Minnesota Pollution Control Agency

Prepared in cooperation with the Minnesota Department of Natural Resources

Artichoke Lake

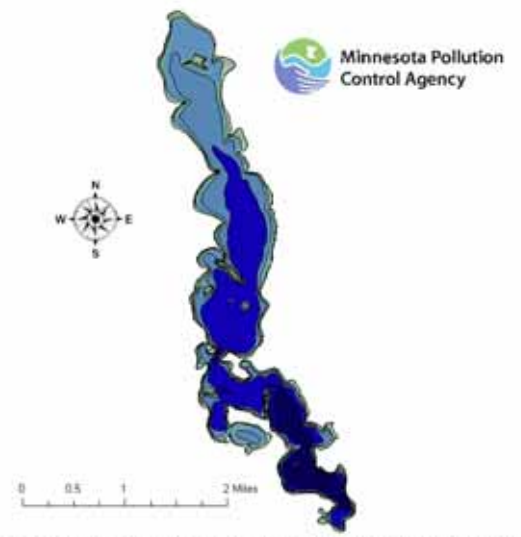
Big Stone County

Sentinel Lakes

Minnesota Lake ID: 06-0002
Area: 1964 Acres
Watershed Area: 41,855 (total) 20,885 (direct) acres
Ecoregion: Northern Glaciated Plains (NGP)

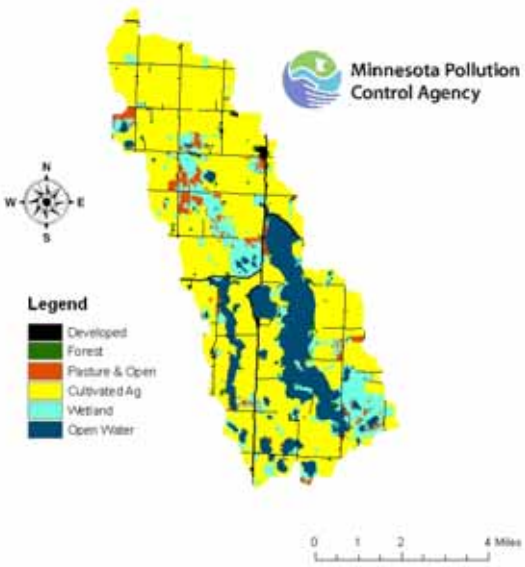
Trophic State: Eutrophic
Maximum Depth: 15.5 feet
Mean Depth: 5.9 feet
Mixing Status: Well Mixed (Polymictic)

Figure 1. Artichoke Lake 3D depth contour



DNR Ecological Services & Fisheries Division 2002
Lake Bathymetric DEM Shaded Relief Image

Figure 2. Artichoke Lake watershed land use



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

Table 1. Land use composition

Land use	Artichoke Lake land use percentage	NGP typical land use percentage
Developed	5	0–2
Cultivated (Ag)	63	60-82
Pasture & Open	3	5-15
Forest	1	0-1
Water & Wetland	28	8-26
Feedlots (#)	4	

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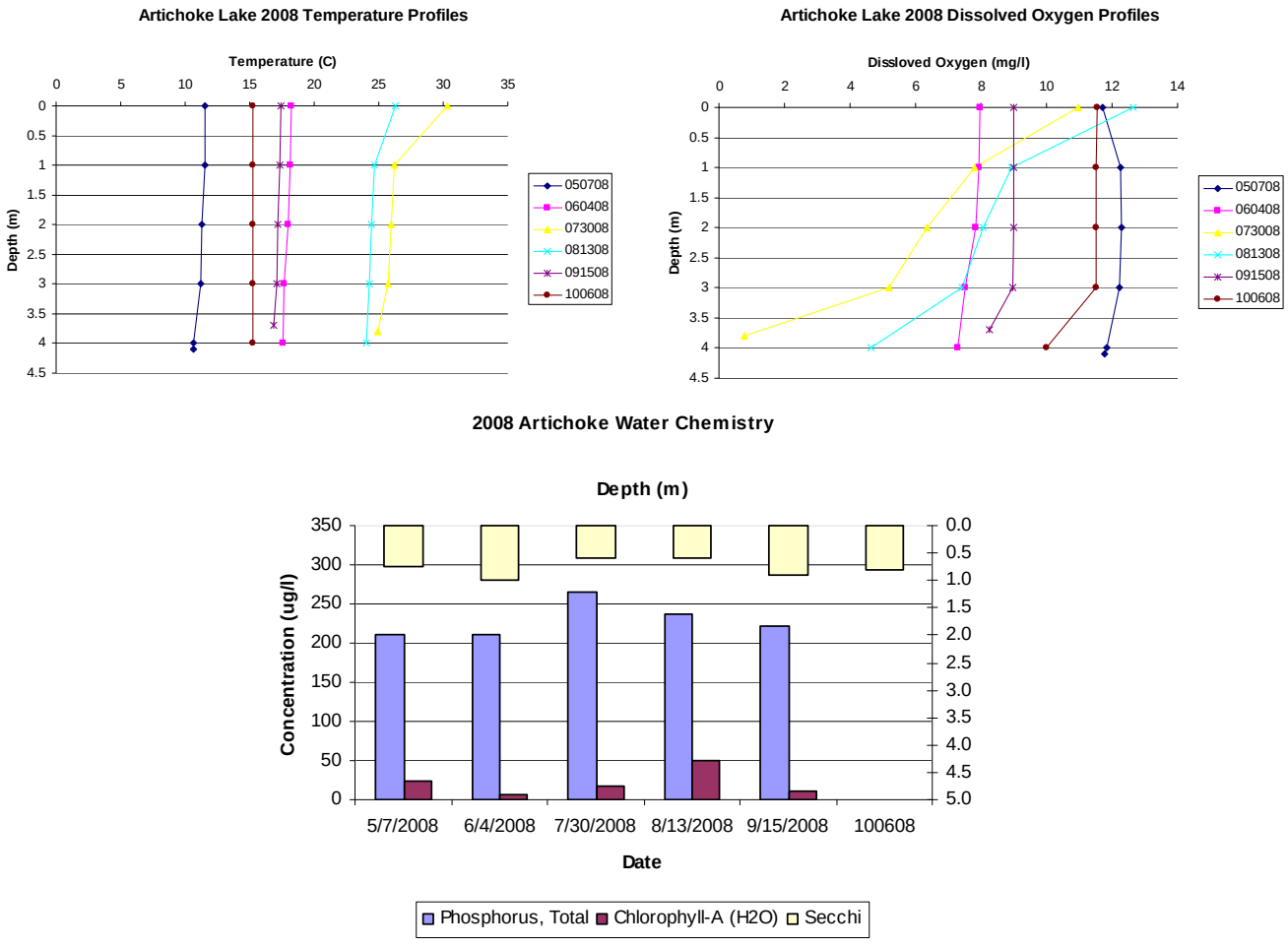
Table 2. Artichoke Lake summer-mean as compared to typical range for NGP ecoregion reference lakes MPCA data based on 2008 sample collections

Parameter	Artichoke 101	Artichoke 102	NGP
Number of reference lakes	-	-	13
Total Phosphorus (µg/L)	229	243	122-160
Chlorophyll mean (µg/L)	22	24	36-61
Secchi Disk (feet) (meters)	2.6 0.8	2.0 0.6	1.3-2.6 (0.4-0.8)
Total Kjeldahl Nitrogen (mg/L)	2.1	-	1.8-2.3
Alkalinity (mg/L)	310	-	160-260
Color (Pt-Co U)	12.5	-	20-30
pH (SU)	8.3	8.4	8.3-8.6
Chloride (mg/L)	17.3	-	11-18
Total Suspended Solids (mg/L)	9.6	-	10-30
Total Suspended Inorganic Solids (mg/L)	4.2	-	5-15
Conductivity (umhos/cm)	887	874	640-900
TN:TP ratio			13:1-17:1

µg/L = micrograms per liter
mg/L = milligrams per liter
umhos/cm = micromhos per centimeter
Pt-Co-U = Platinum Cobalt Units
SU = Standard Units

Figure 3. Artichoke Lake temperature and dissolved oxygen profiles and trophic status data for 2008



Watershed, water quality and fishery summary

Artichoke Lake is a large (1,946 acre), shallow, productive lake (Figure 2) located in eastern Big Stone County. Artichoke was used as an ecoregion reference lake in the mid-1980's because it was thought to be fairly typical (Table 1) and had a moderate-sized watershed (21:1 watershed: lake ratio), with minimal feedlots -- in contrast to many other lakes in the Northern Glaciated Plains (NGP) ecoregion. As a result, water quality and other information were gathered by MPCA.

Artichoke is quite well-mixed (Figure 3), as anticipated, based on its shallowness and large fetch (Figure 1). Total Phosphorus (TP) measurements from 2008 were high throughout the lake (Table 2) and remain above 200 µg/L during the entire summer (Figure 3). While the lake is very nutrient–rich, chlorophyll-a concentrations were not excessively high in 2008 (Figure 4), as compared to the typical range for NGP lakes (Table 2). High nutrient and algal (chlorophyll-a) concentrations will likely cause Artichoke to be included on Minnesota's Impaired Waters (303d) list in a future cycle.

Lake level management can be an important issue for shallow prairie lakes such as Artichoke. In this portion of Minnesota, surface water evaporation far exceeds precipitation, and in dry years lake levels may decline dramatically. During the 1930's drought, only a small portion of the lake bed contained water while major portions of the basin were dry, and in some cases tilled (Figure 4). During periods of high rainfall, lake levels may rise dramatically and allow for new connections with other waterbodies that allow fish to move from one basin to another (e.g. drum). Based on 15 lake level measurements collected between 1957-2008, levels have ranged over 8.6 feet in Artichoke, which can have dramatic effects on the size and depth of the overall lake basin and can have a direct impact on shoreland properties (Figure 4). Future fluctuations in climate may make these extremes more common and, in turn, make water quality and fishery management increasingly challenging.

Figure 4. Artichoke Lake aerial photos as compared to present lake contour and 2008 photo

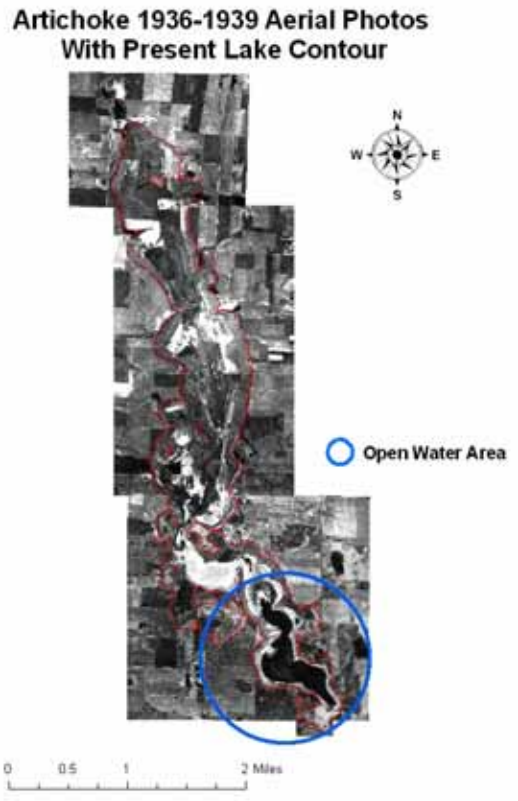


Table 3. Focal species captured during 2008 surveys and their size and abundance compared with other lakes in their lake class

Species	Stocked	Abundance	CPUE Trend	Size	Fish IBI	Notes
Walleye*	Y	High	Stable	Average	Low	
Northern Pike*	Y	Low	Stable	Large		
Black Crappie	N	High	Decreasing	Large		
Largemouth bass	N	Low	Stable	Large		
Bluegill	N	Low	Stable	Small-average		
Yellow perch	N	Not detected	Decreasing	Not detected		
Freshwater drum	N	Average	Decreasing	Average		Discovered in 2001

*Primary species managed

Table 4. Aquatic plant summary

Number of common species (i.e., ≥ 10% cover)	3.0
Infested with non-native plants (variable)	Curly-leaf pondweed

Narrative

Walleye populations are sustained through stocking including fingerlings, yearlings and adults, as needed. Artichoke's high productivity, turbid water, and scant aquatic plant growth generally favors high production of open-water oriented species, such as walleye and black crappie, but there is low overall community integrity. A return to clear water conditions that favor aquatic plants could benefit a greater range of native fish species and improve the IBI score. Northern pike populations have required stocking efforts to sustain their populations in the past. Yellow perch, an important forage species for walleye and northern pike, have declined over time. Interestingly, freshwater drum, a species more common to riverine environments was discovered in 2001, presumably from a flooded Pomme de Terre River. Anecdotal evidence suggests this species has displaced fathead minnows and is now serving as the primary forage base for juvenile and predators in Artichoke. It remains uncertain as to which species is more energetically profitable forage.