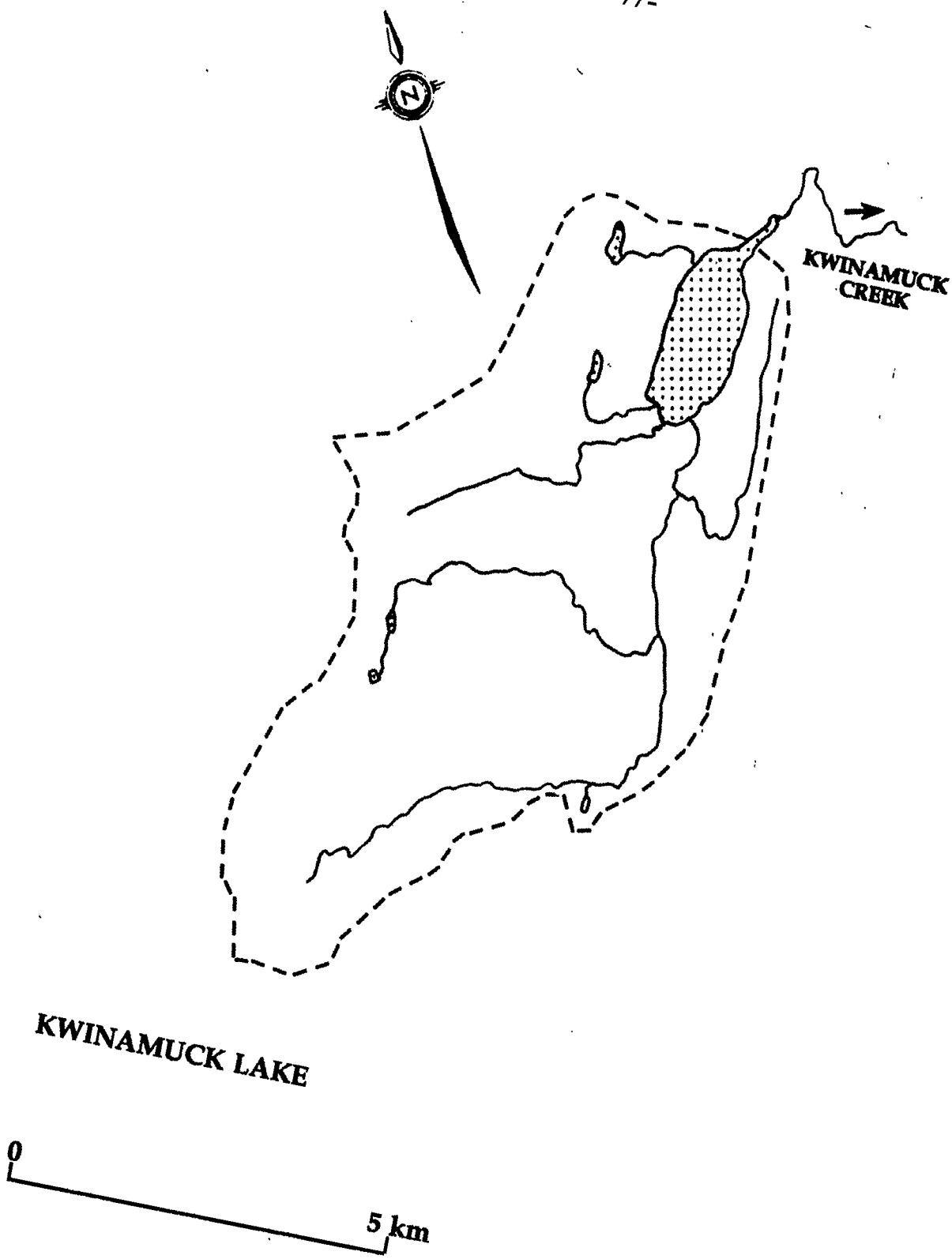


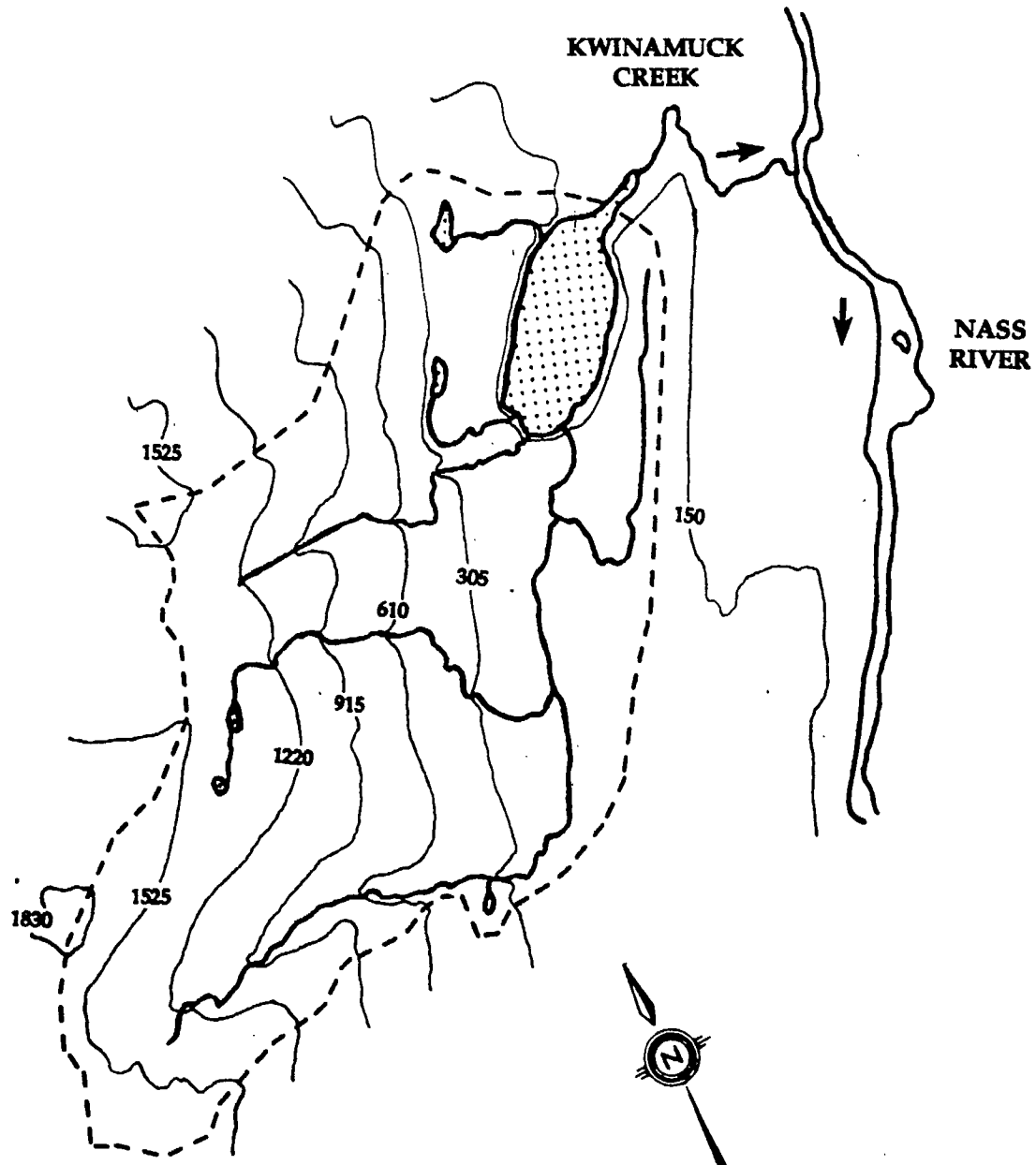
KWINAGEESE LAKE

DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 50 METRES

0 1 km


5
4
3
2
1
N
KWINAGEESE LAKE
● PLANKTON SAMPLE
0
1 km

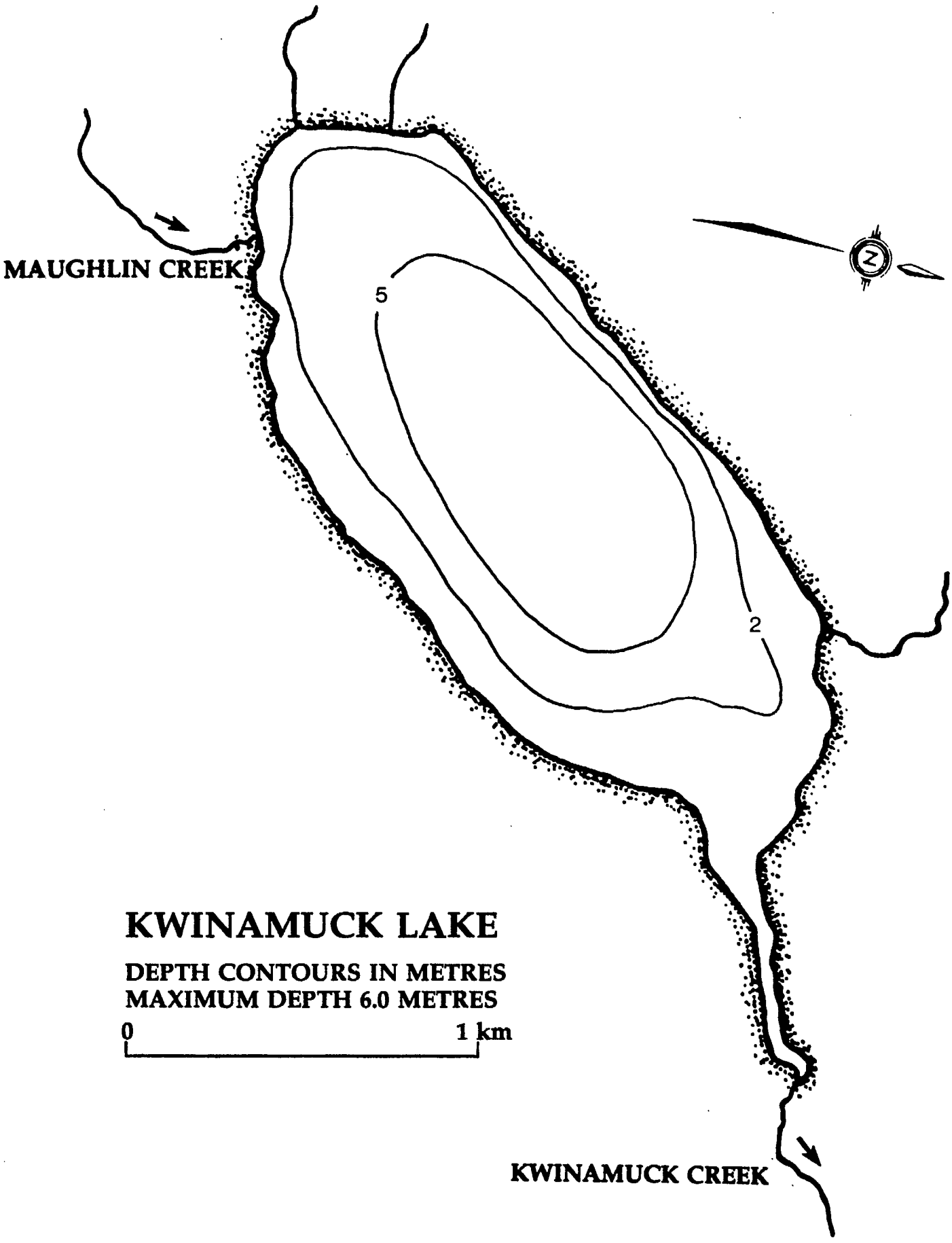

N
KWINAMUCK CREEK
KWINAMUCK LAKE
0
5 km

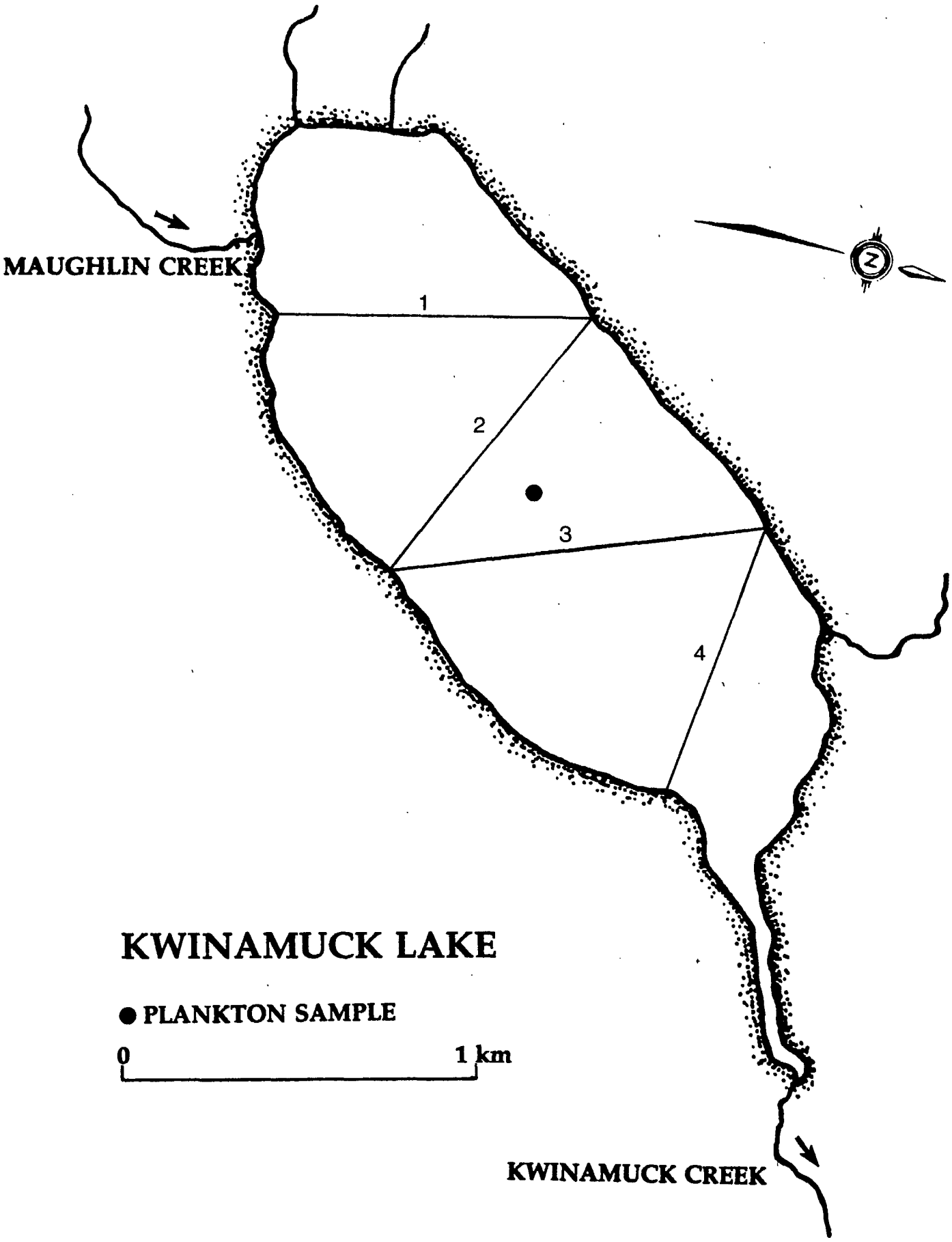


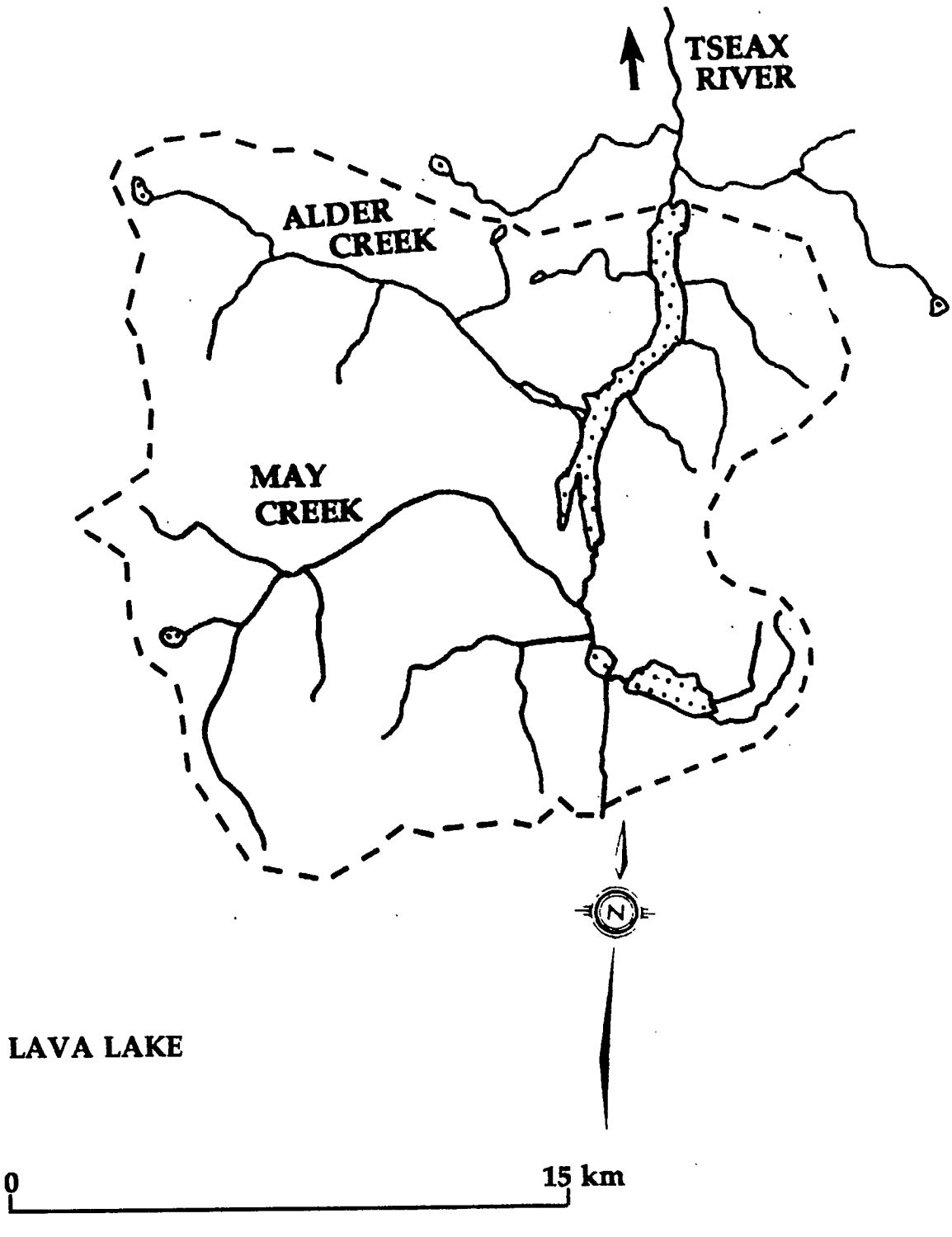
KWINAMUCK LAKE

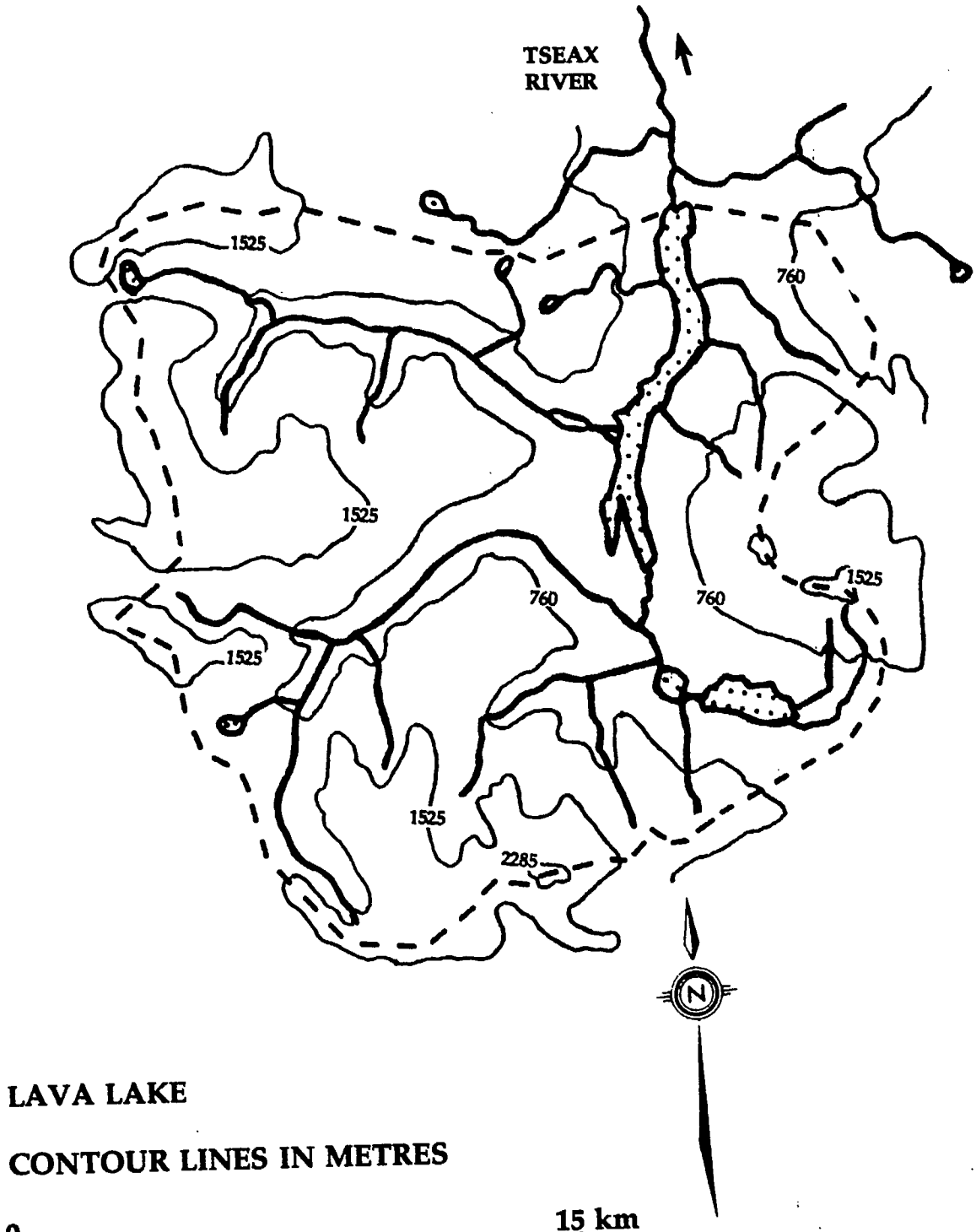
CONTOUR LINES IN METRES

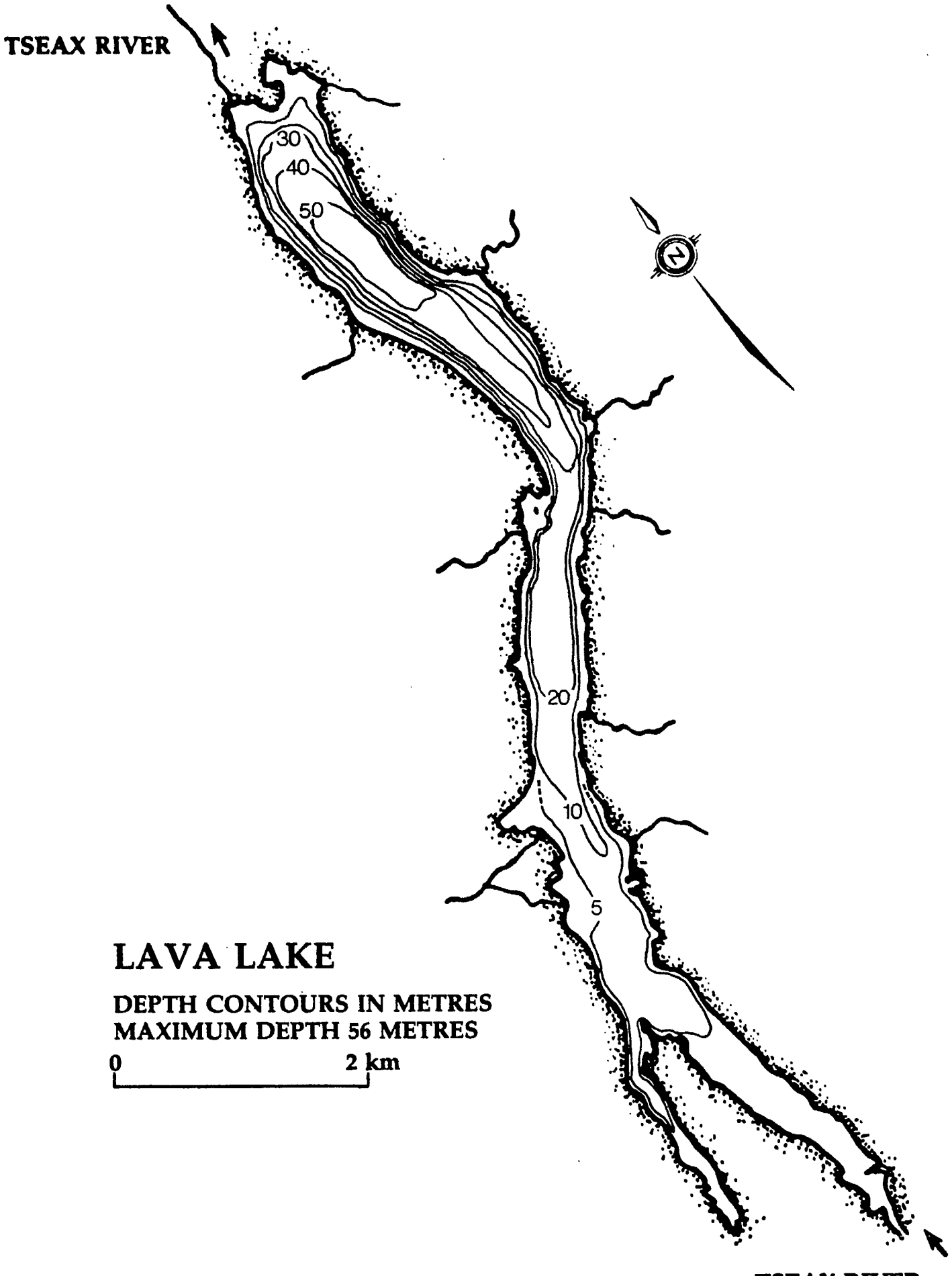
0 **5 km**

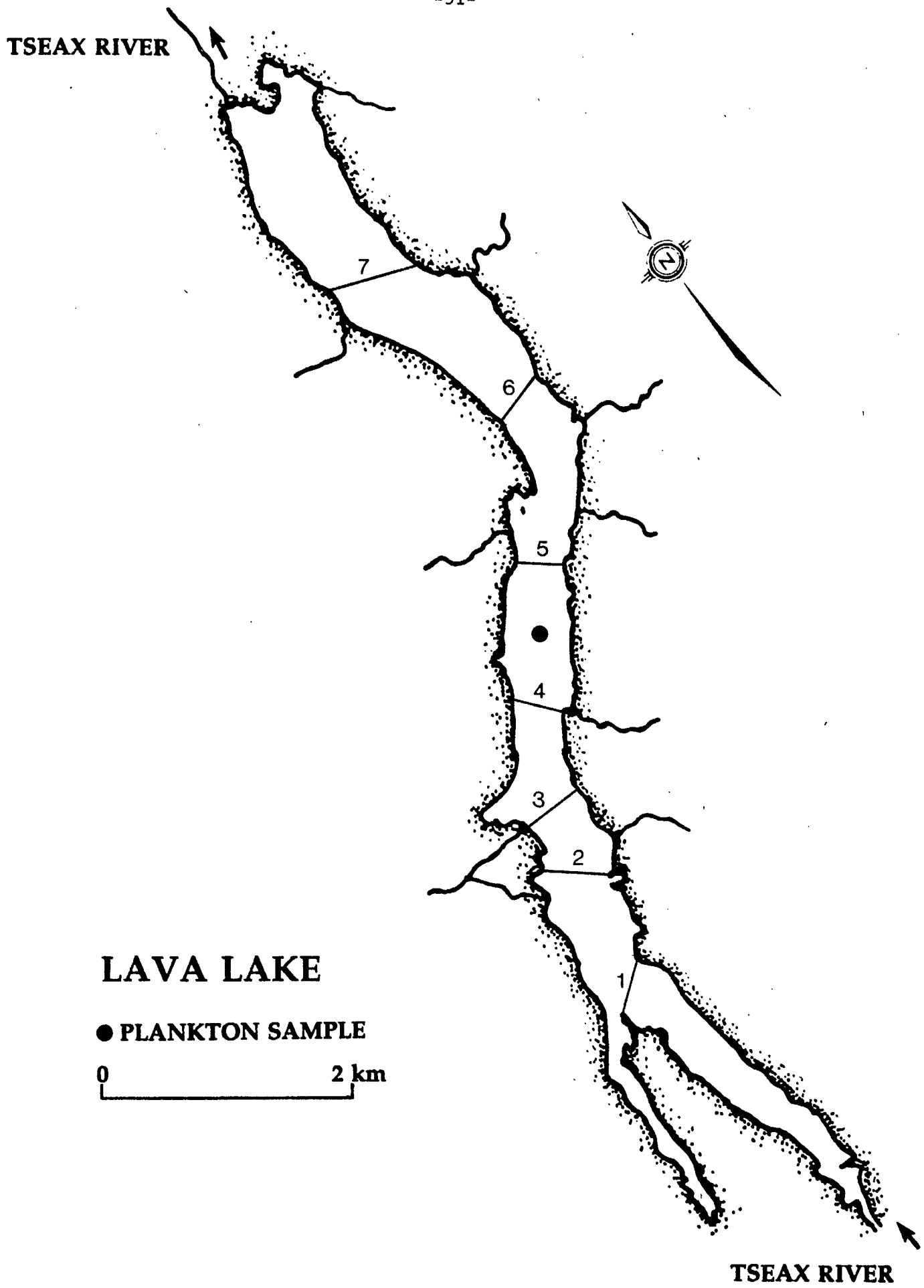

MAUGHLIN CREEK
5
2
N
KWINAMUCK LAKE
DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 6.0 METRES
0
1 km
KWINAMUCK CREEK

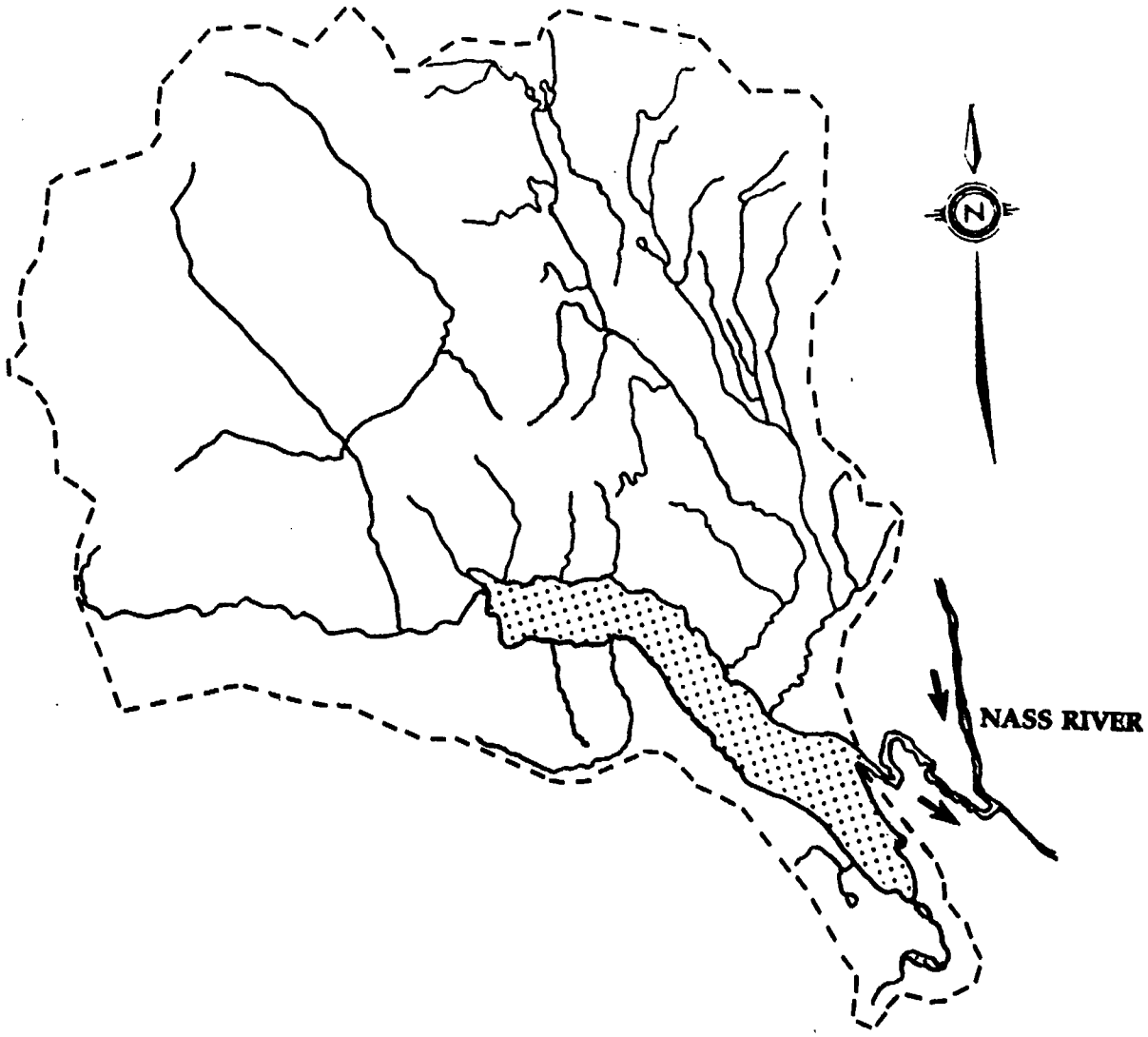

MAUGHLIN CREEK
N
1
2
3
4
KWINAMUCK LAKE
● PLANKTON SAMPLE
0
1 km
KWINAMUCK CREEK


TSEAX
RIVER
ALDER
CREEK
MAY
CREEK
N
LAVA LAKE
0
15 km


TSEAX
RIVER
1525
760
1525
1525
760
760
1525
1525
1525
2285
N
LAVA LAKE
CONTOUR LINES IN METRES
0
15 km

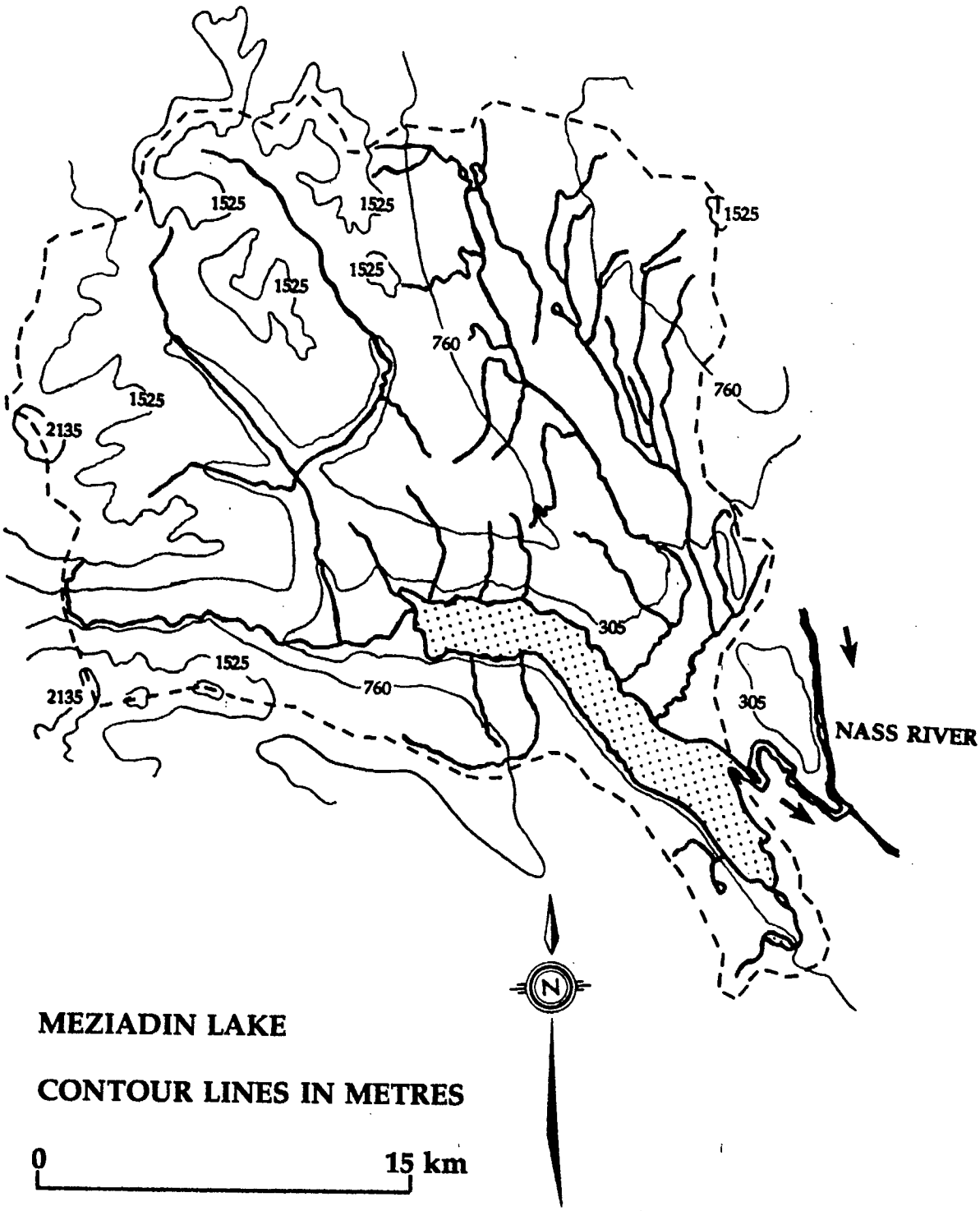

TSEAX RIVER
30
40
50
20
10
5
LAVA LAKE
DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 56 METRES
0
2 km
TSEAX RIVER

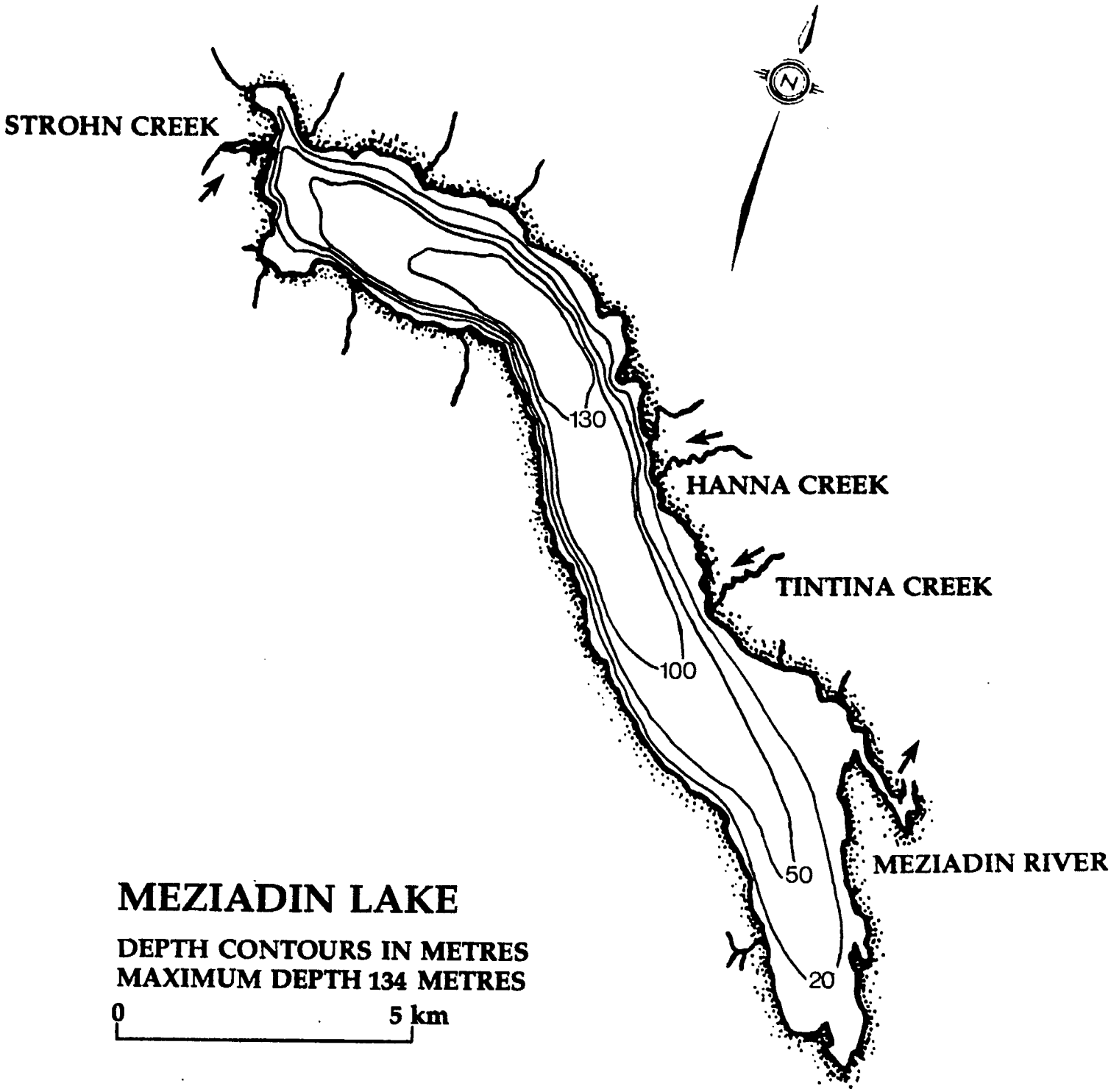

TSEAX RIVER
7
6
5
4
3
2
1
LAVA LAKE
● PLANKTON SAMPLE
0
2 km
TSEAX RIVER

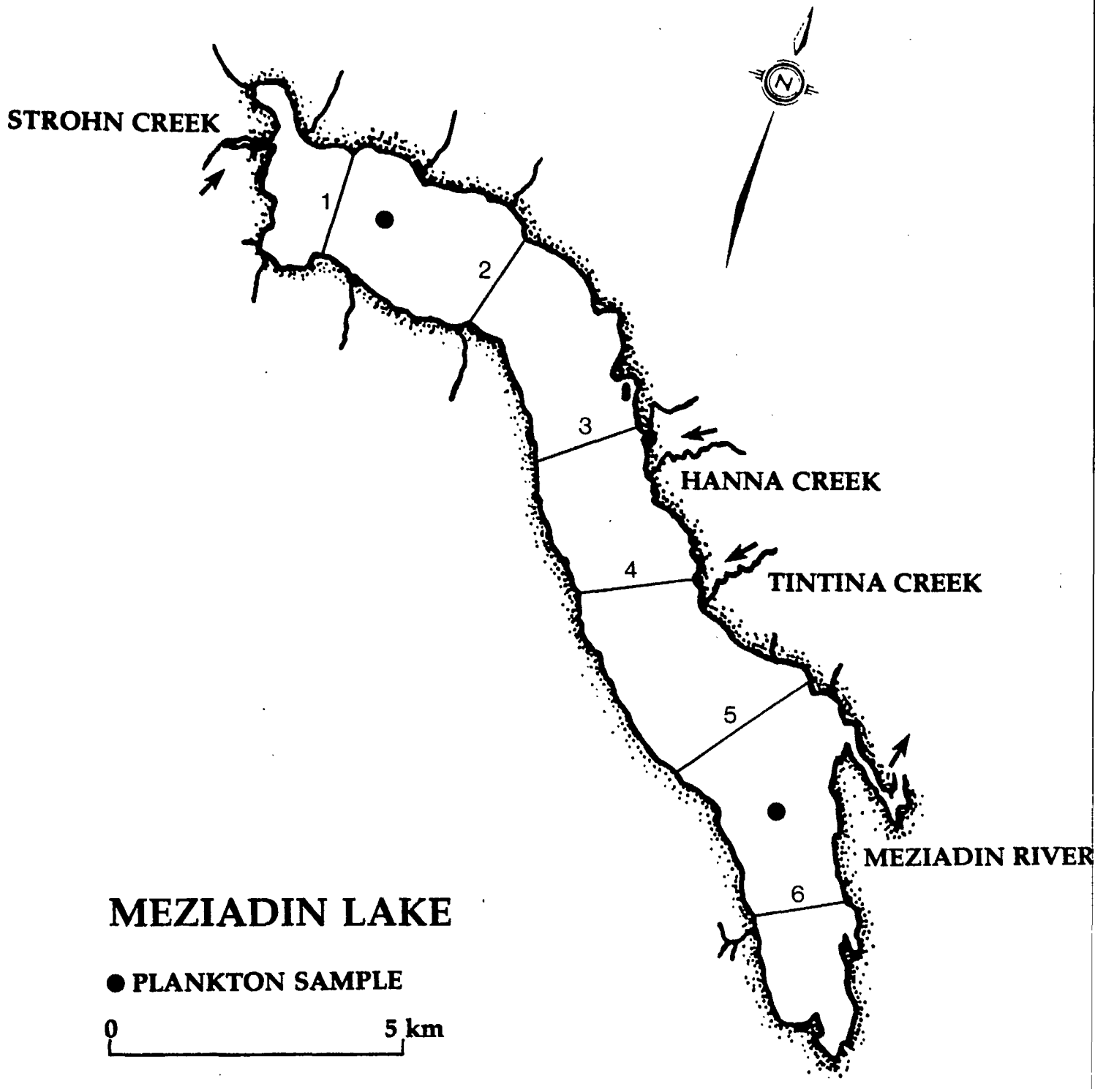


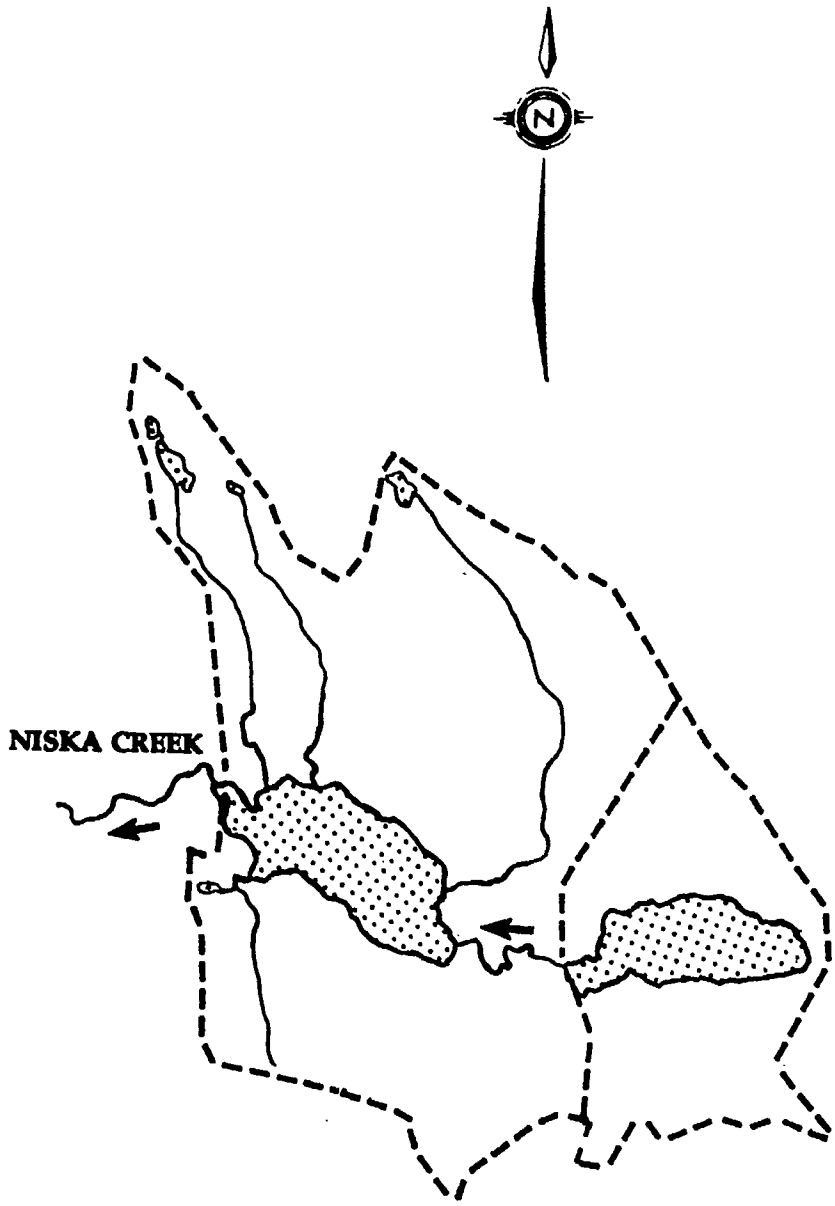
MEZIADIN LAKE

0 15 km


1525
1525
1525
1525
1525
760
760
1525
2135
305
1525
2135
760
305
NASS RIVER
N
MEZIADIN LAKE
CONTOUR LINES IN METRES
0
15 km

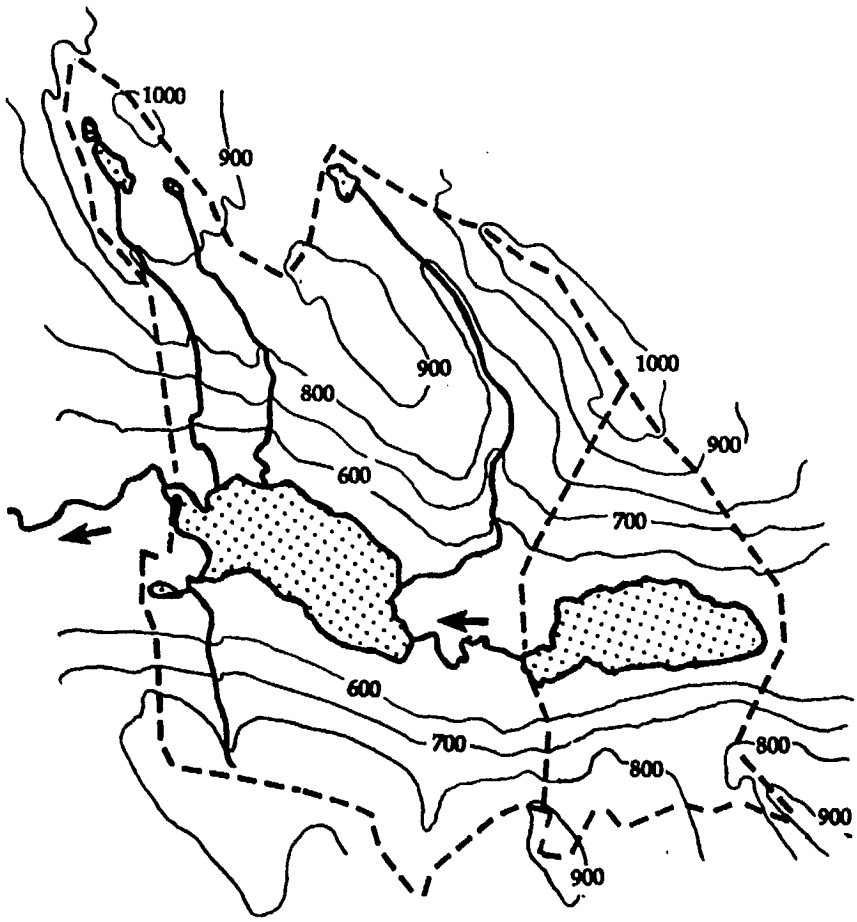

STROHN CREEK
130
HANNA CREEK
TINTINA CREEK
100
50
MEZIADIN RIVER
20
MEZIADIN LAKE
DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 134 METRES
0
5 km


STROHN CREEK
1
2
3
HANNA CREEK
4
TINTINA CREEK
5
MEZIADIN RIVER
6
MEZIADIN LAKE
● PLANKTON SAMPLE
0
5 km



NISKA LAKES

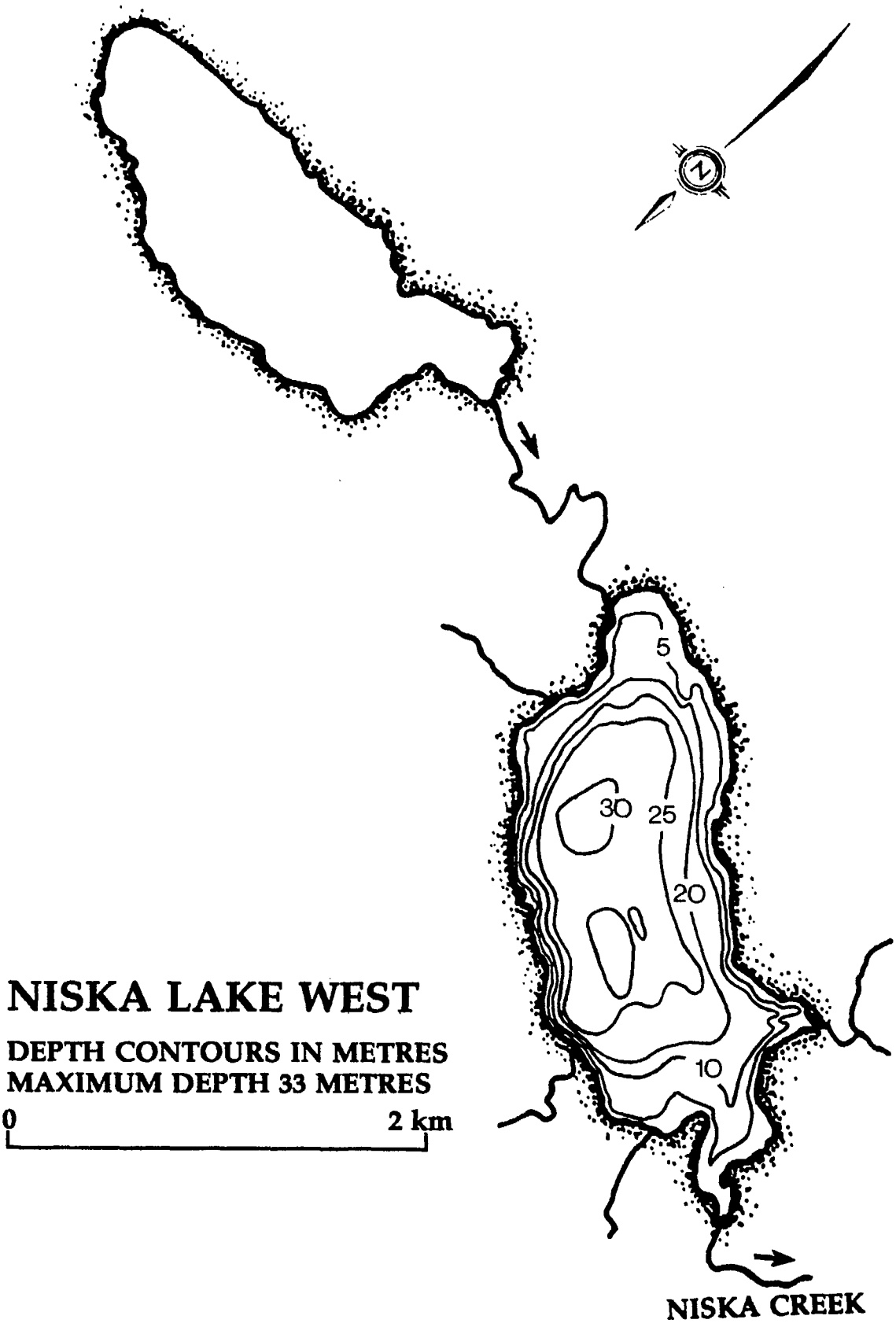
0 10 km



NISKA LAKES

CONTOUR LINES IN METRES

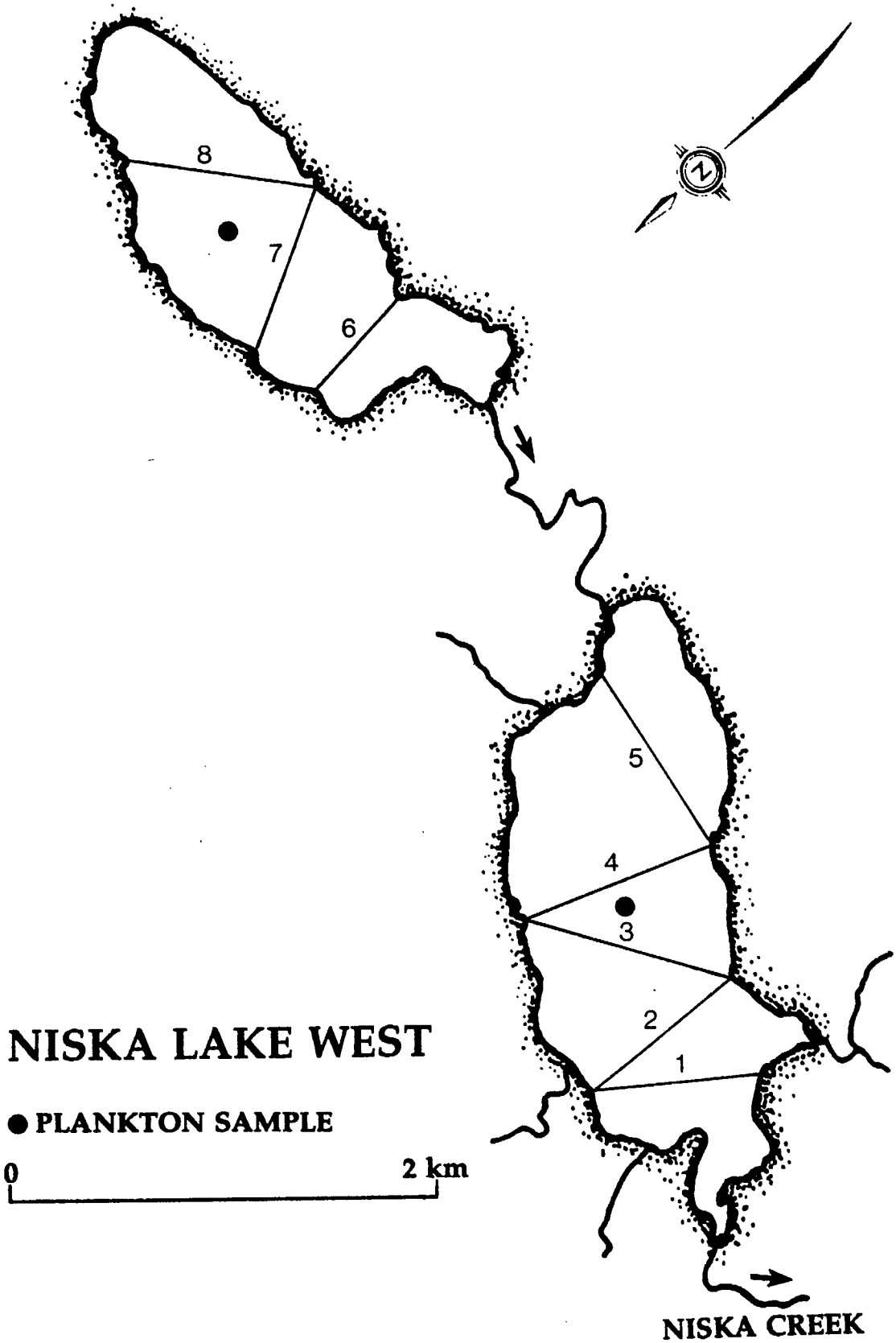
0 **10 km**

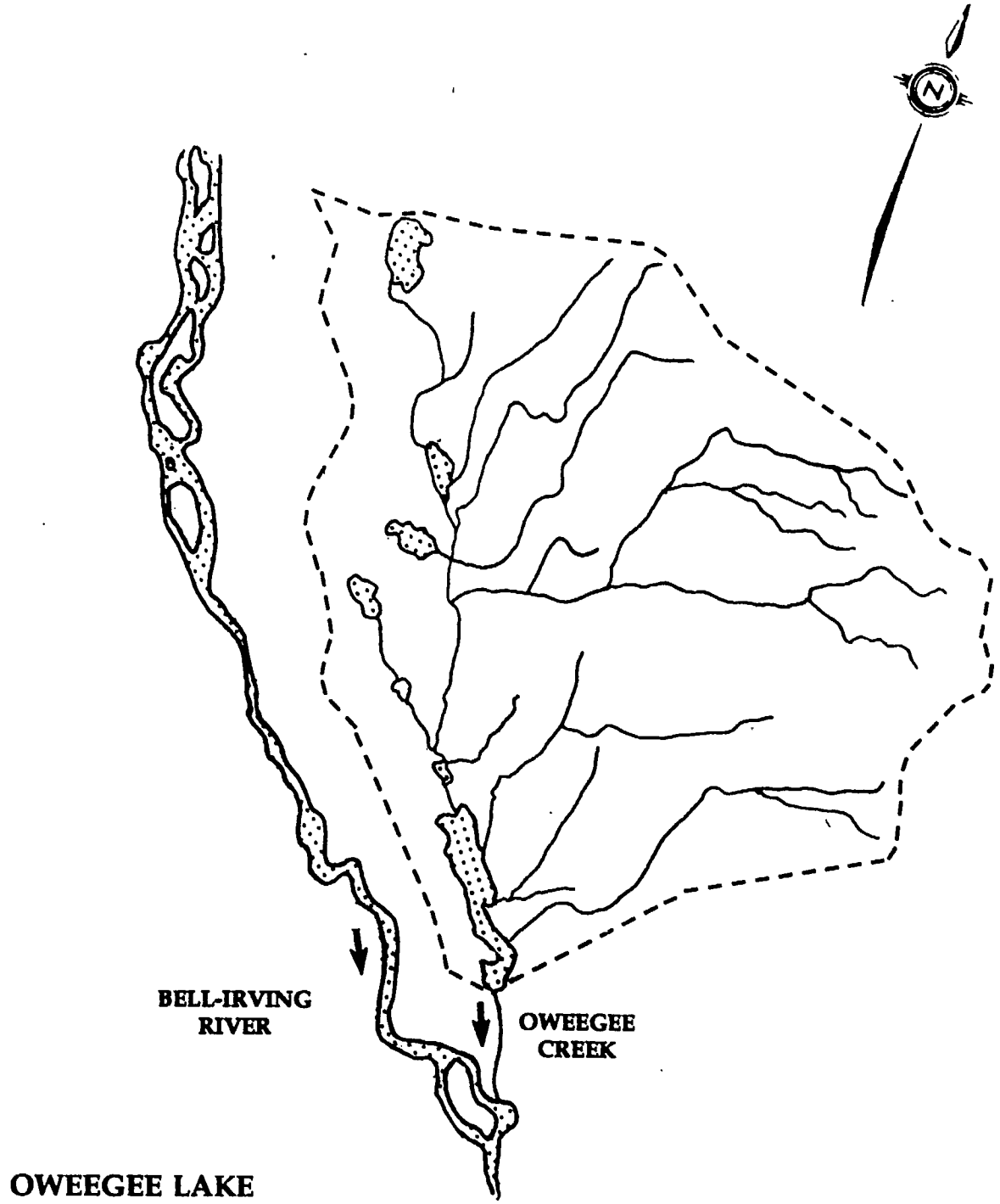


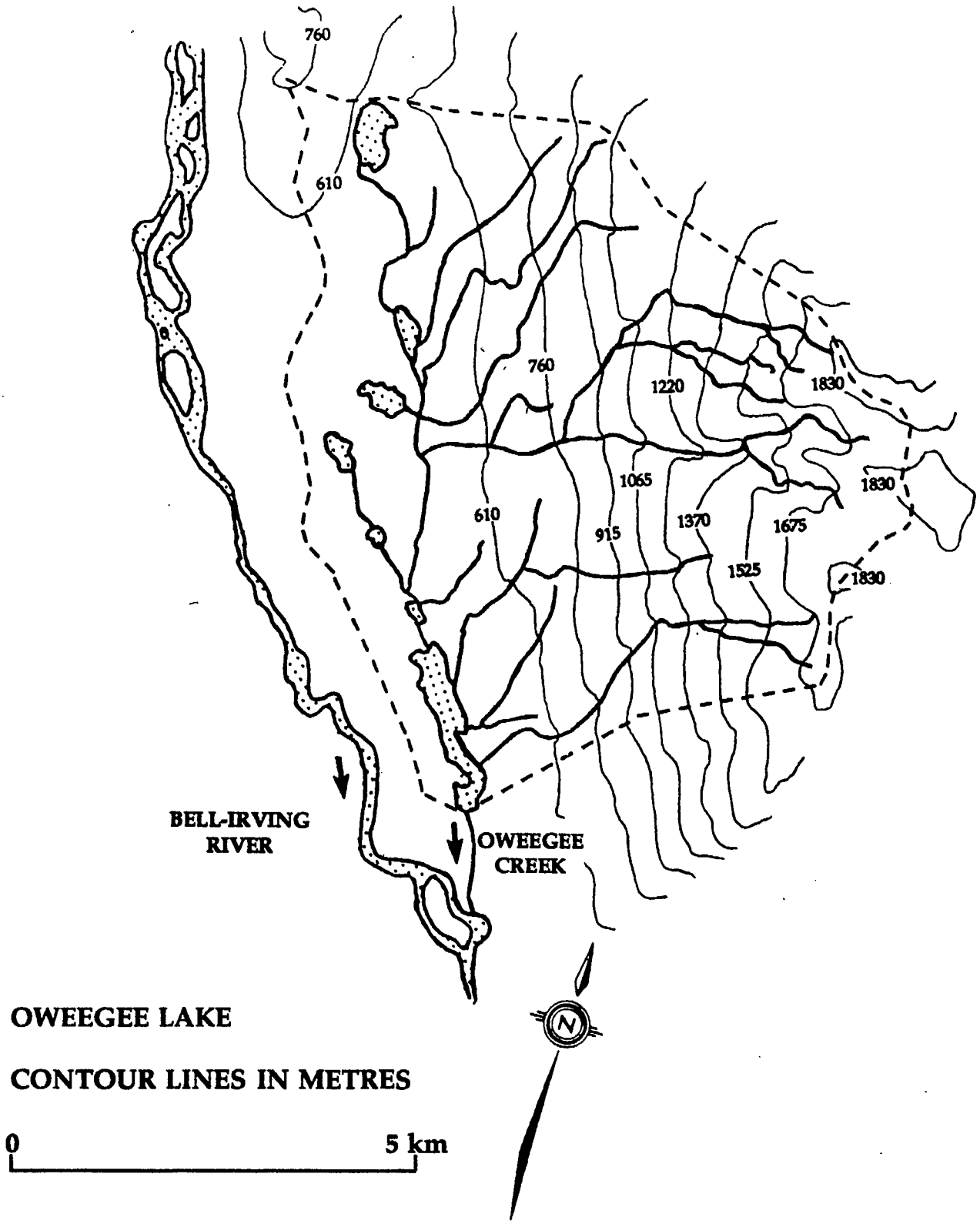
NISKA LAKE WEST

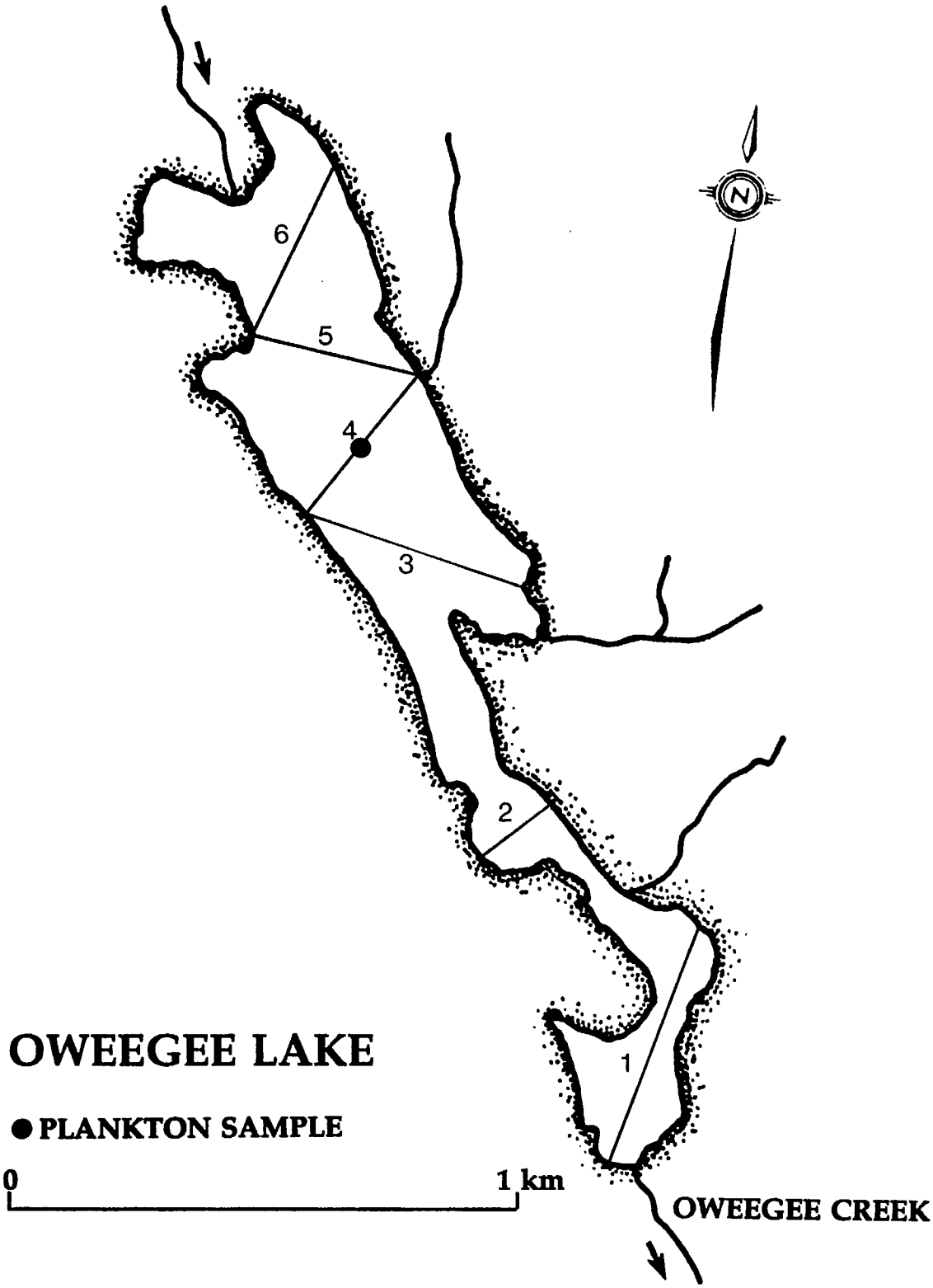
DEPTH CONTOURS IN METRES
MAXIMUM DEPTH 33 METRES

0 **2 km**


8
7
6
5
4
3
2
1
N
NISKA LAKE WEST
● PLANKTON SAMPLE
0
2 km
NISKA CREEK


BELL-IRVING
RIVER
OWEEGEE
CREEK
OWEEGEE LAKE
0
5 km


760
610
760
1220
1830
1065
1830
610
915
1370
1675
1525
1830
BELL-IRVING
RIVER
OWEEGEE
CREEK
N
OWEEGEE LAKE
CONTOUR LINES IN METRES
0
5 km


6
5
4
3
2
1
N
OWEEGEE LAKE
● PLANKTON SAMPLE
0
1 km
OWEEGEE CREEK