2005 SURVEY OF LAKES IN SUPPORT OF ALPINE DEVELOPMENT AND EASTERN NPRA EXPLORATION

Final Report

October 2005

Prepared by:

MJM Research
1012 Shoreland Drive
Lopez Island, WA

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

and

Anadarko Petroleum Corp.
1201 Lake Robbins Dr
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INTRODUCTION

ConocpPhillips Alasa, Inc. operates the Alpine Development within the Colville Delta and plans to continue exploring for oil and gas reserves in eastern NPRA. Both of these operations require withdrawal of water from lakes to support industrial and domestic needs.

During review of exploration, and potentially development, permits, information is required on the biological sensitivity of lakes in the region. The study was designed to provide physical and biological information on these lakes to understand their use by various fish species. In addition, results of the survey can be used, in concert with previous surveys within the area, to direct any future investigations that may be needed.

This 2005 survey was conducted to resurvey 12 lakes used as water sources by the Alpine Development and 5 lakes used to support exploration in eastern NPRA. Lakes in the 2005 study were initially surveyed from 1995 to 2000 using older survey methods. This study updates the previous estimates using more accurate survey techniques developed in 2002. In addition, the bathymetry of lake L9323 was re-calculated using a basemap of geo-referenced aerial photography for the Colville Delta that was not available when the lake was surveyed in 2002. The aerial photography provides a more accurate and detailed representation of shoreline and shallow water features, which aids in obtaining a more accurate contour map.

Objectives of the study were to re-survey selected lakes to obtain updated bathymetry and to document fish presence and habitat use in lakes for lakes that may be used to support exploration activities in association with drilling operations or to support ice road construction between drill sites.

The objectives of the survey were to:

1) obtain up-dated lake bathymetry for selected lakes,

2) re-evaluate fish species in lakes within the project study area, and

3) measure water chemistry parameters to assess suitability of water for potential uses.

The selected lakes are used, or may be used, as sources of freshwater during oil exploration and development for ice road and ice pad construction, as well as for short-term potable water supplies. Permitting decisions on water withdrawal will need to consider potential impacts to fish that depend on an adequate water supply for surviving winter. The inventory of fish and fish habitat provides information for assisting permitting decisions regarding water use and ice road routing.

METHODS

Most of the lakes in the 2005 survey had previously been sampled with gill nets or fyke nets targeting sensitive species. Where sensitive species had been previously documented, the lake was not re-sampled. For lakes where fish had not been documented, or where sampling was considered inadequate to detect resistant species, the biological survey consisted of sampling with gill nets and minnow traps combined with physical measurements. Lakes were sampled with short-duration gill net sets (typically 4 to 6 hours). The gill nets are multimesh, 120 feet long, with six panels of variable mesh, mesh size ranging from 1 to 3.5 inches stretched mesh. These nets have been previously used to collect inventory-level data from lakes throughout the North Slope for similar surveys. Sets were kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Since the objective of the gill netting is to document presence/absence, the nets were pulled after fish were detected. Fish captured were measured and released. Duration of each set was recorded to allow calculation of catch rates.

Minnow traps were used to identify smaller fish species that may not be detected by gill nets. Minnow traps baited with preserved salmon eggs were set in pairs at the edge of surveyed lakes. The traps were set and retrieved in concert with the gill net sampling.

Water chemistry parameters were measured to assess habitat conditions and provide information on the suitability of the water for domestic and industrial uses. Water chemistry measurements included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. Temperature, specific conductance and dissolved oxygen were *in situ* surface measurements taken along the edge of each lake with a YSI Model 85 meter. A sample was returned to the field office to measure pH and turbidity. PH was measured with an Oaktron Acorn Series pH5 meter. Turbidity was measured with an H.F. Scientific DRT15CE turbidity meter. A water sample was sent to Arctic Fox Environmental for laboratory determination of chloride, sodium, calcium, magnesium, and hardness (as CaCO3).

Bathymetric data were collected to allow estimating lake volume. Location and depth were recorded on a Lowrance Model LCX-15MT integrated GPS/depth sounder. Location and depth were recorded at approximately 1-2 second intervals. The study design was to record at least six to eight depth transects on each lake. Lake volume was estimated by contour mapping of depth intervals. Contour maps were prepared by plotting the position and depth data obtained by GPS on GIS basemaps and plotting the contours in 1 or 2 ft intervals on maps of the surveyed lakes. One foot intervals were plotted for lakes where the maximum depth was 10 ft or less, two foot intervals were used on deeper lakes. The surface area of each contour was obtained, then the volume was estimated using the formula for truncated cones:

$V = h/3*(A1+A2+(A1*A2) (1/2))$

Where h = vertical depth of the stratum, A1 = area of the upper surface, and A2 = area of the lower surface of the stratum whose volume is to be determined. The volumes of individual strata are summed to obtain the volume of the desired depth intervals.

The amount allowed for winter water withdrawal when sensitive fish species are present is currently set at 15% of the volume of the lake deeper than 7 feet. When resistant fish species (i.e. ninespine stickleback and Alaska blackfish) are present, the current allocation allowed by Alaska Dept. of Natural Resources is 30% of the volume deeper than 5 feet. There is no withdrawal limit if fish are not present.

The area potentially available for ice aggregate was estimated by calculating the area of the lake shallower than 4 feet, assuming that the ice would grow to at least 4 feet prior to the need for aggregate. If the ice is shallower than 4 feet at the time of ice removal, then the area available will be less.

Lake Summaries

This report uses lake numbering based a researcher/year code. The lake number contains several pieces of information, including the code of the sampler and the year of sampling.

Sampler Code:

MC = McElderry and Craig (1981); sampling in 1979
B = Bendock sampling from 1977-1986
L = Lobdell; water chemistry sampling in 1991-1999
M = Moulton; fish sampling in 1995-2005
MB = Michael Baker Jr., Inc. water chemistry sampling in 2002-2004
N = Netsch et al. (1977) NPRA sampling in 1977
R = Reanier sampling in 2000-2005

First Two Numerals:

Year of Initial Sampling
(if Moulton sampled a lake previously sampled by McElderry and Craig, then the McElderry and Craig lake number is used)

Last Two Numerals:

Numbers from 1 to 99 used to identify the individual lake sampled within a given year

Information contained for each surveyed lake (if measured) includes:

1. A diagram of the lake,
2. Other names utilized for the same lake,
3. Lake location, in latitude/longitude,
4. The USGS quadrangle sheet and the township and range in which the lake is situated
5. Surface area in acres, obtained from USGS digital maps,
6. Maximum depth in feet,
7. Presence or absence of an outlet,
8. Calculated total lake volume
9. Water volume under 4 feet of ice,

10. Water volume under 5 feet of ice
11. Water volume under 7 feet of ice
12. Acres of potential ice aggregate for road construction,
13. Maximum recommended winter water withdrawal, exclusive of volumes related to ice aggregate,
14. Water chemistry measurements,
15. Catch record, including gear used, date sampled, species caught and size range,
16. Where appropriate data exist, the length frequency of dominant species is plotted,
17. Map of potential ice aggregate removal areas, and
18. Map showing measured depth transects.

RESULTS AND DISCUSSION

Biological Observations

Four lakes were re-sampled for fish in 2005, with one lake, R0071, sampled for the first time (Table 2). The four re-sampled lakes did not produce sensitive fish species during the initial sampling, but were not sampled for resistant species at that time. In 2005, two of the re-sampled lakes (M9605 and M9905) were confirmed to support resistant species, while the remaining two (M9921 and M0010) appeared to be fishless. The lake sampled for the first time (R0071) was shallow, with a maximum depth of 2.7 feet. Although it is seasonally connected to a stream system, the lake will be frozen to the bottom by the time exploration activities commence in late December or early January.

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the July 10-21 sampling in 2005 averaged 9.4^{o}C, ranging from 5.8^{o}C to 13.4^{o}C. As expected for natural surface waters, dissolved oxygen was high, averaging around 11.2 mg/l. Specific conductance ranged from 44 to over 6,300 microSiemens/cm. Specific conductance was lowest in lakes in the upper end of the delta near Nuiqsut and highest in tapped lakes or lakes closer to the coast. PH ranged from 7.30 to 8.70.

Evaluation of Fish Concerns

Information from fish sampling and depth measurements was used to evaluate each lake regarding its potential to support fish. Obviously, if fish were captured during gill net sampling, the lake was classified as fish-bearing. Gill net sets were relatively short, however, so absence of catch does not necessarily mean a lake does not support fish. Lakes also were assessed for their proximity to fish-bearing streams and their depth. Lakes deeper than 7 feet are likely to retain unfrozen water during winter, thus have potential to overwinter fish. Deep lakes that are near fish-bearing streams and are likely to have a connection with the stream at some point during the year are classified as potential fish-bearing lakes, with additional sampling needed if further clarification of the designation is

desired. Results of the evaluation are included in Table 4.

Lakes in which fish were verified as present are divided into those lakes containing species sensitive to habitat changes likely to be associated with water withdrawal and those containing species more resistant to such changes. Species sensitive to impacts of water withdrawal (such as reduced dissolved oxygen and increased dissolved solids) include lake trout, broad whitefish, least cisco and arctic grayling, while the more resistant species are Alaska blackfish and ninespine stickleback. Alaska blackfish are particularly resistant to low dissolved oxygen, being able to breathe atmospheric oxygen (Armstrong 1994). Residents of the Yukon Delta have reported observing Alaska blackfish oriented along cracks in the ice during winter to use oxygen in ponds that have gone anoxic. Ninespine stickleback can also withstand low dissolved oxygen (Lewis et al. 1972), although not the same extent as Alaska blackfish. Ninespine stickleback, however, can withstand higher levels of dissolved solids, and often frequent brackish nearshore waters during summer.

When sensitive fish are present, the amount of water available during winter is limited to 15% of the volume under 7 feet of ice. The water withdrawal criteria are relaxed when only resistant fish species are present because of the greater tolerance to lower dissolved oxygen and higher concentrations of dissolved solids. In this case, up to 30% of the water volume under 5 feet of ice is allowed for winter withdrawal. For lakes that do not contain fish, there is currently no limit to the amount taken. For practical reasons, the volume available is limited to the volume of unfrozen water under the ice at the time of withdrawal. In most cases, the withdrawal occurs when the ice is 4 feet thick or greater. In order to provide some estimate of water likely to be available, the volume of water under 4 feet of ice is provided.

Based on the above lake evaluation, lakes re-surveyed for the Alpine Development should provide 91.1 million gallons of water for under-ice withdrawal during winter, while the re-surveyed lakes in eastern NPRA should provide an additional 56.1 million gallons of water. This estimate does not include volumes associated with ice aggregate removal.

The area covered by water less than 4 feet deep, and therefore likely to be suitable for removing ice aggregate, was estimated for each lake (Table 5). A map of the potential ice aggregate area for each lake is included in the individual lake summaries. Based on the above analysis, 1,199 acres are likely to be available for ice chips from lakes re-surveyed for the Alpine Development during 2005, while the re-surveyed eastern NPRA lakes should provide an additional 212 acres for ice chips.

LITERATURE CITED

Armstrong, R.H. 1994. Alaska blackfish. ADF&G's Wildlife Notebook Series. Alaska Dept. Fish and Game. Juneau, AK.

Lewis, D.B., M. Walkey, and H.J.G. Dartnall. 1972. Some effects of low oxygen tensions on the distribution of the three-spined stickleback *Gasterosteus aculeatus* L. and the nine-spined stickleback *Pungitius pungitius* (L). J. Fish. Biol. 4: 103-108.

McElderry, H.I. and P.C. Craig. 1981. A fish survey in the lower Colville River drainage with an analysis of spawning use by Arctic and least cisco. Appendix 2. Final Report, Simpson Lagoon (Part 4, Fish). In: Environmental Assessment of the Alaskan Continental Shelf, Final Reports (Vol. 7). BLM/NOAA OCSEAP, Boulder, Colorado. p. 657-678.

Netsch, N., E. Crateau, G. Love and N. Swanton. 1977. Freshwater fisheries reconnaissance of the coastal plain of National Petroleum Reserve-Alaska (NPR-A), July and August 1977. Preliminary report. USDI: US Fish and Wildlife Service. Anchorage, AK. 214p.

Table 1. Summary of lakes sampled in 2005 for winter water use in Alpine and eastern NPRA development and exploration.

Area	Lake Name	Latitude (NAD83)	Longitude (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (mill. gals)
Alpine									
	B8530	N70.24517	W150.92085	10N	5E	4/5/8/9	424.5	18.6	1,084.89
	L9278	N70.35436	W150.94092	12N	5E	29/31/32	344.0	7.7	356.50
	L9323	N70.29811	W150.99959	11N	4/5E	13/24/19	94.7	21.6	249.49
	L9324	N70.28770	W150.97477	11N	4/5E	24/19/30	130.4	24.1	228.26
	L9327	N70.26363	W150.93064	11N	5E	32	220.4	13.0	443.87
	L9903	N70.41965	W150.87853	12N	5E	4	10.1	22.9	29.96
	M9525	N70.32835	W150.98414	11N	4/5E	12/13/6/7	120.5	8.2	69.78
	M9601	N70.23578	W150.71835	10N	6E	6/7	398.9	9.7	551.35
	M9602	N70.22147	W150.73865	10N	5/6E	12/13/24/7/18/19	658.4	6.4	734.89
	M9605	N70.22099	W150.51572	10N	6E	11/12/13/14/24	349.6	7.2	408.88
	M9606	N70.25109	W150.94929	10N	5E	5/6	103.2	16.6	246.06
	M9608	N70.23888	W150.94887	10N	5E	5/6/7/8	206.0	14.0	538.05
	Nanuk	N70.31494	W151.01286	11N	4E	1/2/11/12/13	176.7	11.7	200.48
Eastern NPRA									
	M9905	N70.24510	W151.74422	10N	1/2E	1/6	26.3	15.0	53.30
	M9921	N70.26541	W151.63768	11N	2E	33	108.6	6.0	114.09
	M0005	N70.26345	W152.04426	11N	1W	35/36	126.7	13.9	309.71
	M0010	N70.27767	W151.81507	11N	1E	26	30.3	8.1	28.46
	R0071	N70.22433	W151.65086	10N	2E	16	80.9	2.7	34.67

Table 2. Catches of fish from lakes sampled in 2005 for Alpine and eastern NPRA.

			Fyke Nets/Gill Nets		Minnow Traps	
Area	Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[2]
Alpine						
	B8530[3]	Jul 25 96	2.5	BDWF,HBWF,LSCS +	--	--
	L9278	Jul 15 95	24.3	BDWF,HBWF,LSCS +	--	--
	L9323	multiple	484.9	7 species	--	--
	L9324	multiple	313.3	12 species	--	--
	L9327	Jul 20 96	11.2	BDWF,LSCS	--	--
	L9903	Jul 26 00	2.3	LSCS	--	--
	M9525	Jul 18 95	23.0	BDWF,LSCS,NSSB	--	--
	M9601	Jul 17 96	4.1	none	--	--
		Jul 15 02	12.6	none	Observed	NSSB
	M9602	Jul 26 96	10.7	none	--	--
		Jul 15 02	11.2	none	Observed	NSSB
	M9605	Jul 18 96	4.3	none	--	--
		Jul 20 05	6.7	none	12.2	NSSB
	M9606	Jul 19 96	13.3	BDWF,LSCS	--	--
	M9608	Jul 25 96	2.6	BDWF,LSCS	--	--
	Nanuk	multiple	354.3	13 species	--	--
Eastern NPRA						
	M9905	Jul 10 99	3.9	none	--	--
		Jul 21 05	9.2	none	5.2	BKFH
	M9921	Jul 15 99	4.3	none	--	--
		Jul 16 05	7.7	none	8.6	none
	M0005	Jul 15 00	6.0	none	Observed	NSSB
	M0010	Jul 17 00	8.0	none	--	--
		Jul 21 05	9.1	none	10.8	none
	R0071	Jul 17 05	6.8	none	7.0	none

[1] BDWF = broad whitefish, HBWF = humpback whitefish, LSCS = least cisco, + = NSSB and/or BKFH also caught

[2] NSSB = ninespine stickleback, BKFH = Alaska blackfish

[3] also sampled in 1985 by Bendock and Burr

Table 3. Water chemistry parameters measured in conjunction with lake sampling in Alpine and eastern NPRA in 2005.

Area	Lake	Date	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium[1] (mg/l	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)
Alpine												
	B8530	Jul 14 05	6.1	12.2	55	1.1	8.11	5.5	2.4	<3	3.4	24
	L9278	Jul 14 05	12.1	10.1	6303	2.8	7.86	59.0	130.0	1000.0	2300.0	680
	L9323	1993	--	--	--	--	--	4.0	2.8	1.5	4.3	17
		Aug 2001	5.8	12.1	71	2.3	7.94	--	--	--	--	--
	L9324	Jul 15 05	12.8	10.3	44	6.1	7.60	9.8	3.9	4.1	4.9	41
	L9327	Jul 13 05	6.7	11.6	63	0.8	7.72	6.6	3.1	<3	4.1	29
	L9903	Jul 15 05	8.1	11.4	488	1.6	8.01	13.0	13.0	61.0	140.0	86
	M9525	Jul 10 05	10.4	11.0	562	1.0	7.30	16.0	12.0	77.0	180.0	89
	M9601	Jul 14 05	11.0	10.4	107	0.7	7.85	20.0	1.7	3.6	130.0	57
	M9602	Jul 12 05	8.8	10.7	142	1.5	8.00	25.0	2.3	4.9	14.8	72
	M9605	Jul 20 05	9.7	11.2	137	0.7	8.10	21.0	1.7	3.3	8.9	59
	M9606	Jul 13 05	8.0	11.8	69	1.7	7.42	7.0	2.9	<3	3.8	29
	M9608	Jul 13 05	6.2	12.0	54	1.0	7.53	5.5	2.2	<3	3.3	23
	Nanuk	Jul 11 05	9.7	11.1	548	31.2	7.90	20.0	12.0	62.0	130.0	99
Eastern NPRA												
	M9905	Jul 21 05	10.5	11.3	44	0.8	7.34	5.5	1.1	<3	4.0	18
	M9921	Jul 16 05	13.4	10.7	211	1.4	8.70	24.0	4.9	7.5	46.0	80
	M0005	Jul 11 05	7.9	11.5	238	1.0	8.33	28.0	6.2	11.0	32.0	95
	M0010	Jul 21 05	11.2	12.7	155	0.8	8.15	19.0	4.0	6.4	16.4	64
	R0071	Jul 17 05	10.1	10.2	95	13.4	7.81	11.0	2.7	5.2	12.0	39

[1] 3 mg/l is the detection limit for sodium

Table 4. Recommended maximum water volumes available for winter water withdrawal from lakes re-surveyed in 2005 for Alpine and eastern NPRA (does not include volume related to ice aggregate).

(requested water based on 15% of winter volume deeper than 7 ft when sensitive species are present, 30% of winter volume deeper than 5 ft when resistant or no fish are likely to be present).

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Calculated Volume (mil. gals)	Volume Under 4ft of Ice (mil. gals)	30% of 5 ft Winter Volume (mil. gals)	15% of 7 ft Winter Volume (mil. gals)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Maximum Winter Withdrawal (mil. gals)
Alpine										
	B8530	424.5	18.6	1,084.89	569.80	134.31	32.00	BDWF,LSCS +	BKFH	32.00
	L9278	344.0	7.7	356.50	46.36	2.54	0.01	BDWF,LSCS +	NSSB	0.01
	L9323	94.7	21.6	249.49	133.70	32.03	8.51	BDWF,LSCS +	BKFH,NSSB	8.51
	L9324	130.4	24.1	228.26	79.58	14.18	1.65	BDWF,LSCS +	BKFH,NSSB	1.65
	L9327	220.4	13.0	443.87	168.63	31.02	1.42	BDWF,LSCS	--	1.42
	L9903	10.1	22.9	29.96	18.33	4.72	1.63	LSCS	--	1.63
	M9525	120.5	8.2	69.78	3.98	0.56	0.02	BDWF,LSCS	NSSB	0.02
	M9601	398.9	9.7	551.35	119.33	12.53	0.00	none	NSSB	12.53
	M9602	658.4	6.4	734.89	42.89	0.78	0.00	none	NSSB	0.78
	M9605	349.6	7.2	408.88	75.95	8.52	0.00	none	NSSB	8.52
	M9606	103.2	16.6	246.06	126.84	29.80	7.21	BDWF,LSCS	--	7.21
	M9608	206.0	14.0	538.05	283.96	67.29	16.65	BDWF,LSCS	--	16.65
	Nanuk	176.7	11.7	200.48	47.52	7.28	0.13	BDWF,LSCS +	NSSB	0.13
Eastern NPRA										
	M9905	26.3	15.0	53.30	22.76	4.95	0.94	none	BKFH	4.95
	M9921	108.6	6.0	114.09	5.32	0.10	0.00	none	none	5.32
	M0005	126.7	13.9	309.71	167.76	40.76	3.34	none	NSSB	40.76
	M0010	30.3	8.1	28.46	5.10	0.77	0.12	none	none	5.10
	R0071	80.9	2.7	34.67	0.00	0.00	0.00	none	none	0.00

[1] Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.
BDWF = broad whitefish LSCS = least cisco + = additional species also caught

[2] Resistant species are Alaska blackfish (BKFH) and ninespine stickleback (NSSB)

-- = not sampled

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, re-surveyed in 2005 for Alpine and eastern NPRA.

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower than 4 feet
Alpine				
	B8530	424.5	18.6	46.7
	L9278	344.0	7.7	161.3
	L9323	94.7	21.6	10.6
	L9324	130.4	24.1	27.8
	L9327	220.4	13.0	17.9
	L9903	10.1	22.9	2.0
	M9525	120.5	8.2	112.4
	M9601	398.9	9.7	122.4
	M9602	658.4	6.4	391.5
	M9605	349.6	7.2	174.1
	M9606	103.2	16.6	17.6
	M9608	206.0	14.0	19.4
	Nanuk	176.7	11.7	95.0
Eastern NPRA				
	M9905	26.3	15.0	5.9
	M9921	108.6	6.0	75.4
	M0005	126.7	13.9	27.7
	M0010	30.3	8.1	21.7
	R0071	80.9	2.7	80.9

Figure 1. Lakes within the Colville Delta surveyed during summer 2005 in support of Alpine Development water needs.

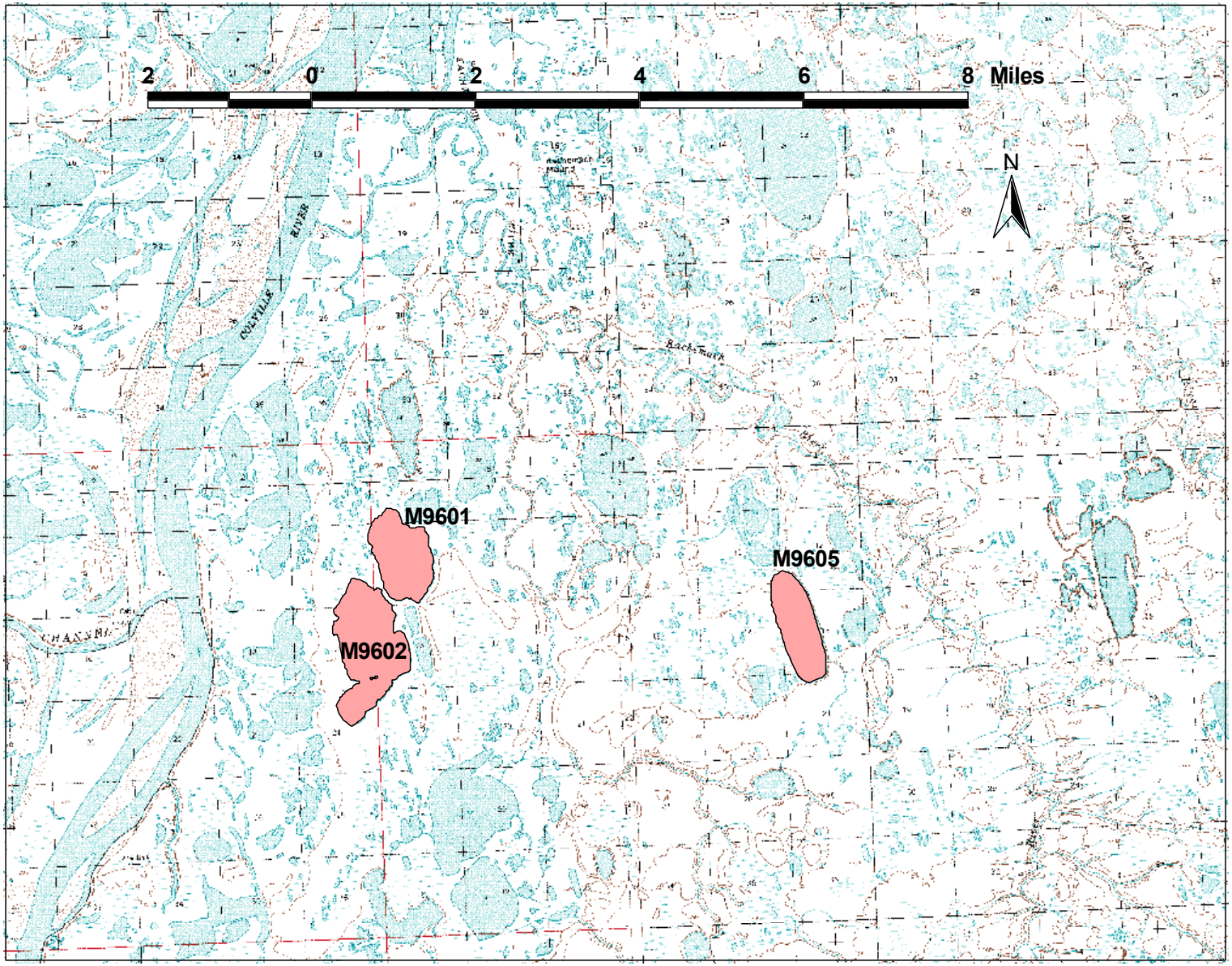


Figure 2. Lakes east of the Colville Delta surveyed during summer 2005 in support of Alpine Development water needs.

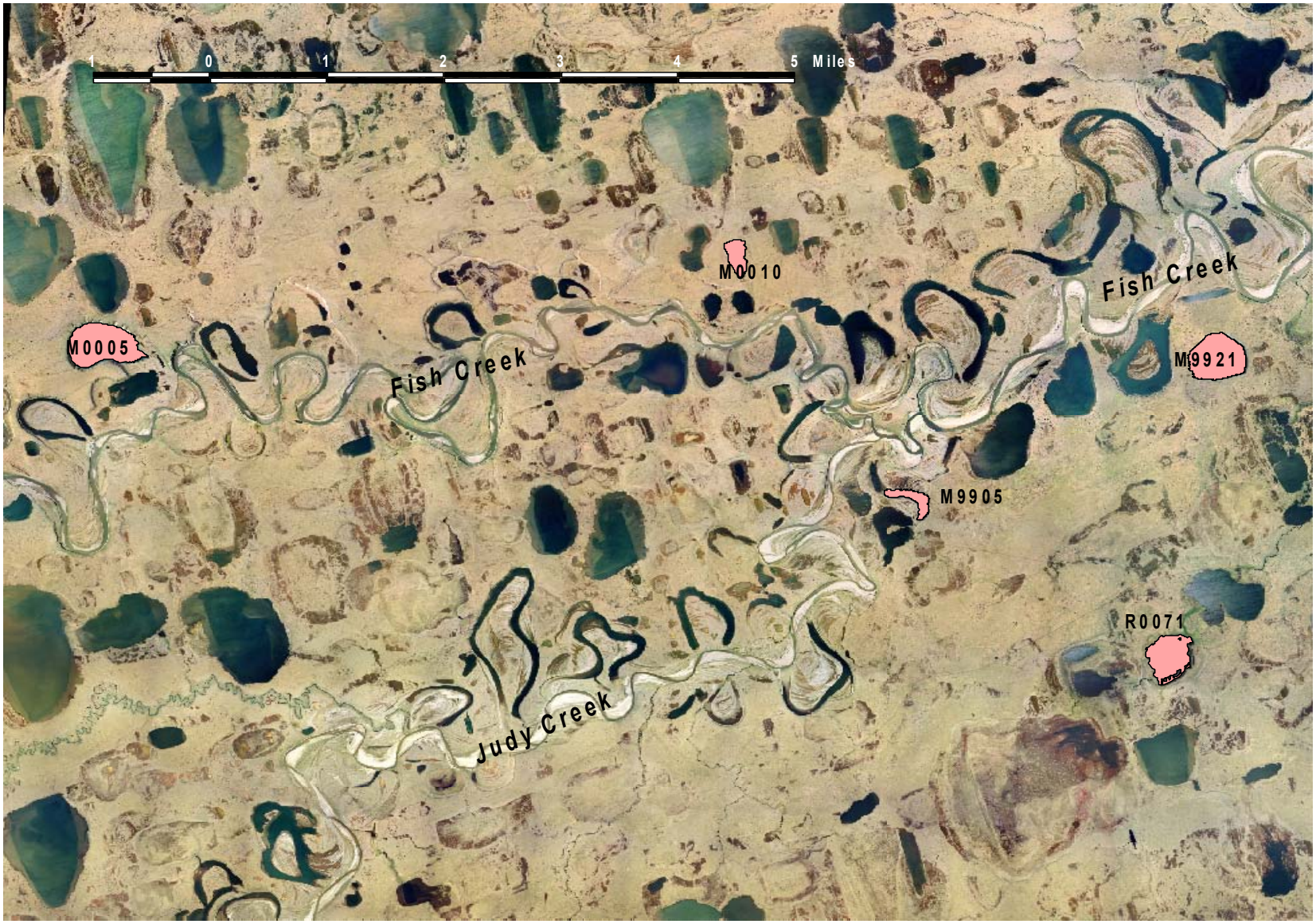
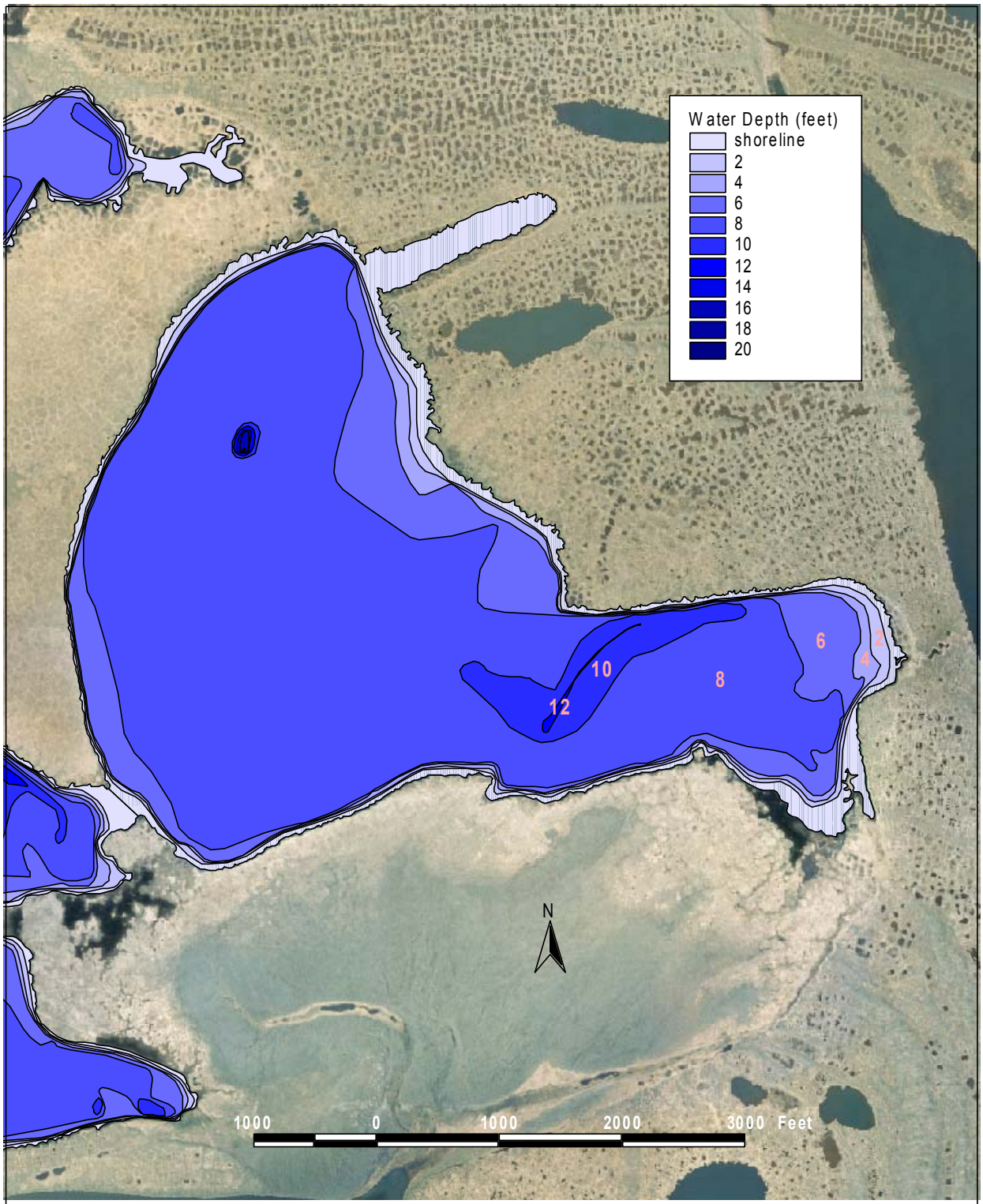


Figure 3. Lakes surveyed in eastern NPRA during summer 2005 for potential use during exploration.

Lake Summaries



Depth contours of lake B8530 based on transects surveyed on July 14, 2005
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake B8530

Other Names: Z6.2
Location: 70.24517°N 150.92085°"W
USGS Quad Sheet Harrison Bay B-2: T10N R5E, Sec 4/5/8/9
Habitat: Perched Lake (Frequent Flooding)
Area: 425 acres
Maximum Depth: 18.6 feet
Active Outlet: No
Total Lake Volume: 1,084.9 million gallons (2005 data)
Water Volume Under 4 ft of ice: 569.8 million gallons
Water Volume Under 5 ft of ice: 447.7 million gallons
Water Volume Under 7 ft of ice: 213.3 million gallons
Potential Ice Aggregate: 46.7 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **32.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

Year	Water Removed (all sources) (mill. Gals)
1998/1999	12.21
1999/2000	4.17
2001/2002	11.46
2002/2003	10.00
2003/2004	9.27
2004/2005	17.42

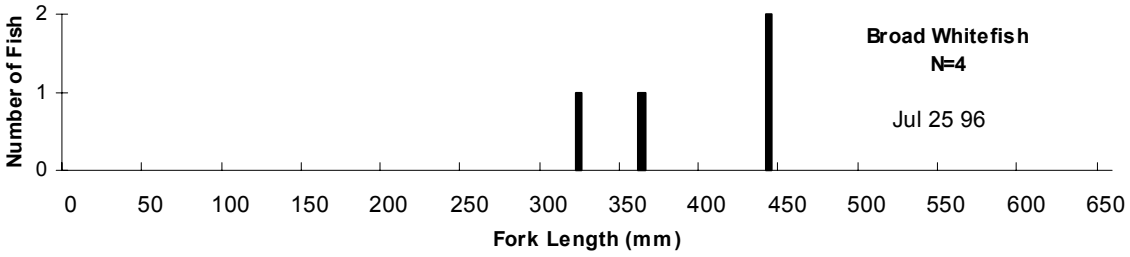
Water Chemistry:

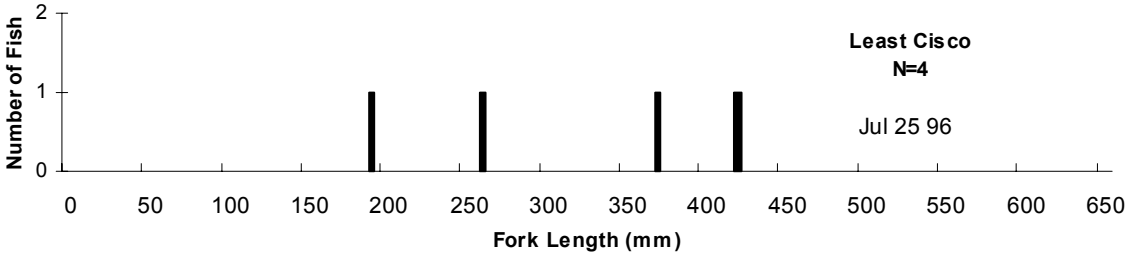
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1985					34	57		7.5	Bendock & Burr 1986
1996	12.2	2.86	17.6	6.1	42.2				J. Lobdell
1997								7.6-7.7	
2005	5.5	2.4	3.4	<3	24	55	1.1	8.11	

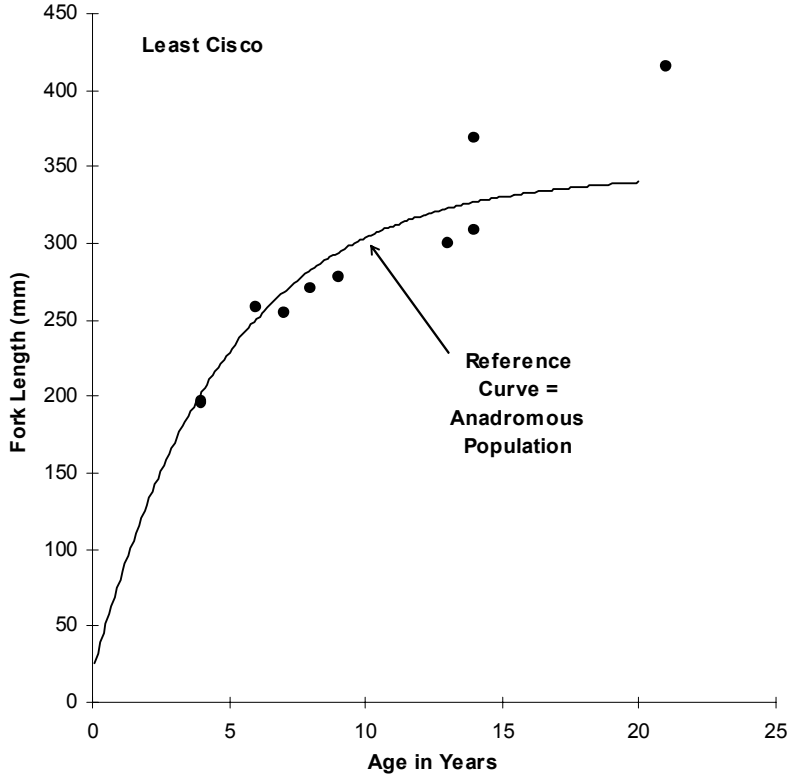
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 16-19, 1985	~24	Broad whitefish	?	
			Humpback whitefish	?	
			Least cisco	?	
			Ninespine stickleback	?	
Gill Net	Jul 25 96	2.5	Broad whitefish	4	323-442
			Least cisco	5	194-425
			Alaska blackfish	6	

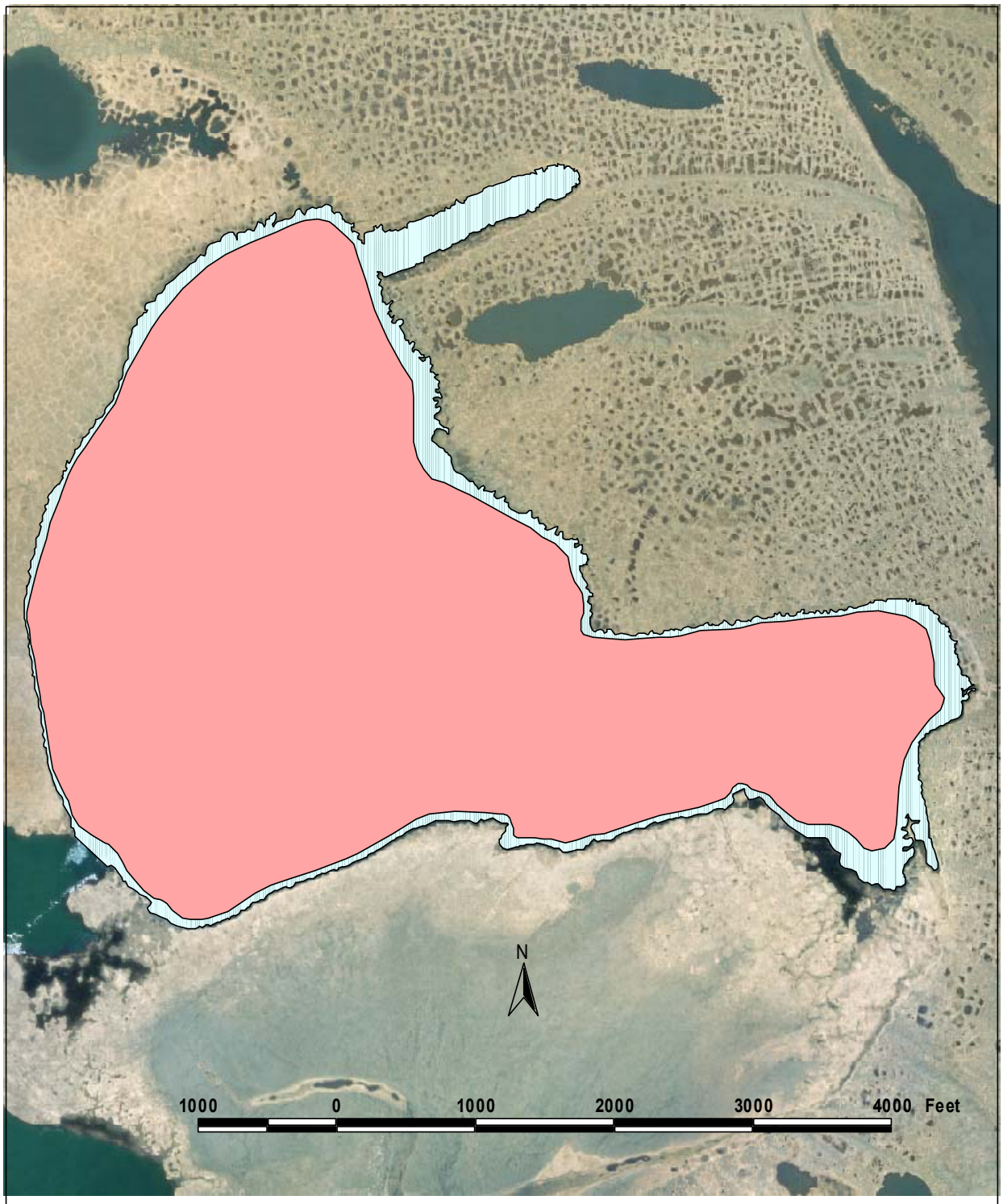
Source of 1985 data: Bendock and Burr 1986





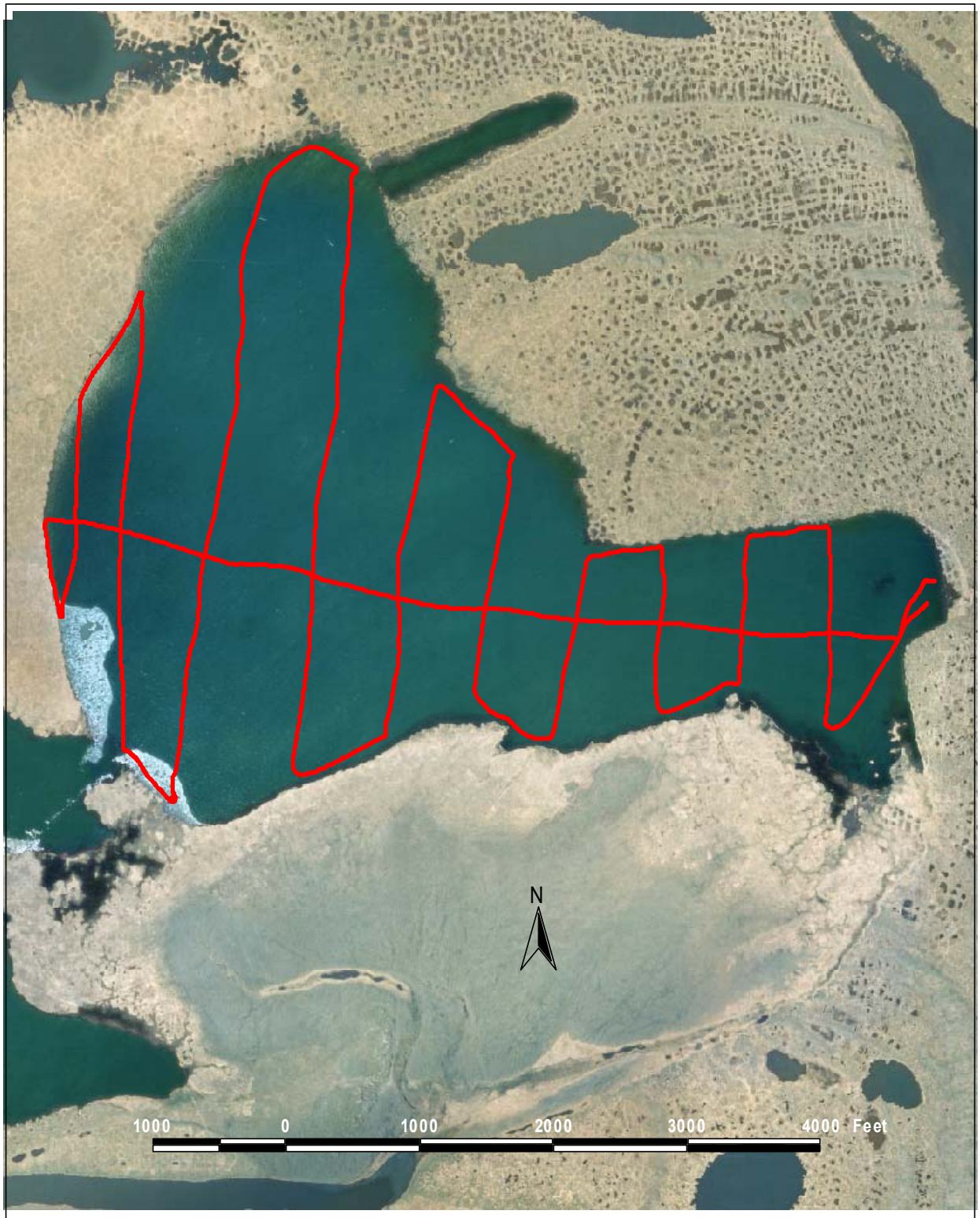


Length frequencies of fish caught in lake B8530 by gill net, and age-length relationship of least cisco, in 1996.

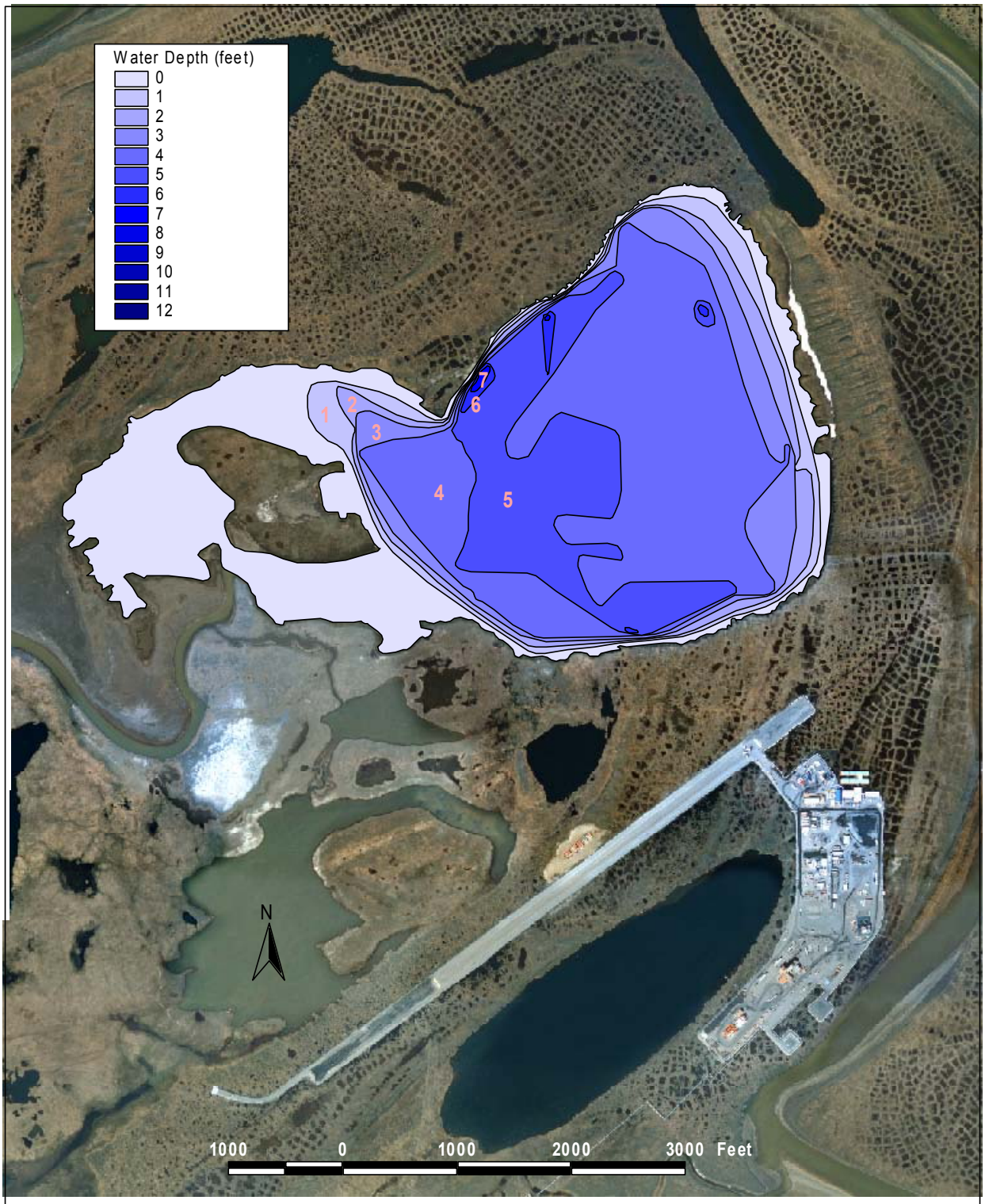


Regions of lake B8530 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 14, 2005 .

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake B8530 on July 14, 2005.



Depth contours of lake L9278 based on transects surveyed on July 14, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake L9278

Other Names: S6.1
Location: 70.35436°N 150.94092°"W
USGS Quad Sheet Harrison Bay B-2: T12N R5E, Sec 29/31/32
Habitat: Tapped Lake
Area: 344 acres
Maximum Depth: 7.7 feet
Active Outlet: Yes
Total Lake Volume: 356.5 million gallons (2005 data)
Volume Under 4 ft of ice: 46.4 million gallons
Volume Under 5 ft of ice: 8.5 million gallons
Volume Under 7 ft of ice: 0.0 million gallons
Potential Aggregate: 161.3 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **0.01 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

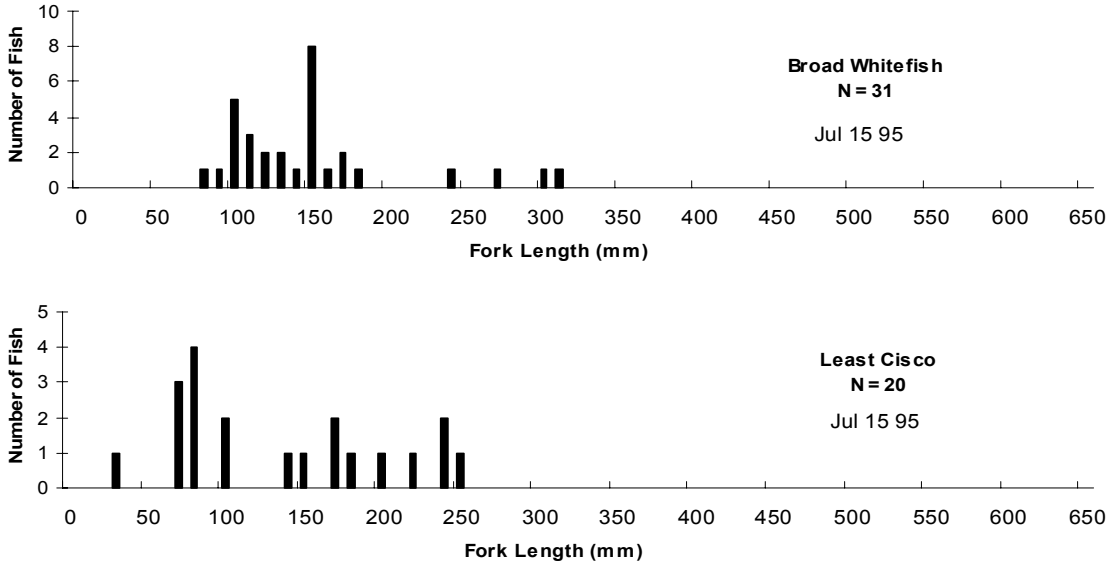
Year	Water Removed (all sources) (mill. Gals)
1999/2000	4.16
2003/2004	2.05
2004/2005	2.47

Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1992	184	83	2400	1300.0	965	5000			J. Lobdell
1995						4235			
2005						6303	2.8	7.86	

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 15 95	24.3	Broad whitefish	31	84-312
			Humpback whitefish	2	148, 152
			Least cisco	20	35-251
			Round whitefish	1	102
			Ninespine stickleback	5	--
Minnow Trap	Jul 15 95	48.1	None	0	
Seine	Jul 15 95		Least cisco	36	
Set Line	Jul 15 95	24.7	None	0	

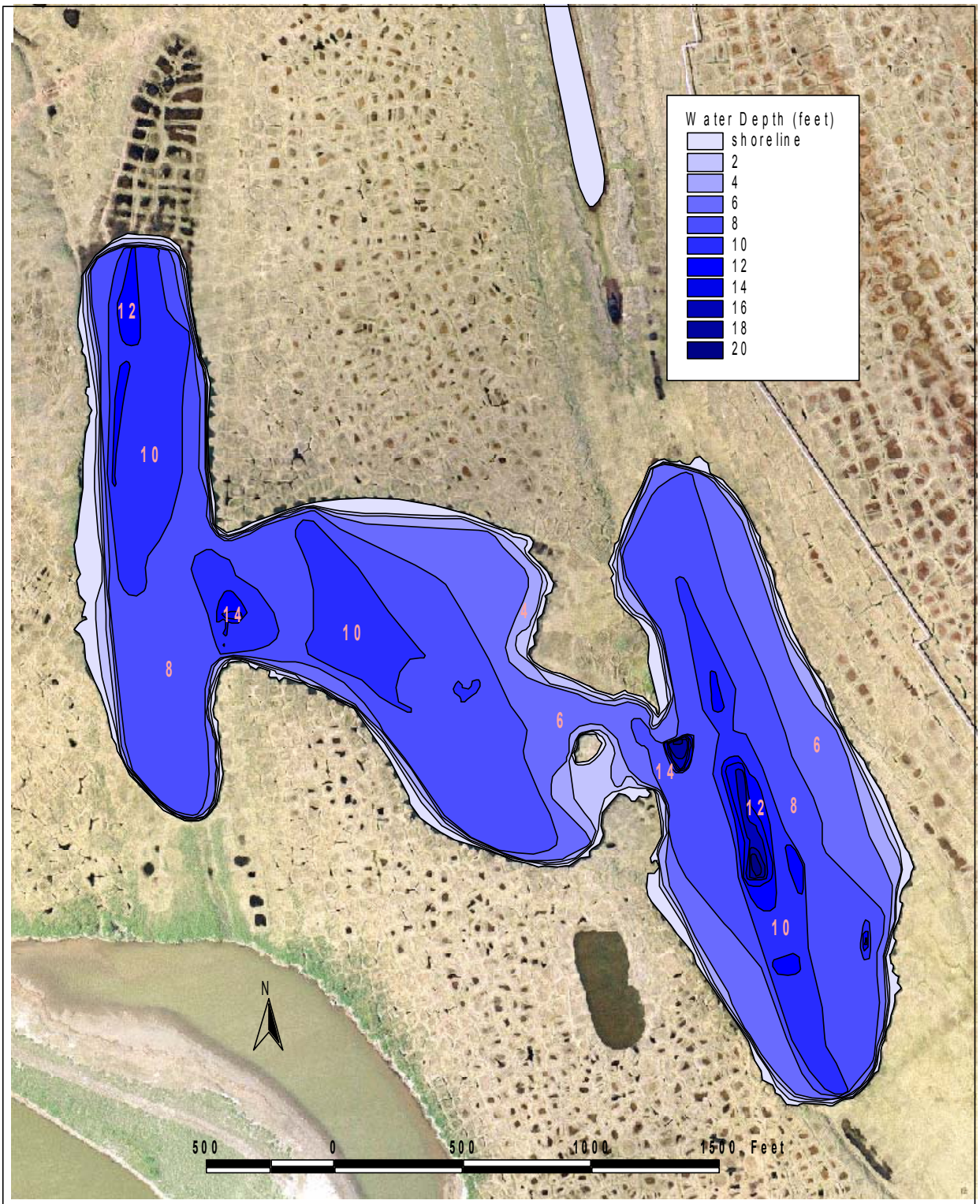


Length frequencies of fish caught in lake L9278 by fyke net, 1995

Regions of lake L9278 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 13, 2005 .

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake L9278 on July 14, 2005.



Depth contours of lake L9323 based on transects surveyed on August 30, 2002.
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake L9323

Other Names: W5.1
Location: 70.29811°N 150.99959°W
USGS Quad Sheet: Harrison Bay B-2: T11N R4/5E, Sec 13/24/19
Habitat: Perched Lake (Infrequent Flooding)
Area: 95 acres
Maximum Depth: 23.2 feet
Active Outlet: No
Total Lake Volume: 249.5 million gallons (2002 data)
Volume Under 4 ft of ice: 133.7 million gallons
Volume Under 5 ft of ice: 106.8 million gallons
Volume Under 7 ft of ice: 56.7 million gallons
Potential Aggregate: 10.6 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **8.51 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

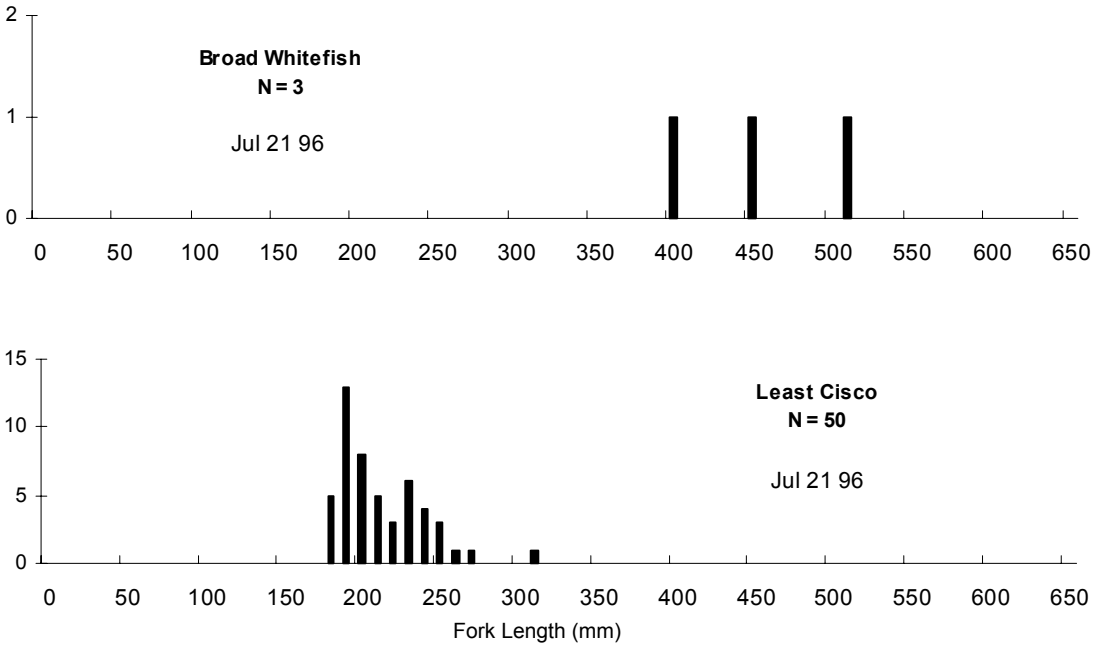
Year	Water Removed (all sources) (mill. Gals)
1998/1999	5.72
1999/2000	4.37

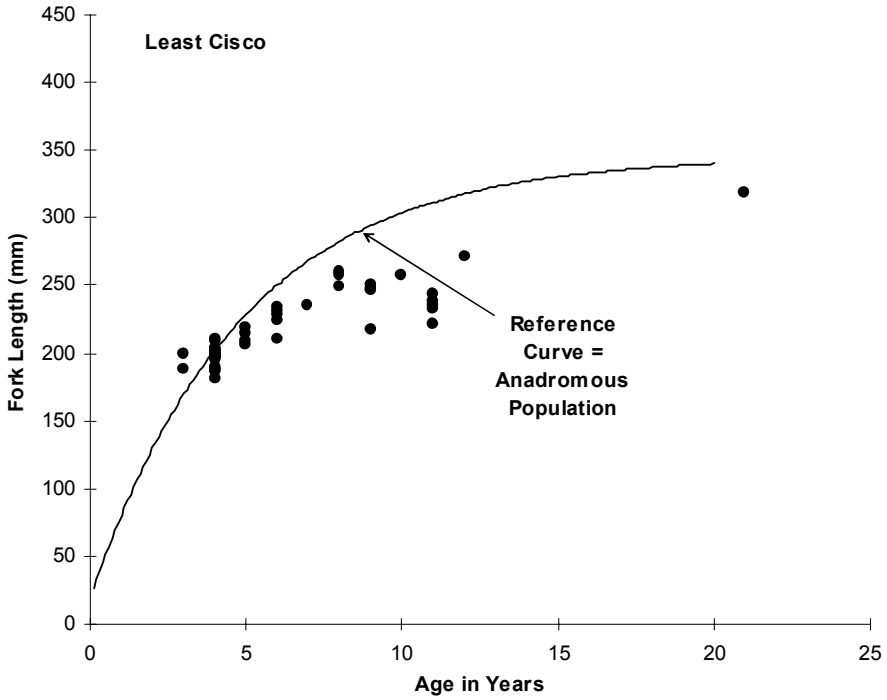
Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1993	4.0	2.8	4.3	1.5	17				J. Lobdell
1999						74			
Jul 2001						61	3.6	7.97	
Aug 2001						71	2.3	7.92	

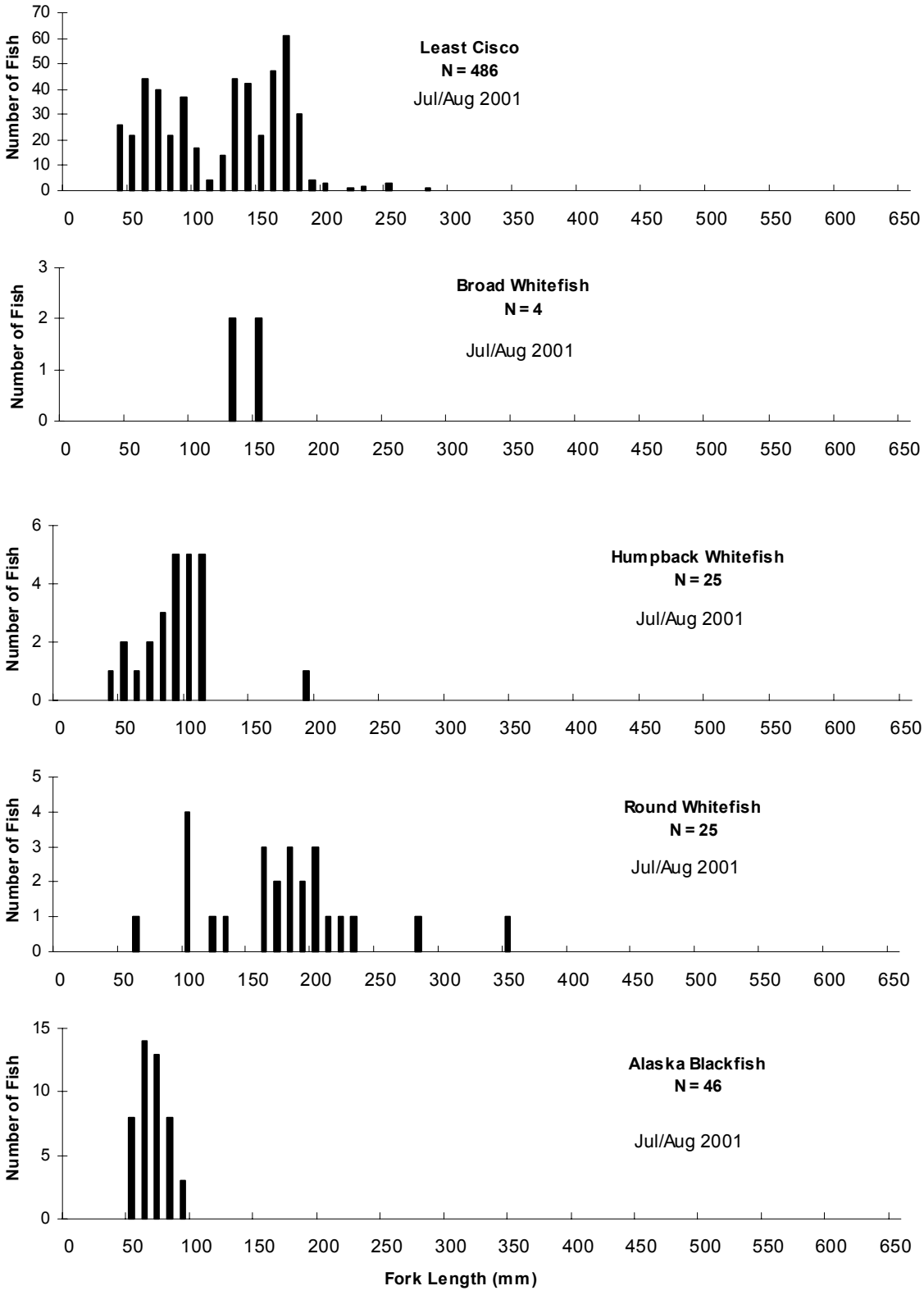
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 96	5.6	Broad whitefish	3	400-512
			Round whitefish	1	217
			Least cisco	50	181-319
Gill Net	Jul 27 99	6.1	Broad whitefish	1	495
			Least cisco	3	227-305
			Round whitefish	1	153
Fyke Net	Jul 12-25, 01 and Aug 18-25, 01	473.2	Broad whitefish	7	137-159
			Humpback whitefish	25	47-192
			Least cisco	486	42-285
			Round whitefish	22	70-352
			Alaska blackfish	43	51-100
			Slimy sculpin	25	35-84
			Ninespine stickleback	565	

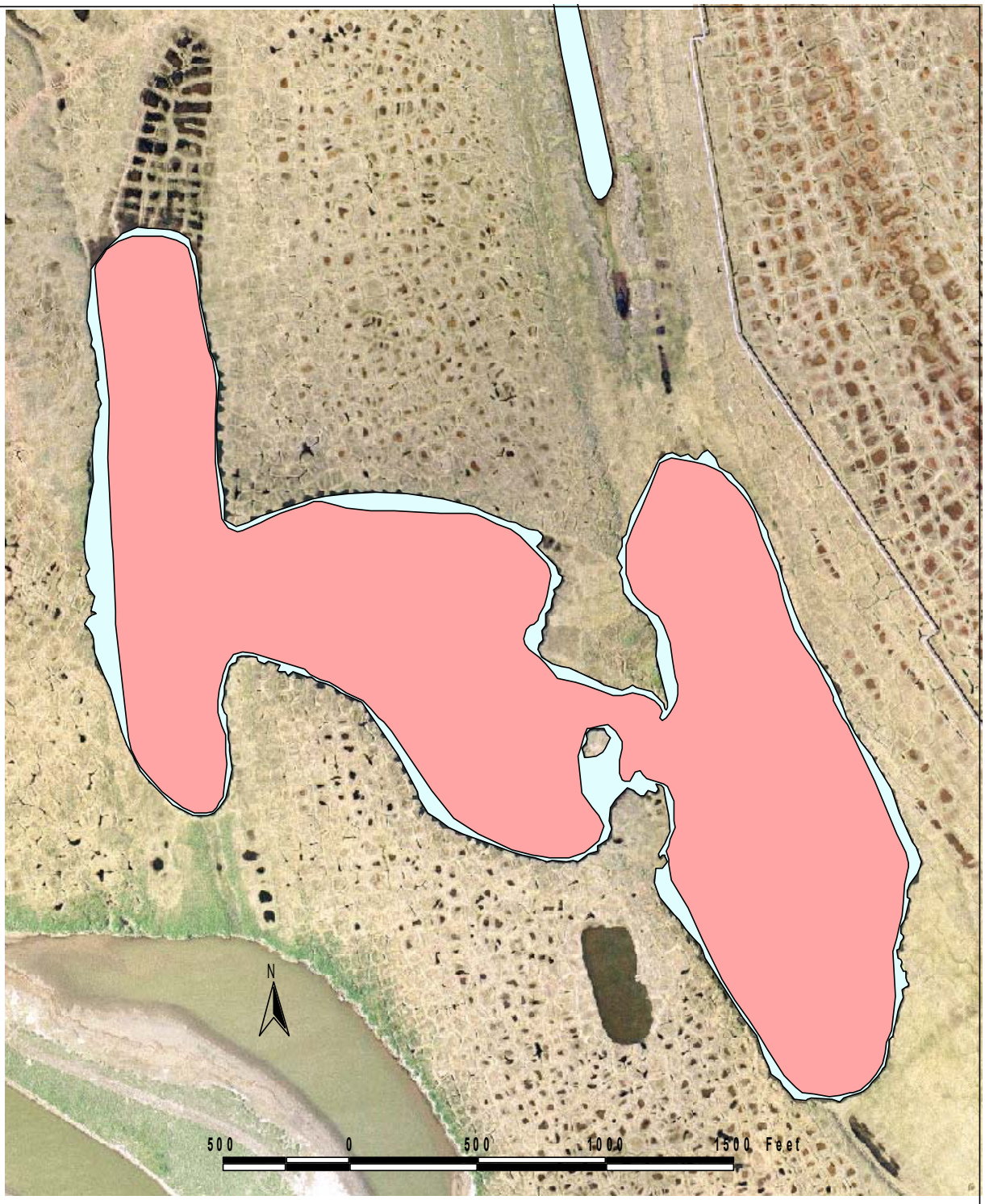




Length frequencies of fish caught in lake L9323 by gill net, and age-length relationship of least cisco, in 1996.



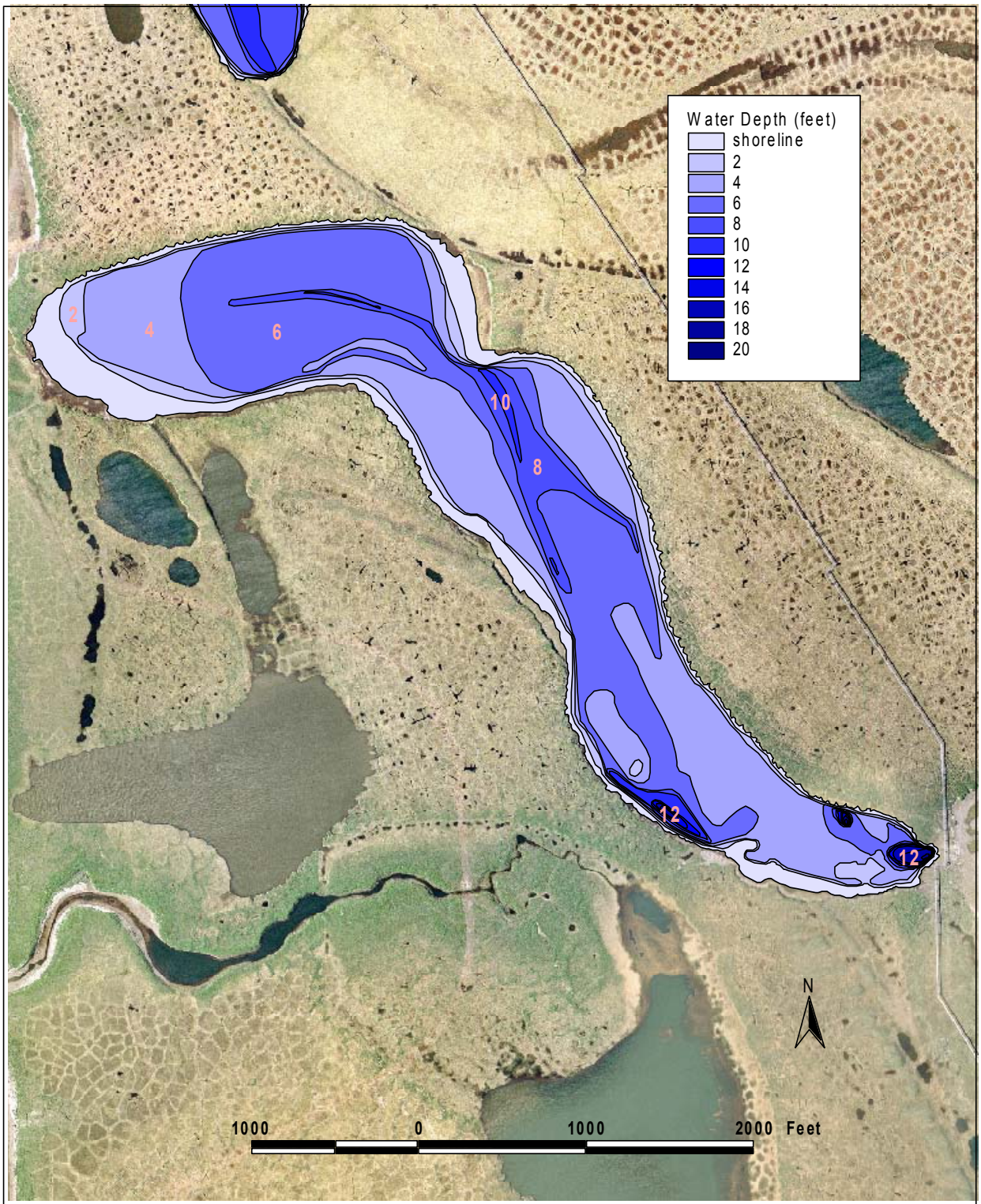
Length frequencies of fish caught in lake L9323 by fyke net, 2001.



Regions of lake L9323 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 30, 2002.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake L9323 on August 30, 2002.



Depth contours of lake L9324 based on transects surveyed on July 15, 2005.
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake L9324

Other Names: W5.2
Location: 70.28770°'N 150.97477°W
USGS Quad Sheet: Harrison Bay B-2: T11N R4/5E, Sec 24/19/30
Habitat: Perched Lake (Frequent Flooding)
Area: 130 acres
Maximum Depth: 24.1 feet
Active Outlet: Yes
Calculated Volume: 228.3 million gallons (2005 data)
Volume Under 4 ft of ice: 79.6 million gallons
Volume Under 5 ft of ice: 47.3 million gallons
Volume Under 7 ft of ice: 11.0 million gallons
Potential Aggregate: 27.8 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **8.51 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

Year	Water Removed (all sources) (mill. Gals)
1998/1999	7.17
1999/2000	5.28
2001/2002	4.65
2002/2003	10.20
2003/2004	2.00
2004/2005	1.99

Water Chemistry:

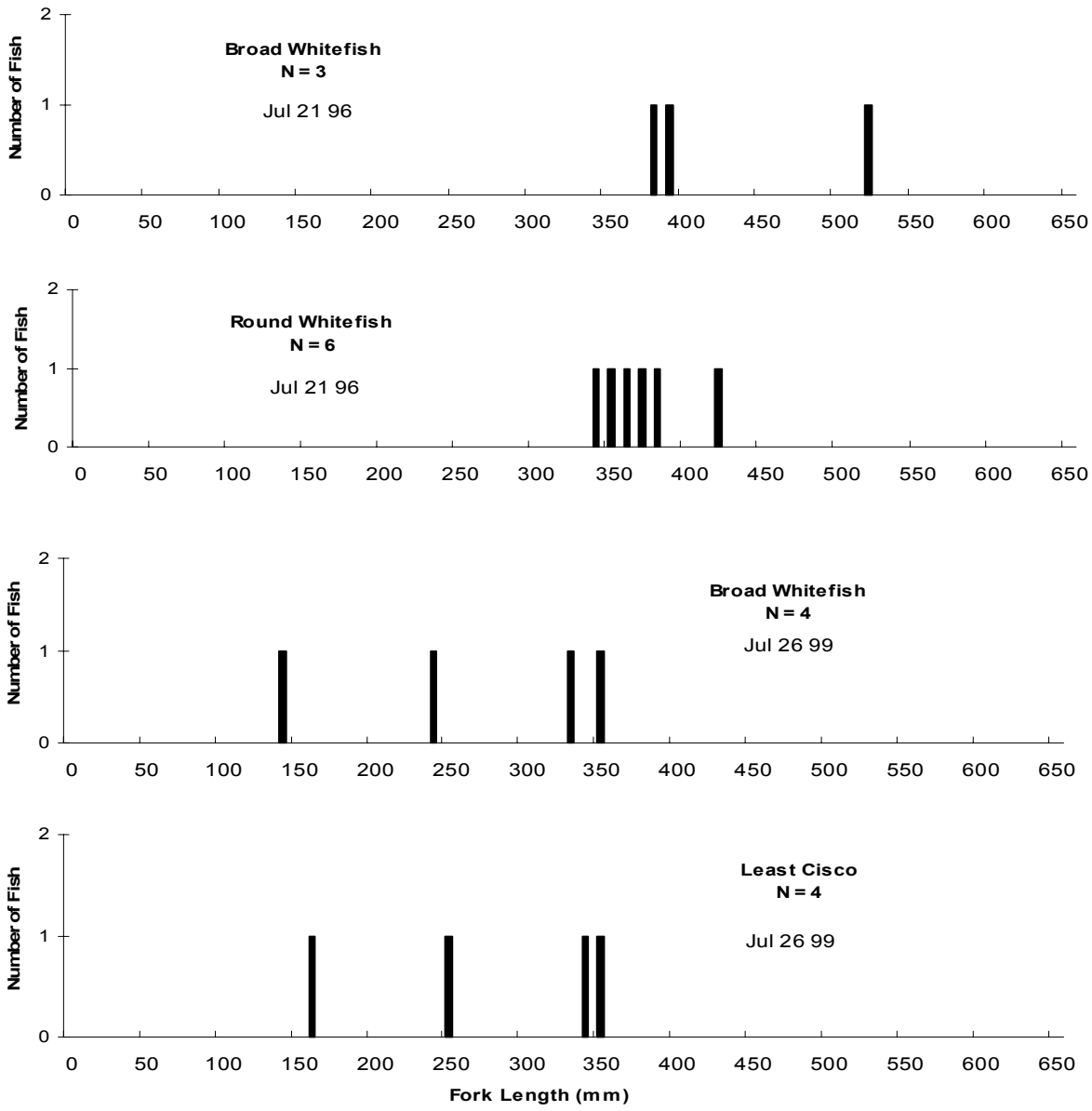
Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1993	1.5	5.3	2.0	1.7	19				J. Lobdell
1996						55.2			
1999						85.3		8.20	
2001						73.3		7.95	
2005	9.8	3.9	4.9	4.1	41	43.7	6.1	7.60	

Catch Record:

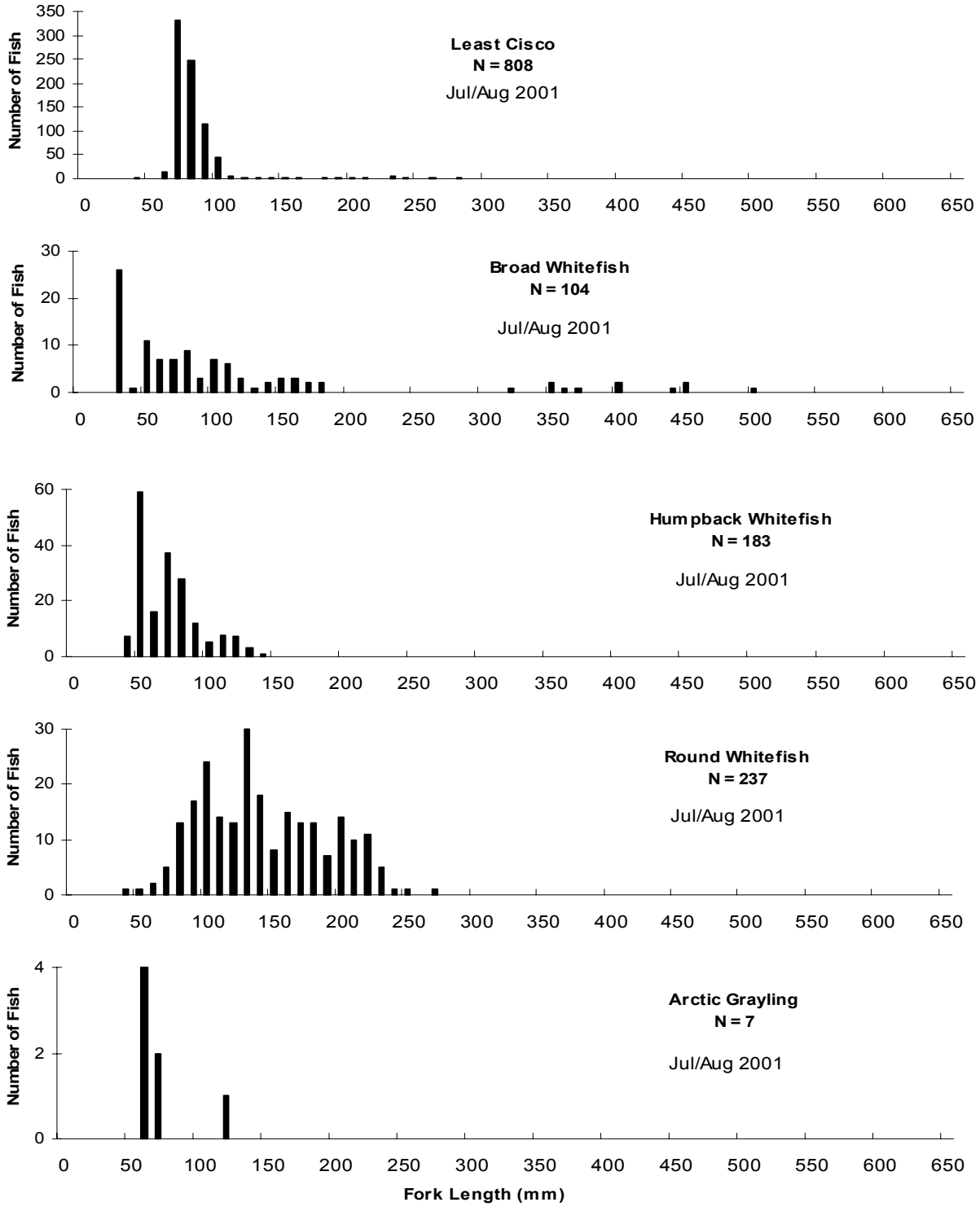
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 96	11.5	Broad whitefish	3	382-528
			Round whitefish	6	340-429
Gill Net	Jul 25 99	4.7	None	0	
Gill Net	Jul 26 99	7.7	Broad whitefish	4	145-357
			Least cisco	4	166-357
Fyke Net	Jul 19-25, 01 and Aug 18-25, 01	313.3	Broad whitefish	103	32-505
			Humpback whitefish	341	43-142
			Arctic cisco	16	82-187
			Least cisco	1,301	38-365
			Round whitefish	237	47-278
			Dolly Varden char	3	293-525
			Arctic grayling	7	64-126
			Alaska blackfish	6	72-110
			Longnose sucker	5	102-151
			Arctic lamprey	1	189
			Slimy sculpin	1	
			Ninespine stickleback	53	

Catch Record (continued):

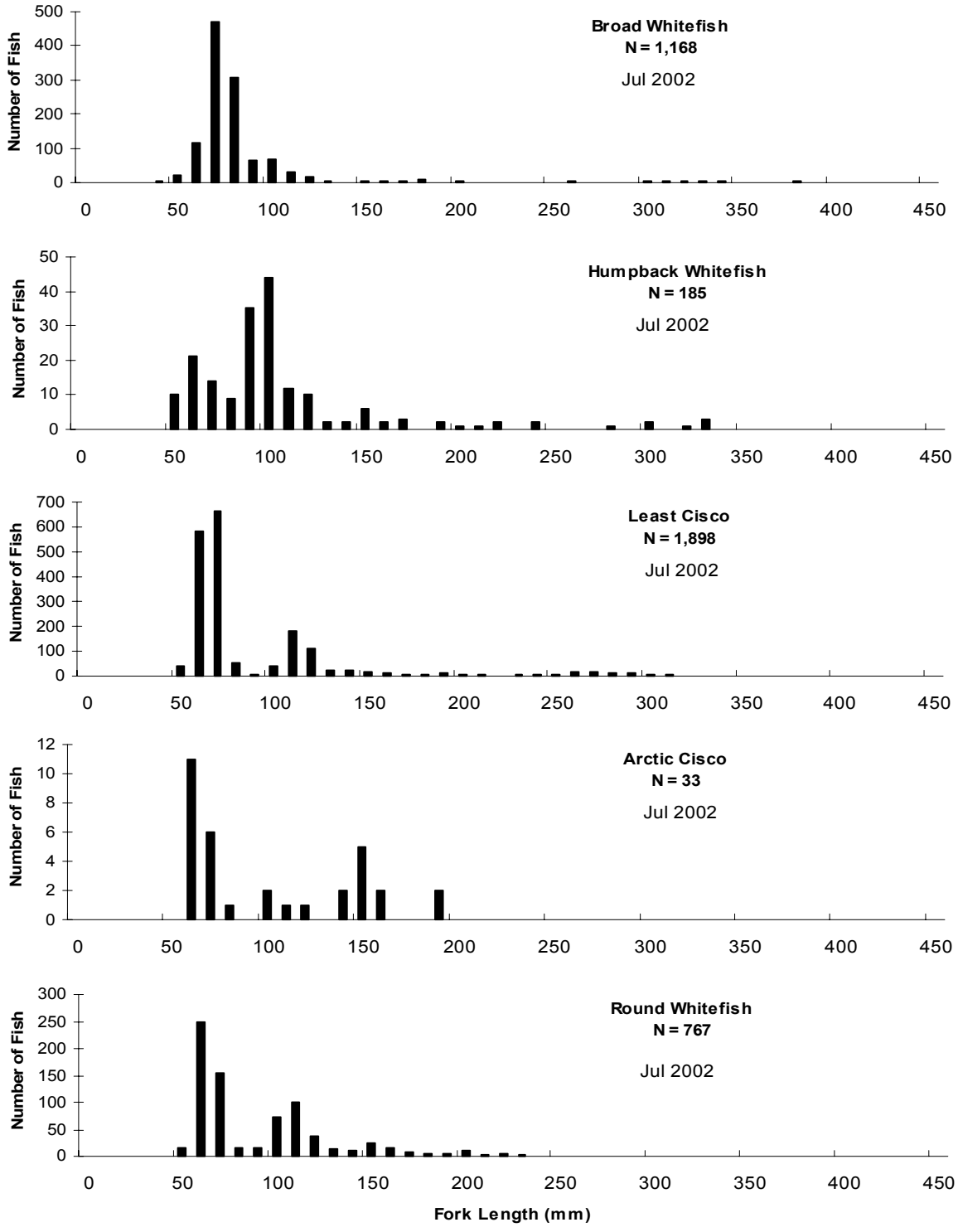
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 11-20, 02	221.5	Chum salmon	1	62
			Broad whitefish	1,174	46-446
			Humpback whitefish	185	52-338
			Arctic cisco	33	61-196
			Least cisco	1,899	42-400
			Arctic grayling	35	55-368
			Round whitefish	767	52-360
			Alaska blackfish	2	71-79
			Longnose sucker	1	122



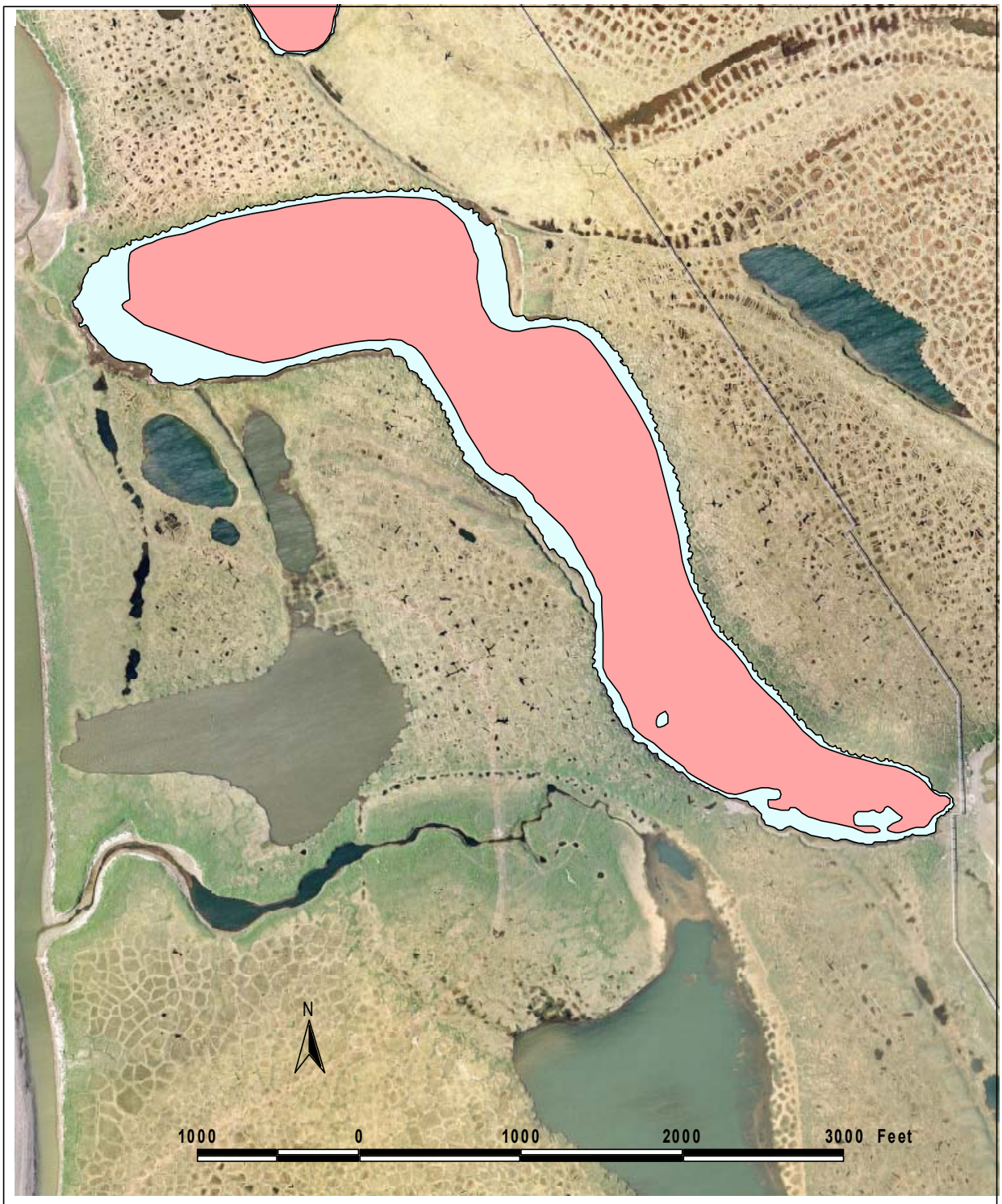
Length frequencies of fish caught in lake L9324 by gill net, 1996 and 1999.



Length frequencies of fish caught in lake L9324 by fyke net, 2001.



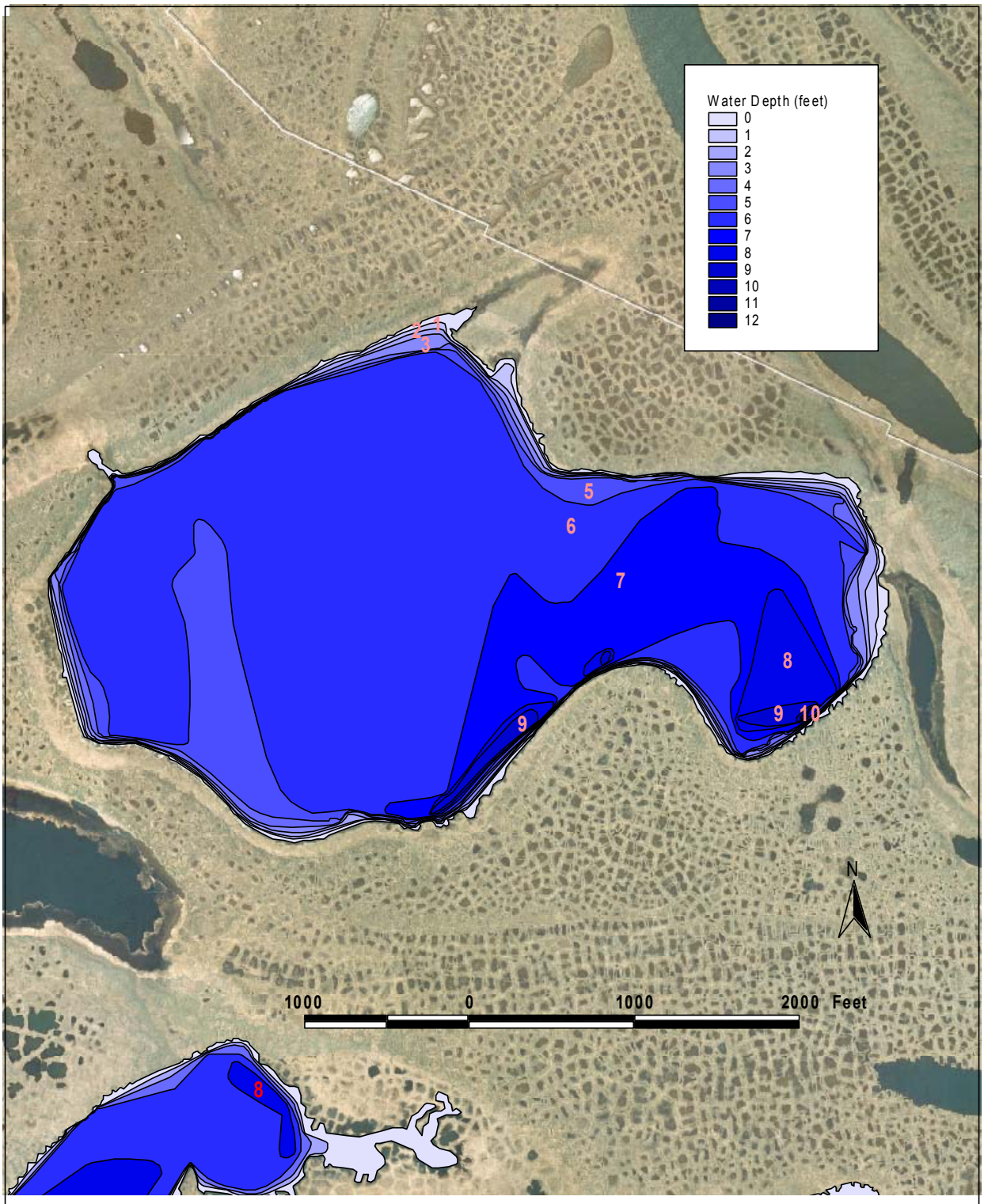
Length frequencies of fish caught in lake L9324 by fyke net, 2002.



Regions of lake L9324 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 15, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake L9324 on July 15, 2005.



Depth contours of lake L9327 based on transects surveyed on July 13, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake L9327

Other Names: Y6.3
Location: 70.26363°N 150.93064°W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E, Sec 32
Habitat: Perched Lake (Infrequent Flooding)
Area: 220 acres
Maximum Depth: 13.0 feet
Active Outlet: No
Calculated Volume: 443.9 million gallons (2005 data)
Volume Under 4 ft of ice: 168.6 million gallons
Volume Under 5 ft of ice: 103.4 million gallons
Volume Under 7 ft of ice: 9.5 million gallons
Potential Aggregate: 17.9 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **1.42 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

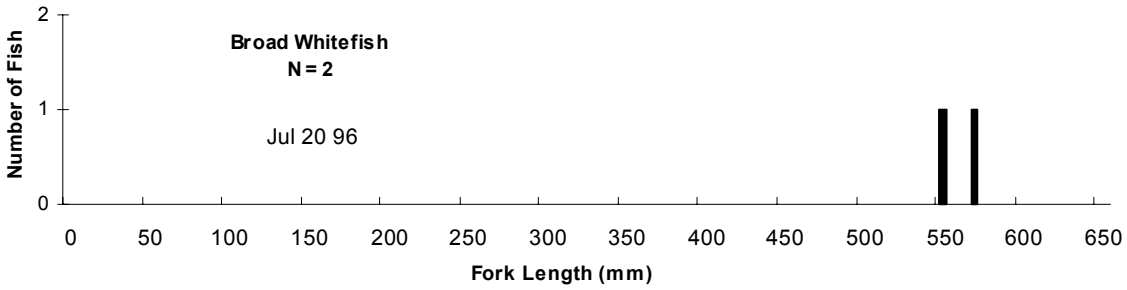
Year	Water Removed (all sources) (mill. Gals)
1998/1999	9.84
1999/2000	8.56
2004/2005	6.33

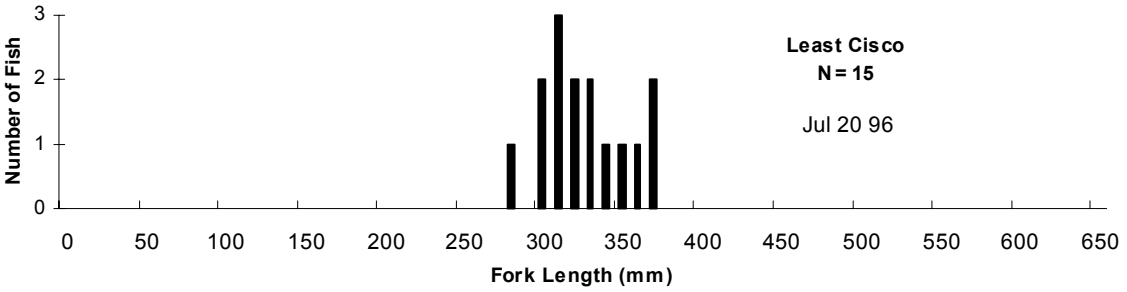
Water Chemistry:

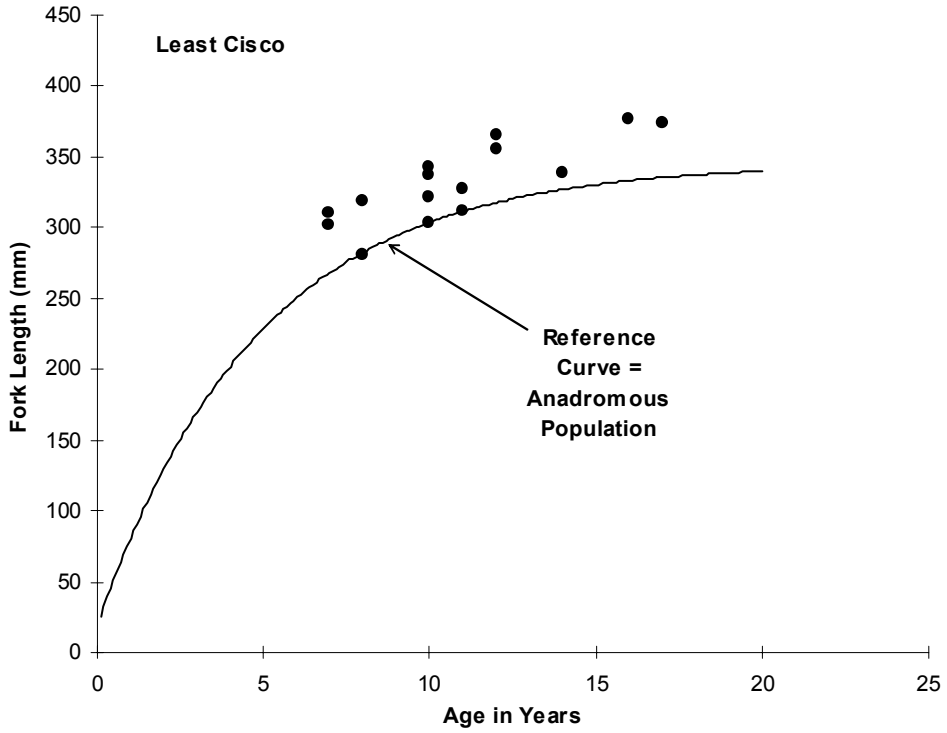
Year of Test	Calcium (mg/l	Magnesium (mg/l	Chloride (mg/l	Sodium (mg/l	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1993	2	1.5	1.7	4.9	19				J. Lobdell
1996						79.8			
2005	6.6	3.1	4.1	<3	29	65.7	2.86	7.52	
2005						62.6	0.75	7.72	

Catch Record:

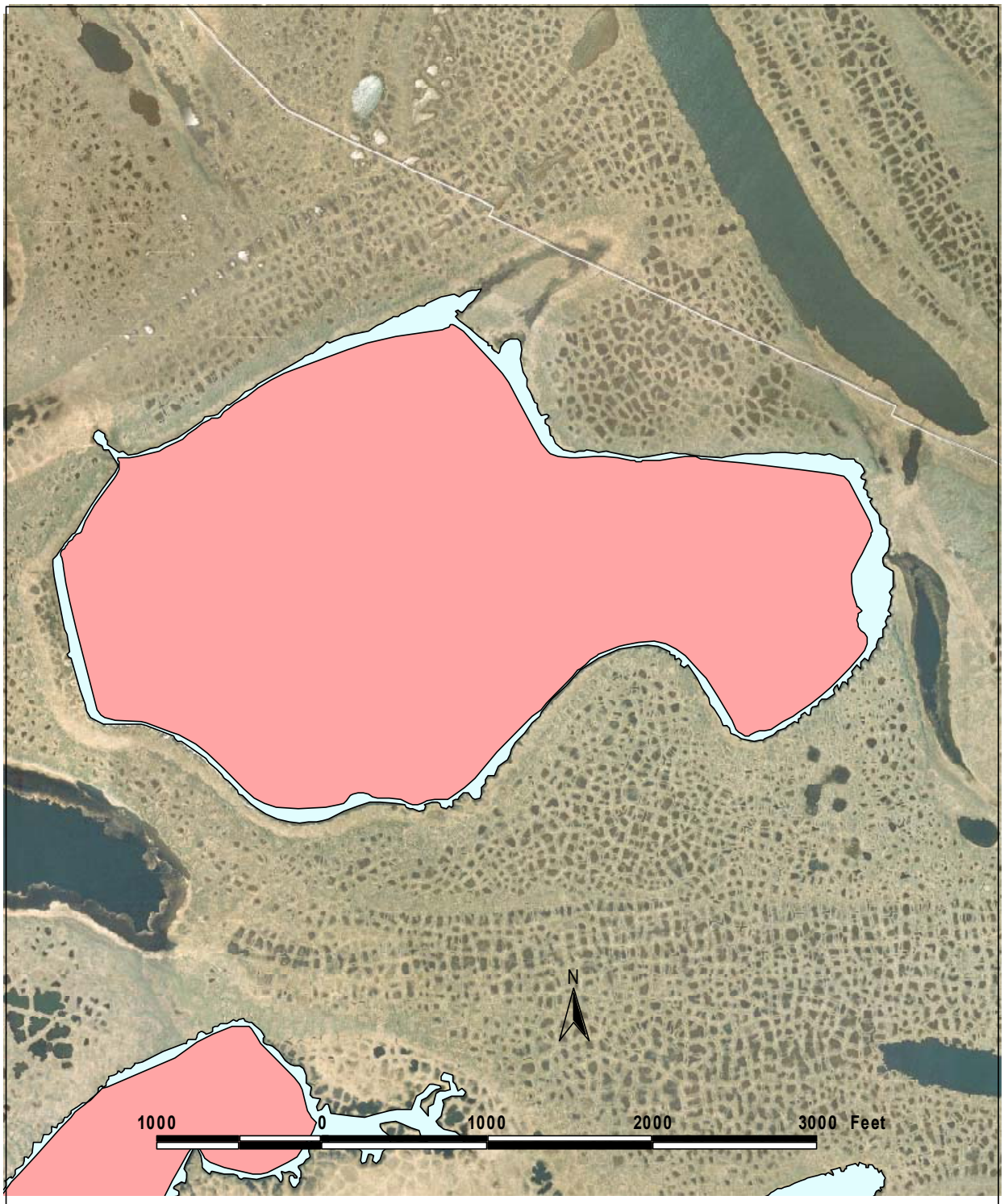
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 20 96	11.2	Broad whitefish	2	552-579
			Least cisco	15	281-376





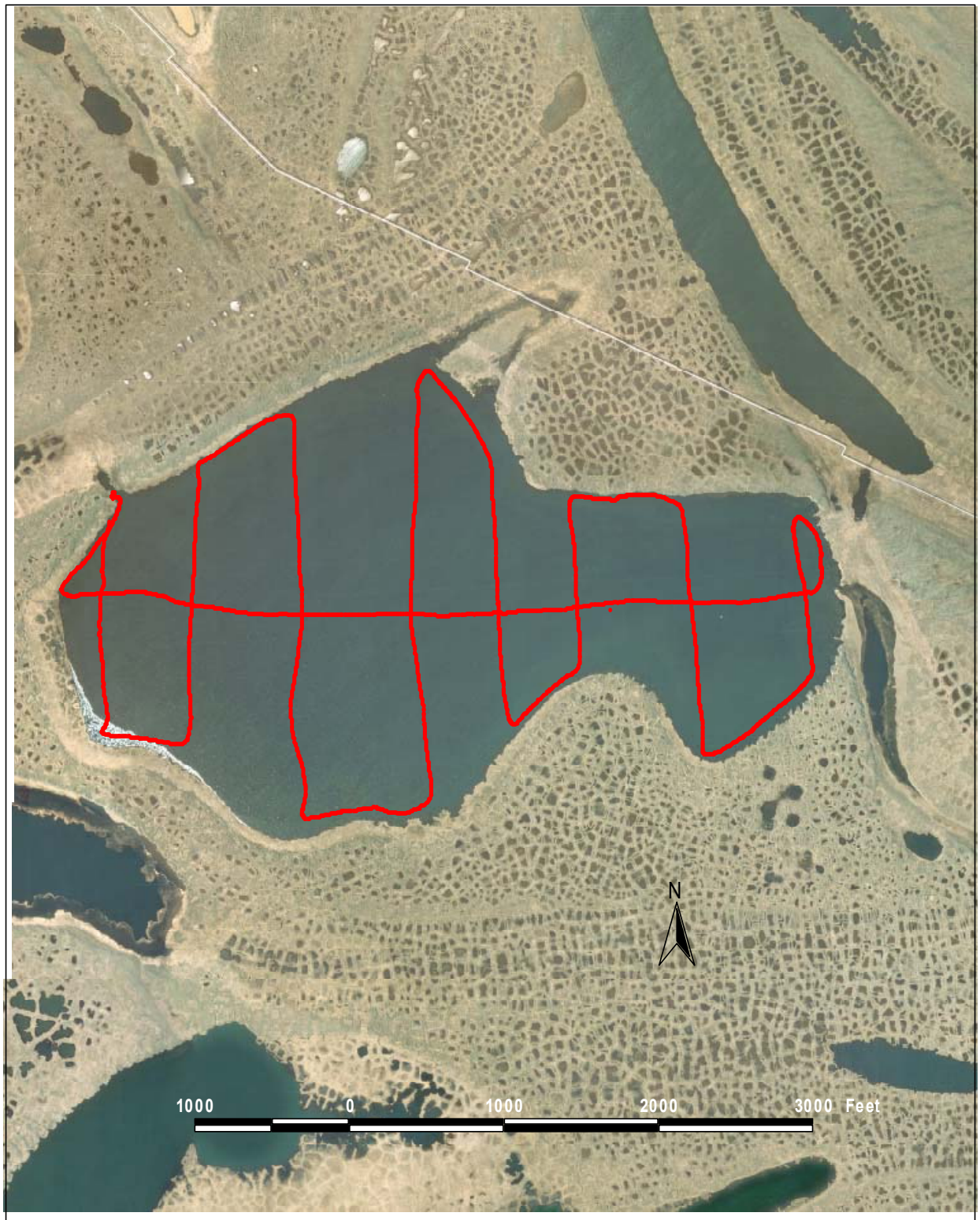


Length frequencies of fish caught in lake L9327 by gill net, and age-length relationship of least cisco, in 1996.

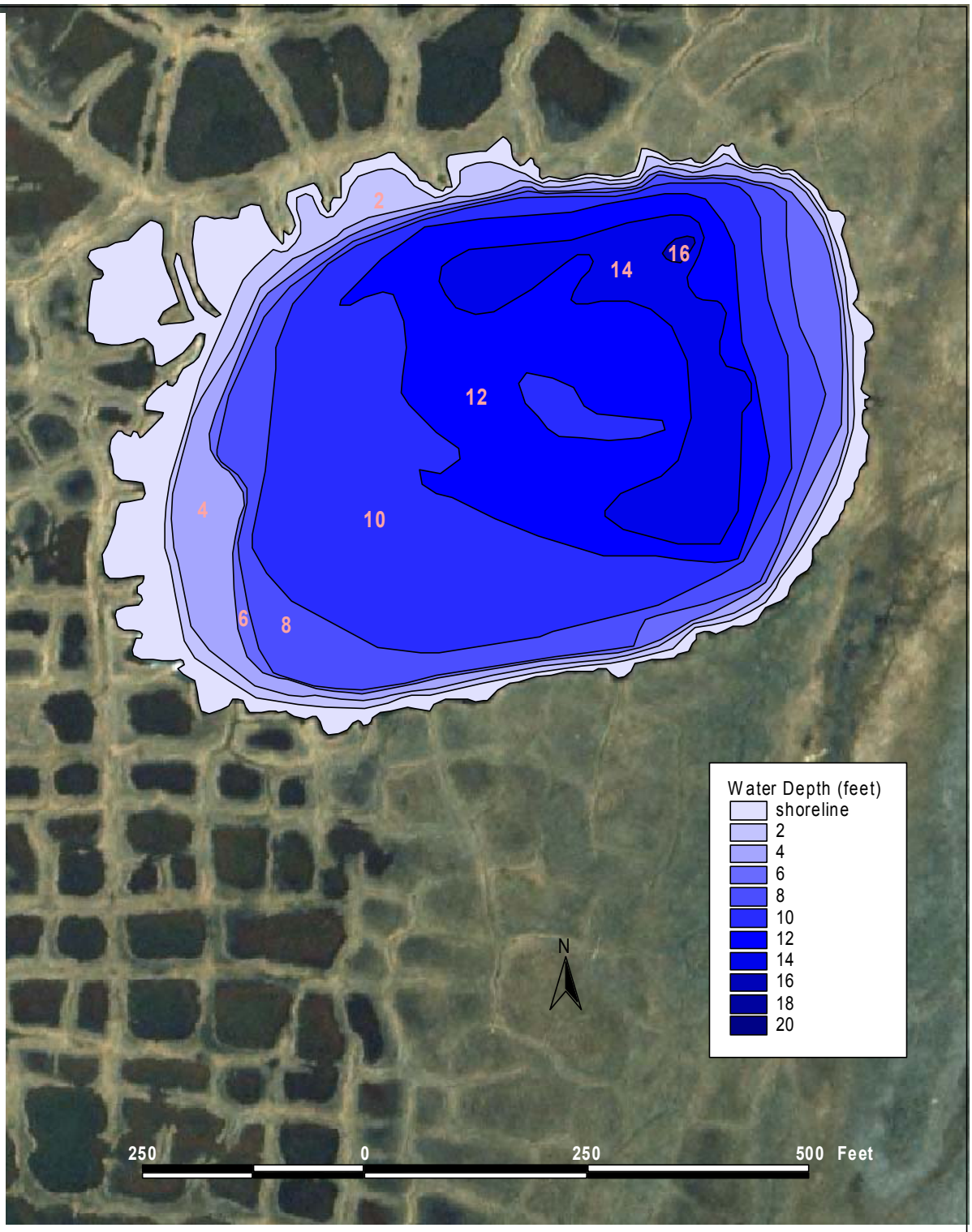


Regions of lake L9327 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 13, 2005 .

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake L9327 on July 13, 2005.



Depth contours of lake L9903 based on transects surveyed on July 15, 2005.
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake L9903

Other Names: O7.1
Location: 70.41965°N 150.87853°W
USGS Quad Sheet: Harrison Bay B-2: T12N R5E, Sec 4
Habitat: Perched Lake
Area: 10 acres
Maximum Depth: 22.9 feet
Active Outlet:
Calculated Volume: 30.0 million gallons (2005 data)
Volume Under 4 ft of ice: 18.3 million gallons
Volume Under 5 ft of ice: 15.7 million gallons
Volume Under 7 ft of ice: 10.9 million gallons
Potential Aggregate: 2.0 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **1.63 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

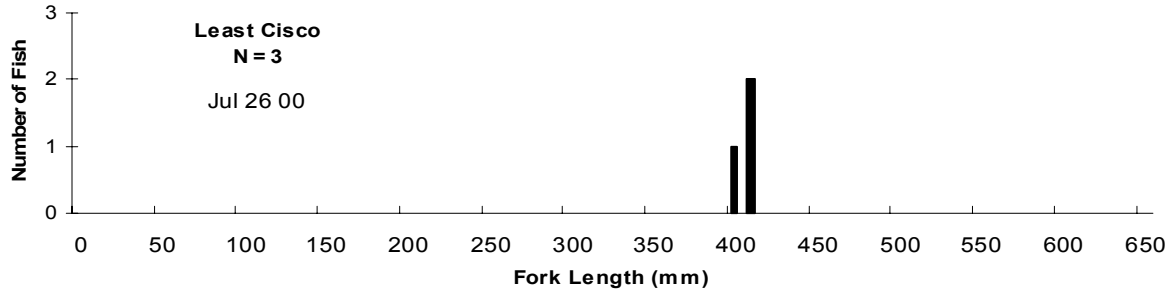
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

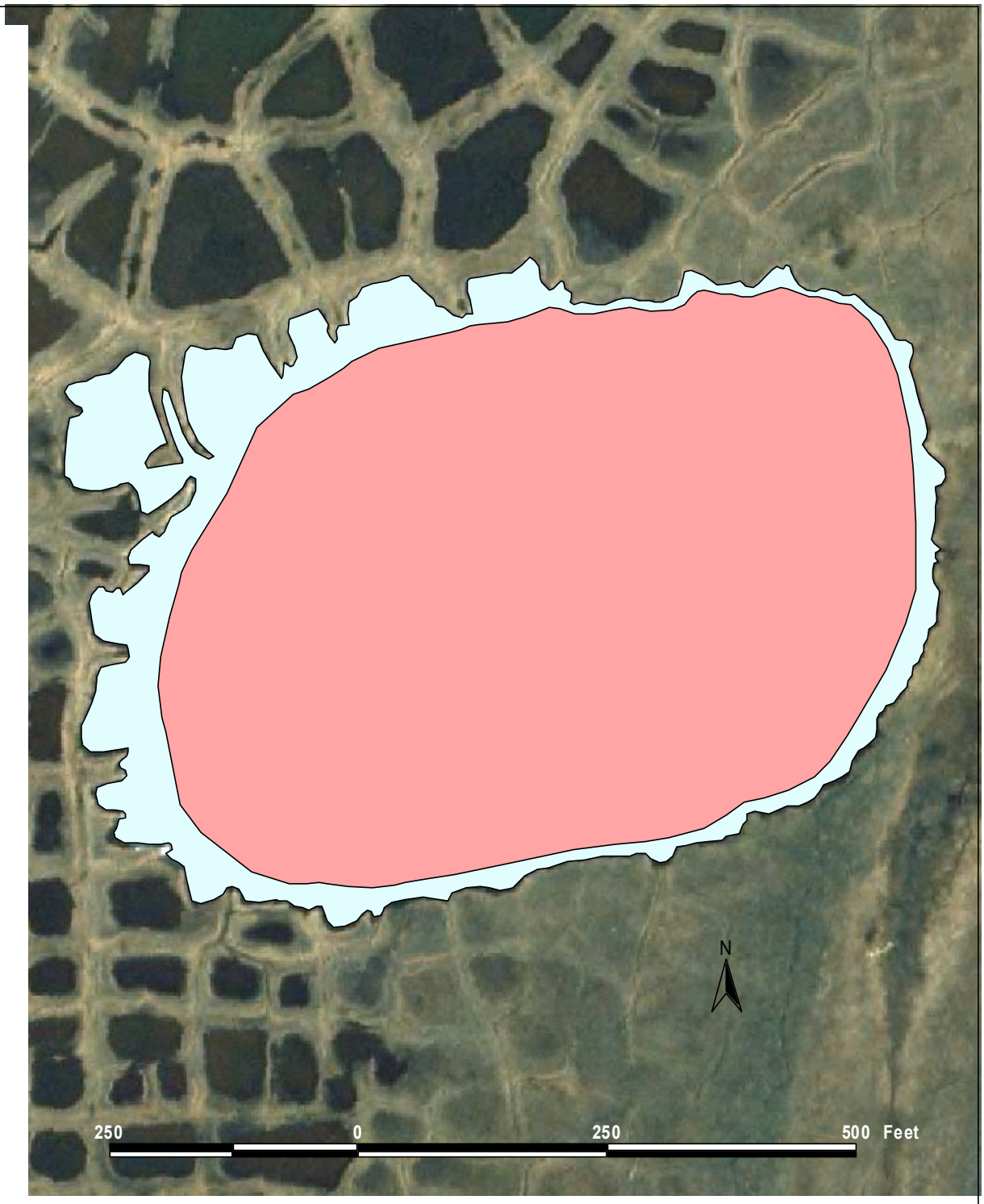
Year of Test	Calcium (mg/l	Magnesium (mg/l	Chloride (mg/l	Sodium (mg/l	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000						836		7.96	
2005	13.0	13.0	140	61.0	86	488	1.6	8.01	

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 26 00	2.3	Least cisco	3	402-415
Minnow Traps	Jul 26 00	4.5	None	0	



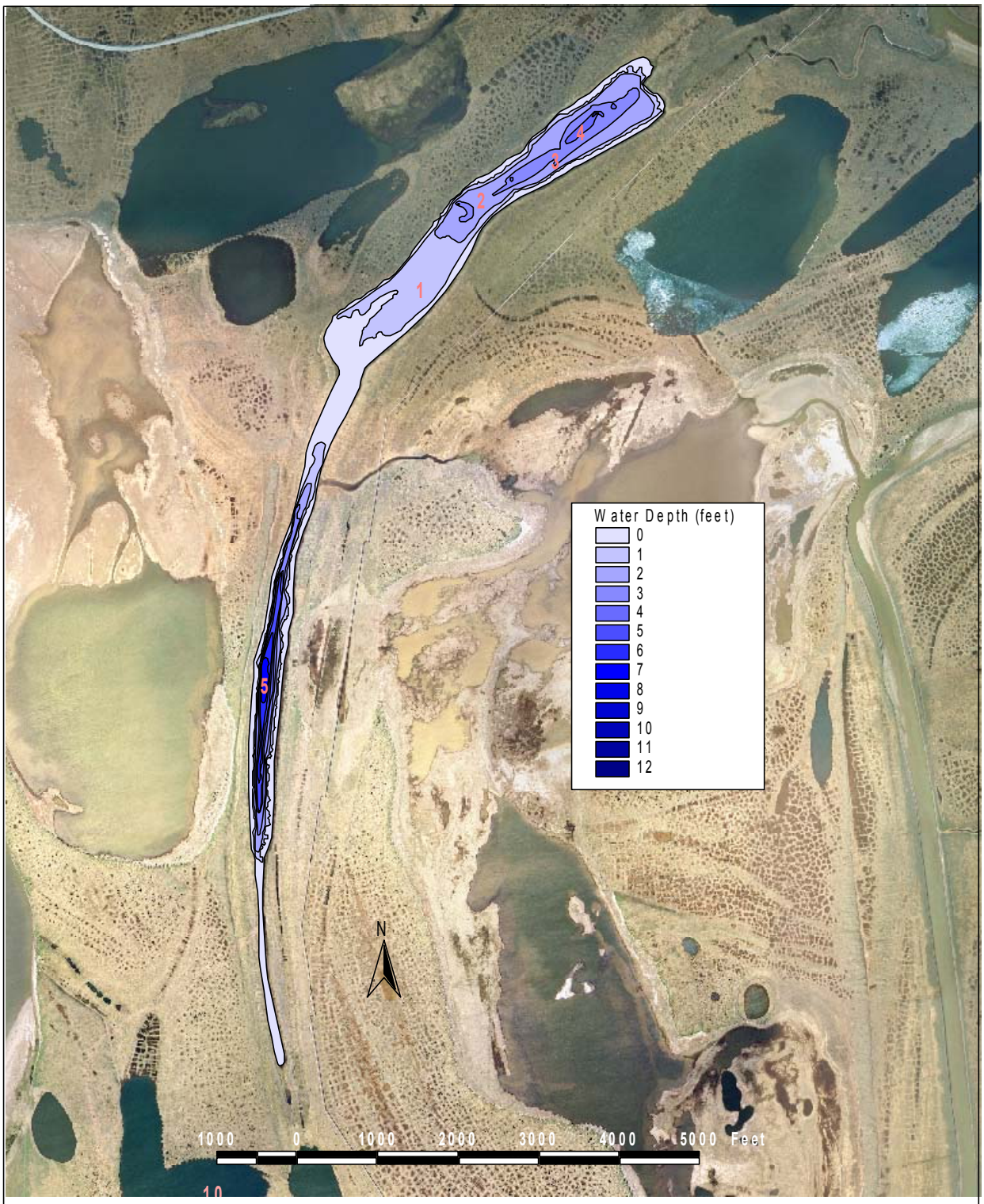
Length frequencies of fish caught in lake L9903 by gill net, 2000.



Regions of lake L9903 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 15, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake L9903 on July 15, 2005.



Depth contours of lake M9525 based on transects surveyed on July 15 anfd 18, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9525

Other Names: U5.1
Location: 70.32835°'N 150.98414°'W
USGS Quad Sheet: Harrison Bay B-2: T11N R4/5E, Sec 12/13/6/7
Habitat: Tapped Lake
Area: 120 acres
Maximum Depth: 7.8 feet
Active Outlet: Yes
Total Lake Volume: 69.8 million gallons (2005 data)
Volume Under 4 ft of ice: 4.0 million gallons
Volume Under 5 ft of ice: 1.9 million gallons
Volume Under 7 ft of ice: 0.1 million gallons
Potential Aggregate: 112.4 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **0.02 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

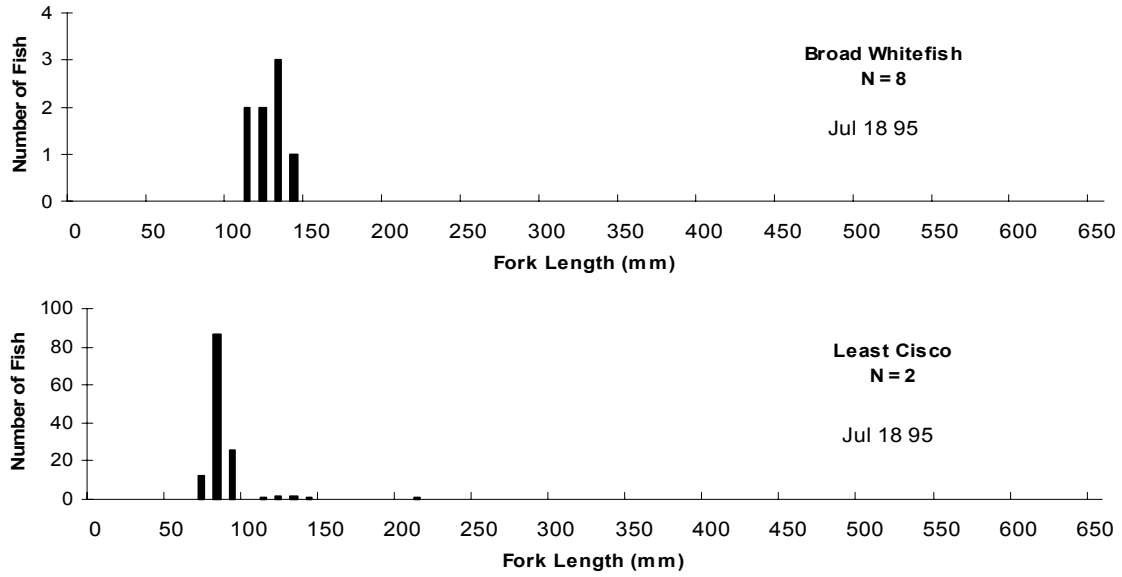
Year	Water Removed (all sources) (mill. Gals)
1999/2000	0.01
2001/2002	2.59
2002/2003	1.51
2003/2004	1.93
2004/2005	2.18

Water Chemistry:

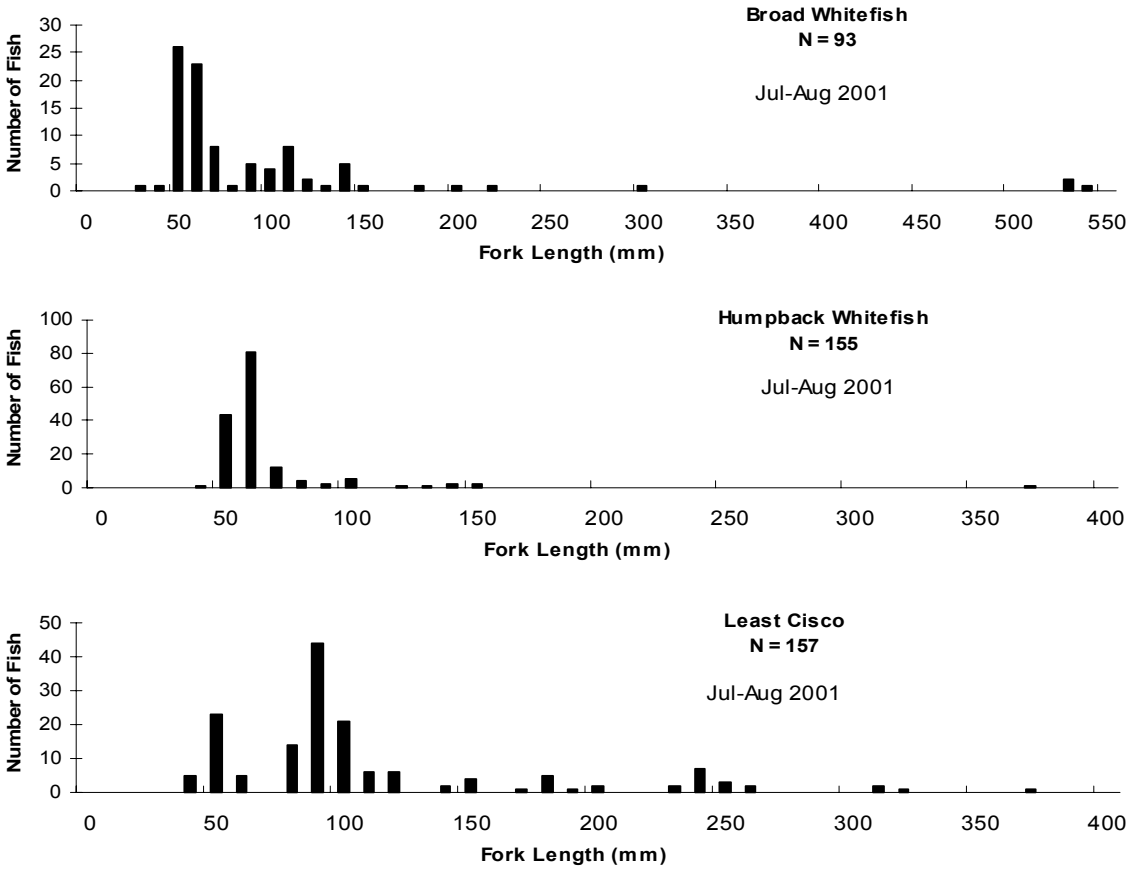
Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH
1995						348		
Jul 2001						151	11.0	7.67
Aug 2001						218	39.2	7.69
2005	16.0	12.0	180	77.0	89	562	1.0	7.30

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 18 95	23.0	Broad whitefish	8	112-141
			Least cisco	2	105, 116
			Ninespine stickleback	376	
Minnow Trap	Jul 18 95	46.0	Ninespine stickleback	33	
Set Line	Jul 18 95	23.1	None	0	
Fyke Net	Jul 13-19, 01	146.0	Broad whitefish	24	31-540
			Humpback whitefish	4	71-86
			Least cisco	108	61-376
			Burbot	1	107
			Ninespine stickleback	236	
Fyke Net	Aug 18-25, 01	136.3	Broad whitefish	69	45-309
			Humpback whitefish	97	47-378
			Least cisco	49	46-319
			Arctic cisco	4	117-196
			Round whitefish	2	139
			Burbot	6	141-152
			Alaska blackfish	5	95-109
			Slimy sculpin	1	54
			Ninespine stickleback	384	



Length frequencies of fish caught in lake M9525 by fyke net, 1995

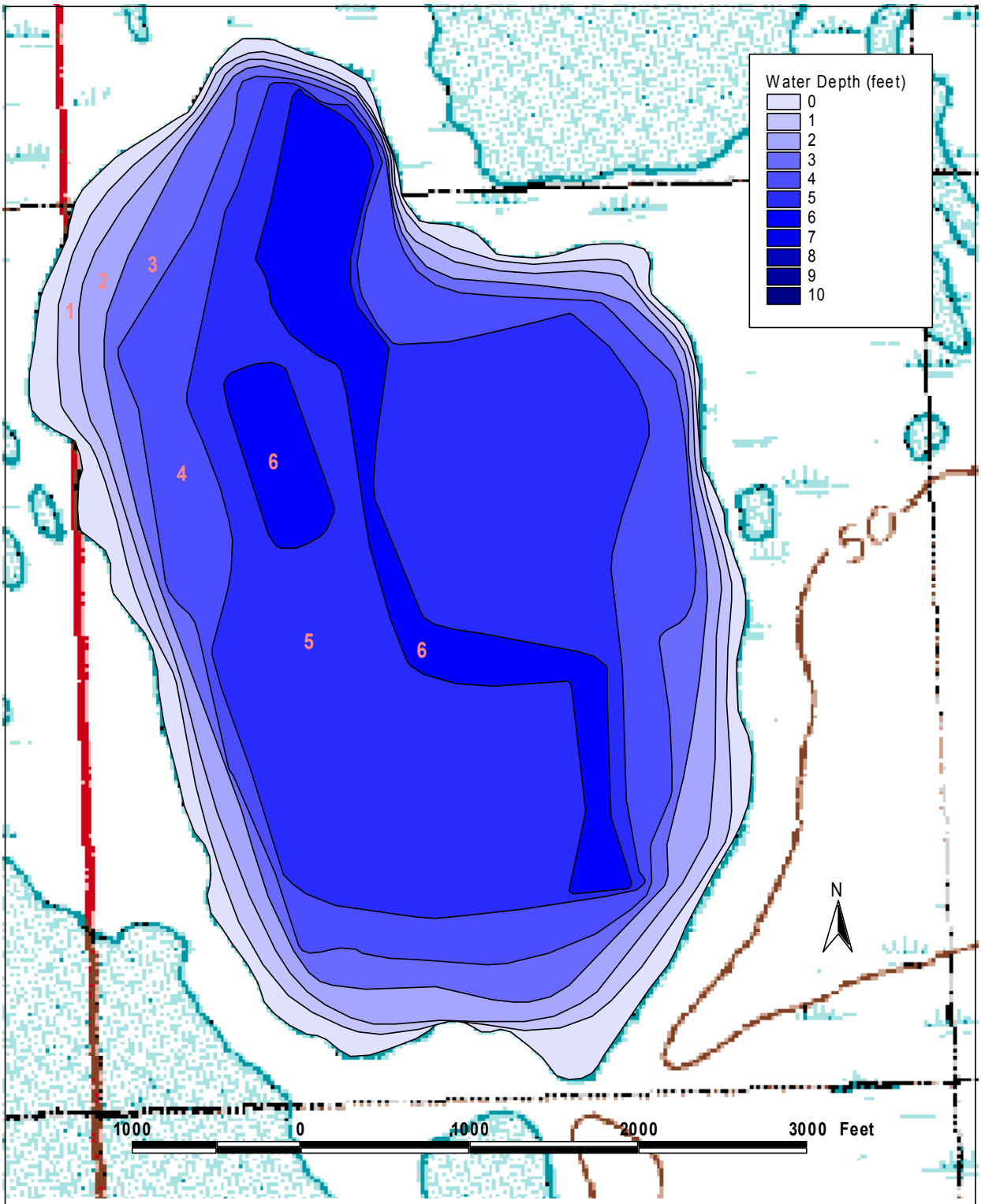


Length frequencies of fish caught in lake M9525 by fyke net, 2001

Regions of lake M9525 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 15 and 18 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured on lake M9525 from July 15 and 18, 2005.



Depth contours of lake M9601 based on transects surveyed on July 14, 2005
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9601

Other Names: Z10.1
Location: 70.23578°N 150.71835°W
USGS Quad Sheet: Harrison Bay A-2: T10N R6E, Sec 6/7
Habitat: Tundra Lake
Area: 399 acres
Maximum Depth: 9.7 feet
Active Outlet: No
Total Lake Volume: 551.4 million gallons (2005 data)
Volume Under 4 ft of ice: 119.3 million gallons
Volume Under 5 ft of ice: 41.8 million gallons
Volume Under 7 ft of ice: 0.0 million gallons
Potential Aggregate: 122.4 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **12.53 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

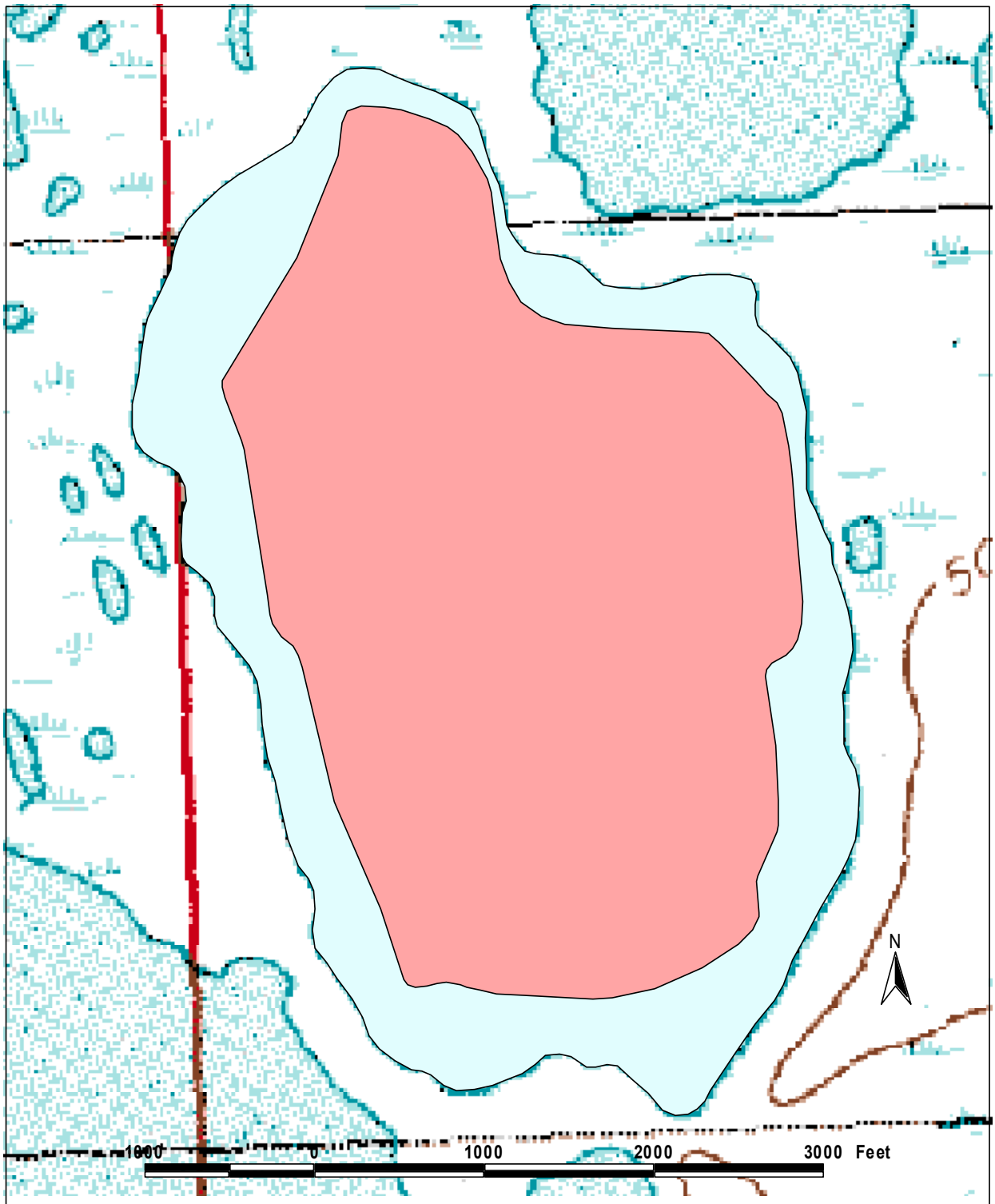
Year	Water Removed (all sources) (mill. Gals)
1998/1999	4.22

Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1996	11.4	9.8	2.7	37.8	105	181.4		7.90	J. Lobdell
1997								7.93	
2002						199.5	1.1	8.08	
2005	20.0	1.7	130.0	3.6	57	106.9	0.7	7.85	

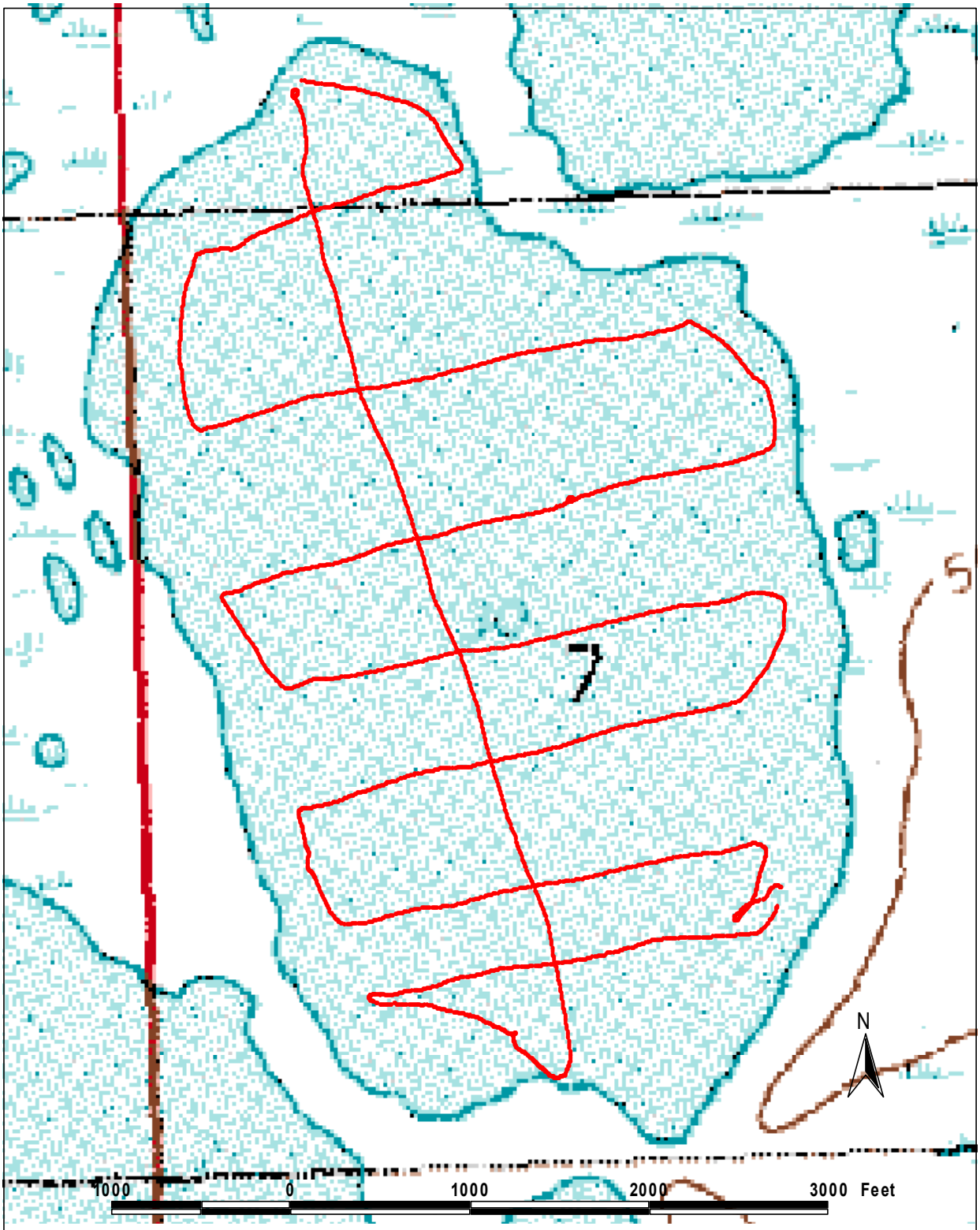
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 17 96	4.1	None	0
Observed	Jul 15 02		Ninespine stickleback	many

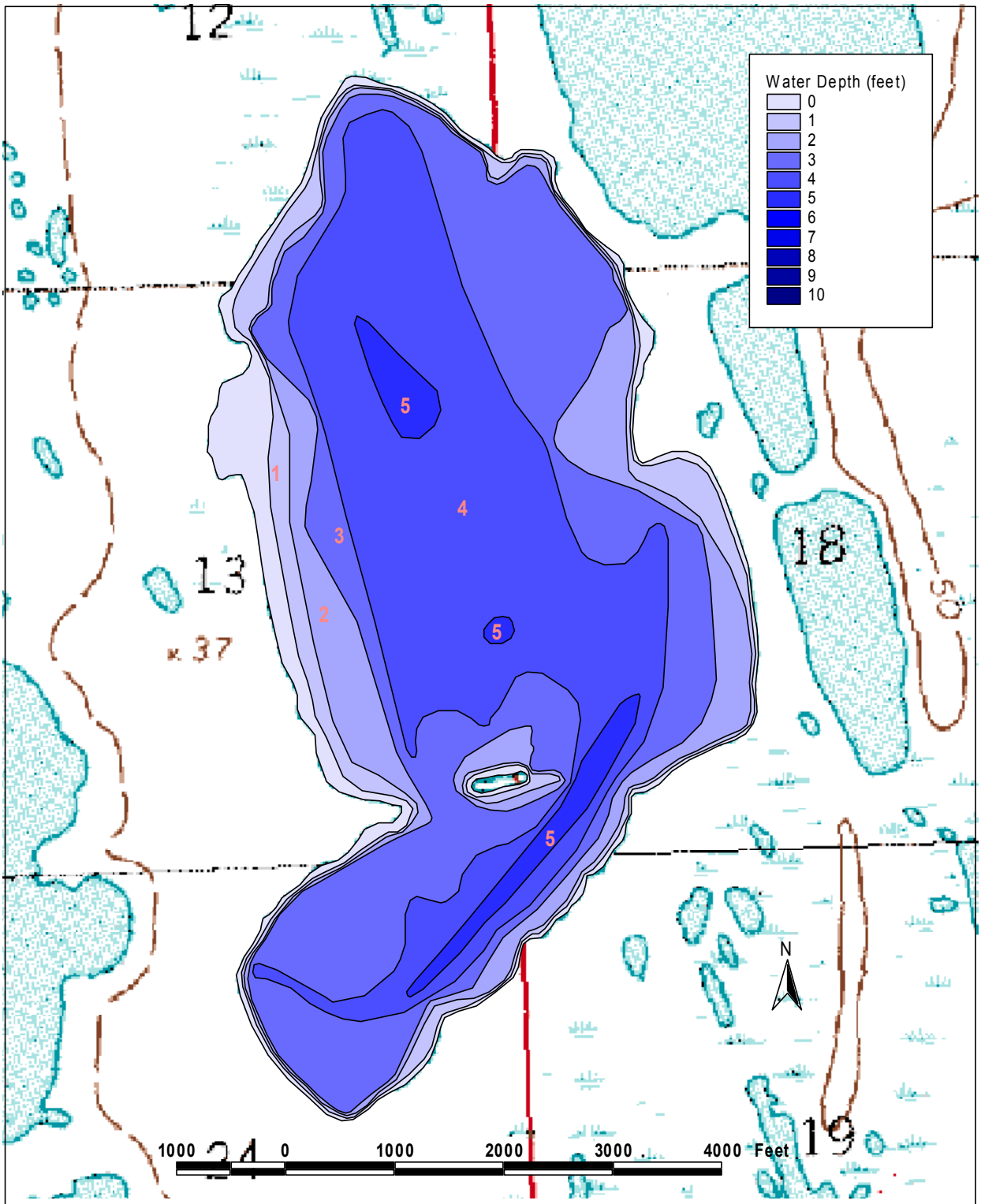


Regions of lake M9601 less than 4 fet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 14, 2005 .

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake M9601 on July 14, 2005.



Depth contours of lake M9602 based on transects surveyed on July 12, 2005
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9602

Other Names: AA10.1
Location: 70.22147°N 150.73865°W
USGS Quad Sheet: Harrison Bay A-2: T10N R5/6E, Sec 112/13/24/7/18/19
Habitat: Tundra Lake
Area: 658 acres
Maximum Depth: 6.4 feet
Active Outlet: No
Total Lake Volume: 734.9 million gallons (2005 data)
Volume Under 4 ft of ice: 42.9 million gallons
Volume Under 5 ft of ice: 2.6 million gallons
Volume Under 7 ft of ice: 0.0 million gallons
Potential Aggregate: 391.5 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **0.78 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

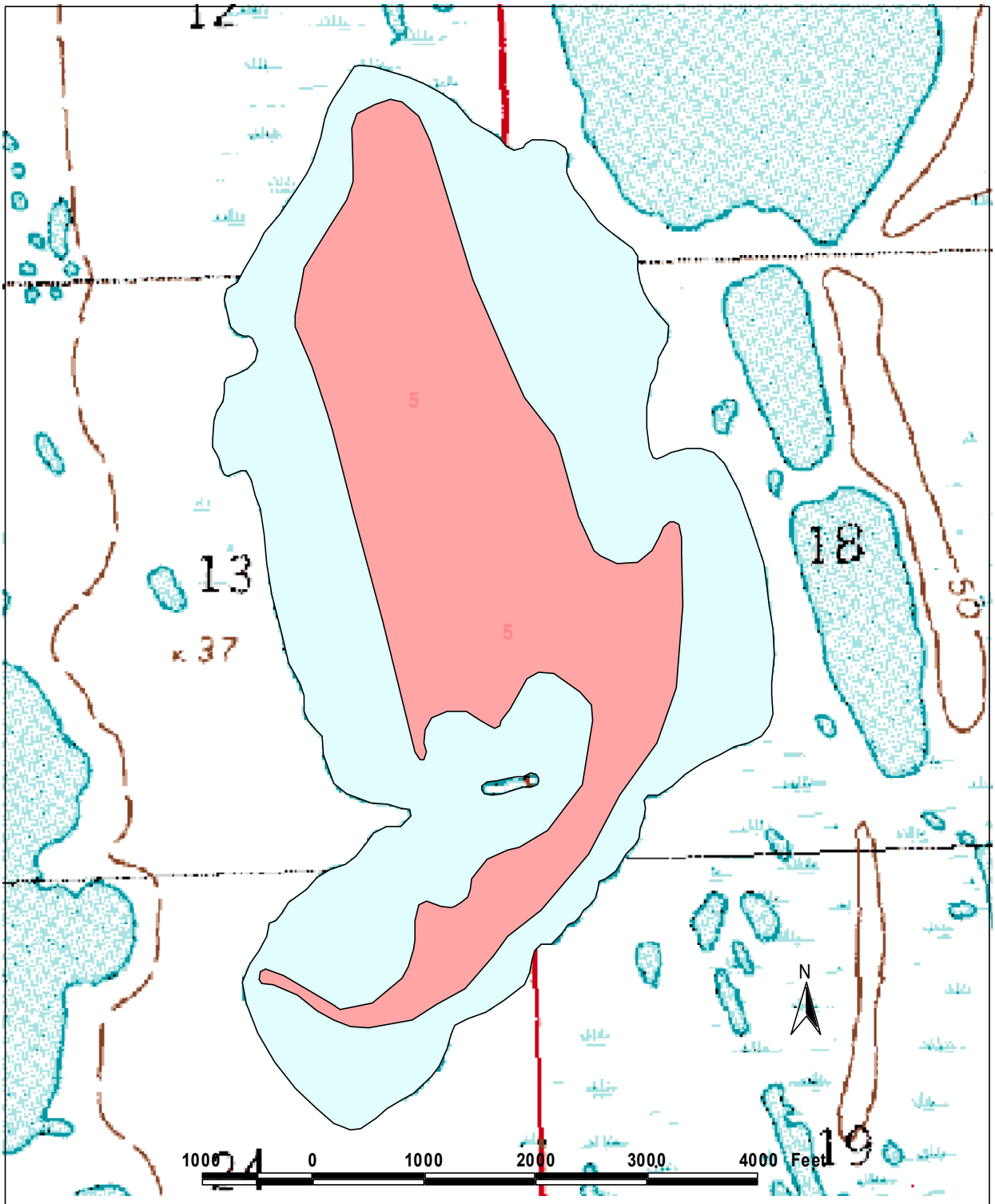
Year	Water Removed (all sources) (mill. Gals)
1998/1999	3.03
2000/2001	7.96
2001/2002	2.84
2002/2003	13.69
2003/2004	3.65
2004/2005	7.83

Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1996	15.9	13.5	2.9	31.5	90				J. Lobdell
1997								8.04	
2002						209	0.8	8.02	
2005	25.0	2.3	14.8	4.9	72	142	1.5	8.00	

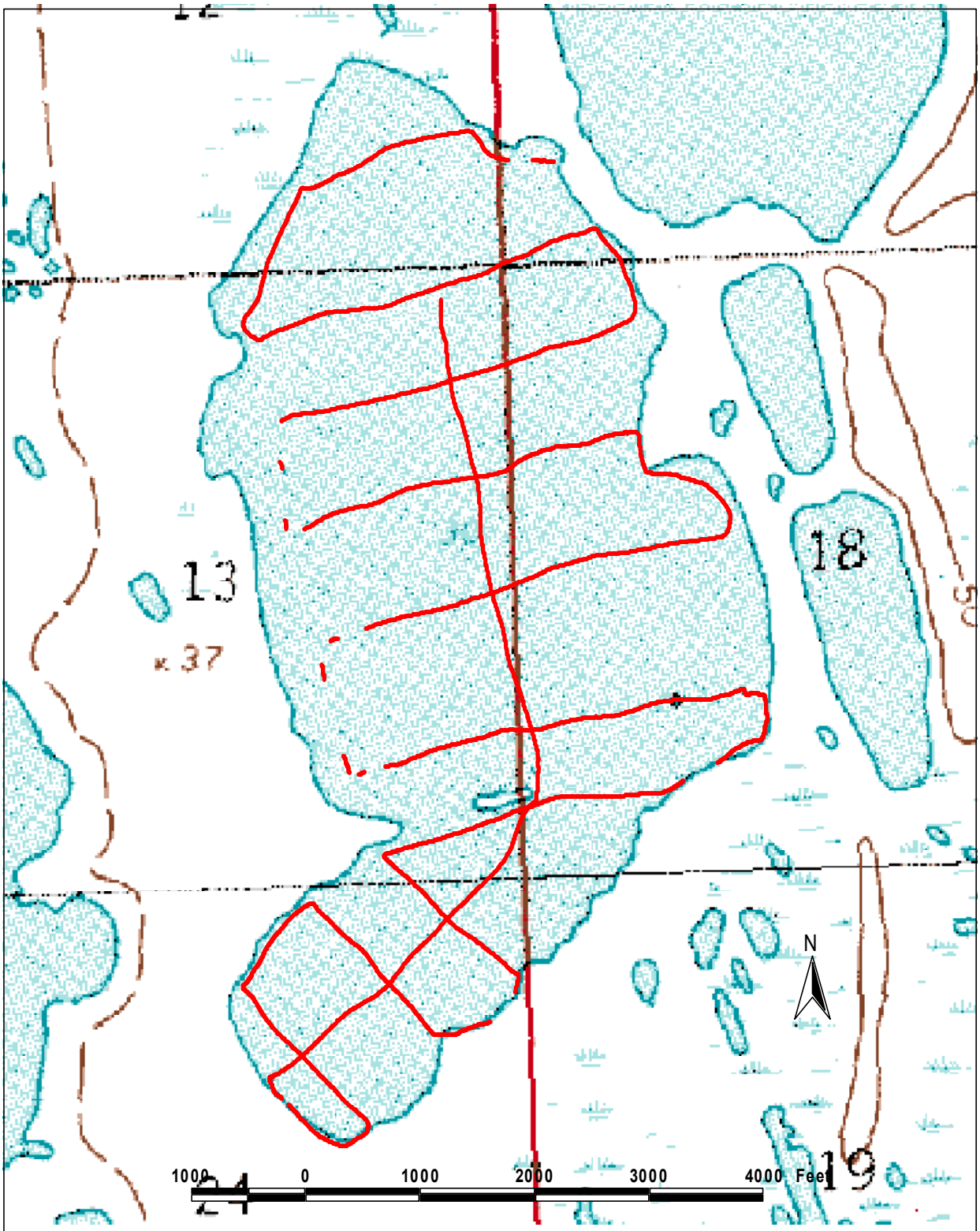
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 26 96	10.7	None	0
Observed	Jul 15 02		Ninespine stickleback	many

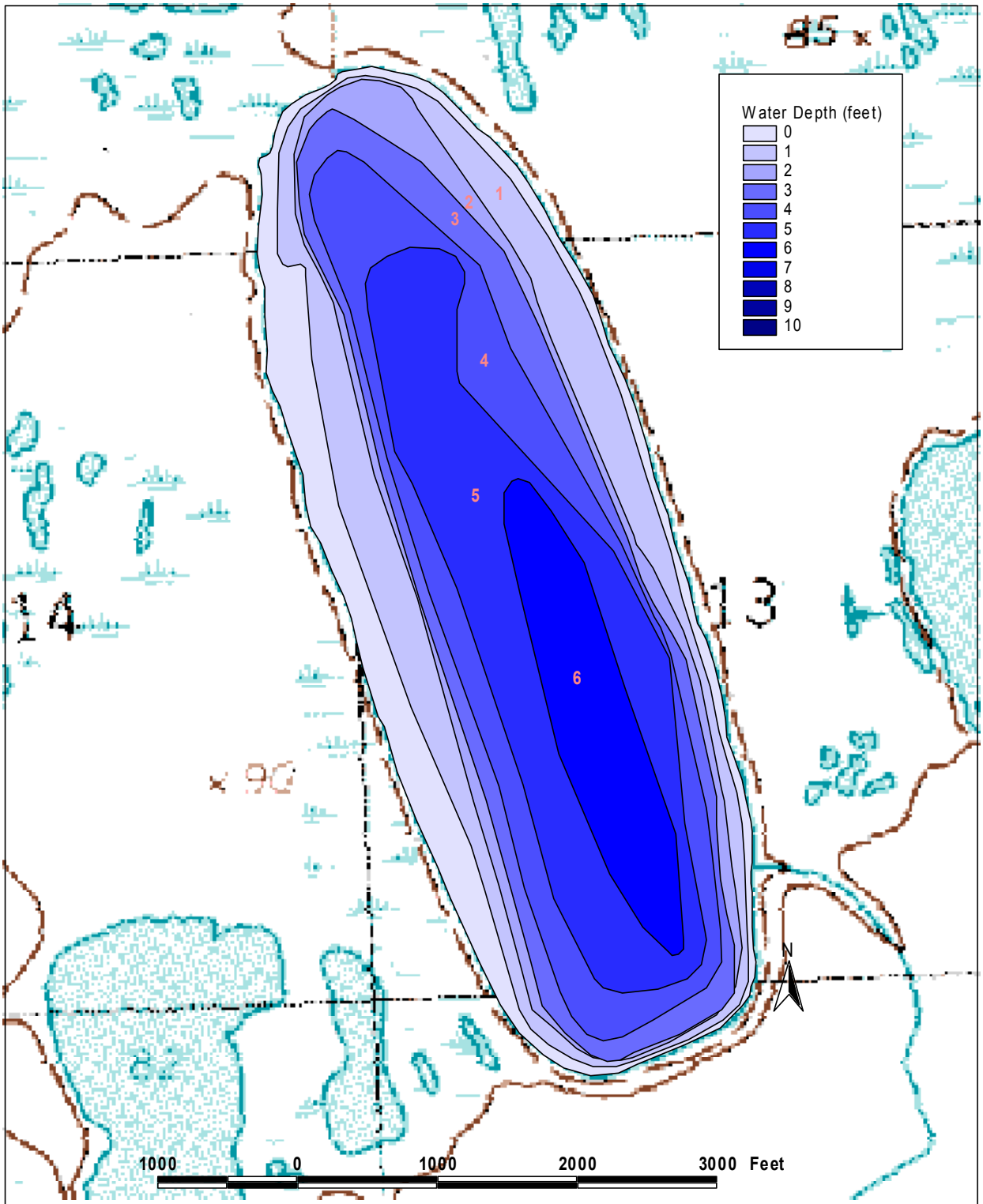


Regions of lake M9602 less than 4 fet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 12, 2005 .

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake M9602 on July 12, 2005.



Depth contours of lake M9605 based on transects surveyed on July 20, 2005
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9605

Other Names: AA14.1
Location: 70.22099°N 150.51572°W
USGS Quad Sheet: Harrison Bay A-1: T10N R6E, Sec 11/12/13/14/24
Habitat: Tundra Lake
Area: 350 acres
Maximum Depth: 7.2 feet
Active Outlet: No
Total Lake Volume: 408.9 million gallons (2005 data)
Volume Under 4 ft of ice: 75.9 million gallons
Volume Under 5 ft of ice: 28.4 million gallons
Volume Under 7 ft of ice: 0.0 million gallons
Potential Aggregate: 174.1 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **8.52 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

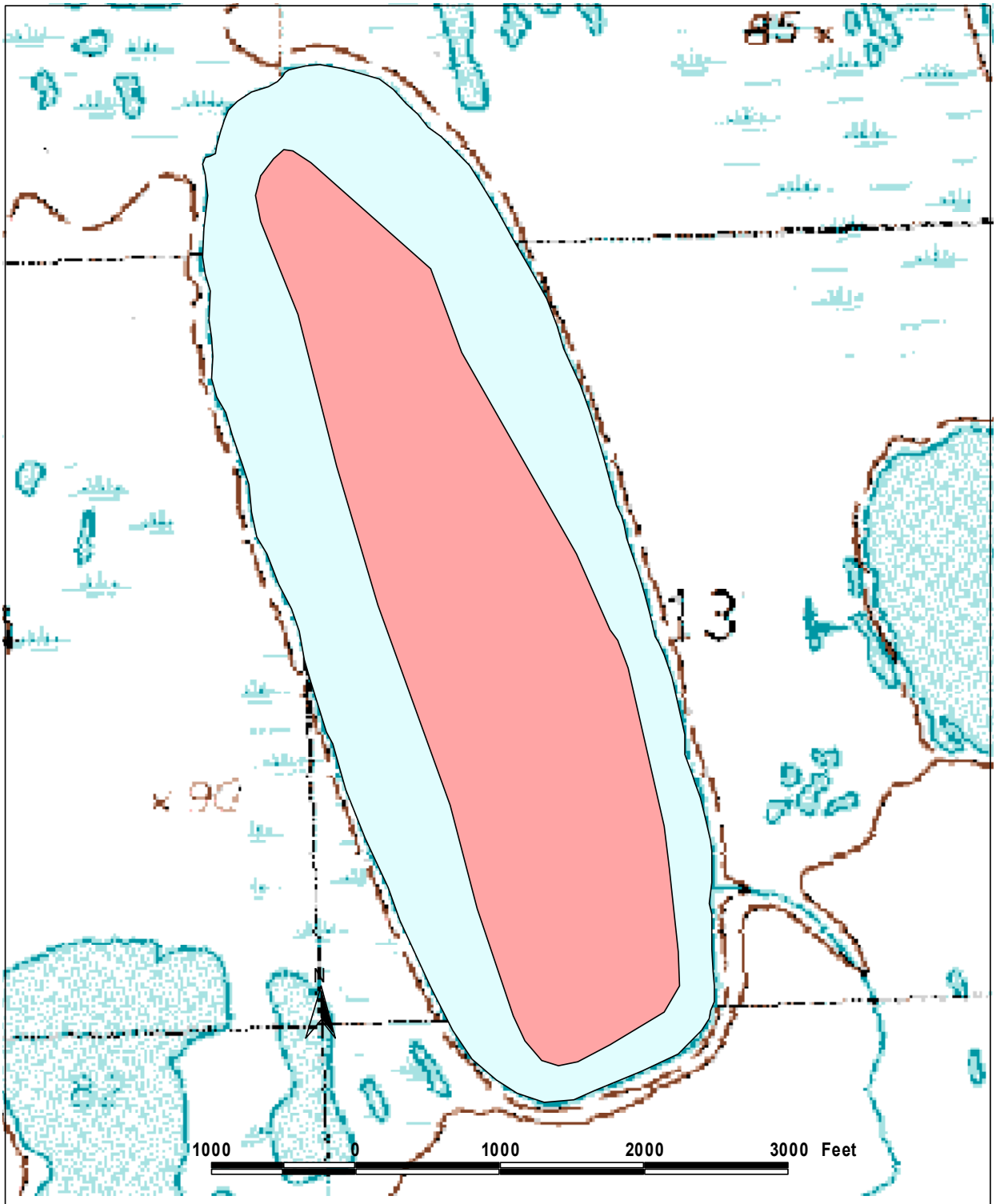
Year	Water Removed (all sources) (mill. Gals)
1998/1999	6.13
2000/2001	18.26
2001/2002	9.22
2002/2003	17.34
2003/2004	5.89
2004/2005	12.82

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1996	9.8	9.8	2.9	31.2	90				J. Lobdell
2005	21.0	1.7	8.9	3.3	59	137	0.7	8.10	

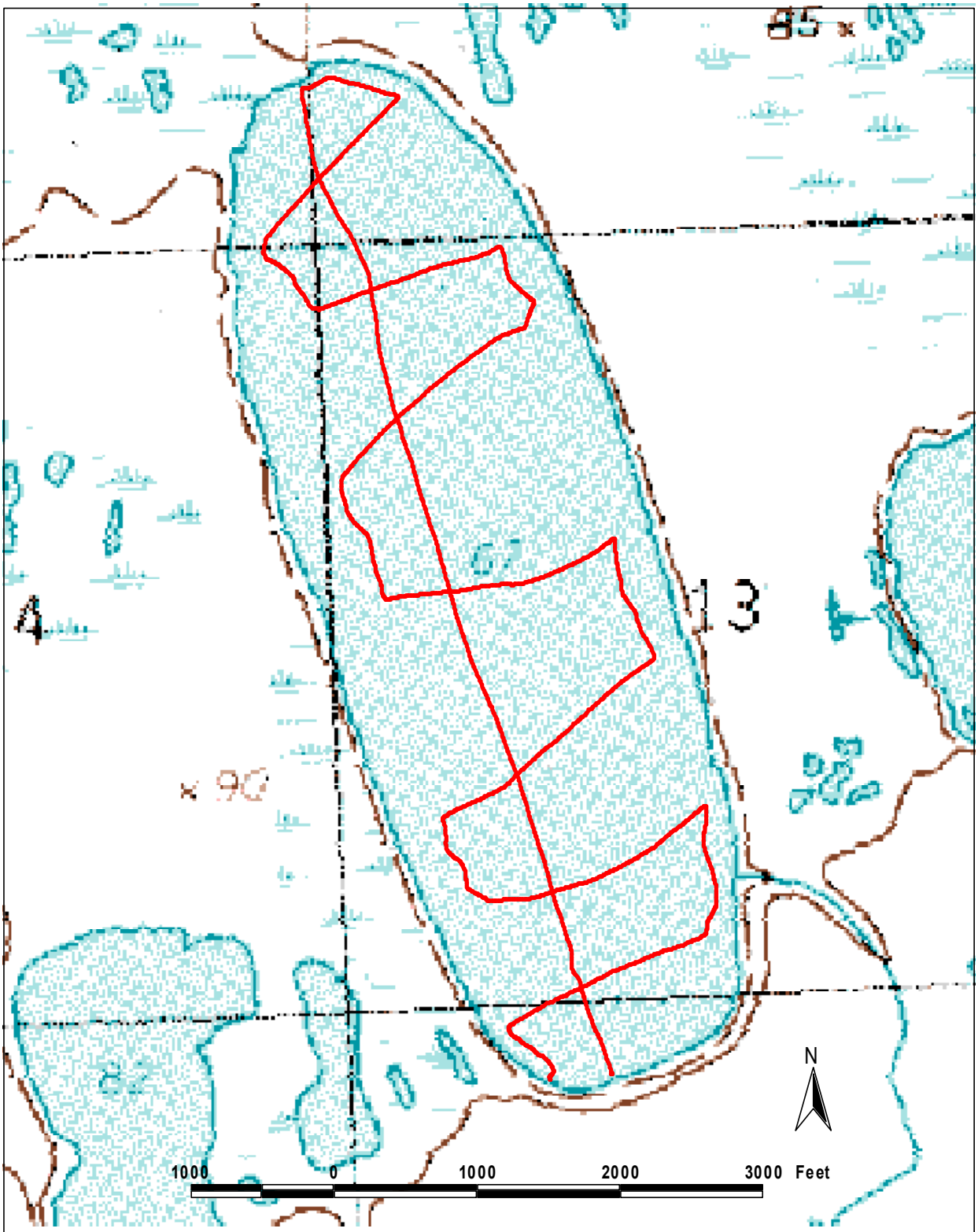
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 18 96	4.3	None	0
Gill Net	Jul 20 05	6.7	None	0
Minnow Traps	Jul 20 05	12.2	Ninespine stickleback	1

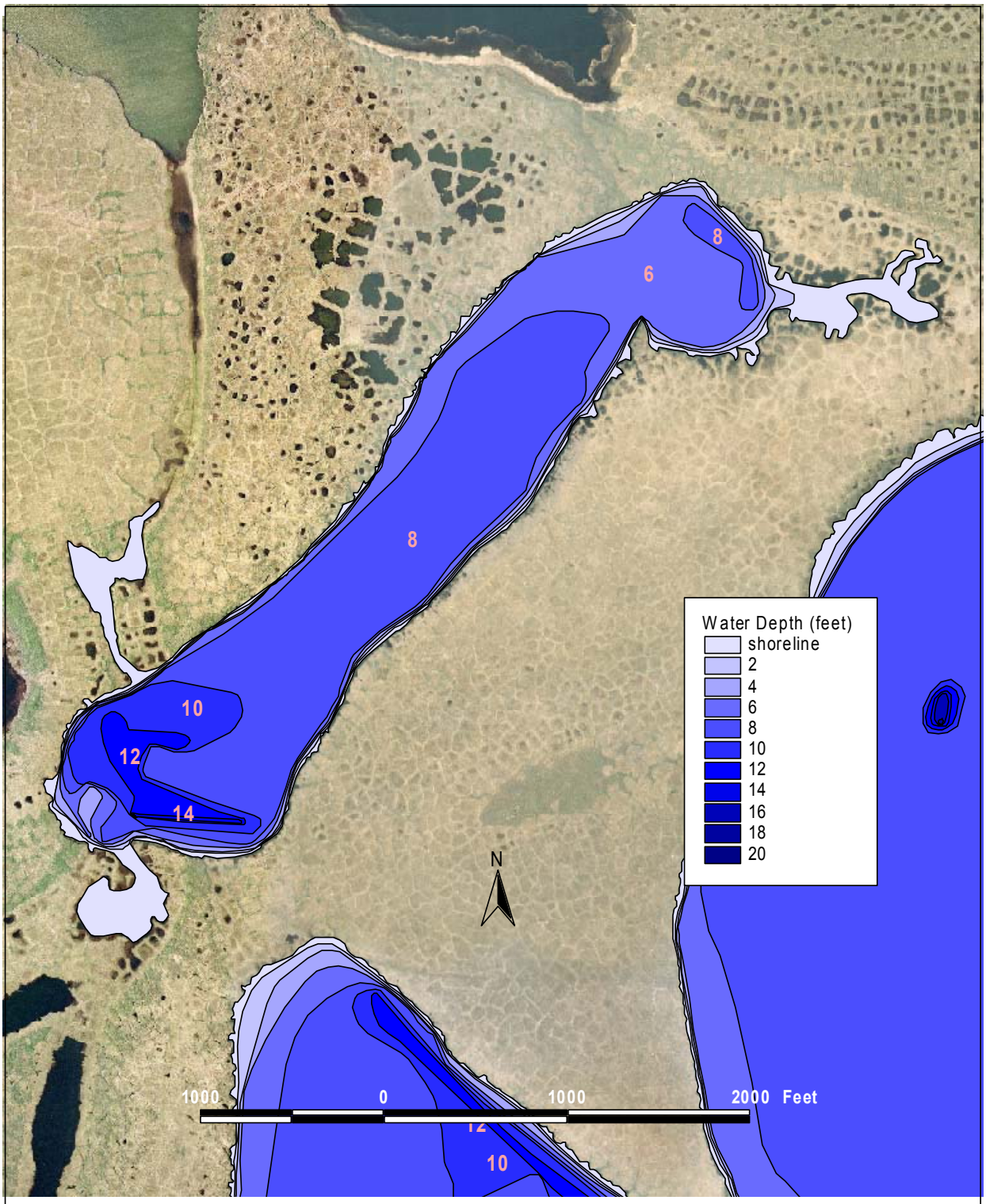


Regions of lake M9605 less than 4 fet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 20, 2005 .

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake M9605 on July 20, 2005.



Depth contours of lake M9606 based on transects surveyed on July 13, 2005.
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9606

Other Names: Y6.1
Location: 70.25109°N 150.94929°W
USGS Quad Sheet: Harrison Bay A-2/B-2: T10N R5E, Sec 5/6
Habitat: Perched Lake (Infrequent Flooding)
Area: 103 acres
Maximum Depth: 16.6 feet
Active Outlet: No
Total Lake Volume: 246.1 million gallons (2005 data)
Volume Under 4 ft of ice: 126.8 million gallons
Volume Under 5 ft of ice: 99.3 million gallons
Volume Under 7 ft of ice: 48.1 million gallons
Potential Aggregate: 17.6 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **7.21 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

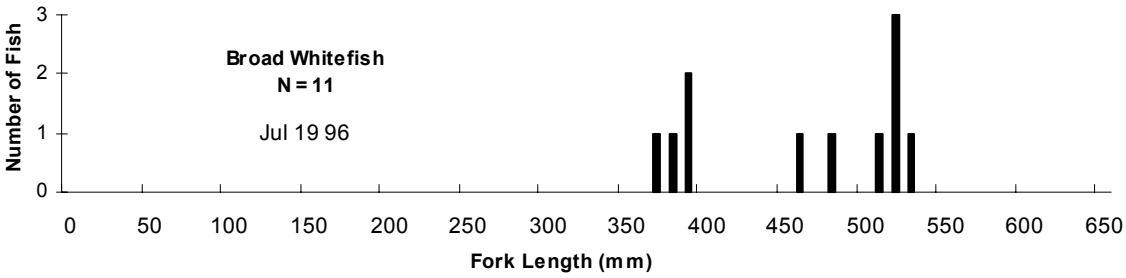
Year	Water Removed (all sources) (mill. Gals)
1999/2000	1.37
2001/2002	1.07

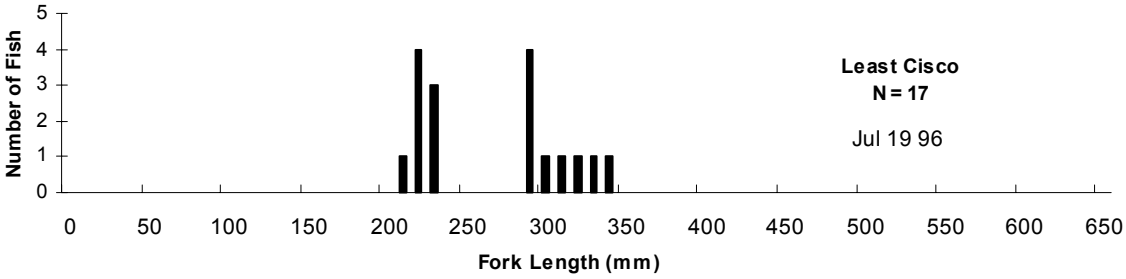
Water Chemistry:

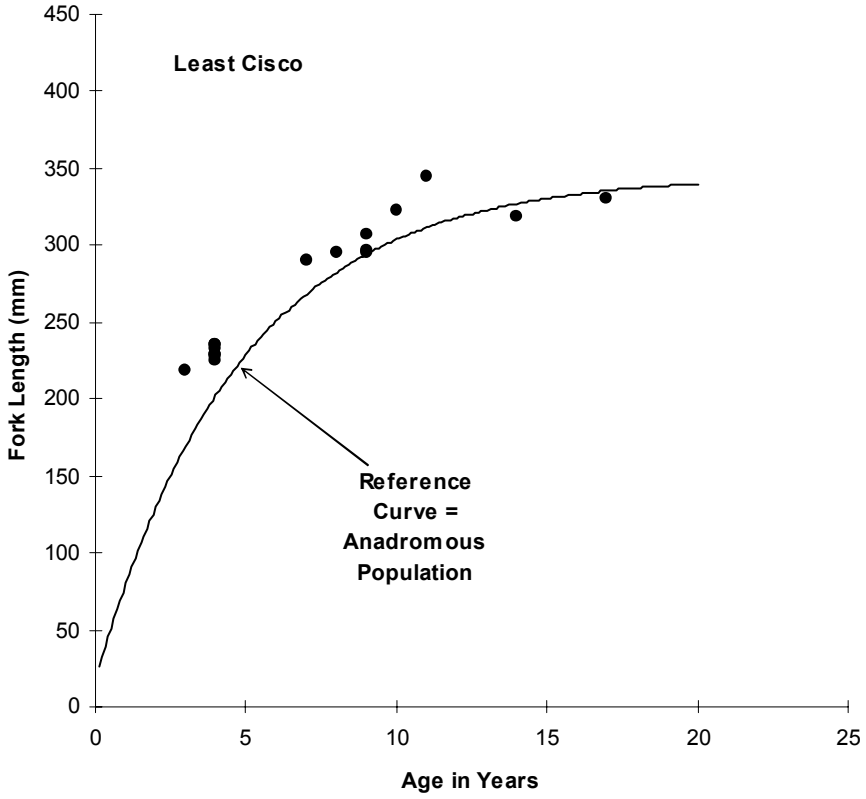
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1996	5.2	7.7	3.5	11.2	42	99			J. Lobdell
2005	7.0	2.9	3.8	<3	29	68	0.87	7.86	

Catch Record:

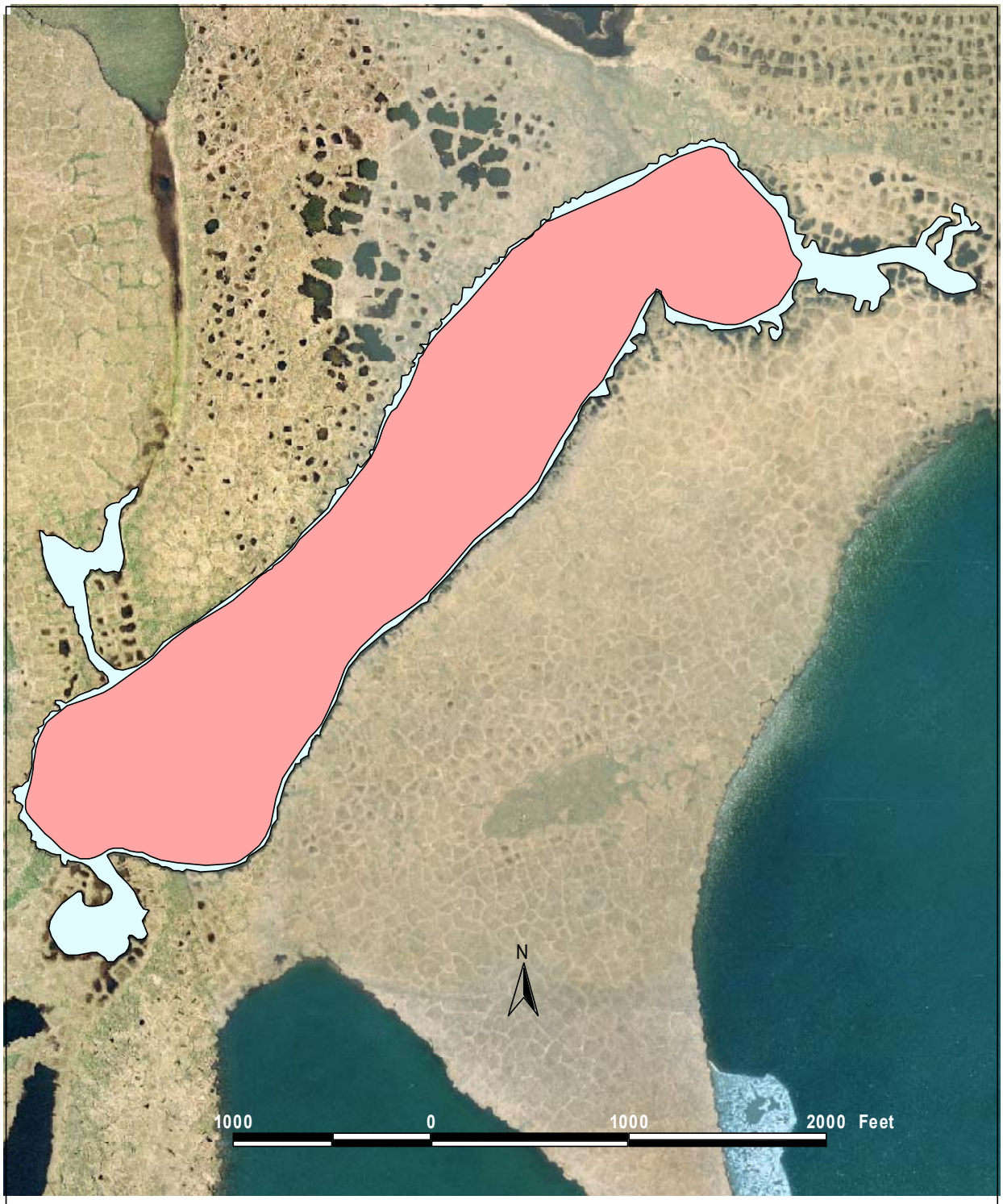
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 19 96	13.3	Broad whitefish	11	373-533
			Least cisco	17	219-345







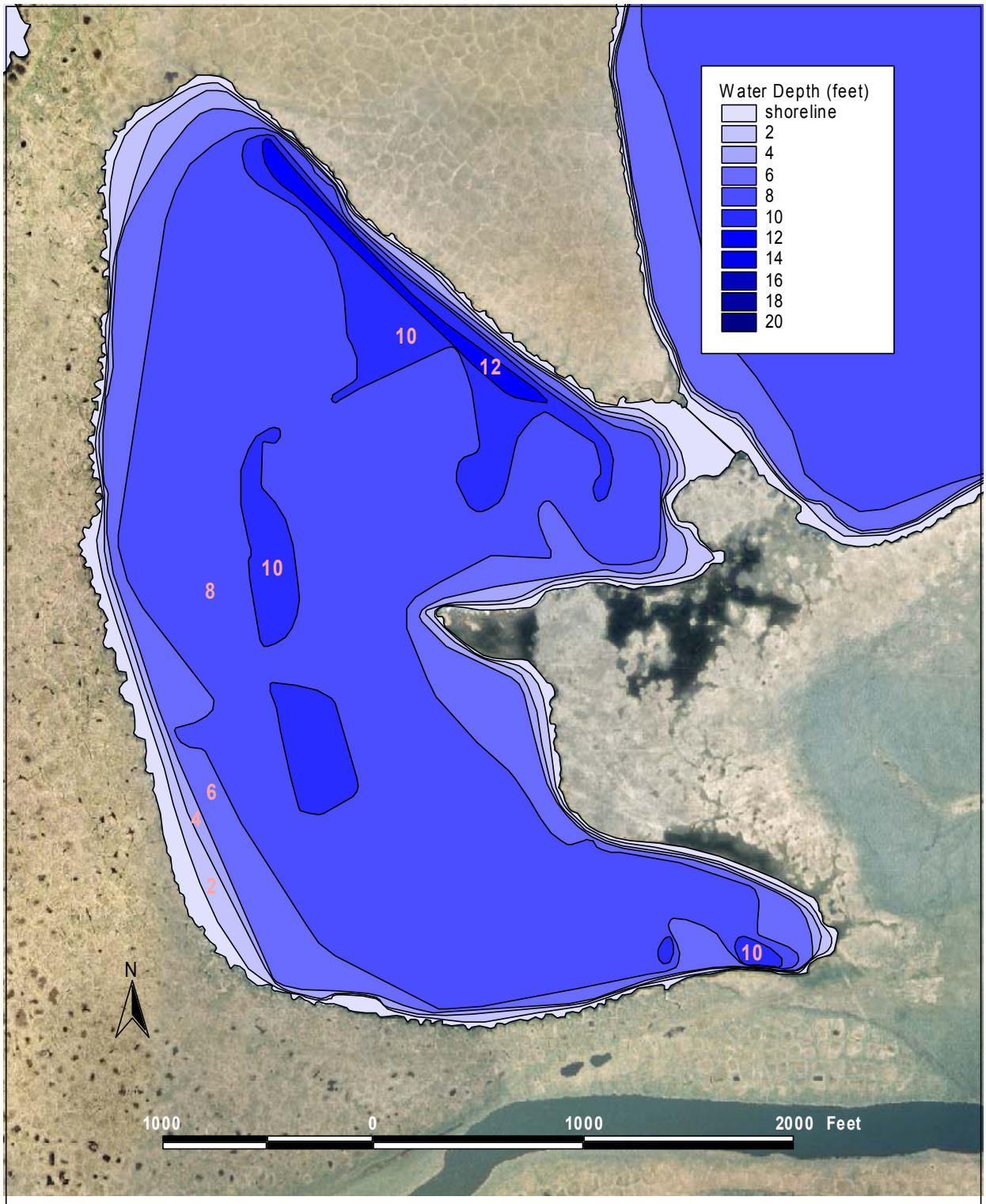
Length frequencies of fish caught in lake M9606 by gill net, and age-length relationship of least cisco, in 1996.



Regions of lake M9606 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 13, 2005 .

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake M9606 on July 13, 2005.



Depth contours of lake M9608 based on transects surveyed on July 13, 2005.
(depths in 2 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9608 (connected to B8530)

Other Names: Z6.1
Location: 70.23888°N 150.94887°W
USGS Quad Sheet: Harrison Bay A-1/B-2: T10N R5E, Sec 5/6/7/8
Habitat: Perched Lake (Frequent Flooding)
Area: 206 acres
Maximum Depth: 14.0 feet
Active Outlet: No
Total Lake Volume: 538.1 million gallons (2005 data)
Volume Under 4 ft of ice: 284.0 million gallons
Volume Under 5 ft of ice: 224.3 million gallons
Volume Under 7 ft of ice: 111.0 million gallons
Potential Aggregate: 20.9 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **16.65 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

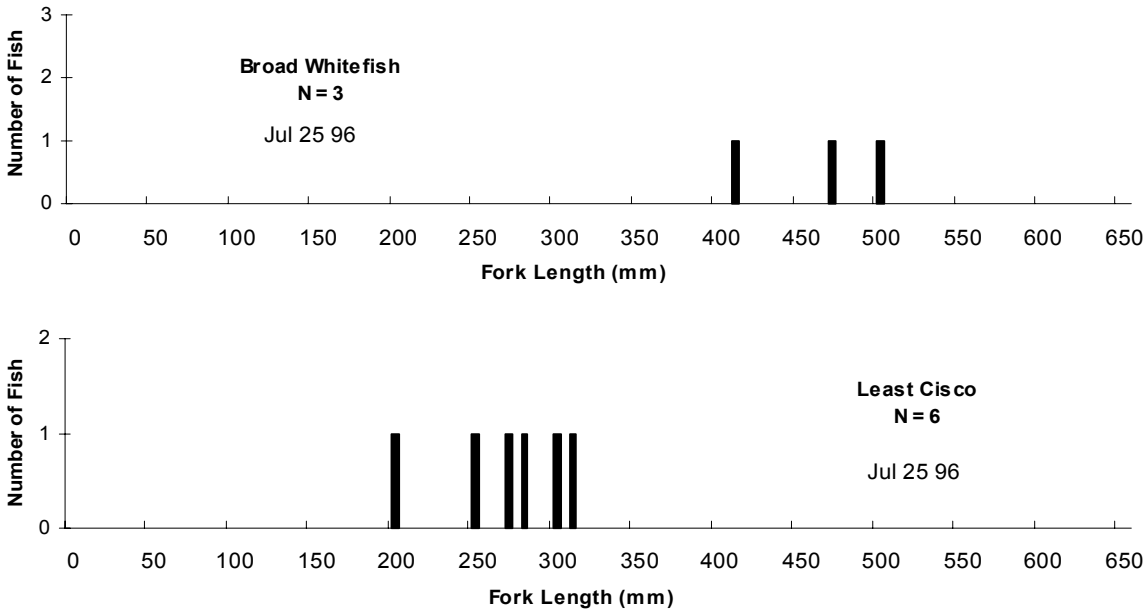
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

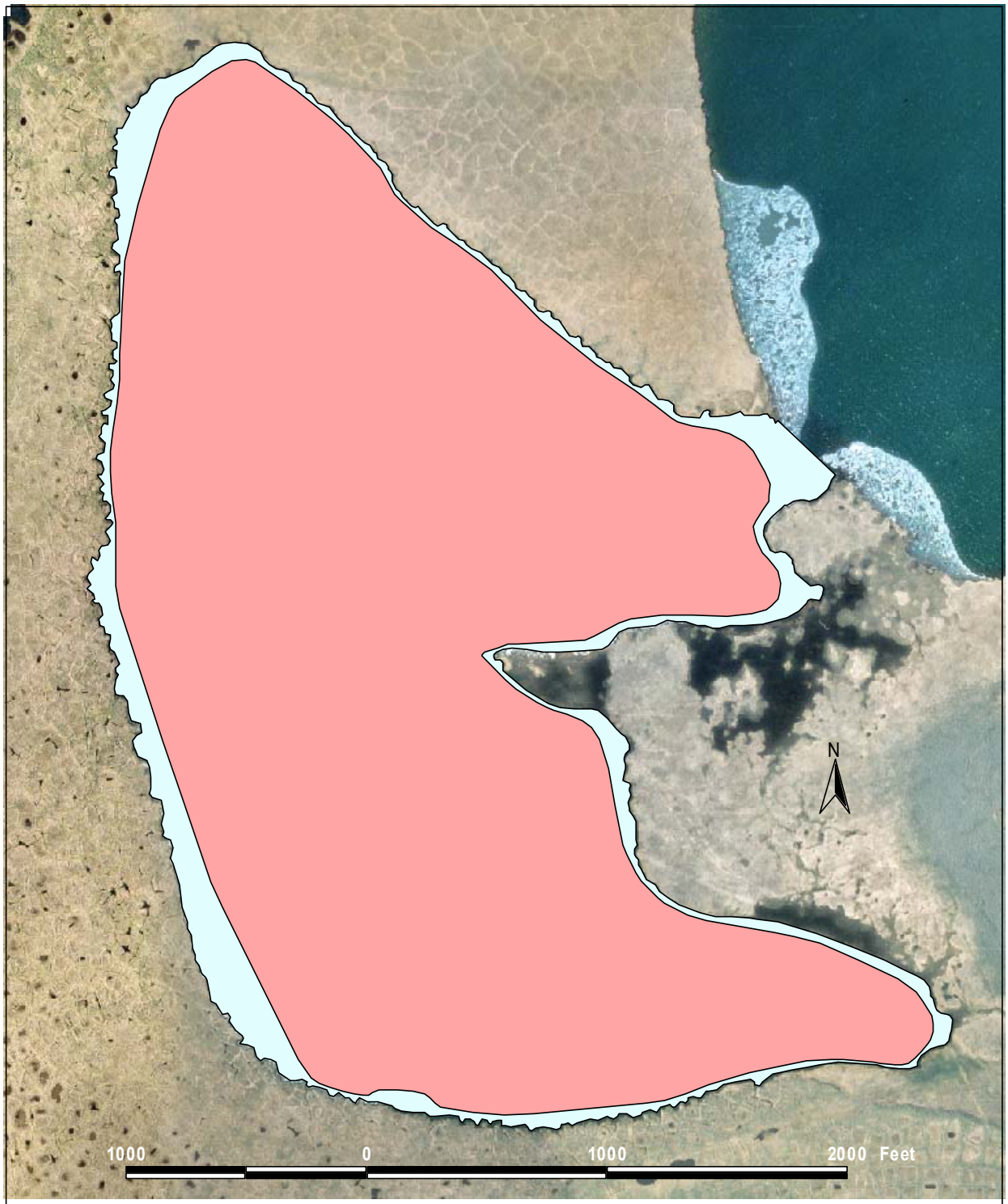
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	5.5	2.2	3.3	<3	23	54	1.01	7.53	

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 25 96	2.6	Broad whitefish	4	414-508
			Least cisco	7	203-315

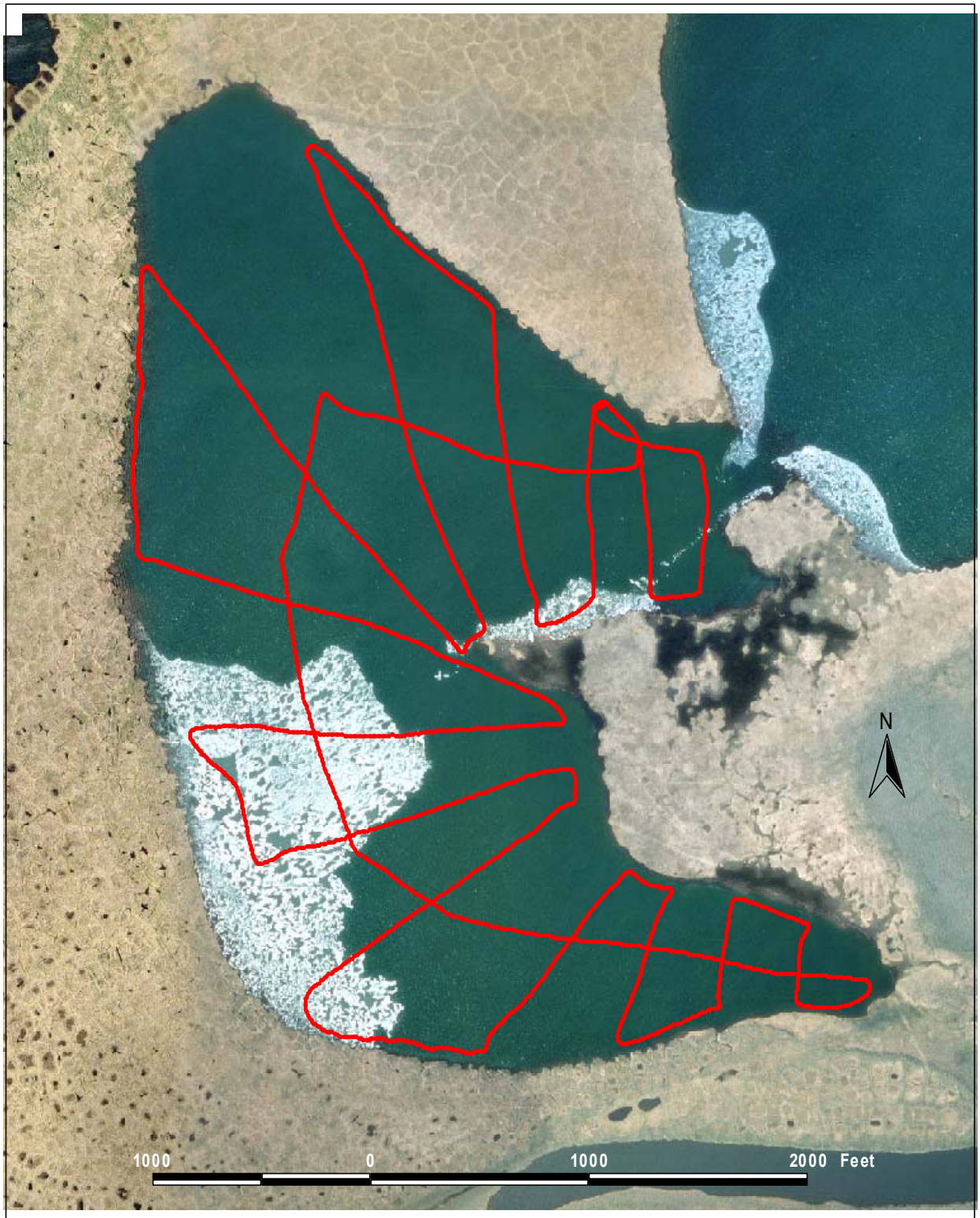


Length frequencies of fish caught in lake M9608 by gill net in 1996

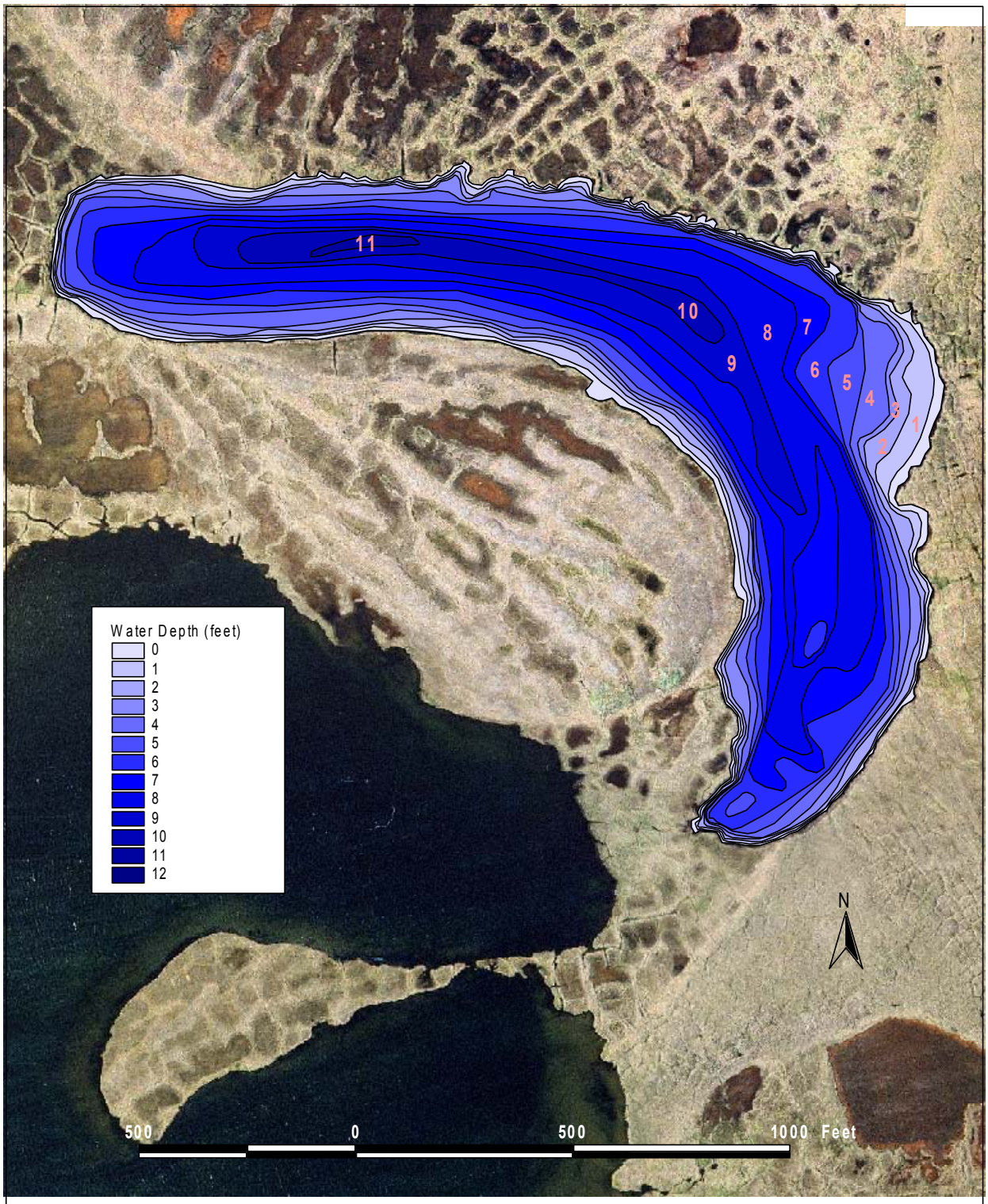


Regions of lake M9608 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 13, 2005 .

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake M9608 on July 13, 2005.



Depth contours of lake M9905 based on transects surveyed on July 21, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9905

Other Names:
Location: 70.24510°N 151.74422°W
USGS Quad Sheet: Harrison Bay A-3: T10N R1/2E Sec. 1/6
Habitat: Perched Lake
Area: 26 acres
Maximum Depth: 15.0 feet
Active Outlet:
Total Lake Volume: 53.3 million gallons (2005 data)
Volume Under 4 ft of ice: 22.8 million gallons
Volume Under 5 ft of ice: 16.5 million gallons
Volume Under 7 ft of ice: 6.3 million gallons
Potential Aggregate: 5.9 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **4.95 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

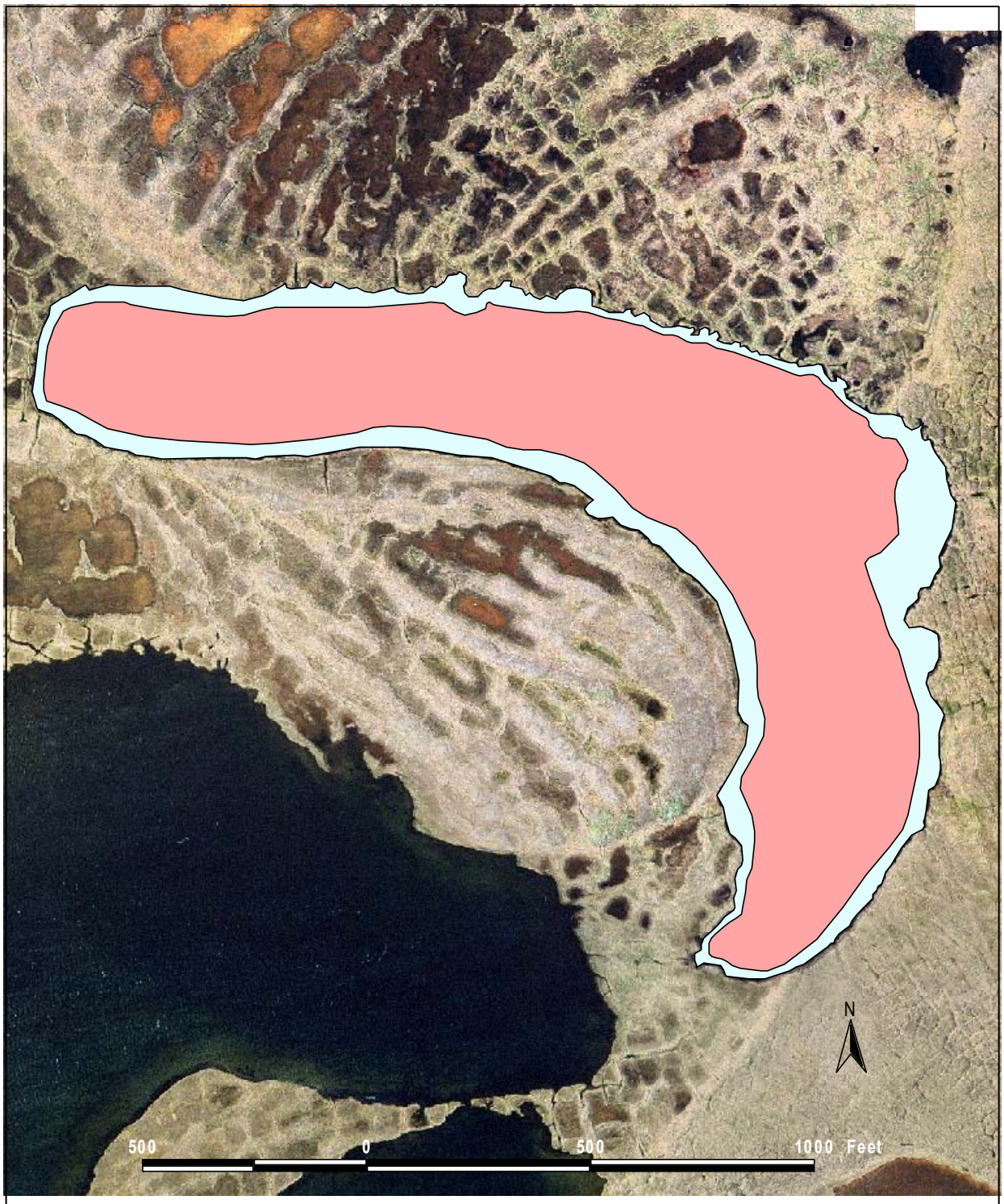
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1999	7.4	2.6	9.9	1.9	33	85		7.97	
2005	5.5	1.1	4.0	<3	18	44	0.8	7.34	

Catch Record:

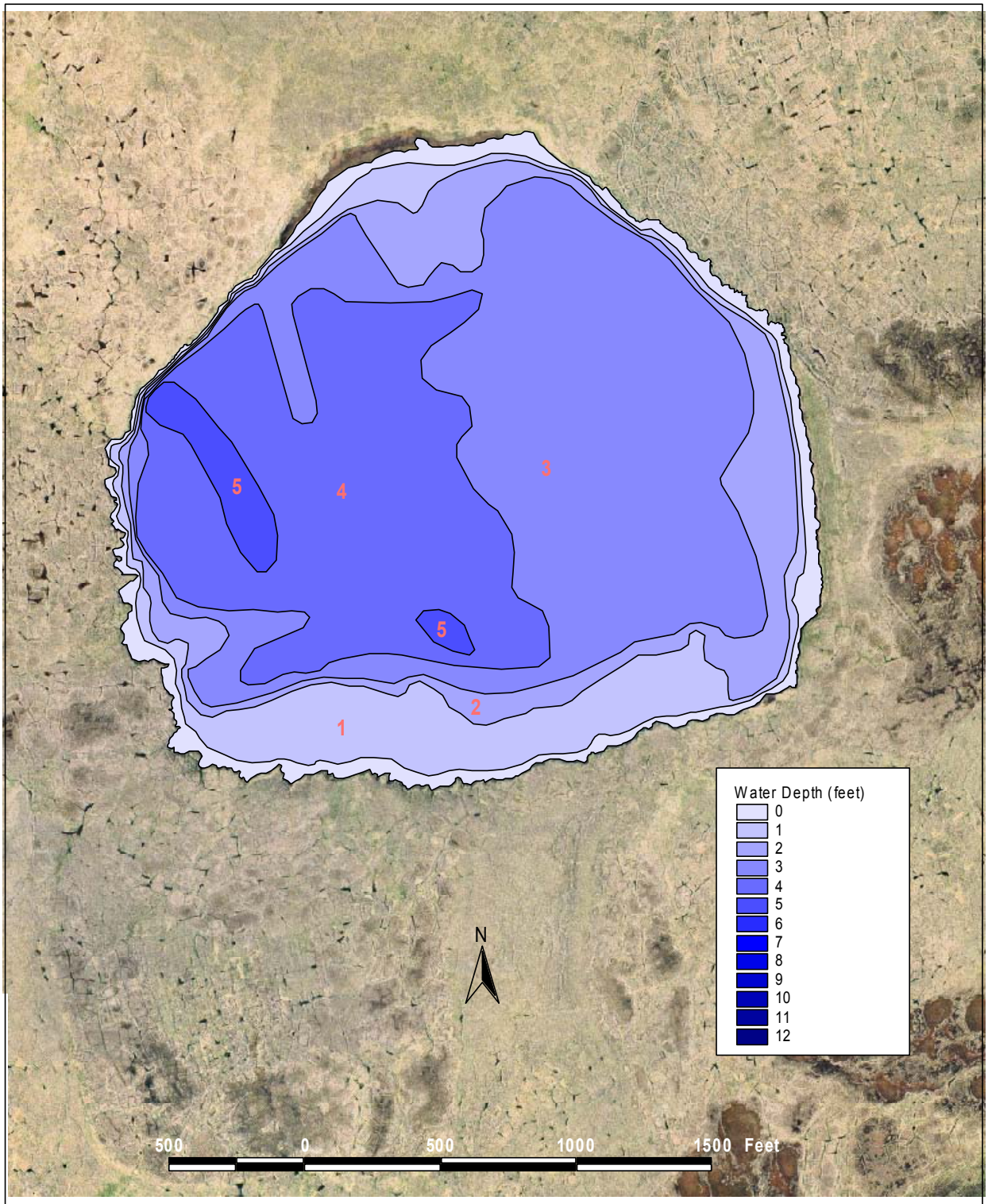
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 10 99	3.9	None	0
Gill Net	Jul 21 05	9.2	None	0
Minnow Traps	Jul 21 05	5.2	Alaska blackfish	1



Regions of lake M9905 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 21, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake M9905 on July 21, 2005.



Depth contours of lake M9921 based on transects surveyed on July 16, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M9921

Other Names: R0072
Location: 70.26541°N 151.63768°W
USGS Quad Sheet: Harrison Bay B-3: T11N R2E Sec. 33
Habitat: Tundra lake
Area: 109 acres
Maximum Depth: 6.0 feet
Active Outlet: No
Total Lake Volume: 114.1 million gallons (2005 data)
Volume Under 4 ft of ice: 5.3 million gallons
Volume Under 5 ft of ice: 0.3 million gallons
Volume Under 7 ft of ice: 0.0 million gallons
Potential Aggregate: 75.4 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **5.32 million gallons**
(volume under 4 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

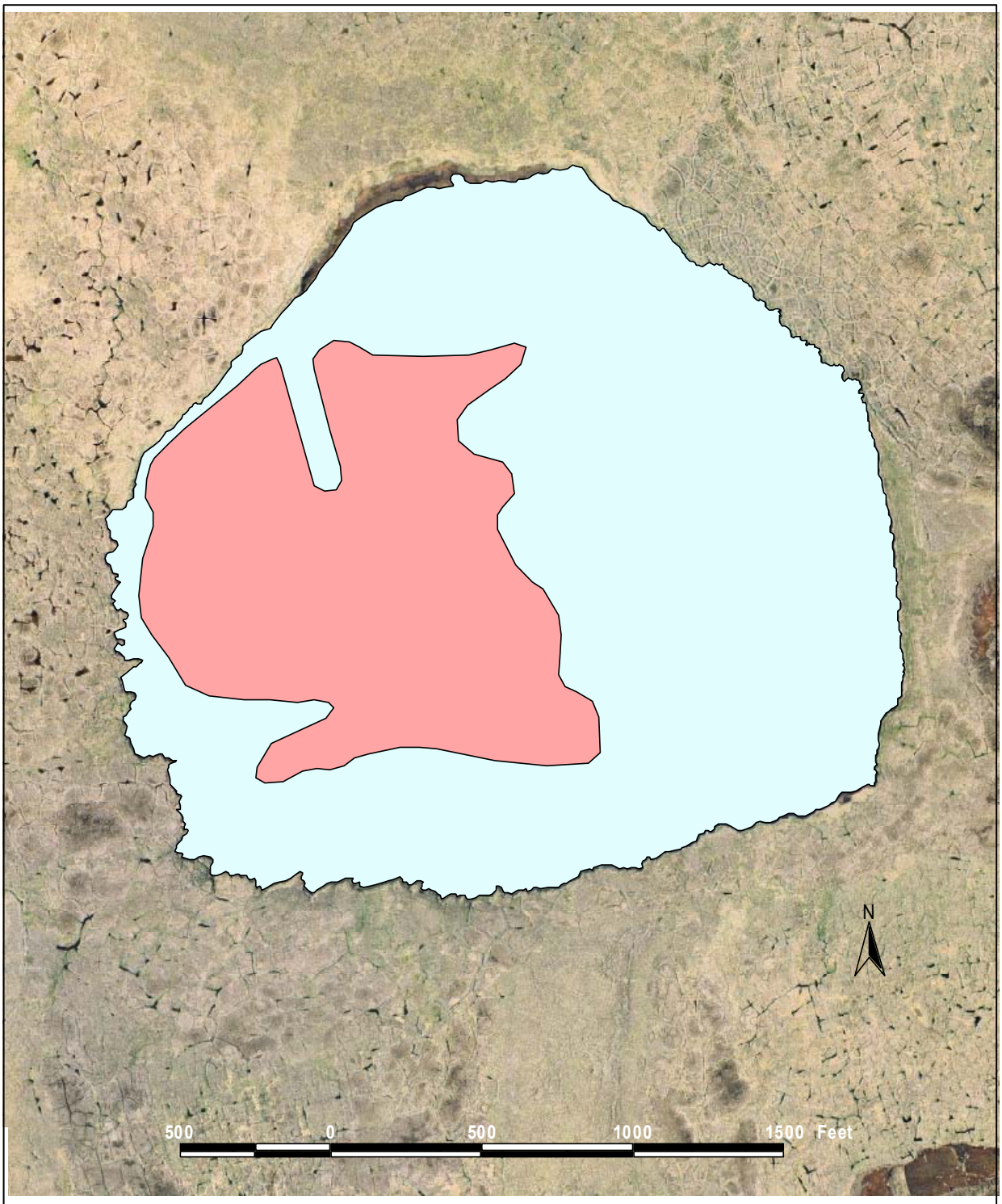
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1999	27.4	8.6	28.3	5.1	92	197		8.02	
2005	24.0	4.9	46.0	7.5	80	211	1.38	8.70	

Catch Record:

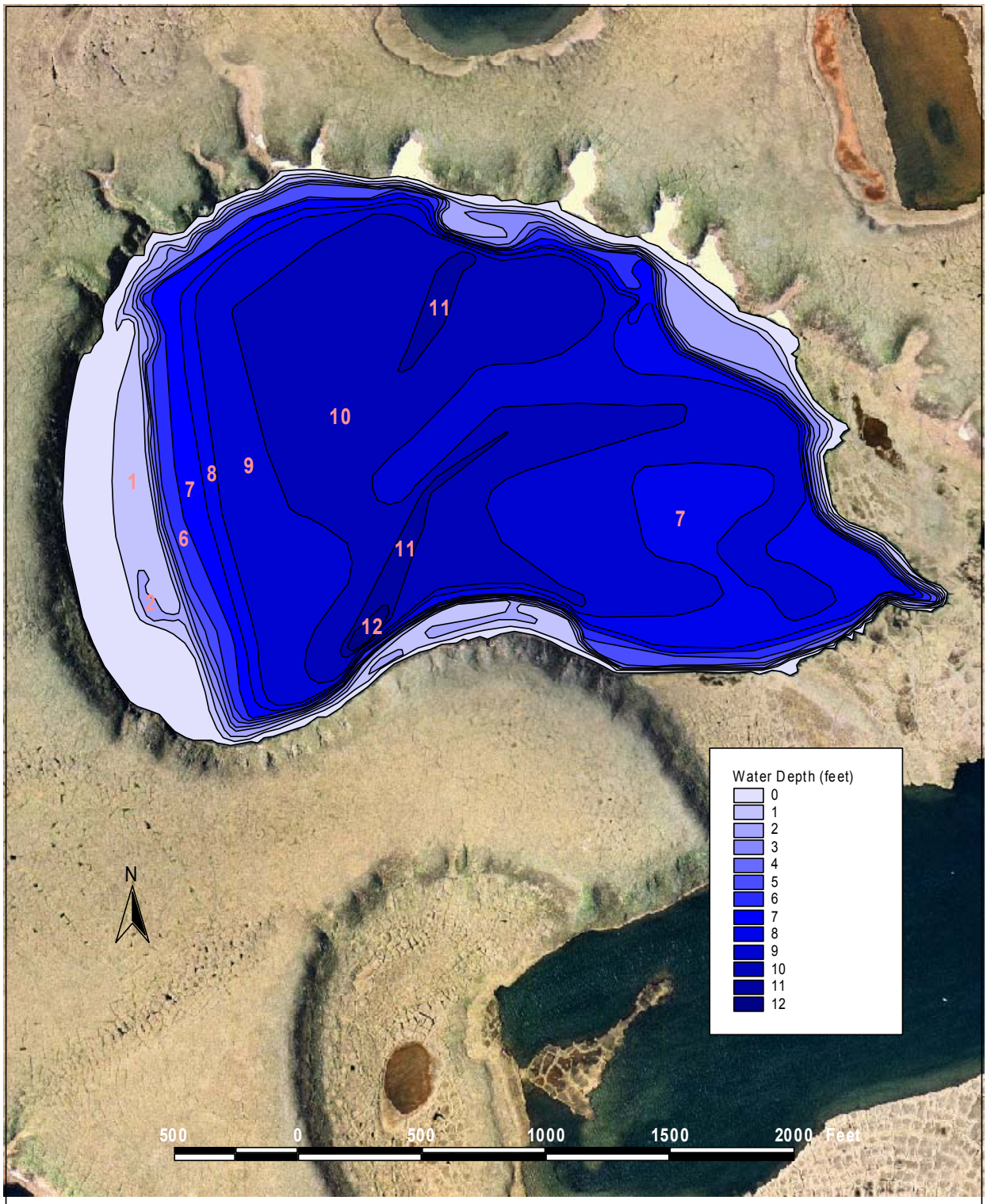
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 16 05	4.3	None	0
Gill Net	Jul 16 05	7.7	None	0
Minnow Traps	Jul 16 05	8.6	None	0



Regions of lake M9921 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 16, 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake M9921 on July 16, 2005.



Depth contours of lake M0005 based on transects surveyed on July 20, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M0005

Other Names:
Location: 70.26345°N 152.04426°W
USGS Quad Sheet: Harrison Bay B-4: T11N R1W, Sec 35/36
Habitat: Tundra lake
Area: 127 acres
Maximum Depth: 13.9 feet
Active Outlet: No
Total Lake Volume: 309.7 million gallons (2005 data)
Volume Under 4 ft of ice: 167.8 million gallons
Volume Under 5 ft of ice: 135.9 million gallons
Volume Under 7 ft of ice: 22.3 million gallons
Potential Aggregate: 27.7 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **40.76 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

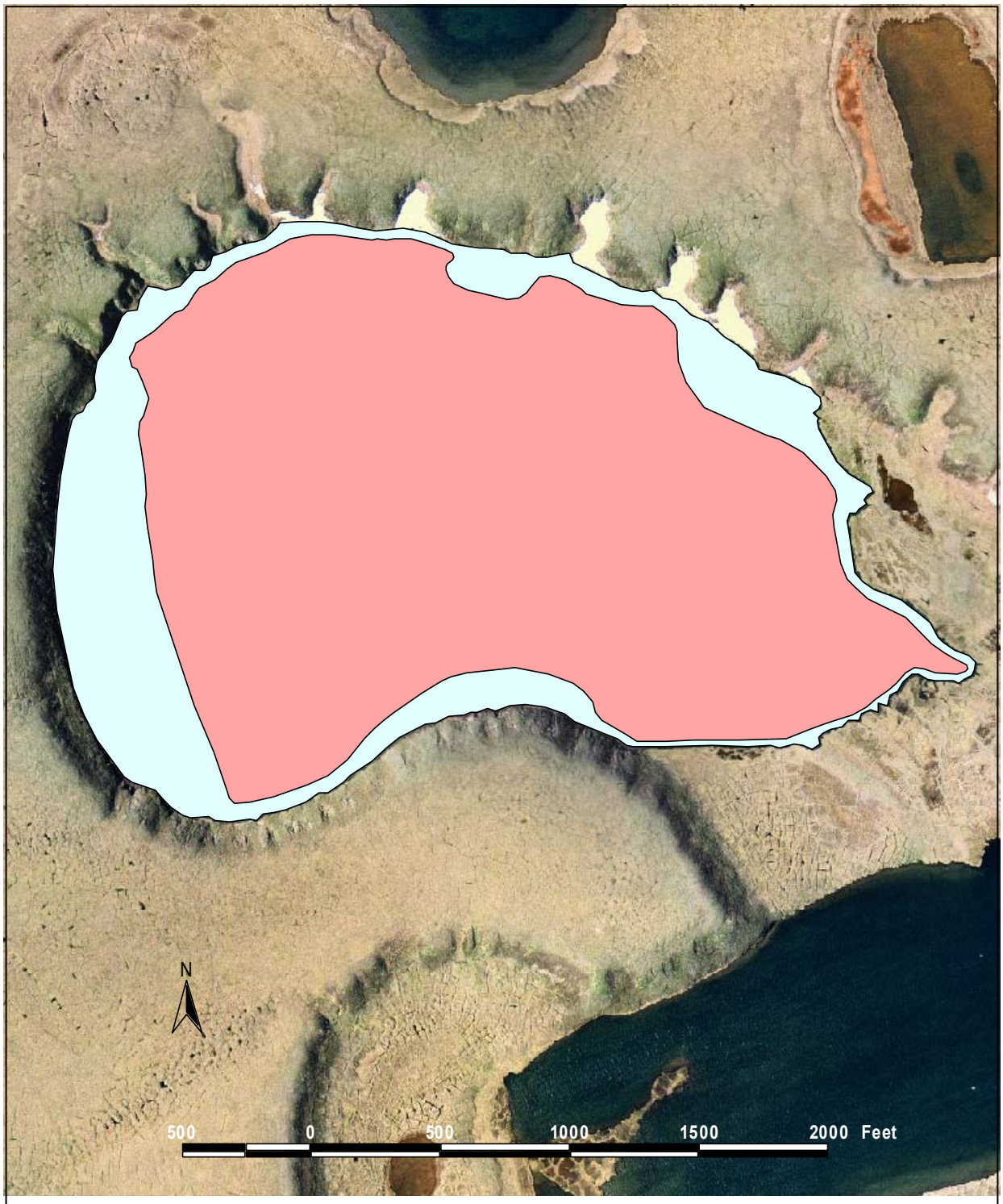
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	29.4	12.3	31.4	6.4	105	282		8.06	
2005	28.0	6.2	32.0	11.0	95	238	1.0	8.33	

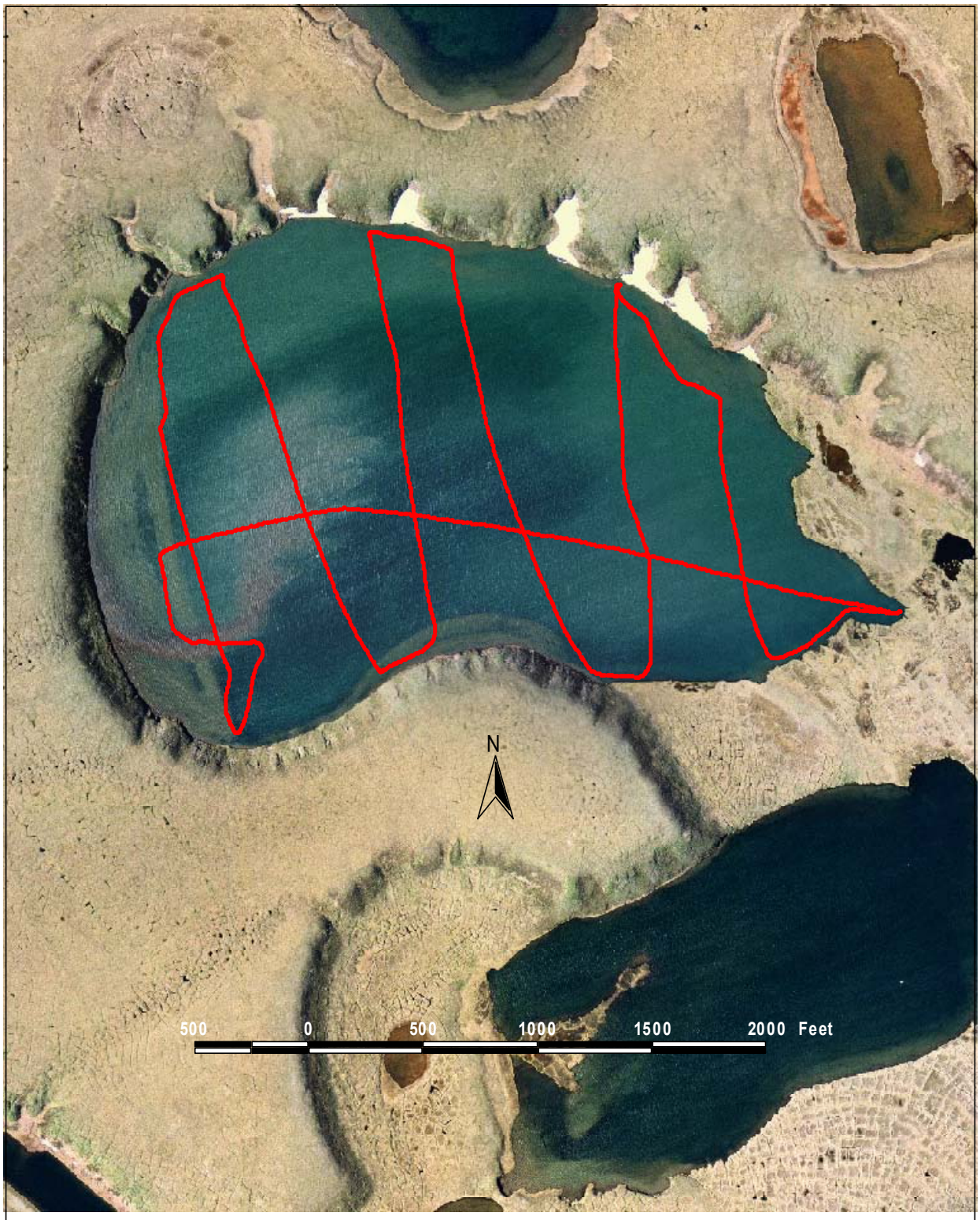
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 15 00	6.0	None	0	
Dip Net	Jul 15 00		Ninespine stickleback	3	44-53

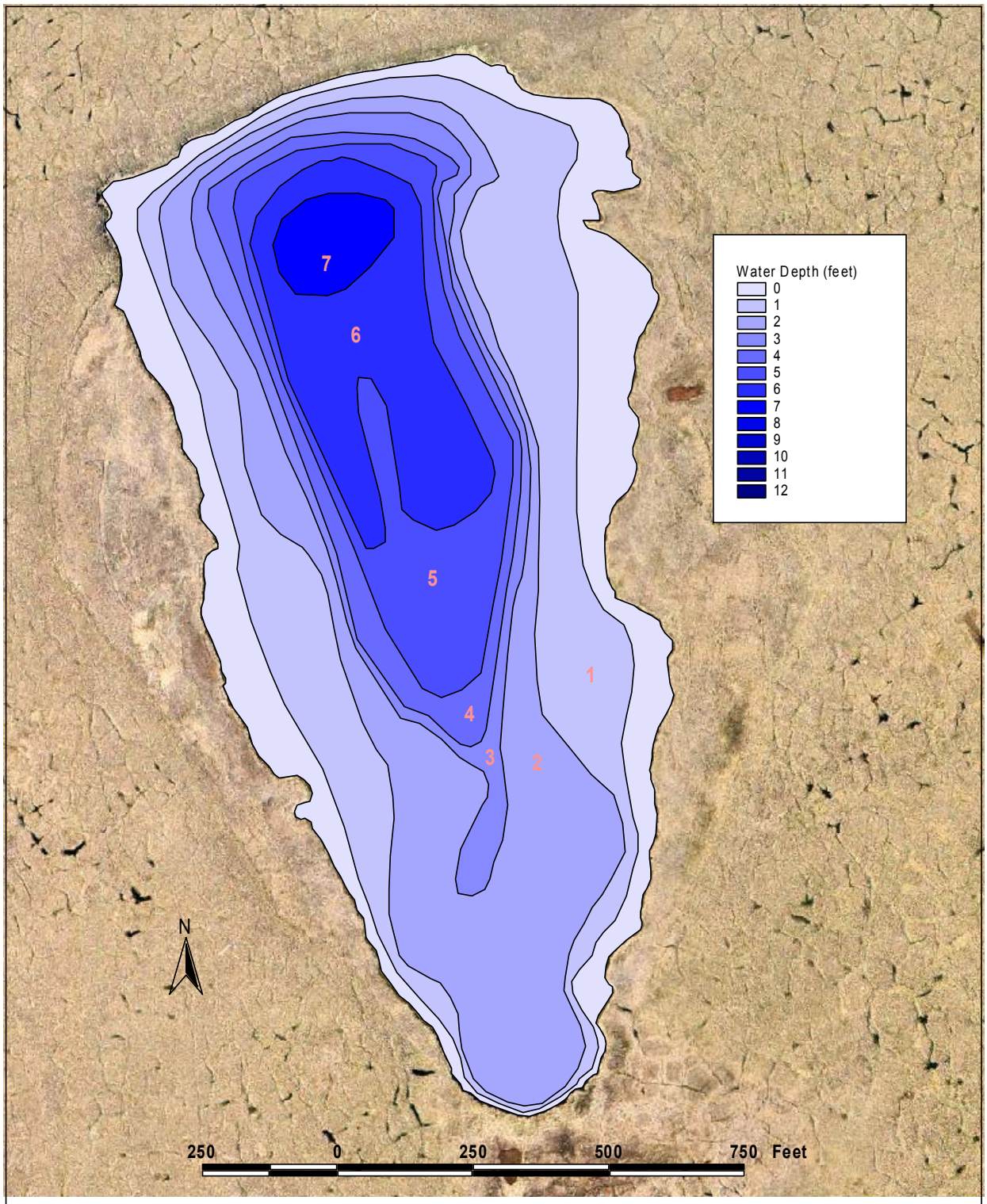


Regions of lake M0005 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 20, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake M0005 on July 20, 2005.



Depth contours of lake M0010 based on transects surveyed on July 21, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake M0010

Other Names:
Location: 70.27767°N 151.81507°W
USGS Quad Sheet: Harrison Bay B-4: T11N R1E, Sec 26
Habitat: Tundra lake
Area: 30 acres
Maximum Depth: 8.1 feet
Active Outlet: No
Total Lake Volume: 28.5 million gallons (2005 data)
Volume Under 4 ft of ice: 5.1 million gallons
Volume Under 5 ft of ice: 2.6 million gallons
Volume Under 7 ft of ice: 0.8 million gallons
Potential Aggregate: 21.7 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **5.10 million gallons**
(volume under 4 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

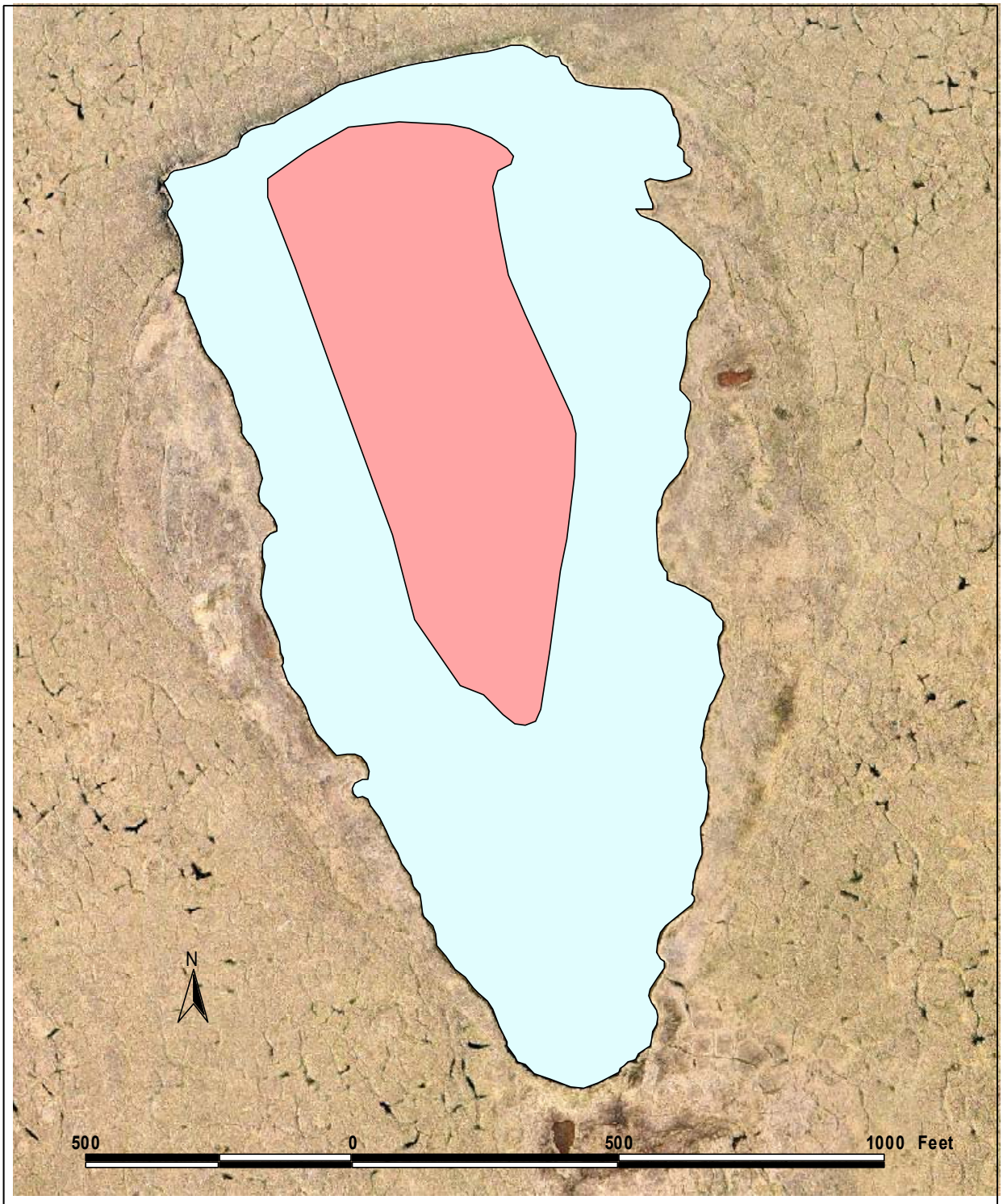
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	14.2	6.2	17.2	3.7	58	150		8.00	
2005	19.0	4.0	16.4	6.4	64	155	0.8	8.15	

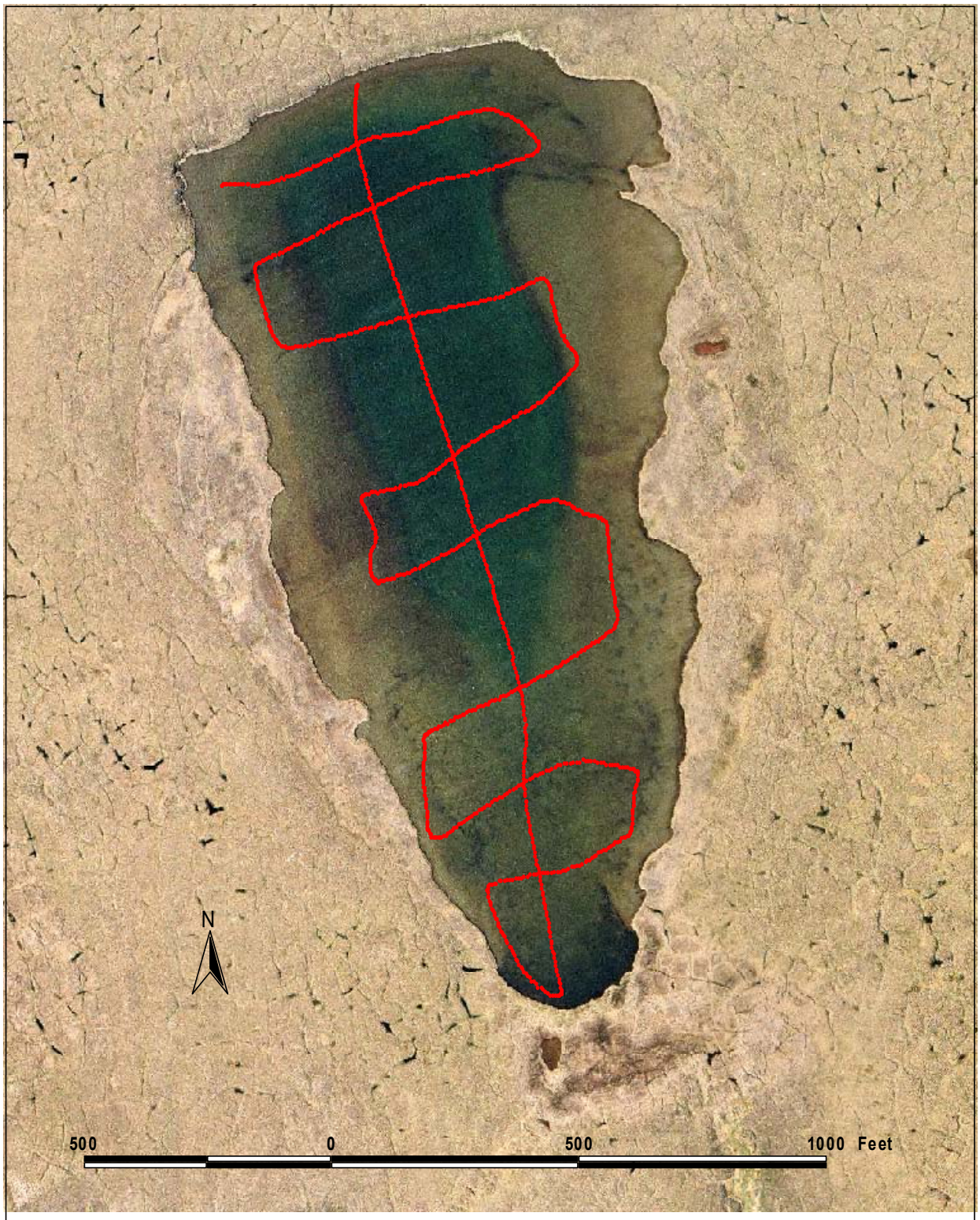
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 17 00	8.0	None	0
Gill Net	Jul 21 05	9.1	None	0
Minnow Traps	Jul 21 05	10.8	None	0

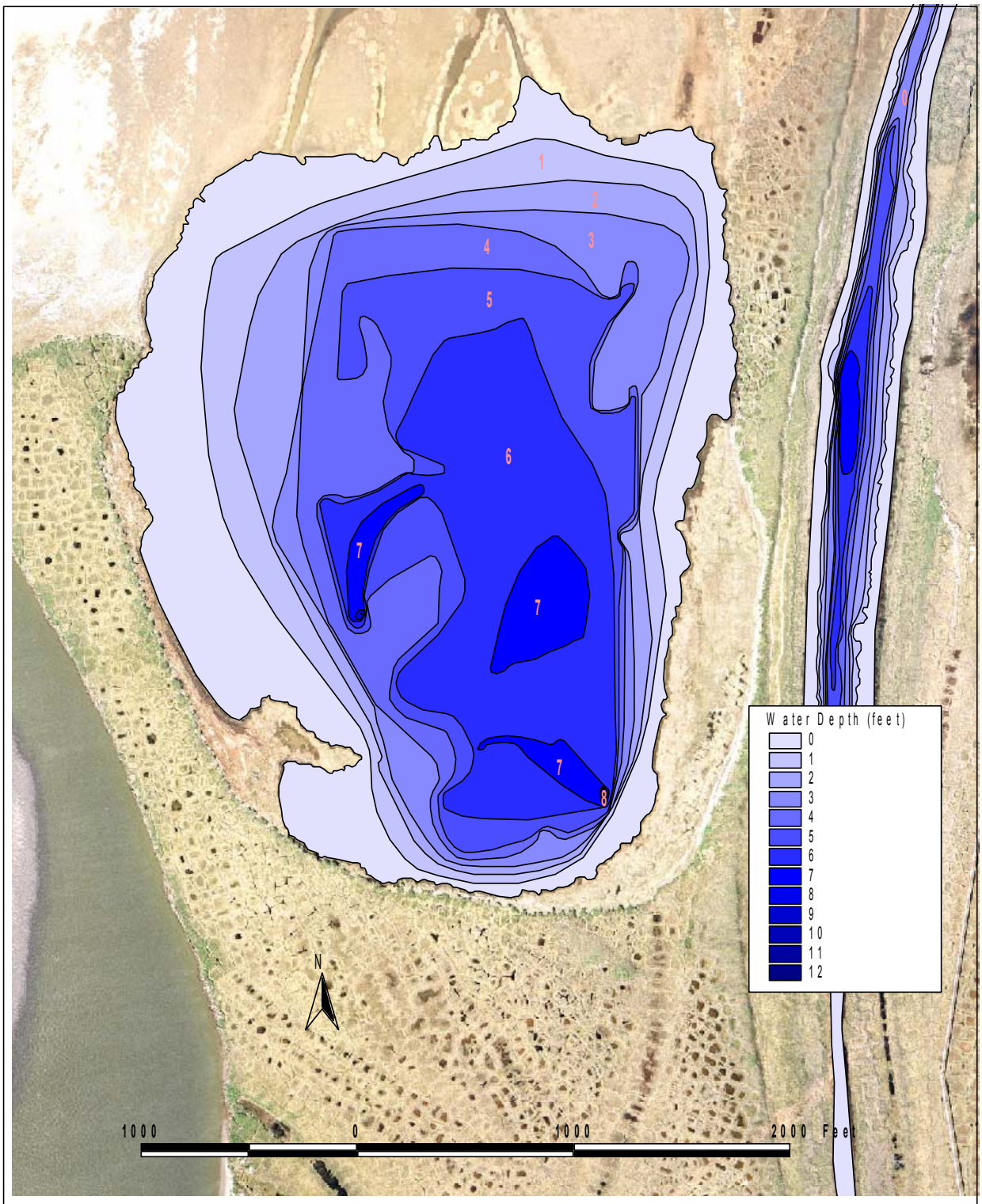


Regions of lake M0010 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 21, 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects measured at lake M0010 on July 21, 2005.



Depth contours of Nanuk Lake based on transects surveyed on July 18, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Nanuk Lake

Other Names:
Location: 70.31494°'N 151.01286°'W
USGS Quad Sheet: Harrison Bay B-2: T11N R4E, Sec 1/2/11/12/13
Habitat: Tapped Lake
Area: 177 acres
Maximum Depth: 11.7 feet
Active Outlet: Yes
Total Lake Volume: 200.5 million gallons (2005 data)
Volume Under 4 ft of ice: 47.5 million gallons
Volume Under 5 ft of ice: 24.3 million gallons
Volume Under 7 ft of ice: 0.8 million gallons
Potential Aggregate: 95.0 acres (water depth 4 ft or less)

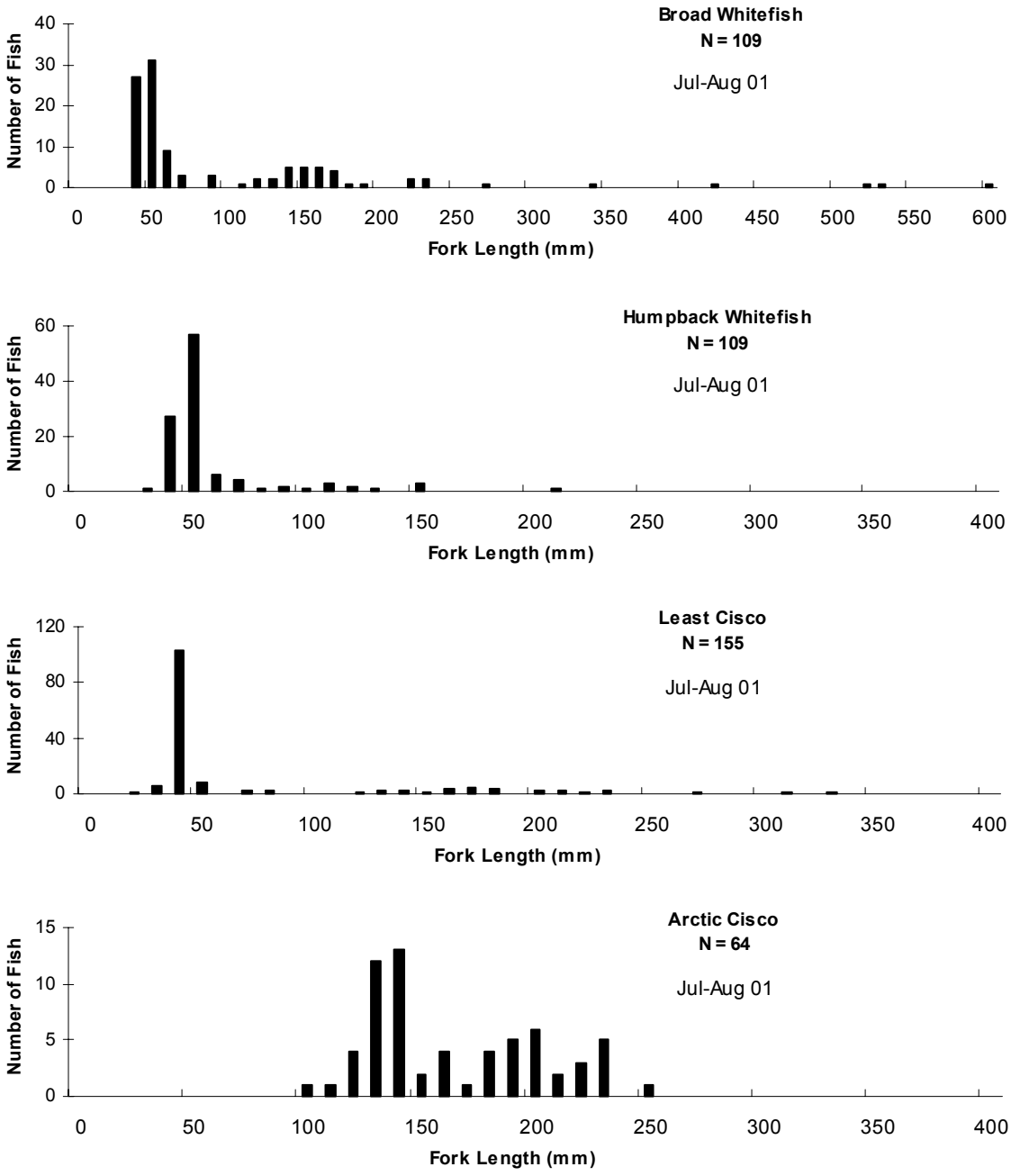
Maximum Recommended Winter Removal: 0.13 million gallons
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Chemistry:

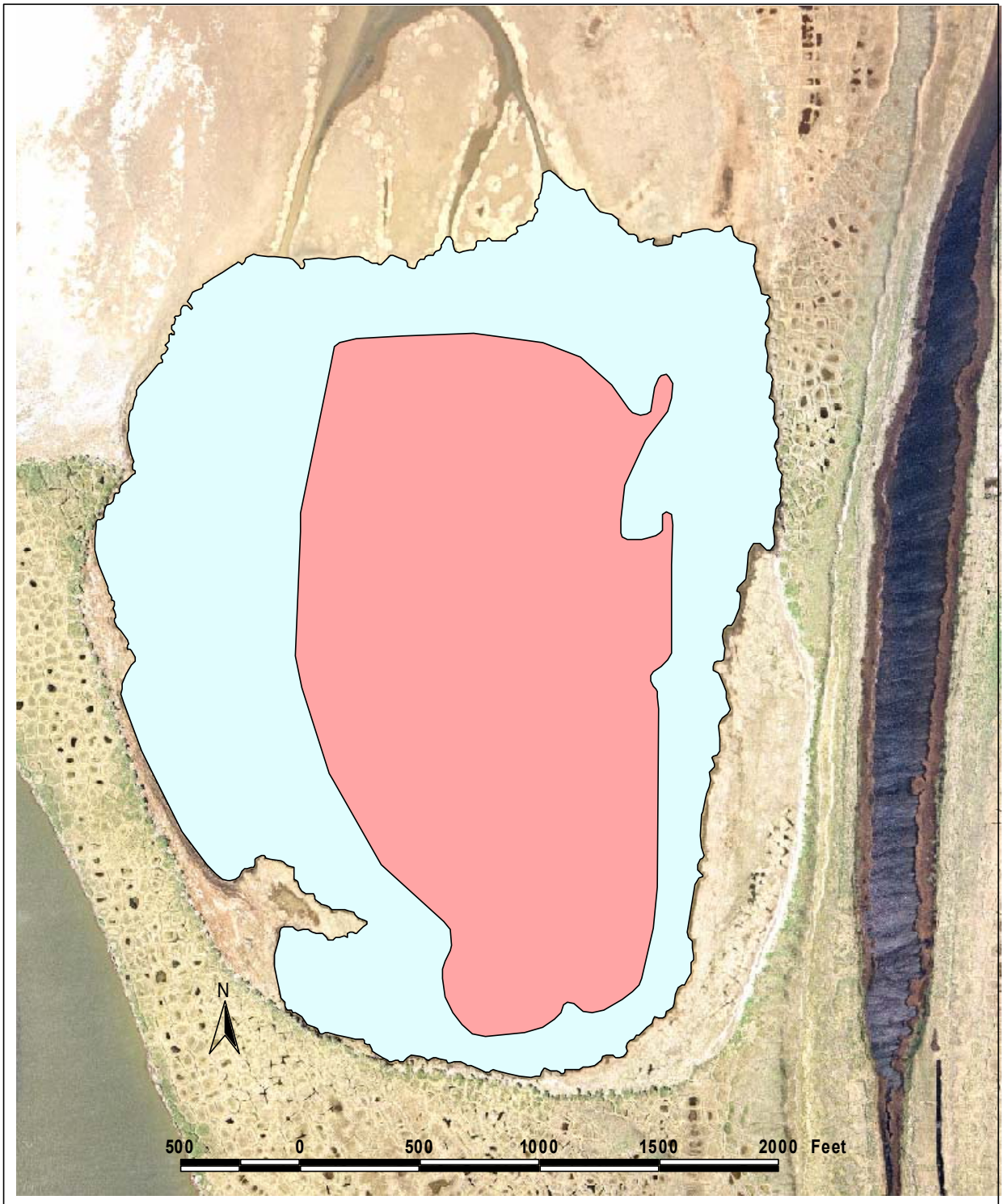
Year of Test	Calcium (mg/l)	Magnesium (mg/l	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
Jul 2001						1052	24.5	8.09	
Aug 2001						460	31.1	7.91	
2005	20.0	12.0	130.0	62.0	99	548	31.2	7.90	

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 13-20, 01	185.8	Broad whitefish	44	62-600
			Humpback whitefish	18	62-210
			Least cisco	37	29-334
			Arctic cisco	64	105-252
			Round whitefish	4	125-207
			Rainbow smelt	1	94-151
			Longnose sucker	1	91
			Fourhorn sculpin	49	156-259
			Ninespine stickleback	61	--
Fyke Net	Aug 18-25, 01	136.8	Broad whitefish	272	40-340
			Humpback whitefish	341	38-114
			Least cisco	3066	35-85
			Arctic grayling	3	197-202
			Dolly Varden char	1	176
			Round whitefish	5	101-210
			Burbot	1	480
			Longnose sucker	1	98
			Slimy sculpin	33	--
			Fourhorn sculpin	41	185
			Ninespine stickleback	40	--

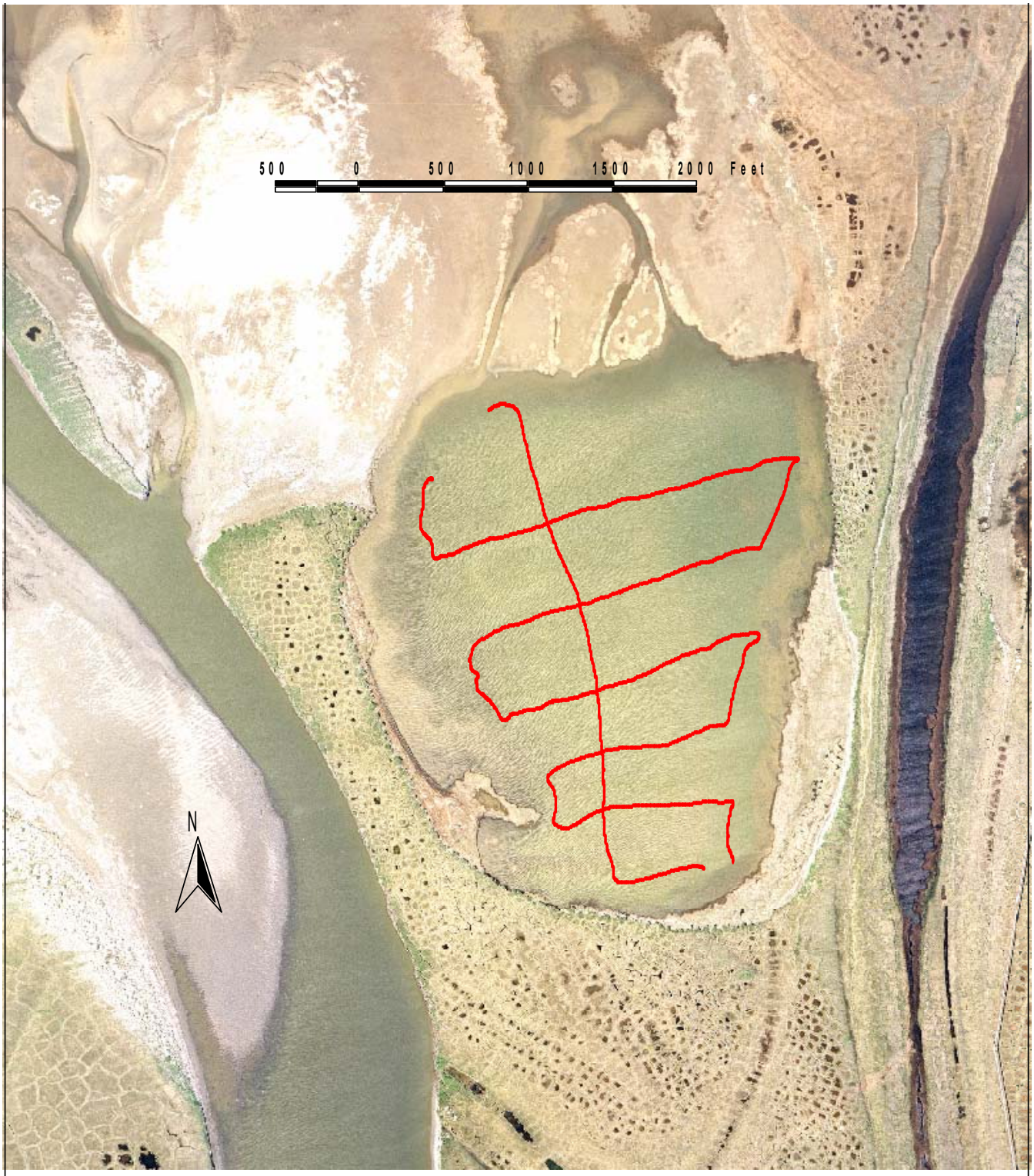


Length frequencies of dominant species caught by fyke net in Nanuk Lake, July-August 2001.

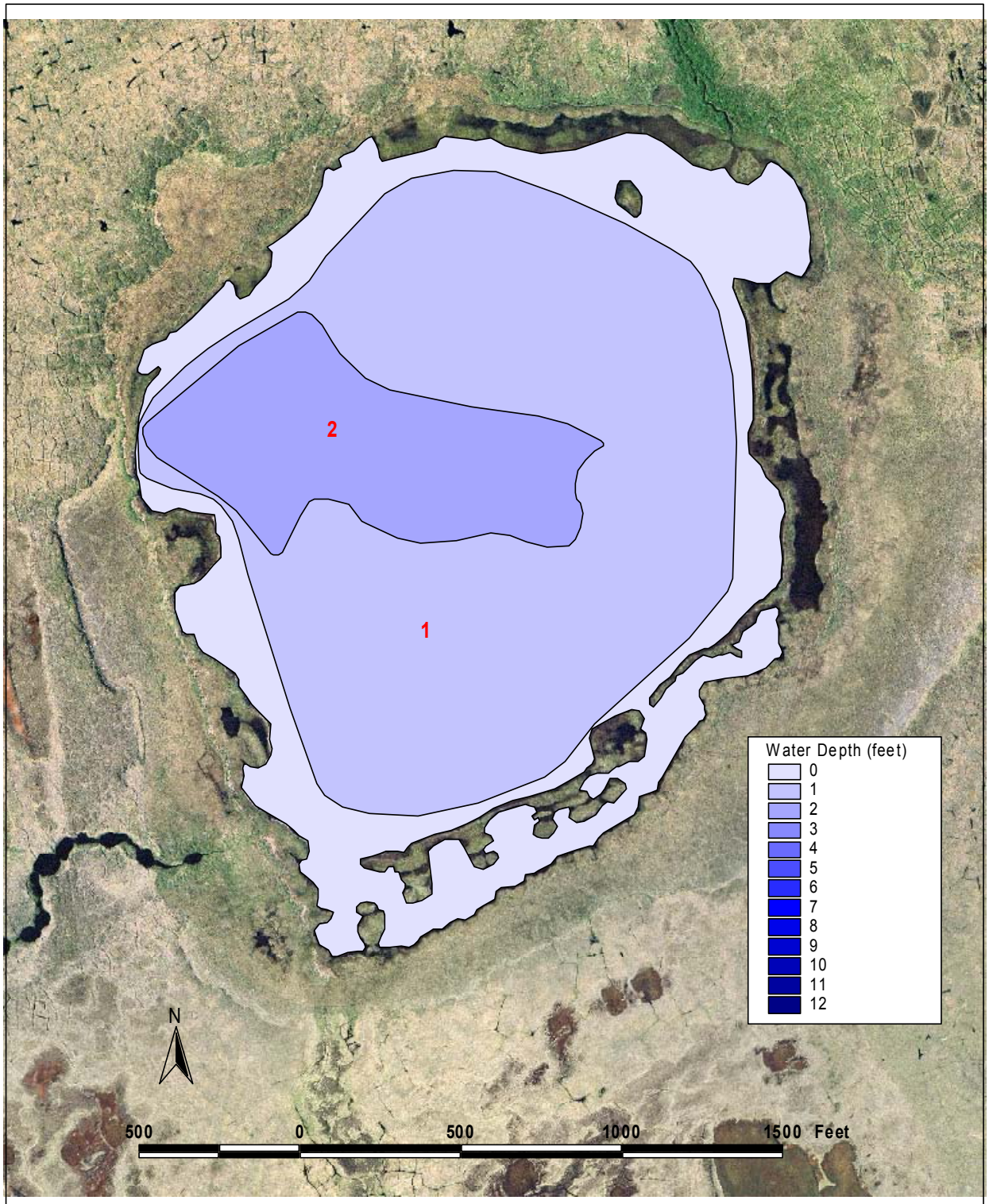


Regions of Nanuk Lake less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 18 2005.

(not to be used for navigation or to direct use of heavy equipment)



Depth transects surveyed at Nanuk Lake on July 18, 2005.



Depth contours of lake R0071 based on transects surveyed on July 17, 2005.
(depths in 1 foot intervals)

(not to be used for navigation or to direct use of heavy equipment)

Lake R0071

Other Names:
Location: 70.22433°N 152.65086°W
USGS Quad Sheet: Harrison Bay A-5/B-5: T10N R2E, Sec. 16
Habitat: Drainage Lake
Area: 80.9 acres
Maximum Depth: 2.7 feet
Active Outlet: Yes
Total Lake Volume: 34.7 million gallons (2005 data)
Water Volume Under 4 ft of ice: 0.0 million gallons
Water Volume Under 5 ft of ice: 0.0 million gallons
Water Volume Under 7 ft of ice: 0.0 million gallons
Potential Ice Aggregate: 80.9 acres (water depth 4 ft or less)

Maximum Recommended Winter Removal: **0.00 million gallons**
(lake is less than 4 feet deep)

Water Use History:

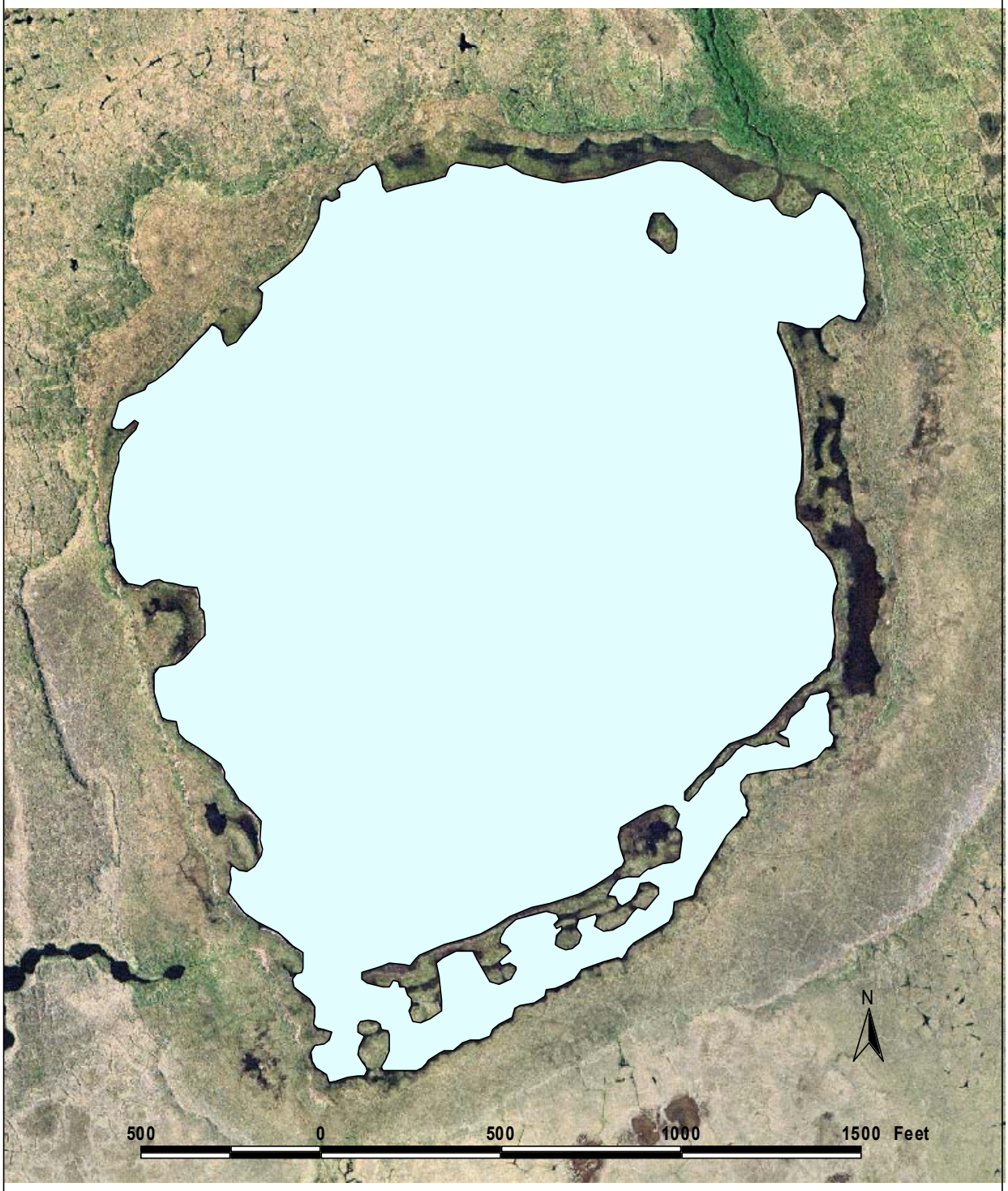
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2005	11.0	2.7	12.0	5.2	39	95	13	7.81	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 17 05	6.8	None	0	
Minnow traps	Jul 17 05	7.0	None	0	



Lake R0071 is less than 4 feet deep and likely to be
available for ice chips, based on transects surveyed on July 17 2005.

(not to be used for navigation or to direct use of heavy equipment)

Depth transects measured at lake R0071 on July 17, 2005.