Minnesota Pollution Control Agency

Prepared in cooperation with the
Minnesota Department of Natural Resources

Portage Lake

Hubbard County

Sentinel Lakes

Minnesota Lake ID: 29-0250
Area: 422 acres
Watershed Area: 6,742 acres
Ecoregion: Northern Lakes and Forests (NLF)

Trophic State: Eutrophic
Maximum Depth: 17 feet
Mean Depth: 6.8 feet
Mixing Status: Not Stratified (Polymictic**)**

Figure 1. Portage Lake Watershed land use

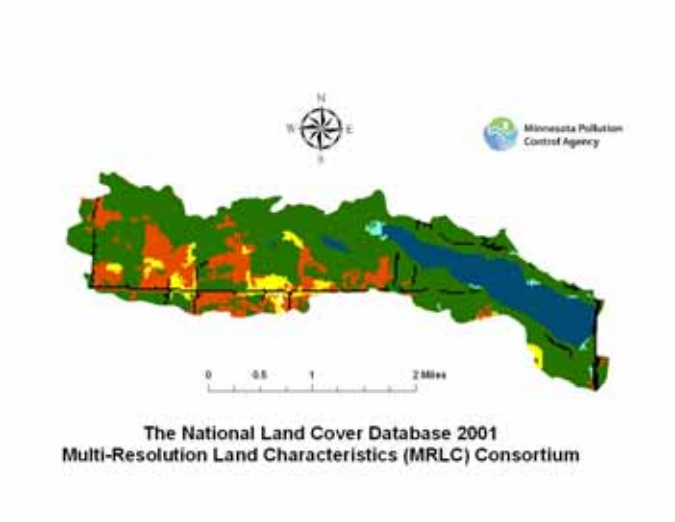


Table 1. land use compositions

Land use	Lake land use percentage	typical land use percentage
Developed	4	0 – 7
Cultivated (Ag)	5	<1
Pasture & Open	19	0 – 6
Forest	56	54 – 87
Water & Wetland	16	14 – 31
Feedlots (#)	0	

Minnesota Pollution Control Agency • 520 Lafayette Rd. N., St. Paul, MN 55155-4194 • www.pca.state.mn.us
651-296-6300 • 800-657-3864 • TTY 651-282-5332 or 800-657-3864 • Available in alternative formats

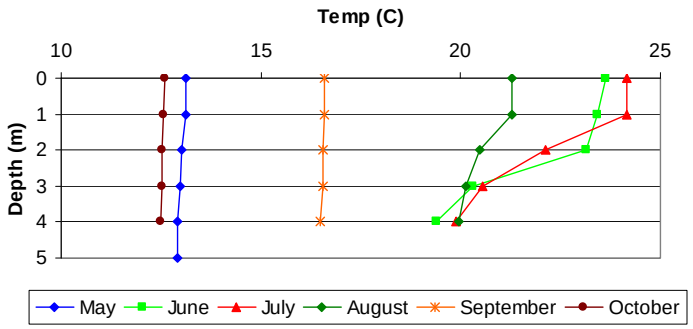
Table 2. Portage Lake 2008 as compared to typical range for NLF ecoregion reference lakes
MPCA data based on 2008 sample collections

Parameter	Portage Lake	NLF
Number of reference lakes	-	32
Total Phosphorus (µg/L)	60	14 – 27
Chlorophyll mean (µg/L)	21	4 – 10
Secchi Disk (feet) (meters)	3.0 0.9	8 -15 2.4 – 4.6
Total Kjeldahl Nitrogen (mg/L)	1.1	0.4 – 0.75
Alkalinity (mg/L)	155	40 – 140
Color (Pt-Co U)	5	10 – 35
pH (SU)	8.5	7.2 – 8.3
Chloride (mg/L)	6.8	0.6 – 1.2
Total Suspended Solids (mg/L)	10.8	<1 – 2
Total Suspended Inorganic Solids (mg/L)	4	<1 - 2
Conductivity (umhos/cm)	274	50 – 250
TN:TP ratio	18:1	25:1 - 35:1

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 2. Portage Lake 2008 temperature and dissolved oxygen profiles

Portage Lake 2008 Temperature Profile



Portage Lake 2008 Dissolved Oxygen Profile

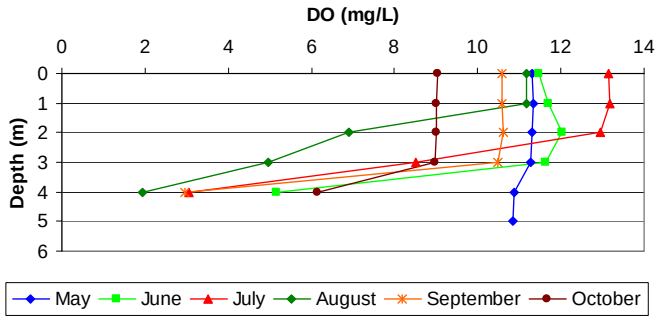


Figure 3. Portage Lake summer 2008 TP (surface and depth), Chl-a, and secchi

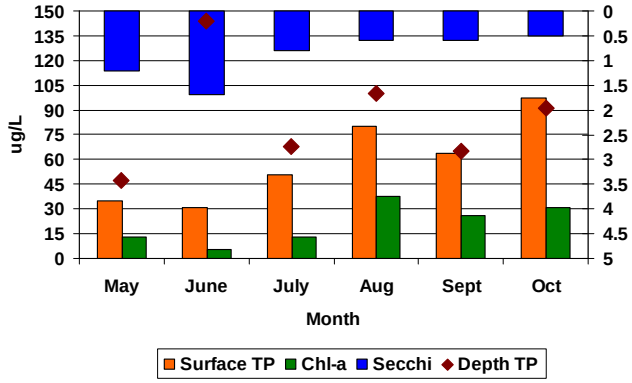


Figure 4. Portage Lake summer-mean secchi transparencies trends

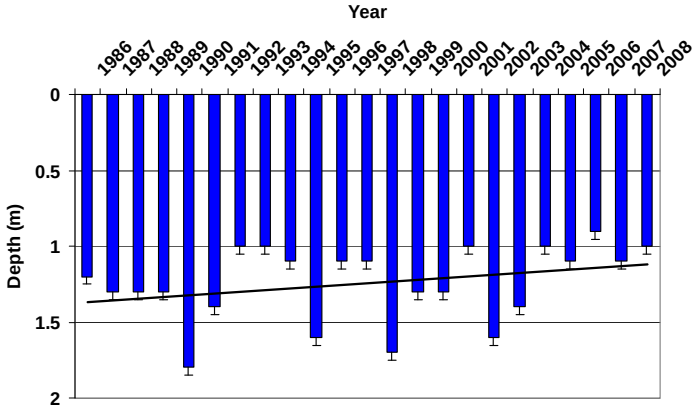
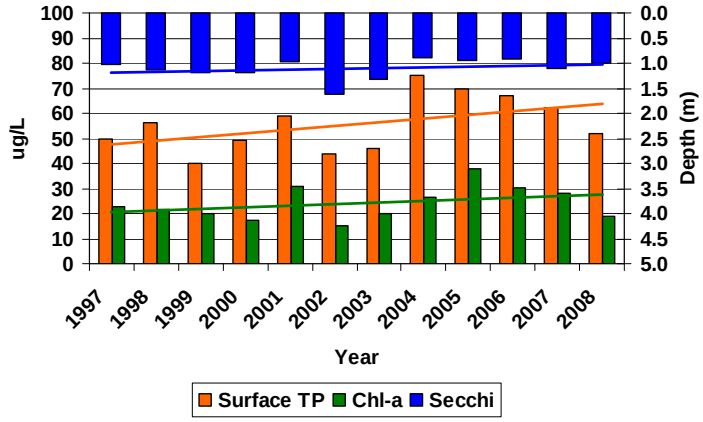


Figure 5. Portage Lake summer mean total phosphorus, Chl-a, and secchi trends



Watershed and water quality summary

Portage Lake is a shallow lake located just north of Park Rapids, Minnesota. The lake has a fair amount of development on the northern and southern shores. U.S. Highway 71 is next to the lake on the eastern shore. It has a moderate-sized watershed relative to its surface area (16:1 watershed: lake ratio). While forest is the dominant land use in the watershed (Figure 1), the percentage of agricultural uses (pasture and cultivated) is relatively high for a lake in the Northern Lakes and Forests (NLF) ecoregion (Table 1).

Portage Lake was sampled for chemistry six times during the summer of 2008 by Minnesota Pollution Control Agency (MPCA) staff. Secchi depth, temperature, and dissolved oxygen (DO) profiles were collected by both staff and volunteer monitor Marilyn Peterson. The lake was well-mixed in the spring and fall with a thermocline developing in June through August below 2 meters. The lake became stratified and developed a thermocline at the sample location at a depth of 10 to 15 feet from June through October (Figure 2). Fall mixing had been completed by September 16. In July and August, DO dropped below the 5 mg/L necessary to support game fish below a depth of approximately 3 meters.

The trophic status indicators and other water quality data for Portage Lake were much worse than the typical range for minimally impacted NLF lakes (Table 2). Total phosphorus (TP) and chlorophyll-a (Chl-*a*) are high at each sample event with the exception of 5.3 ug/L Chl-*a* in June. TP and Chl-*a* levels increased over the summer (Figure 3) similarly to shallow lakes in southern regions of Minnesota. Water clarity decreases and the lake becomes green in color as the summer progresses. The high TP concentrations are likely from higher than average TP loading from agricultural portions of the watershed and various internal recycling processes (e.g. curly-leaf senescence and low DO near the sediments when the lake is intermittently stratified).

With 22 years of data, Portage Lake has one of the best Citizen Lake Monitoring Program (CLMP) Secchi records of all the Sentinel Lakes. A decline in transparency is evident in this record, with transparencies declining from the 1.0-1.5 meter range for the period 1987-2002 to the 0.9-1.1 meter range from 2003-2007 (Figure 4). TP and Chl-*a* historical data is consistent with Secchi results (Figure 5). TP ranged from about 40-60 ug/L from 1997-2003 as compared to 50-75 ug/L in 2004-2007. The peak of 75 ug/L was 48 ug/L above the typical range for NLF lakes.

Portage Lake was assessed as non-supporting of aquatic recreational uses, because of elevated nutrients and was placed on Minnesota's 303(d) "Impaired Waters" list in 2006. This will require that a Total Maximum Daily Load study be conducted for the lake. The projected start date for that project will be 2014.

Fishery and aquatic plant survey summary

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	Trend
Walleye*	Y	Average	Small	Declining since 1997
Northern Pike	N	Average	Small	Little change until low in 2007
Largemouth bass	N	Average	Small	Normal fluctuations
Pumpkinseed	N	Low	Small	Normal fluctuations
Bluegill	N	Average	Small	Increase since 1997
Black crappie	N	Average	Average	Little change
Yellow perch	N	Very low	Small	No change since 1992
White sucker	N	Low	Large	Fluctuating, but low since 1992

*Management emphasis on this species

Table 4. Aquatic plant summary

Percent cover of aquatic plants ≤ 15ft deep	64%
Lake depth beyond which most vegetation disappeared	10.8 ft
Number of common species (i.e., ≥ 10% cover)	5
Frequency of *Chara*	44%
Non-native plant infestation	Curly-leaf pondweed (moderately) Pink-flowered waterlily (lightly)

Surveys in 2008 indicated that Portage Lake supports a fish community that is more diverse than other eutrophic lakes, but average when compared to mesotrophic lakes (the productivity class where Portage Lake might be under unimpaired conditions). The biotic integrity score for Portage Lake was 84, which is above average compared with other lakes of similar productivity. Portage is primarily managed for walleye through supplemental stocking of fry and fingerlings. Portage Lake infrequently experiences partial winterkills due to low levels of dissolved oxygen in winter. Those events can dramatically affect species' abundance and subsequent growth and condition. Perhaps as a combined result of poor habitat conditions, insufficient forage, and/or over harvest, the size-structure of most game fish populations in the lake is poor. Yellow perch have been particularly low in abundance, and black and brown bullheads have increased in abundance in recent years, presumably providing an alternative, but lower quality forage base.

In addition to eutrophication, Portage Lake has seen increasing cover and abundance of the non-native curly-leaf pondweed. Curly-leaf pondweed thrives in nutrient-rich conditions, and at some unknown threshold of nutrient levels it can become a self-sustaining, internal driver of poor water quality conditions. Chara, a planktonic algae-filtering benthic plant, is abundant in the lake, providing an important resilience mechanism that may be opposing internal and external forces pushing the lake towards an undesirable turbid-water regime. Restoring water quality in the lake will be critical to prevent the extirpation of blacknose shiners, banded killifish, and Iowa darter; four species currently present in Portage but intolerant of eutrophication.