

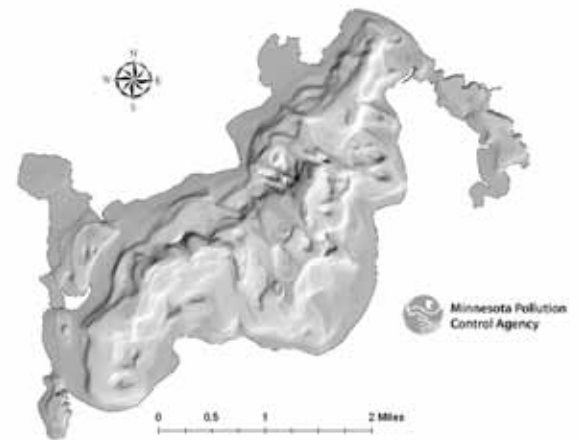
Minnesota Lake ID: 11-0413
Area: 5,047 acres
Watershed Area: 24,828 acres
Ecoregion: Northern Lakes and Forests (NLF)

Trophic State: Mesotrophic
Maximum Depth: 208 feet
Mean Depth: 53 feet
Mixing Status: Thermally Stratified (Dimictic)

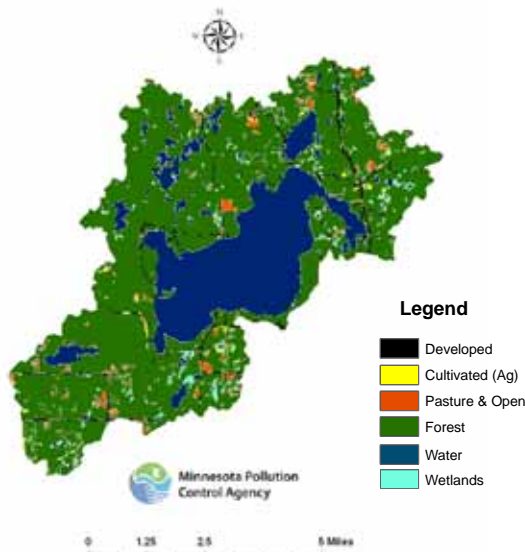


Figure 2. Ten Mile Lake watershed land use

Figure 1. Ten Mile Lake 3D depth contour



DNR Ecological Services and Fisheries Divisions 2002
Lake Bathymetric DEM Shaded Relief Image



The National Land Cover Database 2001
Multi-Resolution Land Characteristics (MRLC) Consortium

Table 1. Land use composition

Land use	Ten Mile Lake land use percentage	NLF typical land use percentage
Developed	3	0 – 7
Cultivated (Ag)	0	<1
Pasture & Open	2	0 – 6
Forest	70	54 – 87
Water & Wetland	25	14 – 31
Feedlots (#)	0	

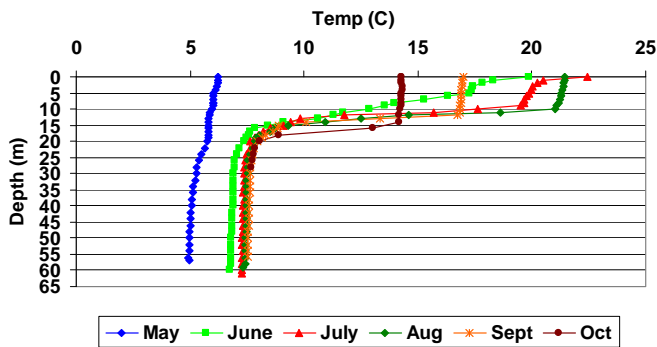
**Table 2. Ten Mile Lake 2008 as compared to typical range for NLF ecoregion reference lakes
MPCA data based on 1985-86 and 2008 sample collections**

Parameter	Ten Mile Lake	NLF
Number of reference lakes	-	32
Total Phosphorus ($\mu\text{g/L}$)	12	14 – 27
Chlorophyll mean ($\mu\text{g/L}$)	2.4	4 – 10
Secchi Disk (feet)	15.7	8 -15
(meters)	4.8	2.4 – 4.6
Total Kjeldahl Nitrogen (mg/L)	0.4	0.4 – 0.75
Alkalinity (mg/L)	110	40 – 140
Color (Pt-Co U)	5	10 – 35
pH (SU)	8.2	7.2 – 8.3
Chloride (mg/L)	1.4	0.6 – 1.2
Total Suspended Solids (mg/L)	Non Detect	<1 – 2
Total Suspended Inorganic Solids (mg/L)	Non Detect	<1 - 2
Conductivity (umhos/cm)	199	50 – 250
TN:TP ratio		25:1 - 35:1

$\mu\text{g/L}$ = micrograms per liter	Pt-Co-U = Platinum Cobalt Units
mg/L = milligrams per liter	SU = Standard Units
umhos/cm = micromhos per centimeter	

Figure 3. Ten Mile Lake 2008 monthly temperature and dissolved oxygen profiles

Ten Mile 2008 Temperature Profiles (Site 202)



Ten Mile 2008 Dissolved Oxygen Profile (Site 202)

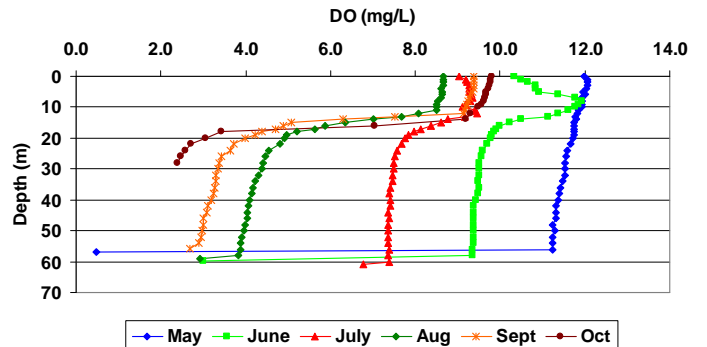


Figure 4. Ten Mile Lake July Temperature and Dissolved Oxygen Profiles (1977 and 2008)

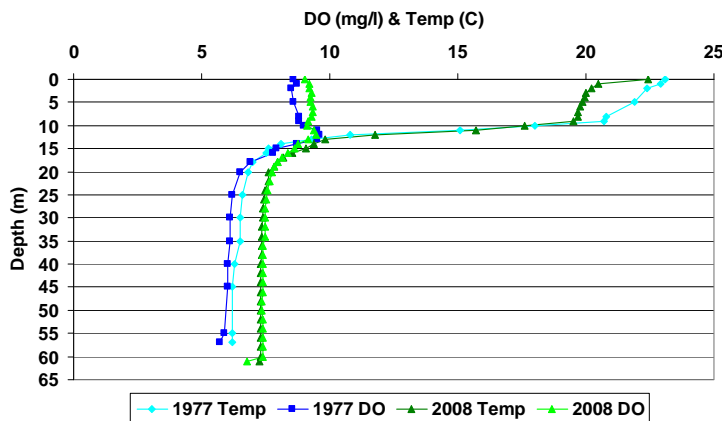


Figure 5. Ten Mile Lake 2008 TP (surface and depth), Chl-a, and secchi (Site 202)

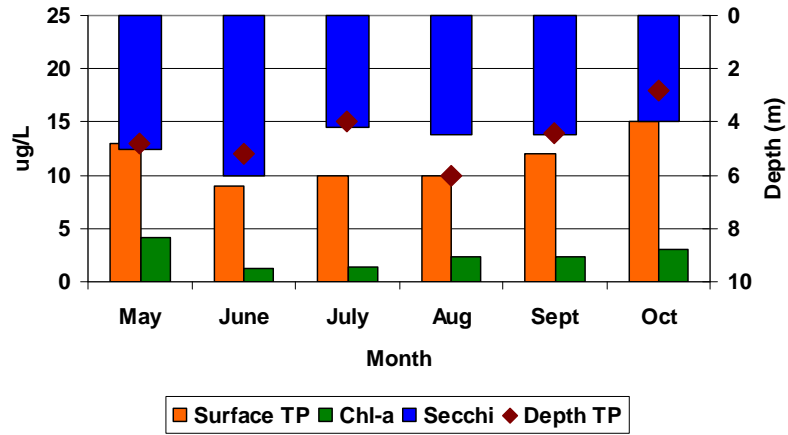
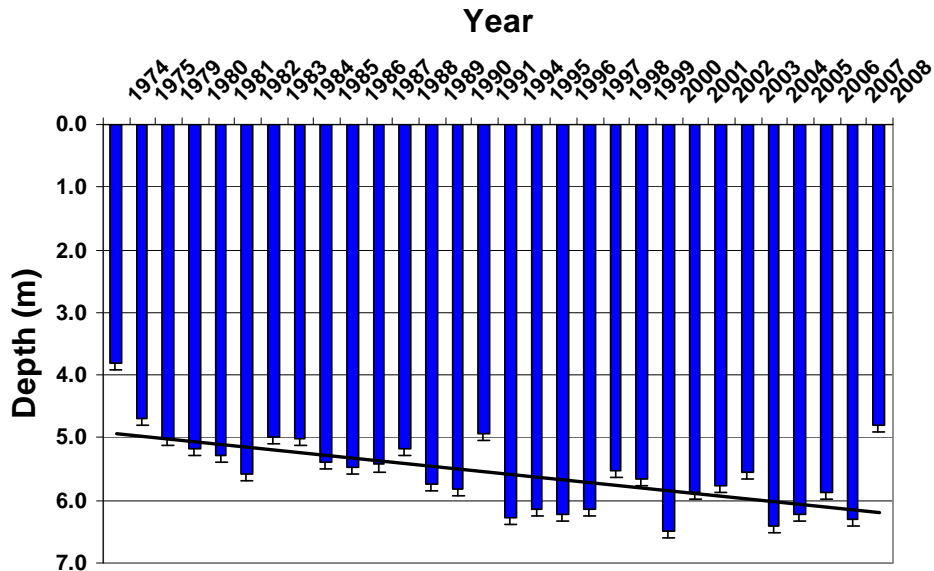


Figure 6. Ten Mile Lake summer-mean secchi transparencies



Watershed and water quality summary

Ten Mile Lake is a clear, deep lake located just north of Hackensack, Minnesota. The lake has moderate development on all shores. The lake currently sees heavy recreational use and is a popular destination. Ten Mile Lake’s watershed is small relative to its surface area with a ratio of 5:1. Land use is dominated by forests and water/wetlands which is typical for the NLF ecoregion.

Ten Mile Lake was sampled at two locations for chemistry six times during the summer of 2008 by MPCA staff. Site 202 is the deepest area of the lake. Site 102 is approximately 300 yards southeast of Angel Island. Surface Total Phosphorus (TP), Chlorophyll-a (Chl-a), Secchi, and profile data were the only parameters collected at 102. Secchi depth, temperature, and dissolved oxygen (DO) profiles were collected by both staff and volunteer monitor, Mr. Bruce Carlson. The lake was well-mixed in mid-May. The lake became stratified and developed a thermocline at a depth of 10 to 15 meters from June through October (Figure 3). Fall mixing had not yet been completed by October 7. In August and September below a depth of approximately 15 meters DO dropped below the 5 mg/L necessary to support game fish. Historical profile data is available from July 1977. When compared to the July 2008 DO and temperature profile the 1977 profile is nearly identical (Figure 4).

The trophic status indicators and other water quality data for Ten Mile Lake were better than the typical range for minimally impacted NLF lakes (Table 2). TP and Chl-*a* are high in May as a result of spring overturn and possibly a diatom bloom. TP declines over the summer as a result of algal uptake and sedimentation. Chl-*a* remains quite low over the summer and Secchi depth remains between 4-5 meters over the summer with a 6 meters reading in June (Figure 5).

Nearly continuous Secchi disk data are available from 1974-2008. Based on this record, summer-mean Secchi typically ranged from a low of 3.8 meters in 1974 to a high of 6.5 meters in 2000; well within the typical range for a lake within the NLF ecoregion. This record shows an improvement in Secchi transparency over time.

Fishery and aquatic plant survey summary conducted in 2006

Table 3. Focal species captured during recent surveys and their size and abundance compared with other lakes in its lake class

Species	Stocked	Abundance	Size	Trends
Walleye*	Y		Large	Consistent catch rate with a good mean size except the 2008 gill net catch rate was the lowest since 1983;
Northern Pike*	N	High	Average	Consistent catch rate with good size structure; however, 2008 GN catch rate was the historical high;
Black Crappie	N			Not effectively sampled; but receive heavy pressure during the spring
Smallmouth bass	N			Discovered in 2003; Not effectively sampled
Largemouth bass	N			Not effectively sampled
Bluegill	N	Average	Average	Consistent catch rate but consisted of smaller fish
White sucker	N	Average	Avg.-large	Consistent for past 10 years
Rock bass	N	High	Average	Increasing but it always had a high gill net catch rate
Cisco	N			Not effectively sampled
Lake whitefish	N			Not effectively sampled
Yellow perch	N	Average	Average	Consistent for past 10 years

*Management emphasis on these species

Table 4. Aquatic plant summary*

Frequency of plants ≤ 15ft	66.5%
90% depth of occurrence	20ft
Total number of taxa	37
Number of species ≥ 10% freq.	1
Infested	N
Frequency of Chara	56%

*Aquatic plant data collected in 2006 by DNR Division of Ecological Resources.

*Perleberg, D. 2007. Aquatic vegetation of Ten Mile Lake (DOW 11-0413-00), Cass County, Minnesota, June 2006. Minnesota Department of Natural Resources, Ecological Services Division, 1601 Minnesota Dr., Brainerd, MN 56401. 23 pp.

http://www.dnr.state.mn.us/ecological_services/pubs_aquatics/veg_reports.html

Compared with the other 23 Sentinel Lakes, Ten Mile Lake is among the best in terms of habitat conditions and fish populations. The Biotic Integrity score for Ten Mile Lake is 136. Ten Mile harbors two coldwater fish species: lake whitefish and dwarf cisco that likely support high quality populations of walleye, northern pike, and smallmouth bass. Nevertheless, the status of whitefish and cisco are uncertain because traditional survey gears do not target these populations. Future hydroacoustic and gillnet assessments targeting these species are tentatively planned. The aquatic plant community is very species-rich, yet interestingly, only one species Chara was found at more than ten percent of the sites. Chara is an architecturally complex species that provides quality habitat for juvenile fish and is an important resilience mechanism in lakes that maintains high water clarity.