2006 SURVEY OF LAKES IN SUPPORT OF THE MAKUA EXPLORATION PROJECT

Final Report

September 2006
(revised December 2006)

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
The Woodlands, TX

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Lawrence Moulton
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ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

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Anadarko Petroleum Corp.
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INTRODUCTION

ConocoPhillips Alaska, Inc. intends to explore for petroleum reserves in the Makua Exploration Area (Figure 1). Activities associated with exploration require withdrawal of water from lakes to support industrial and domestic needs. During review of permit applications for water withdrawal, information is required on the biological sensitivity of lakes proposed for use. 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 2006 survey was conducted to survey or re-survey 15 lakes used as potential water sources for the Makua Exploratoin Project. Many of the lakes in the 2006 study were initially surveyed from 1991 to 2000 using older survey methods. This study updates the previous estimates using more accurate survey techniques developed in 2002. Objectives of the study were to 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) conduct initial surveys on lakes identified as being desirable water sources,

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

4) 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 2006 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. At lakes where bottom contours allowed, a 20 ft seine was pulled through vegetation beds along the lakeshore to detect small fishes.

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 on 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); fish sampling in 1979
B = Bendock fish 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 fish sampling in 1977
R = Reanier depth 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. Gallons of water represented by the surface area available for ice aggregate,
14. Maximum recommended winter water withdrawal, exclusive of volumes related to ice aggregate,
15. Water chemistry measurements,
16. Catch record, including gear used, date sampled, species caught and size range,
17. Where appropriate data exist, the length frequency of dominant species is plotted,
18. Map of potential ice aggregate removal areas, and
19. Map showing measured depth transects.

RESULTS AND DISCUSSION

Biological Observations

One lake (DS-3H) was sampled for fish in 2006 for the first time (Table 2). MC7901 was re-sampled because the last sampling was in 1979. Neither of the sampled lakes produced fish species. DS-3H is a tundra lake immediately west of Kuparuk Drill Site DS-3H. The lake has no defined drainage to Kalubik Creek. MC7901 is a large shallow lake (mostly 5 feet deep) that appears to have an active connection to lower Kalubik Creek, however gill net sampling and extensive seining failed to detect fish in 2006. Fish were also not detected during the 1979 gill net sampling (McElderry and Craig 1981). Lake M0679 was not sampled because the lake had a maximum depth of 5 feet, with no visible outlet. Lake M0680 was breached to Harrison Bay and functioned as a coastal lagoon, thus was not considered to be suitable as a water source. Historical fish sampling data were used to evaluate the remaining 11 lakes.

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the July 31-August 5 sampling in 2006 averaged 12.5^{o}C, ranging from 10.1^{o}C to 15.6^{o}C. Temperatures had decreased to a mean of 4.8^{o}C during sampling on Aug 25-26, 2006. As expected for natural surface waters, dissolved oxygen was high, averaging around 10.4 mg/l. Specific conductance ranged from 257 to over 2,500 microSiemens/cm. Sodium and chloride concentrations were high, which is expected for lakes near the coast. PH ranged from 7.54 to 8.18.

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, the 15 lakes surveyed in 2006 for the Makua Exploration should provide 225.3 million gallons of water for under-ice withdrawal during winter. 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, 581 acres are likely to be available for ice chips from lakes surveyed for the Makua Exploration during 2006, which is equivalent to 45.4 million gallons of water.

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Table 1. Summary of lakes sampled in 2006 for winter water use at the Makua Exploration Area.

Lake Name	Latitude (NAD83)	Longitude (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (mill. gals)
B8542	N70.44292	W150.57267	13N	6E	27/34	94.6	30.5	431.97
B8543	N70.43817	W150.61147	13N	6E	28/33	193.5	15.6	234.96
DS-3H	N70.41144	W150.02395	12N	8E	11	37.4	11.1	66.36
L9101	N70.45624	W150.57003	13N	6E	27	40.2	25.0	160.42
L9103	N70.45573	W150.52079	13N	6E	26	70.6	19.3	199.08
L9201	N70.45917	W150.64490	13N	6E	20/29	36.2	19.6	114.32
L9203	N70.44574	W150.72904	13N	5E	25/36	137.6	19.8	403.41
M9313	N70.42360	W150.90047	12N	5E	4	140.2	25.1	415.11
M9712	N70.42932	W150.92720	12N	5E	5	59.4	11.6	116.20
M9713	N70.42299	W150.93204	12N	5E	5	17.0	11.0	37.80
M0019	N70.42980	W150.88829	12/13N	5E	4/32	6.0	10.8	10.75
M0182	N70.43586	W150.92783	13N	5E	31/32	126.2	10.5	116.94
M0679	N70.43168	W150.89256	13N	5E	32	25.7	6.0	18.25
M0680	N70.45255	W150.89436	13N	5E	28/29	44.7	--	--
MC7901	N70.41314	W150.20024	12N	8E	5/6/7/8	462.8	7.3	439.41

Table 2. Summary of fish sampling for lakes surveyed in 2006 for the Makua Exploration Project.

		Fyke Nets/Gill Nets		Minnow Traps		Seine or Other	
Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[2]	Effort	Fish Species[2]
B8542[3]	1985-1992	46.0	BDWF,LSCS	--	--	--	
B8543[3]	1985-1991	95.0	BDWF,LSCS+	--	--	--	
DS-3H	Aug 26 06	7.2	none	--	--	12 seine hauls	none
L9101	Nov 02 92	25.0	LSCS	--	--	--	
L9103	Oct 28 92	46.5	BDWF,LSCS+	--	--	--	
L9201	Oct 31 92	27.5	BDWF,HBWF,LSCS+	--	--	--	
L9203	Nov 01 92	23.0	BDWF,HBWF+	--	--	--	
M9313	1993-2000	209.3	LSCS,NSSB	27.0	none	--	
M9712	Aug 08 97	11.8	none	--	--	--	
M9713	Aug 08 97	11.7	none	--	--	--	
M0019	Jul 25 00	7.0	none	9.8	none	--	
M0182	2001	352.8	BDWF,HBWF,LSCS+	--	--	--	
M0679	Nets not set - lake mostly less than 5 ft deep						
M0680	Nets not set - coastal lagoon open to Harrison Bay						
MC7901[4]	1979 & 2006	31.3	none	--	--	10 seine hauls	none

[1] BDWF = broad whitefish, HBWF = humpback whitefish, LSCS = least cisco
+= additional species caught

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

[3] also sampled in 1985 by Bendock and Burr

[4] also sampled in 1979 by McElderry and Craig

Table 3. Water chemistry parameters measured in conjunction with 2006 lake sampling in the Makua Exploration Area.

Lake	Date	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)
B8542	Aug 25 06	5.7	12.5	257	1.10	7.55	8.49	5.62	22.5	54.3	44.3
B8543	Aug 02 06	12.3	10.7	325	7.88	8.03	25.2	9.69	30.2	43.2	103
DS-3H	Aug 26 06	4.7	--	338	1.02	--	37.1	6.63	13.2	55.0	120
L9101	Aug 02 06	13.5	10.0	430	6.01	7.90	9.76	8.85	66.5	113	60.8
L9103	Aug 02 06	13.8	9.9	486	3.53	8.07	14.0	11.7	65.6	122	83.1
L9201	Aug 04 06	12.9	10.0	521	2.38	7.68	18.1	13.7	67.1	130	102
L9203	Aug 25 06	4.9	--	473	3.28	7.54	8.10	8.30	54.6	128	54.4
M9313	Jul 25 00	10.1	--	759	--	7.86	21.2	16.4	71.3	192	120
M9712	Jul 31 06	15.6	9.8	2,544	2.84	8.18	35.2	53.7	405	785	309
M9713	Aug 05 06	11.7	9.9	1,215	1.23	8.02	21.5	24.7	197	348	155
M0019	Aug 05 06	11.4	10.2	609	1.65	7.96	17.7	13.2	74.1	174	98.6
M0182	Aug 02 06	11.3	11.0	2,739	4.98	8.02	37.0	55.2	488	825	320
M0679	Aug 05 06	10.1	10.4	1,023	0.92	7.91	21.4	20.5	142	270	138
M0680	Aug 02 06	--	--	--	--	--	--	--	--	--	--
MC7901	Aug 26 06	3.7	--	321	2.45	--	38.6	4.03	15.5	39.7	113

Table 4. Recommended maximum water volumes available for winter water withdrawal from lak surveyed in 2006 for Makua project needs (does not include volume related to ice aggregate (revised Dec 1, 2006 to correct values for B8542 and B8543, indicated in bold)

(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).

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]	Recommended Winter Withdrawal (mil. gals)
B8542	94.6	30.5	431.97	318.30	87.52	36.04	BDWF,LSCS	--	**36.04**
B8543	193.5	15.6	234.96	58.86	11.34	2.08	BDWF,LSCS+	--	**2.08**
DS-3H	37.4	11.1	66.36	24.50	4.87	0.43	none	none	24.50
L9101	40.2	25.0	160.42	114.33	31.20	12.60	LSCS	--	12.60
L9103	70.6	19.3	199.08	113.98	28.38	8.74	BDWF,LSCS+	--	8.74
L9201	36.2	19.6	114.32	72.40	18.91	6.81	BDWF,LSCS+	--	6.81
L9203	137.6	19.8	403.41	239.01	60.34	19.57	BDWF,LSCS+	--	19.57
M9313	140.2	25.1	415.11	242.61	60.67	19.00	LSCS,NSSB	--	19.00
M9712	59.4	11.6	116.20	43.98	8.81	1.58	none	--	43.98
M9713	17.0	11.0	37.80	16.97	3.67	0.63	none	--	16.97
M0019	6.0	10.8	10.75	4.47	1.34	0.48	none	none	4.47
M0182	126.2	10.5	116.94	3.91	1.17	0.03	BDWF,LSCS+	--	0.031
M0679	25.7	6.0	18.25	0.29	0.01	0.00	none	--	0.29
M0680	44.7	--	44.67	coastal lagoon, water likely not suitable for use					0.00
MC7901	462.8	7.3	439.41	30.17	0.29	0.00	none	none	30.17

[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, surveyed in 2006 for the Makua Exploration Project.

Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower than 4 feet	Gallons of Water As Chips (millions gallons)
B8542	94.6	30.5	12.3	0.96
B8543	193.5	15.6	118.5	9.27
DS-3H	37.4	11.1	10.7	0.84
L9101	40.2	25.0	8.2	0.64
L9103	70.6	19.3	10.0	0.78
L9201	36.2	19.6	6.9	0.54
L9203	137.6	19.8	19.3	1.51
M9313	140.2	25.1	14.7	1.15
M9712	59.4	11.6	8.9	0.70
M9713	17.0	11.0	2.0	0.16
M0019	6.0	10.8	1.9	0.15
M0182	126.2	10.5	97.7	7.64
M0679	25.7	6.0	23.9	1.87
M0680	44.7	coastal lagoon, water likely not suitable for use		
MC7901	462.8	7.3	245.7	19.22

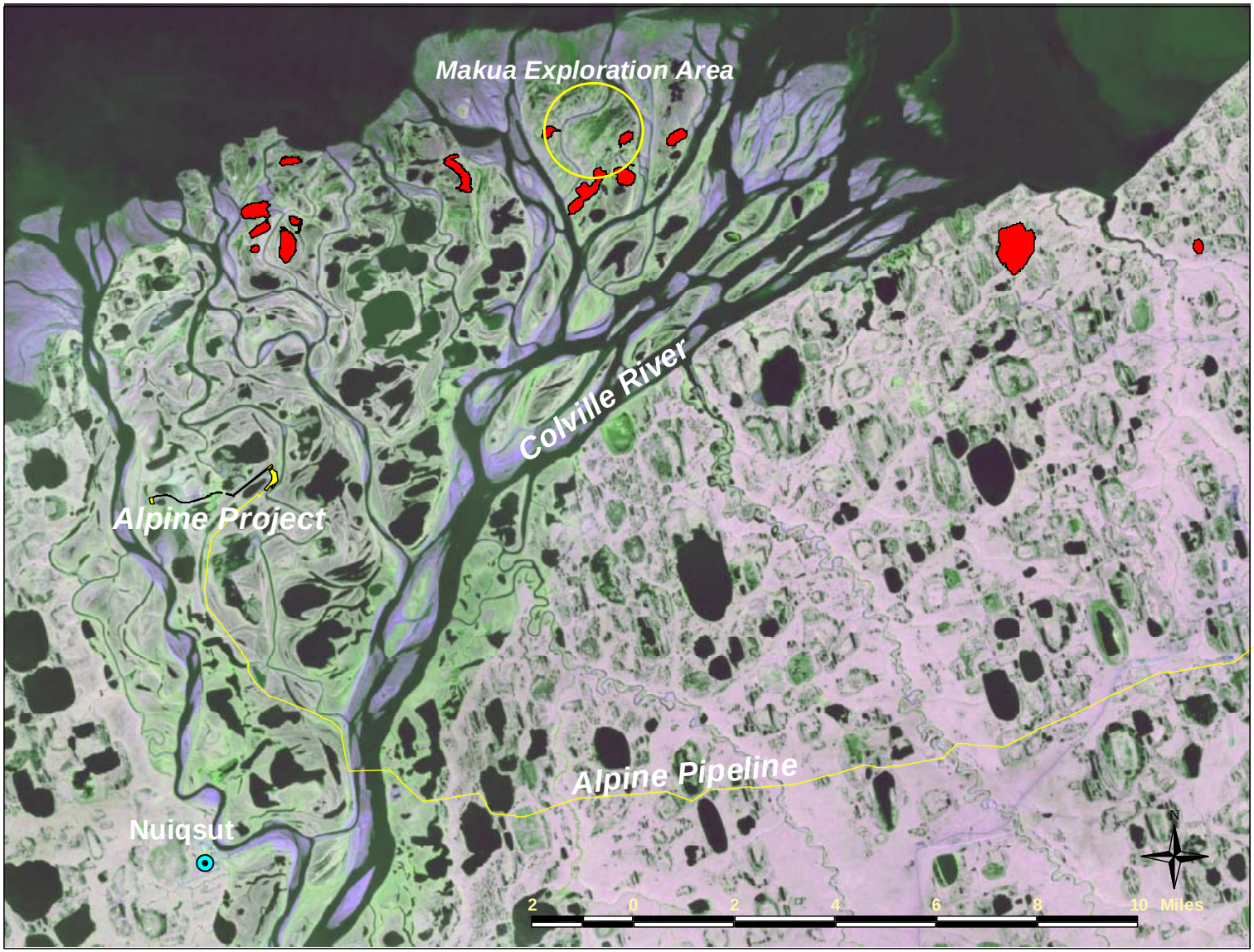


Figure 1. Lakes surveyed for the Makua Exploration, 2006 (surveyed lakes in red).

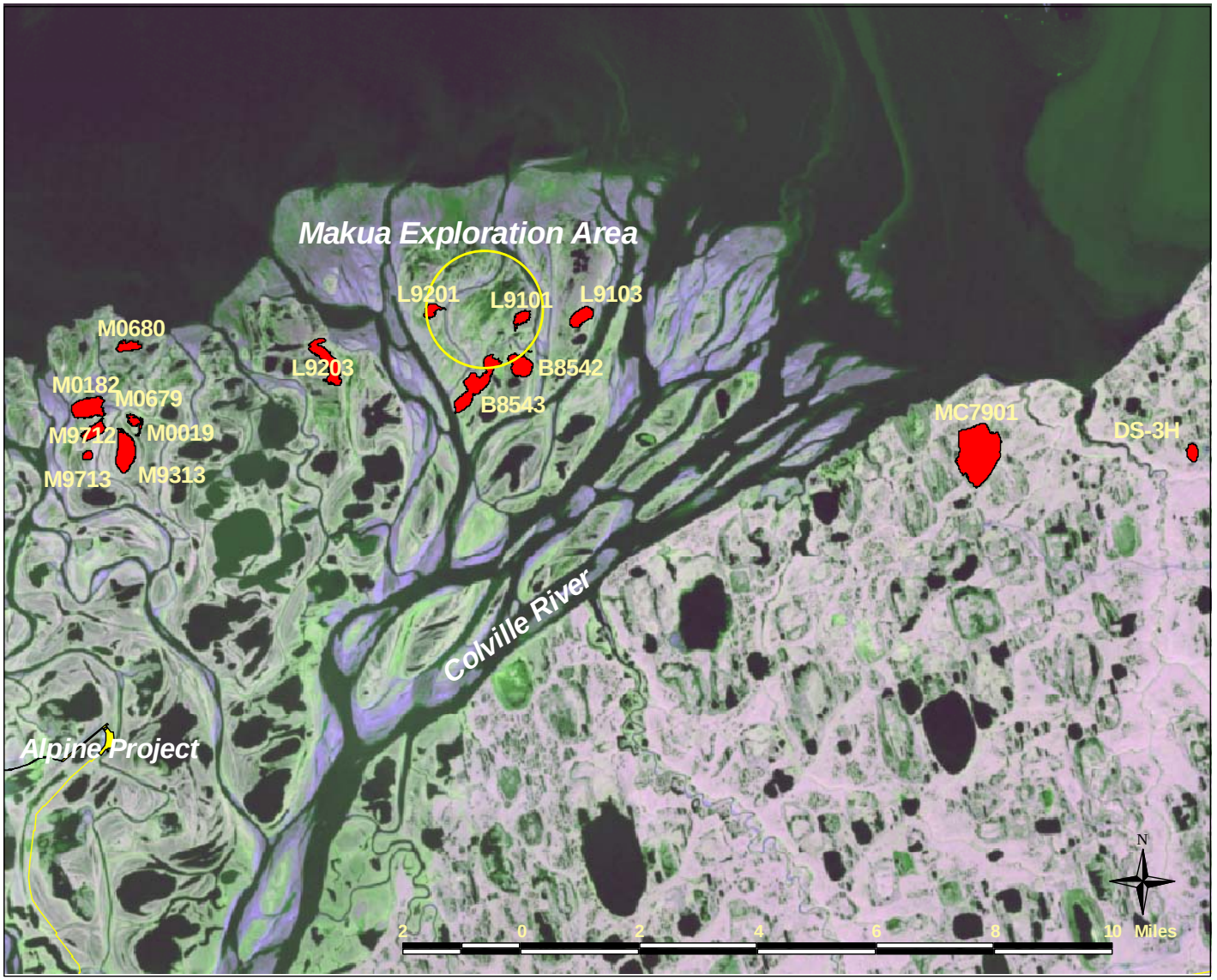
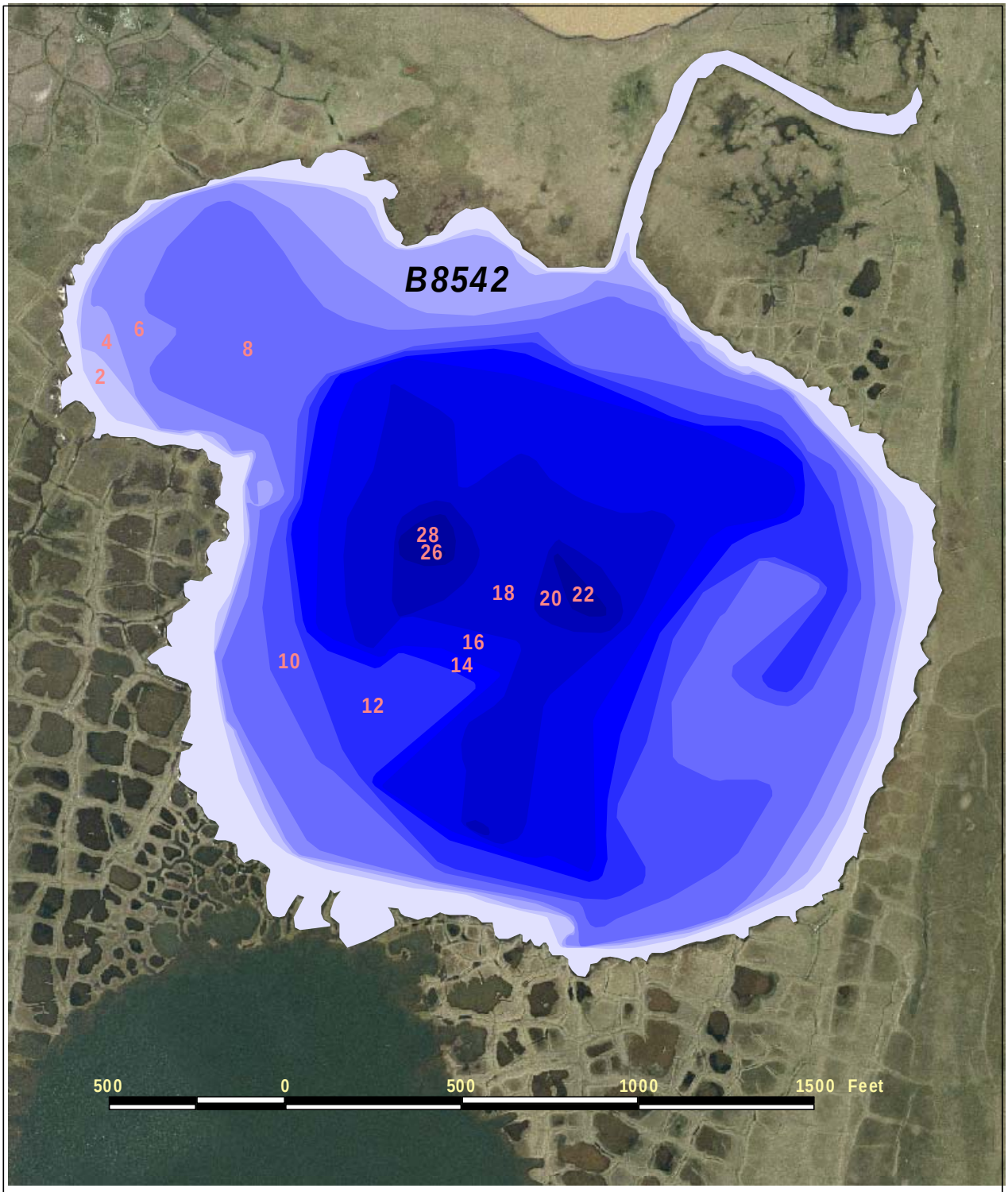


Figure 2. Lakes surveyed in the northern portion of the Colville Delta for the Makua Exploration, 2006.

Lake Summaries



Depth contours of lake B8542 based on transects surveyed on August 25, 2006.
(depths in 2 foot intervals)

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

Lake B8542

Other Names: N13.1; L9104; M9205
Location: 70.44292 °N 150.57267°W
USGS Quad Shee Harrison Bay B-1: T13N R6E, Sec. 27/34
Habitat: Perched Lake (Frequent Flooding)
Area: 95 acres
Maximum Depth: 30.5 feet
Active Outlet: No
Total Lake Volume: 432.0 million gallons (2006 data)
Water Volume Under 4 ft of ice: 318.30 million gallons
Water Volume Under 5 ft of ice: 291.72 million gallons
Water Volume Under 7 ft of ice: 240.27 million gallons

Potential Ice Aggregate: 12.3 acres (water depth 4 ft or less)
0.96 million gallons

Maximum Recommended Winter Removal: **36.04 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	3.45

Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1985	--	--	--	--	51	238	--	7.50	Bendock & Burr 1986
1991	13	7.6	330	60	64	--	--	--	J. Lobdell
1998	15.2	10.8	46.1	91	82.4	--	--	--	Moulton 98
2006	8.49	5.62	22.5	54.3	44.3	257	1.1	7.55	this study

Catch Record:

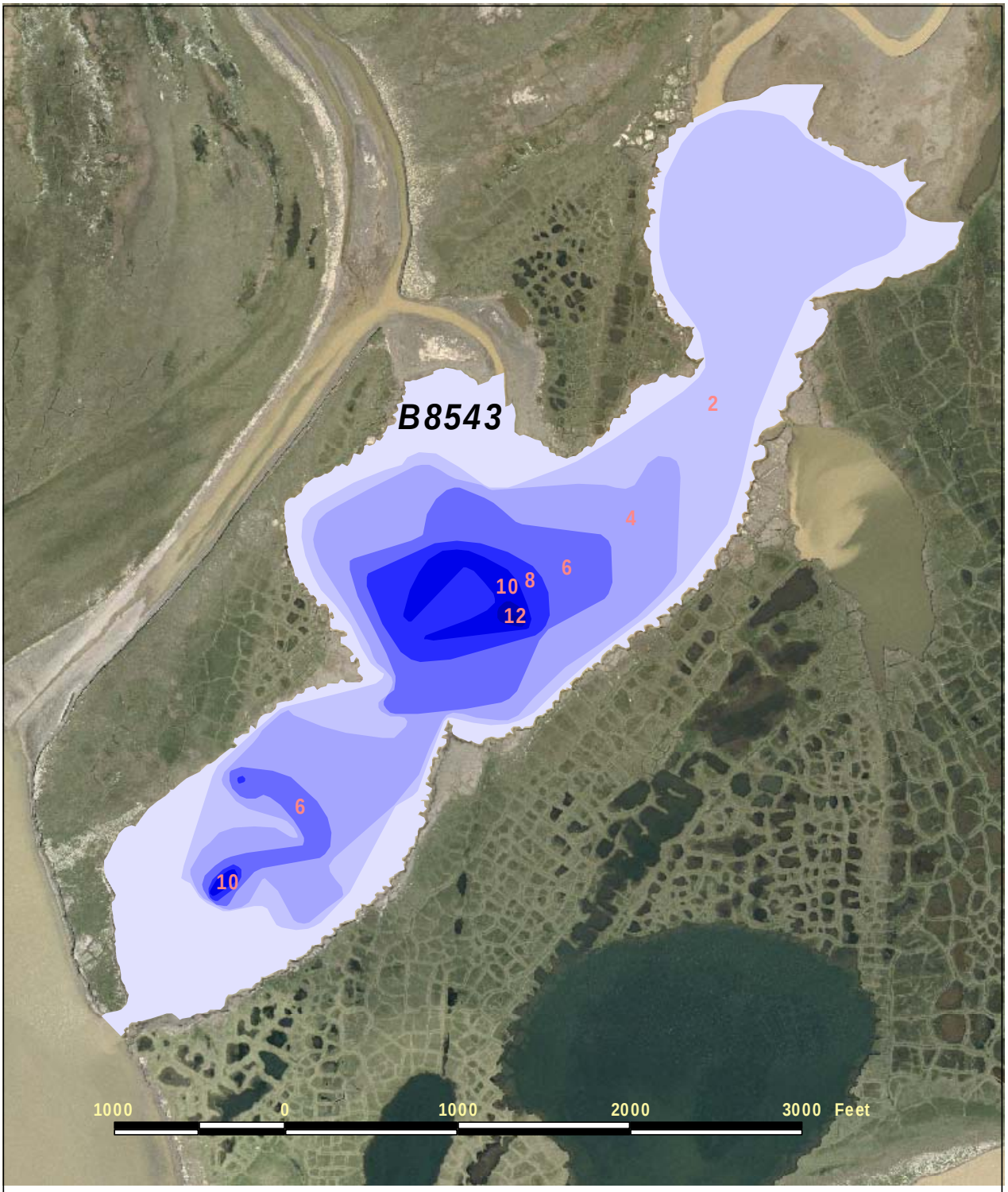
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 16-19, 1985	~24	Broad whitefish	?	
			Least cisco	?	
			Arctic cisco	?	
Gill Net	Oct 30 92	22.0	Least cisco	2	280,290

Source of 1985 data: Bendock & Burr 1986

Regions of lake B8542 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 25, 2006.

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

Depth transects measured on lake B8542 on August 25, 2006.



Depth contours of lake B8543 based on transects surveyed on August 2, 2006.
(depths in 2 foot intervals)

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

Lake B8543

Other Names: N12.1; L9202; M9102
Location: 70.43817 °N 150.61147°W
USGS Quad Sheet: Harrison Bay B-1&2: T13N R6E, Sec. 28/33
Habitat: Tapped Lake
Area: 194 acres
Maximum Depth: 15.6 feet
Active Outlet: Yes
Total Lake Volume: 235.0 million gallons (2006 data)
Water Volume Under 4 ft of ice: 58.86 million gallons
Water Volume Under 5 ft of ice: 37.81 million gallons
Water Volume Under 7 ft of ice: 13.87 million gallons

Potential Ice Aggregate: 118.5 acres (water depth 4 ft or less)
9.27 million gallons

Maximum Recommended Winter Removal: **2.08 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	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1985	--	--	--	--	188	1261	--	8.50	Bendock & Burr 1986
1993	75	160	1400	2700	846	--	--	--	J. Lobdell
2006	25.2	9.69	30.2	43.2	103	325	7.9	8.03	this study

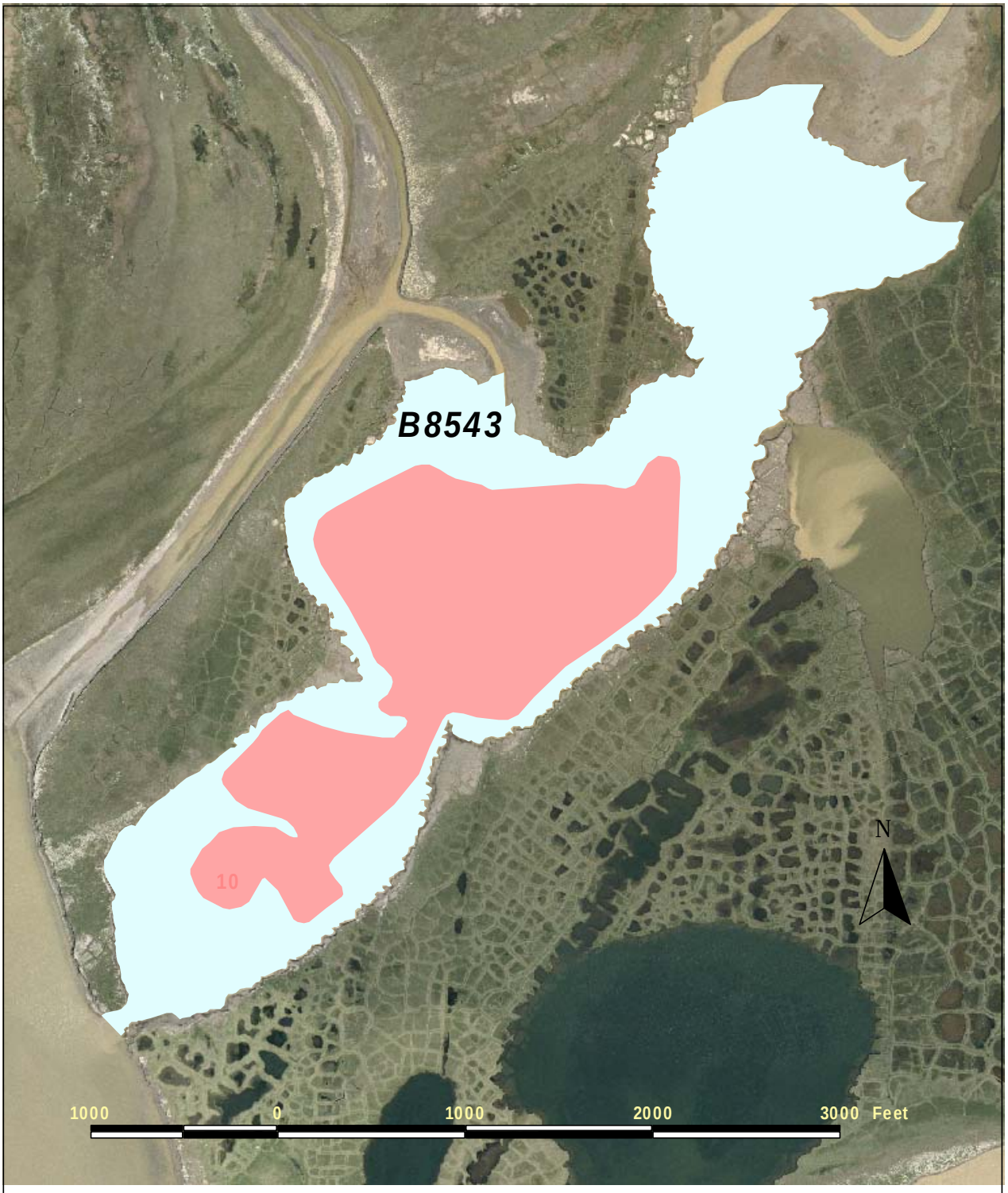
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 16-19, 1985	~24	Broad whitefish	?	
			Least cisco	?	
			Arctic cisco	?	
			Round whitefish	?	
			Arctic flounder	?	
			Fourhorn sculpin	?	
Gill Net	Nov 3 91	23.0	Rainbow smelt	3	265-272
Gill Net	Nov 5 91	48.0	Arctic cisco	2	241, 252
			Rainbow smelt	10	137-278

Source of 1985 data: Bendock & Burr 1986

Salinity Profile:

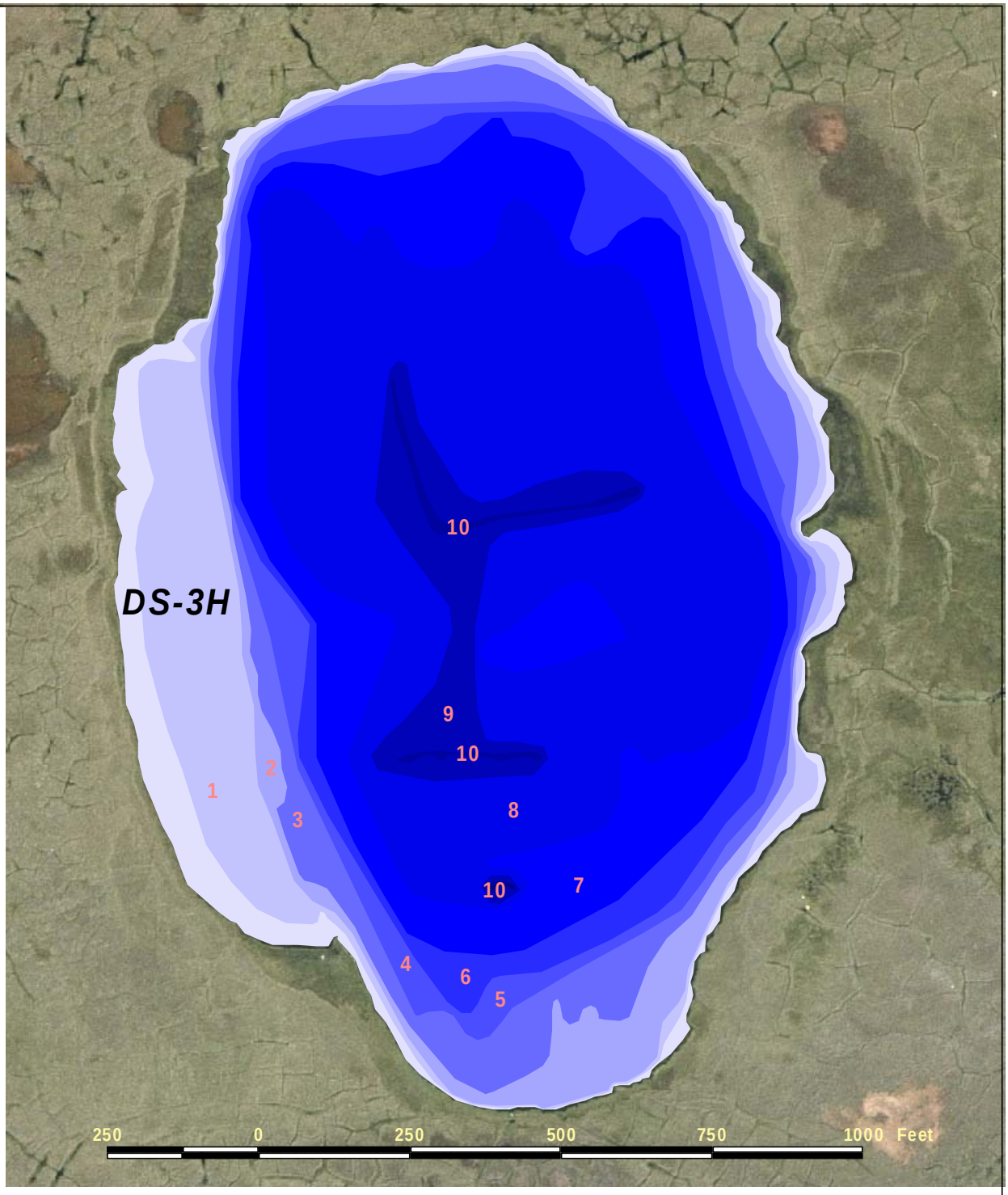
Date	Depth (m)	Salinity (ppt)
Nov 2 91	0.0	7.5
	0.5	7.5
	1.0	9.5
	1.5	11.9
	2.0	13.0
	2.5	14.5
	3.0	15.6
	3.5	16.1
	4.0	17.7
Nov 5 91	0.0	10.0
	0.5	10.0
	1.0	12.0
	1.5	16.3
	2.0	18.5
	2.5	19.4
	3.0	19.8



Regions of lake B8543 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 2, 2006.

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

Depth transects measured on lake B8543 on August 2, 2006.



Depth contours of lake DS-3H based on transects surveyed on August 26, 2006.
(depths in 1 foot intervals)

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

Lake DS-3H

Other Names:
Location: 70.41144 °N 150.02395°W
USGS Quad Sheet: Harrison Bay B-1: T12N R8E, Sec. 11
Habitat: Tundra Lake
Area: 37.4 acres
Maximum Depth: 11.1 feet
Active Outlet: No
Total Lake Volume: 66.4 million gallons (2006 data)
Water Volume Under 4 ft of ice: 24.5 million gallons
Water Volume Under 5 ft of ice: 16.2 million gallons
Water Volume Under 7 ft of ice: 2.9 million gallons

Potential Ice Aggregate: 10.7 acres (water depth 4 ft or less)
0.84 million gallons

Maximum Recommended Winter Removal: **24.50 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

Water Use History:

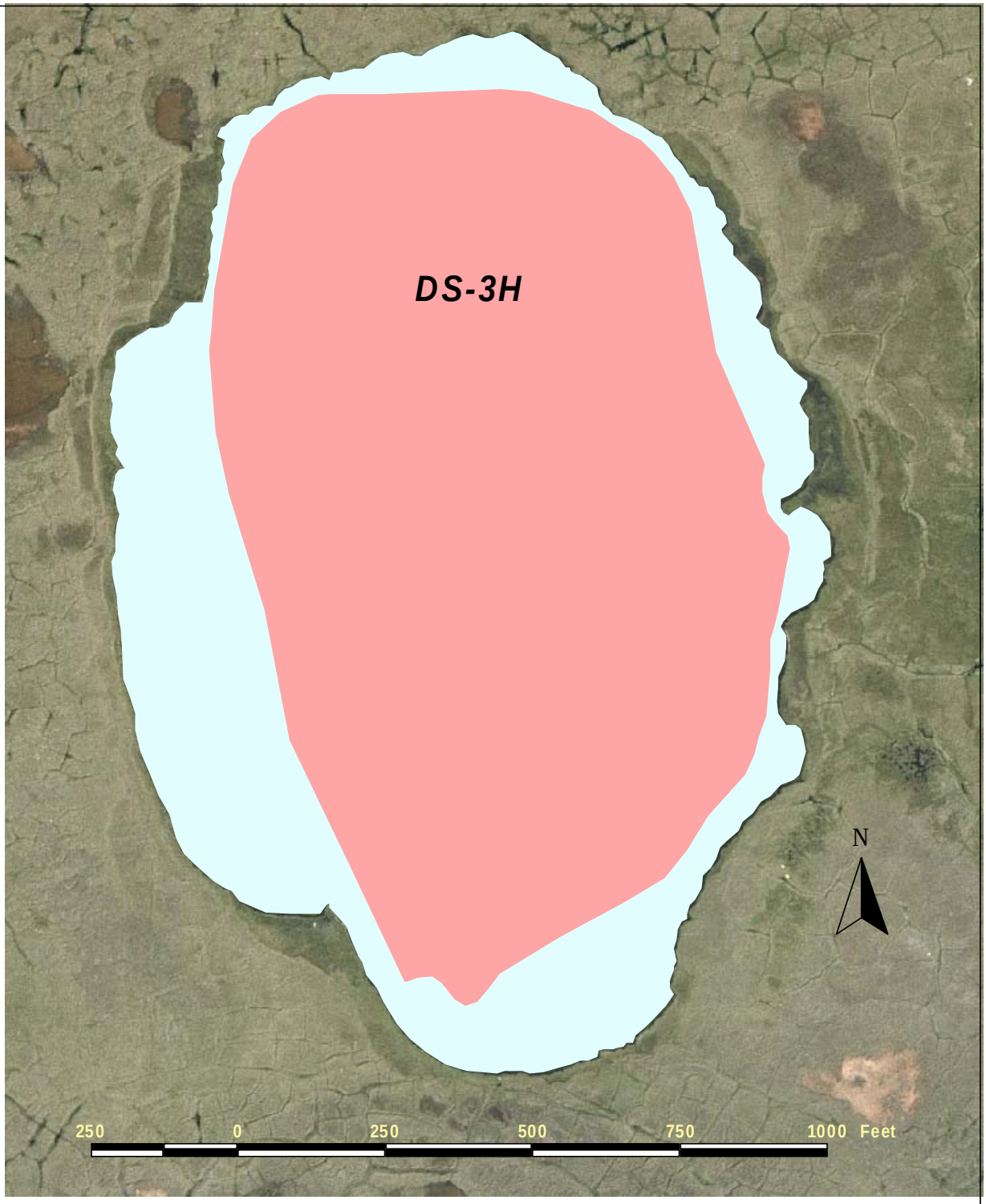
Year	Water Removed (all sources) (mill. Gals)
1998-1999	5.81
1999-2000	21.35
2000-2001	
2001-2002	
2002-2003	
2003-2004	
2004-2005	
2005-2006	

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2006	37.1	6.6	13.2	55.0	120	338	1.0	--	this study

Catch Record:

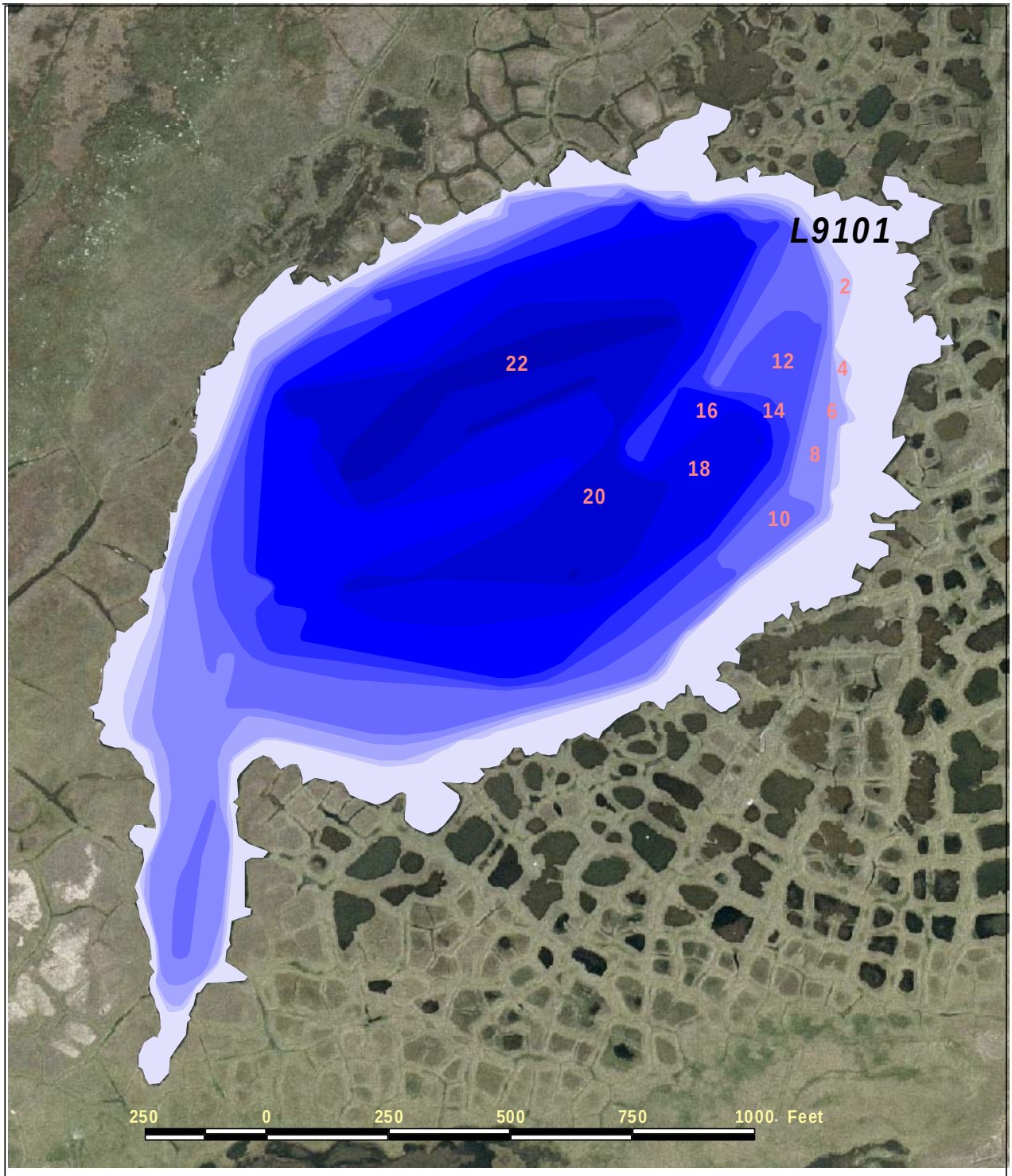
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 26 06	7.2	None	0
Seine	Aug 26 06	12 hauls	None	0



Regions of lake DS-3H less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 26, 2006.

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

Depth transects measured on lake DS-3H on August 26, 2006.



Depth contours of lake L9101 based on transects surveyed on August 2, 2006.
(depths in 2 foot intervals)

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

Lake L9101

Other Names: M13.1; M9204
Location: 70.45624 °N 150.57003°W
USGS Quad Sheet: Harrison Bay B-1: T13N R6E, Sec. 27
Habitat: Perched Lake (Infrequent Flooding)
Area: 40 acres
Maximum Depth: 25 feet
Active Outlet: No
Total Lake Volume: 160.4 million gallons (2006 data)
Water Volume Under 4 ft of ice: 114.3 million gallons
Water Volume Under 5 ft of ice: 104.0 million gallons
Water Volume Under 7 ft of ice: 84.0 million gallons

Potential Ice Aggregate: 8.2 acres (water depth 4 ft or less)
0.64 million gallons

Maximum Recommended Winter Removal: **12.60 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

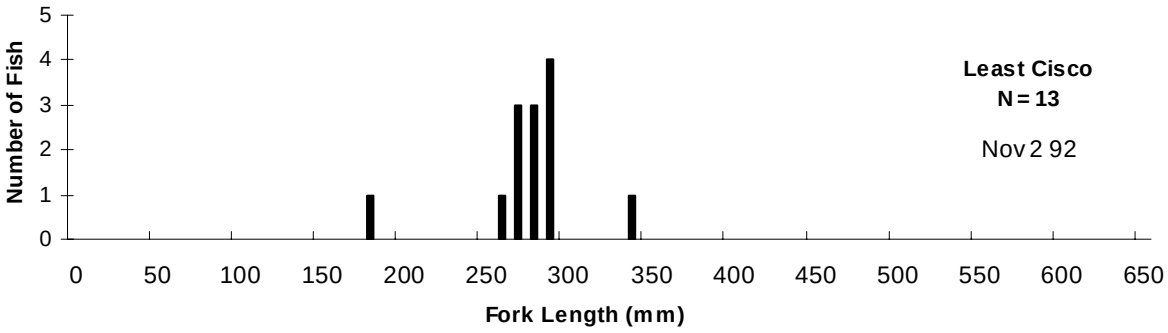
Year	Water Removed (all sources) (mill. Gals)
1999-2000	6.82

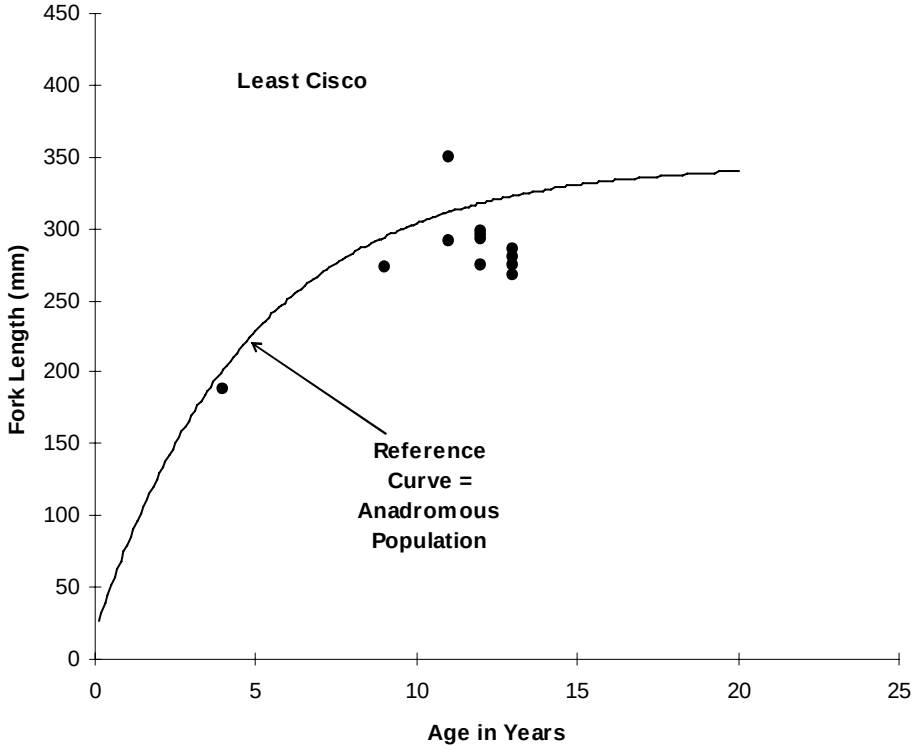
Water Chemistry:

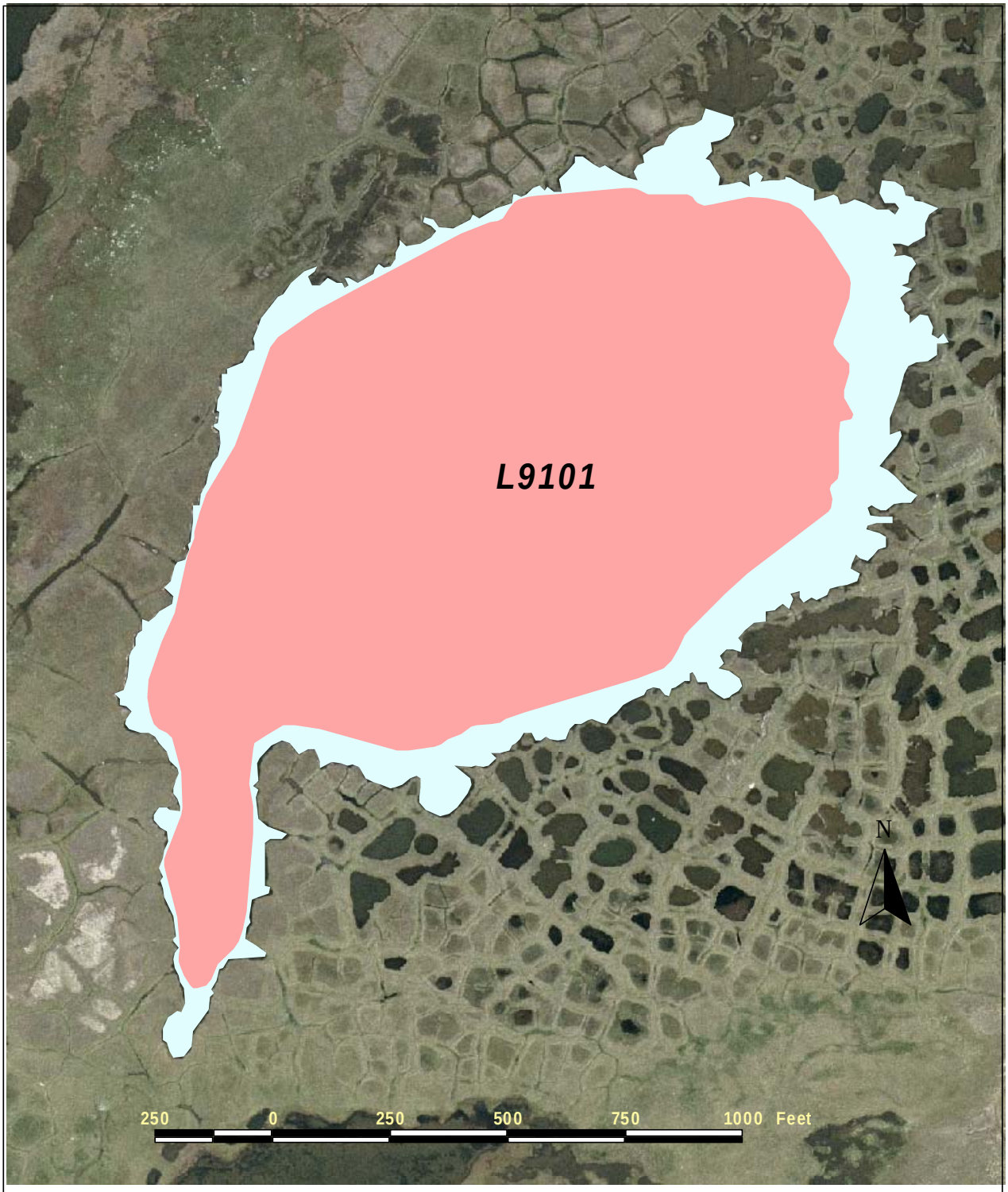
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1991	37.0	52.0	430	730	306	--	--	--	J. Lobdell
2006	9.8	8.9	66.5	113	61	430	6.0	7.90	this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Nov 2 92	25.0	Least cisco	13	188-349

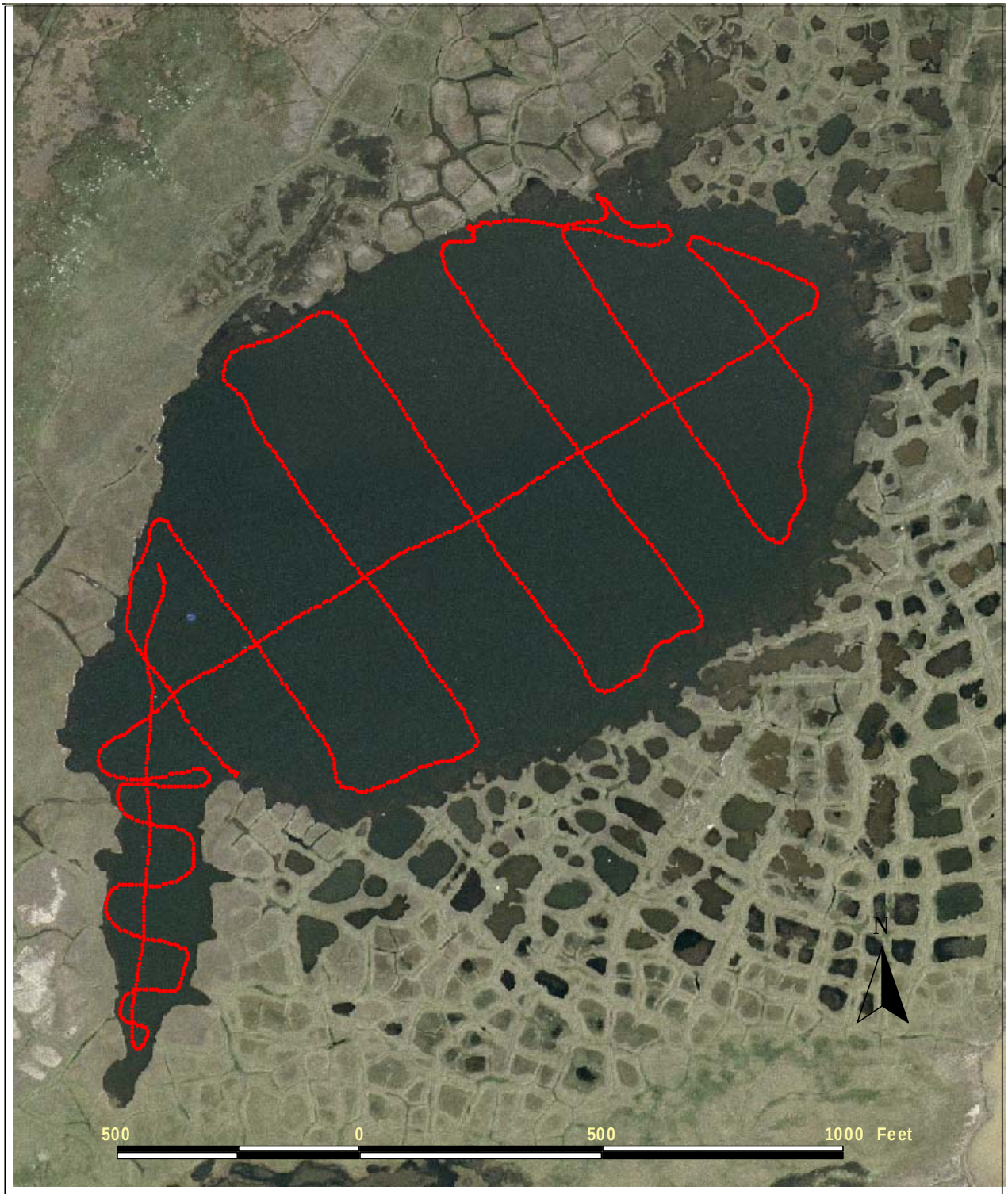

Number of Fish
0
1
2
3
4
5
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)
Least Cisco
N = 13
Nov 2 92


Fork Length (mm)
0
50
100
150
200
250
300
350
400
450
0
5
10
15
20
25
Age in Years
Least Cisco
Reference
Curve =
Anadromous
Population

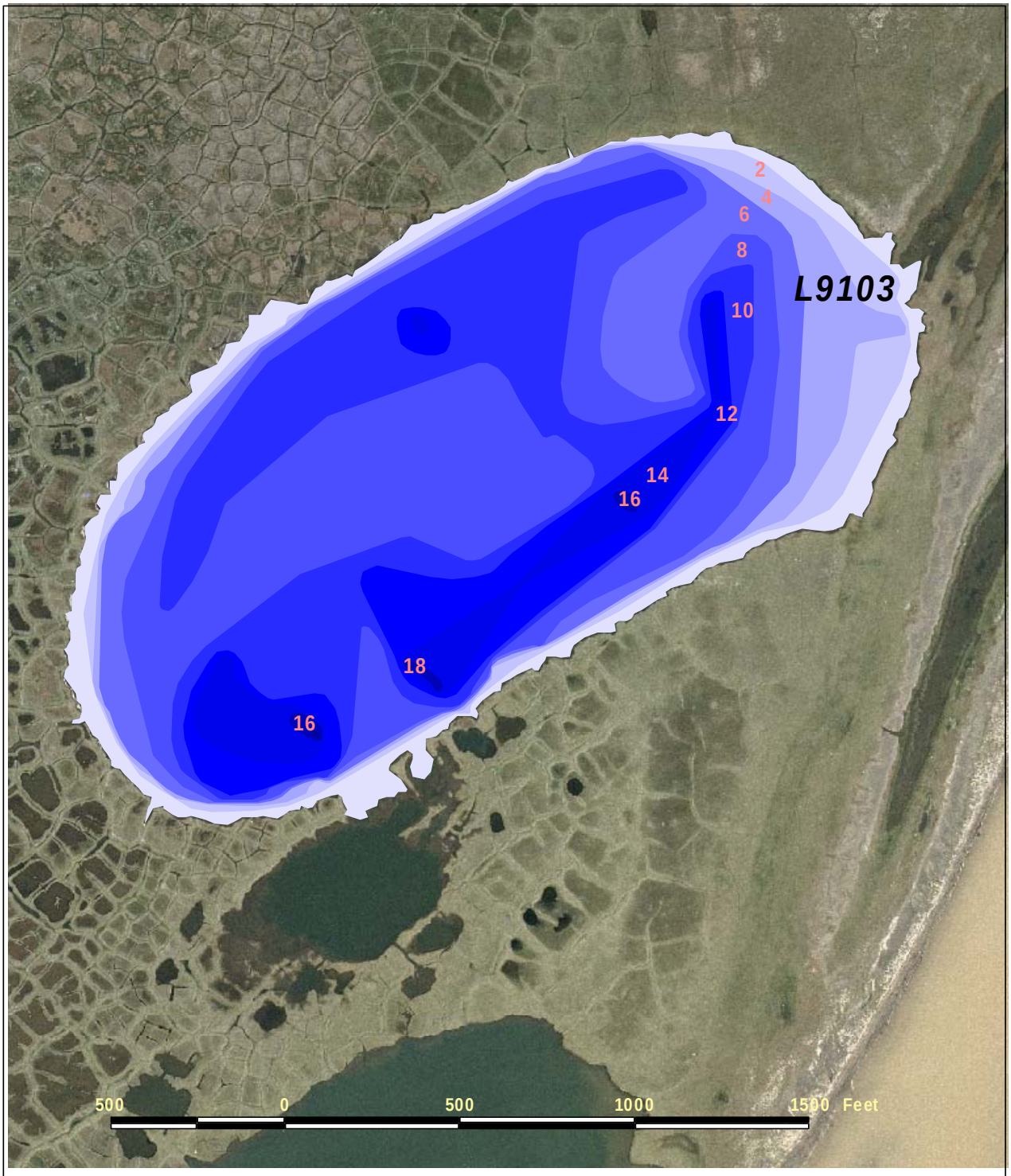


Regions of lake L9101 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 2, 2006.

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



Depth transects measured on lake L9101 on August 2, 2006.



Depth contours of lake L9103 based on transects surveyed on August 2, 2006.
(depths in 2 foot intervals)

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

Lake L9103

Other Names: M14.2; M9203
Location: 70.45573 °N 150.52079°W
USGS Quad Sheet: Harrison Bay B-1: T13N R6E, Sec. 26
Habitat: Perched Lake (Frequent Flooding)
Area: 71 acres
Maximum Depth: 19.3 feet
Active Outlet: Yes

Total Lake Volume:	199.1	million gallons	(2006 data)
Water Volume Under 4 ft of ice:	114.0	million gallons	
Water Volume Under 5 ft of ice:	94.6	million gallons	
Water Volume Under 7 ft of ice:	58.3	million gallons	
Potential Ice Aggregate:	10.0	acres (water depth 4 ft or less)	
	0.78	million gallons	

Maximum Recommended Winter Removal: **8.74 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

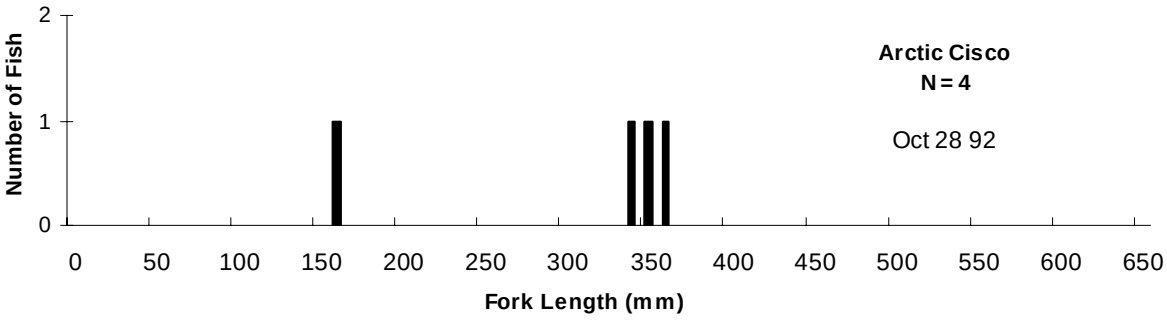
Year	Water Removed (all sources) (mill. Gals)
1999-2000	6.82

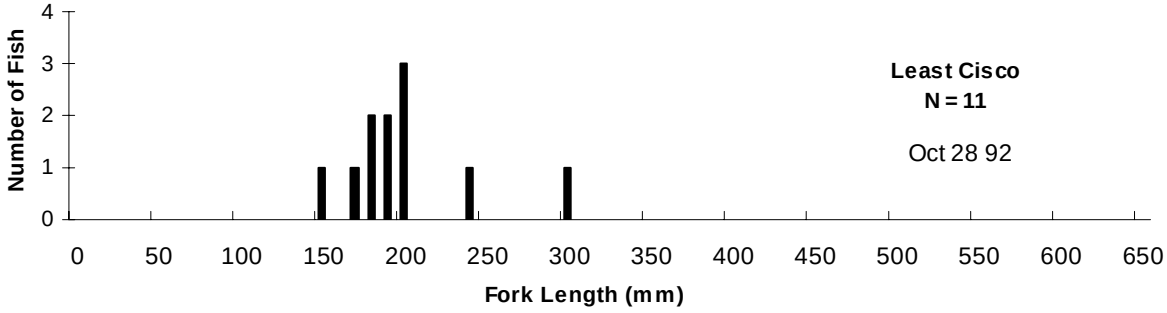
Water Chemistry:

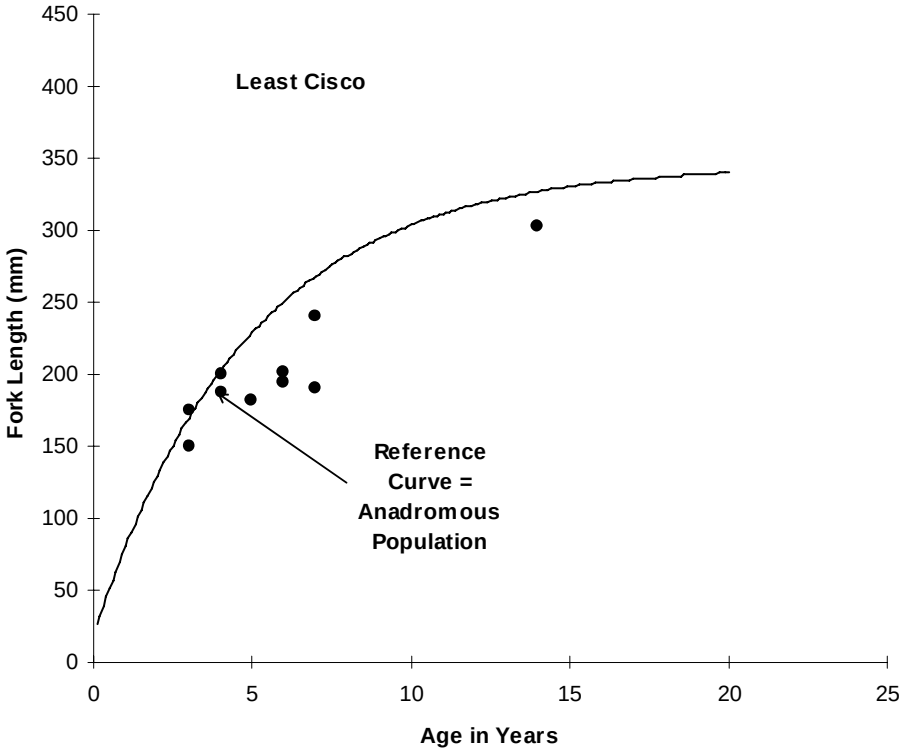
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1991	51.0	71.0	540	970	420	--	--	--	J. Lobdell
1998	62.5	95.2	724	1410	548	--	--	--	Moulton 98
2006	14.0	11.7	65.6	122	83	486	3.5	8.07	this study

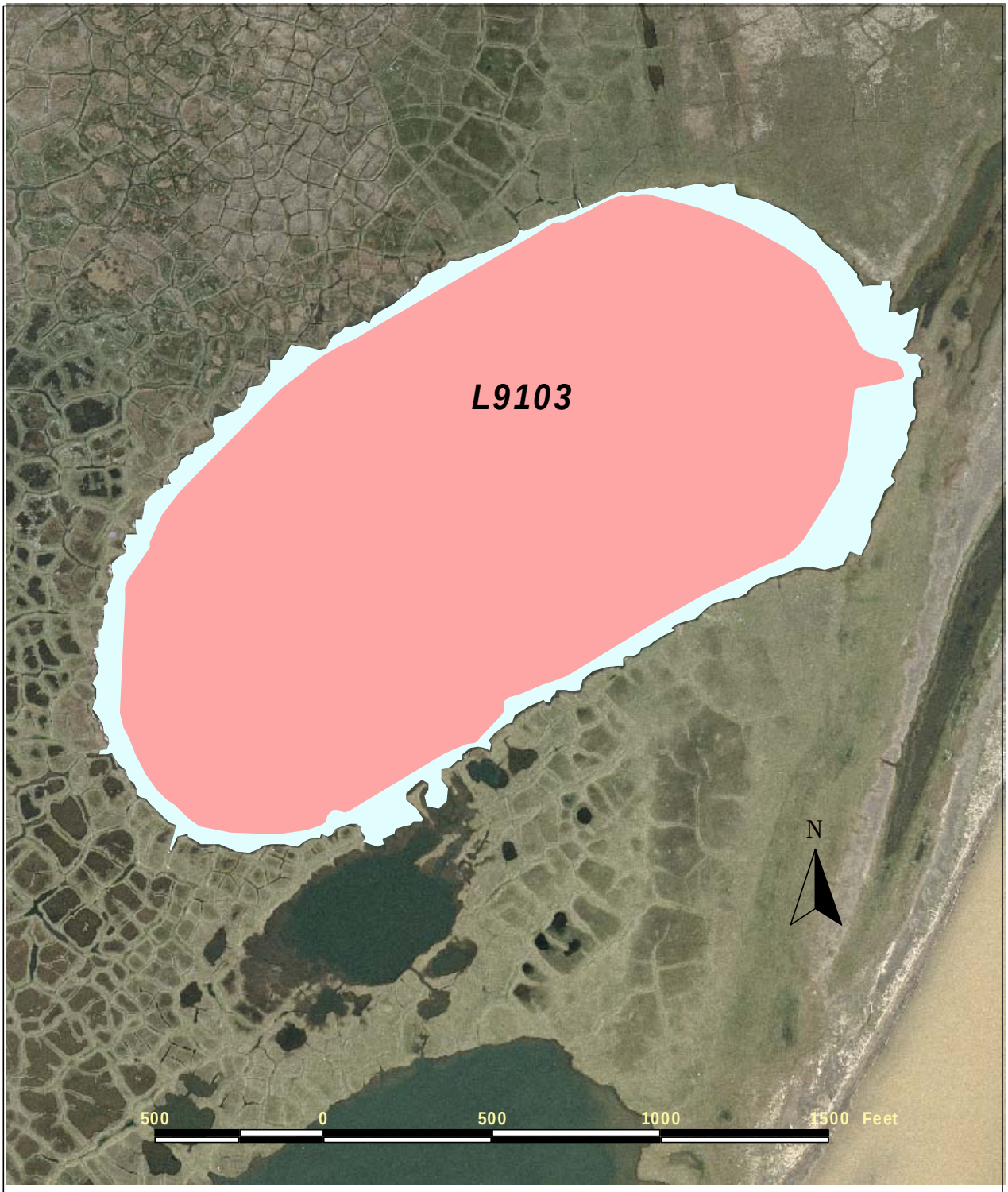
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Oct 28 92	46.5	Broad whitefish	1	183
			Least cisco	11	150-303
			Arctic cisco	4	160-363


Number of Fish
Arctic Cisco
N = 4
Oct 28 92
Fork Length (mm)


Number of Fish
Least Cisco
N = 11
Oct 28 92
Fork Length (mm)

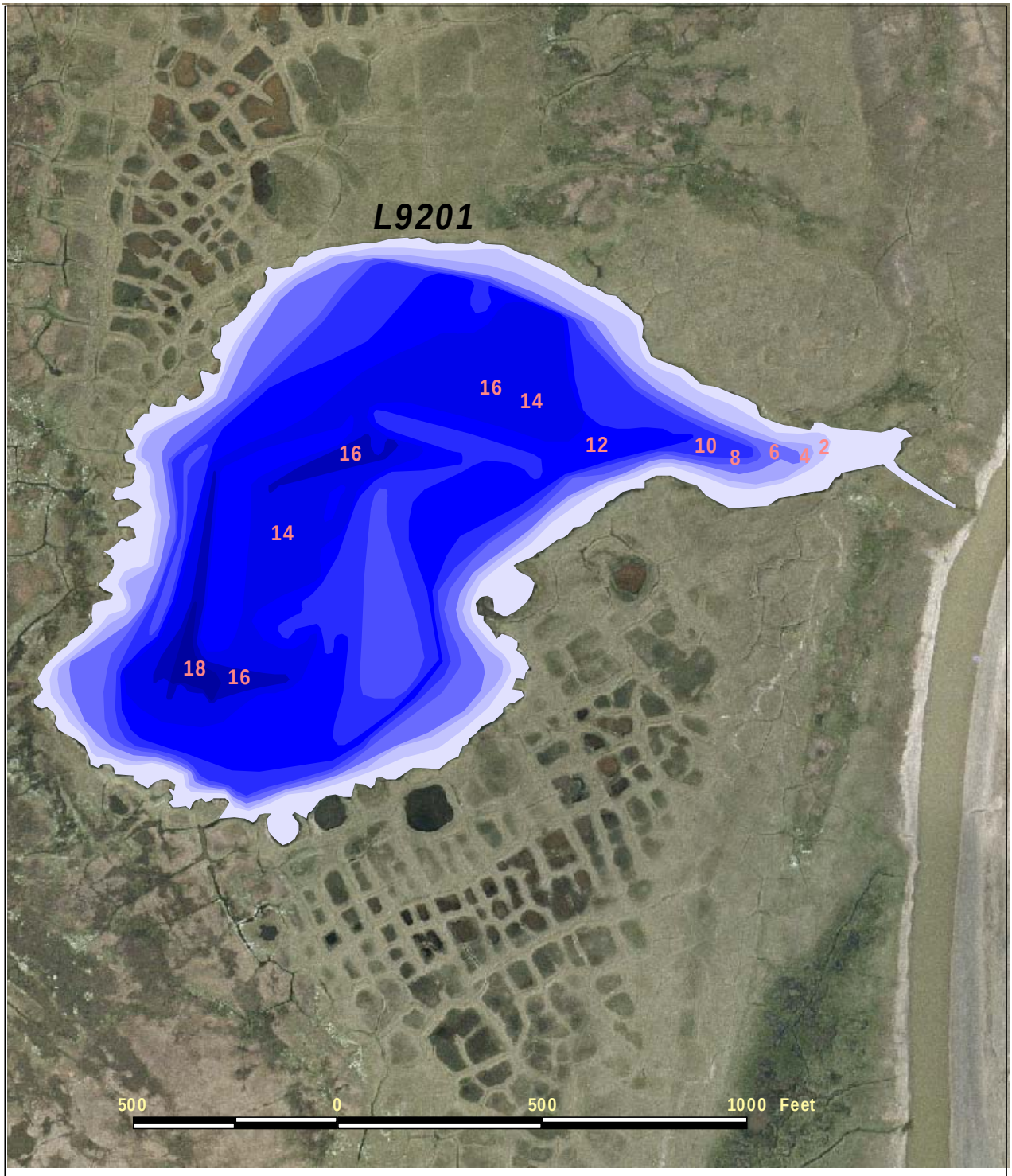

Least Cisco
Fork Length (mm)
Reference Curve = Anadromous Population
Age in Years



Regions of lake L9103 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 2, 2006.

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

Depth transects measured on lake L9103 on August 2, 2006.



Depth contours of lake L9201 based on transects surveyed on August 4, 2006.
(depths in 2 foot intervals)

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

Lake L9201

Other Names: M12.1; M9207
Location: 70.45917 °N 150.64490°W
USGS Quad Sheet: Harrison Bay B-2: T13N R6E, Sec. 20/29
Habitat: Perched Lake (Frequent Flooding)
Area: 36 acres
Maximum Depth: 19.6 feet
Active Outlet: Yes

Total Lake Volume:	114.3	million gallons	(2006 data)
Water Volume Under 4 ft of ice:	72.4	million gallons	
Water Volume Under 5 ft of ice:	63.0	million gallons	
Water Volume Under 7 ft of ice:	45.4	million gallons	

Potential Ice Aggregate: 6.9 acres (water depth 4 ft or less)
0.54 million gallons

Maximum Recommended Winter Removal: **6.81 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

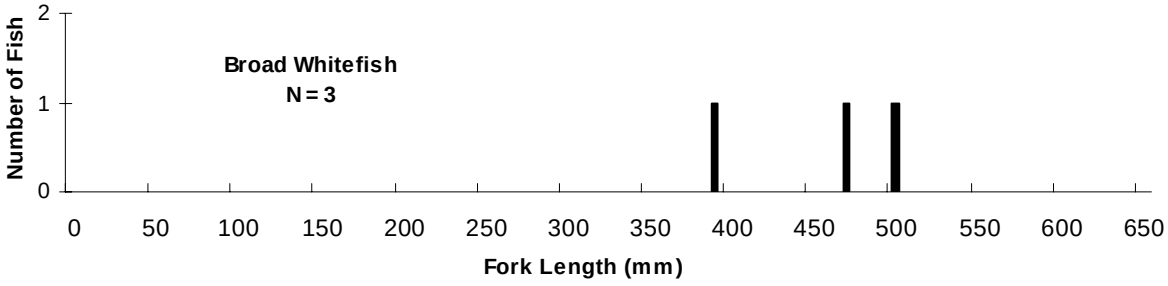
Year	Water Removed (all sources) (mill. Gals)
	none

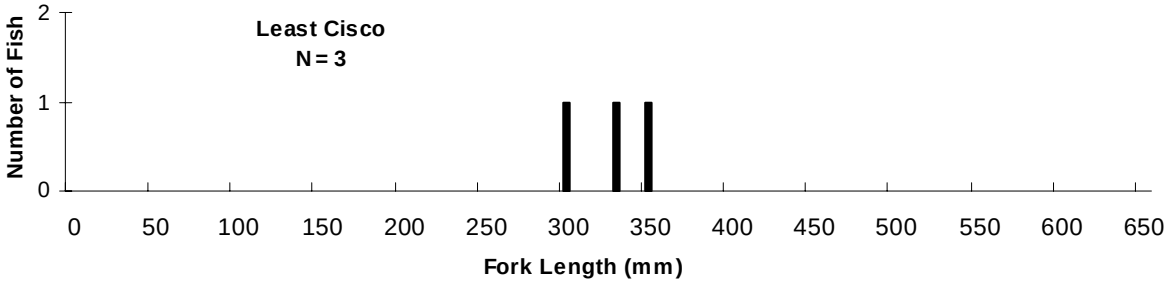
Water Chemistry:

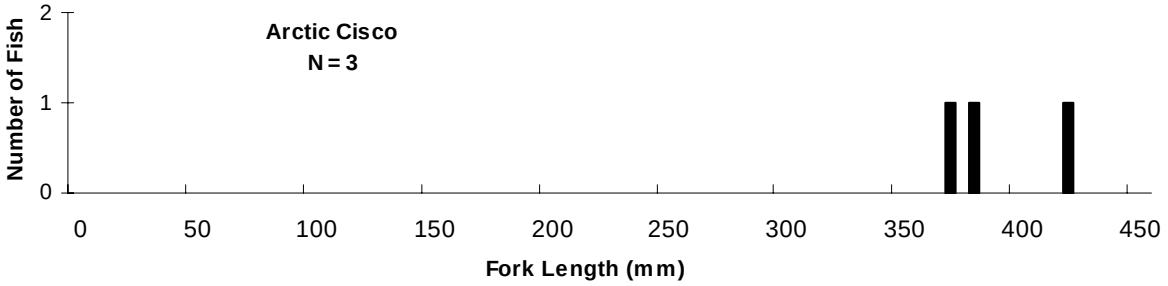
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1992	30.0	27.0	150	300	186	--	--	--	J. Lobdell
2006	18.1	13.7	67.1	130	102	521	2.4	7.68	this study

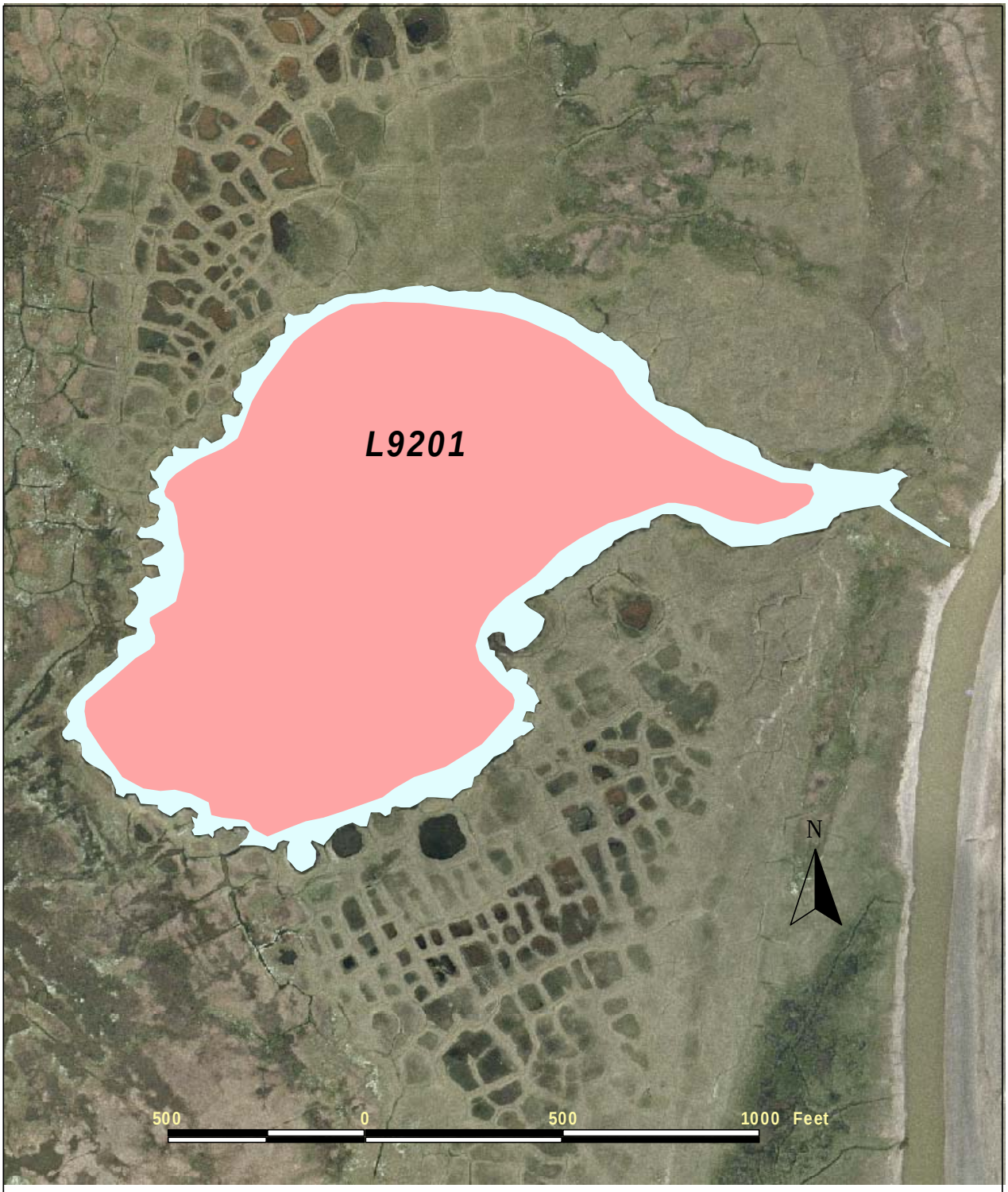
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Oct 31 92	27.5	Broad whitefish	3	392-505
			Humpback whitefish	1	168
			Least cisco	3	303-353
			Arctic cisco	3	372-429


Broad Whitefish
N = 3
Number of Fish
0
1
2
0 50 100 150 200 250 300 350 400 450 500 550 600 650
Fork Length (mm)


Least Cisco
N = 3
Number of Fish
0
1
2
0 50 100 150 200 250 300 350 400 450 500 550 600 650
Fork Length (mm)

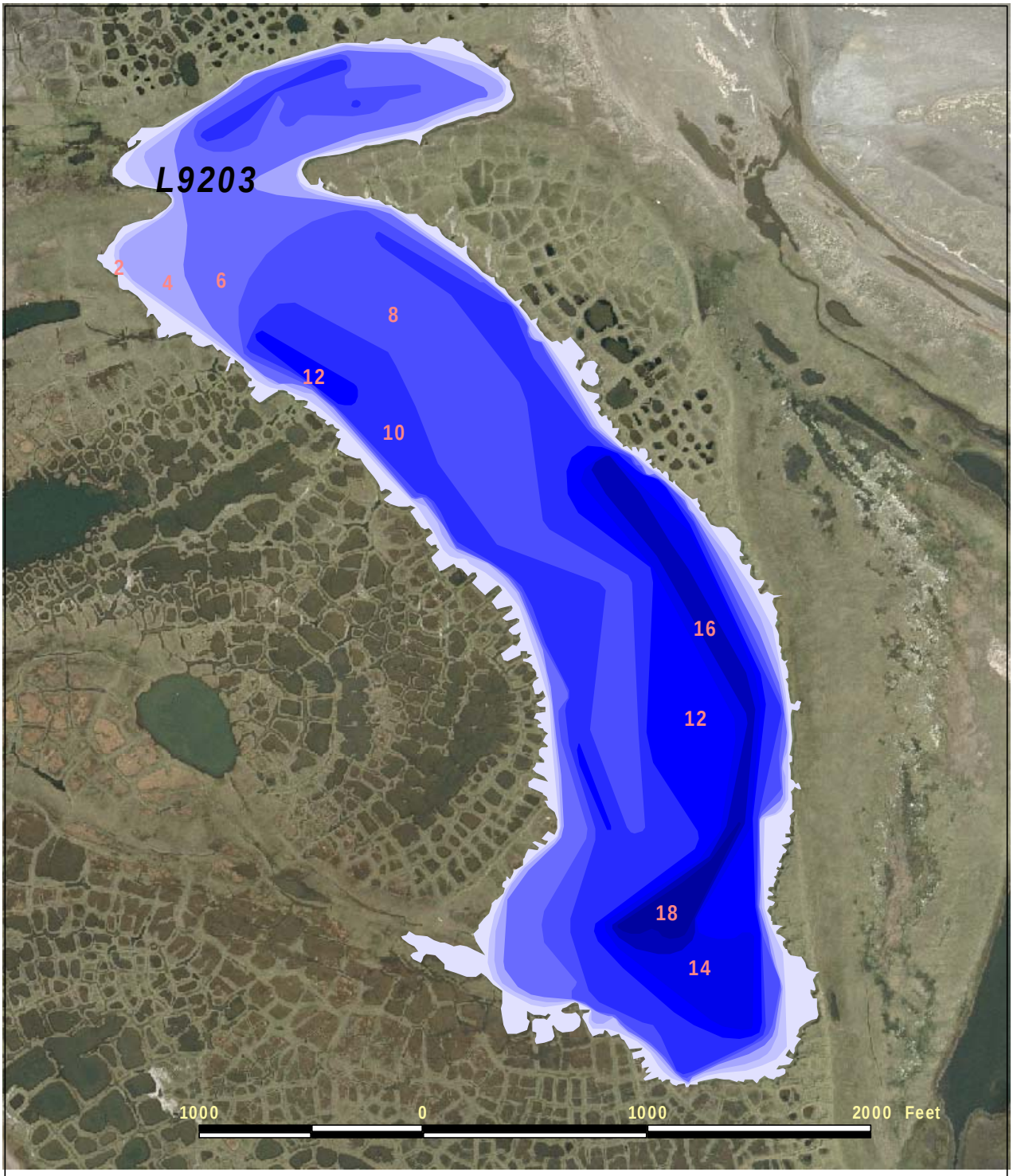

Arctic Cisco
N = 3
Number of Fish
0
1
2
0 50 100 150 200 250 300 350 400 450
Fork Length (mm)



Regions of lake L9201 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 4, 2006.

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

Depth transects measured on lake L9201 on August 4, 2006.



Depth contours of lake L9203 based on transects surveyed on August 25, 2006.
(depths in 2 foot intervals)

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

Lake L9203

Other Names: N10.1; M9208
Location: 70.44574 °N 150.72904°W
USGS Quad Sheet: Harrison Bay B-2: T13N R5E, Sec. 25/36
Habitat: Perched Lake (Frequent Flooding)
Area: 138 acres
Maximum Depth: 19.8 feet
Active Outlet: No
Total Lake Volume: 403.4 million gallons (2006 data)
Water Volume Under 4 ft of ice: 239.0 million gallons
Water Volume Under 5 ft of ice: 201.1 million gallons
Water Volume Under 7 ft of ice: 130.5 million gallons

Potential Ice Aggregate: 19.3 acres (water depth 4 ft or less)
1.51 million gallons

Maximum Recommended Winter Removal: **19.57 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

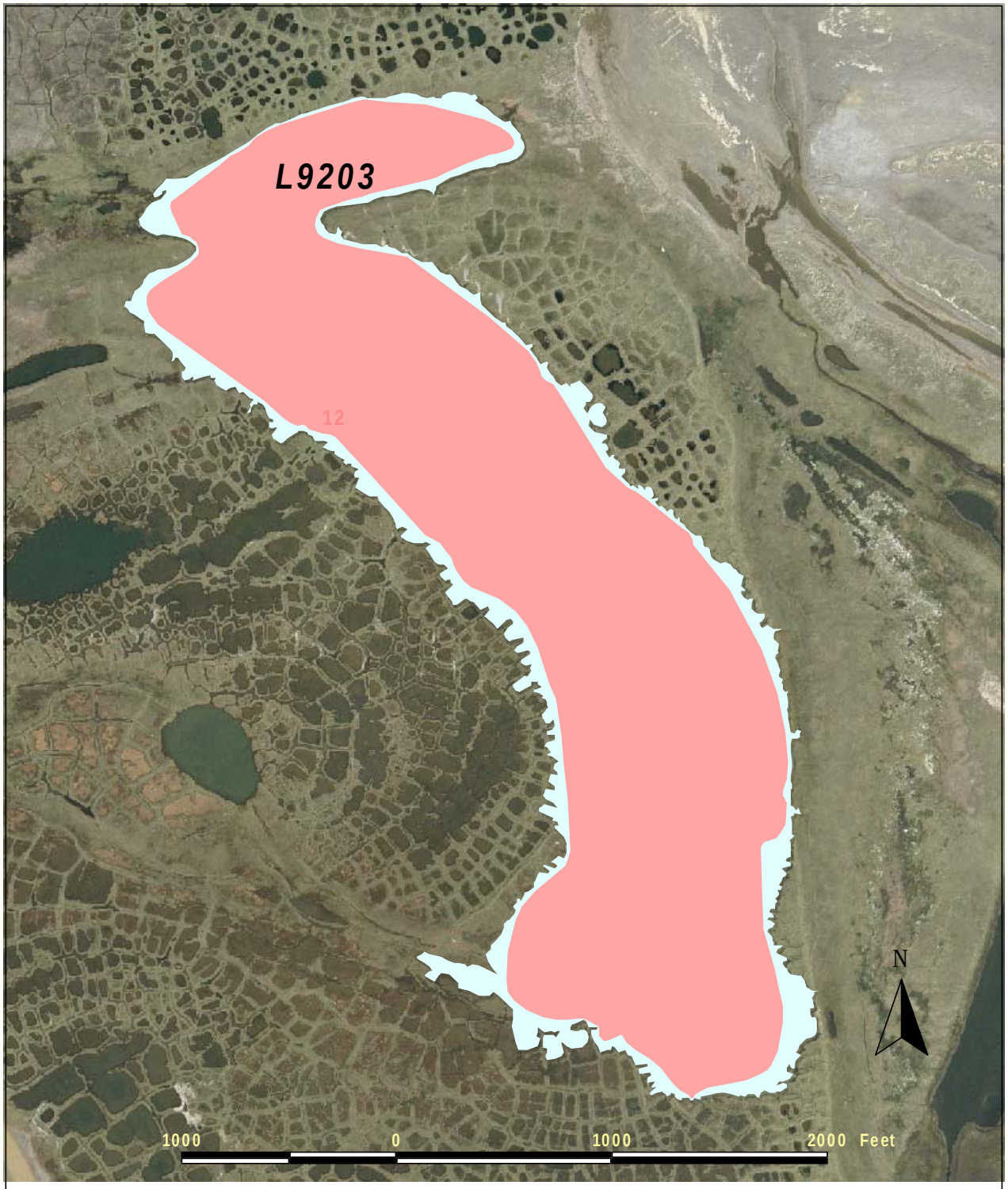
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1992	9.2	9.8	57	120	63	--	--	--	J. Lobdell
1998	17.2	19.9	134	265	125	--	--	--	Moulton 98
2006	8.1	8.3	54.6	128	54	473	3.3	7.54	this study

Catch Record:

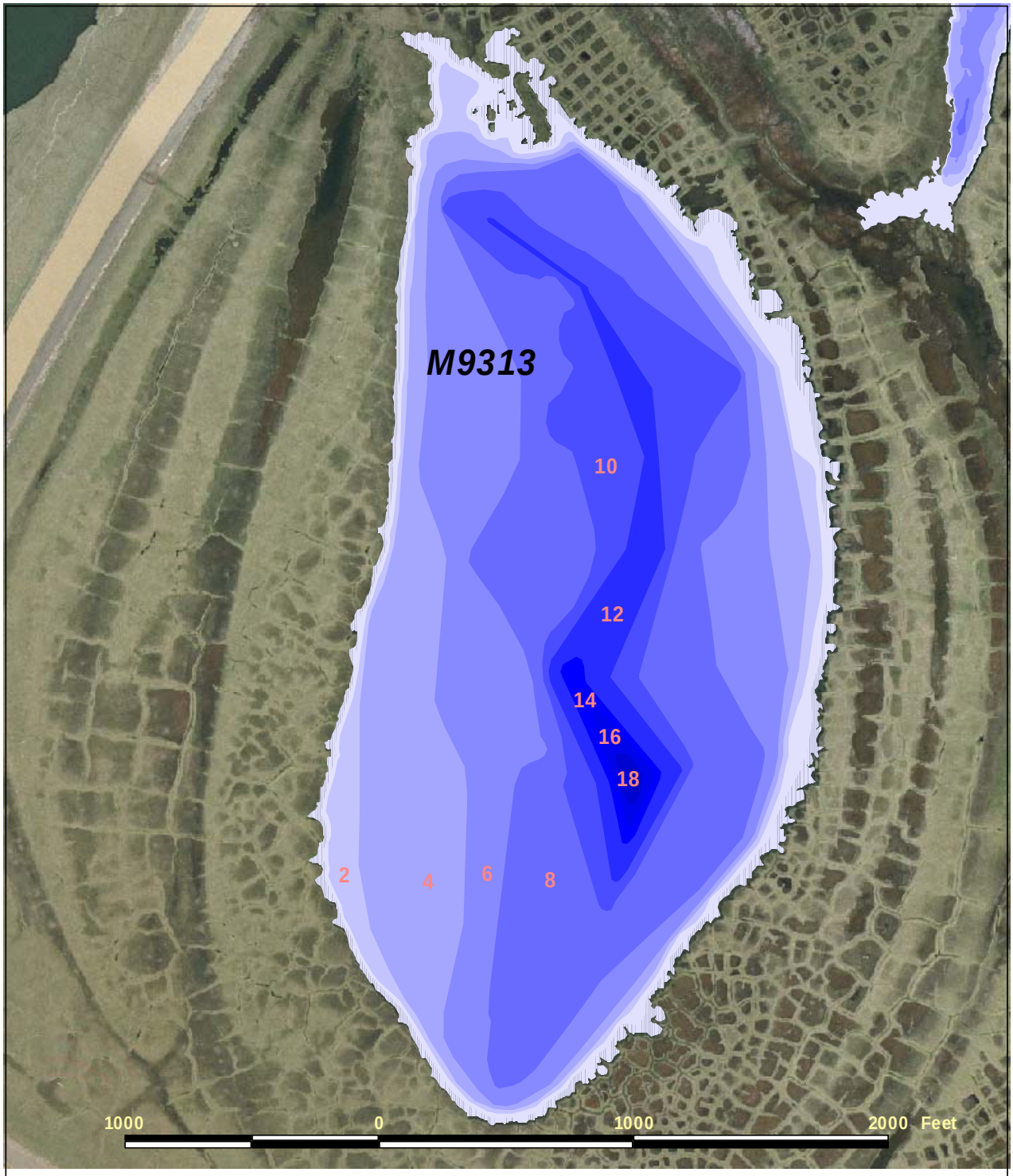
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Nov 1 92	23.0	Broad whitefish	1	354
			Humpback whitefish	1	420
			Arctic cisco	1	157



Regions of lake L9203 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 25, 2006.

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

Depth transects measured on lake L9203 on August 25, 2006.



Depth contours of lake M9313 based on transects surveyed on September 1, 2002.
(depths in 2 foot intervals)

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

Lake M9313

Other Names: O7.1
Location: 70.42360°N 150.90047°W
USGS Quad Sheet: Harrison Bay B-2: T12N R5E, Sec. 4
Habitat: Perched Lake (Infrequent Flooding)
Area: 140 acres
Maximum Depth: 25.1 feet
Active Outlet: No
Total Lake Volume: 415.1 million gallons (2002 data)
Water Volume Under 4 ft of ice: 242.6 million gallons
Water Volume Under 5 ft of ice: 202.2 million gallons
Water Volume Under 7 ft of ice: 126.7 million gallons

Potential Ice Aggregate: 14.7 acres (water depth 4 ft or less)
1.15 million gallons

Maximum Recommended Winter Removal: **19.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

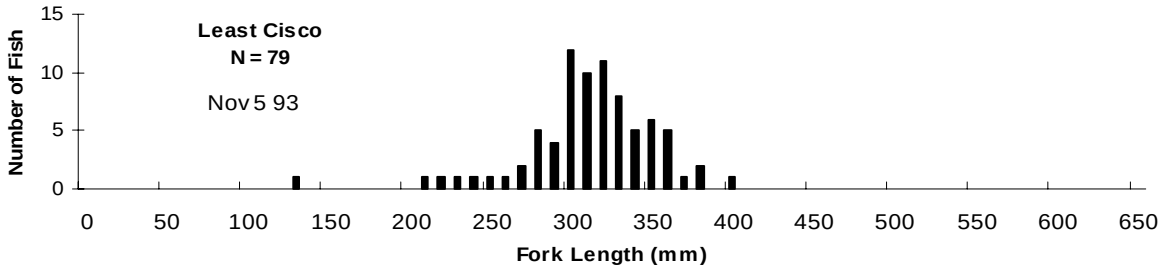
Year	Water Removed (all sources) (mill. Gals)
1998-1999	23.09
1999-2000	7.38
2004-2005	5.27
2005-2006	5.94

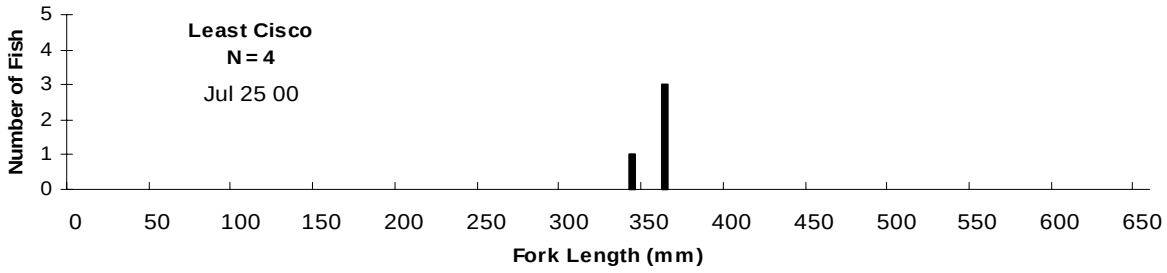
Water Chemistry:

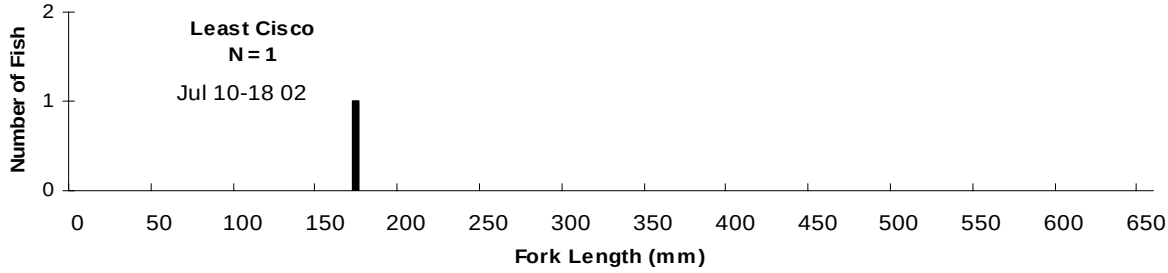
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1998	28.8	21.9	108	259	162	839	--	8.30	J. Lobdell
2000	21.2	16.4	71.3	192	120	759	--	7.86	Moulton 02
2002	--	--	--	--	--	726	0.9	7.72	Moulton 02

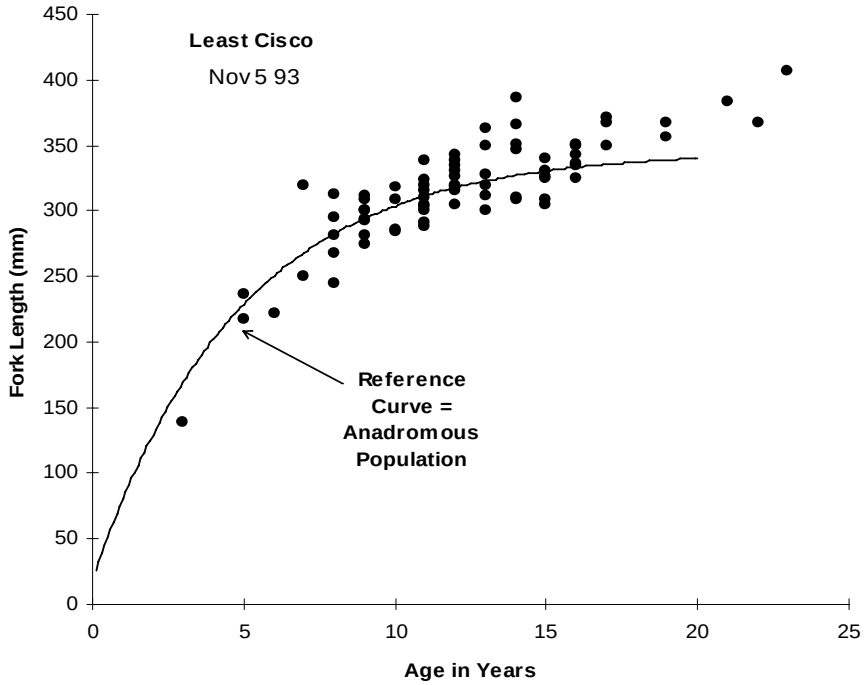
Catch Record:

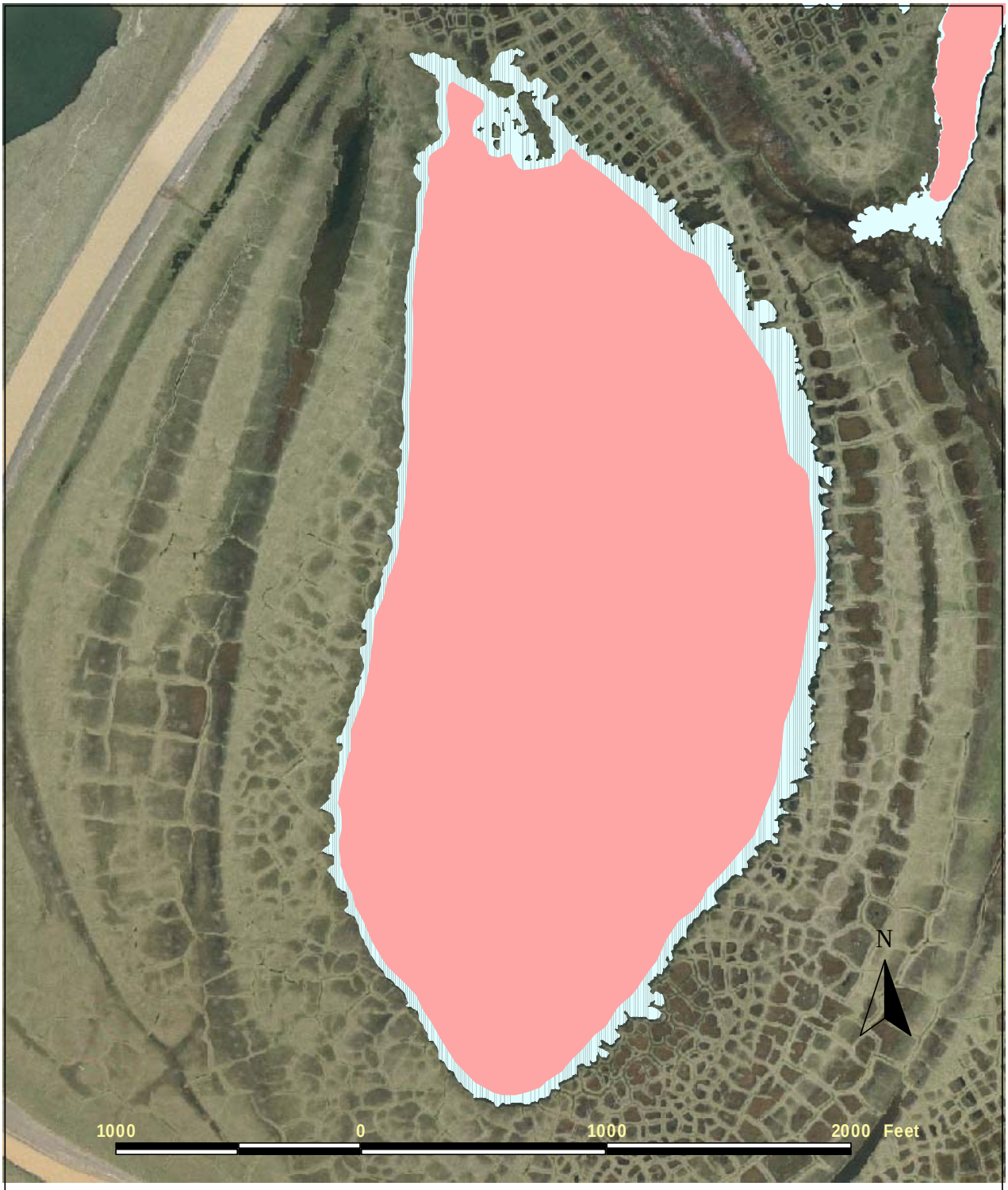
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Nov 5 93	20.7	Least cisco	79	138-406
	Jul 25 00	2.1	Least cisco	4	344-369
Minnow Trap	Nov 5 93	20.7	None	0	
	Jul 25 00	6.3	None	0	
Fyke Net	Jul 10-18, 03	186.6	Least cisco	1	171
			Ninespine stickleback	951	


Least Cisco
N = 79
Nov 5 93
Number of Fish
Fork Length (mm)


Least Cisco
N = 4
Jul 25 00
Number of Fish
Fork Length (mm)

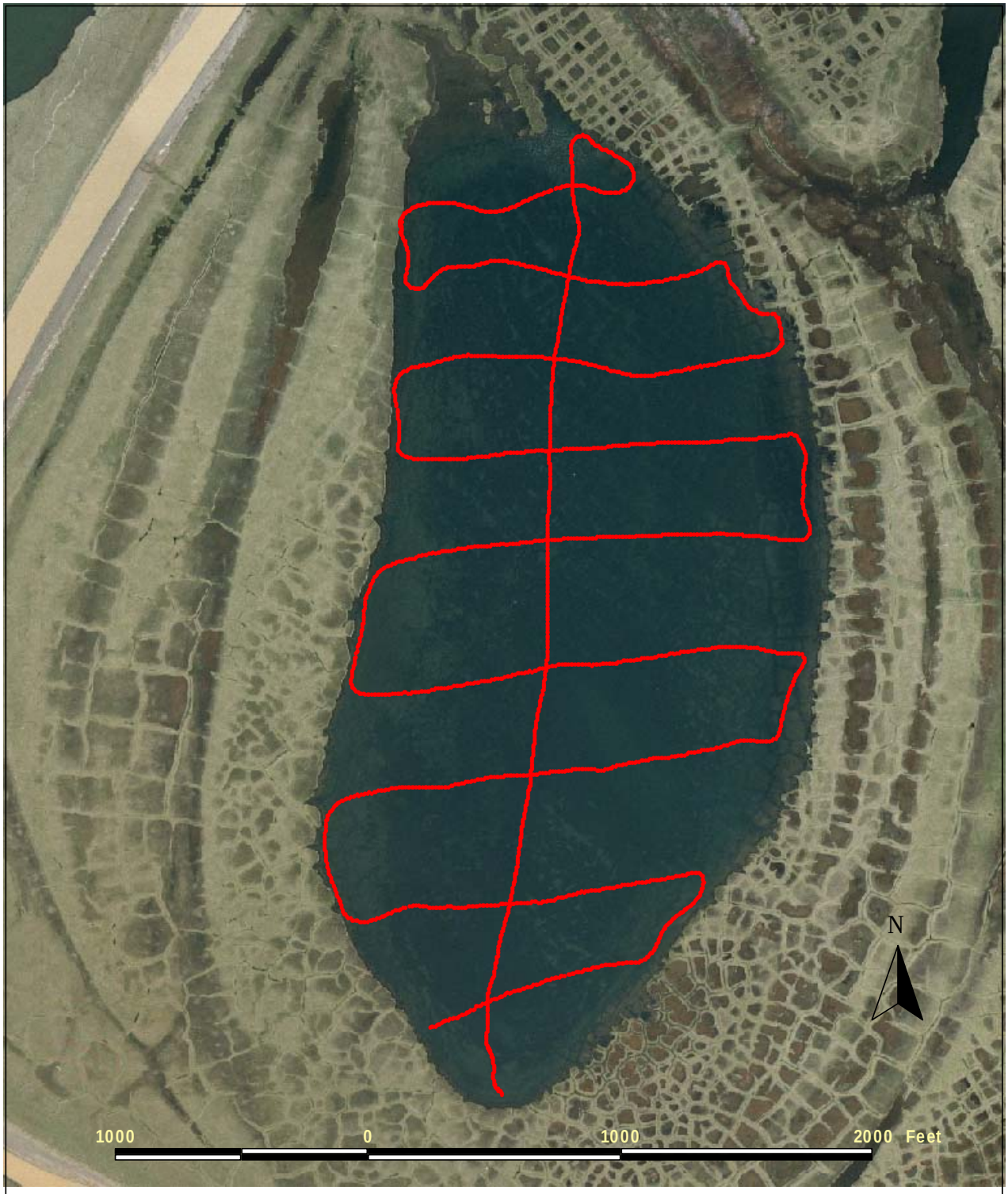

Least Cisco
N = 1
Jul 10-18 02
Number of Fish
Fork Length (mm)


Least Cisco
Nov 5 93
Reference Curve = Anadromous Population
Fork Length (mm)
Age in Years

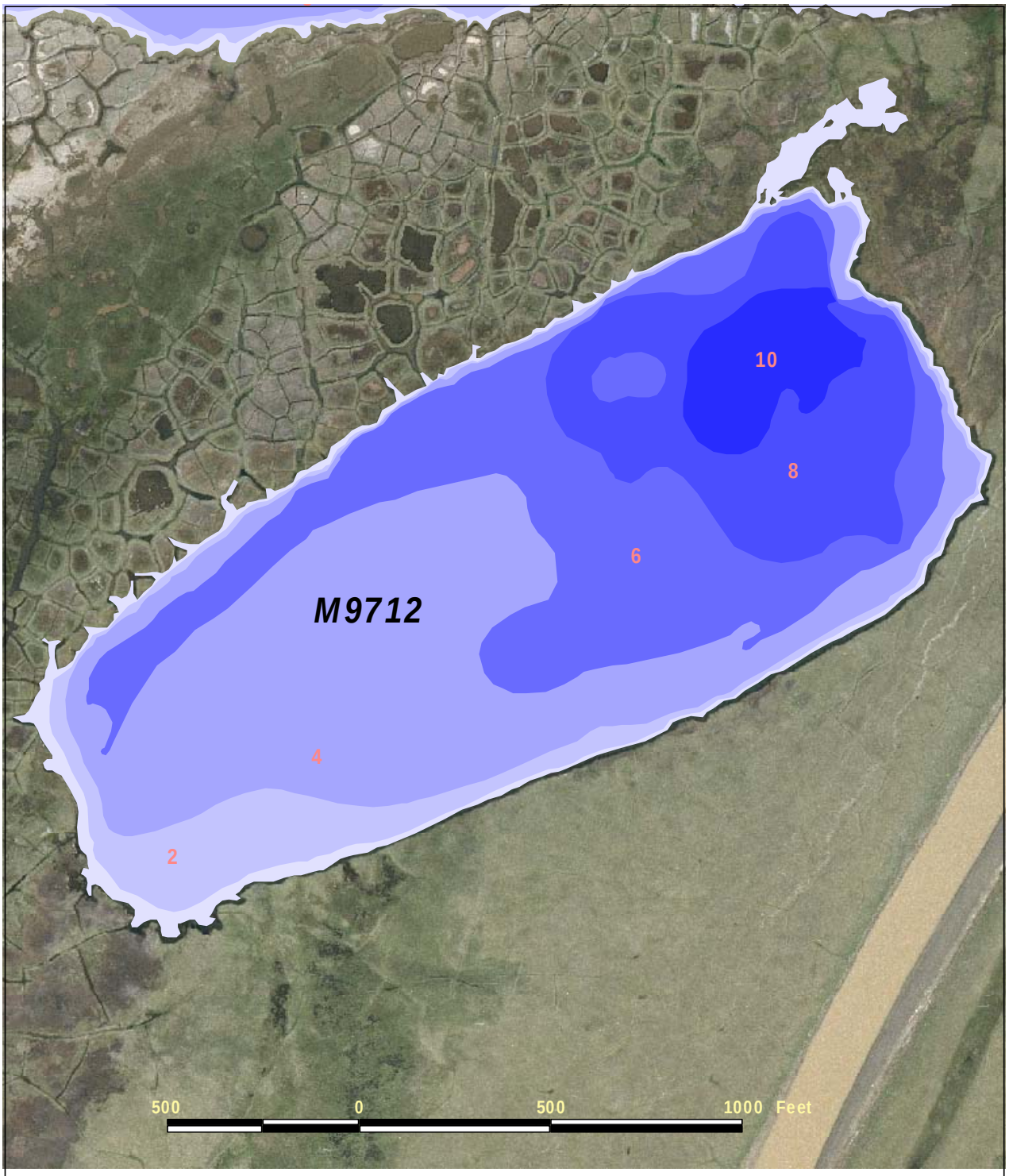


Regions of lake M9313 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on September 1, 2002.

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



Depth transects measured on lake M9313 on September 1, 2002.



Depth contours of lake M9712 based on transects surveyed on July 31, 2006.
(depths in 2 foot intervals)

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

Lake M9712

Other Names: O6.2
Location: 70.42932°N 150.92720°W
USGS Quad Sheet: Harrison Bay B-2: T12N R5E, Sec. 5
Habitat: Perched Lake (Infrequent Flooding)
Area: 59.4 acres
Maximum Depth: 11.6 feet
Active Outlet: No
Total Lake Volume: 116.2 million gallons (2006 data)
Water Volume Under 4 ft of ice: 44.0 million gallons
Water Volume Under 5 ft of ice: 29.4 million gallons
Water Volume Under 7 ft of ice: 10.5 million gallons

Potential Ice Aggregate: 8.9 acres (water depth 4 ft or less)
0.70 million gallons

Maximum Recommended Winter Removal: **43.98 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

Water Use History:

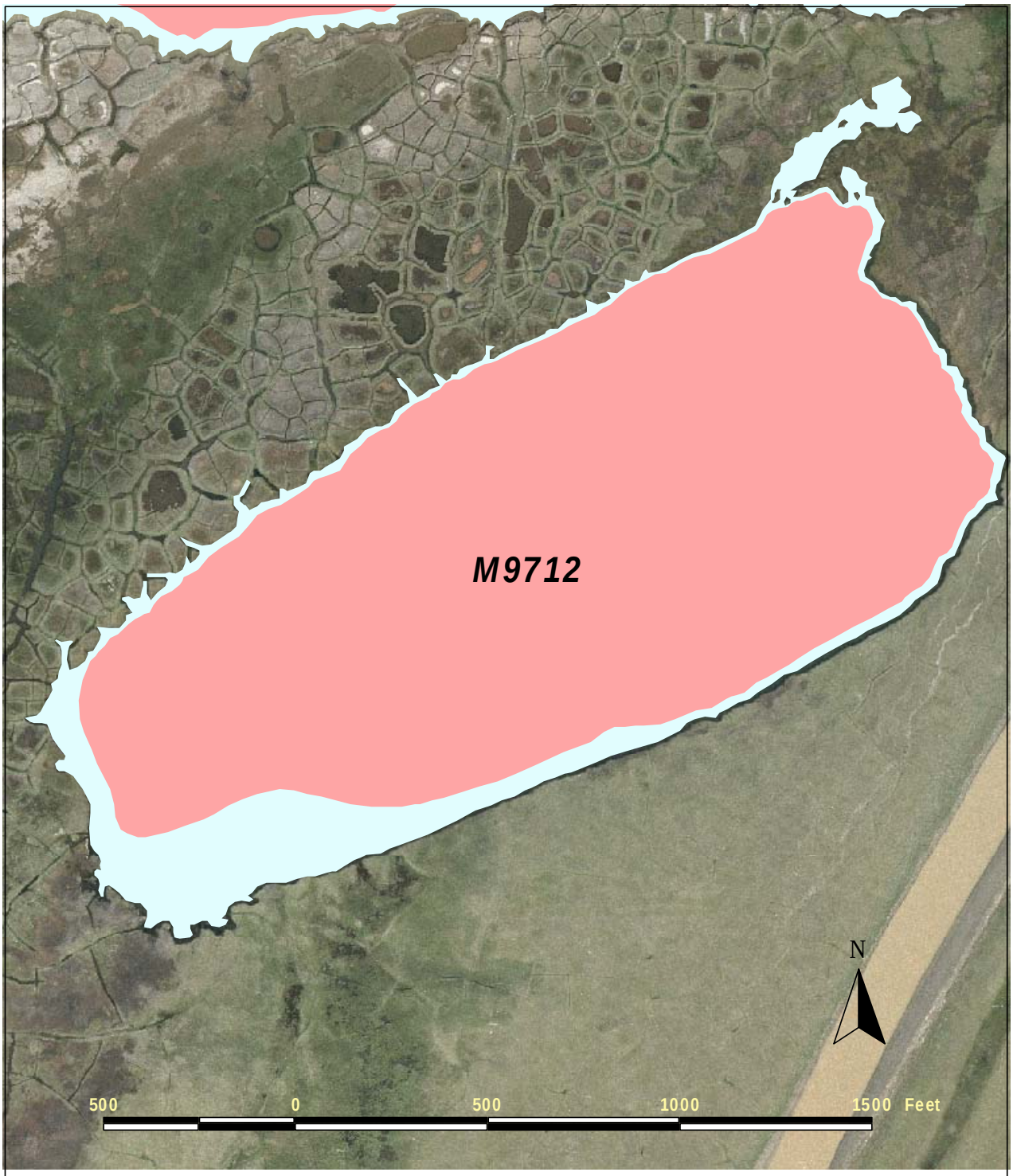
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1997	--	--	--	--	--	3767	--	7.90	Moulton 98
2006	35.2	53.7	405.0	785.0	309	2544	2.8	8.18	this study

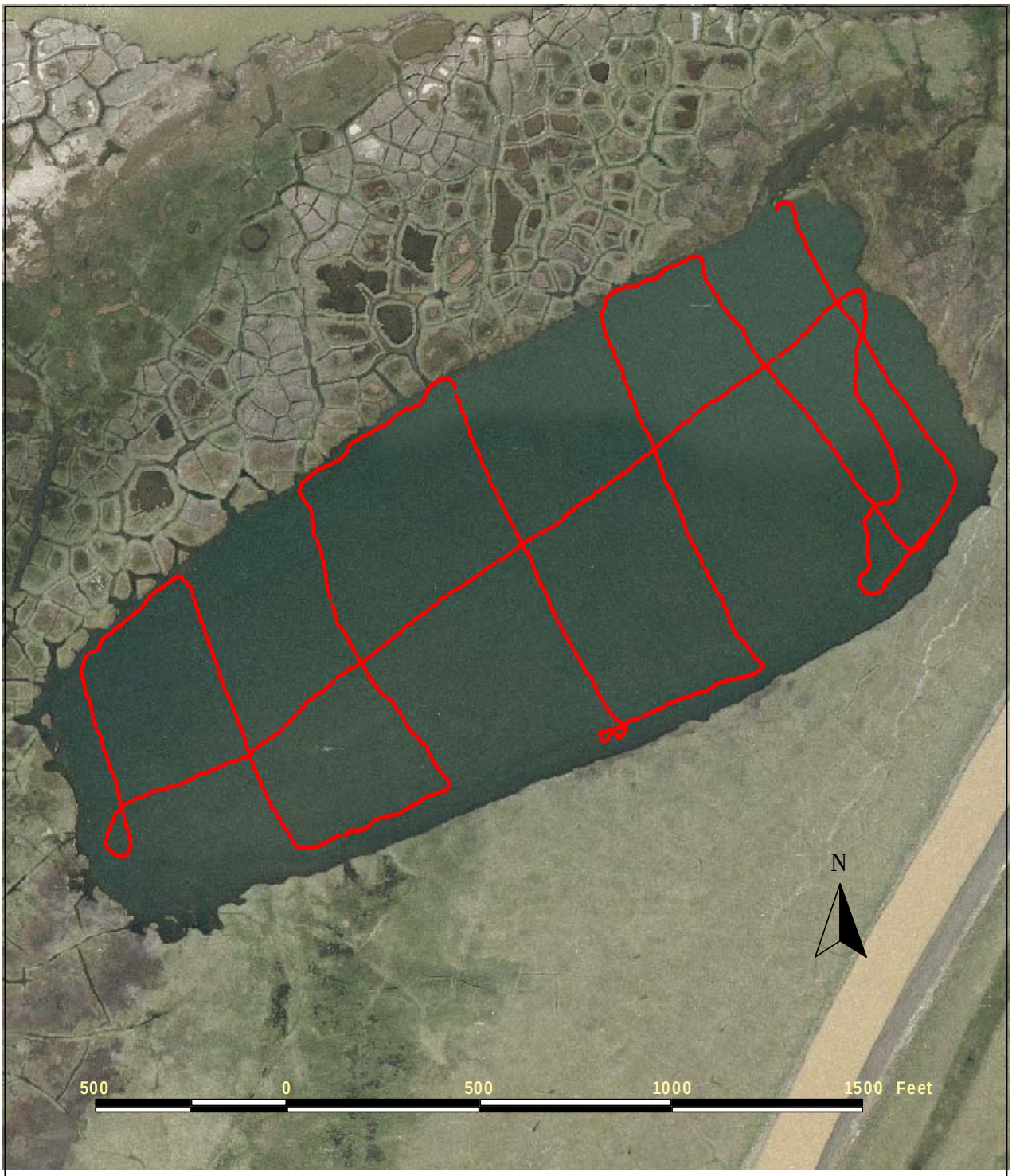
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 7 97	6.0	None	0
	Aug 8 97	5.8	None	0

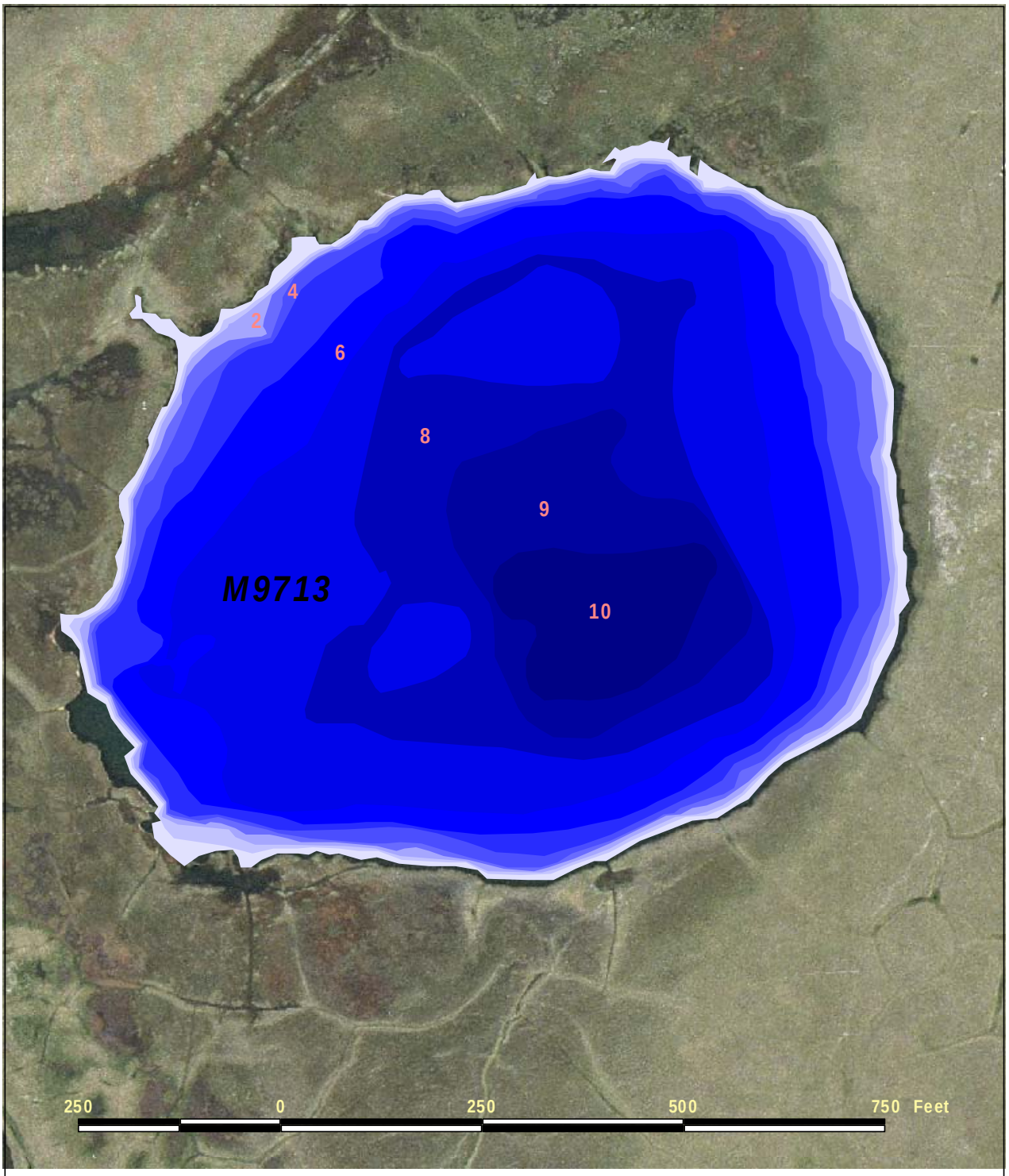


Regions of lake M9712 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 31, 2006.

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



Depth transects measured on lake M9712 on July 31, 2006.



Depth contours of lake M9713 based on transects surveyed on August 5, 2006.
(depths in 1 foot intervals)

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

Lake M9713

Other Names: O6.1
Location: 70.42299°N 150.93204°W
USGS Quad Sheet: Harrison Bay B-2: T12N R5E, Sec. 5
Habitat: Perched Lake (Infrequent Flooding)
Area: 17.0 acres
Maximum Depth: 11.0 feet
Active Outlet: No
Total Lake Volume: 37.8 million gallons (2006 data)
Water Volume Under 4 ft of ice: 17.0 million gallons
Water Volume Under 5 ft of ice: 12.2 million gallons
Water Volume Under 7 ft of ice: 4.21 million gallons

Potential Ice Aggregate: 2.0 acres (water depth 4 ft or less)
0.16 million gallons

Maximum Recommended Winter Removal: **16.97 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

Water Use History:

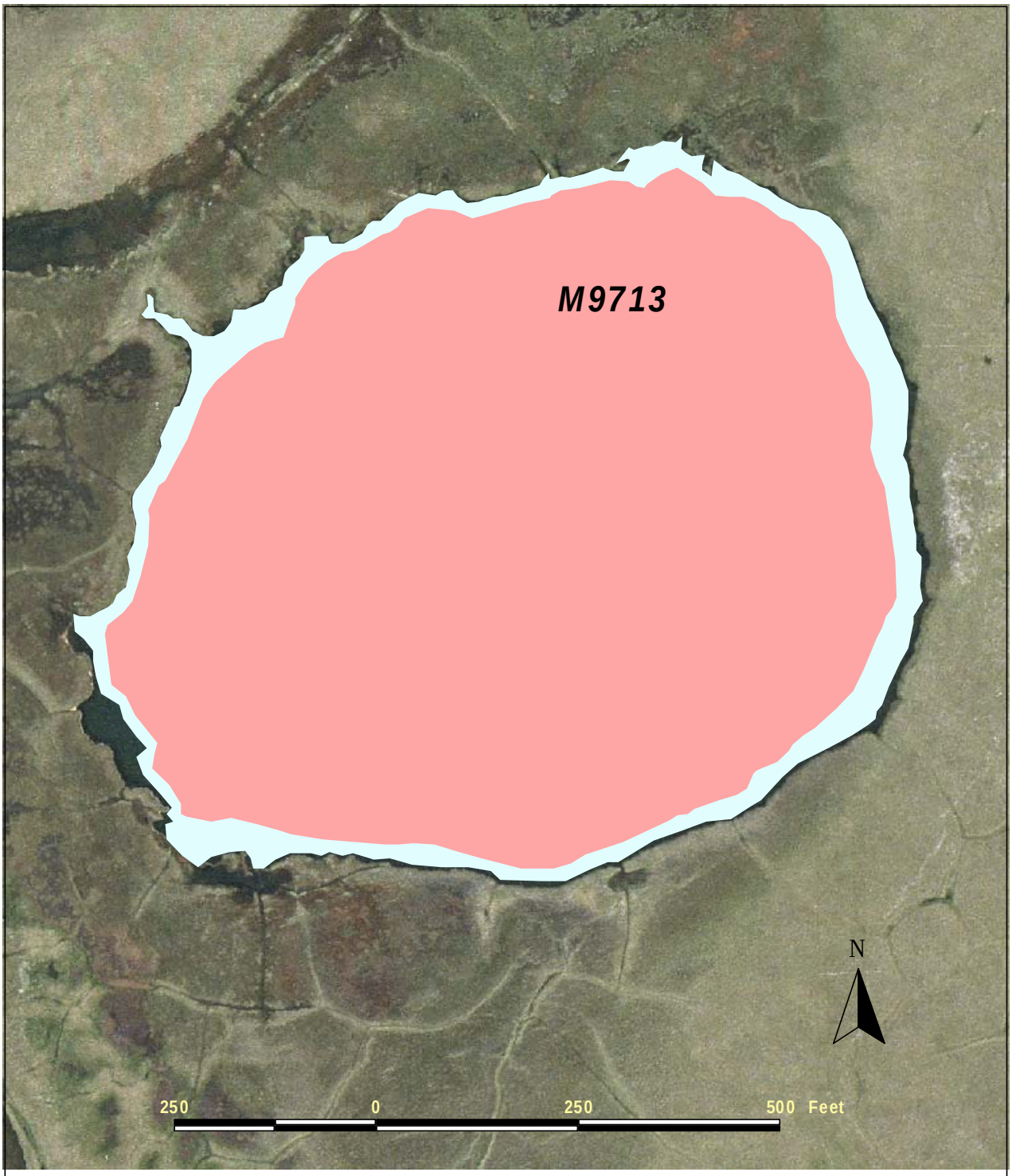
Year	Water Removed (all sources) (mill. Gals)
2004-2005	0.55

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
1997	--	--	--	--	--	3302	--	7.93	Moulton 98
1998	49.0	64.6	556.0	1090.0	388	--	--	--	this study
1999	38.4	53.6	439.0	836.0	317	--	--	--	this study
2006	21.5	24.7	197.0	348.0	155	1215	1.2	8.02	this study

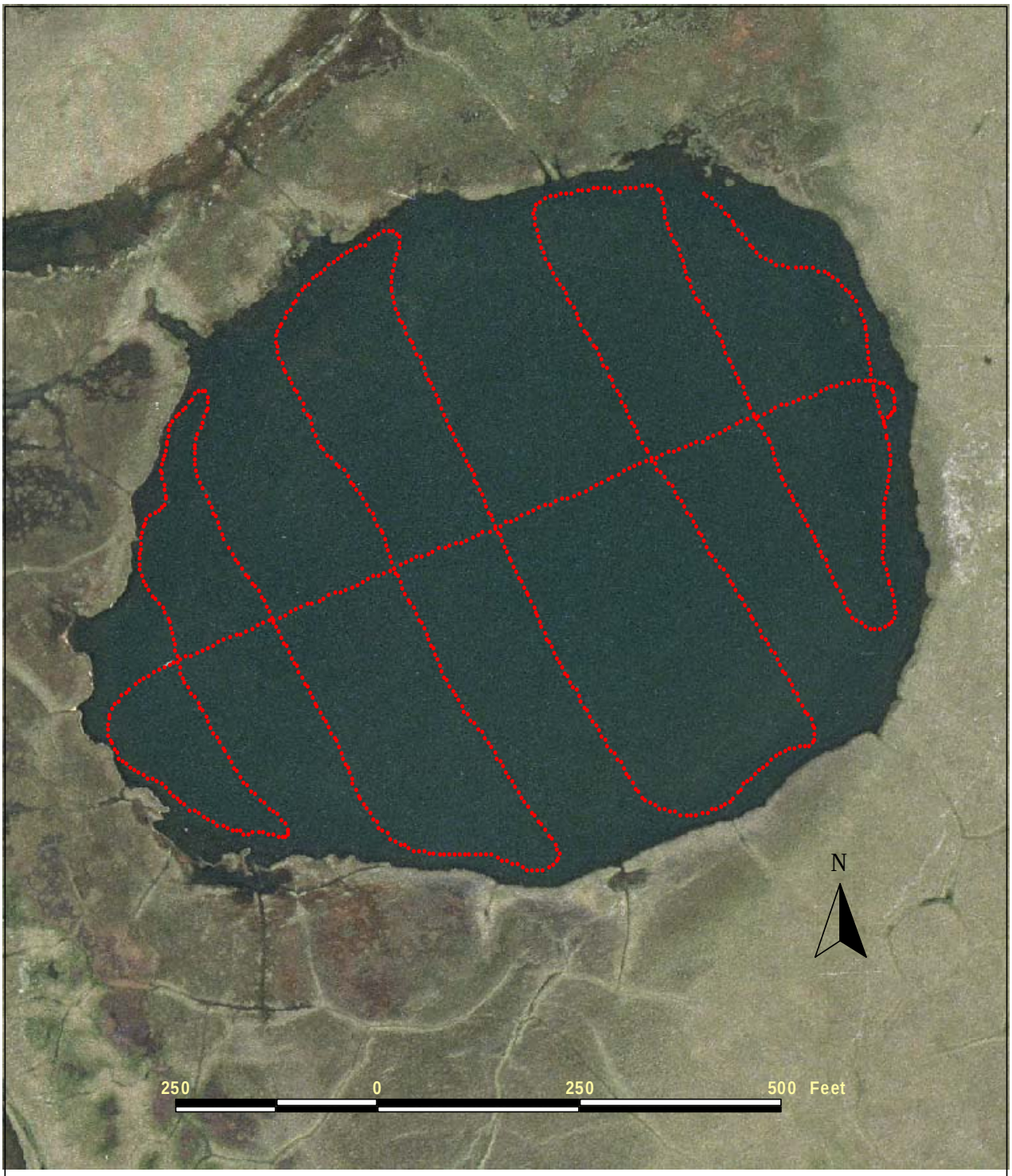
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 7 97	5.0	None	0
	Aug 8 97	6.7	None	0

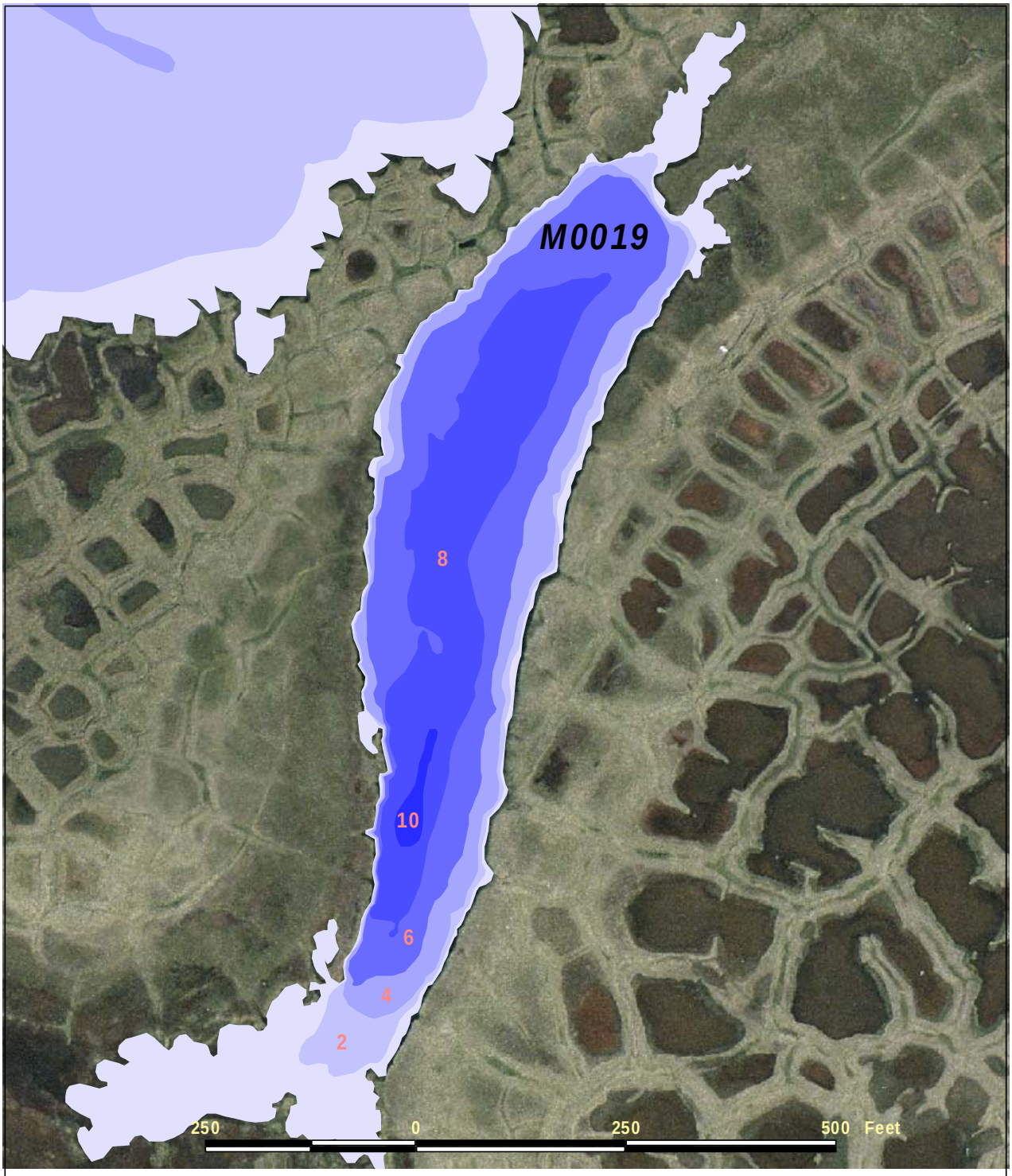


Regions of lake M9713 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on August 5, 2006.

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



Depth transects measured on lake M9713 on August 5, 2006.



Depth contours of lake M0019 based on transects surveyed on August 5, 2006.
(depths in 2 foot intervals)

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

Lake M0019

Other Names: O7.2
Location: 70.42980 °N 150.88829°W
USGS Quad Sheet: Harrison Bay B-2: T12/13N R5E Sec. 4/32
Habitat: Perched Lake (Infrequent Flooding)
Area: 6 acres
Maximum Depth: 10.8 feet
Active Outlet:
Total Lake Volume: 10.8 million gallons (2006 data)
Water Volume Under 4 ft of ice: 4.5 million gallons
Water Volume Under 5 ft of ice: 3.2 million gallons
Water Volume Under 7 ft of ice: 1.1 million gallons

Potential Ice Aggregate: 1.9 acres (water depth 4 ft or less)
0.15 million gallons

Maximum Recommended Winter Removal: **4.47 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

Water Use History:

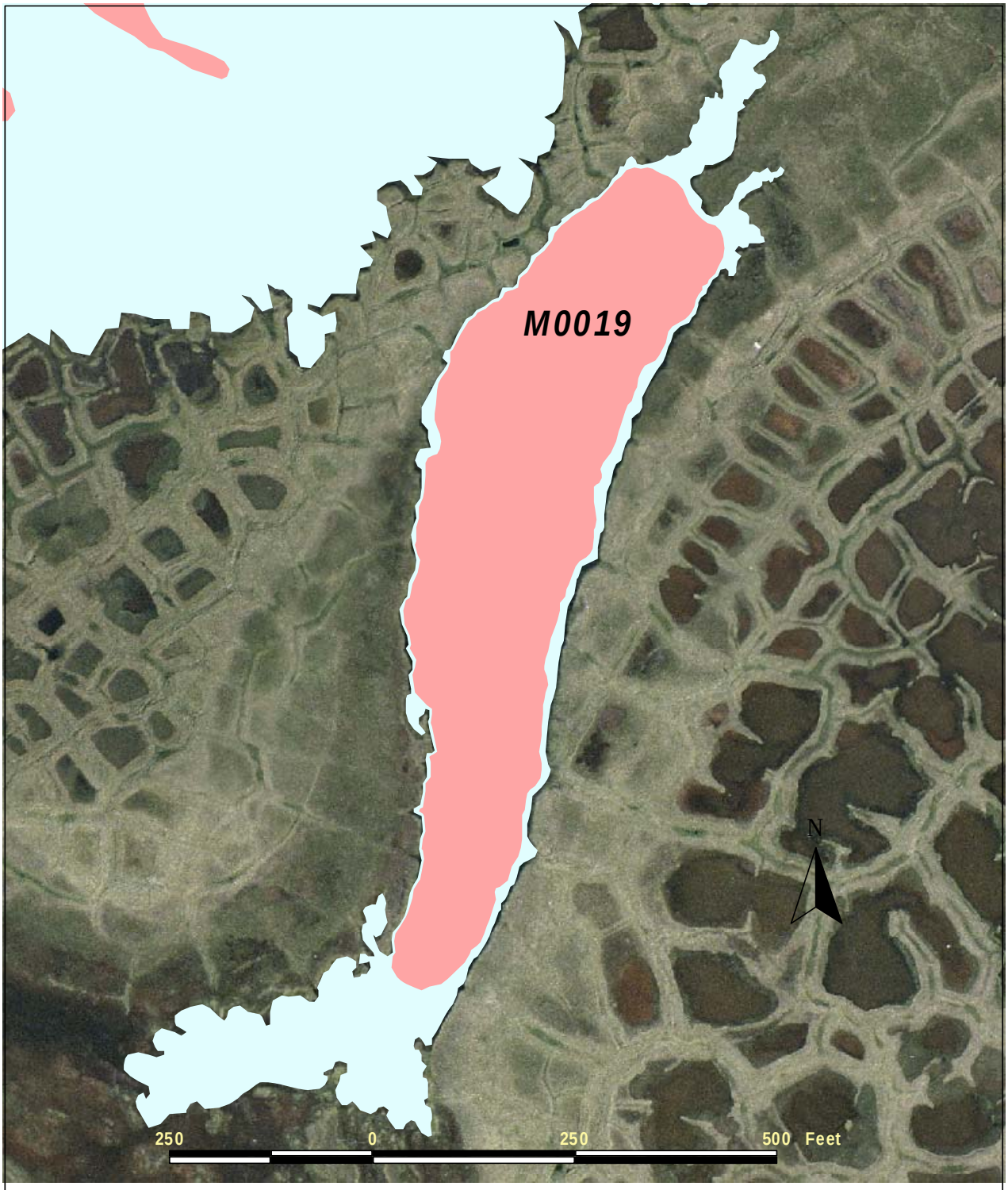
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	15.1	12.8	58	146	90	584	--	7.88	Moulton 00
2006	17.7	13.2	74.1	174	99	609	1.7	7.96	this study

Catch Record:

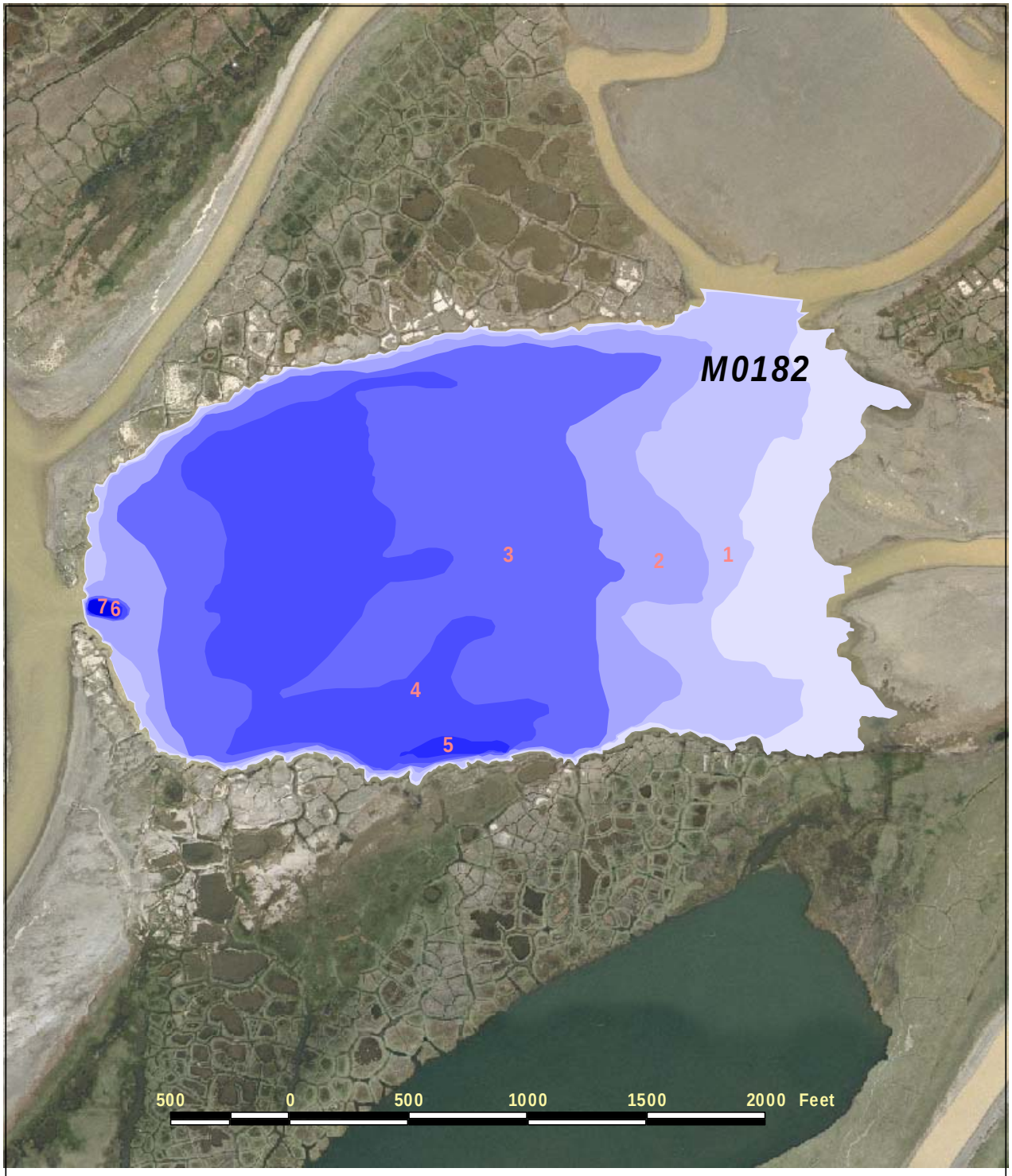
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 25 00	7.0	None	0
Minnow Traps	Jul 25 00	9.8	None	0



Regions of lake M0019 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 5, 2006.

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

Depth transects measured on lake M0019 on August 5, 2006.



Depth contours of lake M0182 based on transects surveyed on August 2, 2006.
(depths in 1 foot intervals)

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

Lake M0182

Other Names: Field ID = M0606
Location: 70.43620 °N 150.92691°W
USGS Quad Sheet: Harrison Bay B-2: T13N R5E, Sec. 31/32
Habitat: Tapped Lake
Area: 126.2 acres
Maximum Depth: 10.5 feet
Active Outlet:
Total Lake Volume: 116.9 million gallons (2006 data)
Water Volume Under 4 ft of ice: 3.9 million gallons
Water Volume Under 5 ft of ice: 0.2 million gallons
Water Volume Under 7 ft of ice: 0.0 million gallons

Potential Ice Aggregate: 97.7 acres (water depth 4 ft or less)
7.64 million gallons

Maximum Recommended Winter Removal: **0.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

Water Use History:

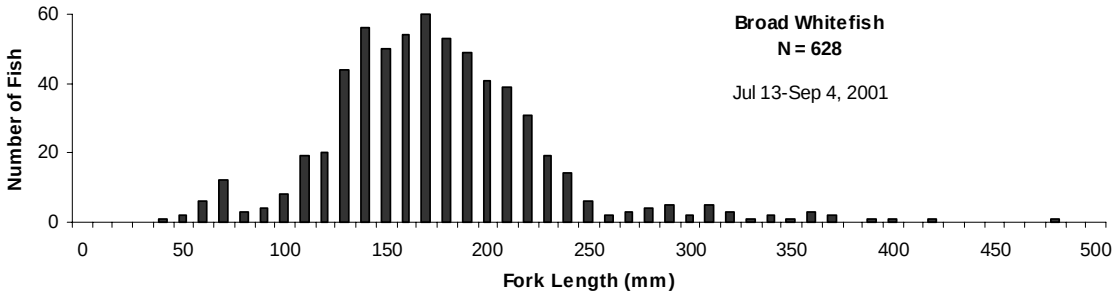
Year	Water Removed (all sources) (mill. Gals)
	none

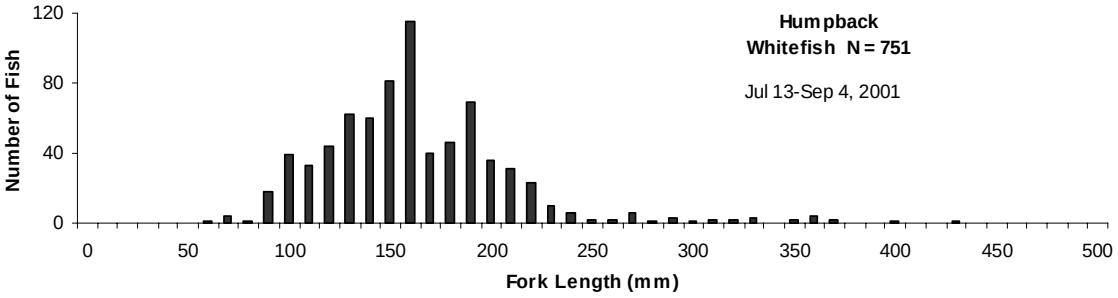
Water Chemistry:

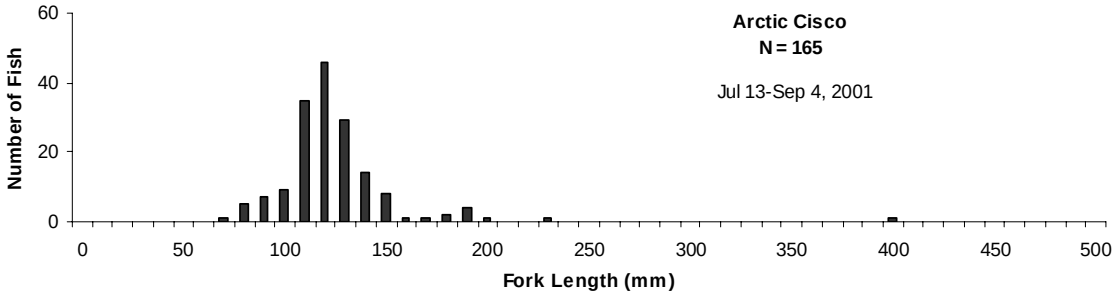
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2001	--	--	--	--	--	2749	71	8.00	Moulton 02
2006	37.0	55.2	488.0	825.0	320	2739	5.0	8.02	this study

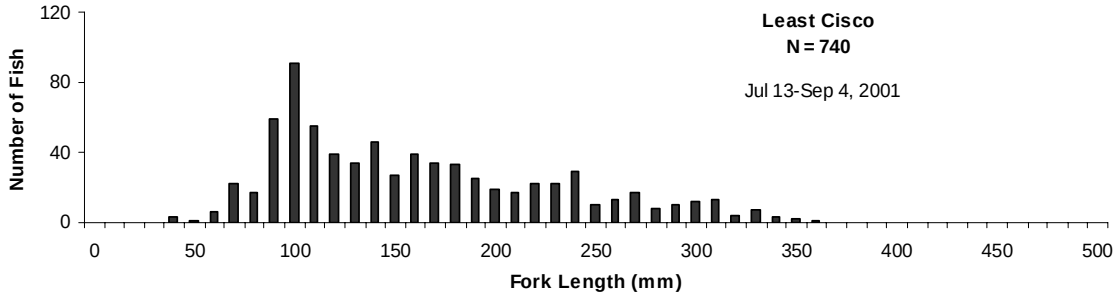
Catch Record:

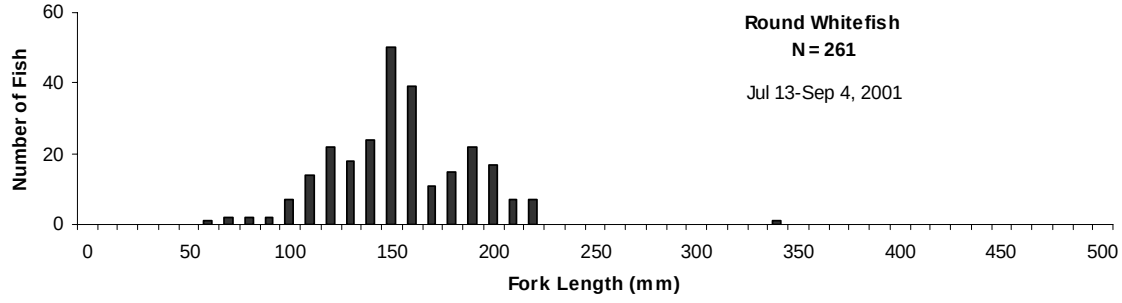
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 13-Sep 4, 01	352.8	Broad whitefish	629	46-486
			Humpback whitefish	752	67-432
			Arctic cisco	164	78-403
			Least cisco	738	40-363
			Round whitefish	261	68-347
			Dolly Varden char	4	163-240
			Burbot	1	510
			Rainbow smelt	328	56-300
			Arctic flounder	39	86-222
			Fourhorn sculpin	617	100-309

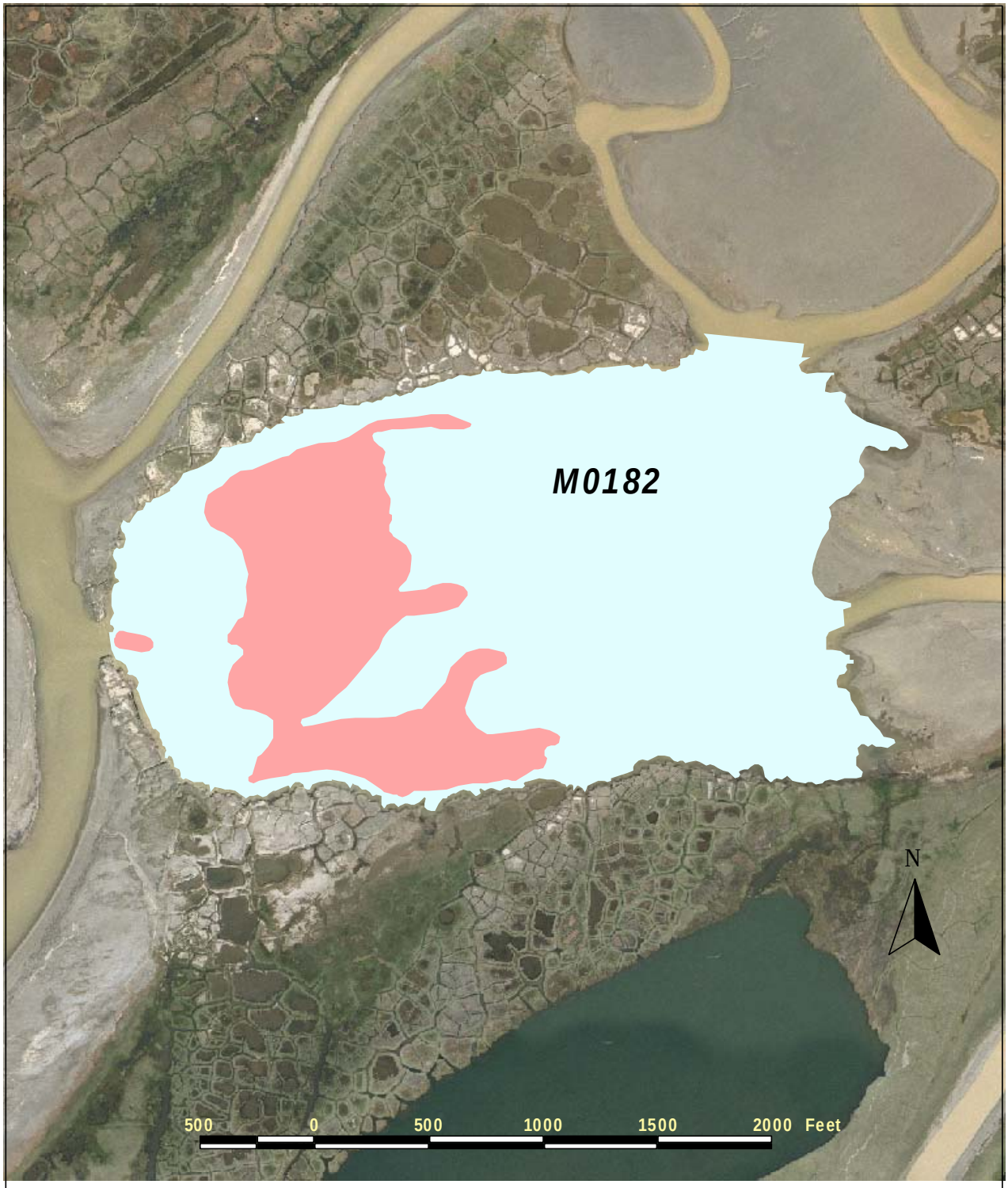

Broad Whitefish
N = 628
Jul 13-Sep 4, 2001
Number of Fish
Fork Length (mm)


Humpback
Whitefish N = 751
Jul 13-Sep 4, 2001
Number of Fish
Fork Length (mm)


Arctic Cisco
N = 165
Jul 13-Sep 4, 2001
Number of Fish
Fork Length (mm)

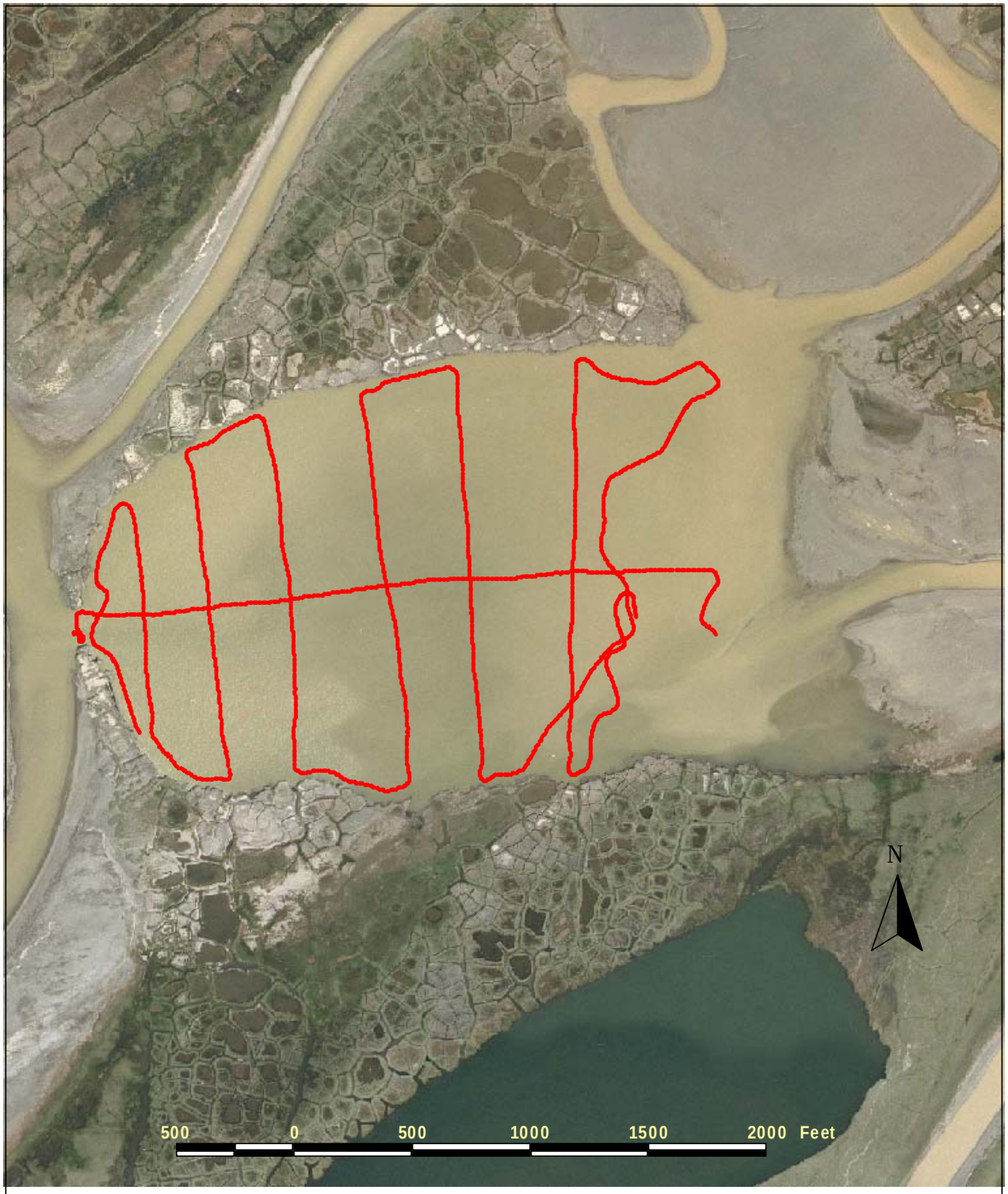

Least Cisco
N = 740
Jul 13-Sep 4, 2001
Number of Fish
Fork Length (mm)


Round Whitefish
N = 261
Jul 13-Sep 4, 2001
Number of Fish
Fork Length (mm)

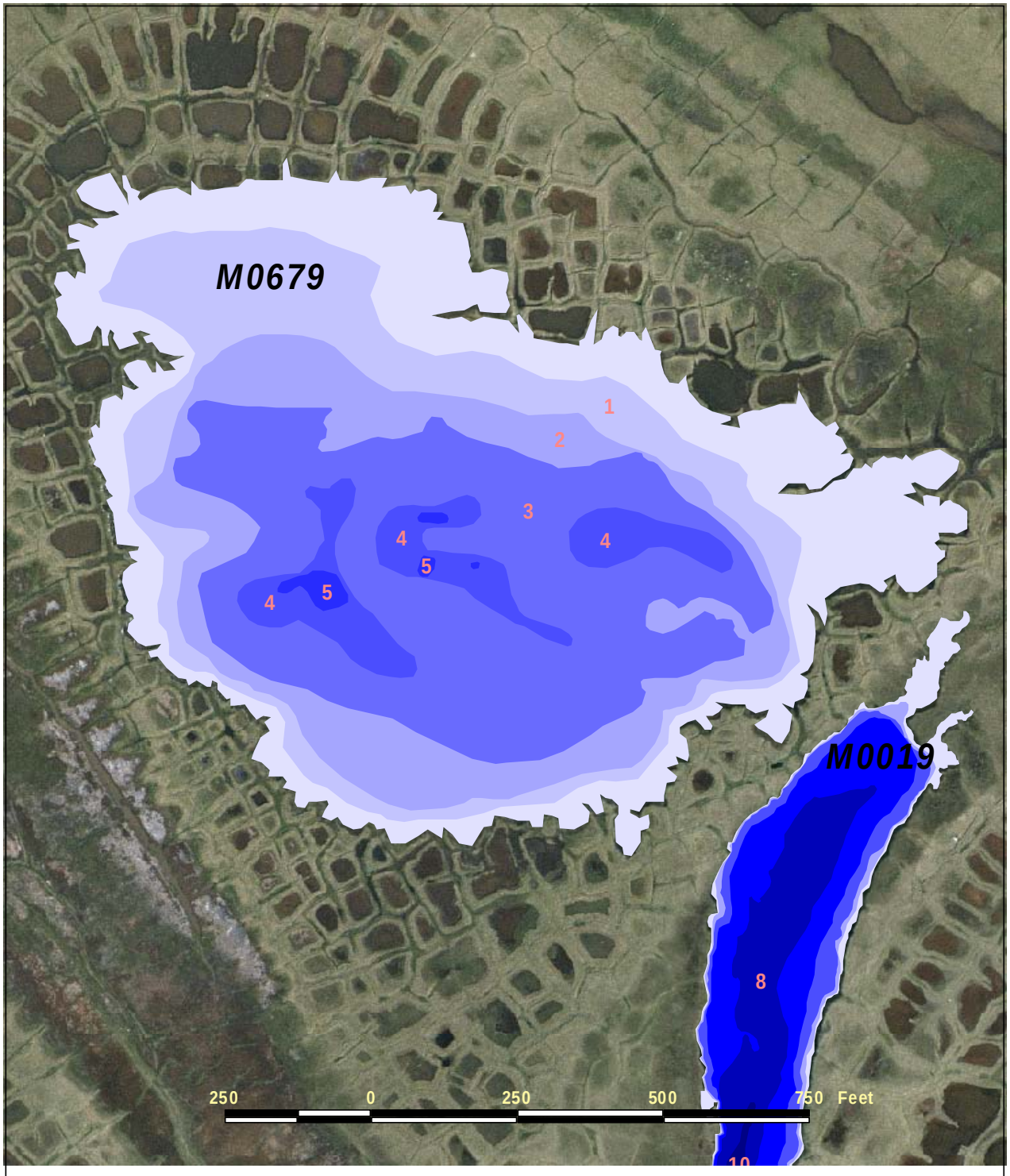


Regions of lake M0182 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 2, 2006.

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



Depth transects measured on lake M0182 on August 2, 2006.



Depth contours of lake M0679 based on transects surveyed on August 5, 2006.
(depths in 1 foot intervals)

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

Lake M0679

Other Names: Field ID = M0608
Location: 70.43168 °N 150.89256°W
USGS Quad Sheet: Harrison Bay B-2: T13N R5E, Sec. 32
Habitat: Perched Lake (Infrequent Flooding)
Area: 25.7 acres
Maximum Depth: 6.0 feet
Active Outlet:
Total Lake Volume: 18.3 million gallons (2006 data)
Water Volume Under 4 ft of ice: 0.3 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: 23.9 acres (water depth 4 ft or less)
1.87 million gallons

Maximum Recommended Winter Removal: **0.29 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

Water Use History:

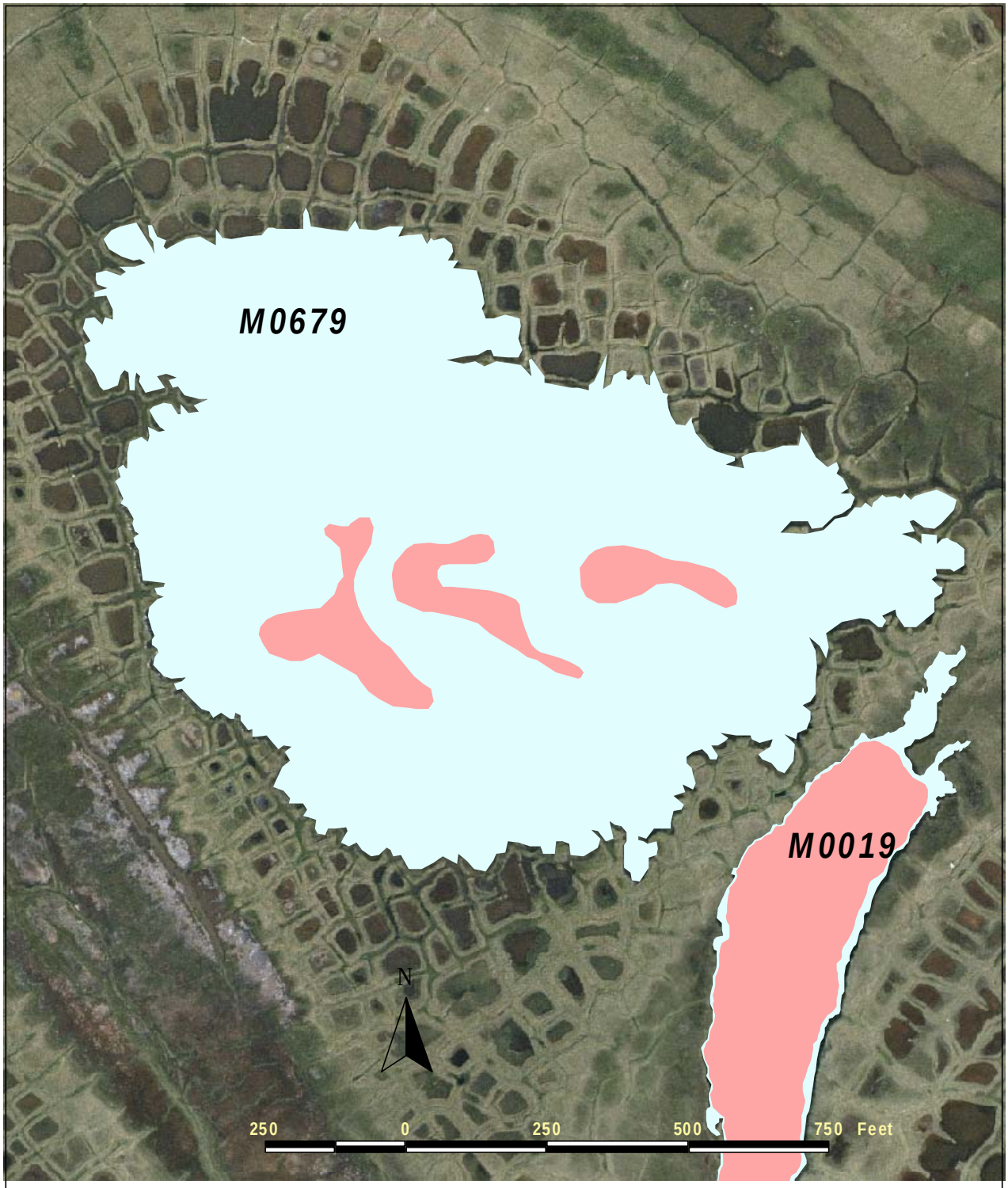
Year	Water Removed (all sources) (mill. Gals)
	none

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2006	21.4	20.5	142.0	270.0	138	1023	0.9	7.91	this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Nets not set - lake mostly less than 5 ft deep				
Extensive visual survey in Arctophila beds, no fish observed				



Regions of lake M0679 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 5, 2006.

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

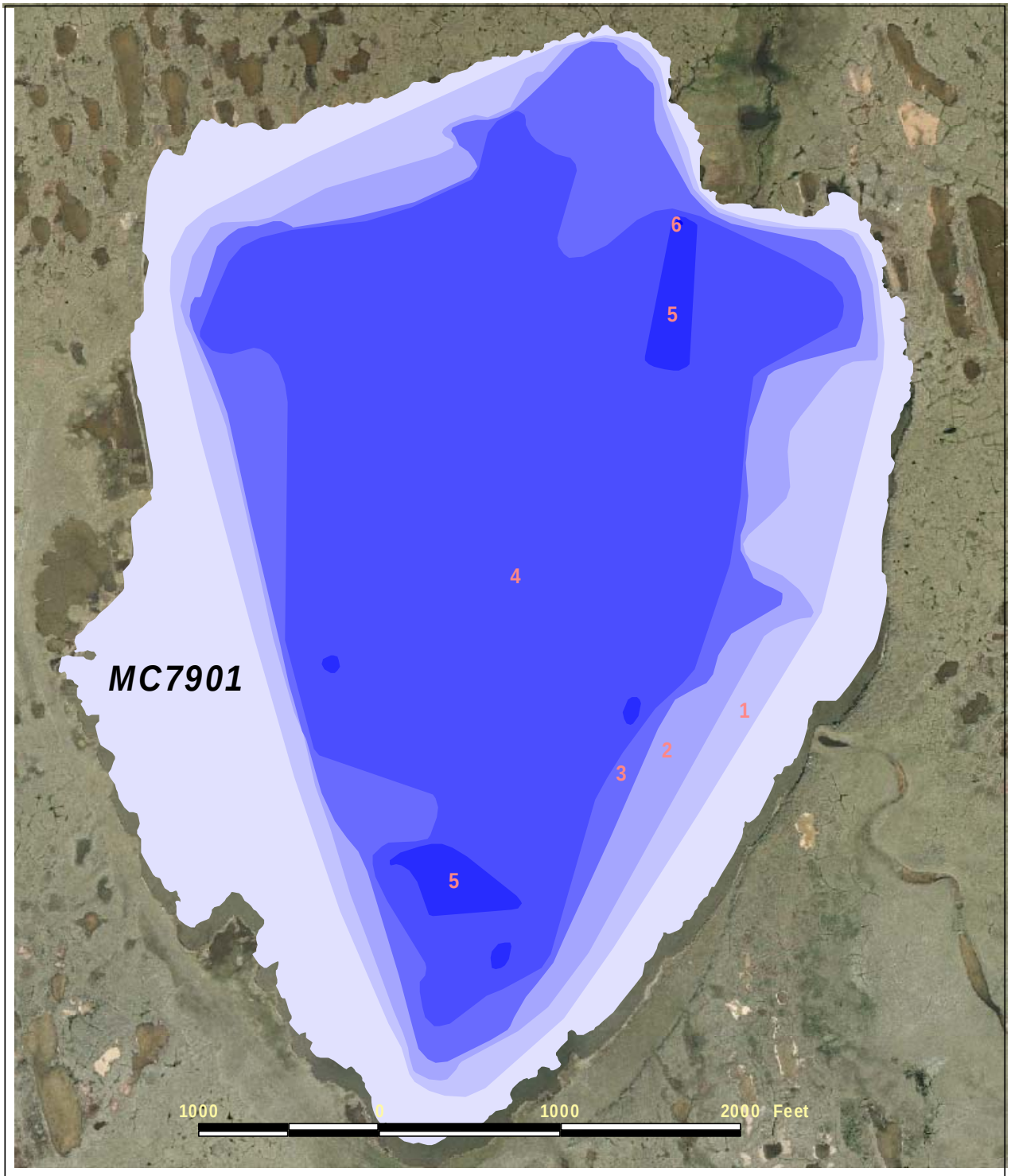
Depth transects measured on lake M0679 on August 5, 2006.

Lake M0680 was breached and open to Harrison Bay when surveyed on August 2, 2006, consequently a contour map was not developed.

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

Lake M0680

Other Names:	Field ID = M0607
Location:	70.45255 °N 150.89436°W
USGS Quad Sheet:	Harrison Bay B-2: T13N R5E, Sec. 28/29
Habitat:	Coastal Lagoon - lake breached by wave action
Area:	44.7 acres
Maximum Depth:	(not surveyed)
Active Outlet:	Yes



Depth contours of lake MC7901 based on transects surveyed on August 26, 2006.
(depths in 1 foot intervals)

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

Lake MC7901

Other Names: P21.1; L9115
Location: 70.41314°N 150.20024°W
USGS Quad Sheet: Harrison Bay B-1: T12N R8E, Sec. 5/6/7/8
Habitat: Drainage Lake
Area: 463 acres
Maximum Depth: 7.3 feet
Active Outlet: Yes
Total Lake Volume: 439.4 million gallons (2006 data)
Water Volume Under 4 ft of ice: 30.2 million gallons
Water Volume Under 5 ft of ice: 1.0 million gallons
Water Volume Under 7 ft of ice: 0.0 million gallons

Potential Ice Aggregate: 245.7 acres (water depth 4 ft or less)
19.22 million gallons

Maximum Recommended Winter Removal: **30.17 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

Water Use History:

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

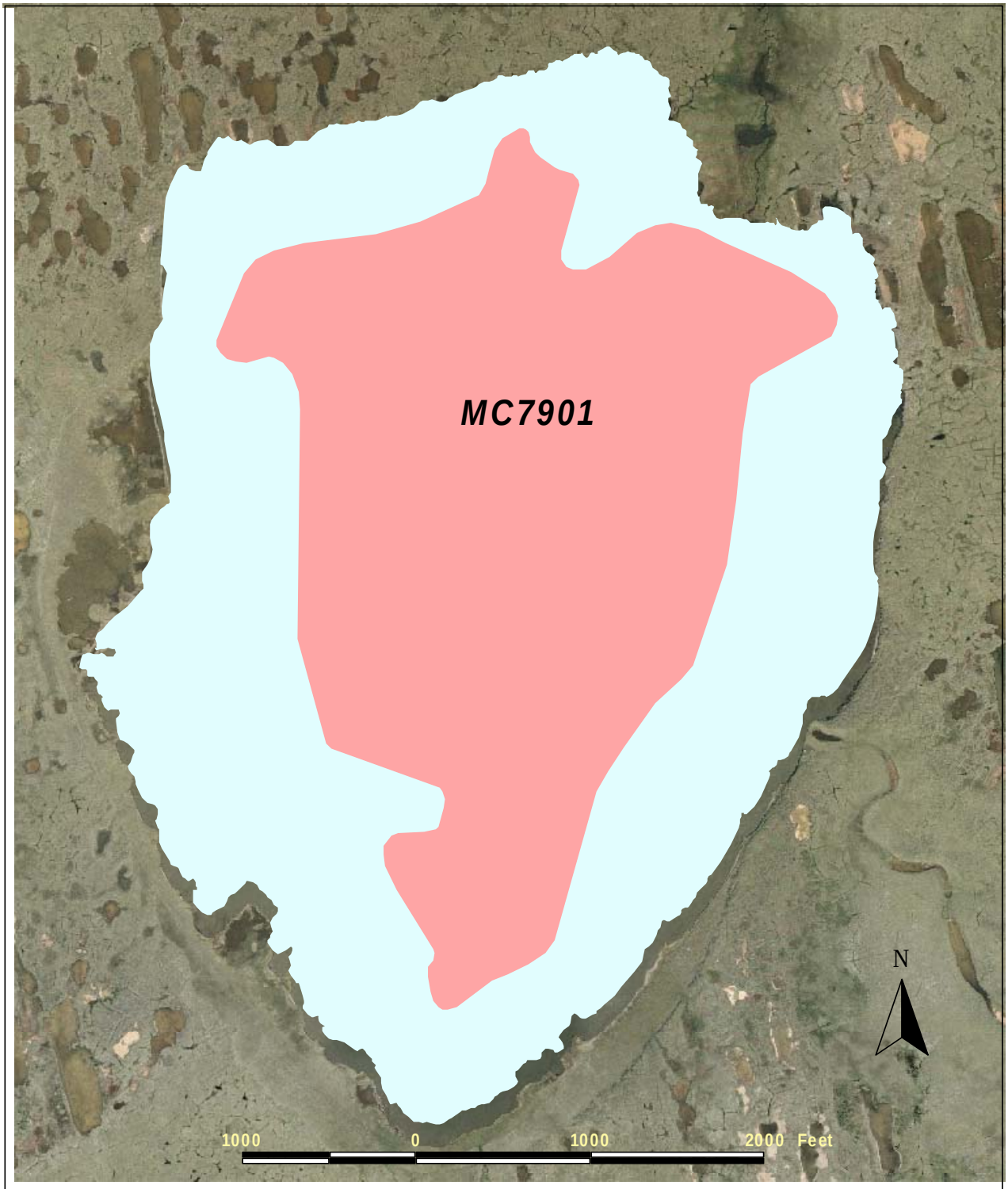
Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2006	38.6	4.0	15.5	39.7	113	321	2.5	--	this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Sep 5 79	?	None	0
	Aug 26 06	7.25	None	0
Seine	Aug 26 06	10 hauls	None	0

extensive visual survey along shore, no fish detected
Source of 1979 data: McElderry & Craig 1981



Regions of lake MC7901 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 26, 2006.

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

Depth transects measured on lake MC7901 on August 26, 2006.