

# METHODS FOR DETERMINING VEGETATION & FISH HEALTH

## Overview

Biodiversity is important in maintaining a healthy lake ecosystem. Biodiversity is considered to be a principle driver of ecosystem function and critical to ecosystem resilience and stability. A diverse ecosystem provides a number of services such as nutrient recycling, improved water quality, and increased recreational opportunities. Human disturbances often lead to a decrease in species diversity resulting in a weakening and/or loss of support to the ecosystem services provided by healthy biotic community.

The development of health assessment indices have provided a means in which natural resources managers can evaluate and monitor the health of a lake's biological community to help focus restoration and preservation efforts. The species that make up a community vary in their tolerance to human disturbances, therefore, as the episodic and cumulative disturbances occur to a system a decrease in species richness and a shift to species that are very tolerant to disturbance. Assessment tools developed by the MnDNR use these tolerance differences to relate the relative health of a given lake. Specifically, different sets of tools have been developed to relate the health of the fish community (Fish IBI) and another set of tools for the vegetation community (FQI).

## Floristic Quality Index

The Floristic Quality Index (FQI) is a vegetation health assessment tool that is based on a metric of species richness and a Coefficient of Conservatism (C), which is a score (0 -10) that relates a species site fidelity and tolerance to disturbance. Thus, species that have narrow habitat ranges and/or low tolerance to stress have high C-values. Therefore, the more species observed in a lake and the greater the C-values the greater the system health.

FQI assessment was designed to allow for health assessment from various community sampling techniques. Three different survey methods can be used: Minnesota Biological Survey methods, MnDNR transects or point intercept surveys (most common). All three methods have limitations yet all are relatively good at capturing and evaluating the health of the vegetation community.

Due to natural differences in species composition between deep and shallow lakes and ecoregions, two unique sets of thresholds were developed for FQI scoring for the North Central Hardwoods ecoregion (Table 1). The MnDNR has performed at least one survey and FQI assessment on all of the CRWD lakes presented in this appendix. Each lake report card shows the most recent FQI score for each lake and how it relates to the impairment thresholds presented in Table 1. It should be pointed out that the report cards only show FQI assessments conducted by the MnDNR, and therefore do not include any FQI assessments based on surveys performed by CRWD or other parties.

**Table 1: Minnesota Department of Natural Resources North Central Hardwoods ecoregion point intercept and transect sampling FQI impairment thresholds for deep and shallow lakes.**

Classification	Deep	Shallow
Exceptional	32.4	26.0
Impaired	18.6	17.7

## Fish Index of Biotic Integrity

The Fish IBI is comprised of multiple metrics that integrate aspects of species richness, community assemblage, and trophic composition. The combining of all individual metrics results in a single score that relates the relative health of the fish community with healthier systems having greater overall scores. Low scores are typically associated to imbalanced communities filled with tolerant species and high scores are typically received when communities are balanced and filled with intolerant species.

Fish IBI sampling includes trap and gill net surveys along with nearshore backpack electrofishing and beach seining. Together these various sampling gears are able to capture information from various habitats throughout a lake and also target all fish species.

Minnesota lakes that fall within lake classes 20 - 43 (Schupp lake classification) have been partitioned into four distinct Fish IBIs. Lake class groups are clustered together using eight lake attributes that account for the expected variability of a fish community due natural phenomenon (Table 2).

**Table 2: Minnesota Department of Natural Resources fish IBI tool classification.**

IBI Tool	Schupp's Lake Class	Lake Classification Group Description
2	22, 23, 24, 25, 27	Generally, deep lakes with high shoreline complexity (SDI) that are typically less than 80% littoral.
4	28, 29, 30, 31, 32	Compared to LCG 2 these lakes on average are smaller, have intermediate littoral area, have less shoreline complexity (typically rounder basins). They also typically have a low trophic status, low phosphorus levels, and clearer water compared to LCG2.
5	33, 34, 35, 36, 37, 39	Central and Northern MN lakes of shallow to moderate depths (mostly littoral). Generally, naturally eutrophic lakes with lots of vegetation and soft sediment.
7	38, 41, 42, 43	Shallowest lakes typically consisting of > 80% littoral area. Primarily in the southern half of the state. Excludes winterkill lakes (w/in 10 years) and riverine lakes

Due to these expected differences and unique IBIs each tool has its own set of thresholds to generalize the relative health of a lake's fish community (Table 3).

**Table 3: Minnesota Department of Natural Resources impairment thresholds for fish IBI tools.**

Classification	Tool 2	Tool 4	Tool 5	Tool 7
Exceptional	64	59	61	NA
Impaired	44	38	24	36

The MnDNR has performed Fish IBI assessments on six lakes throughout the CRWD: Cedar, Betsy, Louisa, Clearwater, School Section, and Bass. The lake report cards for each of these lakes present the Fish IBI score and how it relates to the impairment thresholds presented in Table 3.

More information on Fish IBI methodology can be found on the MnDNR's website:

[http://www.dnr.state.mn.us/waters/surfacewater\\_section/lake\\_ibi/index.html](http://www.dnr.state.mn.us/waters/surfacewater_section/lake_ibi/index.html)

# ALBION LAKE

## QUICK FACTS

**Littoral Area:** 251 acres

**Residence Time:** 1477 days

**Surface Area:** 251 acres

**Subwatershed Area:** 1,094 acres

**Maximum Depth:** 9 feet

**Upstream Waters:** None

### Common Fish

Common carp,  
black bullhead

### Dominant Vegetation

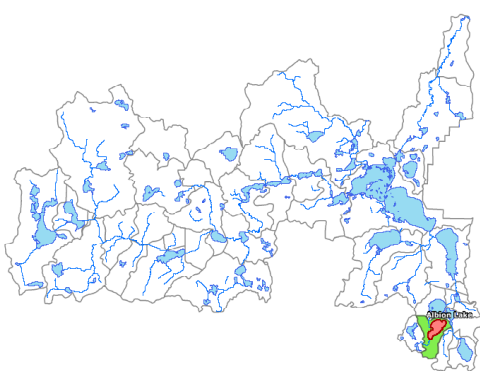
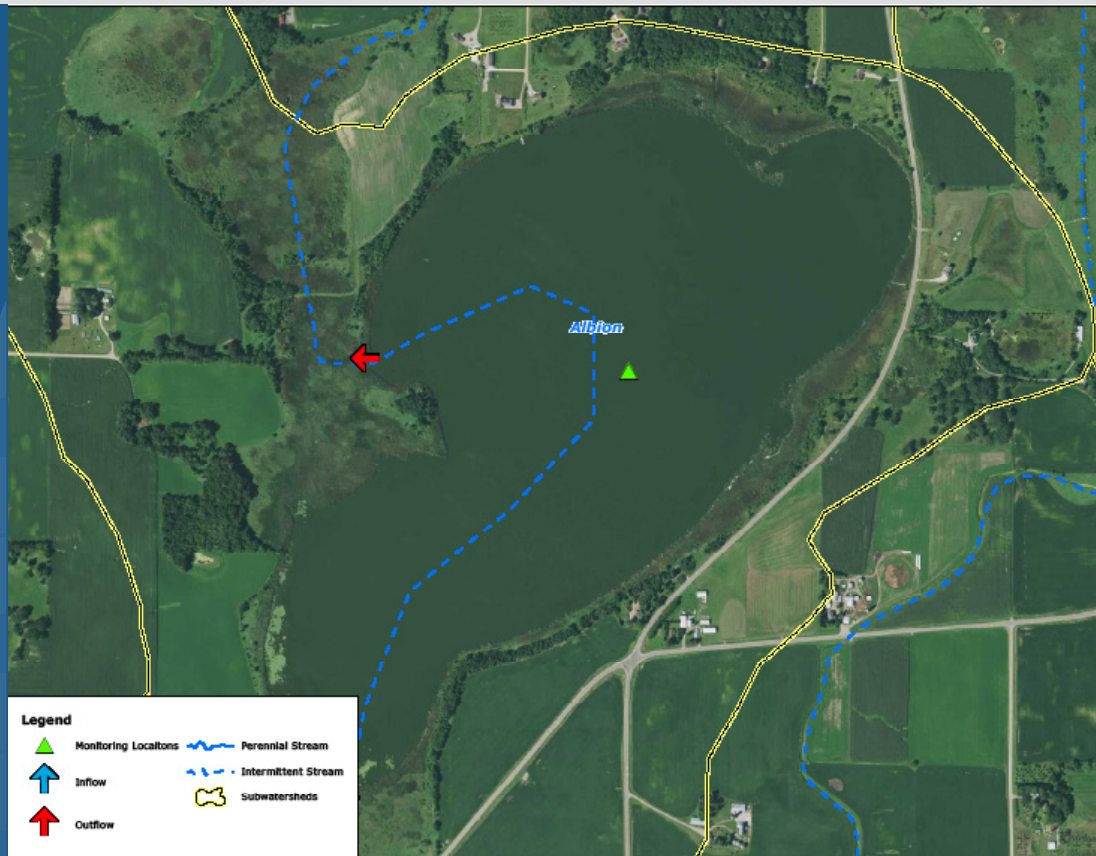
Sago pondweed

### Invasive Species

Curly-leaf  
pondweed

### Status

Impaired; TMDL  
Completed 2010



## TO DO LIST

- ▲ Rough fish management
- ▲ AIS management
- ▲ Manage upstream loads

Fish Health  
(IBI)

Impaired

Supporting

0

36

100

\*Fish IBI has not been assessed

12.7

Vegetation Health  
(FQI)

Impaired

Supporting

Exceptional

0

17.8

26

\*Sample date: 8/14/2015

Sediment P Release  
(mg/m<sup>2</sup>/day)

Low

Moderate

High

0

3.3

7.5

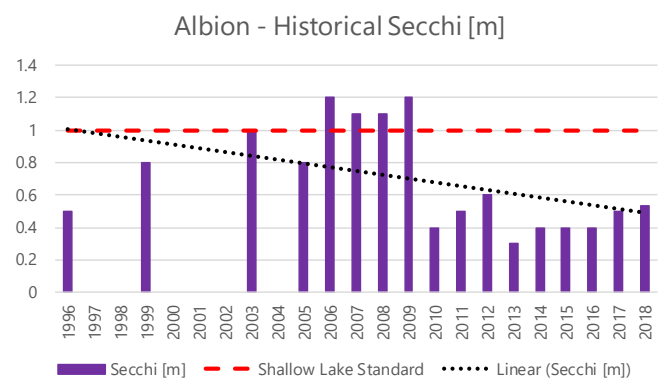
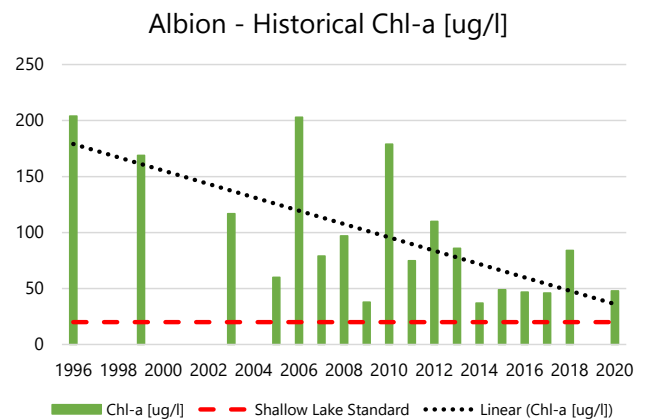
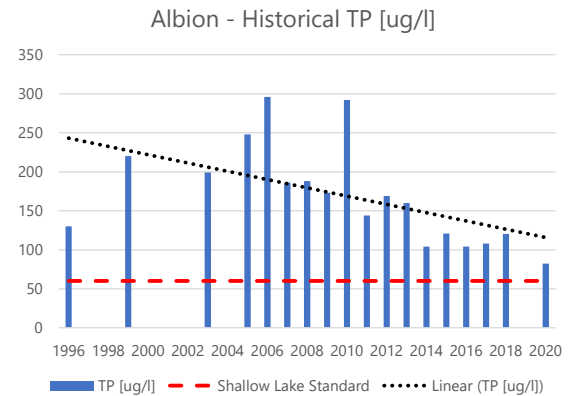
\*Sediment release rate has not been assessed

# ALBION LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# BASS LAKE

## QUICK FACTS

**Littoral Area:** 96 acres

**Surface Area:** 222 acres

**Subwatershed Area:** 796 acres

**Maximum Depth:** 34 feet

**Upstream Waters:** None

### Common Fish

Bluegill, Northern Pike, Yellow Bull-head, Largemouth Bass

### Dominant Vegetation

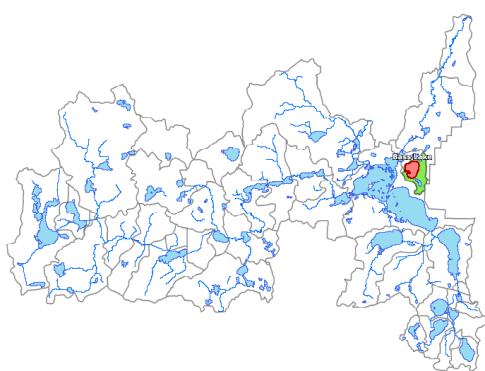
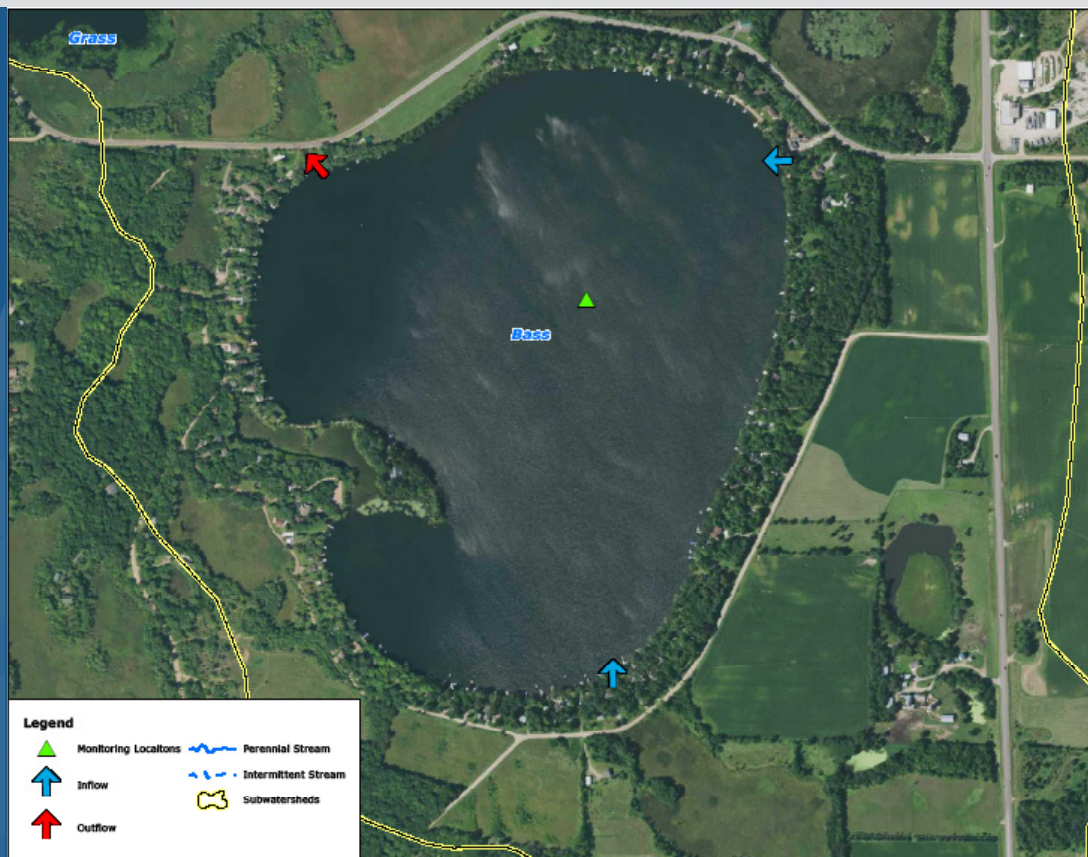
Currently obtaining vegetation info from DNR

### Invasive Species

Currently obtaining vegetation info from DNR

### Status

Not impaired



## TO DO LIST

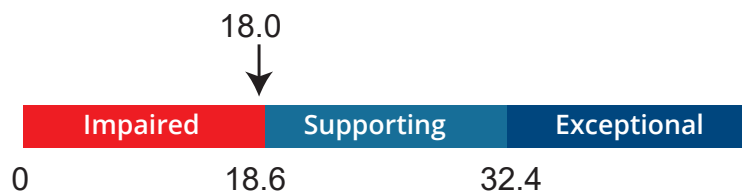
- ▲ Protect water quality
- ▲ Manage upstream loads
- ▲ AIS management and prevention

Fish Health (IBI)



\*Sample date: 8/09/2017

Vegetation Health (FQI)



\*Sample date: 8/10/2015

Sediment P Release (mg/m<sup>2</sup>/day)



\*Sediment release rate has not been assessed

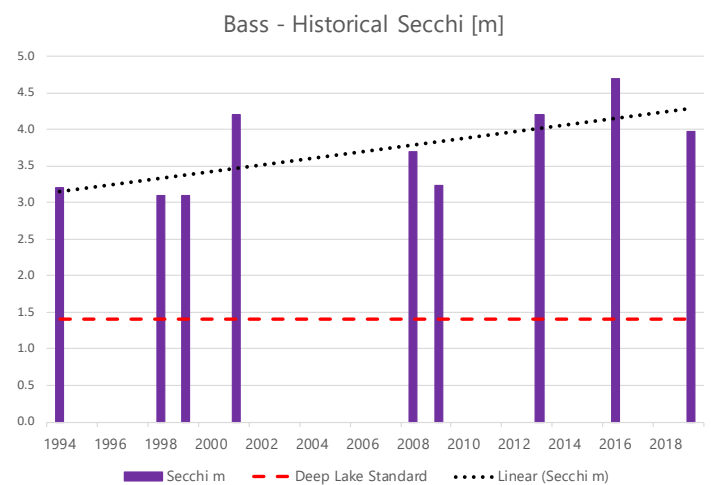
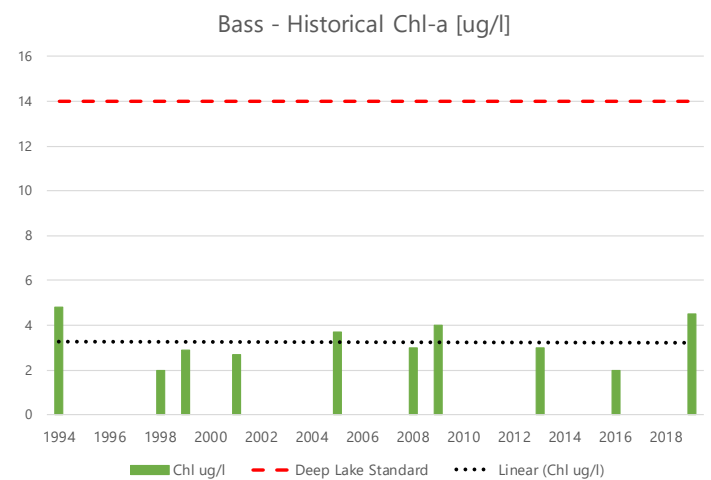
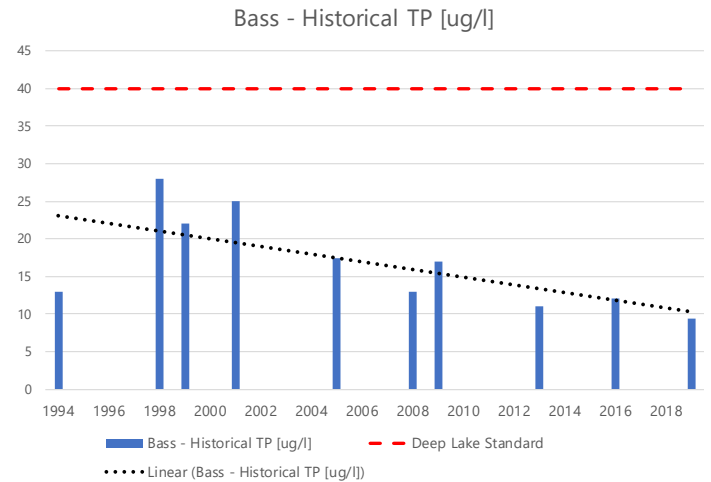


# BASS LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# CEDAR LAKE

## QUICK FACTS

**Littoral Area:** 315 acres

**Surface Area:** 790 acres

**Subwatershed Area:** 9,715 acres

**Maximum Depth:** 108 feet

**Upstream Waters:** Swartout, Albion, Henshaw

### Common Fish

Bluegill, Northern Pike, Walleye, Largemouth Bass

### Dominant Vegetation

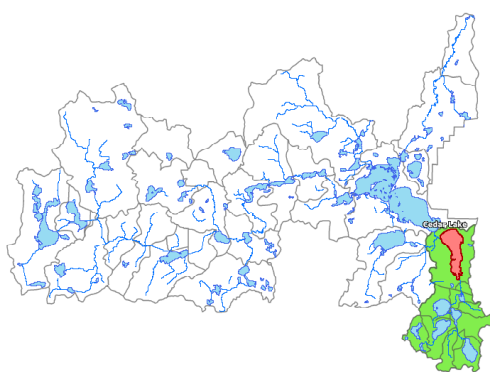
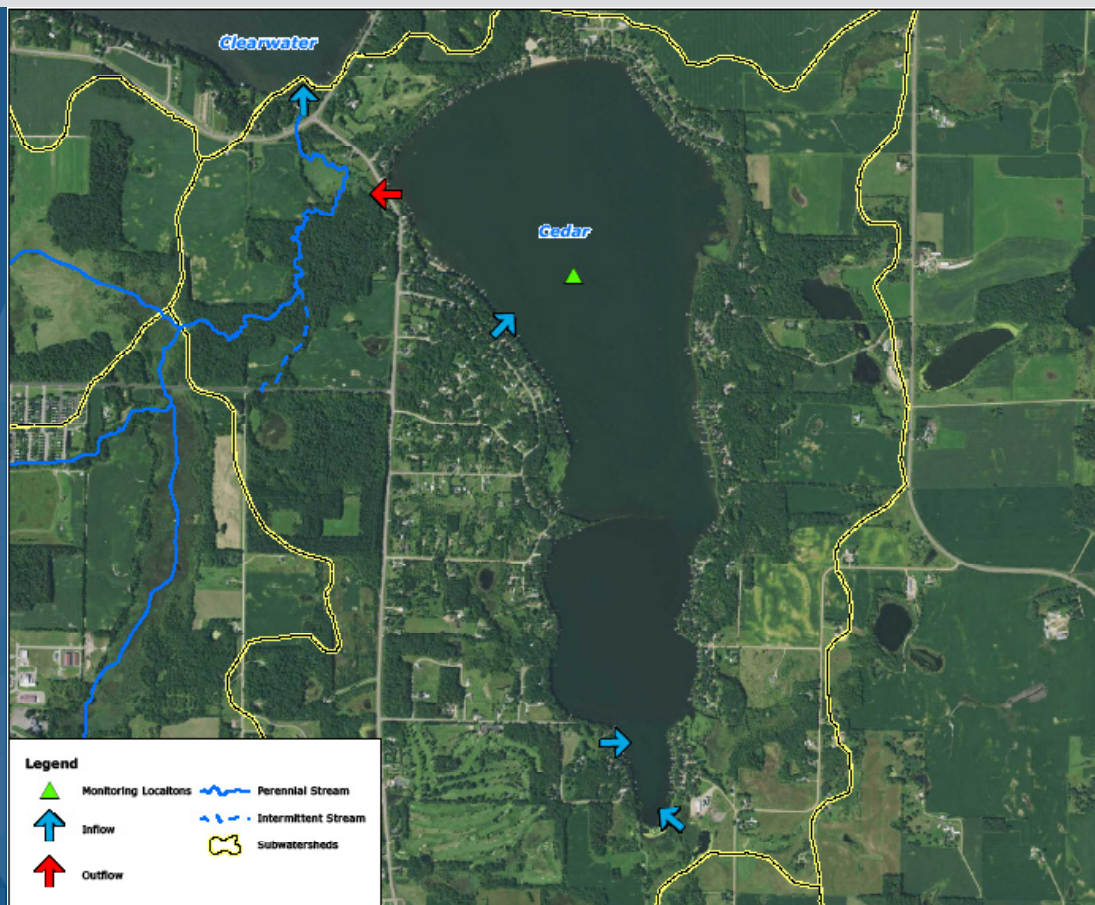
Coontail, northern water milfoil, chara

### Invasive Species

Eurasian water milfoil, curly-leaf pondweed

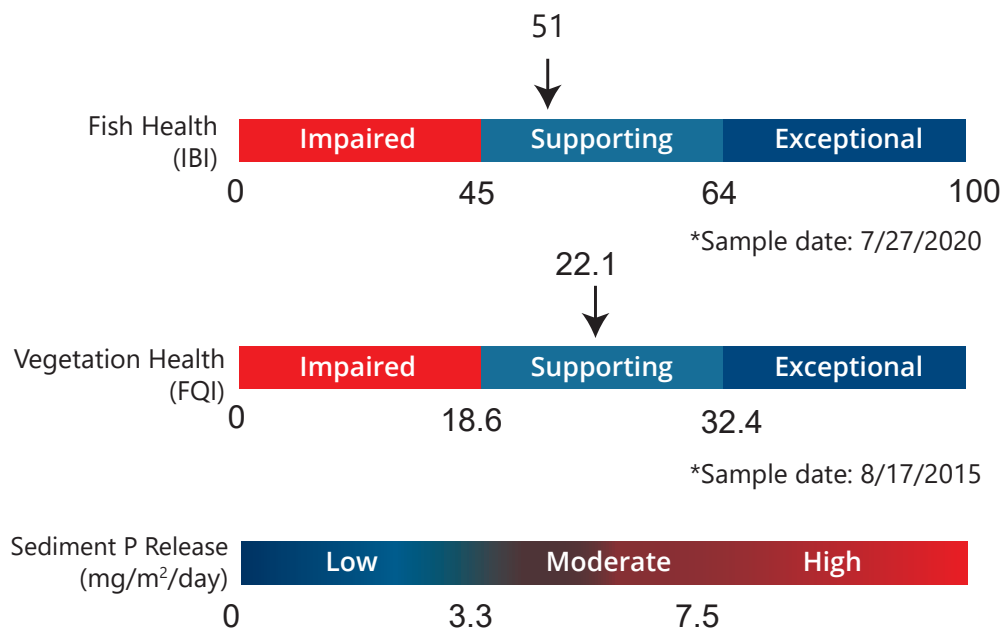
### Status

Not Impaired



## TO DO LIST

- ▲ AIS management
- ▲ Rough fish management in upstream lakes
- ▲ Manage upstream soluble P loads

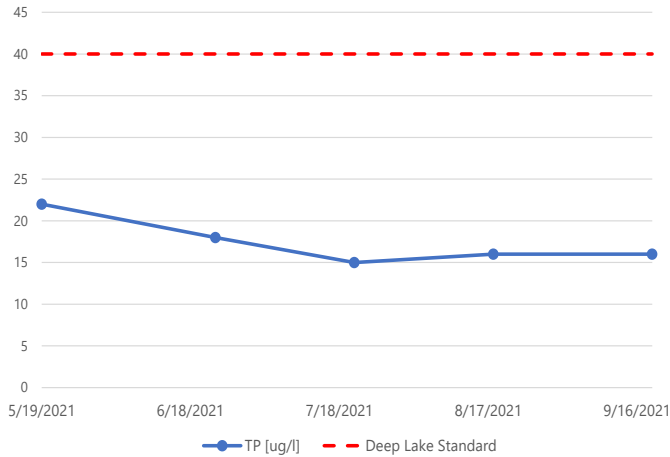


\*Sediment release rate has not been assessed

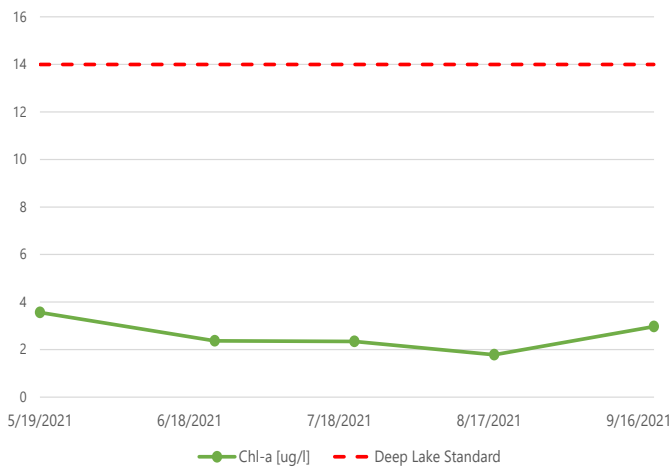
# CEDAR LAKE

## 2021 Water Quality

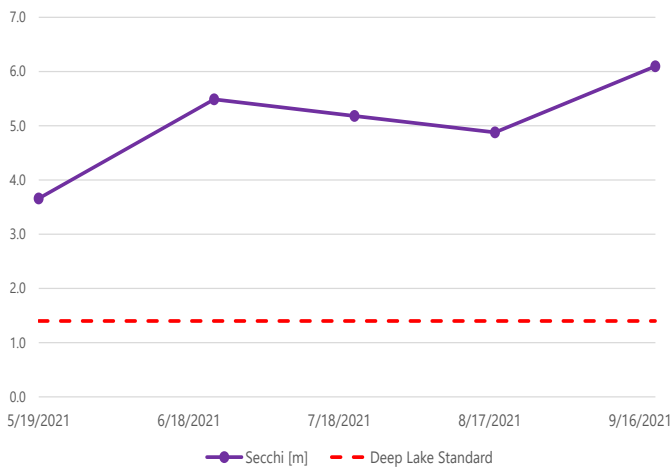
Cedar - 2021 TP[ug/l]



Cedar - 2021 Chl-a [ug/l]

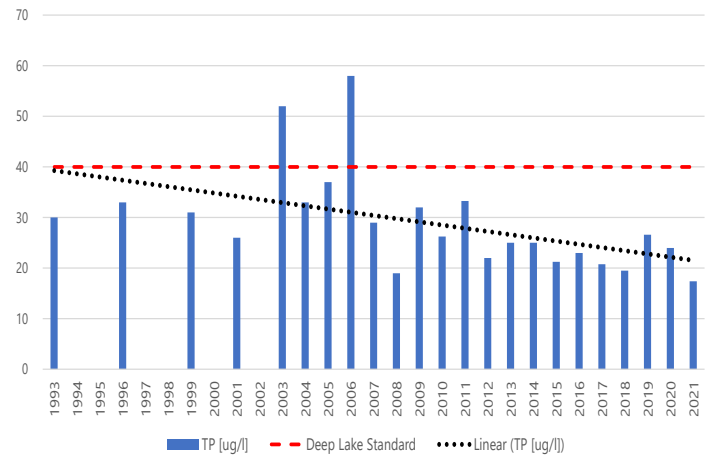


Cedar - 2021 Secchi Depth [m]

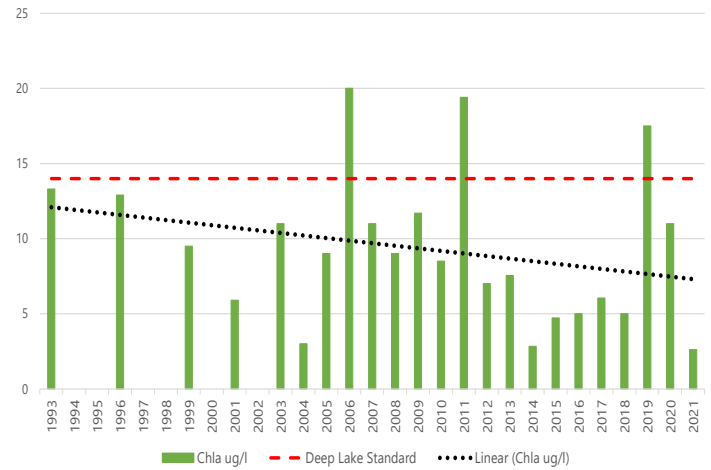


## Historic Water Quality

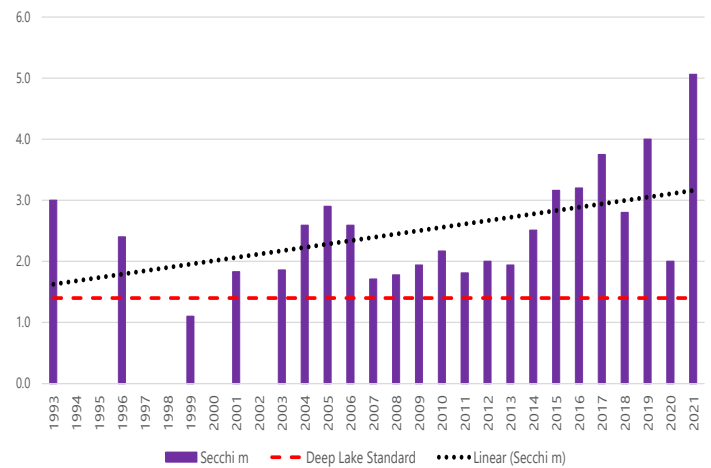
Cedar - Historical TP [ug/l]



Cedar - Historical Chl-a [ug/l]



Cedar - Historical Secchi Depth [m]



# CLEAR LAKE

## QUICK FACTS

**Littoral Area:** 441 acres

**Residence Time:** 686 days

**Surface Area:** 529 acres

**Subwatershed Area:** 6,801 acres

**Maximum Depth:** 18 feet

**Upstream Waters:** None

### Common Fish

Northern Pike,  
Black Crappie,  
Walleye, Bluegill

### Dominant Vegetation

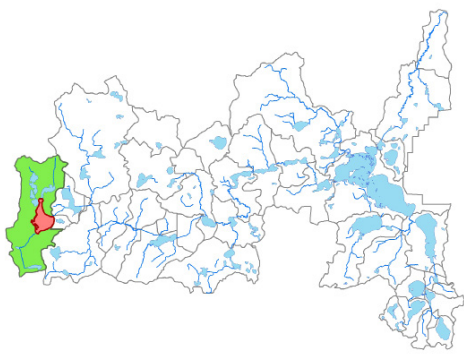
Coontail

### Invasive Species

Eurasian water  
milfoil, Curly-leaf  
pondweed

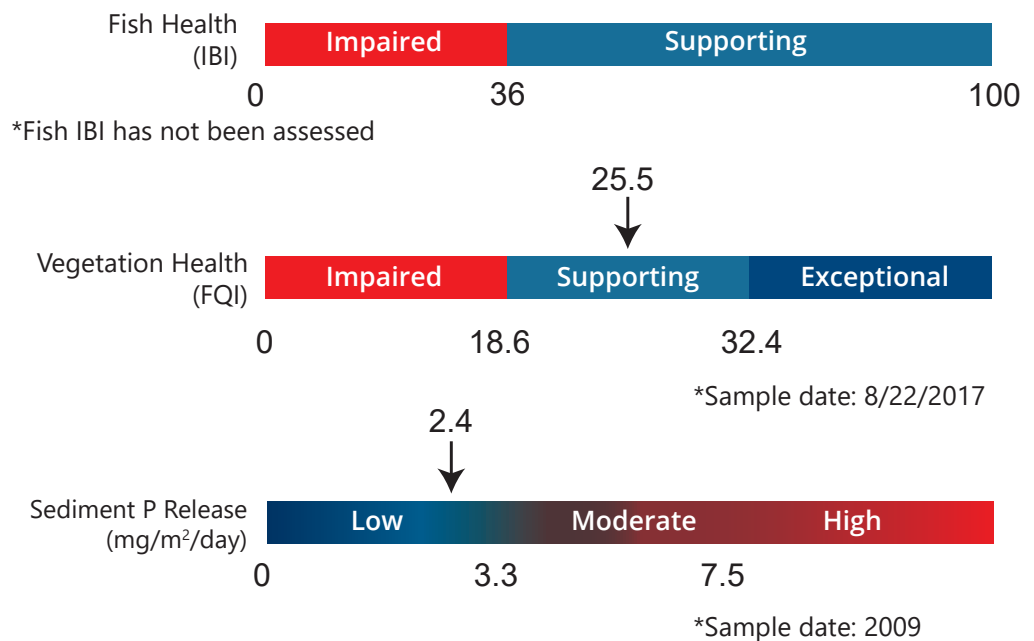
### Status

Impaired, TMDL  
completed in 2009



## TO DO LIST

- ▲ AIS Management
- ▲ Manage rough fish
- ▲ Manage upstream soluble P loads

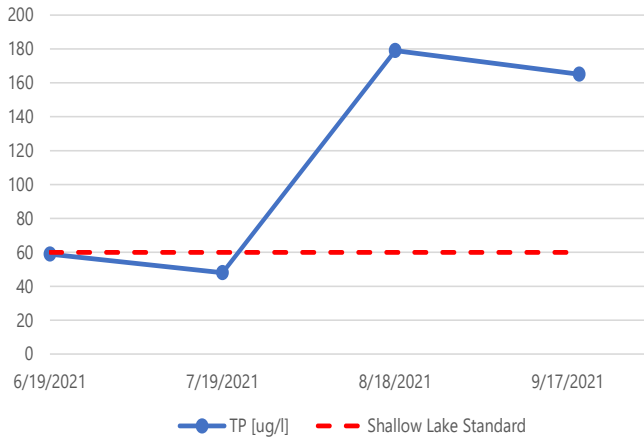




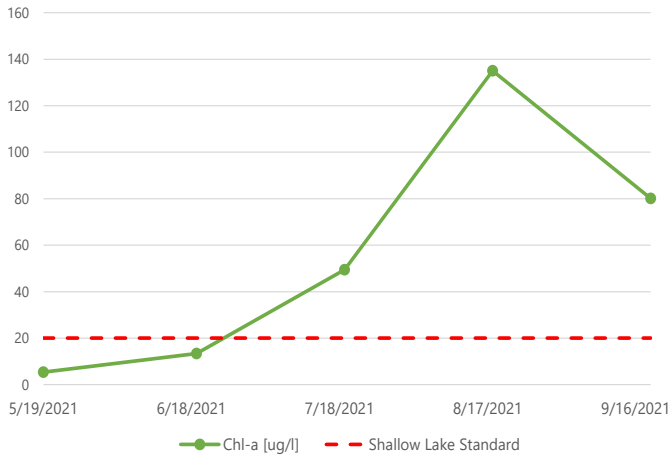
# CLEAR LAKE

## 2021 Water Quality

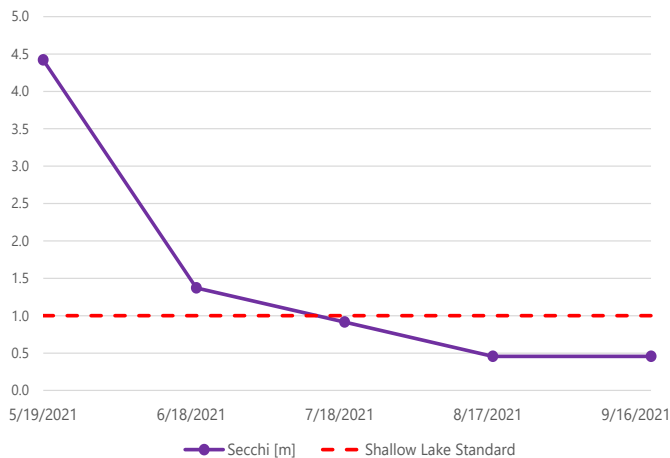
Clear - 2021 TP [ug/l]



Clear - 2021 Chl-a [ug/l]

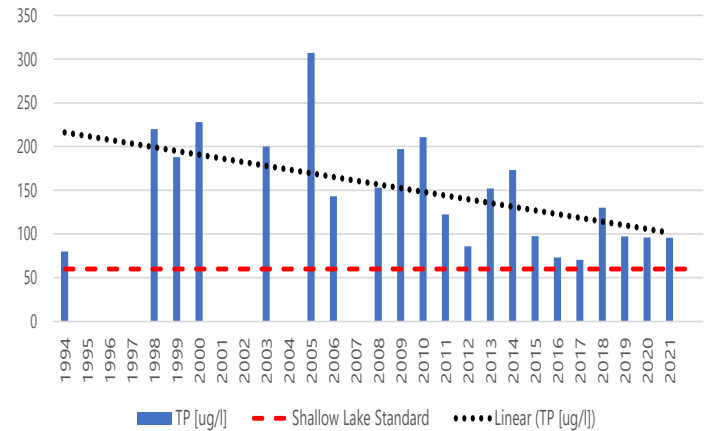


Clear - 2021 Secchi Depth [m]

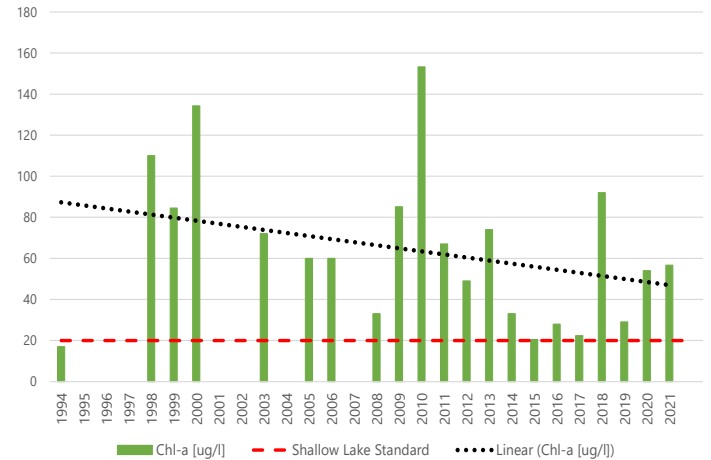


## Historic Water Quality

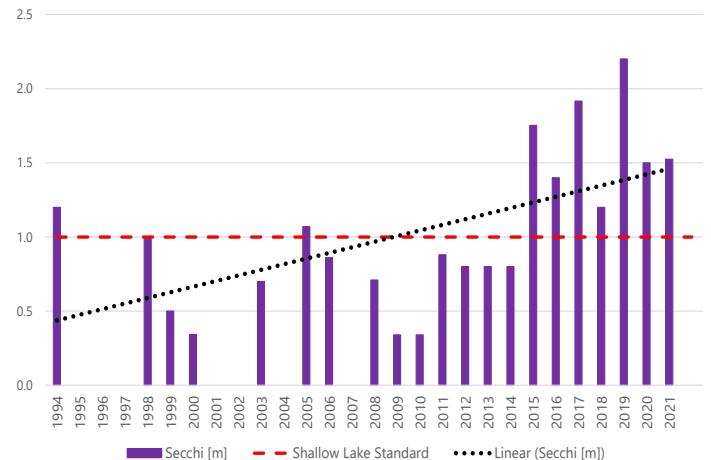
Clear - Historical TP [ug/l]



Clear - Historical Chl-a [ug/l]



Clear - Historical Secchi Depth [m]



# CLEARWATER LAKE

## QUICK FACTS

**Littoral Area:** 1,596 acres

**Surface Area:** 3,158 acres

**Subwatershed Area:** 100,232 acres

**Maximum Depth:** 73 feet

**Upstream Waters:** Clearwater River, Augusta, Cedar, Otter, and Pleasant Lake

### Common Fish

Bluegill, Northern Pike, Walleye, Largemouth Bass, Yellow Bullhead

### Dominant Vegetation

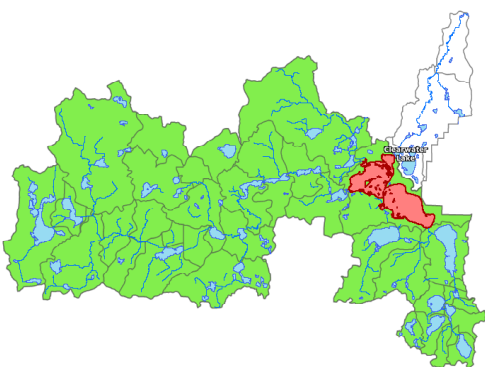
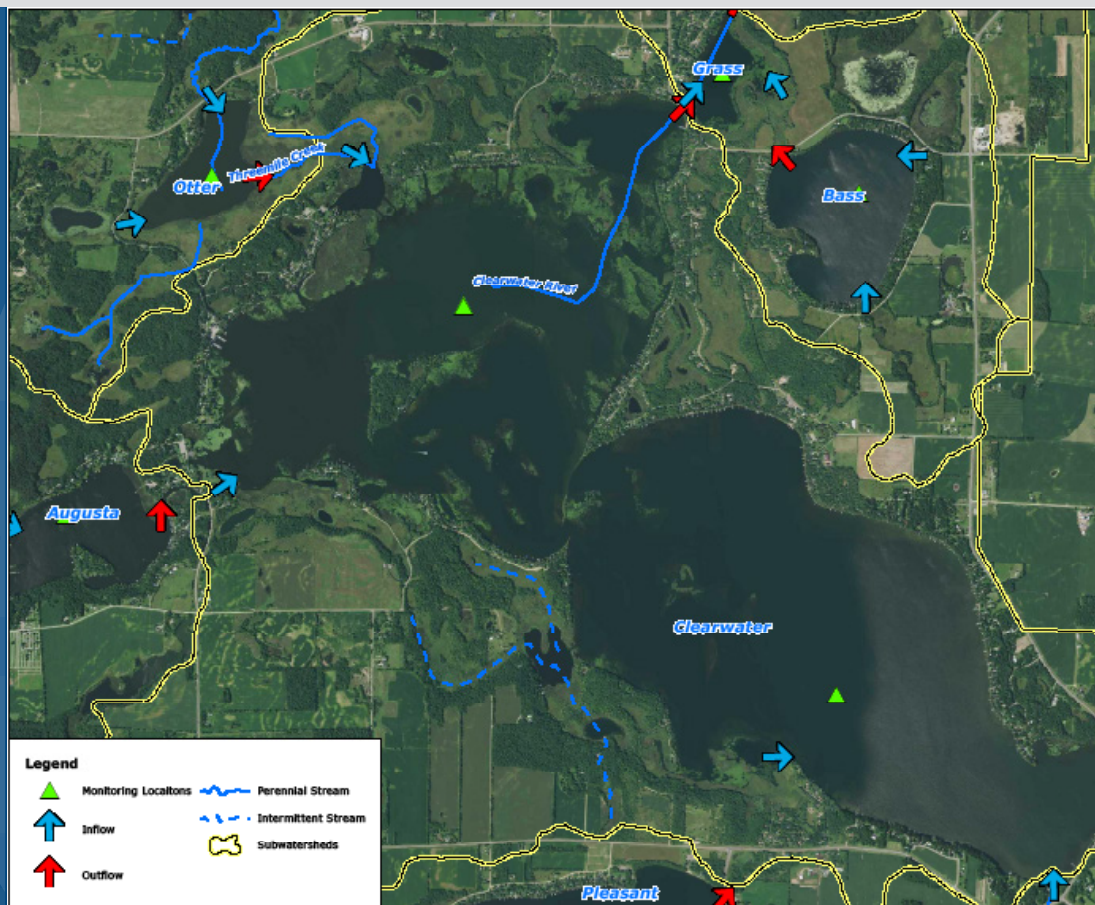
Obtaining Recent Survey from DNR

### Invasive Species

Eurasian water milfoil, curly-leaf pondweed, zebra mussels

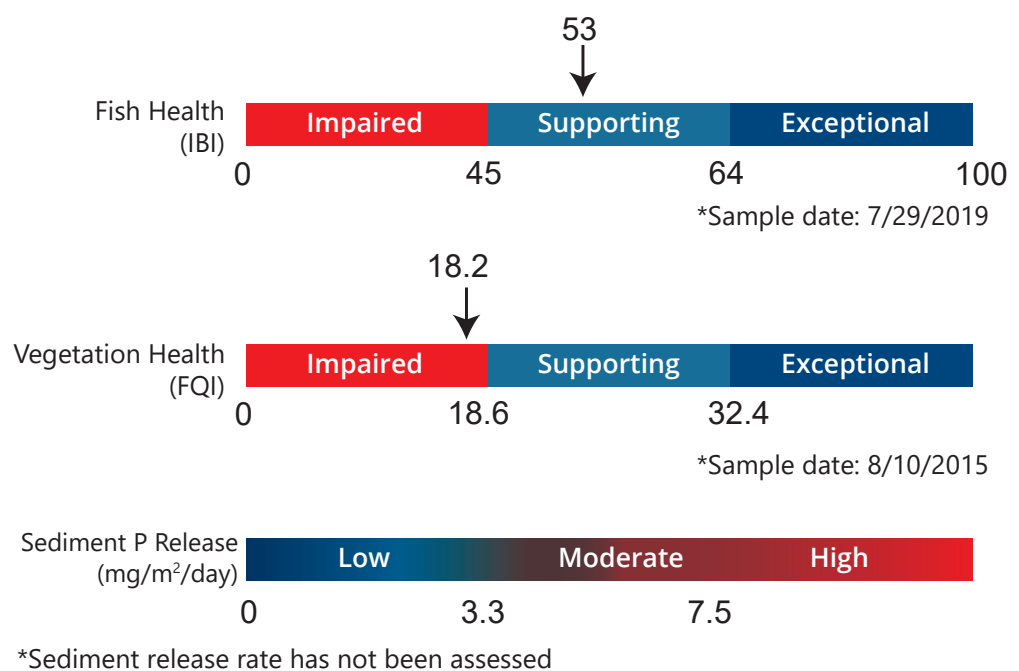
### Status

Not Impaired



## TO DO LIST

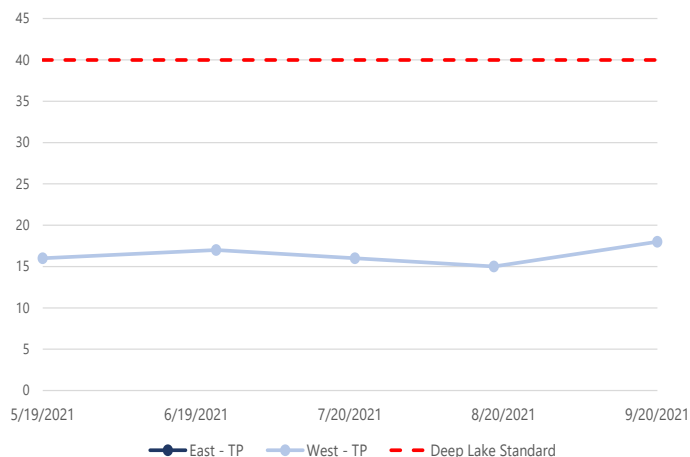
- ▲ Protect water quality
- ▲ Manage upstream loads
- ▲ AIS management



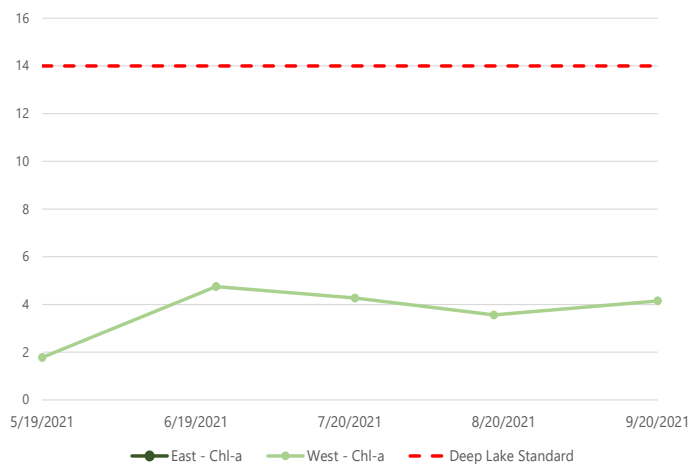
# CLEARWATER LAKE

## 2021 Water Quality

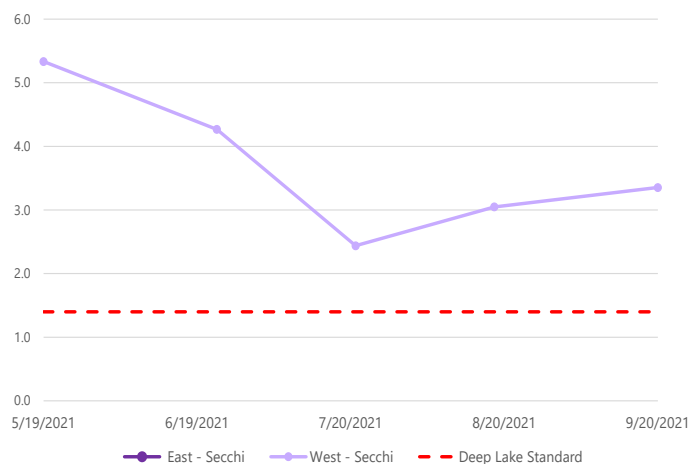
Clearwater - 2021 TP [ug/l]



Clearwater - 2021 Chl-a [ug/l]

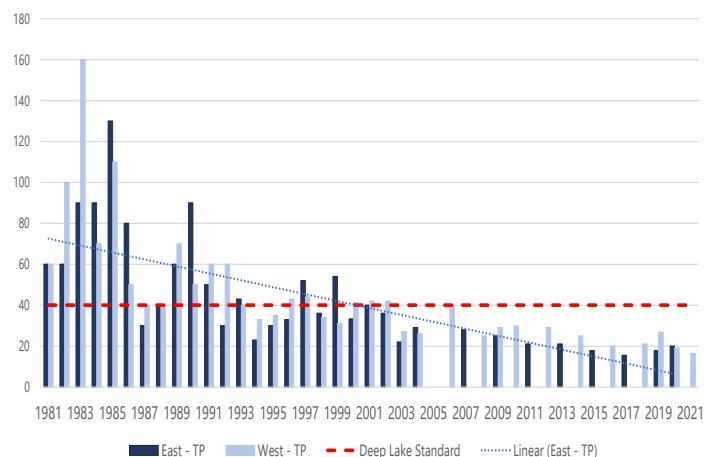


Clearwater - 2021 Secchi Depth [m]

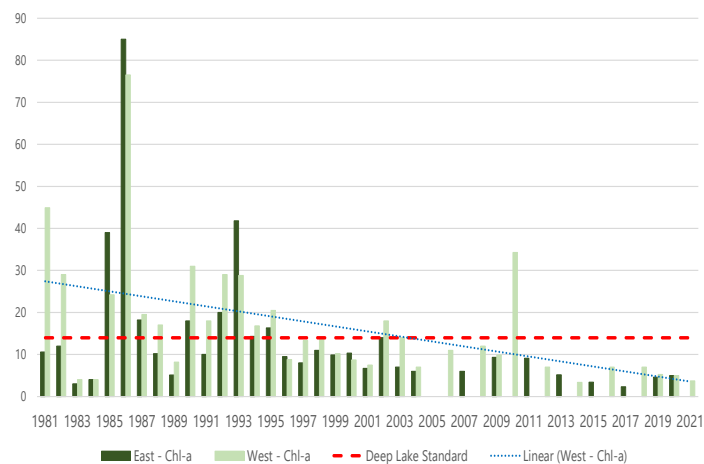


## Historic Water Quality

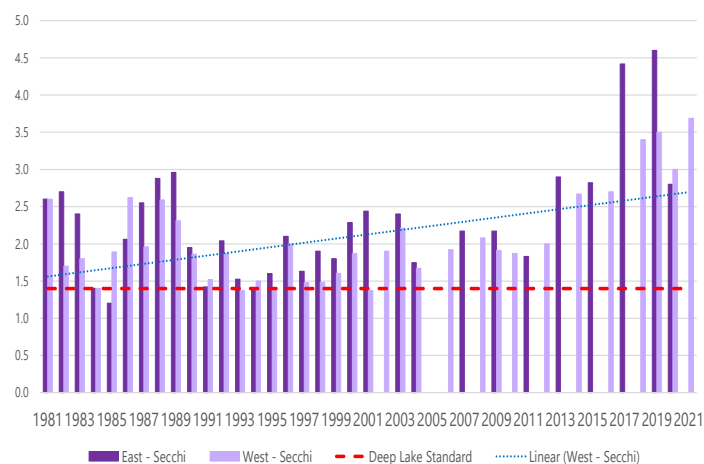
Clearwater - Historical TP [ug/l]



Clearwater - Historical Chl-a [ug/l]



Clearwater - Historical Secchi [m]



# GRASS LAKE

## QUICK FACTS

**Littoral Area:** 62 acres

**Surface Area:** 71 acres

**Subwatershed Area:** 101,508 acres

**Maximum Depth:** 35 feet

**Upstream Waters:** Clearwater Lake, Clearwater River, Bass Lake

### Common Fish

Bluegill,  
Northern Pike,  
Yellow Bullhead

### Dominant Vegetation

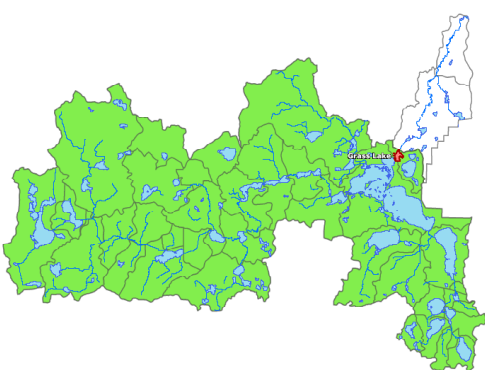
No Recent Survey

### Invasive Species

Zebra Mussels

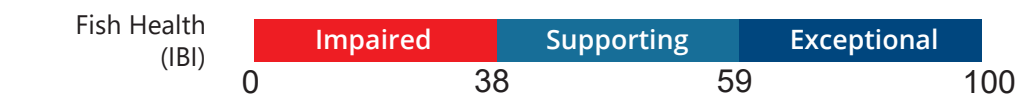
### Status

Not Impaired

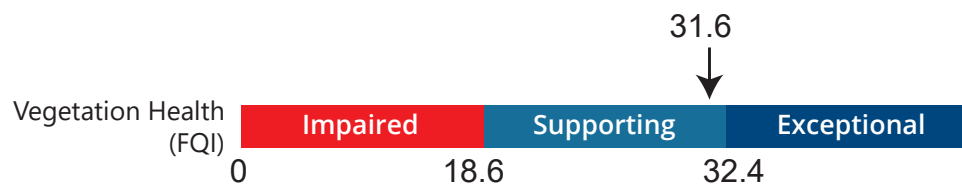


## TO DO LIST

- Protect water quality
- Manage upstream loads
- AIS Management



\*Fish IBI has not been assessed



\*Sample date: 8/01/2005



\*Sediment release rate has not been assessed

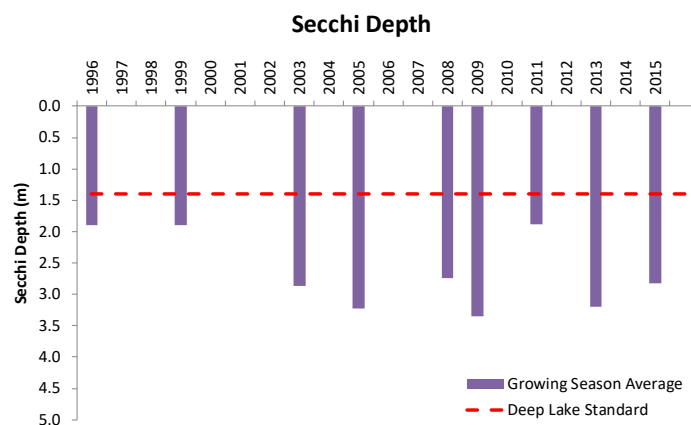
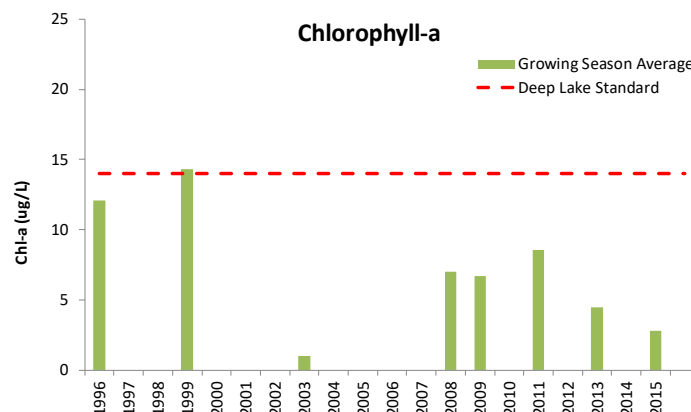
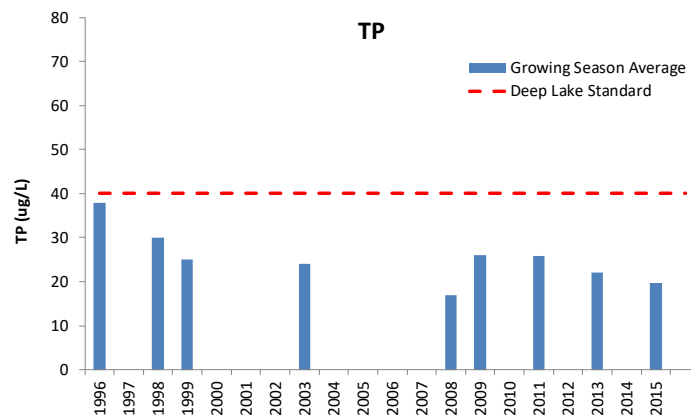


# GRASS LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# HENSHAW LAKE

## QUICK FACTS

**Littoral Area:** 271 acres

**Residence Time:** 1,697 days

**Surface Area:** 272 acres

**Subwatershed Area:** 903 acres

**Maximum Depth:** 8 feet

**Upstream Waters:** None

### Common Fish

Black Bullhead,  
Common Carp

### Dominant Vegetation

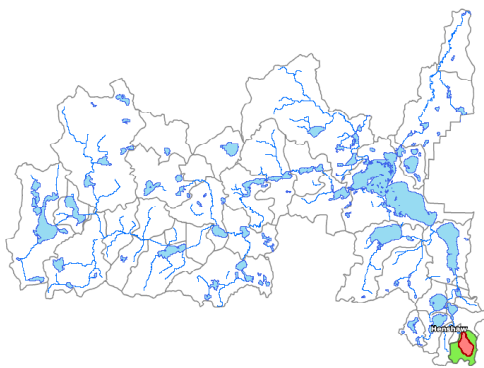
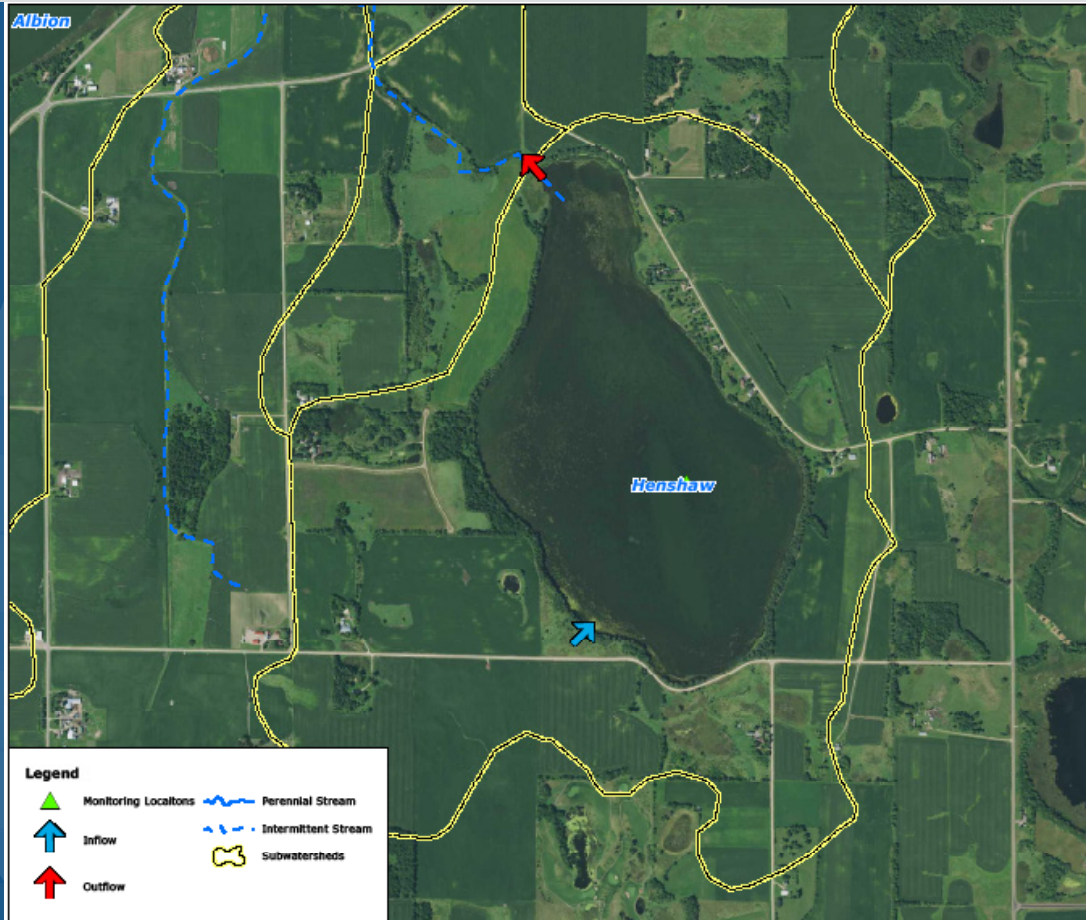
Sago pondweed,  
Coontail, Bushy  
pondweed

### Invasive Species

Curly-leaf  
pondweed

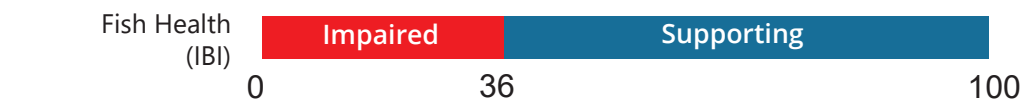
### Status

Impaired, TMDL  
Completed 2010

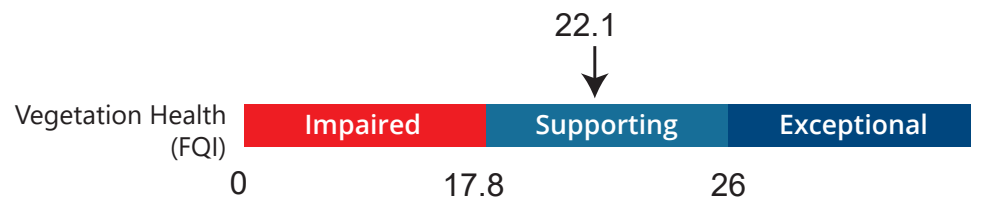


## TO DO LIST

- ▲ Rough fish management
- ▲ AIS management
- ▲ Internal load management study
- ▲ Manage upstream load



\*Fish IBI has not been assessed



\*Sample date: 8/26/2014



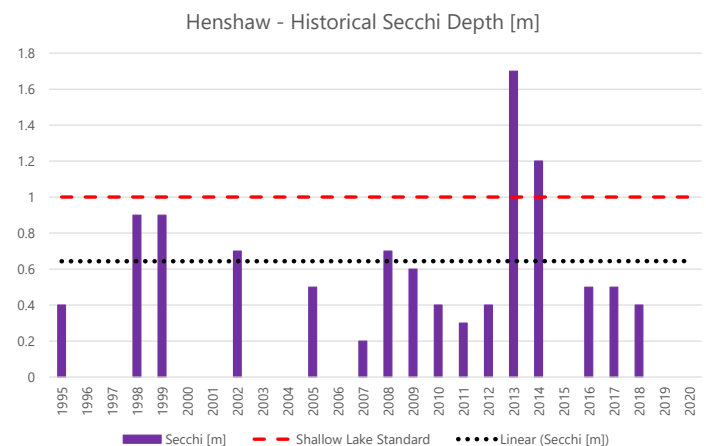
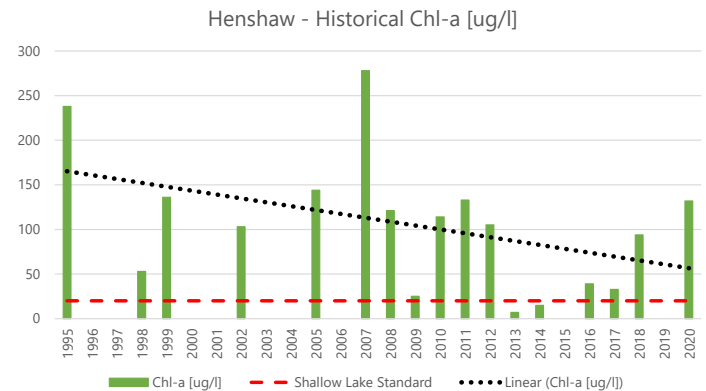
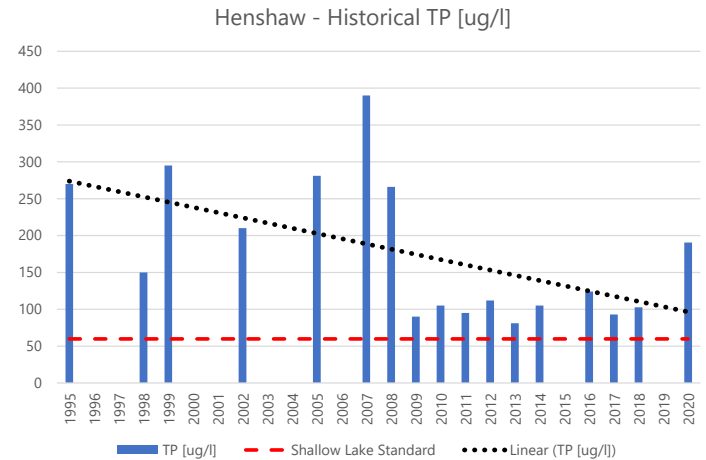
\*Sediment release rate has not been assessed

# HENSHAW LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# LITTLE MUD LAKE

## QUICK FACTS

**Littoral Area:** 25.1 acres

**Residence Time:** 1299 days

**Surface Area:** 37.4 acres

**Subwatershed Area:** 294 acres

**Maximum Depth:** 42 feet

**Upstream Waters:** None

**Common Fish**

No Recent Survey

**Dominant Vegetation**

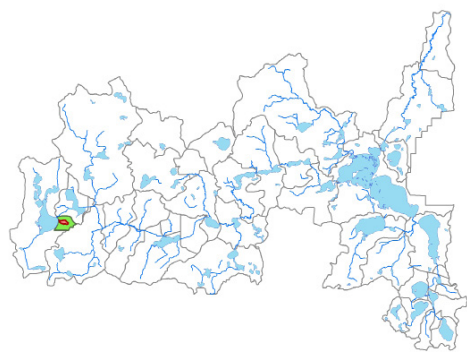
Coontail

**Invasive Species**

Eurasian watermilfoil

**Status**

Not Impaired



## TO DO LIST

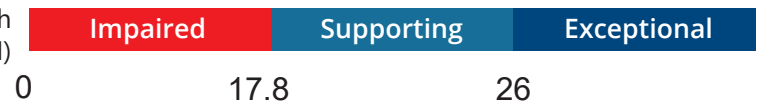
- ▲ Rough fish management
- ▲ AIS management
- ▲ Internal load management study
- ▲ Manage upstream load

Fish Health  
(IBI)



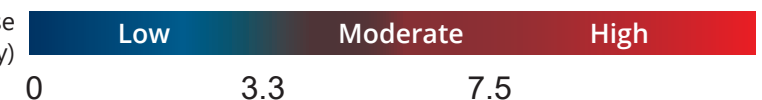
\*Fish IBI has not been assessed

Vegetation Health  
(FQI)



\*Vegetation FQI has not been assessed

Sediment P Release  
(mg/m<sup>2</sup>/day)



\*Sediment release rate has not been assessed

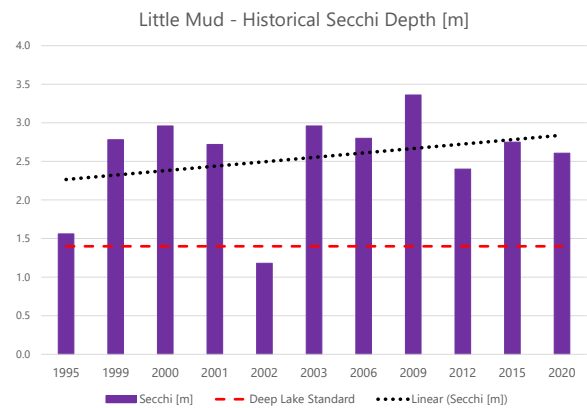
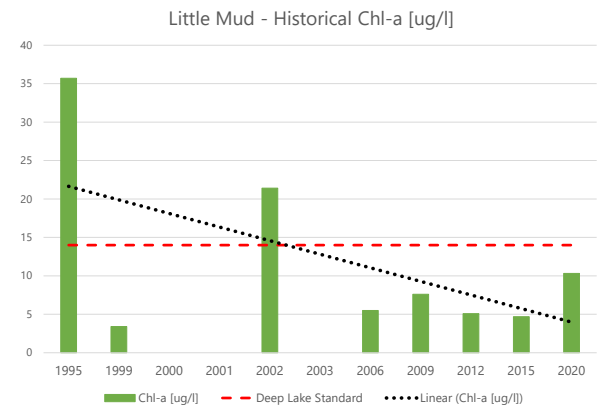
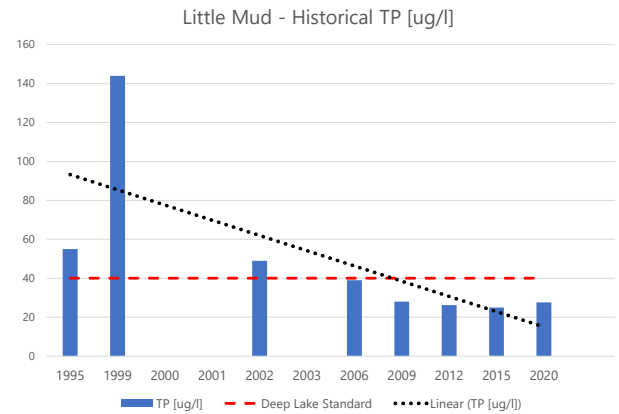


# LITTLE MUD LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# LAKE AUGUSTA

## QUICK FACTS

**Littoral Area:** 65 acres

**Residence Time:** 55 days

**Surface Area:** 187 acres

**Subwatershed Area:** 62,936 acres

**Maximum Depth:** 82 feet

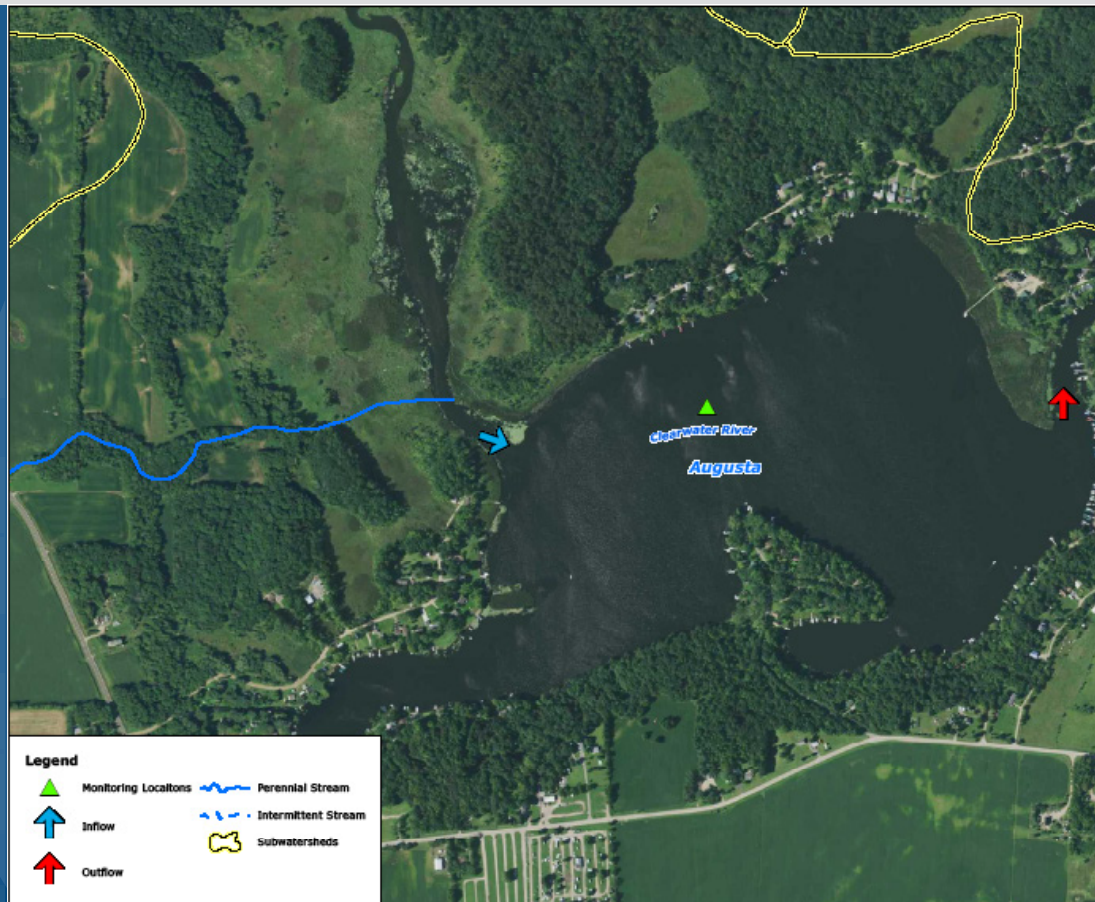
**Upstream Waters:** Caroline, Louisa, Marie

**Common Fish** Bluegill, Northern Pike, Crappie, Yellow Bullhead, Common Carp

**Dominant Vegetation** No species was dominant (>50% occurrence)

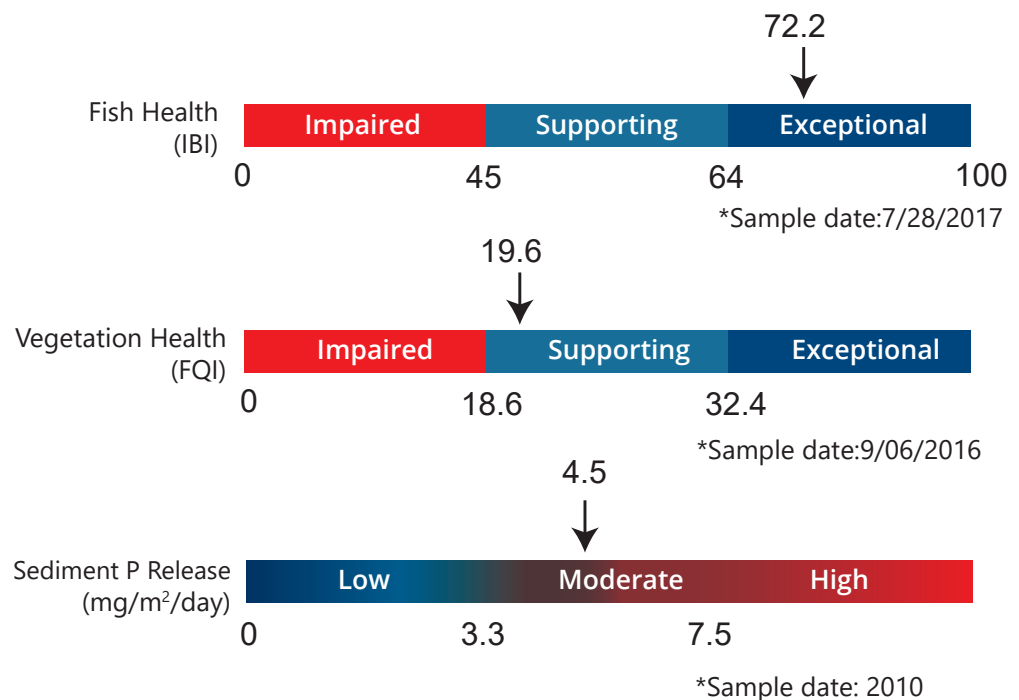
**Invasive Species** Eurasian water milfoil, curly-leaf pondweed, zebra mussels

**Status** Impaired, TMDL completed in 2010



## TO DO LIST

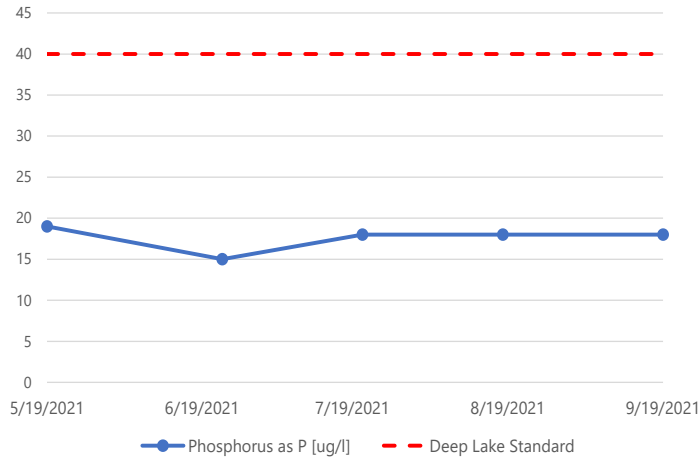
- Manage upstream loads
- AIS management



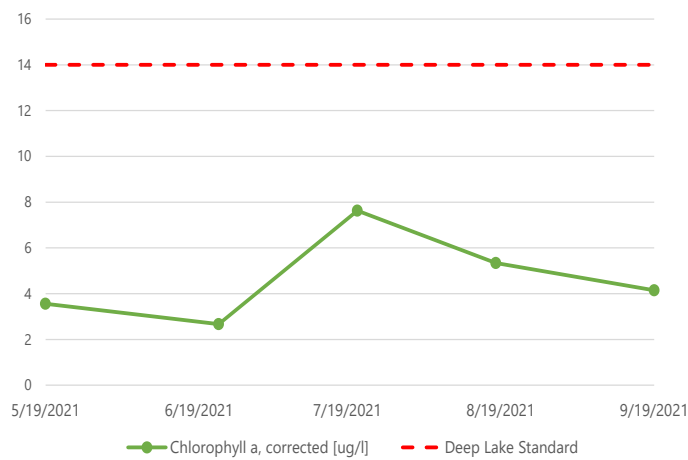
# LAKE AUGUSTA

## 2021 Water Quality

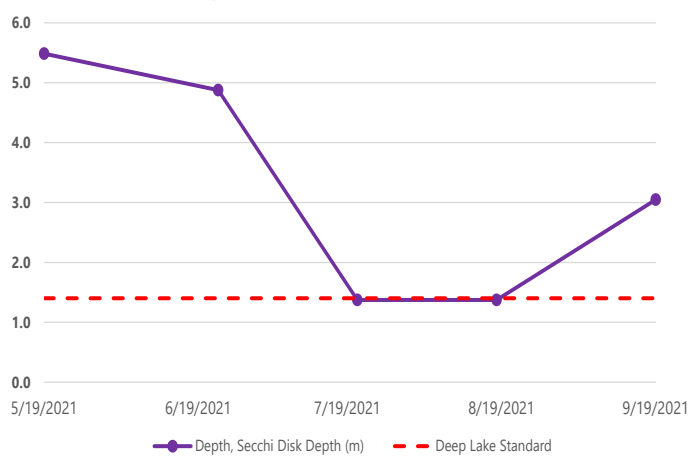
Augusta - 2021 TP [ug/L]



Augusta - 2021 Chl-a [ug/L]

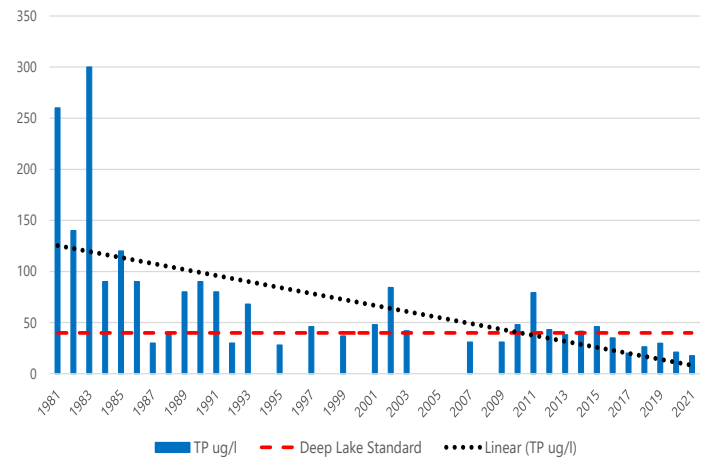


Augusta - 2021 Secchi Depth [m]

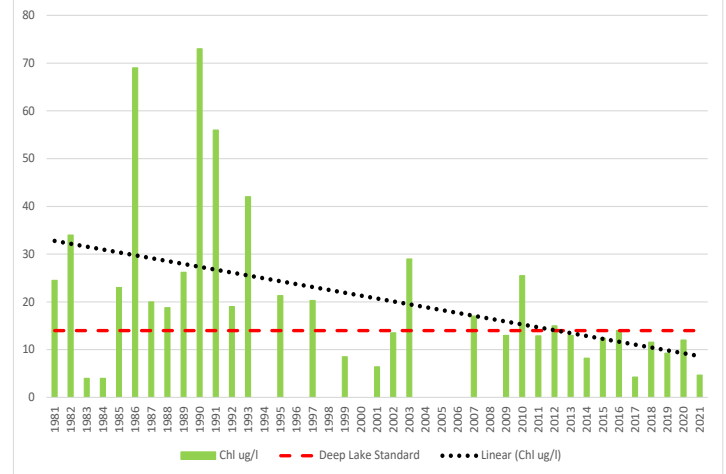


## Historic Water Quality

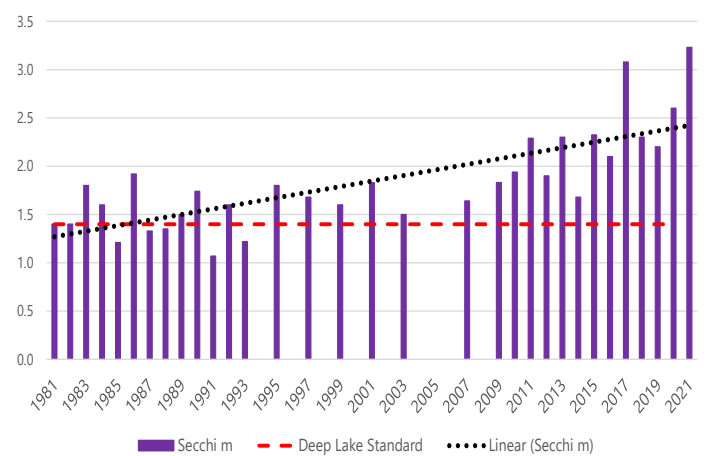
Augusta - Historical TP [ug/L]



Augusta - Historical Chl-a [ug/L]



Augusta - Historical Secchi [m]



# LAKE BETSY

## QUICK FACTS

**Littoral Area:** 90 acres

**Residence Time:** 33 days

**Surface Area:** 154 acres

**Subwatershed Area:** 43,789 acres

**Maximum Depth:** 29 feet

**Upstream Waters:** Clearwater River

### Common Fish

Channel Catfish,  
Northern Pike, Black  
Crappie, Bluegill,  
Common Carp

### Dominant Vegetation

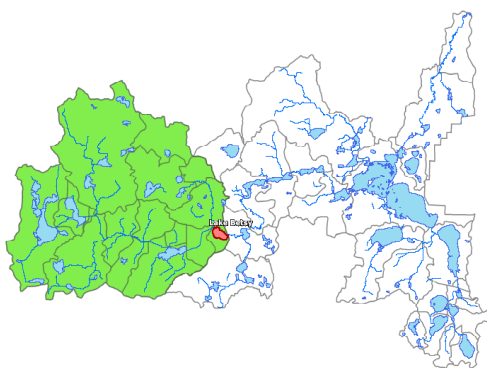
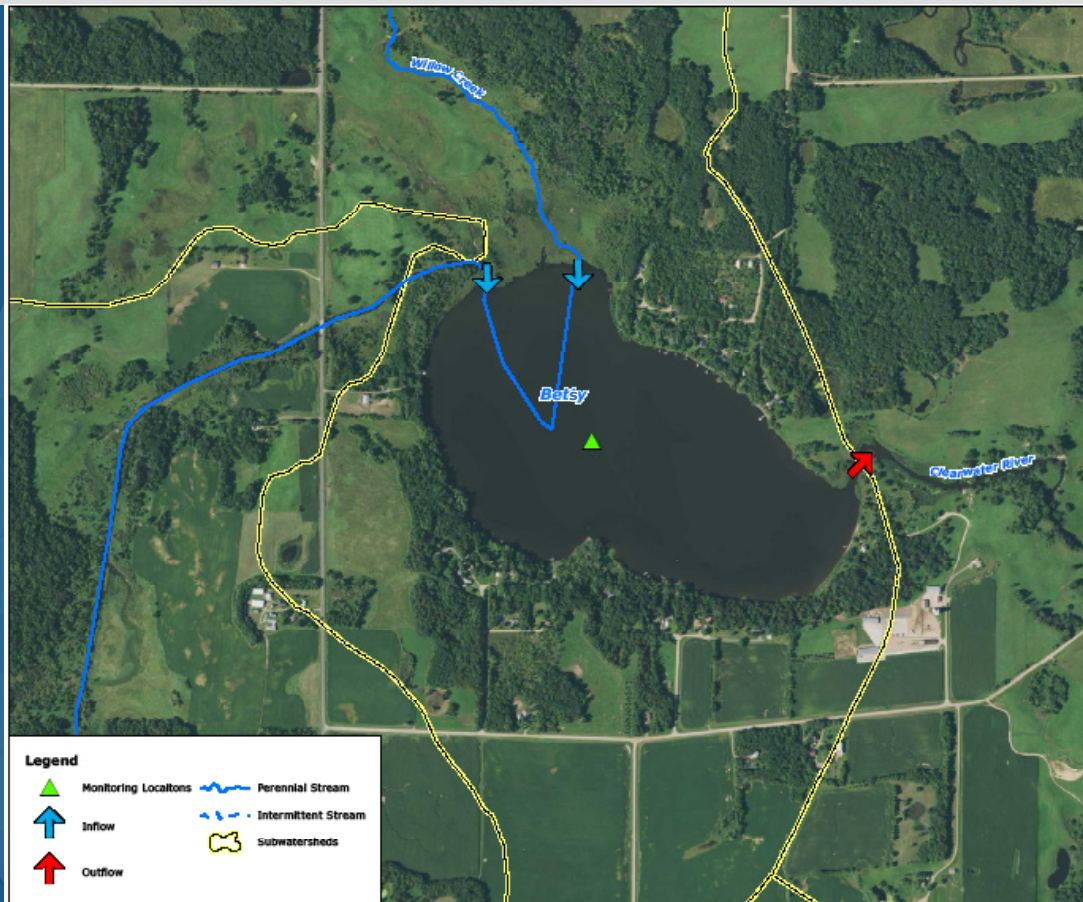
Coontail, Curly-  
leaf pondweed

### Invasive Species

Curly-leaf  
pondweed

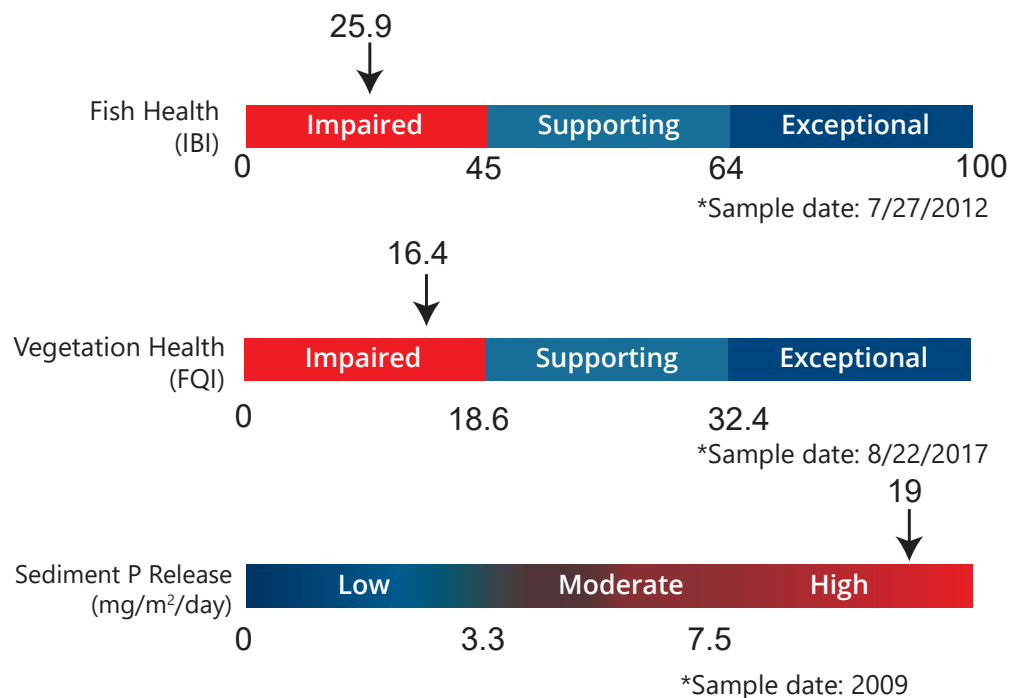
### Status

Impaired, TMDL  
completed in 2009



## TO DO LIST

- ▲ Rough fish management
- ▲ Internal load reduction study and implementation
- ▲ Manage upstream loads
- ▲ AIS management

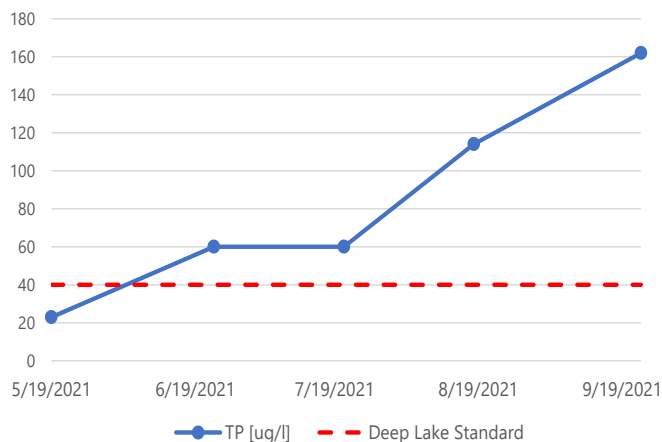




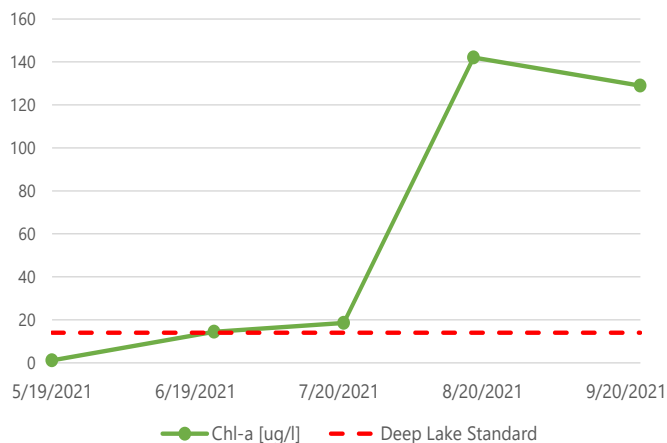
# LAKE BETSY

## 2021 Water Quality

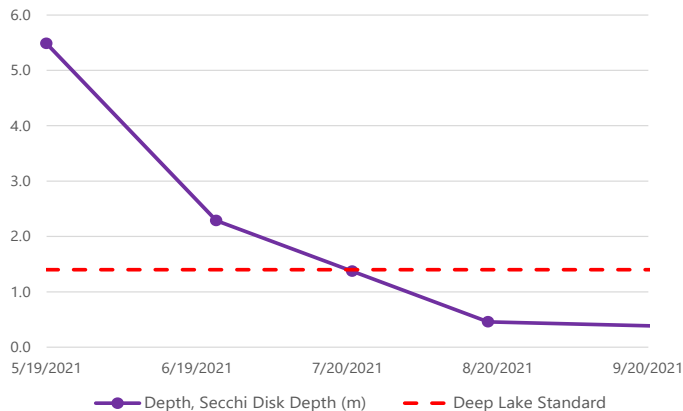
Betsy - 2021 TP [ug/l]



Betsy - 2021 Chl-a [ug/L]

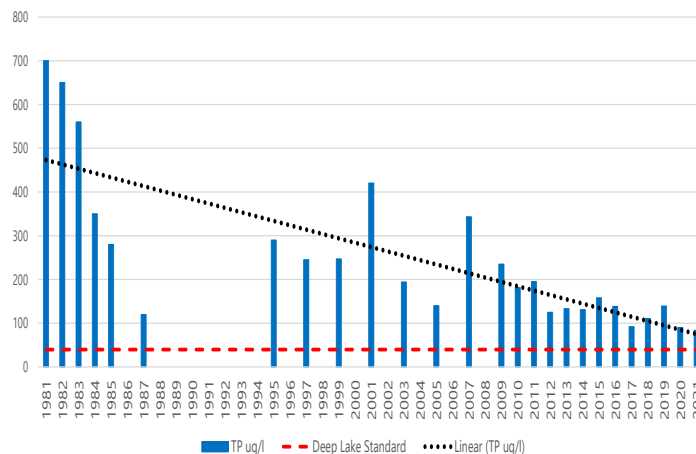


Betsy - 2021 Secchi Depth [m]

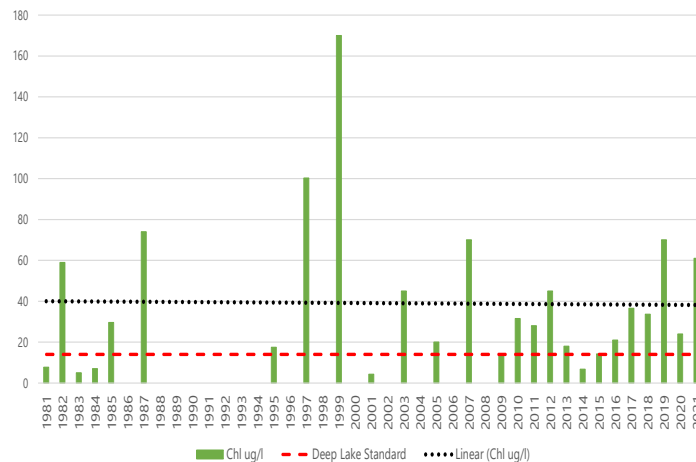


## Historic Water Quality

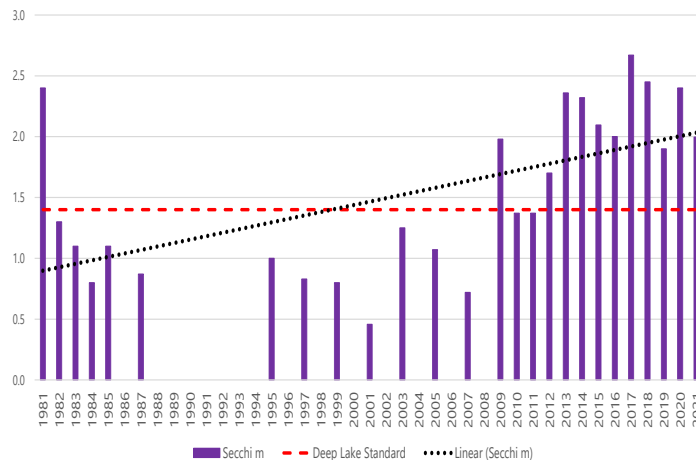
Betsy -Historical TP [ug/L]



Betsy - Historical Chl-a [ug/L]



Betsy - Historical Secchi [m]



# LAKE CAROLINE

## QUICK FACTS

**Littoral Area:** 46 acres

**Residence Time:** 26 days

**Surface Area:** 135 acres

**Subwatershed Area:** 60,132 acres

**Maximum Depth:** 45 feet

**Upstream Waters:** Louisa, Marie

### Common Fish

Black Crappie,  
Bluegill, Northern Pike,  
Largemouth Bass,  
Common Carp, Walleye,  
White Sucker

### Dominant Vegetation

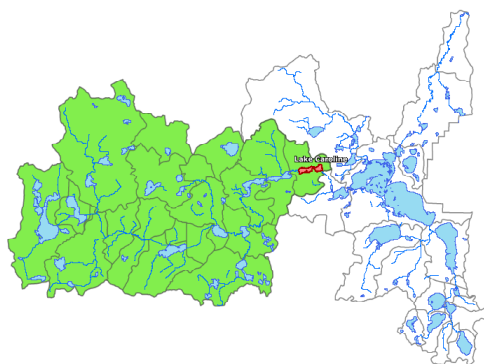
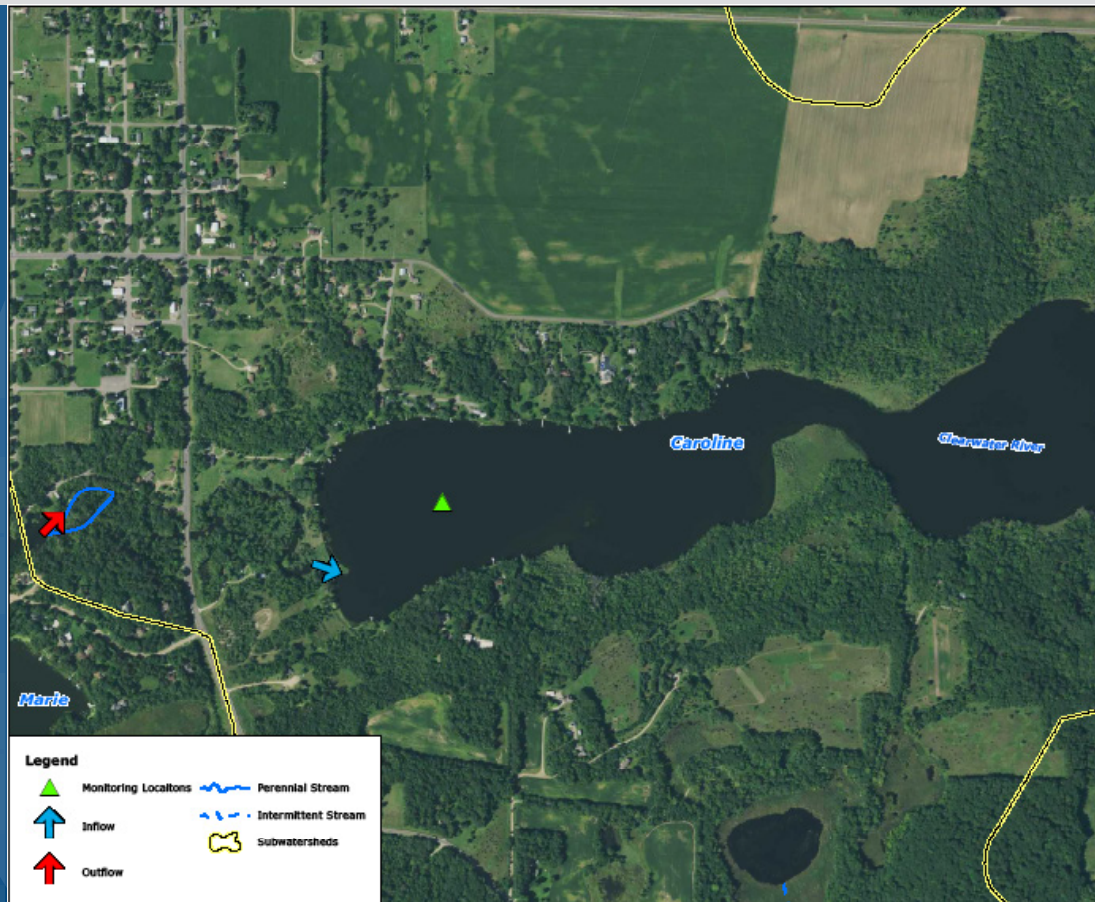
No Recent Survey

### Invasive Species

Curly-leaf  
pondweed,  
Eurasian watermilfoil

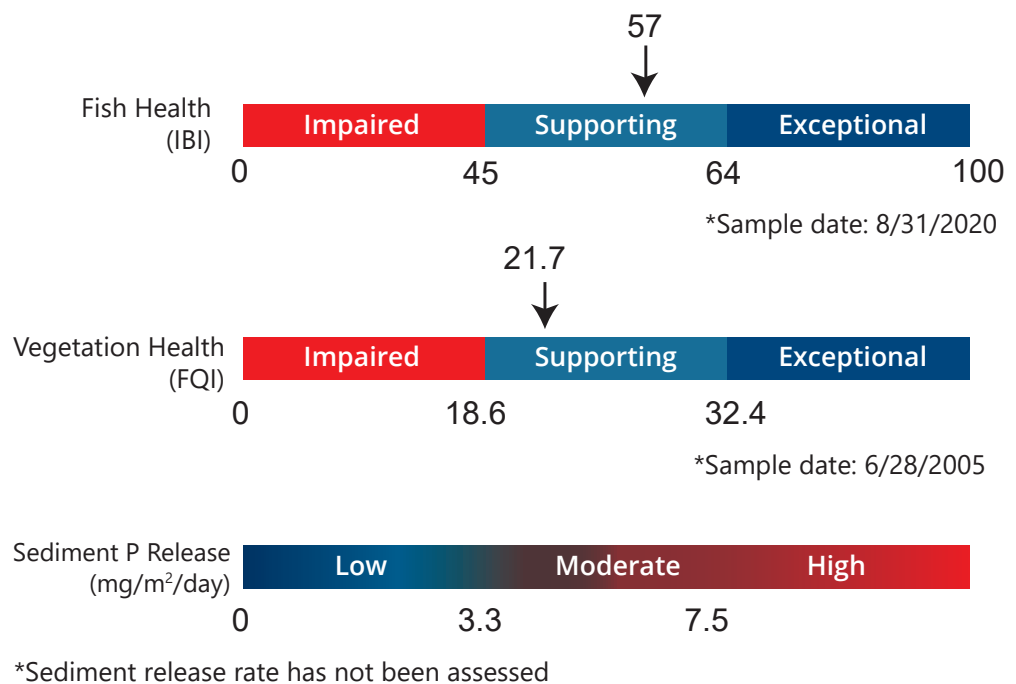
### Status

Impaired, TMDL  
completed in 2010



## TO DO LIST

- Manage upstream loads
- AIS management
- Internal load management study

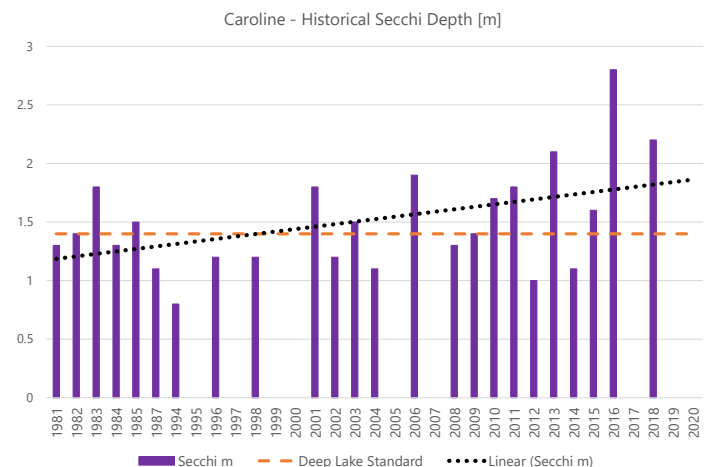
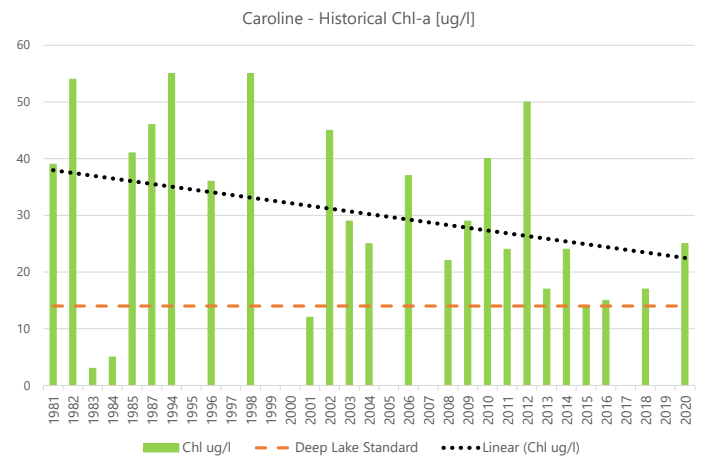
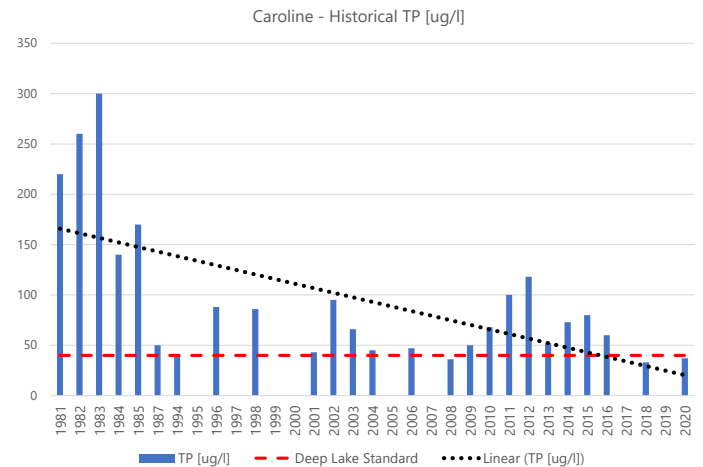


# LAKE CAROLINE

## 2021 Water Quality

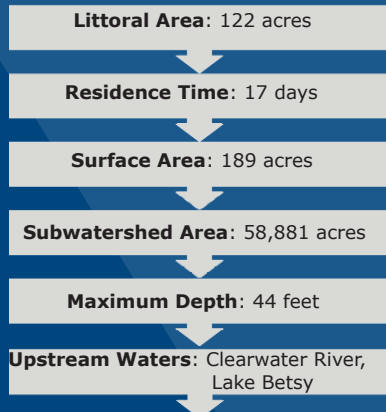
Lake not sampled

## Historic Water Quality



# LAKE LOUISA

## QUICK FACTS



### Common Fish

Bluegill, Northern Pike, Largemouth Bass, White Sucker

### Dominant Vegetation

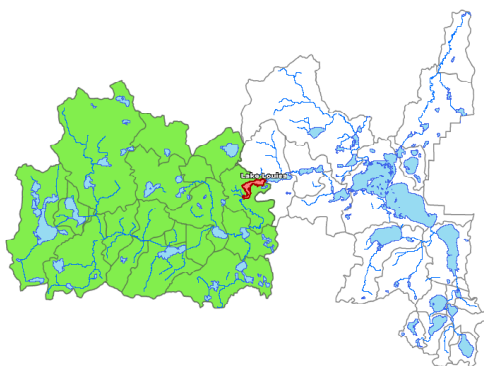
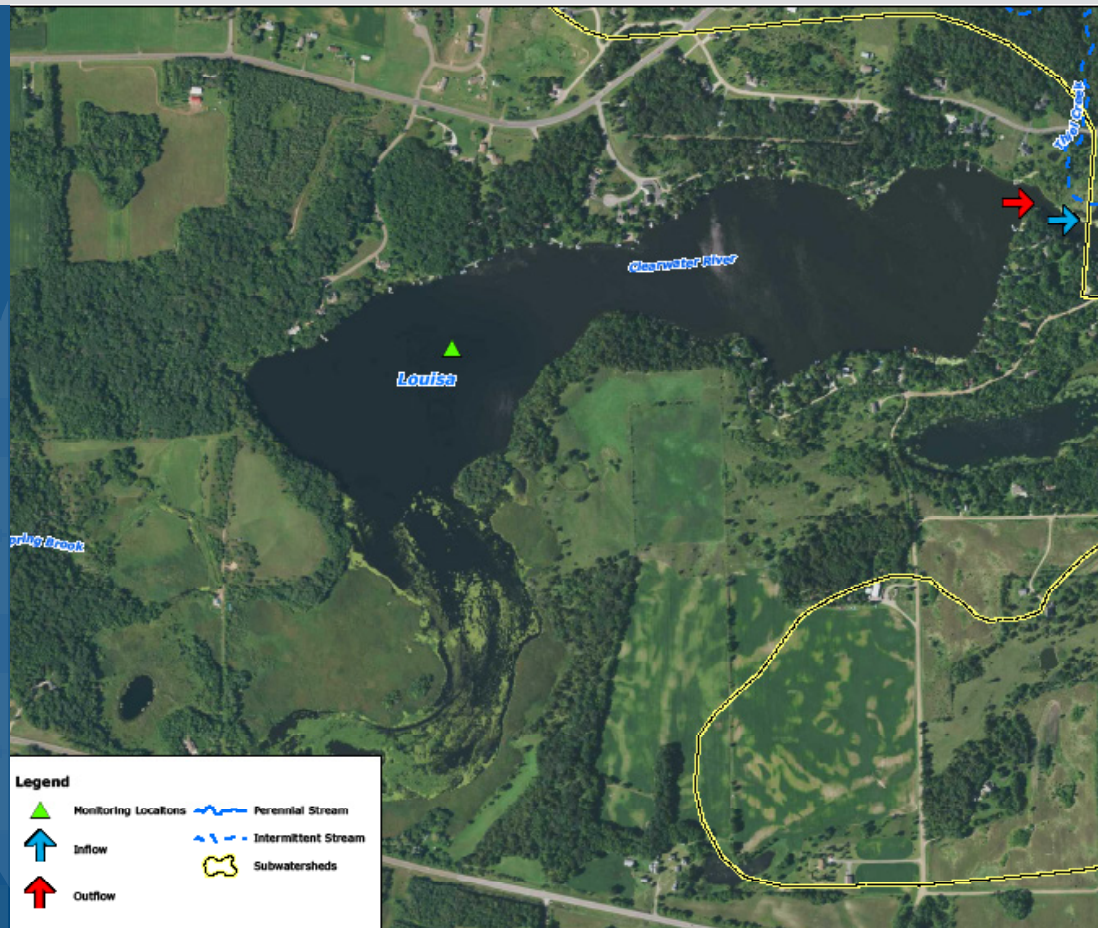
Coontail

### Invasive Species

Curly-leaf pondweed

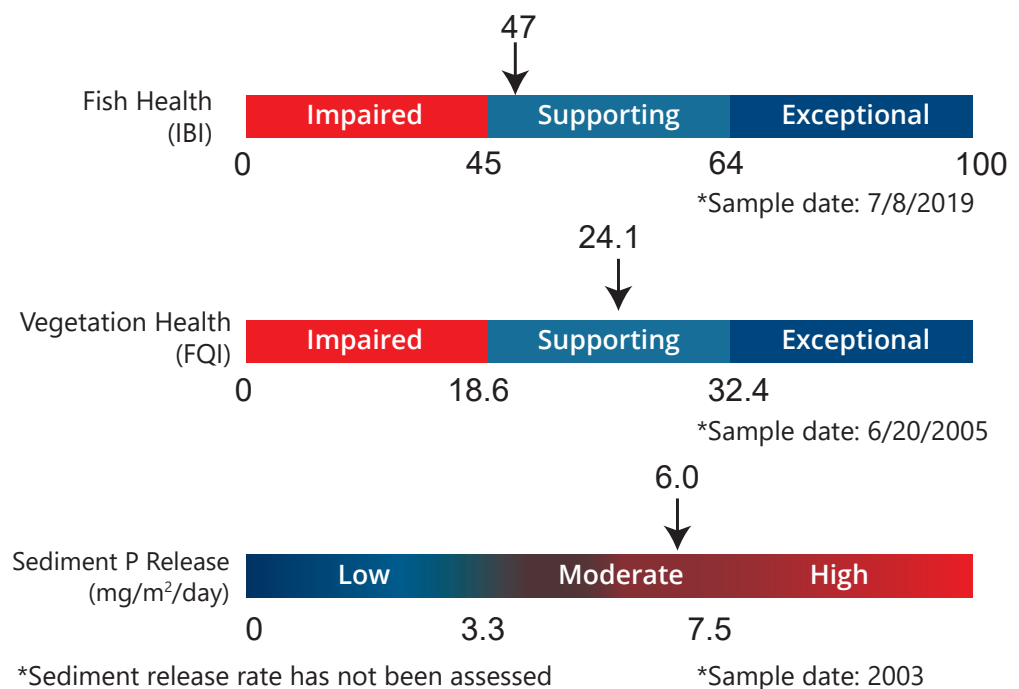
### Status

Impaired, TMDL Completed 2009



## TO DO LIST

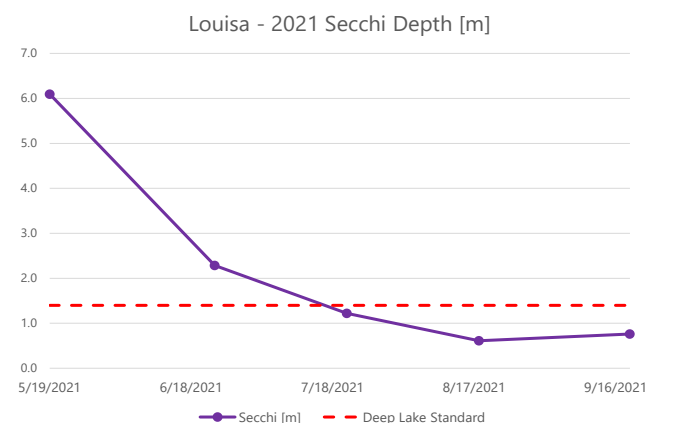
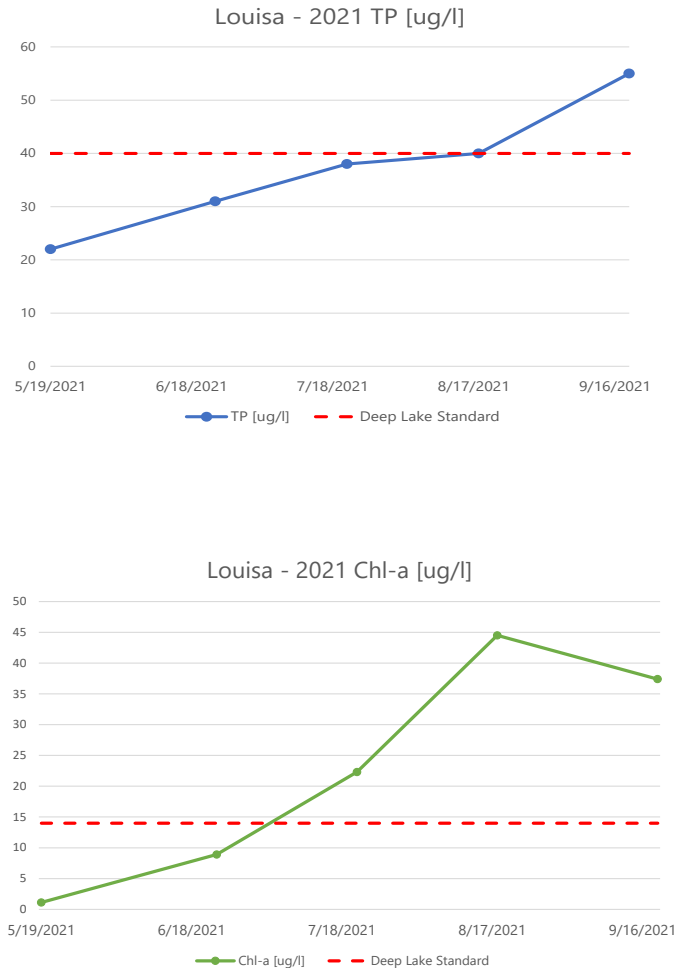
- ▲ Manage upstream loads
- ▲ AIS management
- ▲ Internal load management study



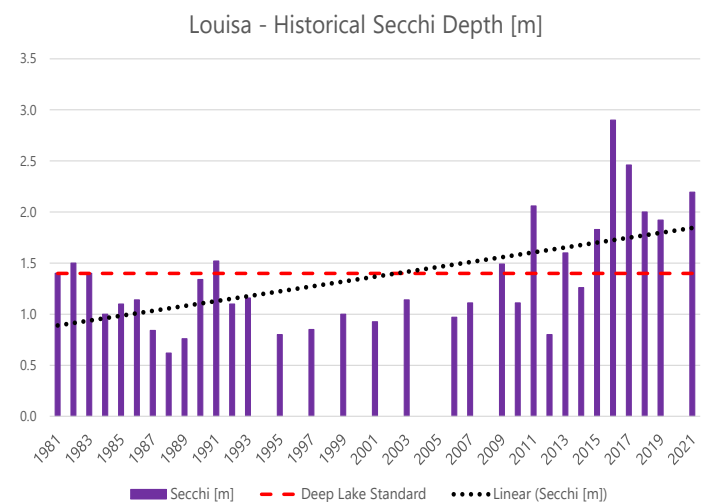
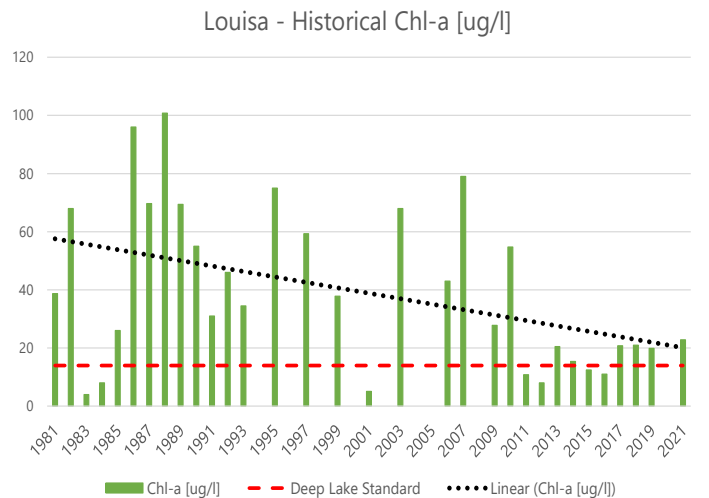
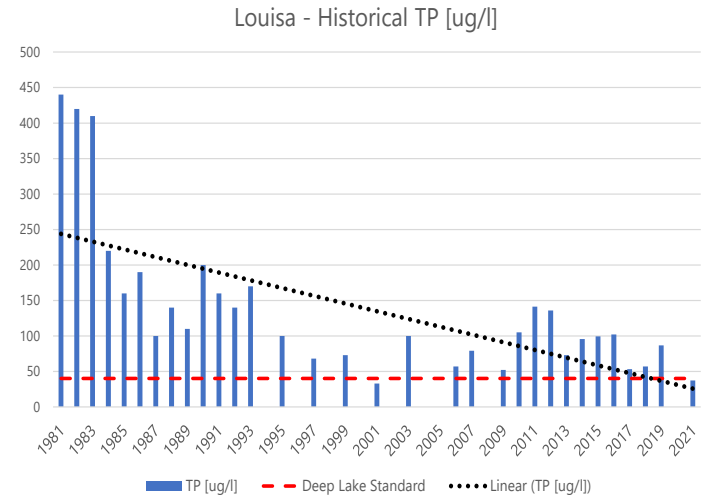


# LAKE LOUISA

## 2021 Water Quality



## Historic Water Quality



# LAKE MARIE

## QUICK FACTS

**Littoral Area:** 107 acres

**Residence Time:** 24 days

**Surface Area:** 146 acres

**Subwatershed Area:** 59,837 acres

**Maximum Depth:** 36 feet

**Upstream Waters:** Clearwater River, Louisa

### Common Fish

Black Crappie, Bluegill, Northern Pike, White Sucker, Yellow Perch

### Dominant Vegetation

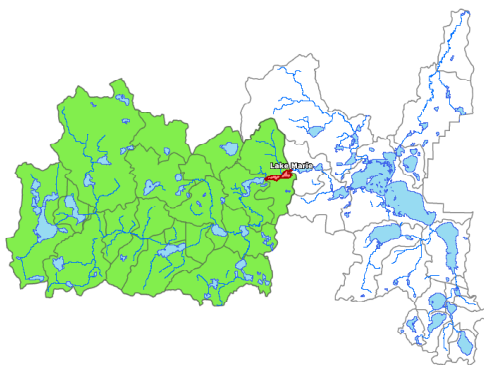
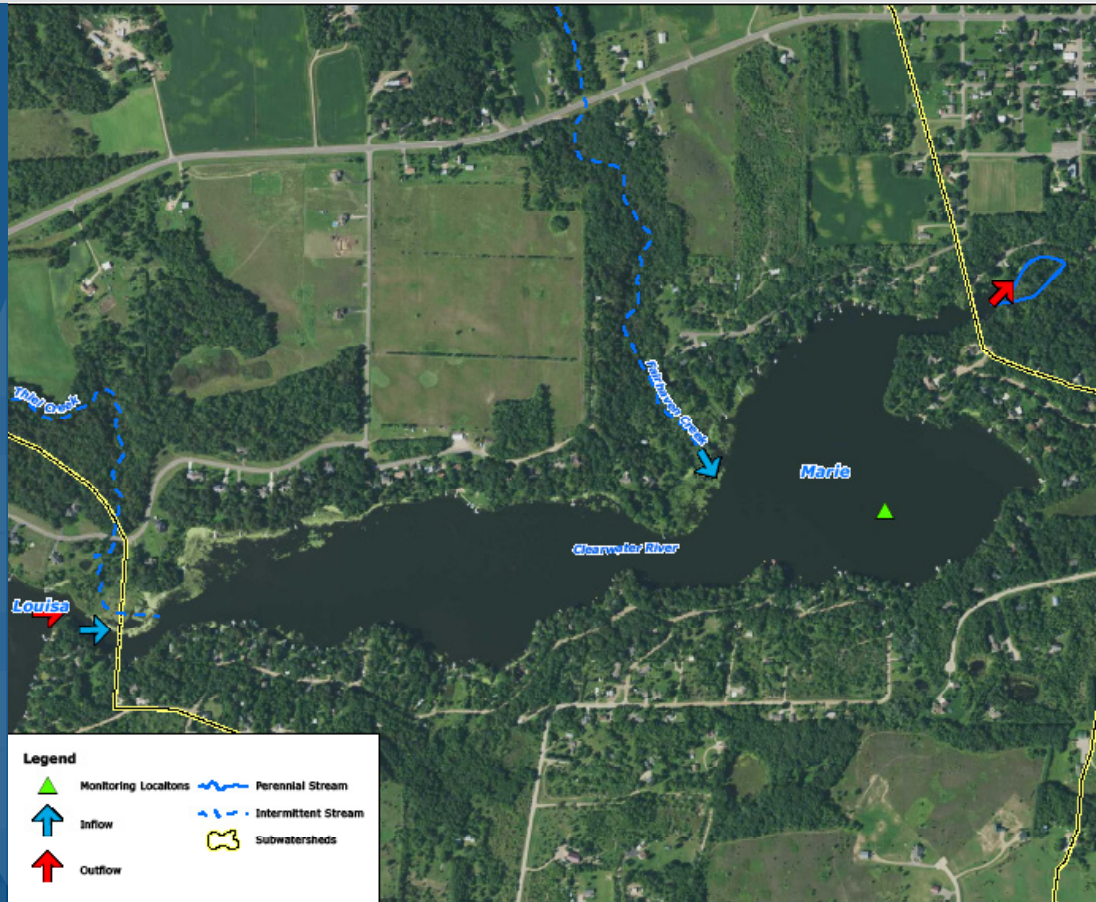
Coontail, Canadian waterweed

### Invasive Species

Curly-leaf pondweed

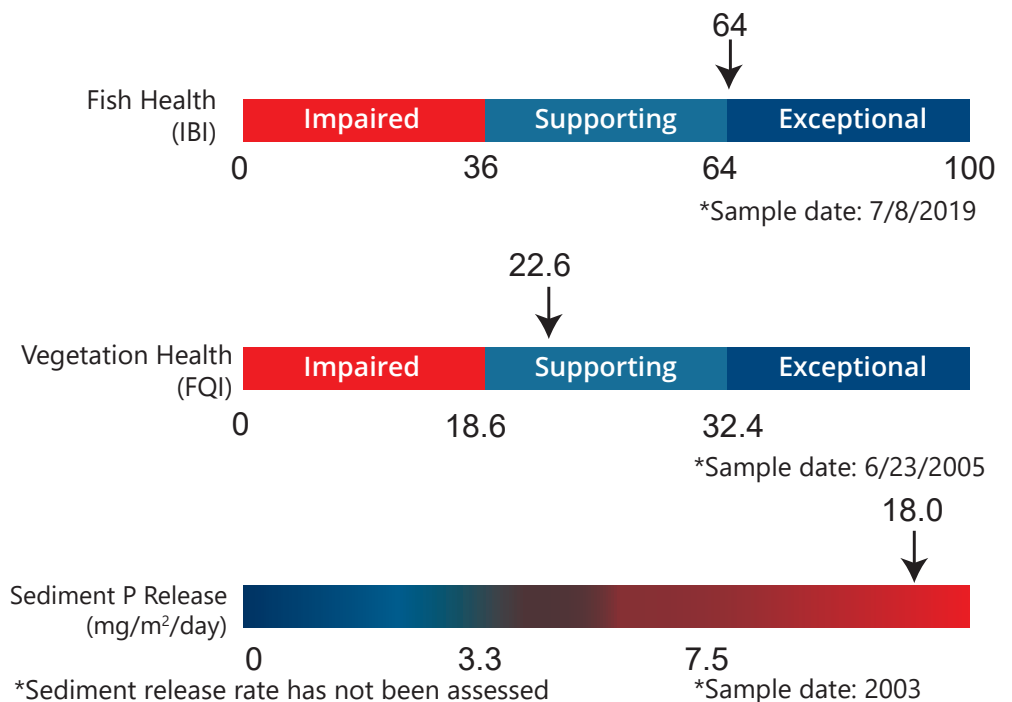
### Status

Impaired, TMDL Completed 2009



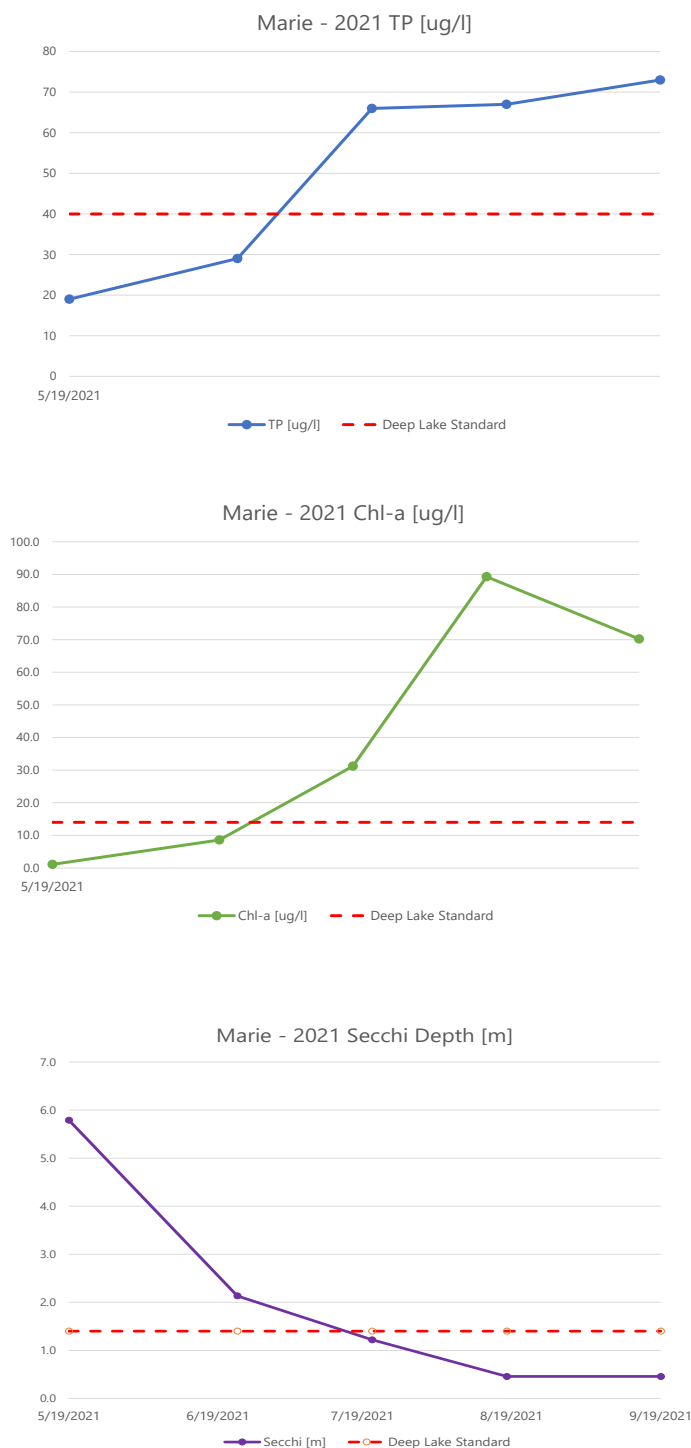
## TO DO LIST

- ▲ Manage upstream loads
- ▲ AIS management
- ▲ Internal load management study

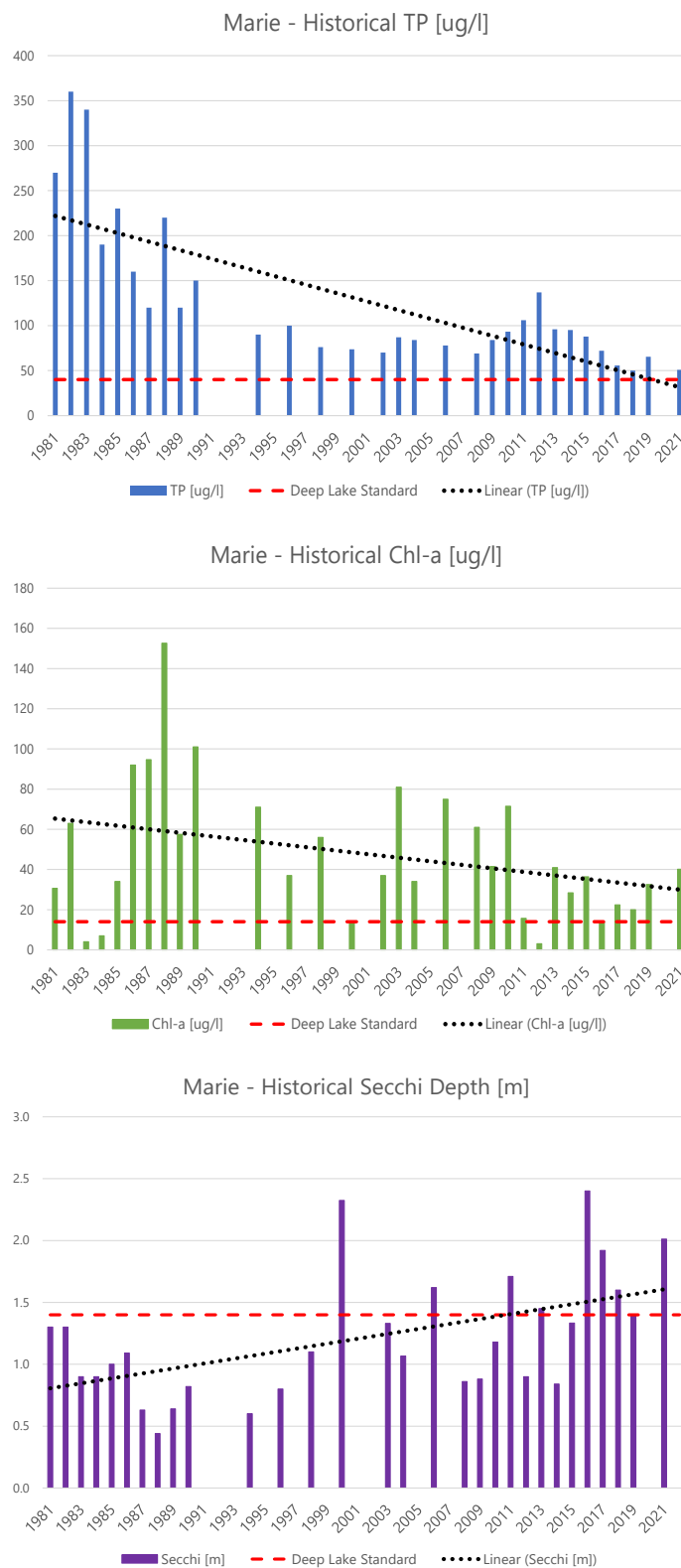


# LAKE MARIE

## 2021 Water Quality



## Historic Water Quality

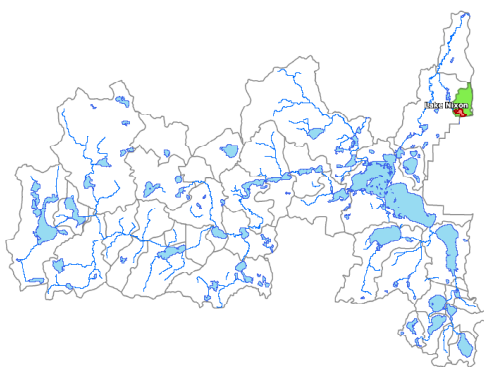
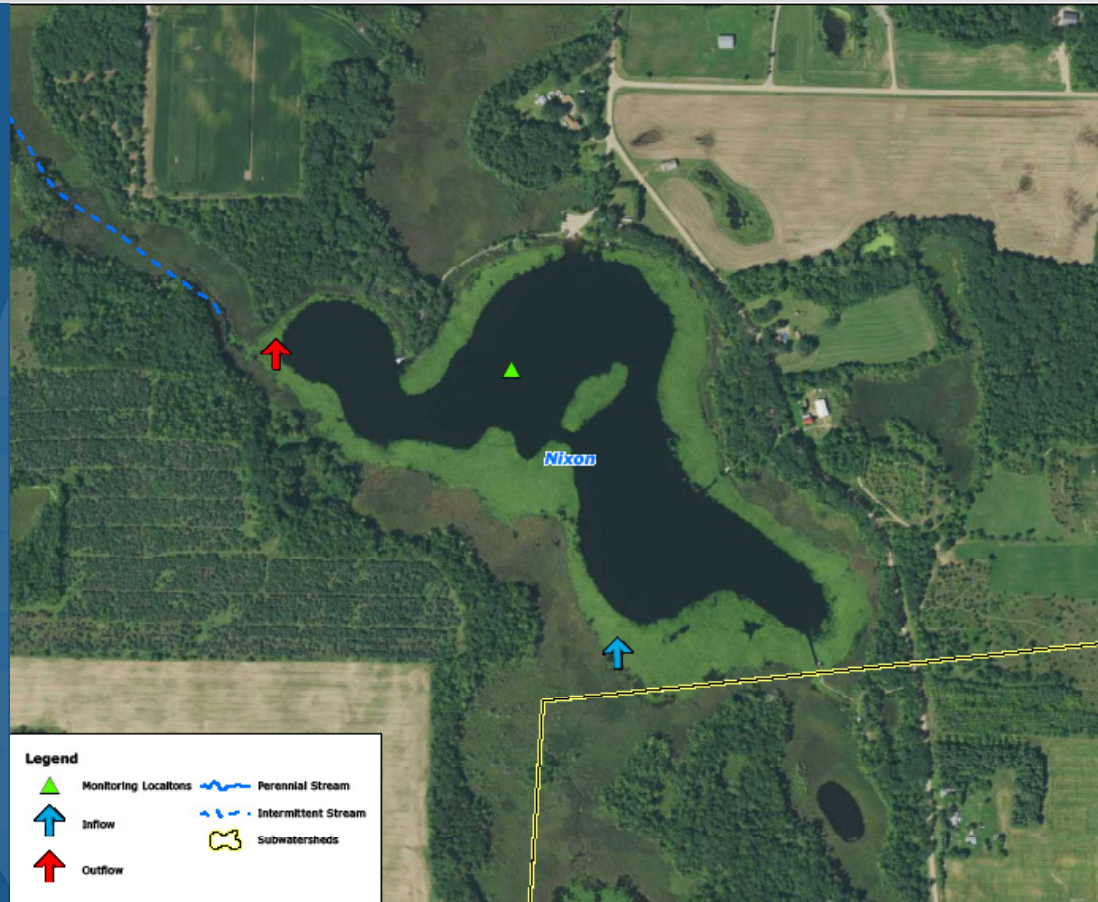


# NIXON LAKE

## QUICK FACTS

<b>Littoral Area:</b> 33 acres
<b>Surface Area:</b> 60 acres
<b>Subwatershed Area:</b> 690 acres
<b>Maximum Depth:</b> 67 feet
<b>Upstream Waters:</b> None

<b>Common Fish</b>	Bluegill, Northern Pike, Yellow Bull-head, Largemouth Bass
<b>Dominant Vegetation</b>	Currently obtaining vegetation info from DNR
<b>Invasive Species</b>	Currently obtaining vegetation info from DNR
<b>Status</b>	Not impaired

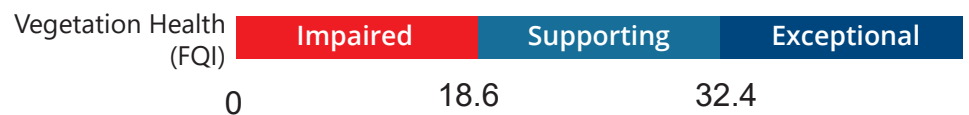


## TO DO LIST

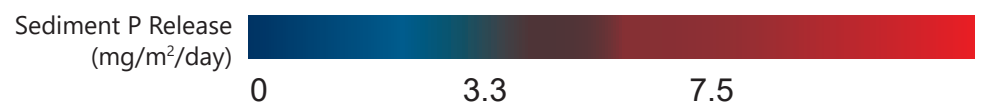
- ▲ Protect water quality
- ▲ Manage upstream loads
- ▲ AIS management and prevention



\*Fish IBI has not been assessed



\*Vegetation FQI has not been assessed



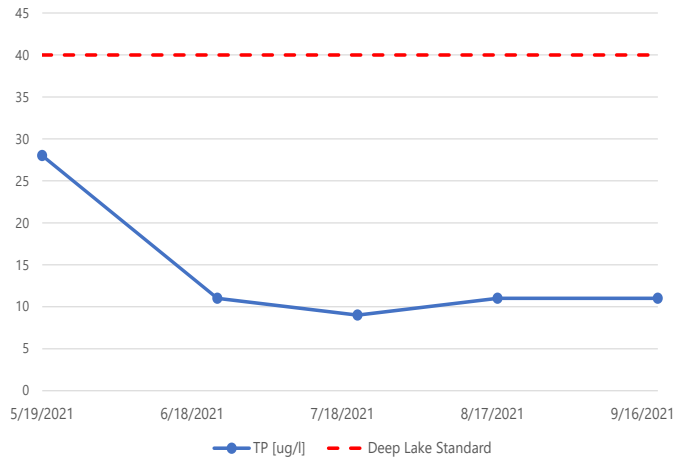
\*Sediment release rate has not been assessed



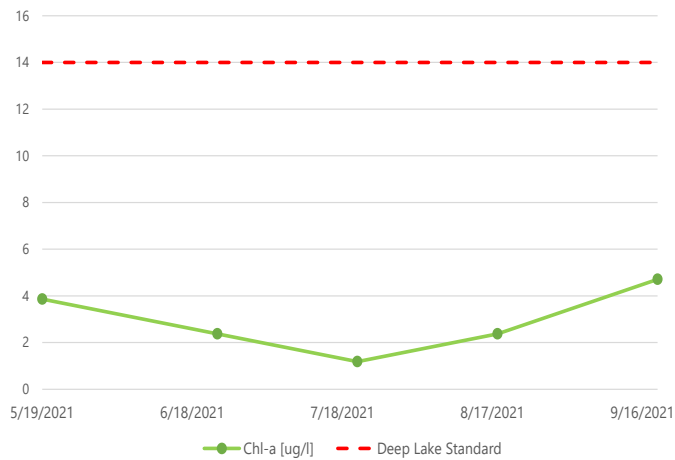
# NIXON LAKE

## 2021 Water Quality

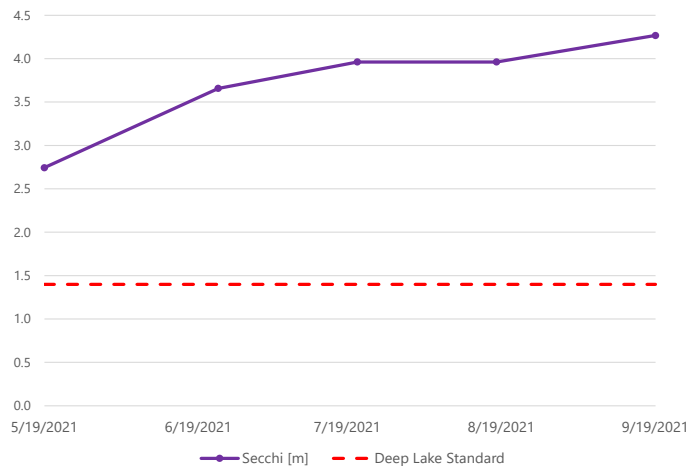
Nixon - 2021 TP [ug/l]



Nixon - 2021 Chl-a [ug/l]

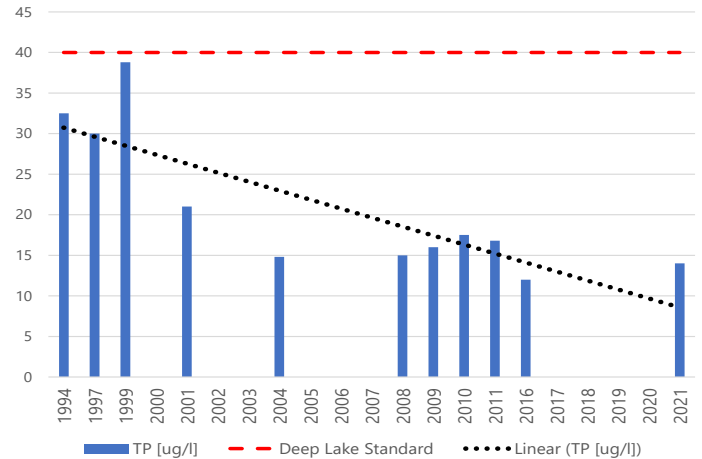


Nixon - 2021 Secchi Depth [m]

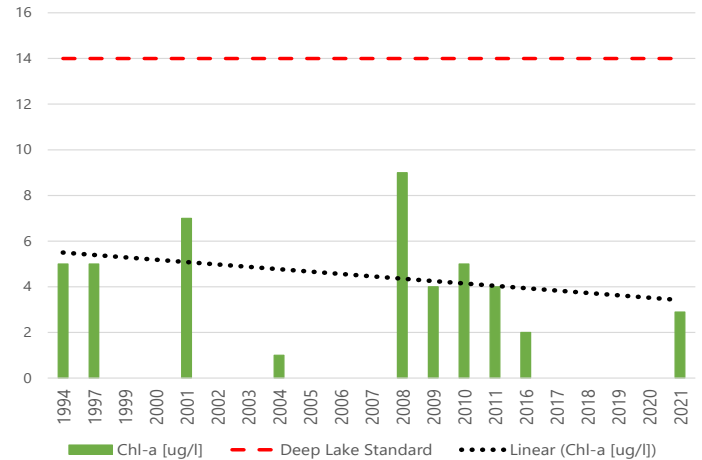


## Historic Water Quality

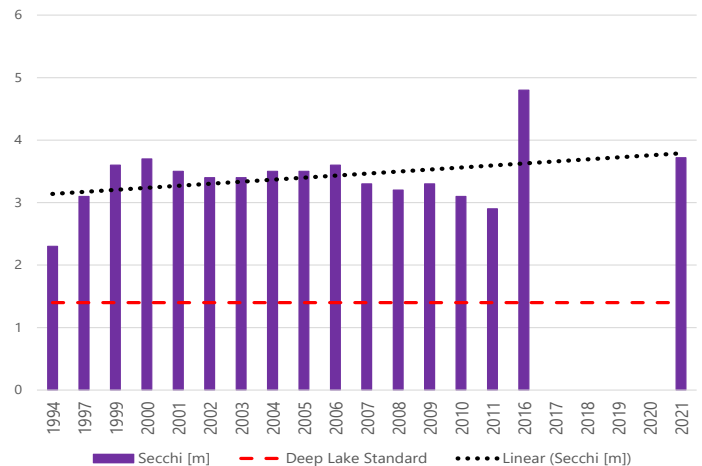
Nixon - Historical TP [ug/l]



Nixon - Historical Chl-a [ug/l]



Nixon - Historical Secchi Depth [m]



# OTTER LAKE

## QUICK FACTS

**Littoral Area:** 32 acres

**Surface Area:** 92 acres

**Subwatershed Area:** 10,574 acres

**Maximum Depth:** 51 feet

**Upstream Waters:** Lake Laura

### Common Fish

Black Crappie,  
Bluegill, Northern  
Pike, Largemouth  
Bass, Walleye

### Dominant Vegetation

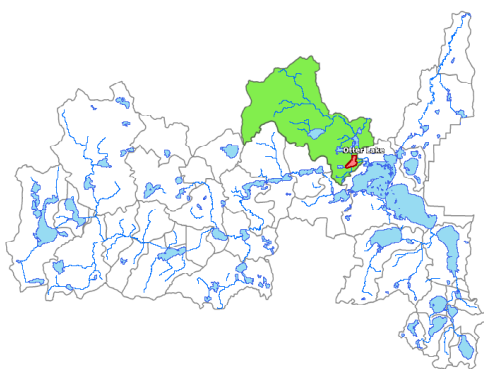
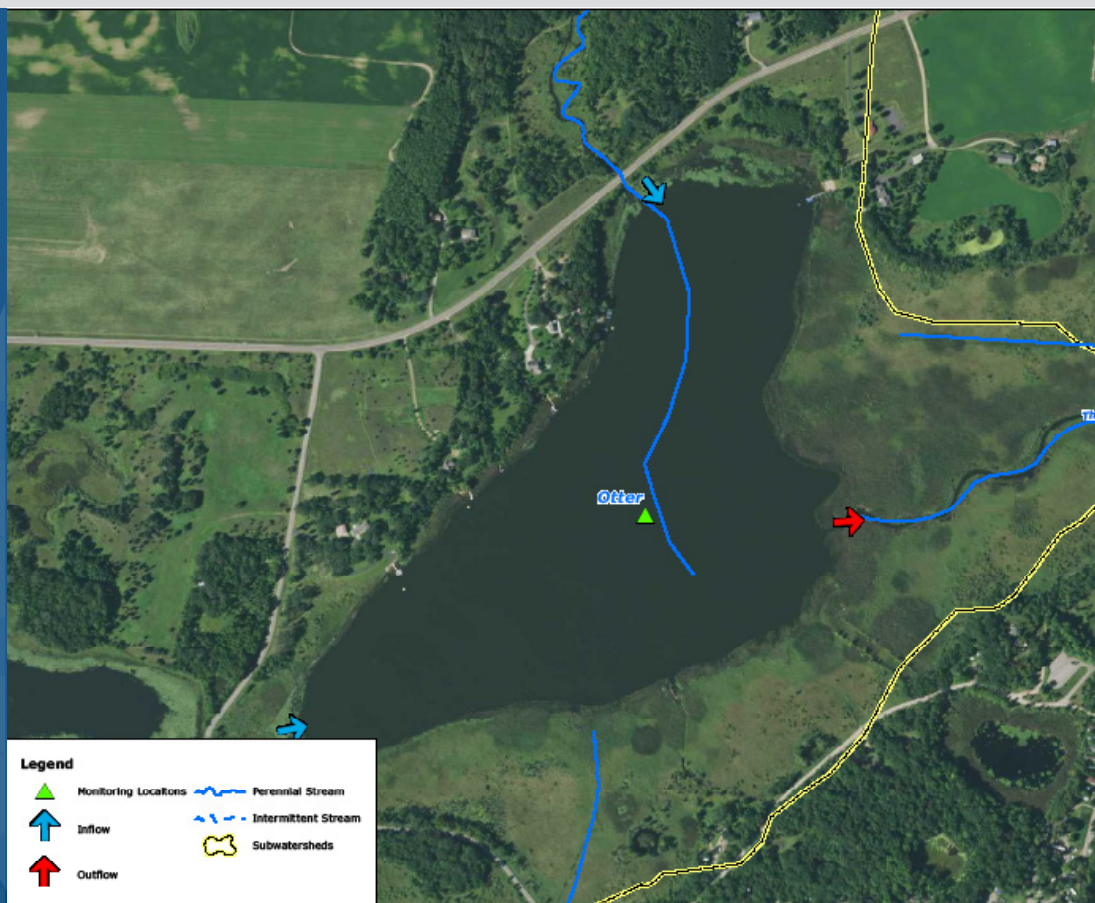
Diverse  
community

### Invasive Species

Curly-leaf  
pondweed,  
Eurasian water  
milfoil

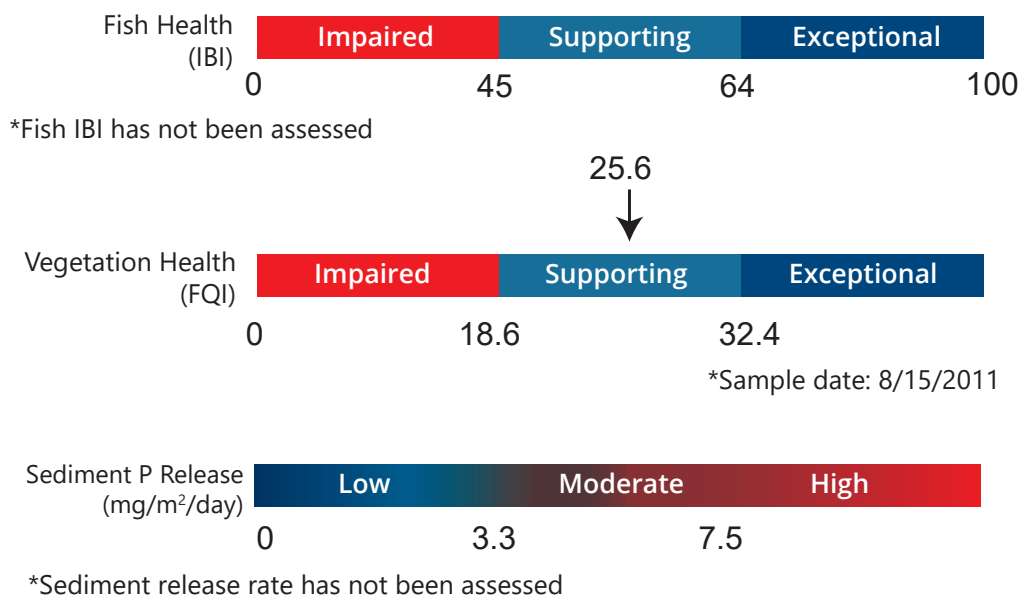
### Status

Not impaired



## TO DO LIST

- ▲ Protect water quality
- ▲ Manage upstream loads

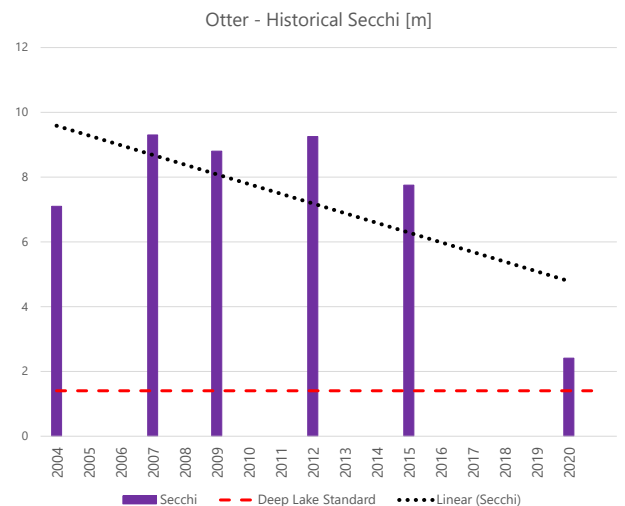
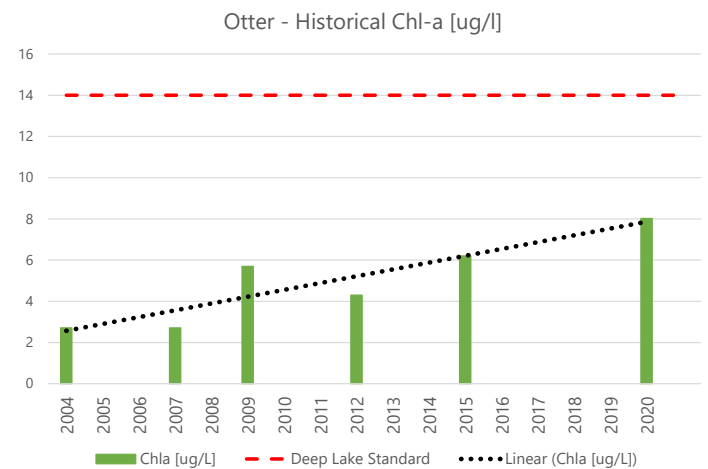
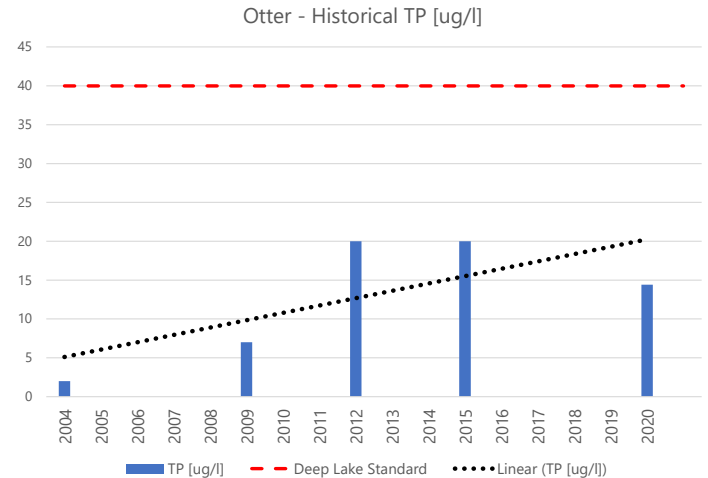


# OTTER LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# PLEASANT LAKE

## QUICK FACTS

**Littoral Area:** 260 acres

**Surface Area:** 597 acres

**Subwatershed Area:** 4,325 acres

**Maximum Depth:** 74 feet

**Upstream Waters:** None

### Common Fish

Bluegill, Yellow Bullhead, Northern Pike, Pumpkinseed Sunfish

### Dominant Vegetation

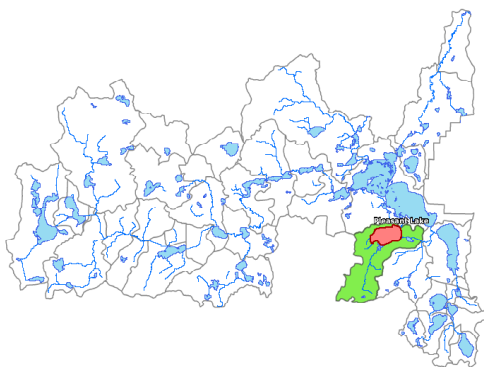
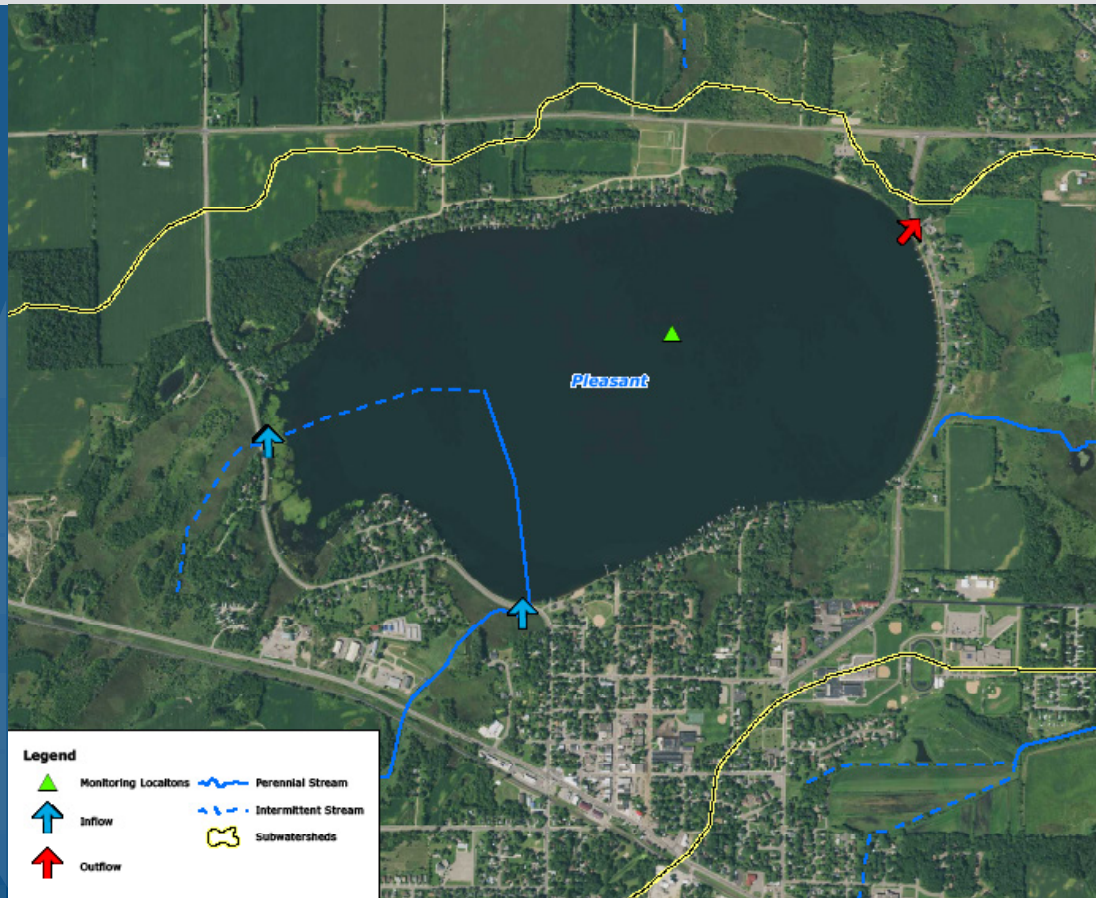
Curlyleaf, Coontail, chara species, Eurasian watermilfoil

### Invasive Species

Currently obtaining vegetation info from DNR

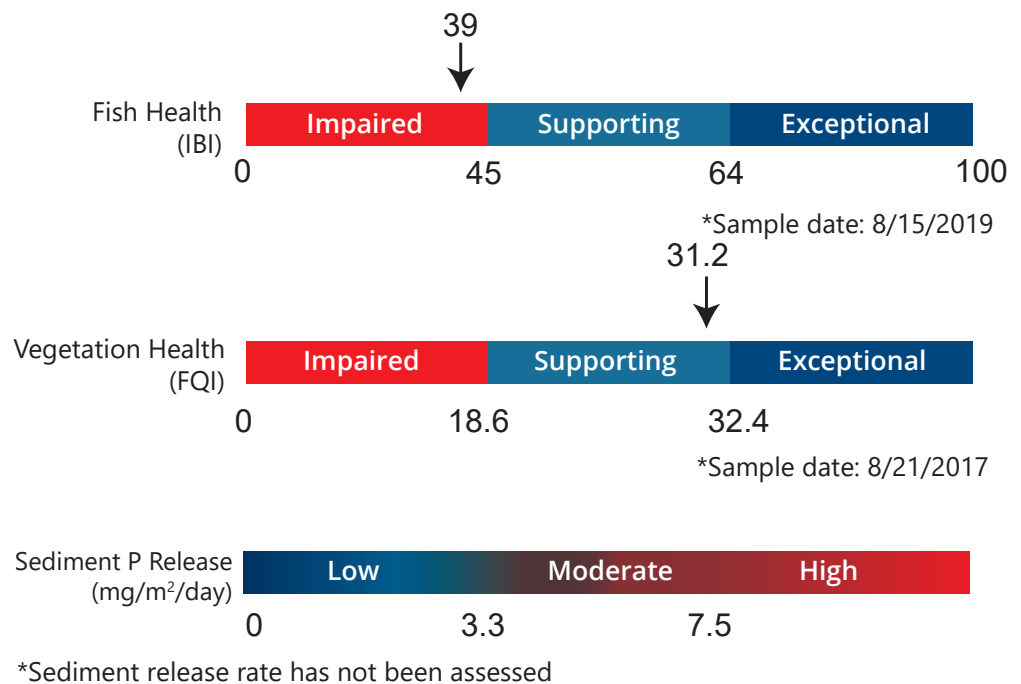
### Status

Not impaired



## TO DO LIST

- Manage watershed loads
- Protect water quality
- Operate outlet to minimize flooding



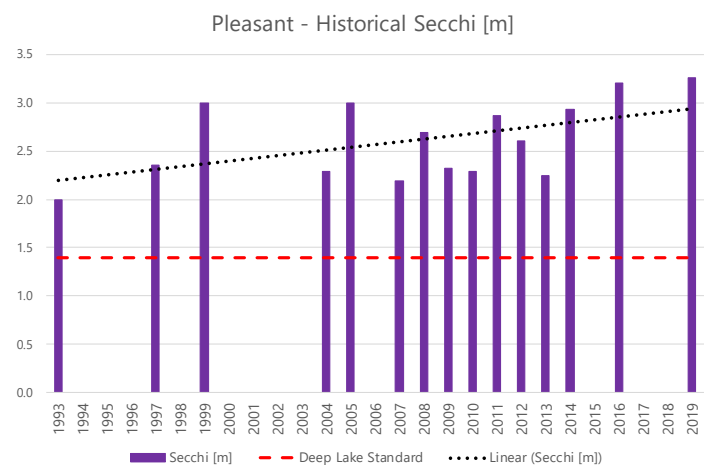
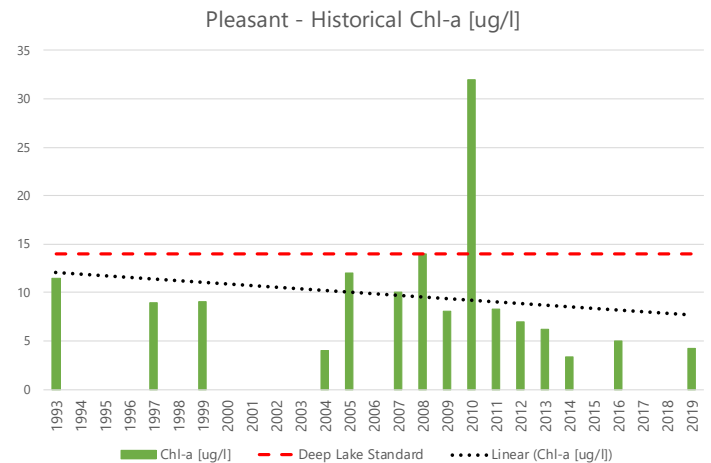
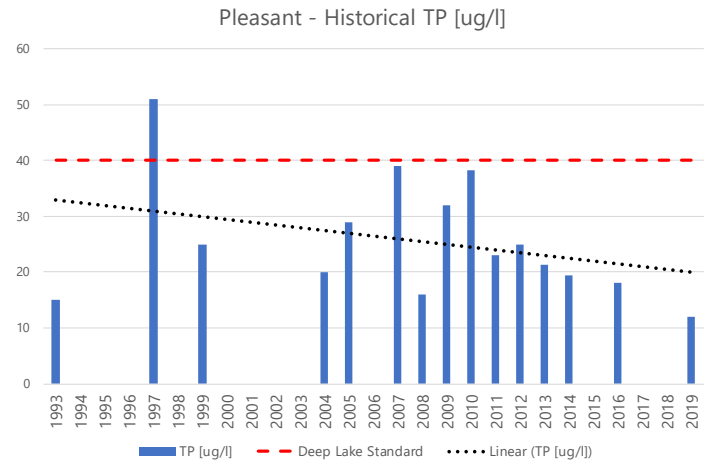


# PLEASANT LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# SCHOOL SECTION LAKE

## QUICK FACTS

**Littoral Area:** 188 acres

**Surface Area:** 193 acres

**Subwatershed Area:** 1,843 acres

**Maximum Depth:** 12 feet

**Upstream Waters:** None

### Common Fish

Black bullhead,  
Bluegill, Northern Pike

### Dominant Vegetation

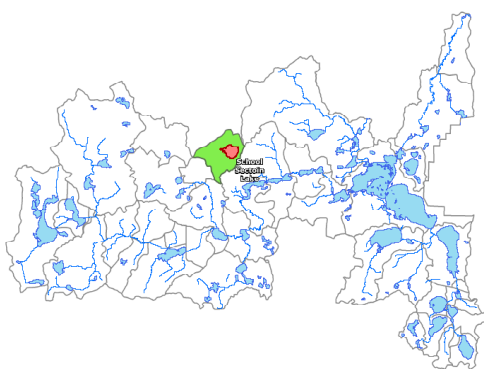
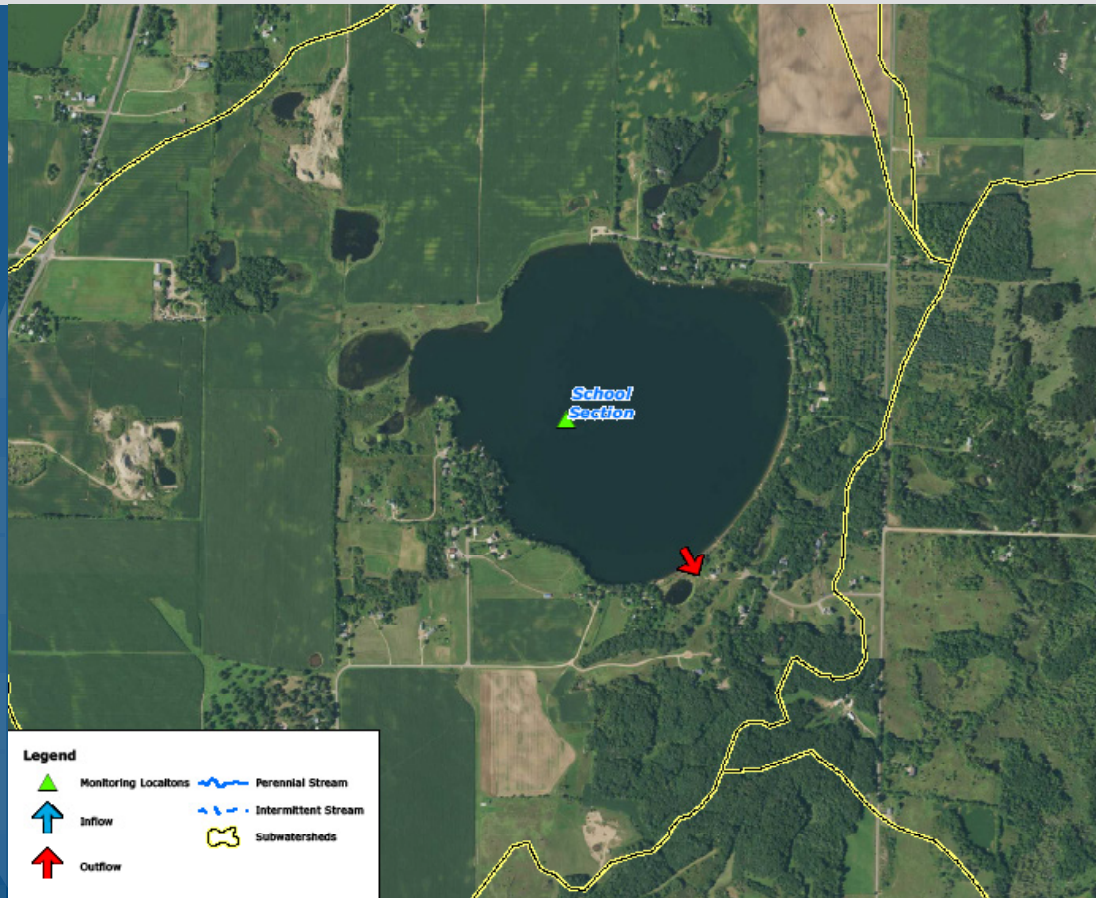
Northern water  
milfoil, Illinois  
pondweed, muskrass

### Invasive Species

Curly-leaf  
pondweed

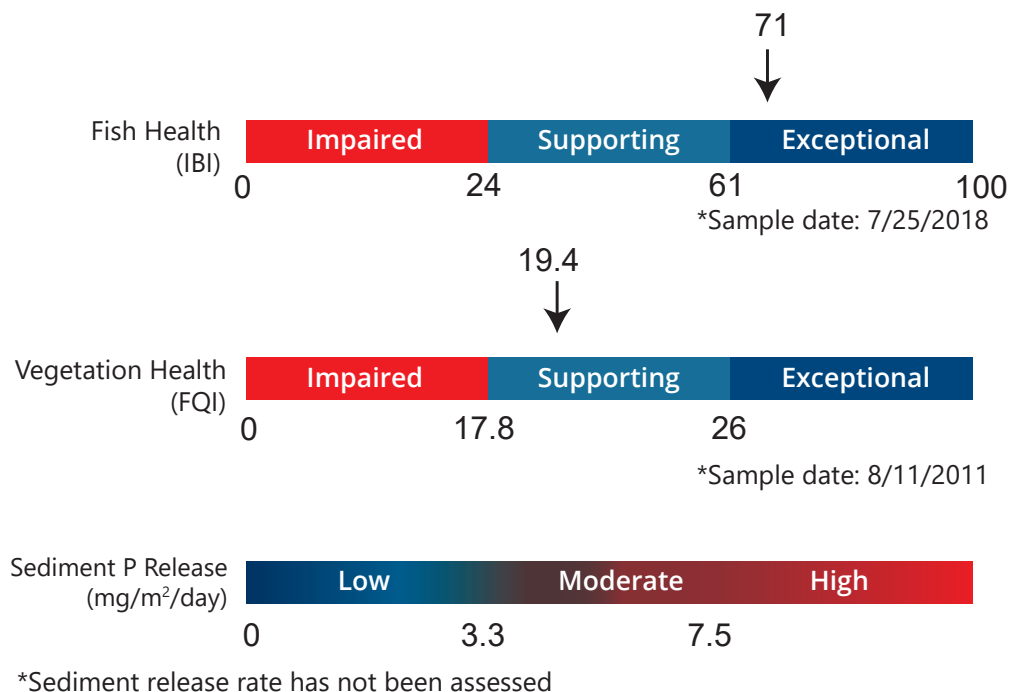
### Status

Not impaired



## TO DO LIST

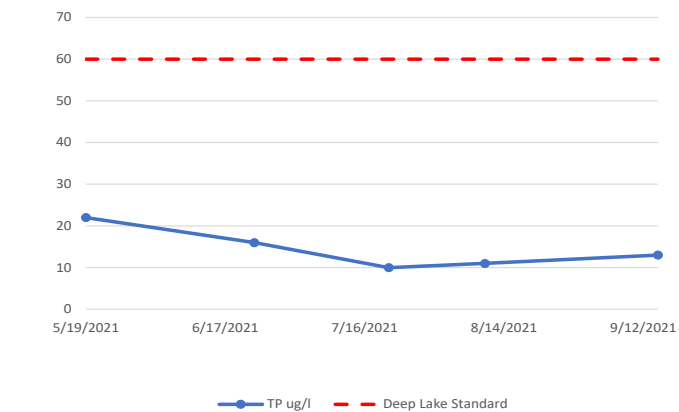
- Operate outlet to minimize flooding
- Protect water quality



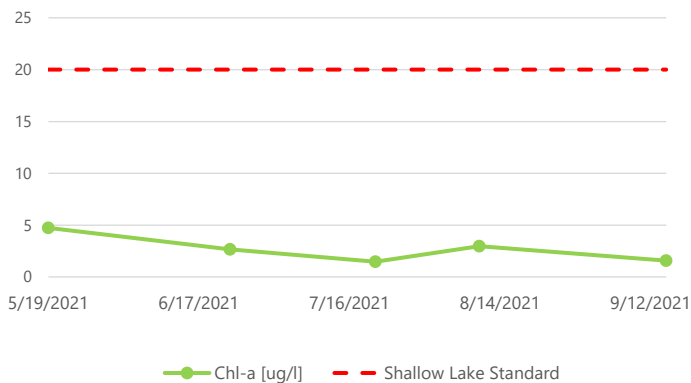
# SCHOOL SECTION LAKE

## 2021 Water Quality

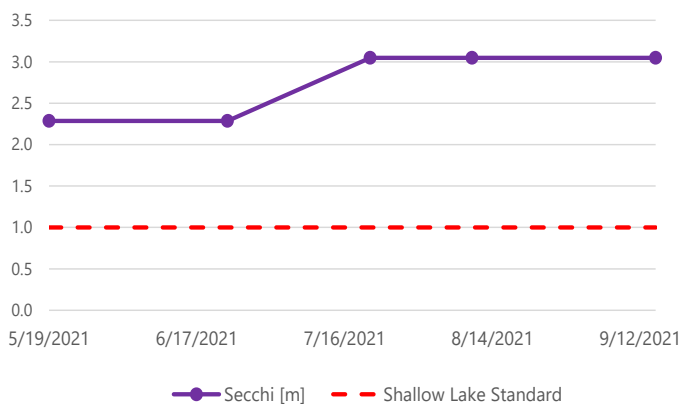
School Section - 2021 TP [ug/L]



School Section - 2021 Chl-a [ug/l]

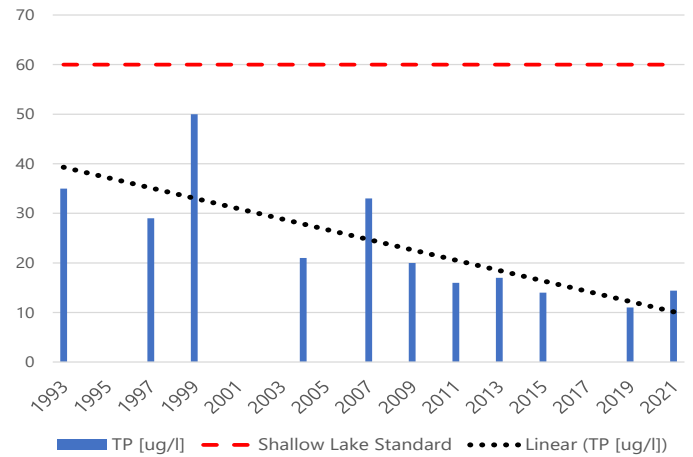


School Section - 2021 Secchi [m]

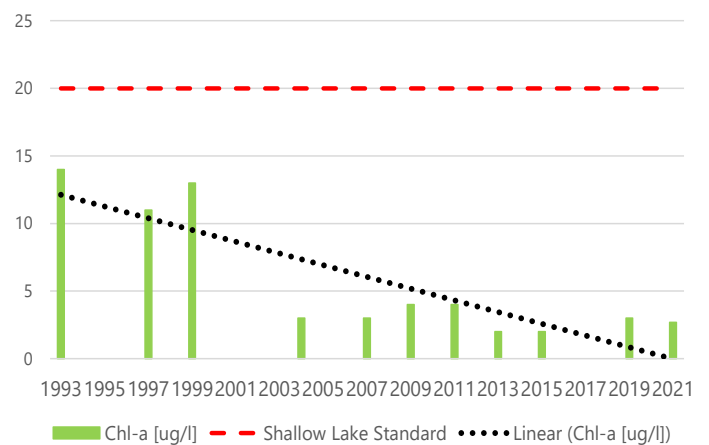


## Historic Water Quality

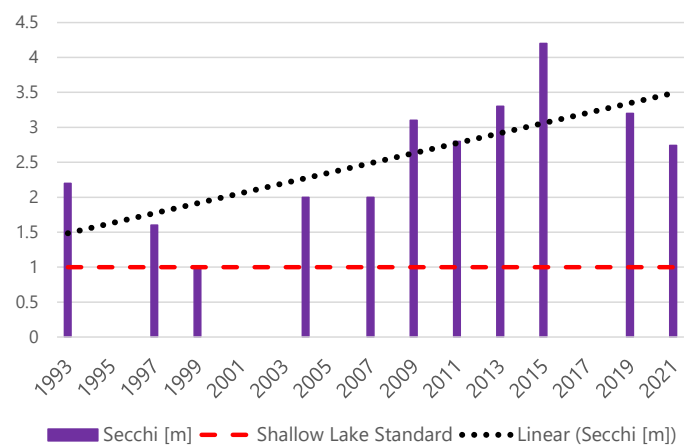
School Section - Historical TP [ug/l]



School Section - Historical Chl-a [ug/l]



School Section - Historical Secchi [m]



# SCOTT LAKE

## QUICK FACTS

**Littoral Area:** 52 acres

**Residence Time:** 12 days

**Surface Area:** 80 acres

**Subwatershed Area:** 51,000 acres

**Maximum Depth:** 23 feet

**Upstream Waters:** Clearwater River,  
Lake Betsy, Union Lake

### Common Fish

Black Crappie,  
Bluegill,  
Channel Catfish,  
White Sucker

### Dominant Vegetation

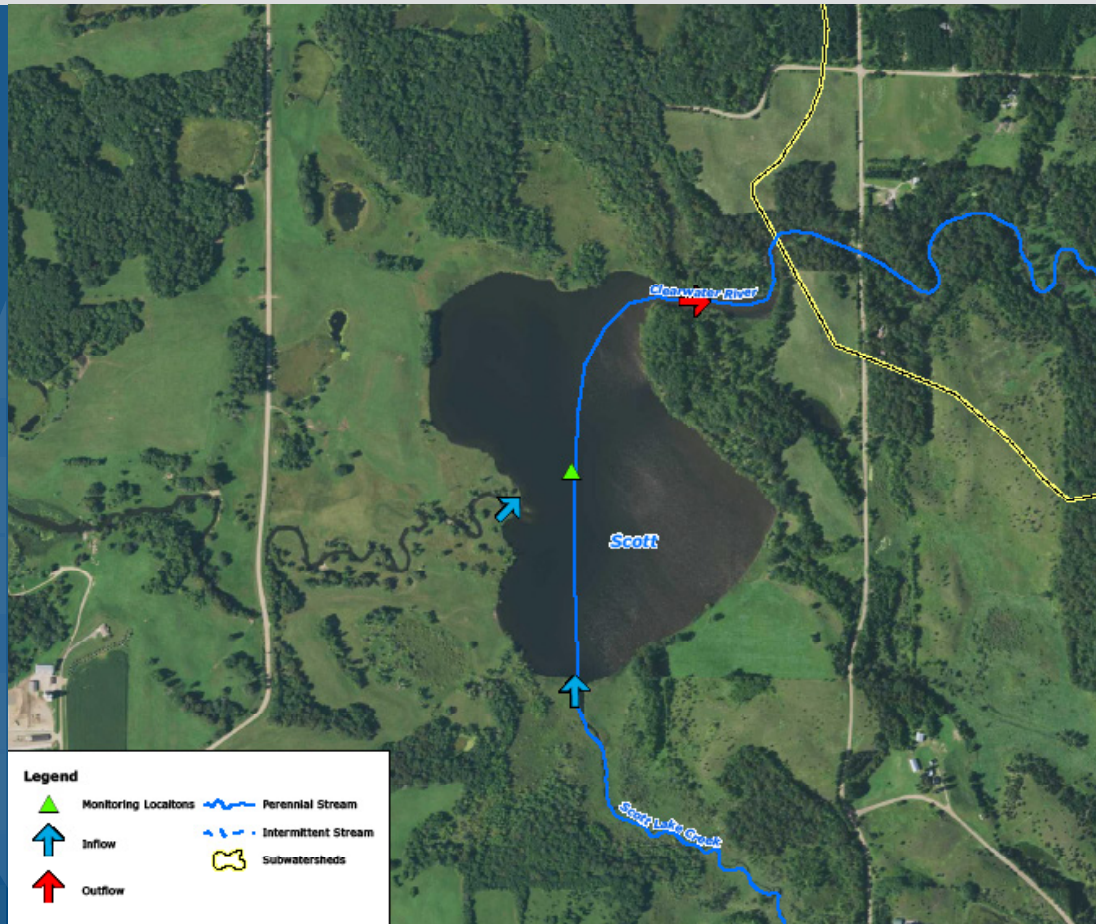
No Recent Survey

### Invasive Species

Curly-leaf  
pondweed

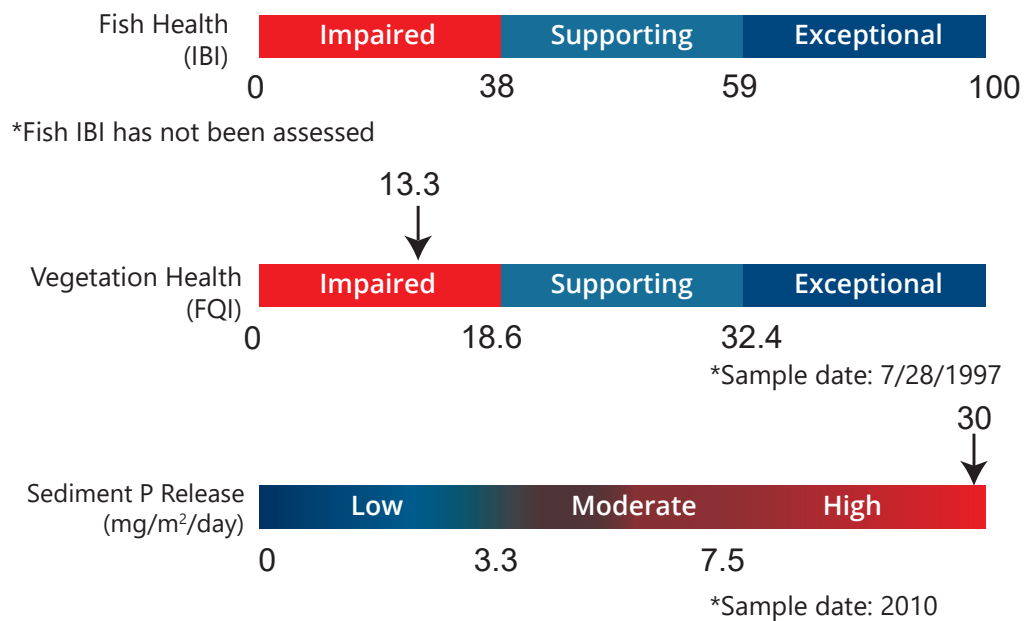
### Status

Impaired, TMDL  
Completed 2009



## TO DO LIST

- ▲ Rough fish management
- ▲ Manage upstream loads
- ▲ Internal load management study



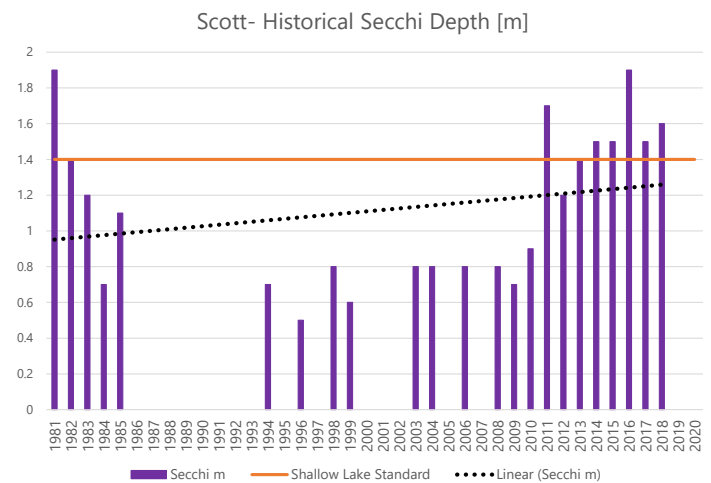
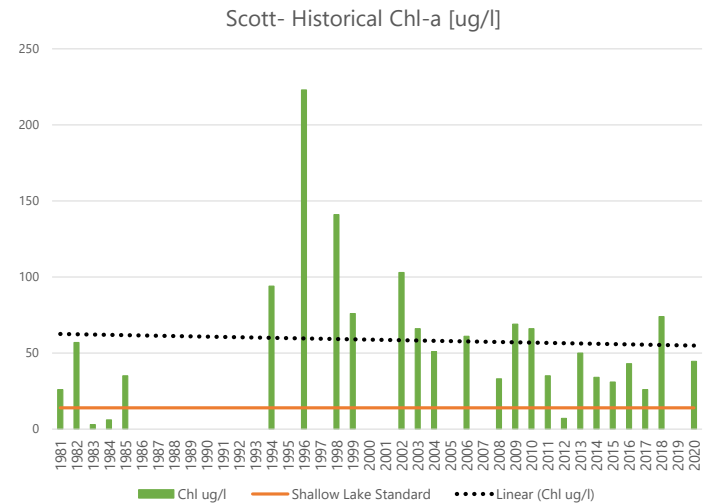
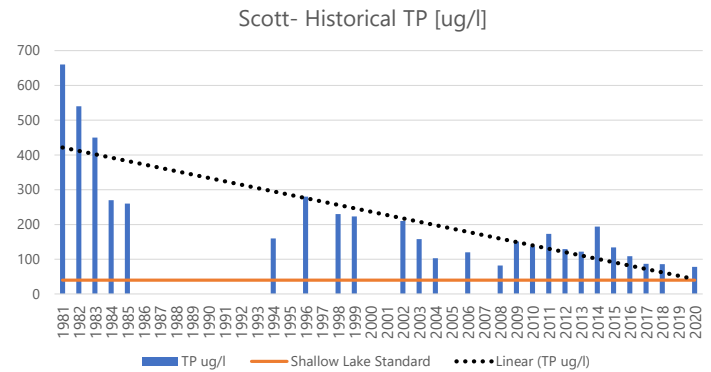


# SCOTT LAKE

## 2021 Water Quality

Lake not sampled

## Historic Water Quality



# SWARTOUT LAKE

## QUICK FACTS

Littoral Area: 171 acres

Residence Time: 460 days

Surface Area: 171 acres

Subwatershed Area: 5,551 acres

Maximum Depth: 12 feet

Upstream Waters: Henshaw, Albion

### Common Fish

Black Bullhead,  
Black Crappie,  
Common Carp

### Dominant Vegetation

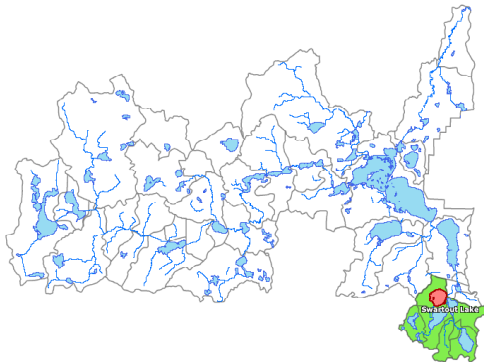
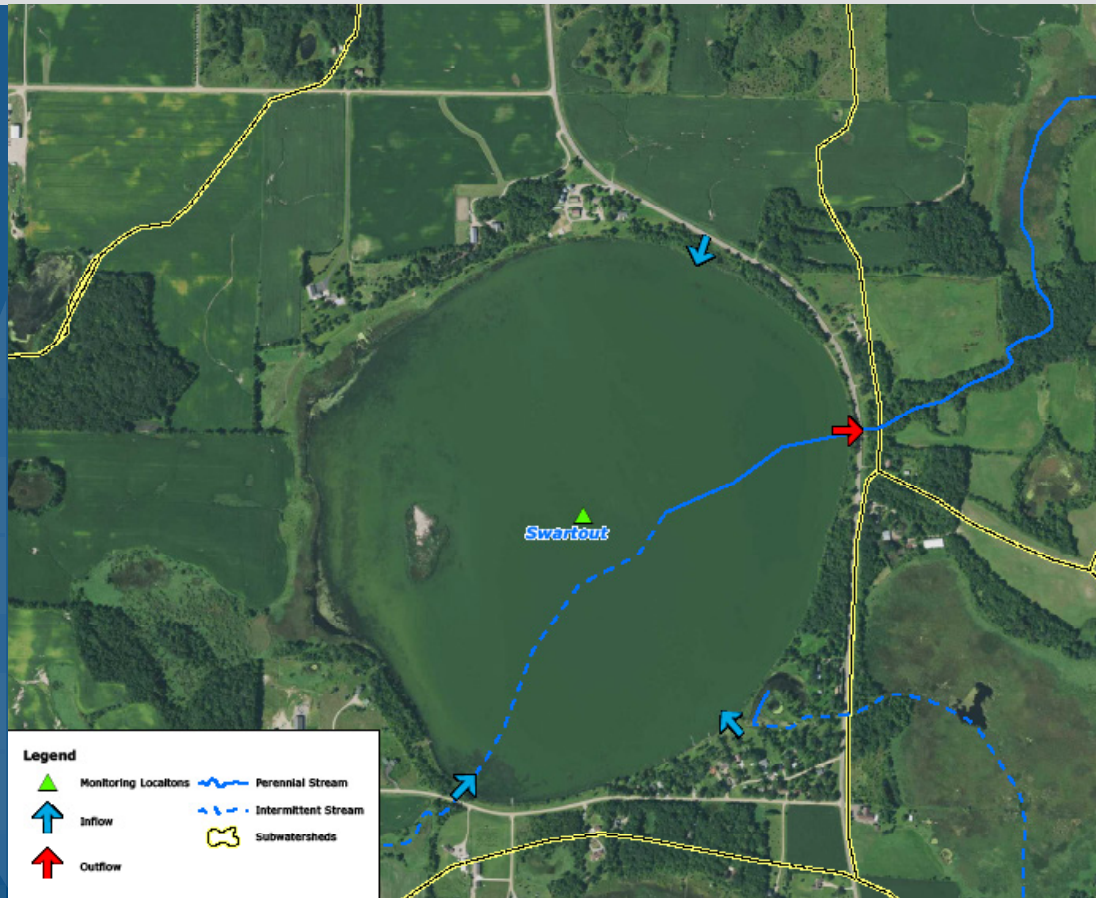
Coontail, sago  
pondweed, bushy  
pondweed

### Invasive Species

Curly-leaf  
pondweed

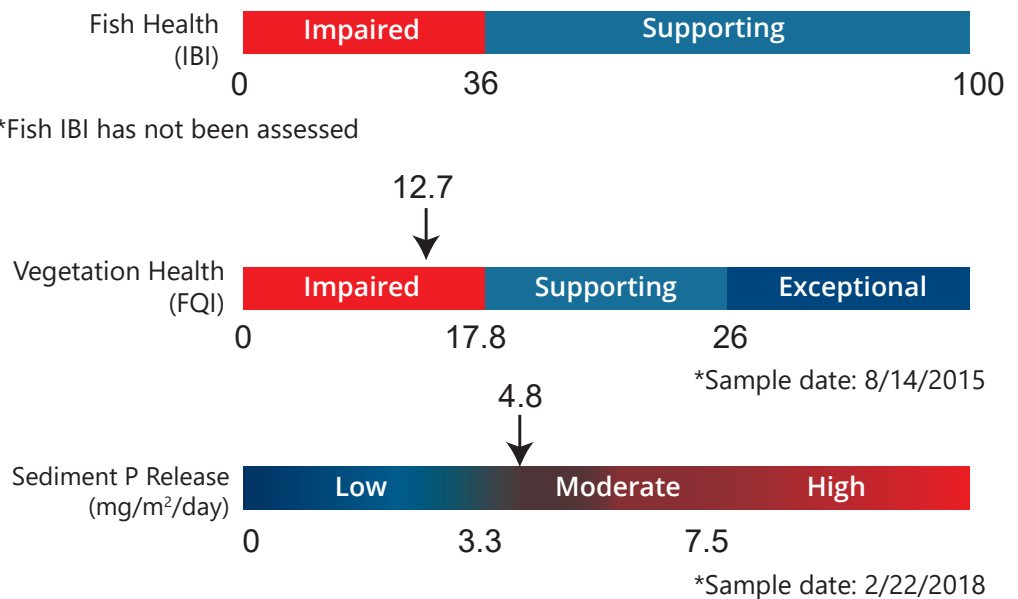
### Status

Impaired, TMDL  
Completed 2010



## TO DO LIST

- ▲ AIS management
- ▲ Rough fish management
- ▲ Manage upstream loads



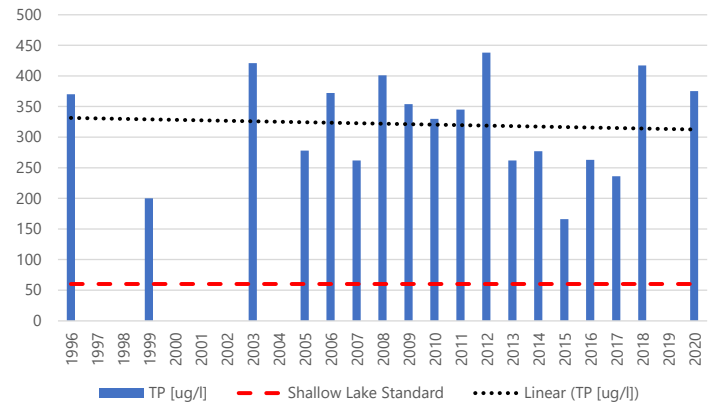
# SWARTOUT LAKE

## 2021 Water Quality

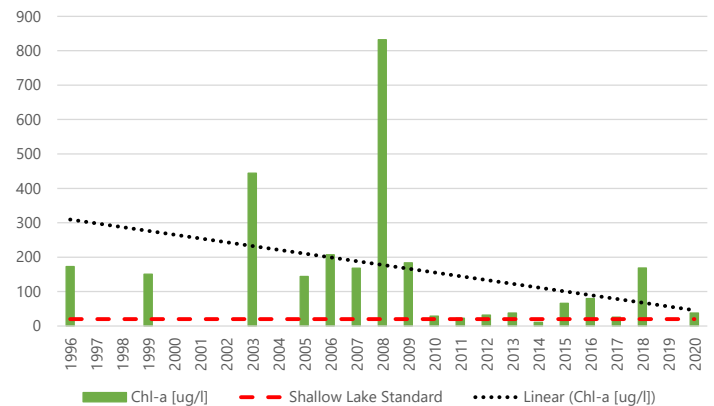
Lake not sampled

## Historic Water Quality

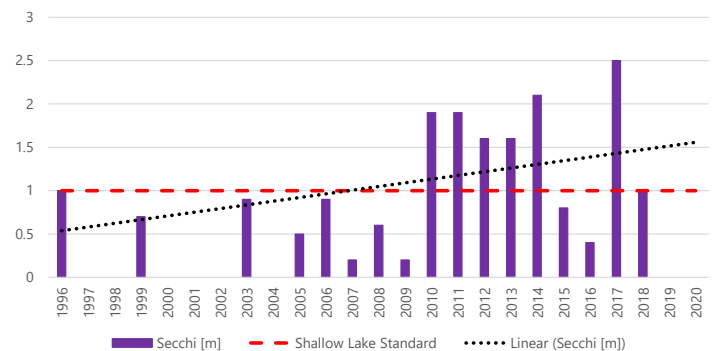
Swartout - Historical TP [ug/l]



Swartout - Historical Chl-a [ug/l]



Swartout - Historical Secchi Depth [m]



# UNION LAKE

## QUICK FACTS

Littoral Area: 27 acres

Residence Time: 291 days

Surface Area: 93 acres

Subwatershed Area: 4,741 acres

Maximum Depth: 35 feet

Upstream Waters: None

### Common Fish

Black Crappie,  
Bluegill, Northern  
Pike, Largemouth  
Bass

### Dominant Vegetation

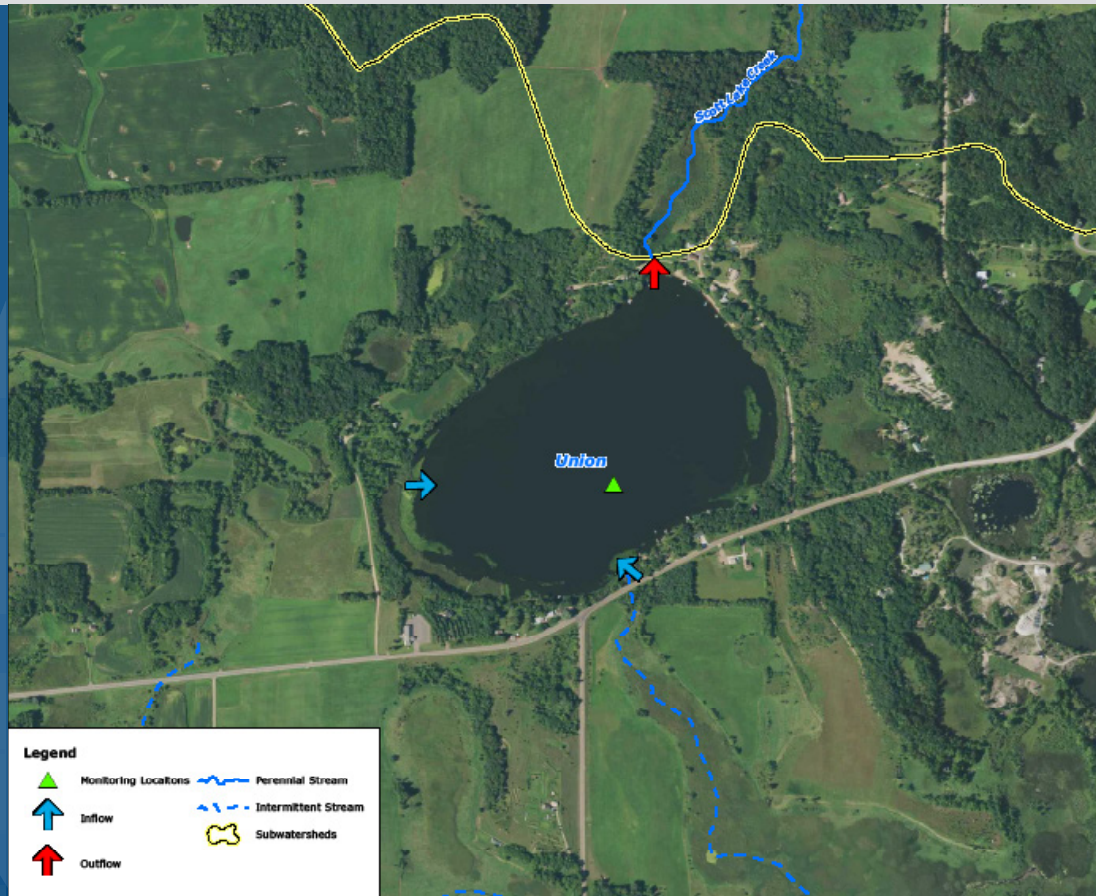
Coontail, curly-leaf  
pondweed, sago  
pondweed

### Invasive Species

Curly-leaf  
pondweed

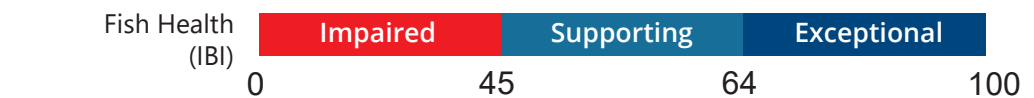
### Status

Impaired, TMDL  
Completed 2009

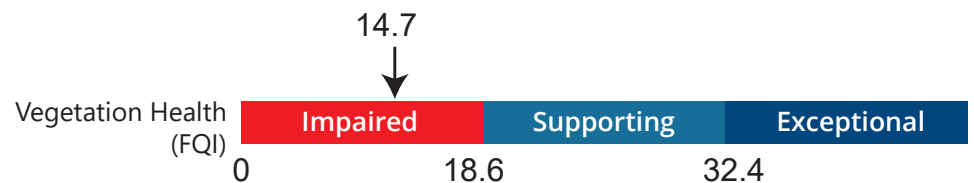


## TO DO LIST

- ▲ Manage upstream loads



\*Fish IBI has not been assessed



\*Sample date: 6/17/2016



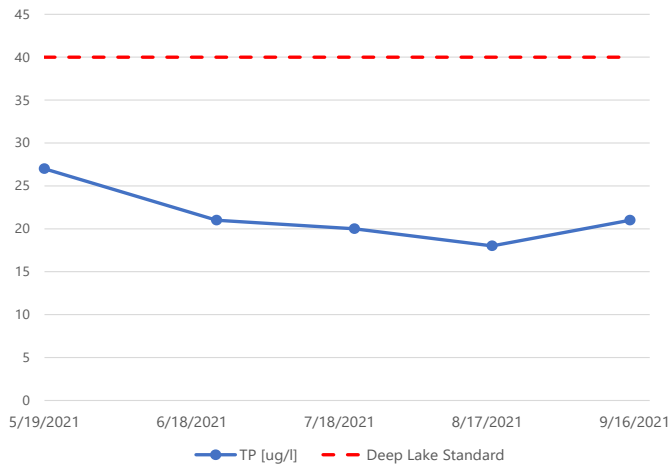
\*Sediment release rate has not been assessed



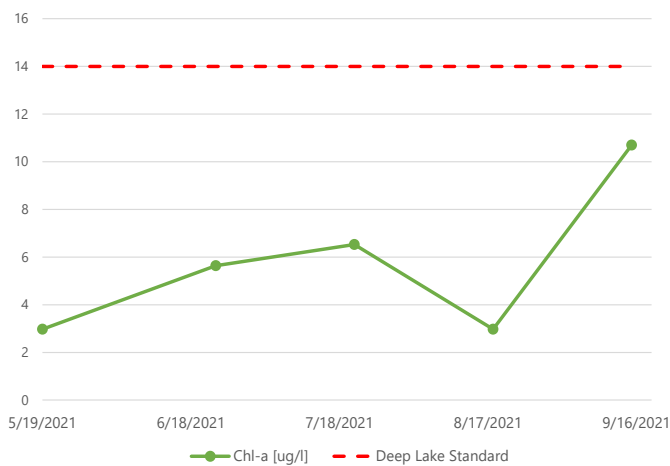
# UNION LAKE

## 2021 Water Quality

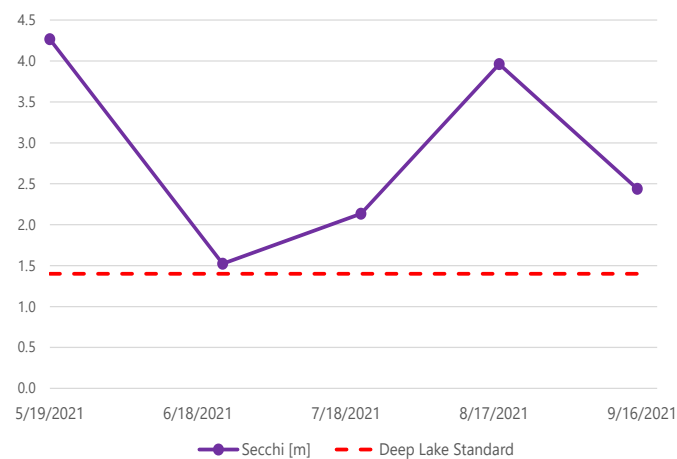
Union - 2021 TP [ug/l]



Union - 2021 Chl-a [ug/l]

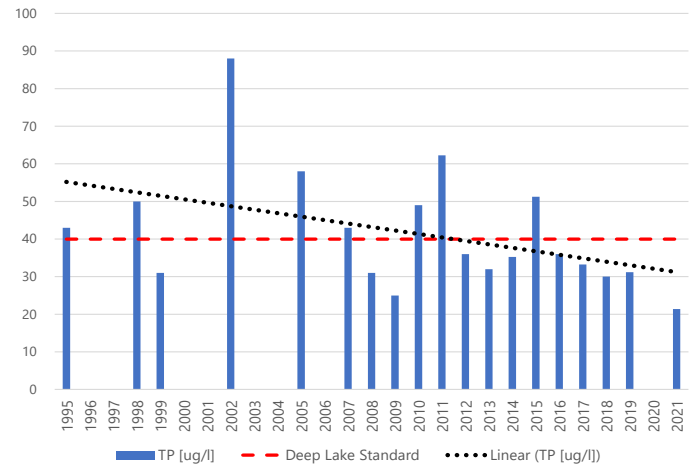


Union - 2021 Secchi Depth [m]

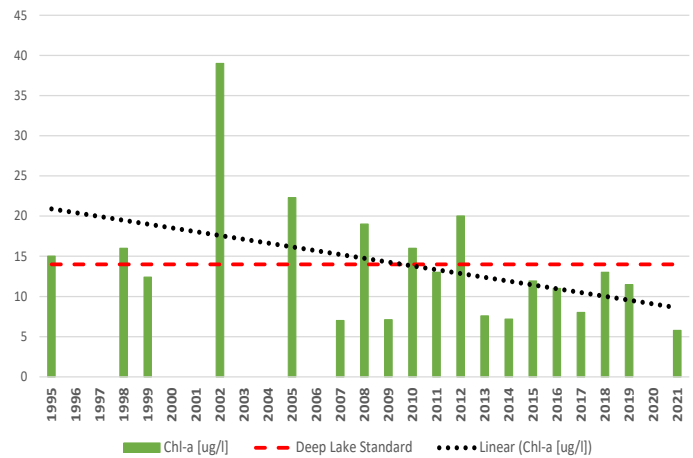


## Historic Water Quality

Union - Historical TP [ug/l]



Union - Historical Chl-a [ug/l]



Union - Historical Secchi Depth [m]

