The Role of Science in the Long-Term Rehabilitation of Delavan Lake, Wis.

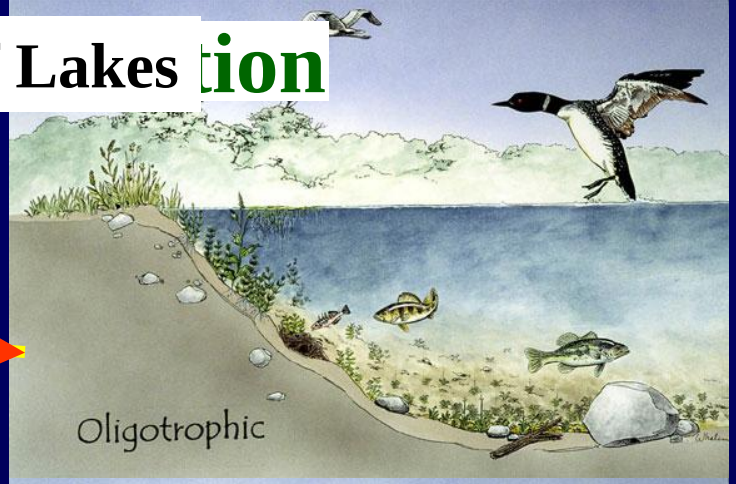
Dale Robertson

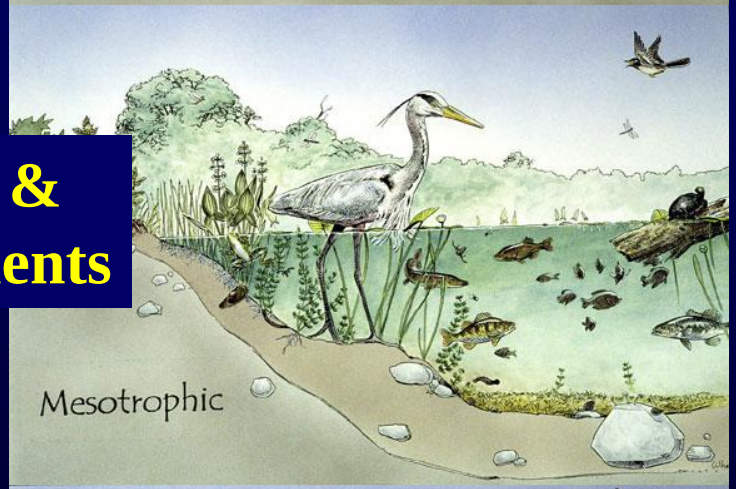
U.S. Geological Survey, Wisconsin Water Science Center
Email: dzrobert@usgs.gov Phone: 608-821-3867

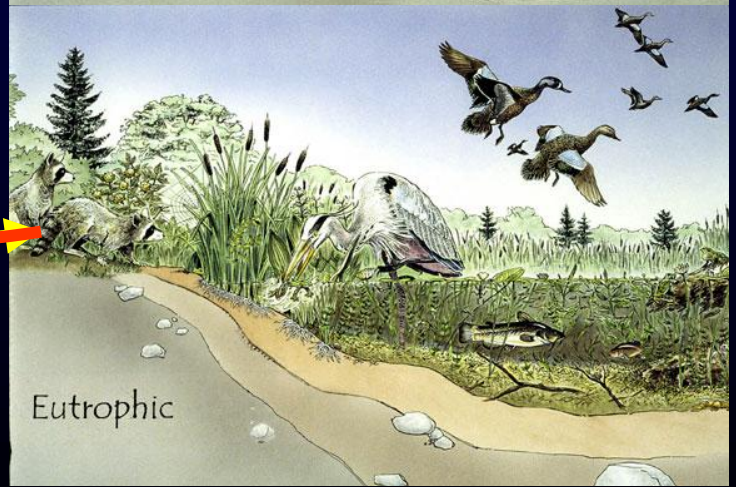
In Collaboration with:
Delavan Lake Sanitary District
Town of Delavan
Wisconsin DNR
University of Wisconsin
U.S. Army Corps of Engineers
U.S. EPA
U.S. Dept. of Agriculture

USGS

Types of Lakes tion







Time & Nutrients

Oligotrophic
- Low Nutrient Conc.
- Low Productivity.
- Clear Water
- Desirable Fishery but often limited

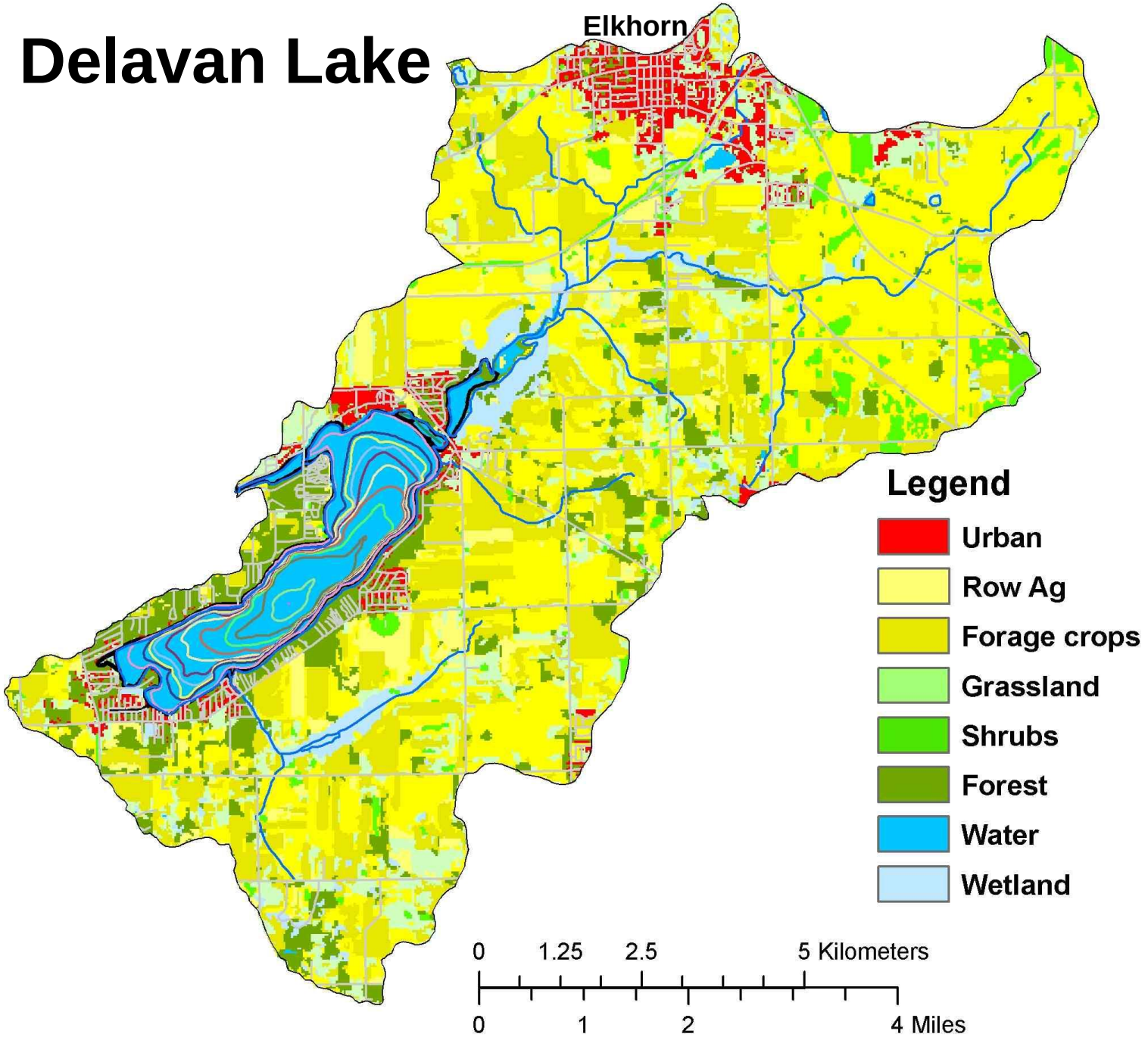
Mesotrophic
- Moderate Nutient Conc.
- Increased Productivity
- Occasional Algal Bloom
- Good Fishery

Eutrophic
- High Nutrient Conc.
- Very Productive
- Frequent Algal Blooms
- Freq. Deep DO Depletion
- Rough Fish Common

Delavan Lake

Morphometry
Area – 700 ha; 3.7 mi^2
Fetch – 6 km; 3.5 mi
Max Depth – 16.5 m; 54 ft
Mean Depth – 7.6 m; 25 ft

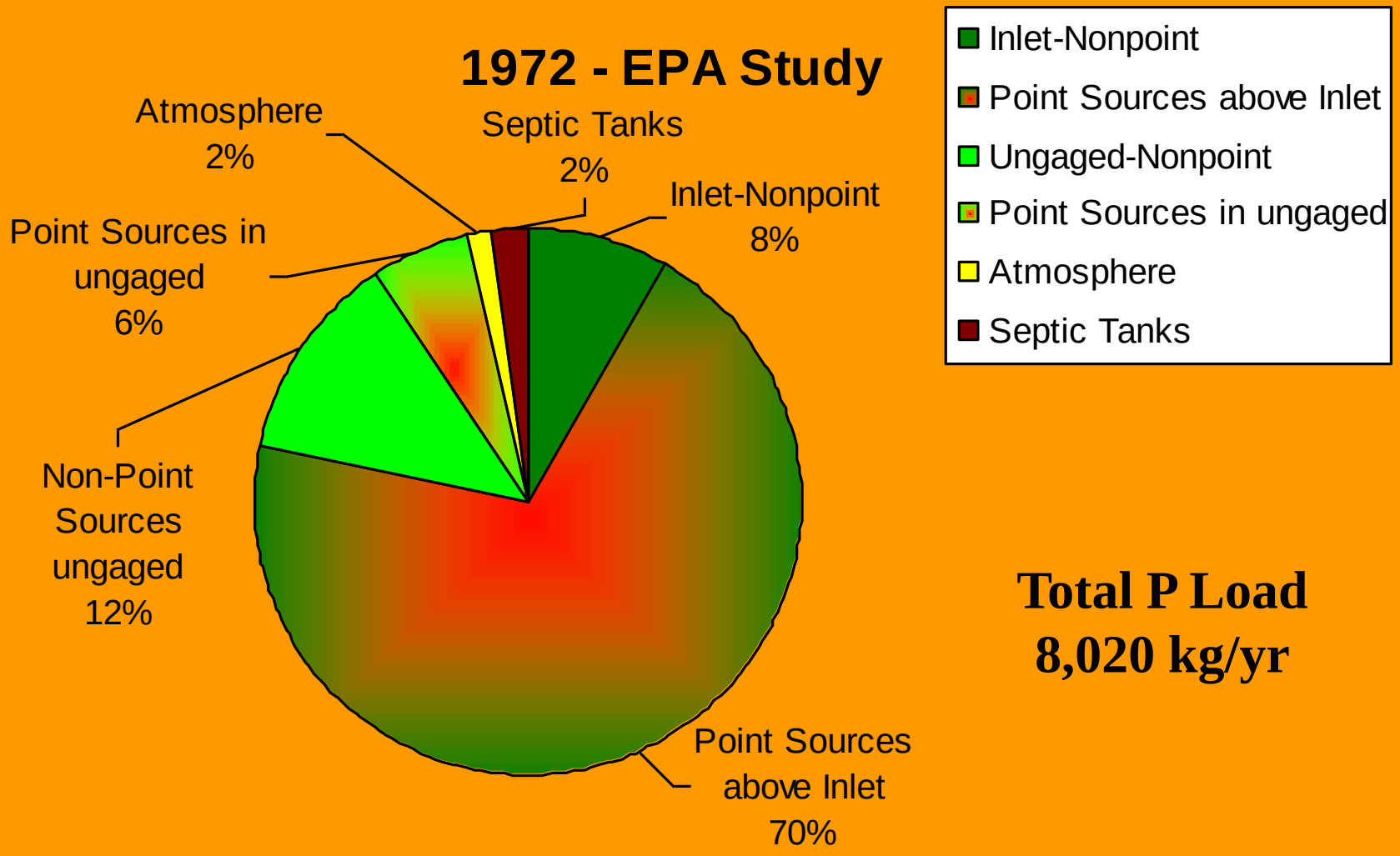
Delavan Lake



Delavan Lake - Productivity


LUND

Sources of Nutrients to Delavan Lake

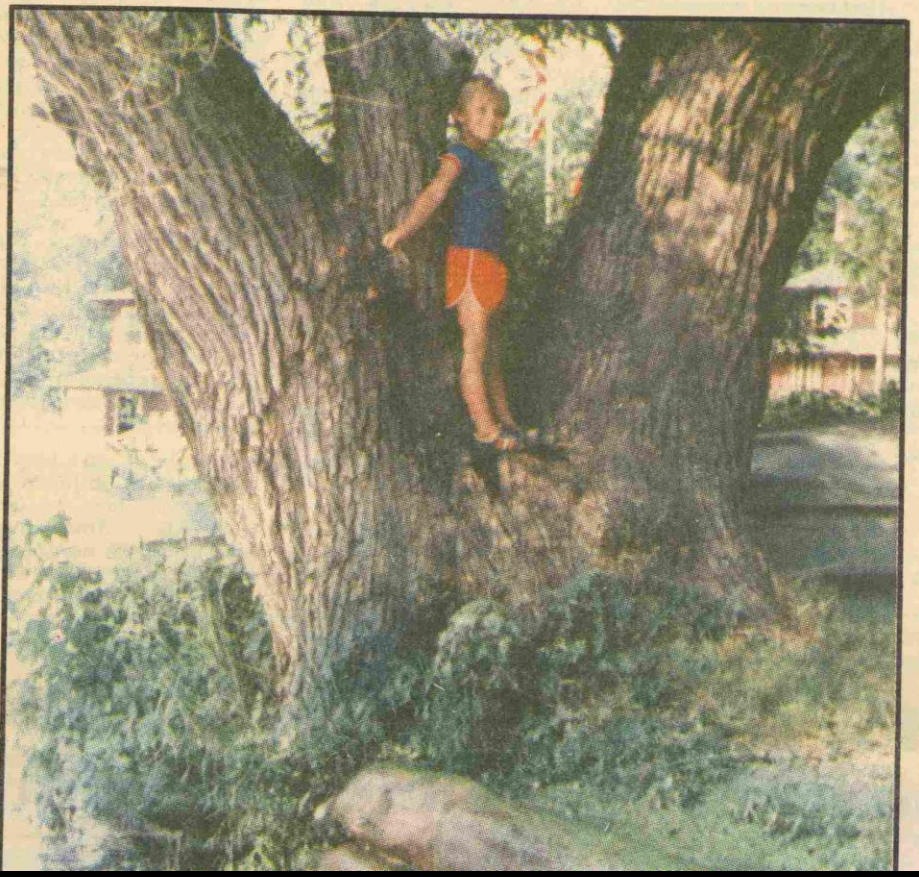


Total P Load
8,020 kg/yr

Point Sources Contribute ~76% of the Phosphorus Loading to the Lake

WALWORTH COUNTY Week

Supplement to *The Janesville Gazette, published in Walworth County*—Tuesday, July 19, 1983



Algae in Delavan Lake triggers health worries, sends vacationers home

By Jon Henkes

DELAVAN LAKE—Year-round residents and vacationers at public and private beaches here have been warned that swimming in the lake may be hazardous to their health.

Concerned that decaying algae in the lake is emitting a toxic substance proven harmful to aquatic life, a state Department of Natural Resources official told lake residents last week to instruct their families and friends that swimming in Delavan Lake could produce gastrointestinal ailments such as nausea, vomiting and diarrhea.

That warning prompted the exodus of several vacationing families from the area, while prompting many others to drive to the city of Delavan's Mill Pond swimming area or to Geneva Lake to go swimming.

At the town of Delavan lakefront park, where major improvements have recently been made to attract summer vacationers, about 250 beachgoers drove away in disgust on the weekend of July 9-10.

That disaster occurred, however, three days before the DNR announcement about potential health problems.

On July 9 and 10, a thick coating of dead algae permeated nearly the entire lake, the end result of the spraying of a chemical algaecide into the lake on June 30 and July 7.

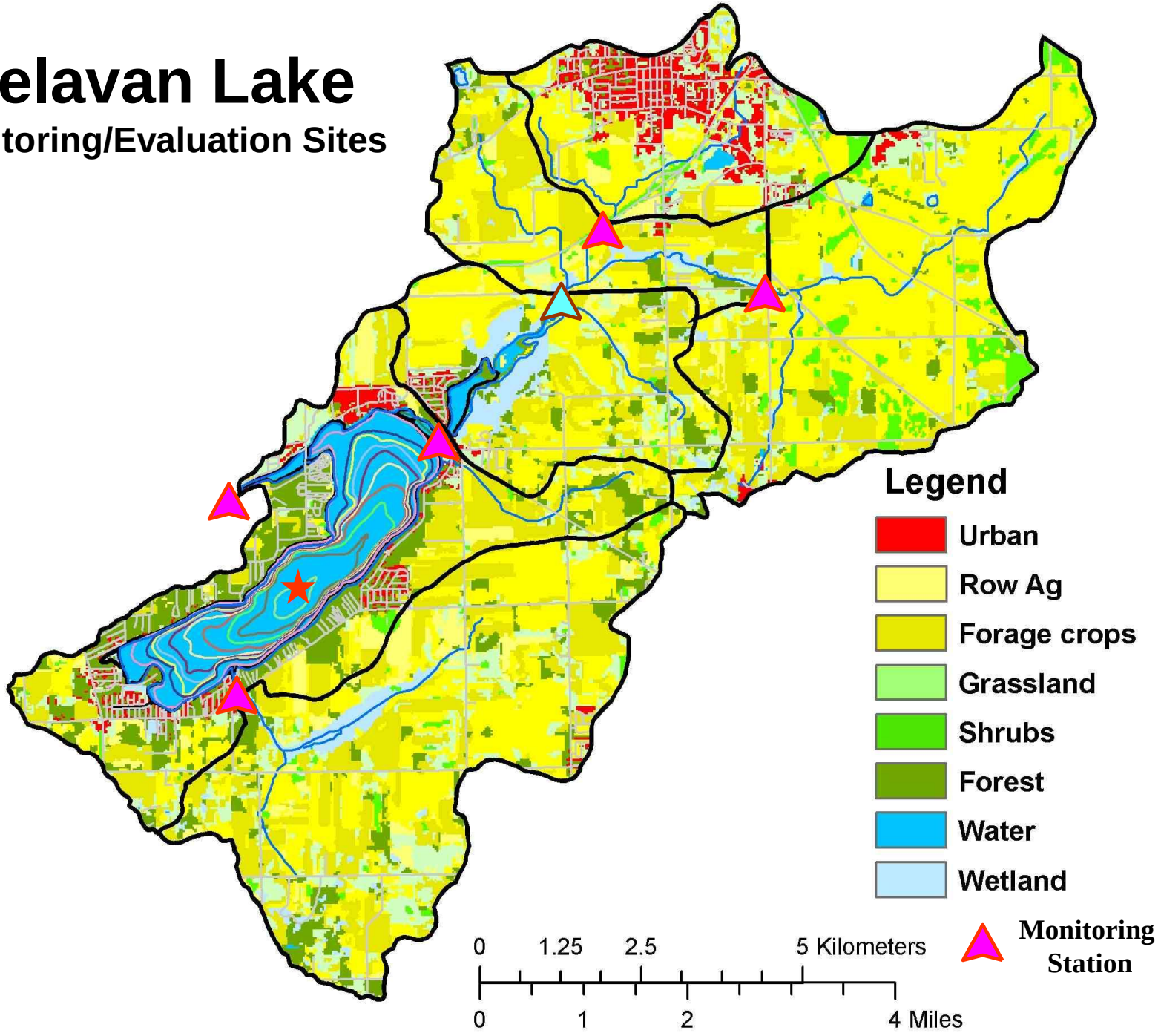
> *"Several families have requested refunds for their cottages and have packed their bags and left because of the algae. There were some children who became sick after swimming. The beach has been very quiet all week."*

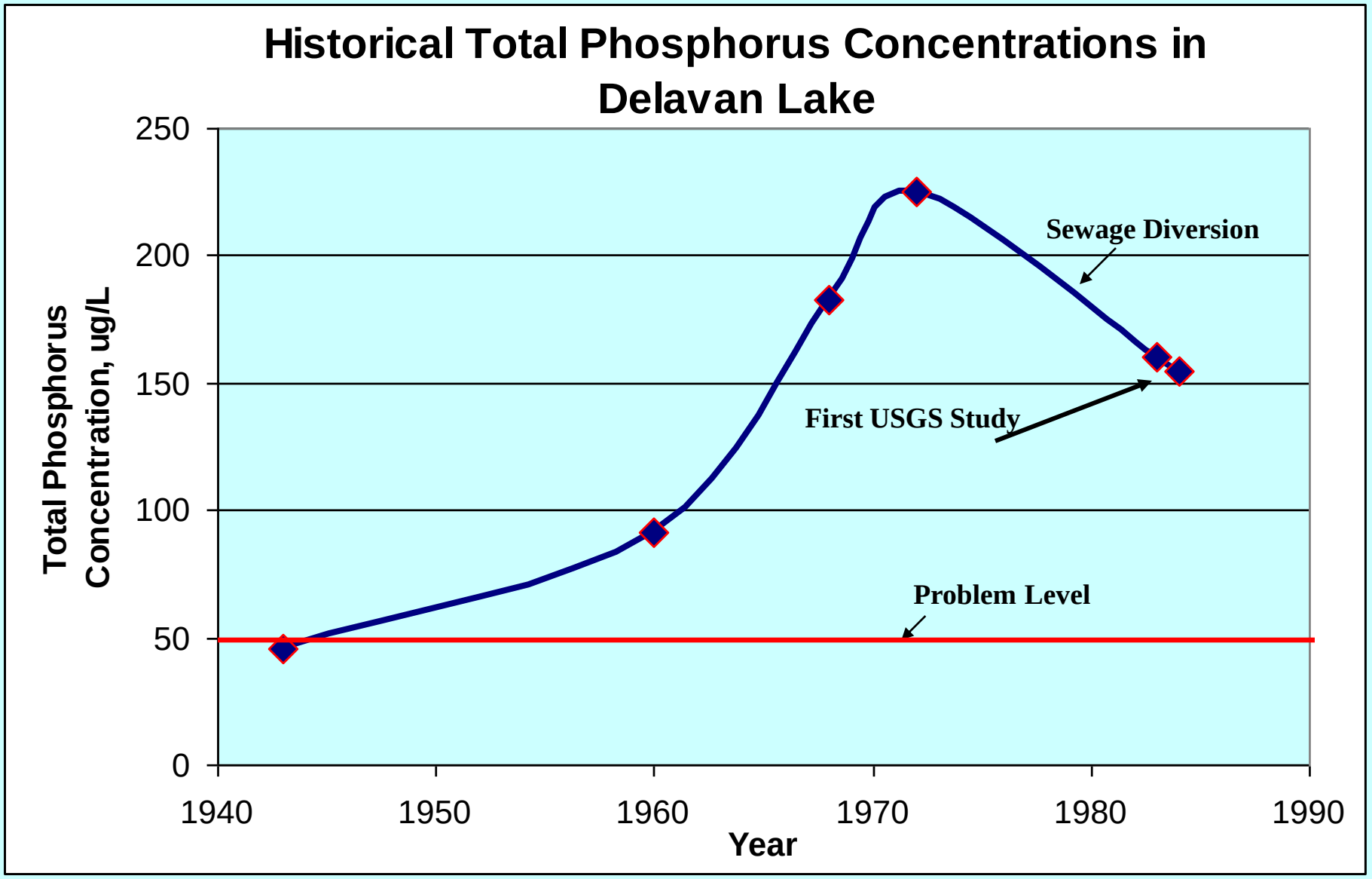
Visually uninviting the lake was not known then to contain toxic dead algae. Year-round lake resident Bill Morelli said

Turn to page 10

Delavan Lake

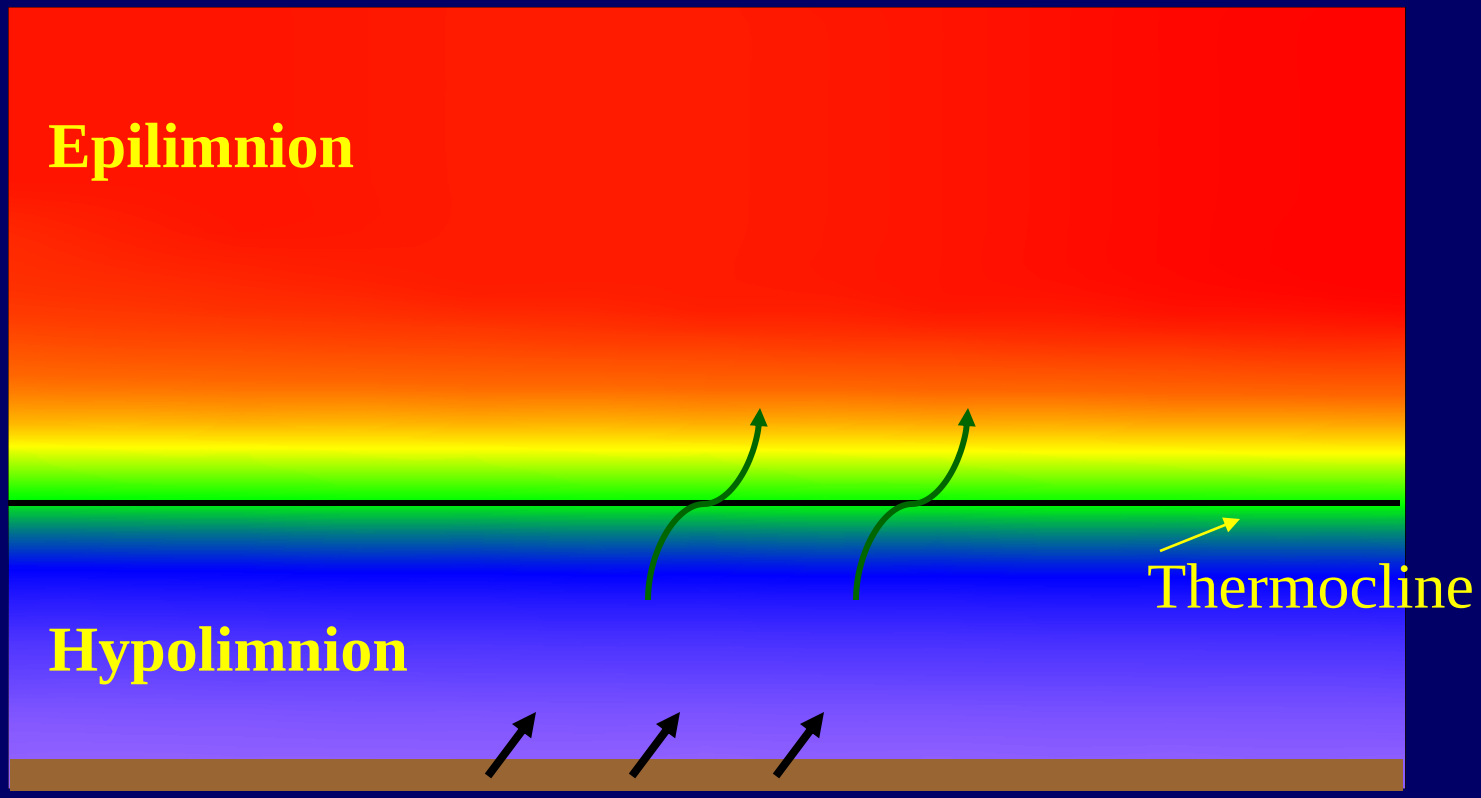
Monitoring/Evaluation Sites



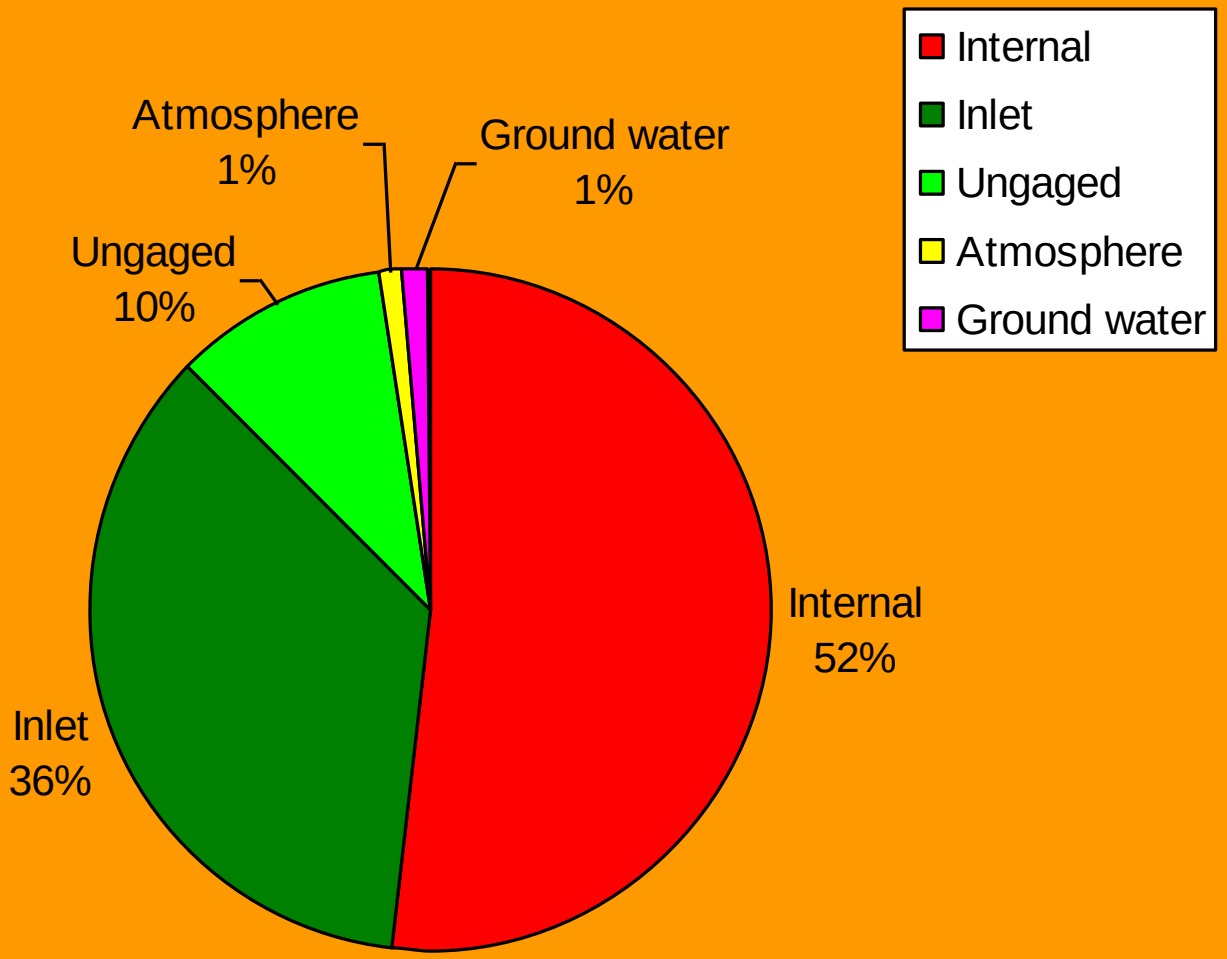


USGS science for a changing world

Internal Release of Phosphorus from Deep Sediment
"Internal Loading"



Phosphorus Budget For Delavan Lake – 1984-85

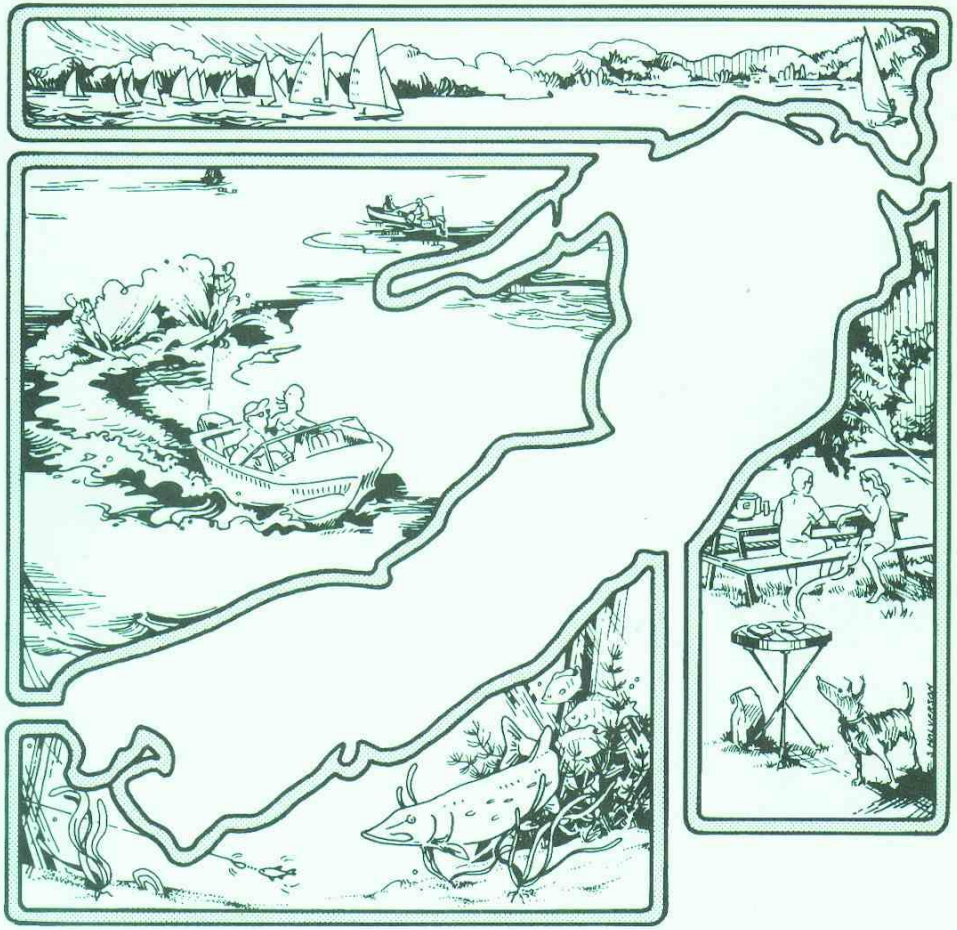


Total P Loading – 8,700 kg/yr

USGS science for a changing world

Delavan Lake: A Recovery and Management Study

Water Resources Management Workshop



Institute for Environmental Studies, University of Wisconsin—Madison
in cooperation with
Wisconsin Department of Natural Resources

September 1986

Management Strategies based on Scientific Monitoring Data and Scientific Relations/Models

Goals for Delavan Lake Rehabilitation

Increase Water Clarity – Increase Average Summer Secchi Depth from ~1.0 m to at least 1.5 m

↑

Decrease Average Summer Chlorophyll a concentration from ~30 – 50 ug/L to 14 ug/L

↑

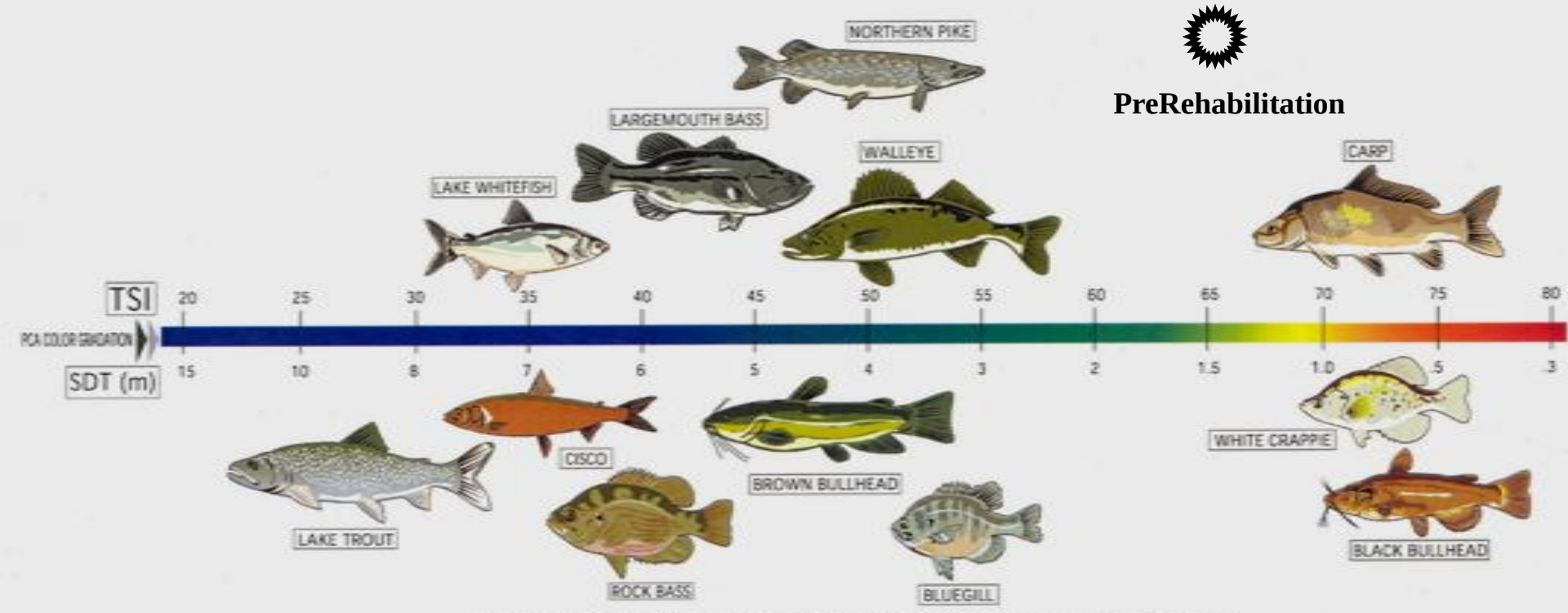
Decrease in lake spring P concentration from ~100 – 120 ug/L to about 34 ug/L

↑

Decrease P Loading to the lake from about 8,700 kg/yr to about 1,900 kg/yr

Typical conditions associated with trophic status

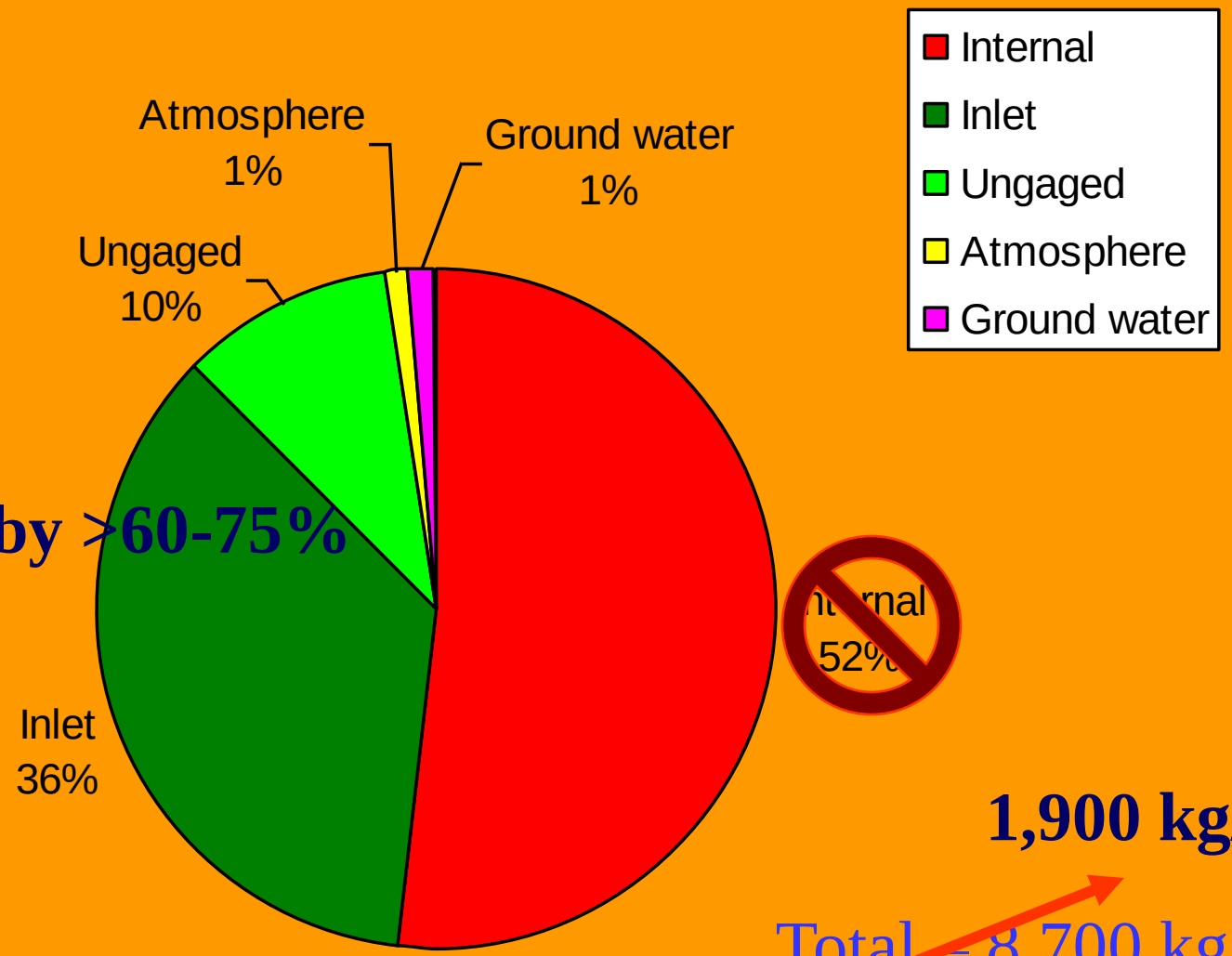
Oligotrophic **Mesotrophic** **Eutrophic** **Hypereutrophic**



PreRehabilitation

Based on work of Dennis Schupp MDNR Fisheries

Phosphorus Budget For Delavan Lake – 1984-85



Reduce by >60-75%

1,900 kg/yr

Total – 8,700 kg/yr

USGS
science for a changing world

WDNR > Dingle Johnson Funds

Local Support > Cash and In-kind

State Government

Dept. Ag. > Nonpoint Funds

USGS > Cooperative Funds

USEPA > Clean Lake Funding

> <u>Water Pollution Control Project</u> House Public Works Committee

> <u>Natural Prototype Project</u> for Rehabilitating Lakes

>> ~$ 7 Million

Kickoff Meeting with Congressman Les Aspin, 1989

External Sources

Watershed Management - BMP’s

The county has ordered removal of drainage tile on the land off Mound road.

Farmer Told Remove Tiles, Pumps

Investigation of a farmland drainage system by county and state officials has resulted in an order to remove pumping stations and drain tiles from almost six acres of property near Delavan Lake.

In a letter released last week, Frank Dobbs stated that construction of the

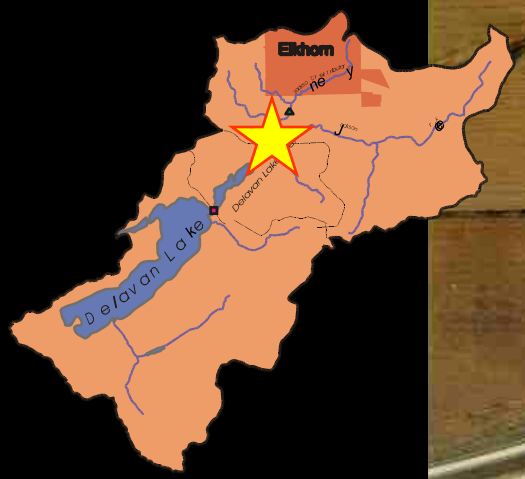
(DNR) traveled to the property Sept. 20. Based on an inspection of the construction site, Dobbs said he was able to determine that parts of the drainage system violate the county's zoning ordinance.

Town Of Delavan officials were the

diameter plastic pipe in the ground. Those pipes are then connected to an excavated pit which contains a pump. The pump transports water drained from the pipes into the pit into Jackson Creek.

When completed, the system will allow the property to be used as tillable farmland.

External Sources



SEDGE MEADOW

USGS STATION

North Pond

WET PRAIRIE

West Pond

WET PRAIRIE

East Pond

SEDGE MEADOW

WEIR

SHALLOW WATER MARSH

USGS STATION

Delavan Lake Inlet

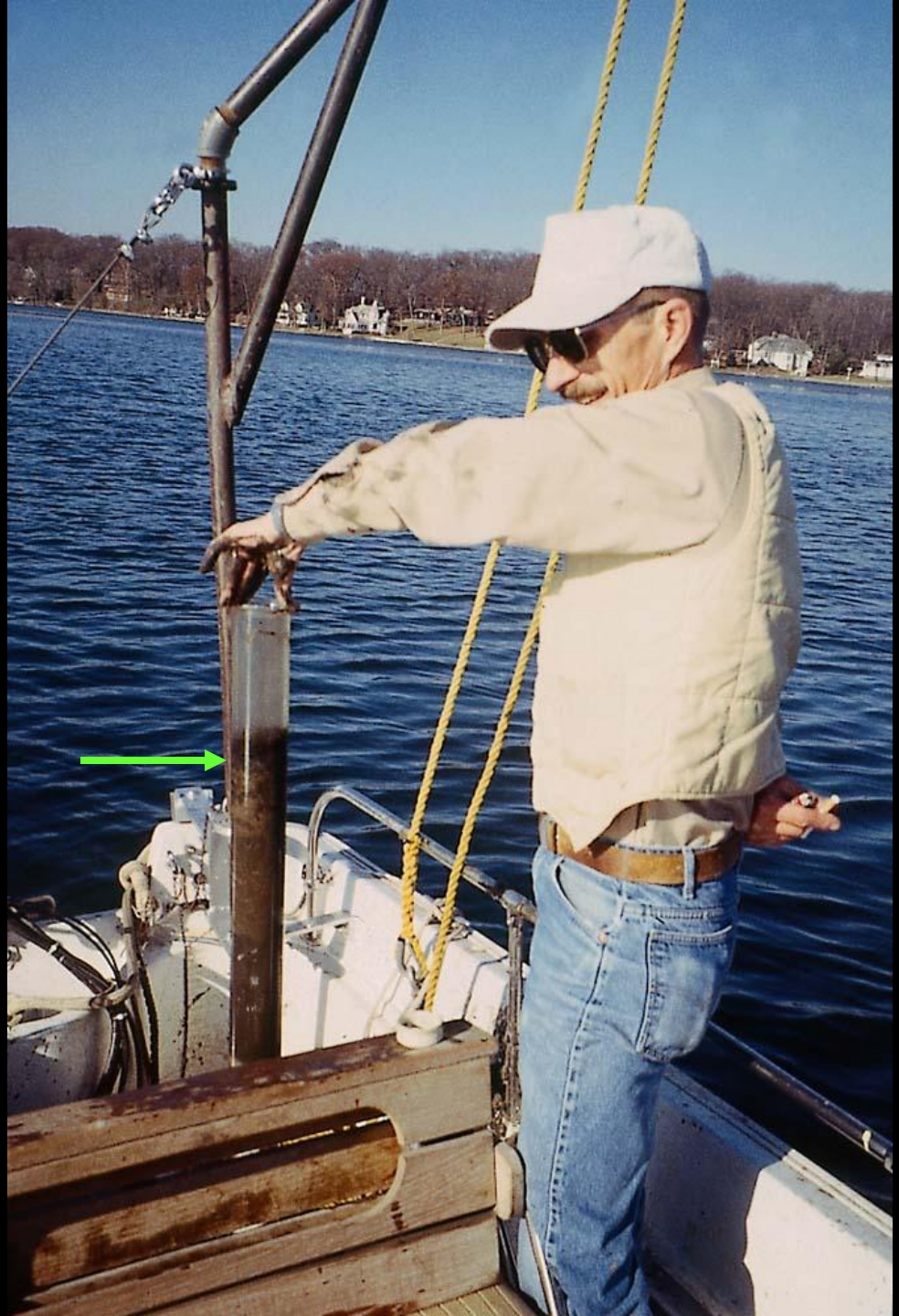
Jackson Creek Wetland

Jackson Creek Short-Circuiting

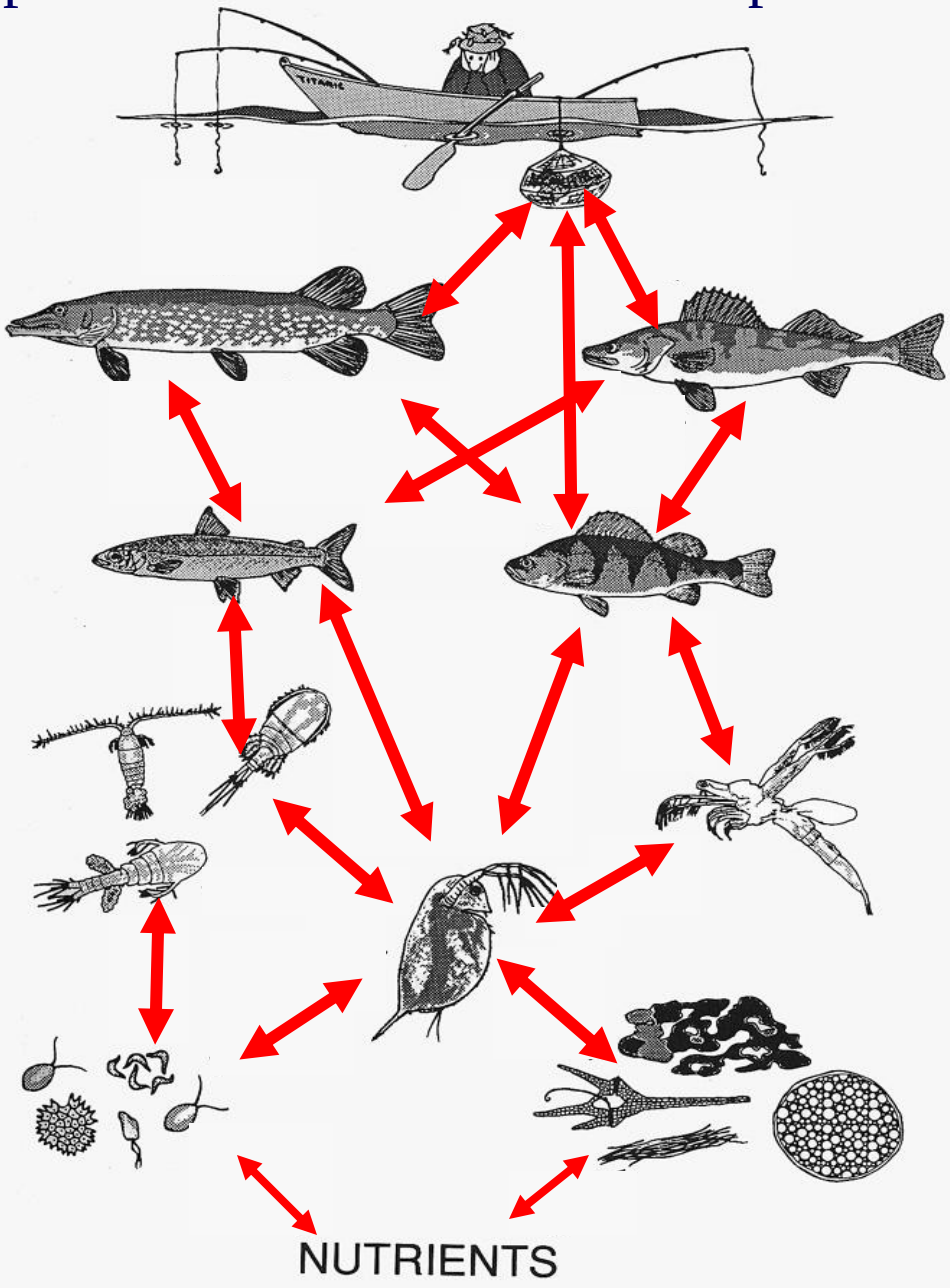

CATERPILLAR


DAM

Internal Sources Chemical Application of Alum

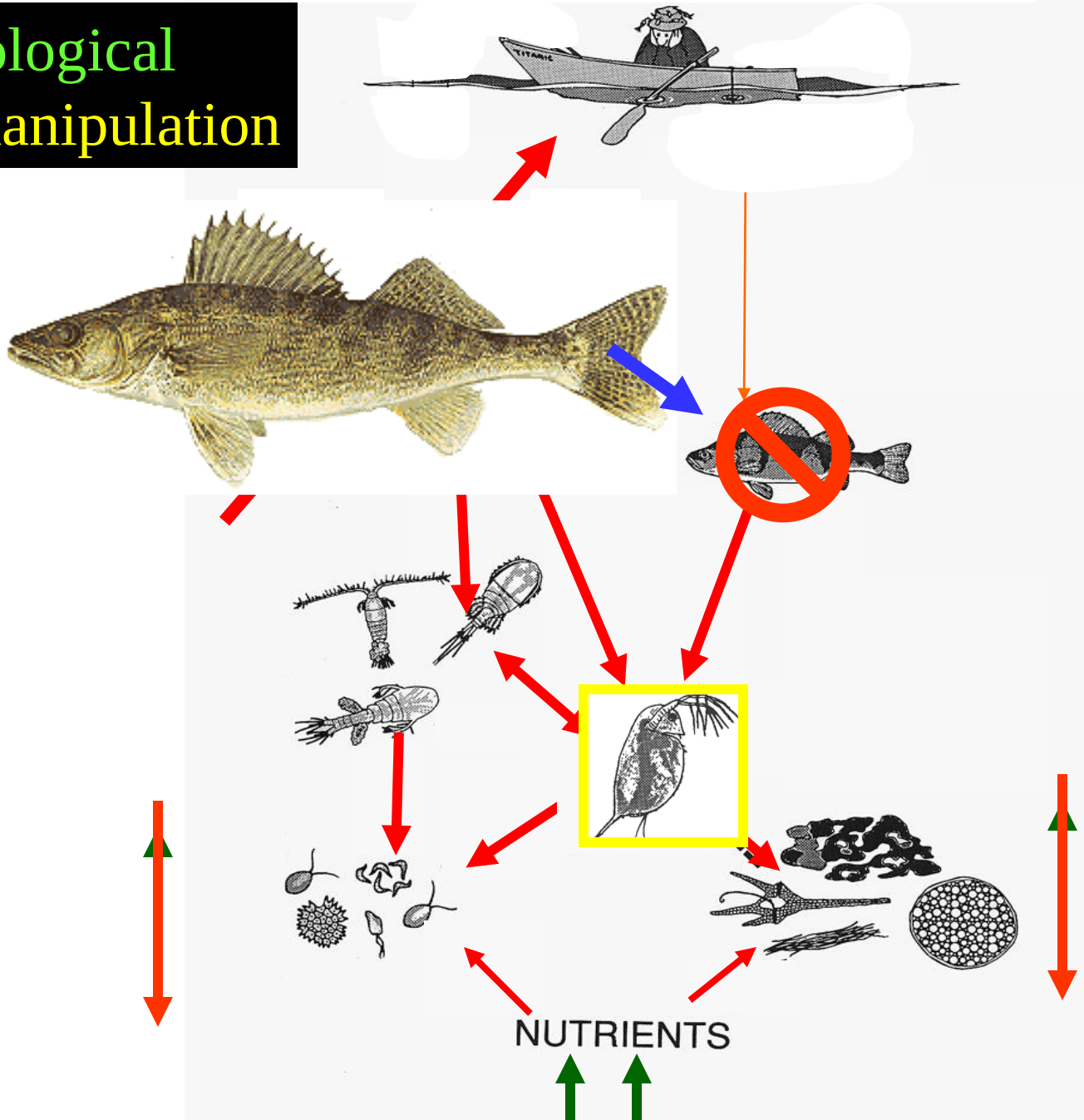


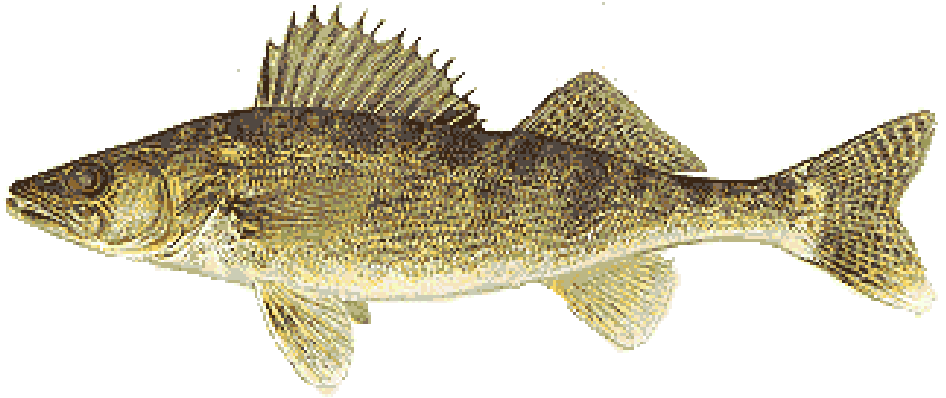
Typical Food Web of a Mesotrophic Lake



Delavan Lake - Postmanipulation

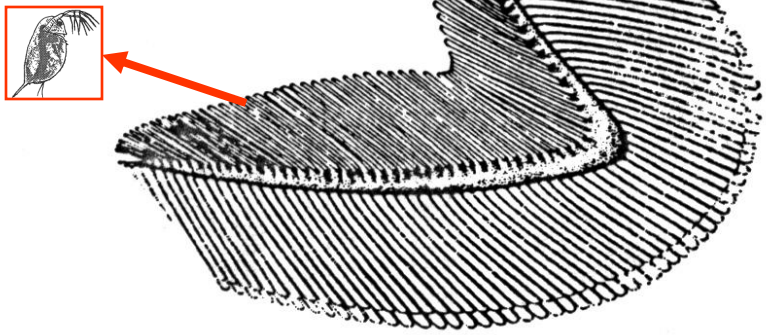
Biological - Biomanipulation

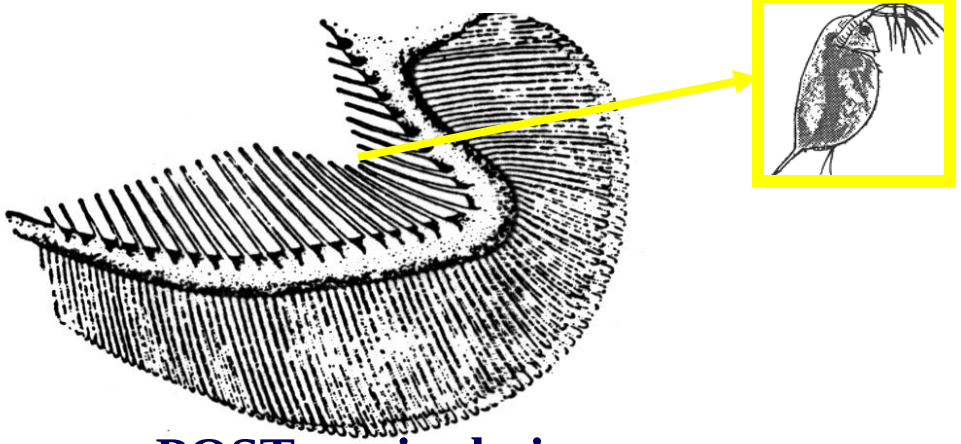




Planktivores

Piscivores





PREmanipulation

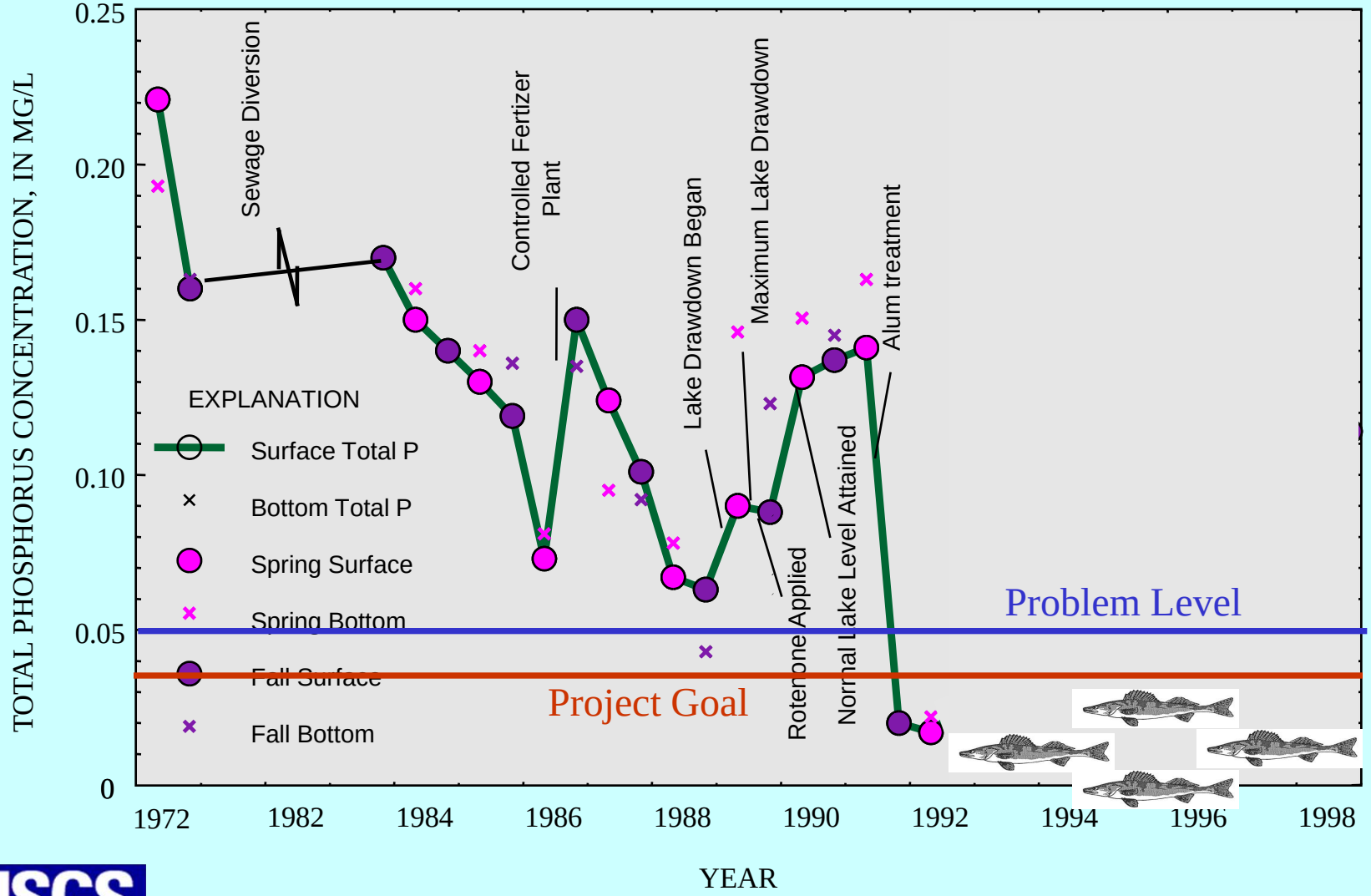
POSTmanipulation

Figure 16-29.

Lower left: First branchial arch with closely spaced gill rakers that act as a plankton sieve. *Lower right:* First branchial arch with widely spaced gill rakers of *A. mediocris*, a species that feeds primarily on small fish. (From Brooks, J. L., and Dodson, S. I.: Predation, body size, and composition of plankton. Science, 150(3692):28–35, 1965. Copyright 1965 by the American Association for the Advancement of Science.)

Rotenone Addition

DELAVAN LAKE TOTAL PHOSPHORUS CONCENTRATIONS, 1972-1992



USGS science for a changing world

/dale/projects/delavan/lakesum/laketp.g2
/dale/projects/delavan/laeksum/delsftp.t

TECHNICAL EXCELLENCE AWARD

Honoring The

DELAVAN LAKE PROJECT

- 1991 -

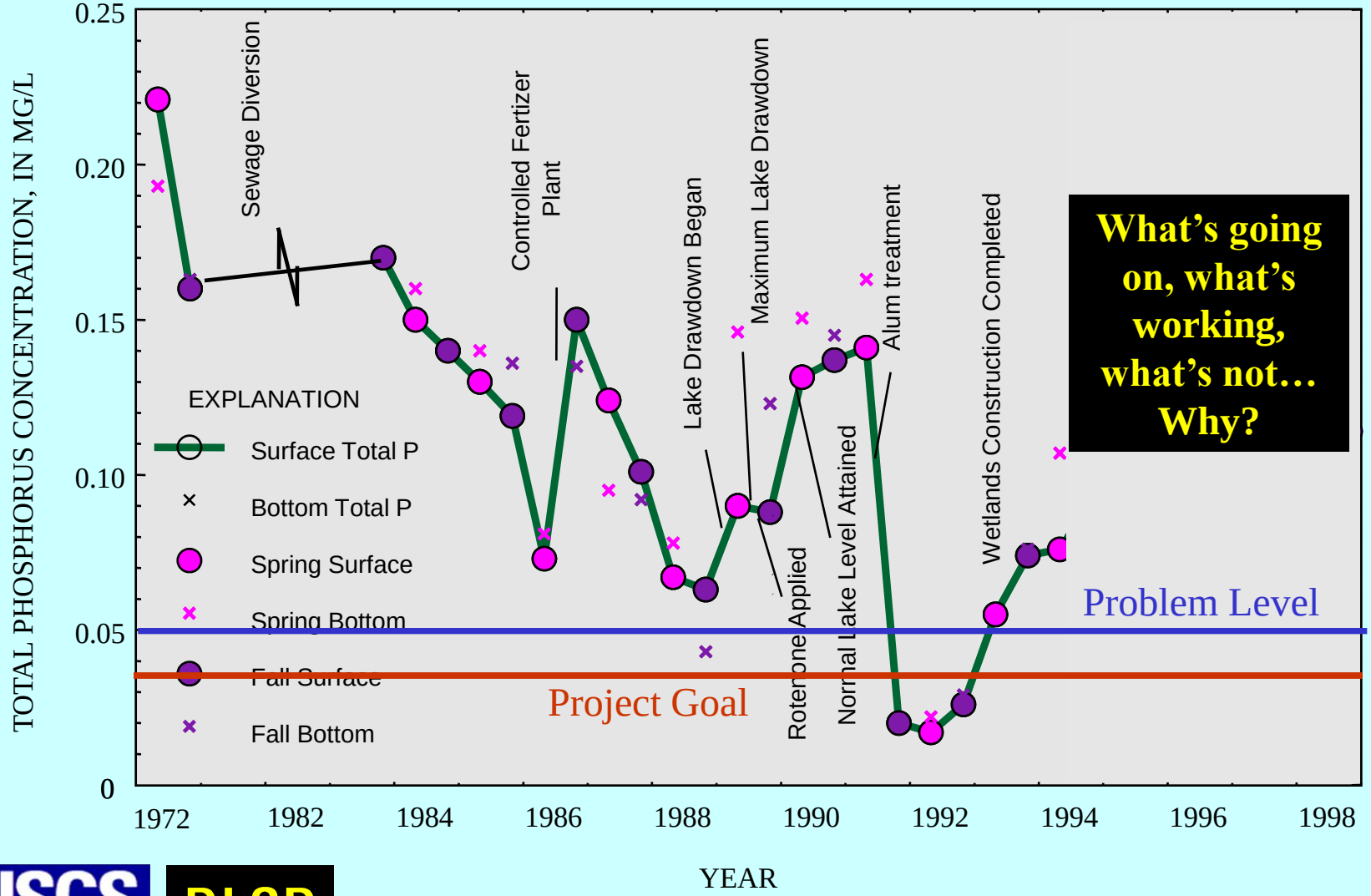
In Recognition Of
Outstanding Achievement In Lake
Restoration, Protection and Management

North American Lake Management Society

****

Midwest Floods of 1993

DELAVAN LAKE TOTAL PHOSPHORUS CONCENTRATIONS, 1972-1994



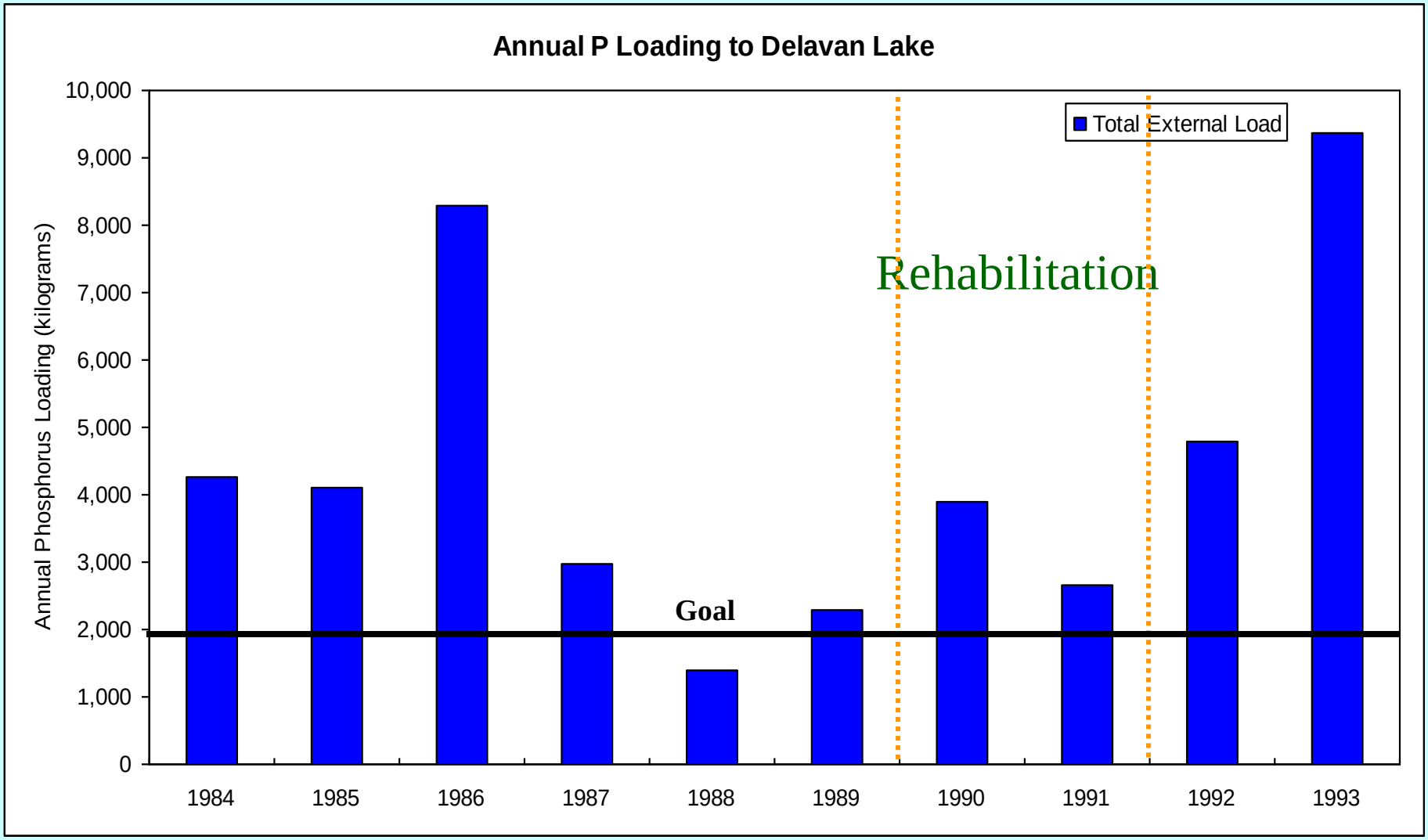
USGS science for a changing world

DLSD

/dale/projects/delavan/lakesum/laketp.g2
/dale/projects/delavan/laeksum/delsftp.t


GENEVA LANDINGS
GENEVA LANDINGS
MEMBERS & GUESTS ONLY
PRIVATE PROPERTY
NO TRESPASSING
TRESPASSERS WILL BE PROSECUTED

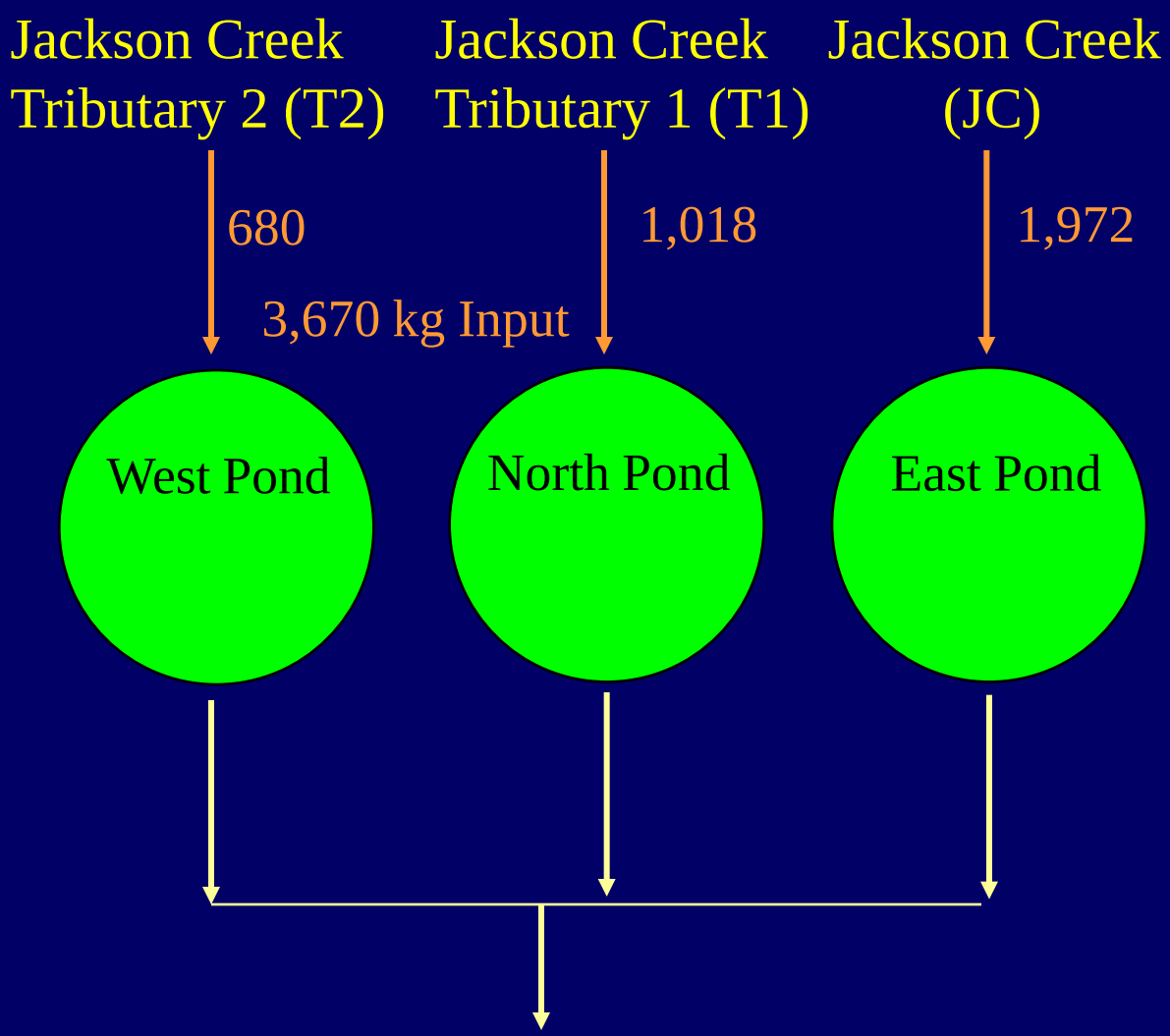
Phosphorus Loading to Delavan Lake



USGS science for a changing world


SEDGE MEADOW
USGS STATION
North Pond
WET PRAIRIE
West Pond
WET PRAIRIE
East Pond
SEDGE MEADOW
WEIR
SHALLOW WATER MARSH
USGS STATION
Delavan Lake Inlet
Jackson Creek Wetland

Phosphorus Budget - kg's



Tributary inflow

Pond Accumulation

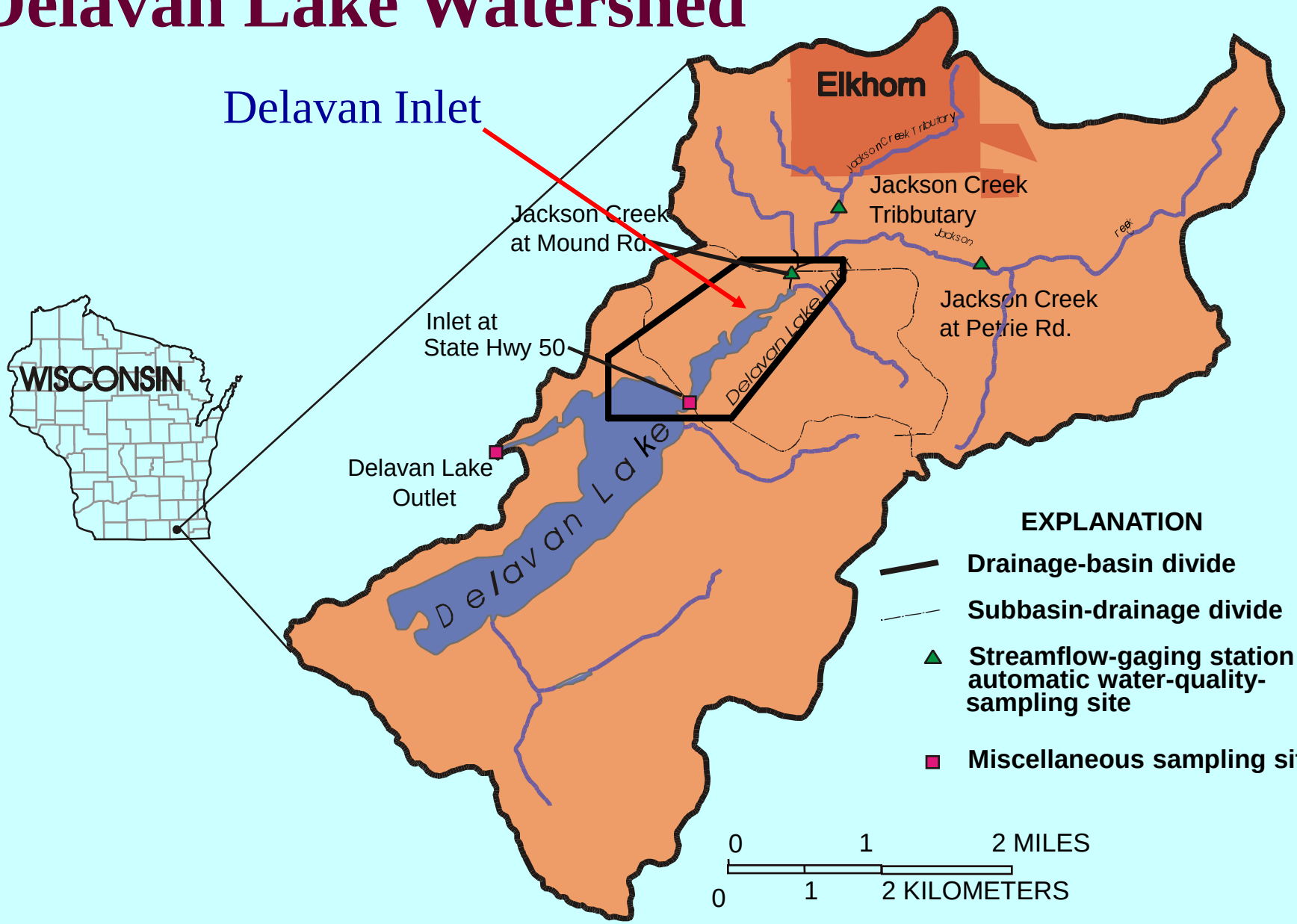
Estimated Pond Loss

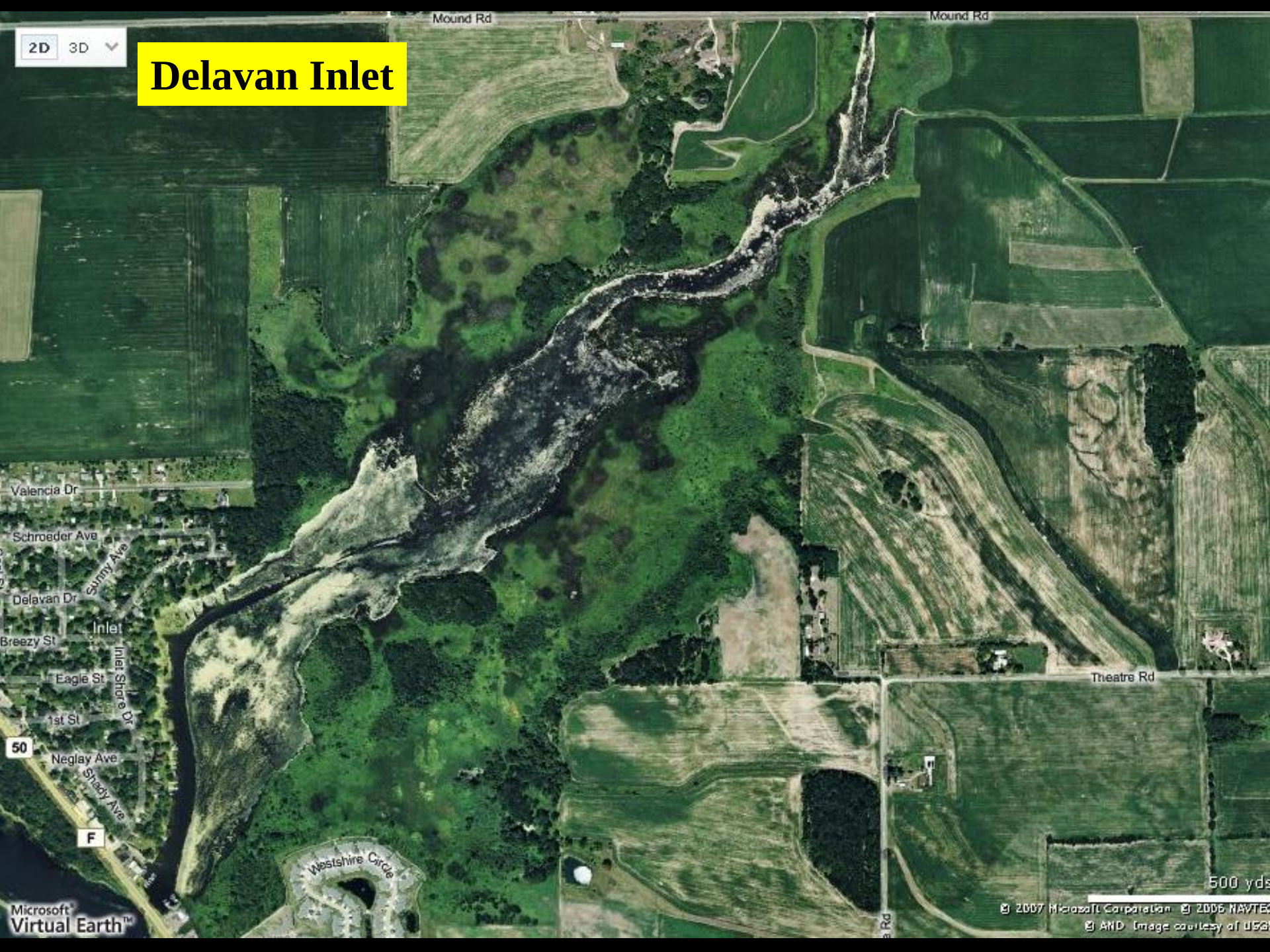
Phosphorus outflow @ Mound Rd.

2,560 kg Output
- 30% P Removal

USGS science for a changing world

Delavan Lake Watershed

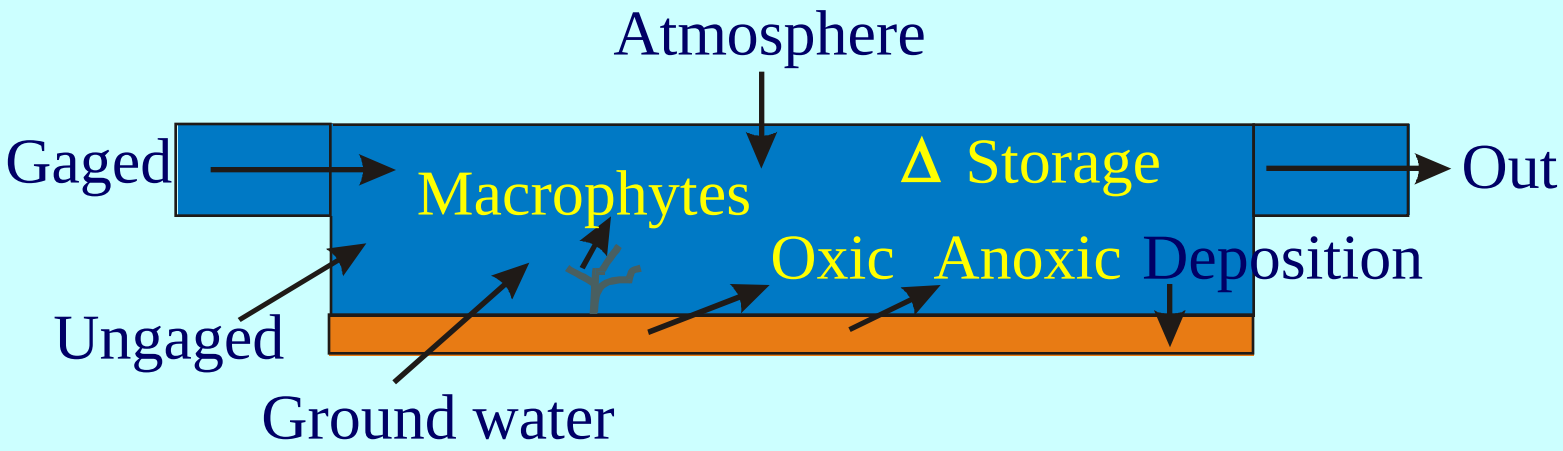



2D
3D
Delavan Inlet
Mound Rd
Mound Rd
Valencia Dr
Schroeder Ave
Sunny Ave
Delavan Dr
Inlet
Breezy St
Eagle St
Inlet Shore Dr
1st St
50
Neglay Ave
Shady Ave
F
Westshire Circle
Theatre Rd
500 yds
Microsoft
Virtual Earth™

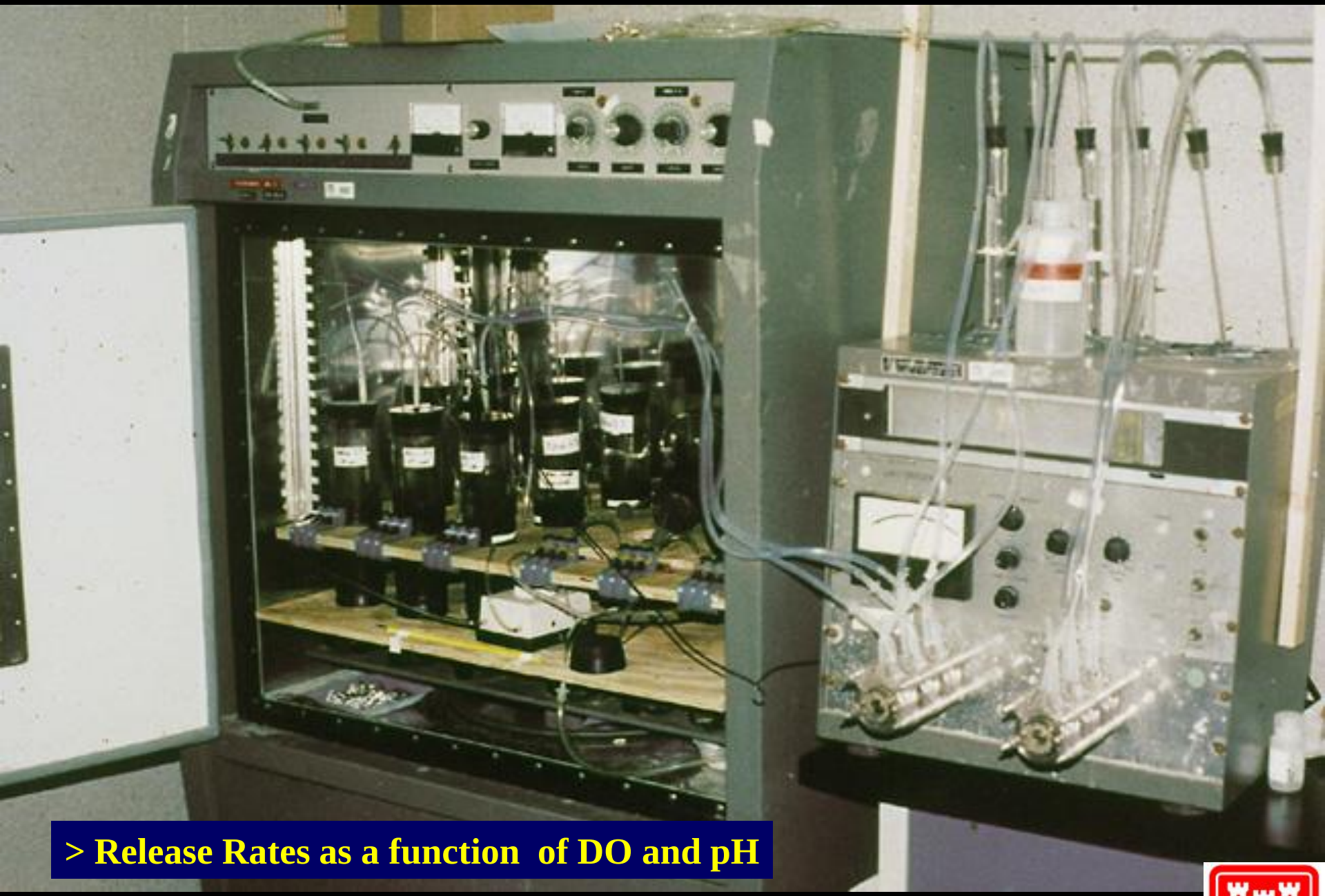

9 1 19

Phosphorus Budget for Delavan Lake Inlet

$$P_G + P_{UG} + G_{GW} + P_{ATM} + \{(P_{SO} + P_{SA} + P_{MAC}) + \Delta S - P_{DEP}\} = P_{OUT}$$




5 3 94

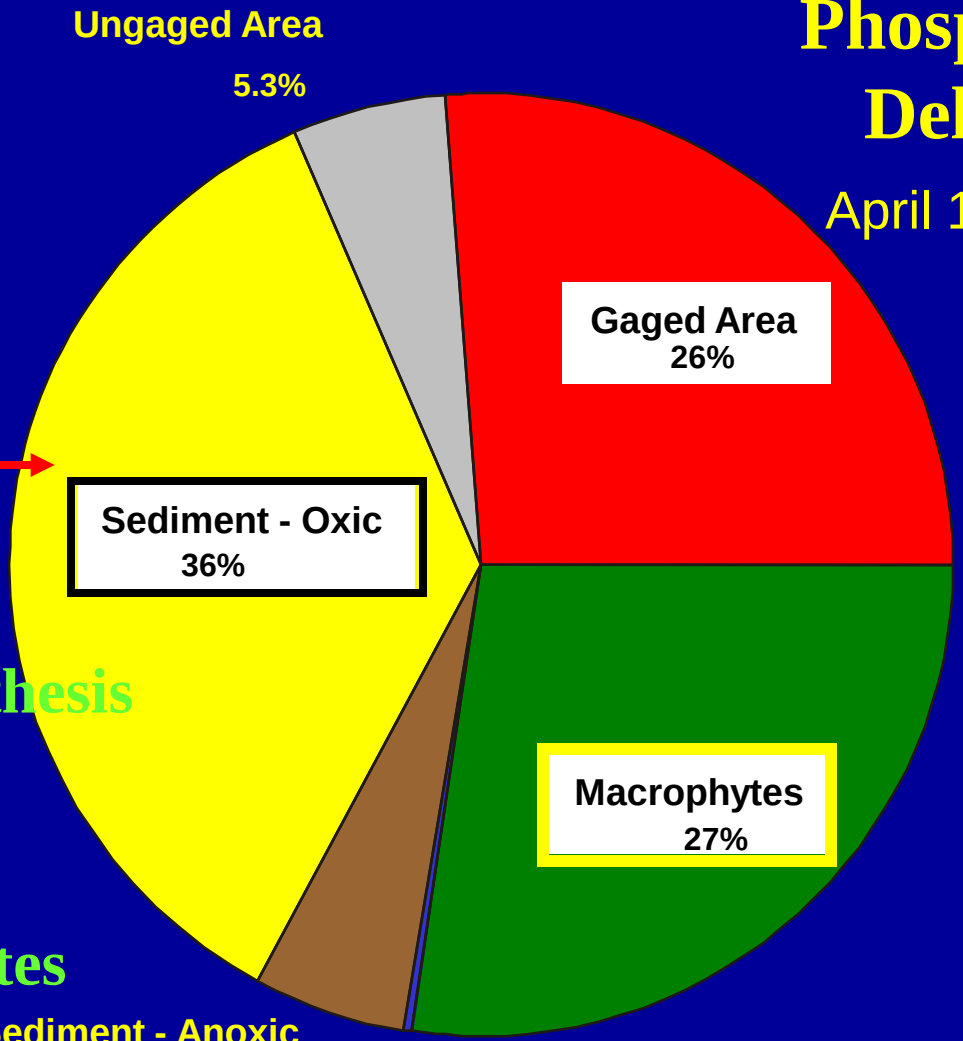


> Release Rates as a function of DO and pH

USGS
science for a changing world

Phosphorus Budget for Delavan Lake Inlet

April 14 - September 30, 1994



pH ^^

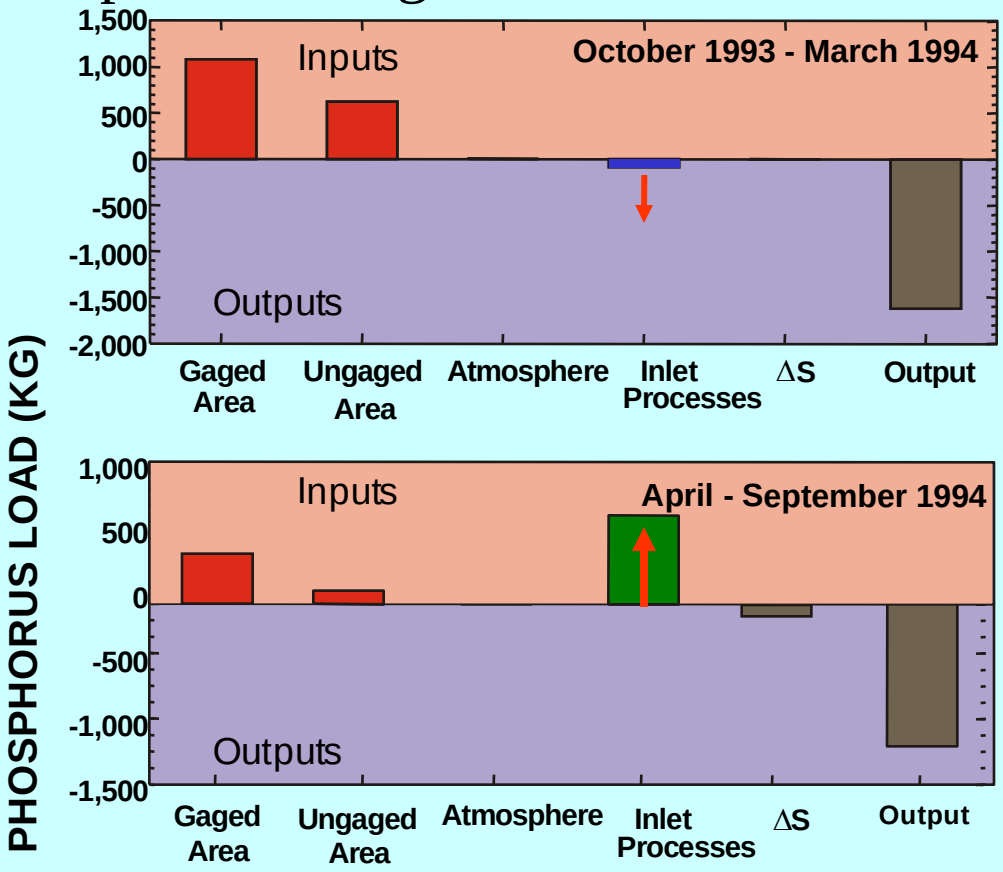
photosynthesis

macrophytes

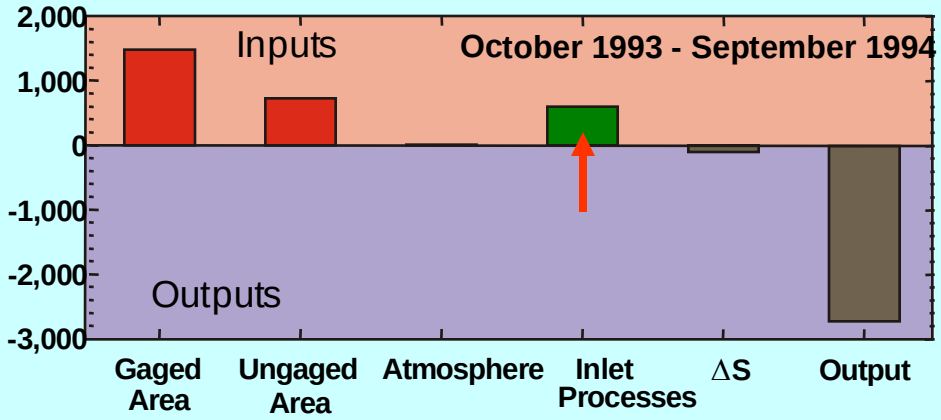
clarity

USGS science for a changing world

Phosphorus Budget for Delavan Lake Inlet



Detailed Study

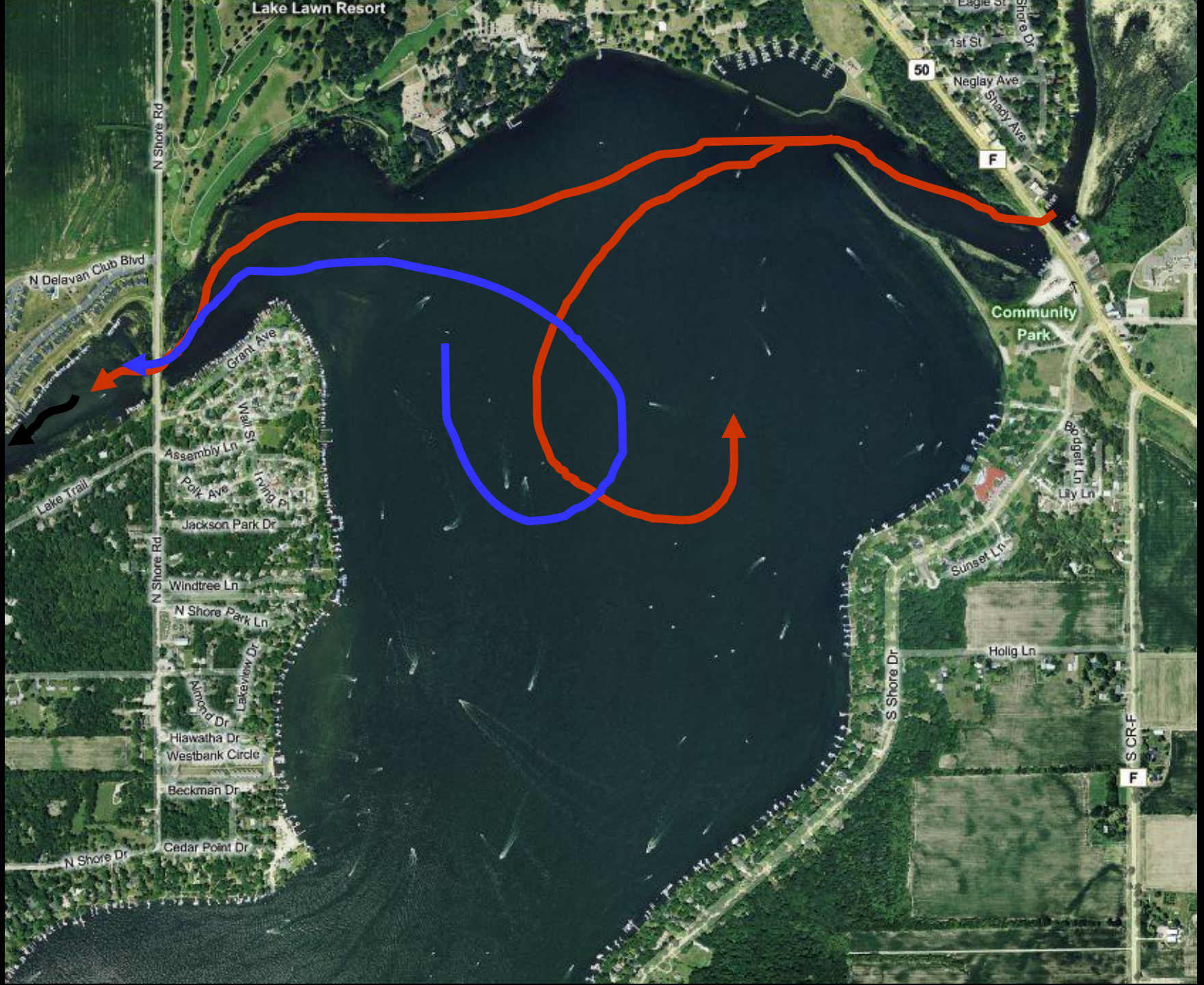


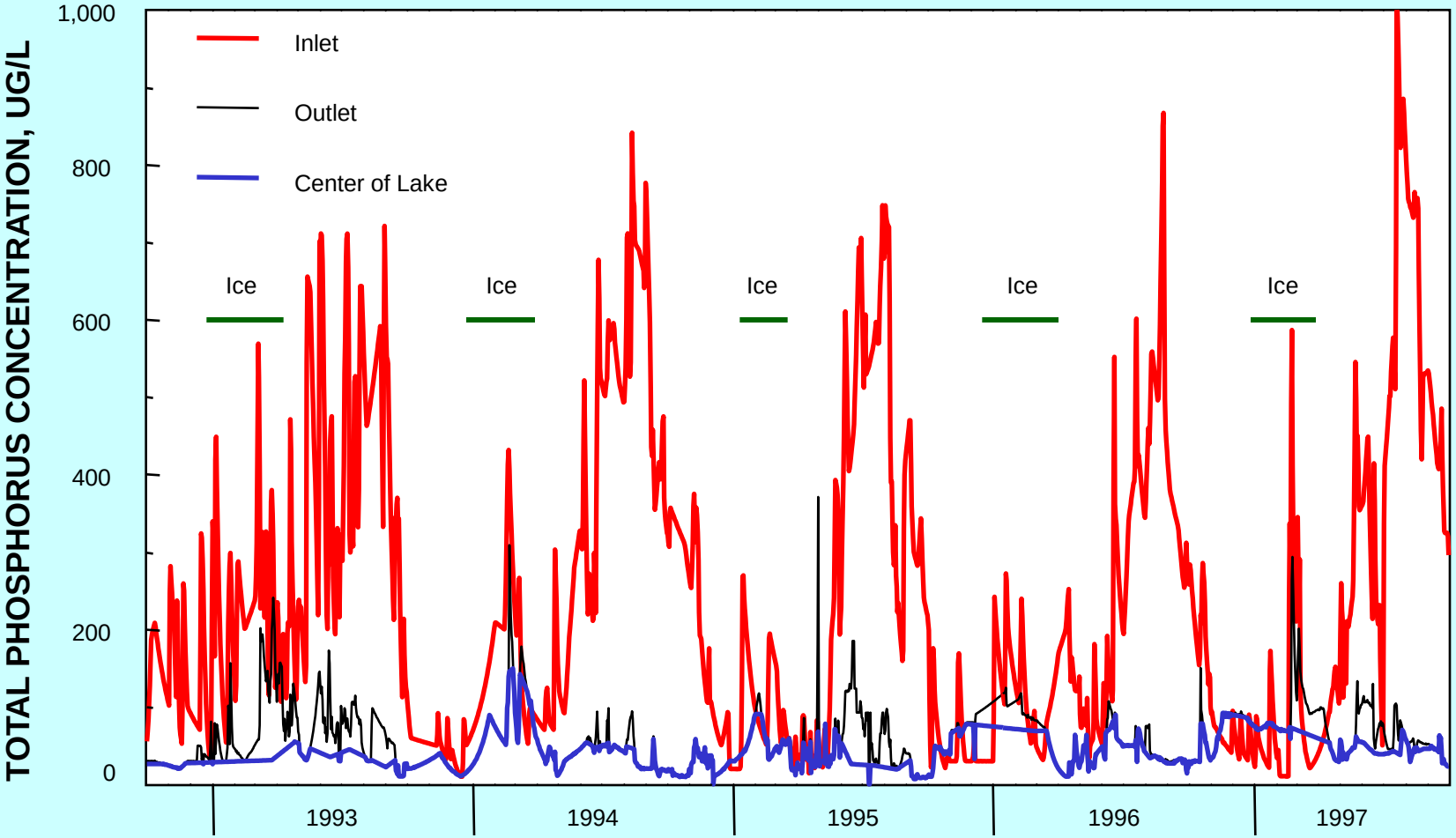
Annual Budget

30% ↑

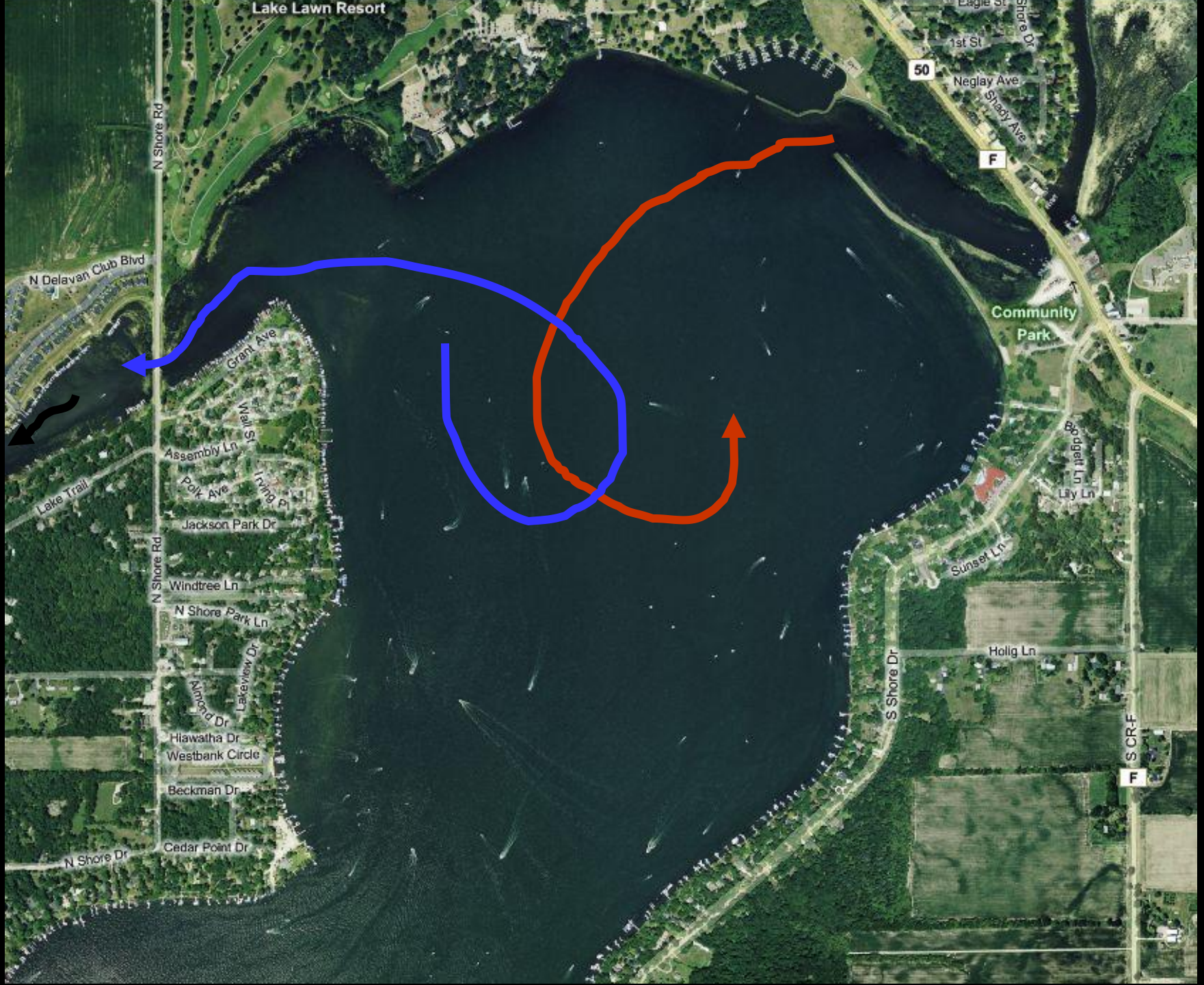
USGS science for a changing world

Jackson Creek Short-Circuiting


Lake Lawn Resort
N Shore Rd
N Delavan Club Blvd
Grant Ave
Wall St
Assembly Ln
Polk Ave
Irving Pl
Lake Trail
Jackson Park Dr
Windtree Ln
N Shore Park Ln
Lakeview Dr
Nimrod Dr
Hiawatha Dr
Westbank Circle
Beckman Dr
Cedar Point Dr
N Shore Dr
Eagle St
Shore Dr
1st St
50
Neglay Ave
Shady Ave
F
Community Park
Bridgett Ln
Lily Ln
Sunset Ln
Holig Ln
S Shore Dr
S CR-F
F



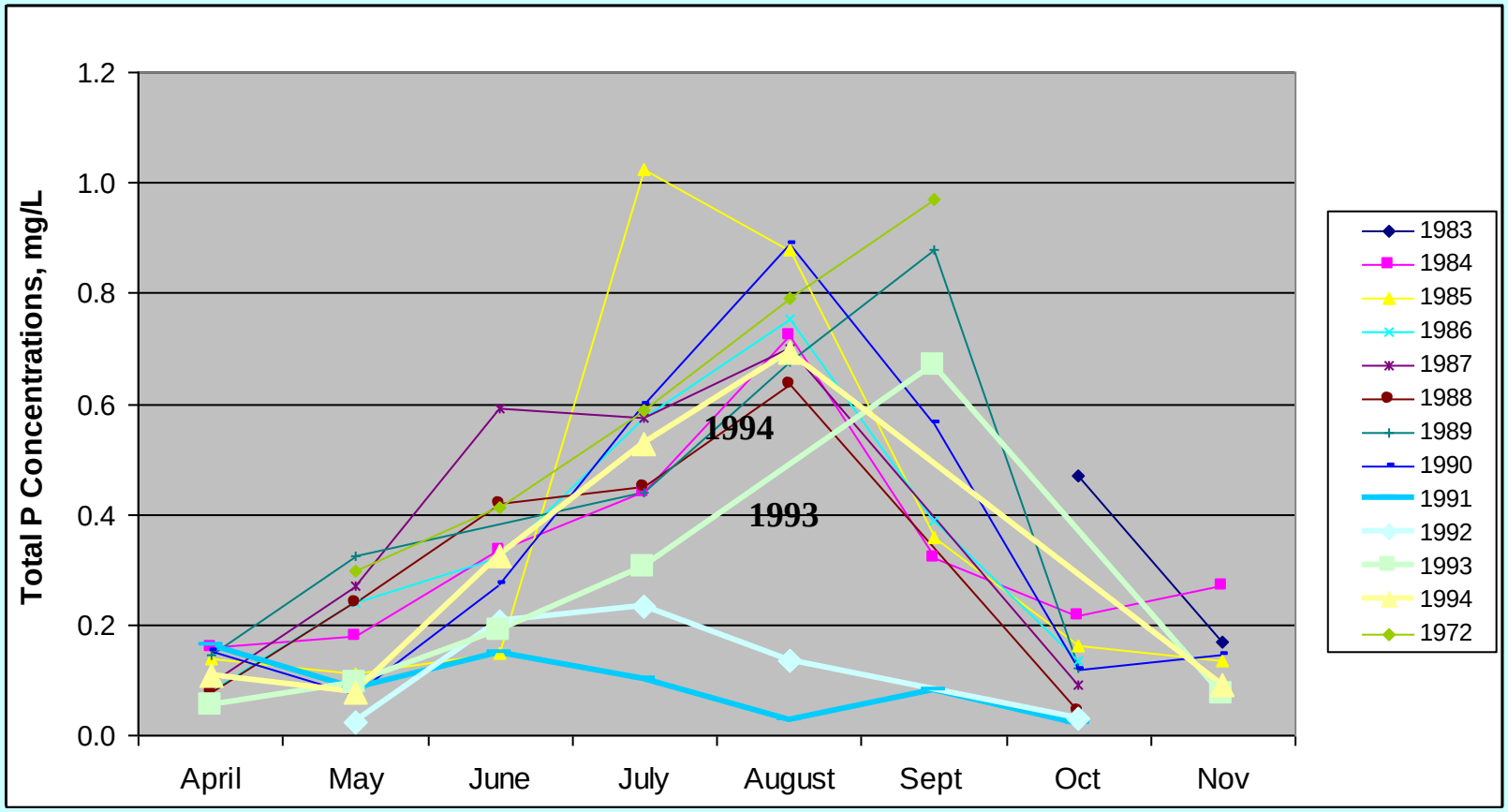
USGS
science for a changing world


Lake Lawn Resort
N Shore Rd
N Delavan Club Blvd
Grant Ave
Wall St
Assembly Ln
Polk Ave
Irving Pl
Lake Trail
Jackson Park Dr
Windtree Ln
N Shore Park Ln
Lakeview Dr
Nimrod Dr
Hiawatha Dr
Westbank Circle
Beckman Dr
Cedar Point Dr
N Shore Dr
Eagle St
Shore Dr
1st St
50
Neglay Ave
Shady Ave
F
Community Park
Bridgett Ln
Lily Ln
Sunset Ln
Holig Ln
S Shore Dr
S CR-F
F

Internal Sources Chemical Application of Alum

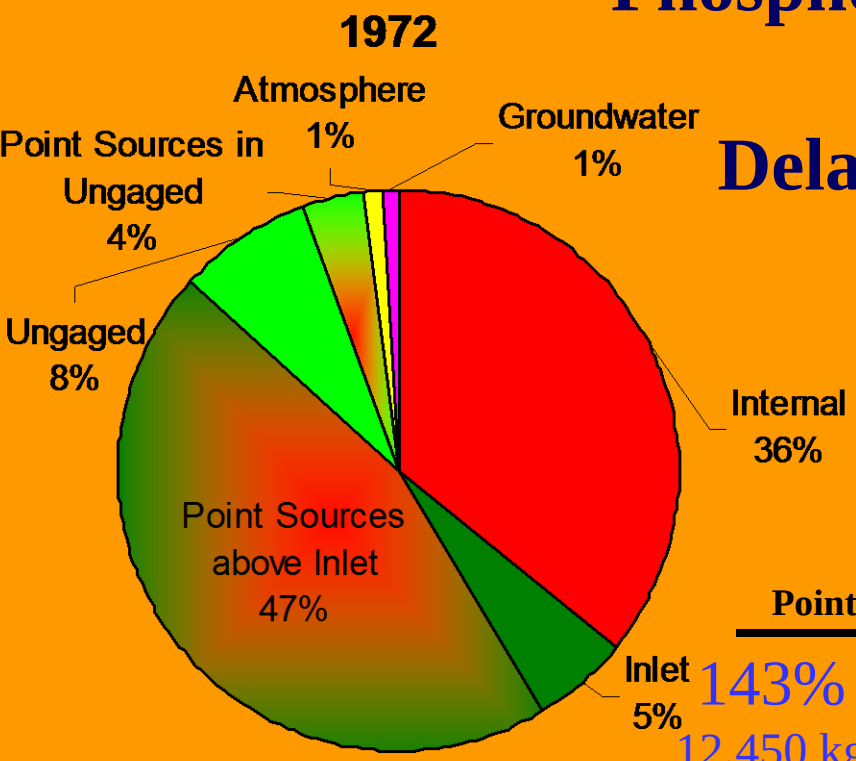
Internal Loading

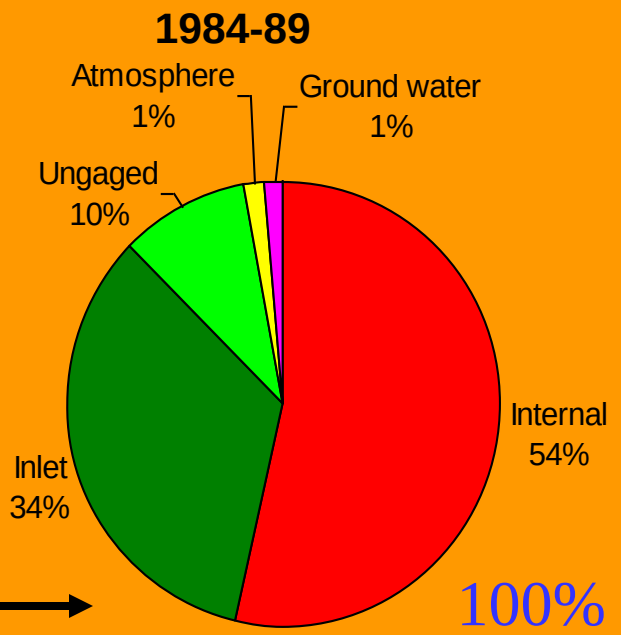
Near Bottom Total Phosphorus Concentrations



USGS science for a changing world

Phosphorus Budgets For Delavan Lake



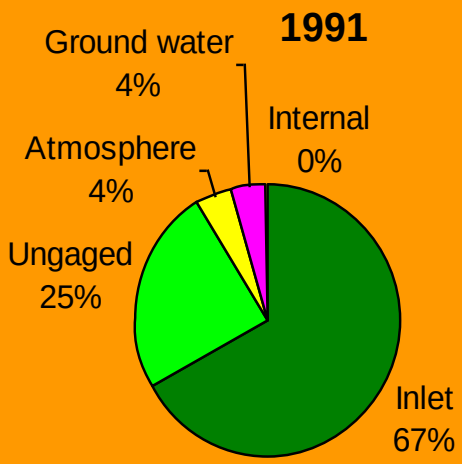


Point Source Removal

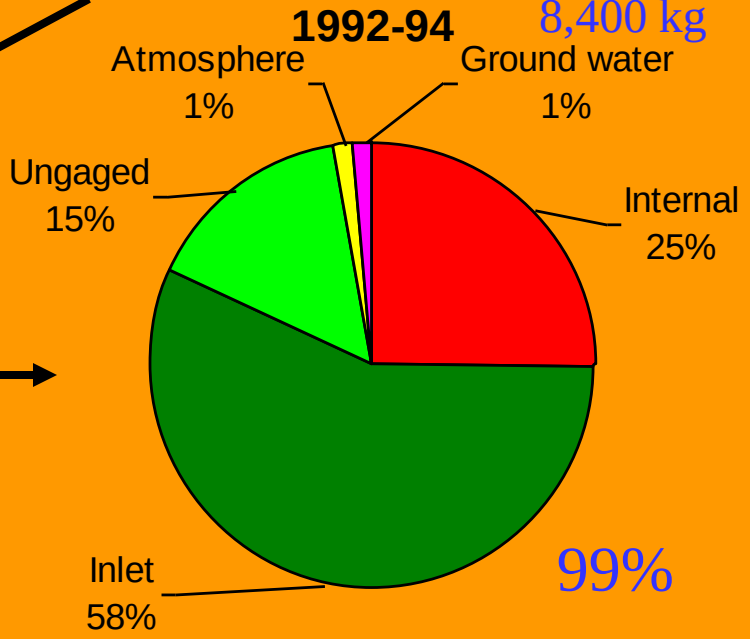
143%
12,450 kg

100%
8,400 kg

Internal Load Removal



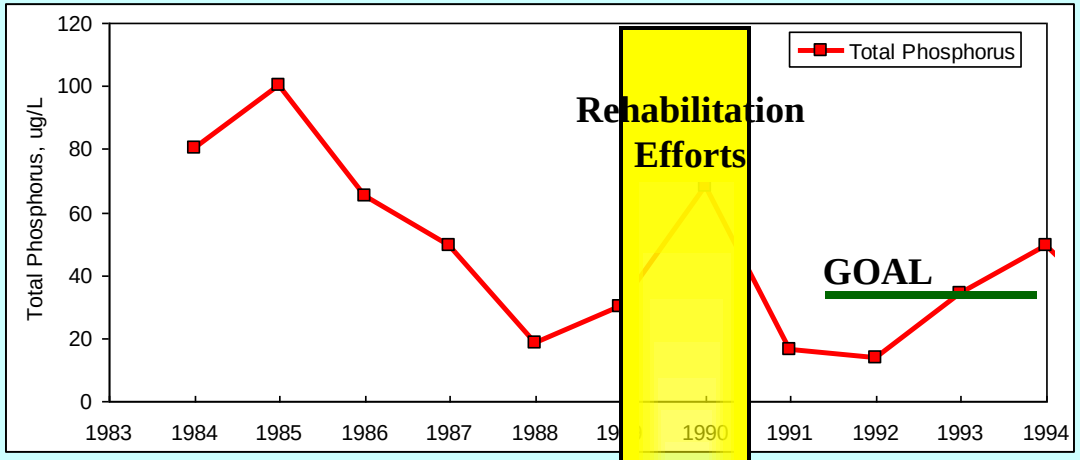
32%

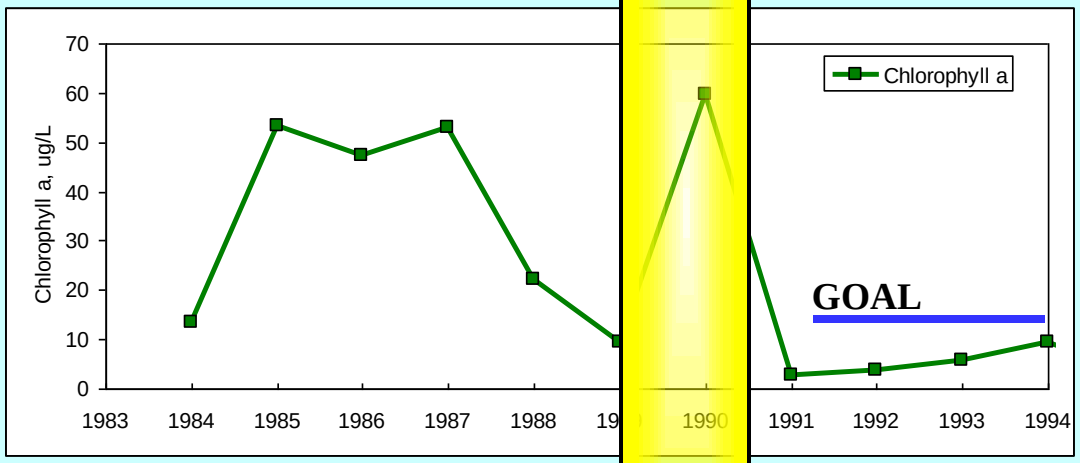


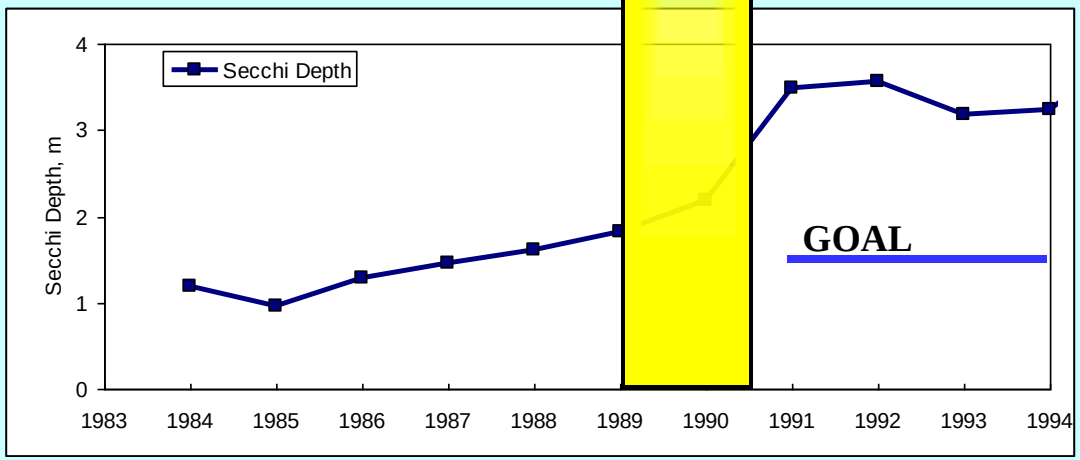
99%

In-lake Water Quality

Summer Average
June - August

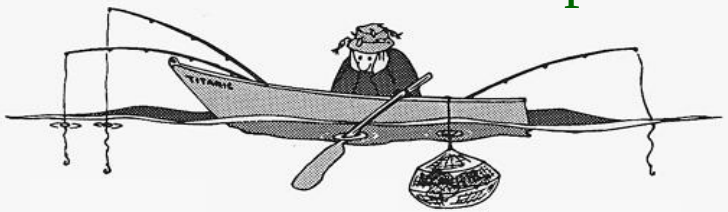




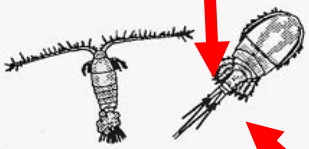


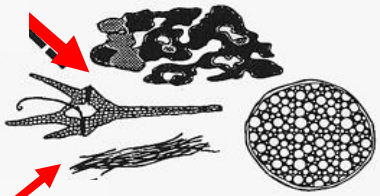
USGS science for a changing world

Delavan Lake - Premanipulation



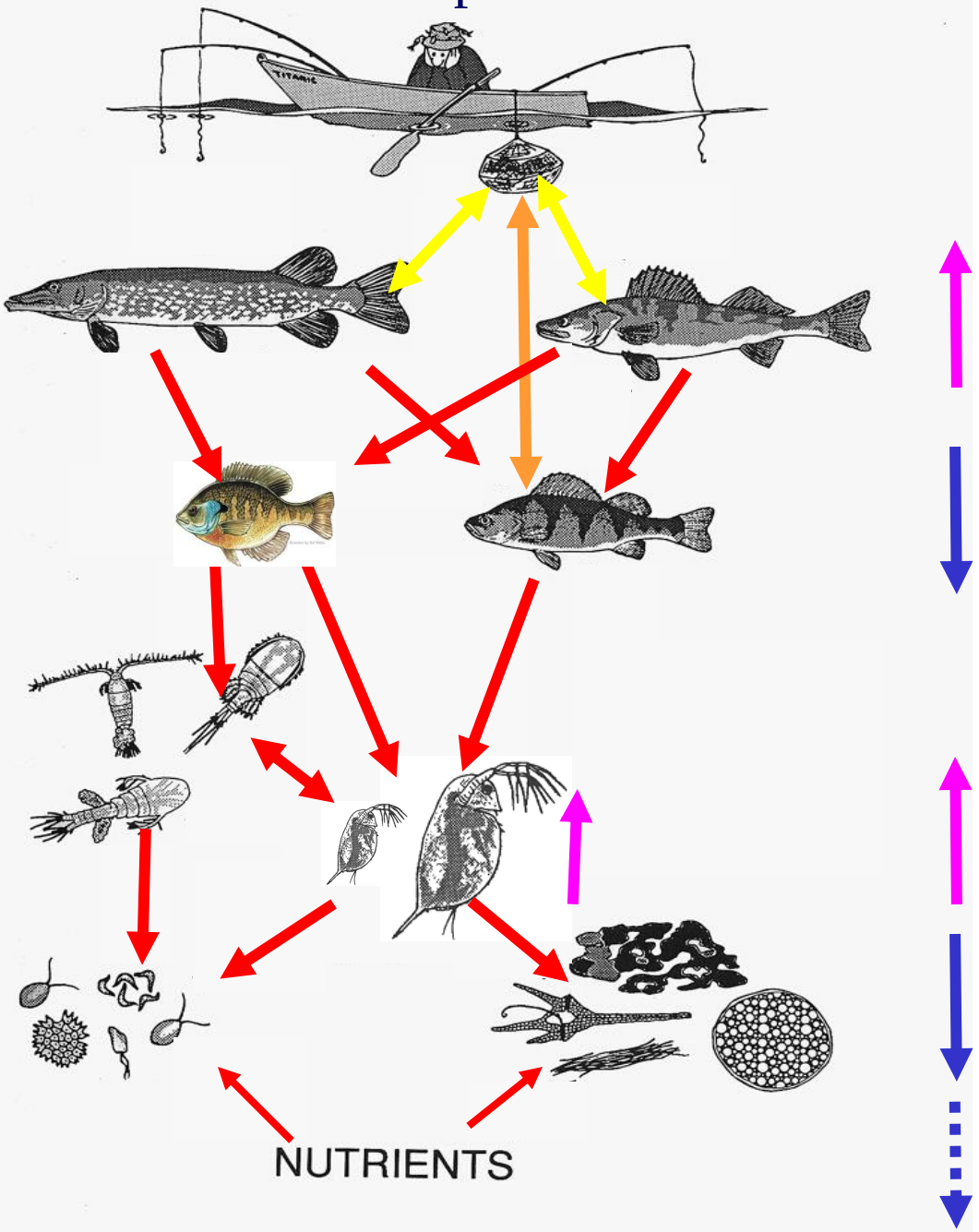
Carp & Buffalo

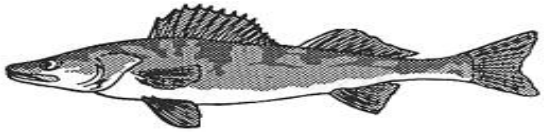


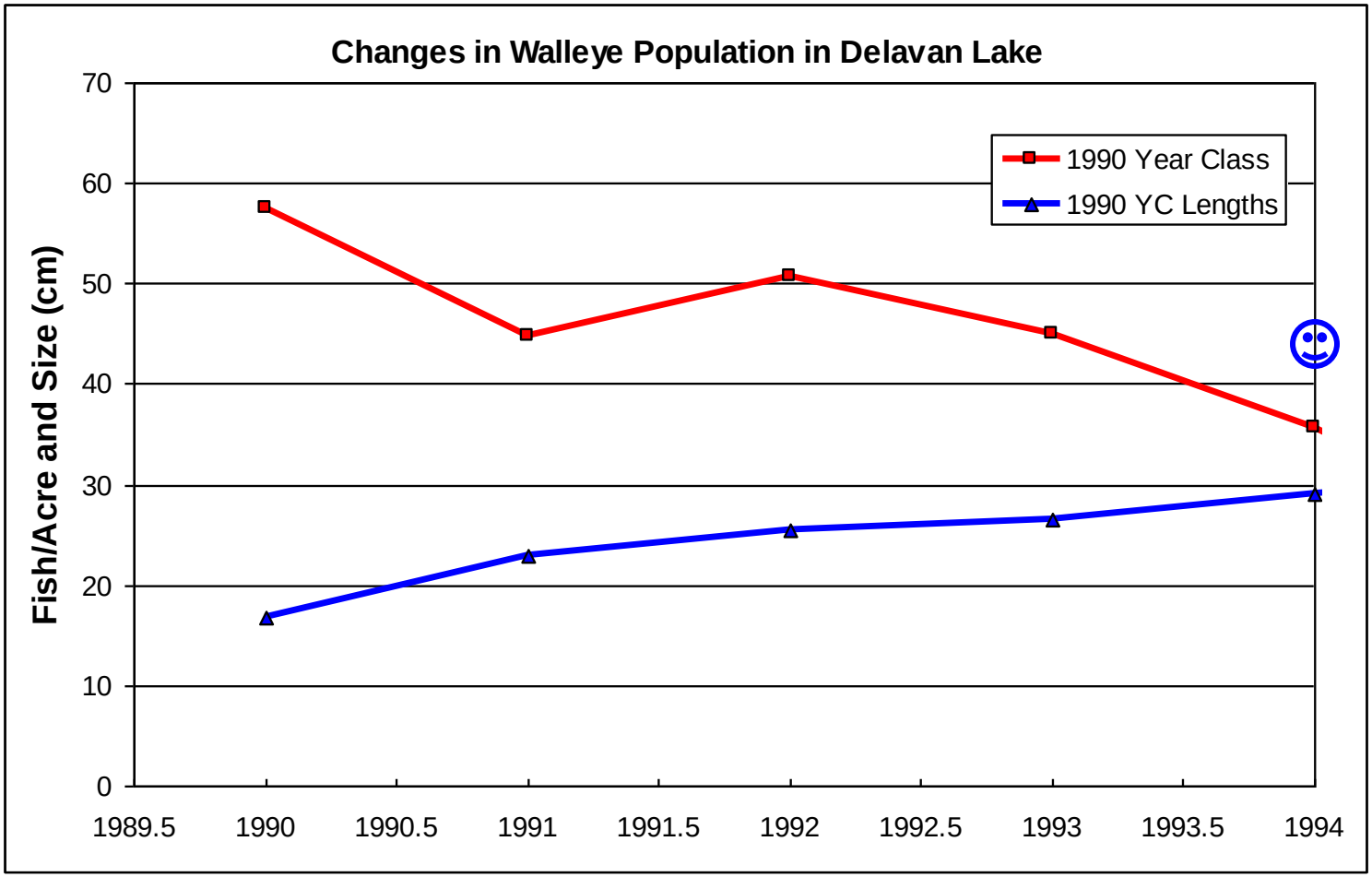


NUTRIENTS

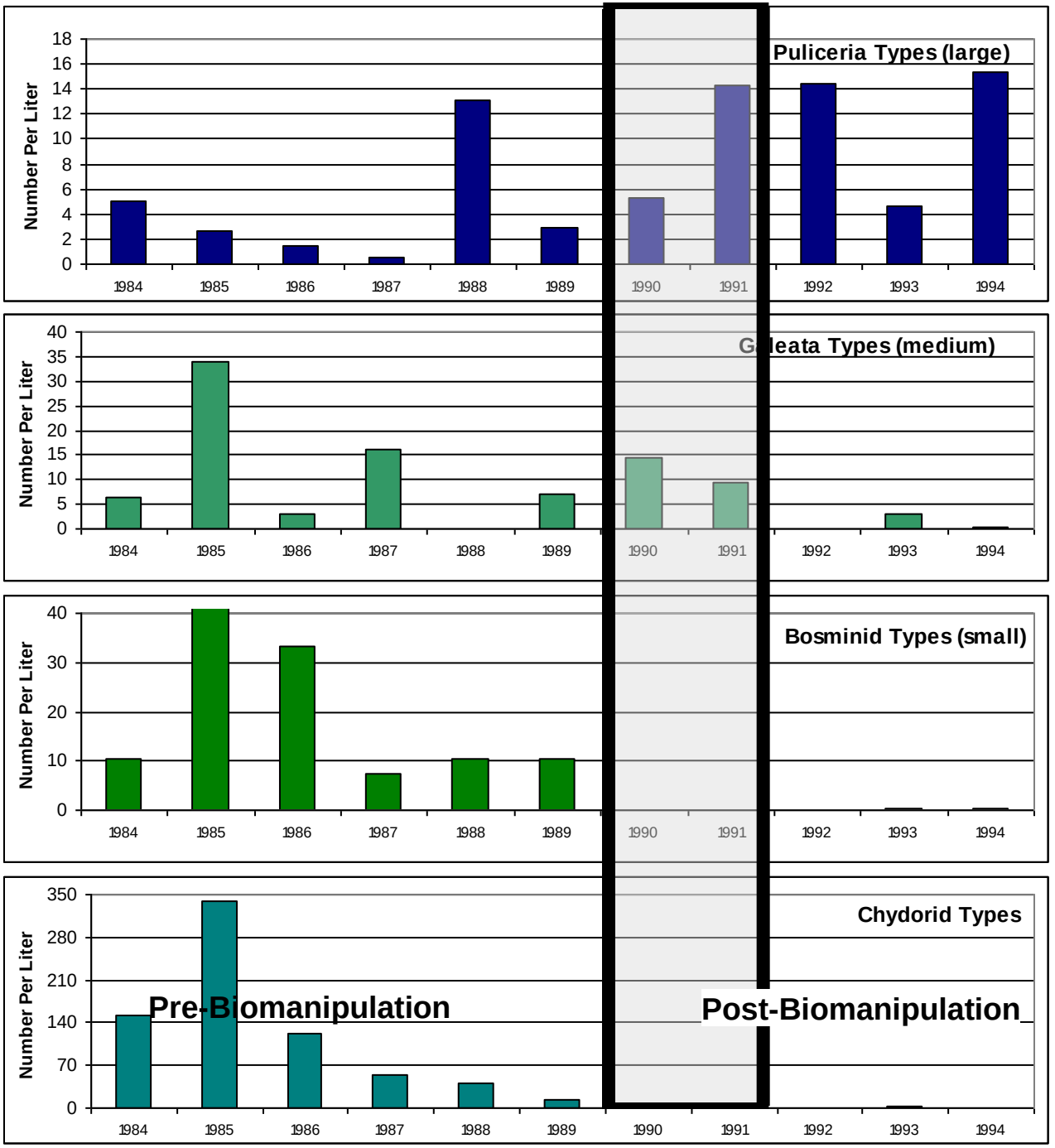
Post-manipulation





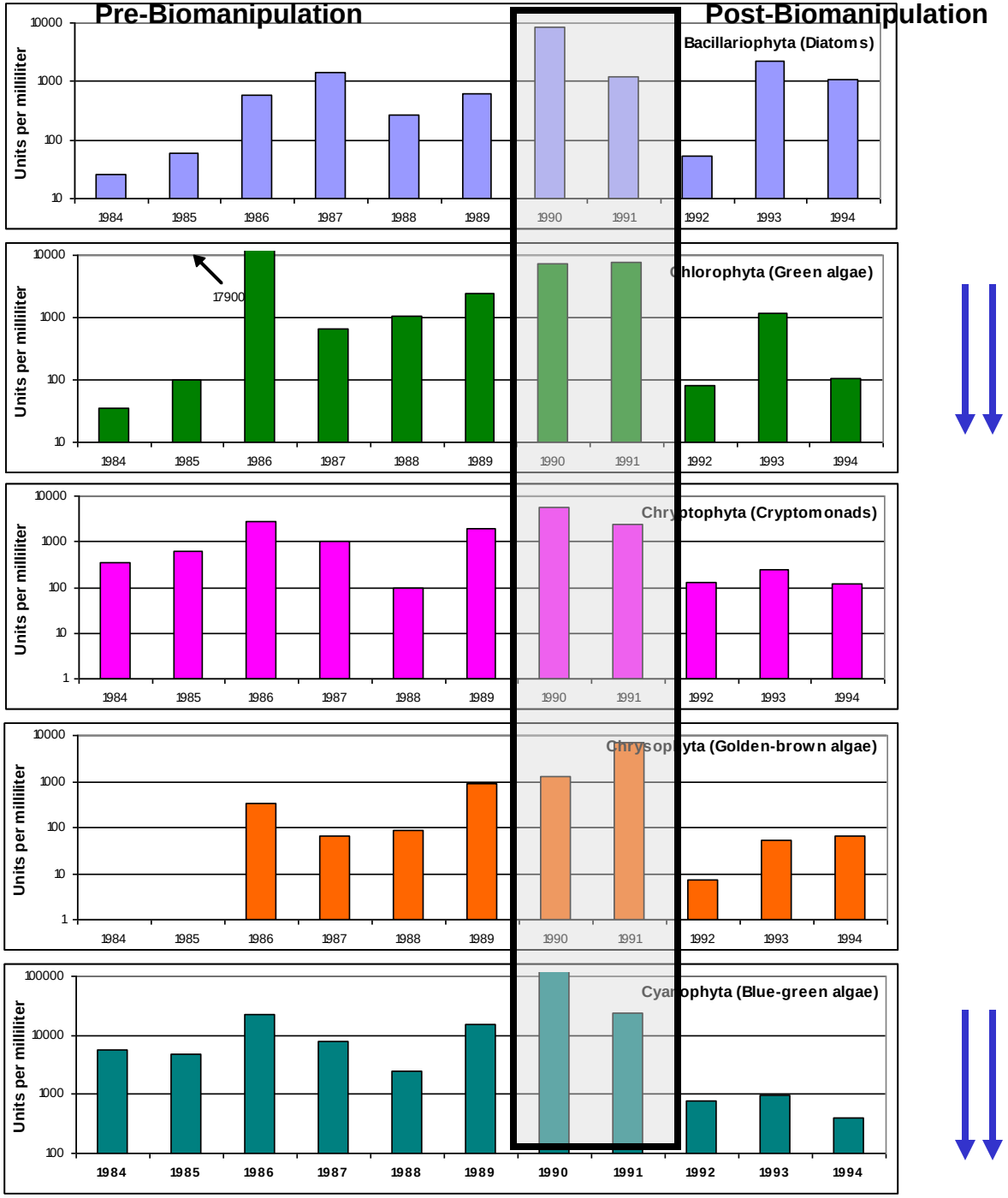

Changes in Walleye Population in Delavan Lake
Fish/Acre and Size (cm)
70
60
50
40
30
20
10
0
1989.5
1990
1990.5
1991
1991.5
1992
1992.5
1993
1993.5
1994
1990 Year Class
1990 YC Lengths

Zooplankton Populations



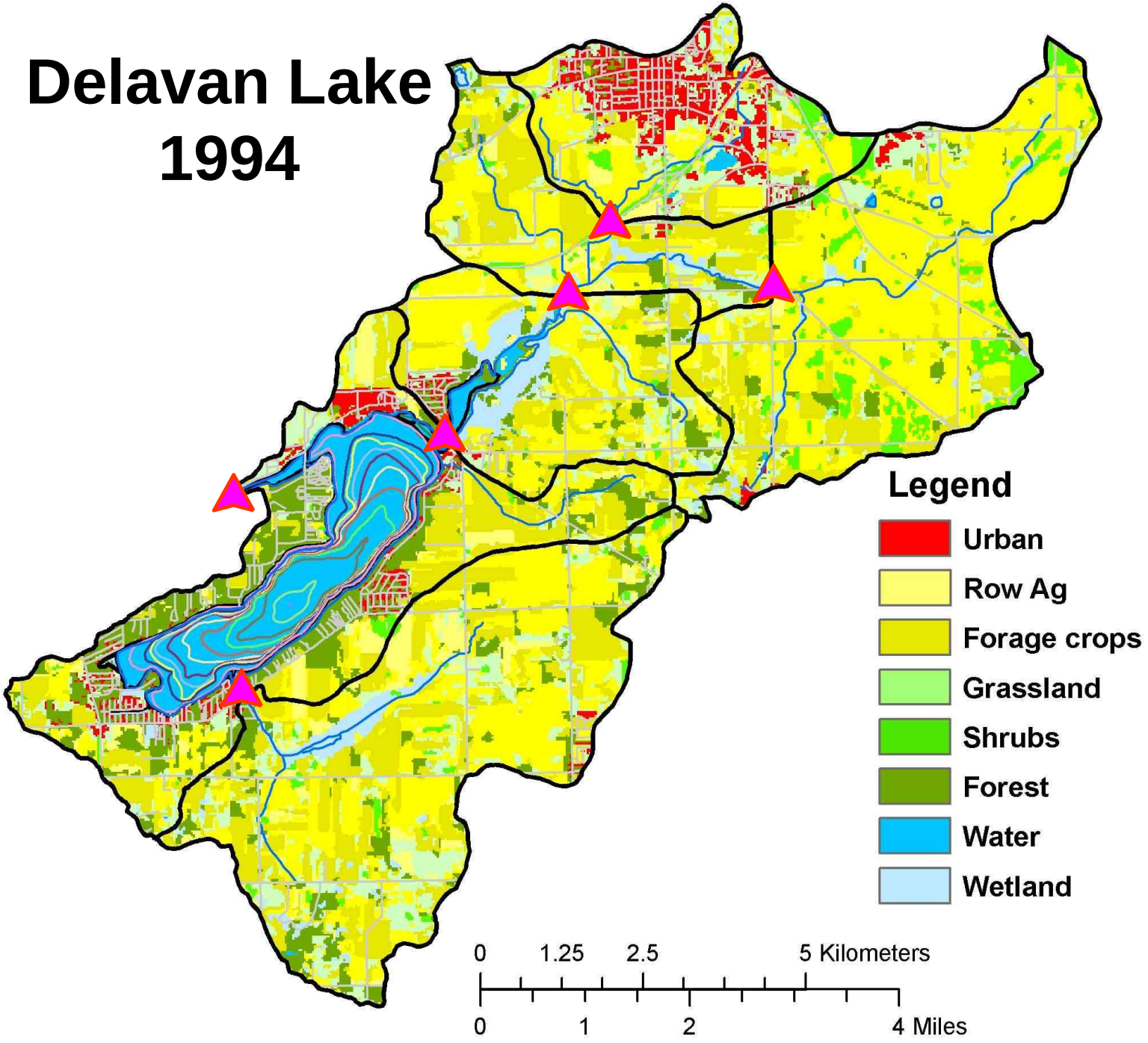
USGS science for a changing world

Phytoplankton Populations

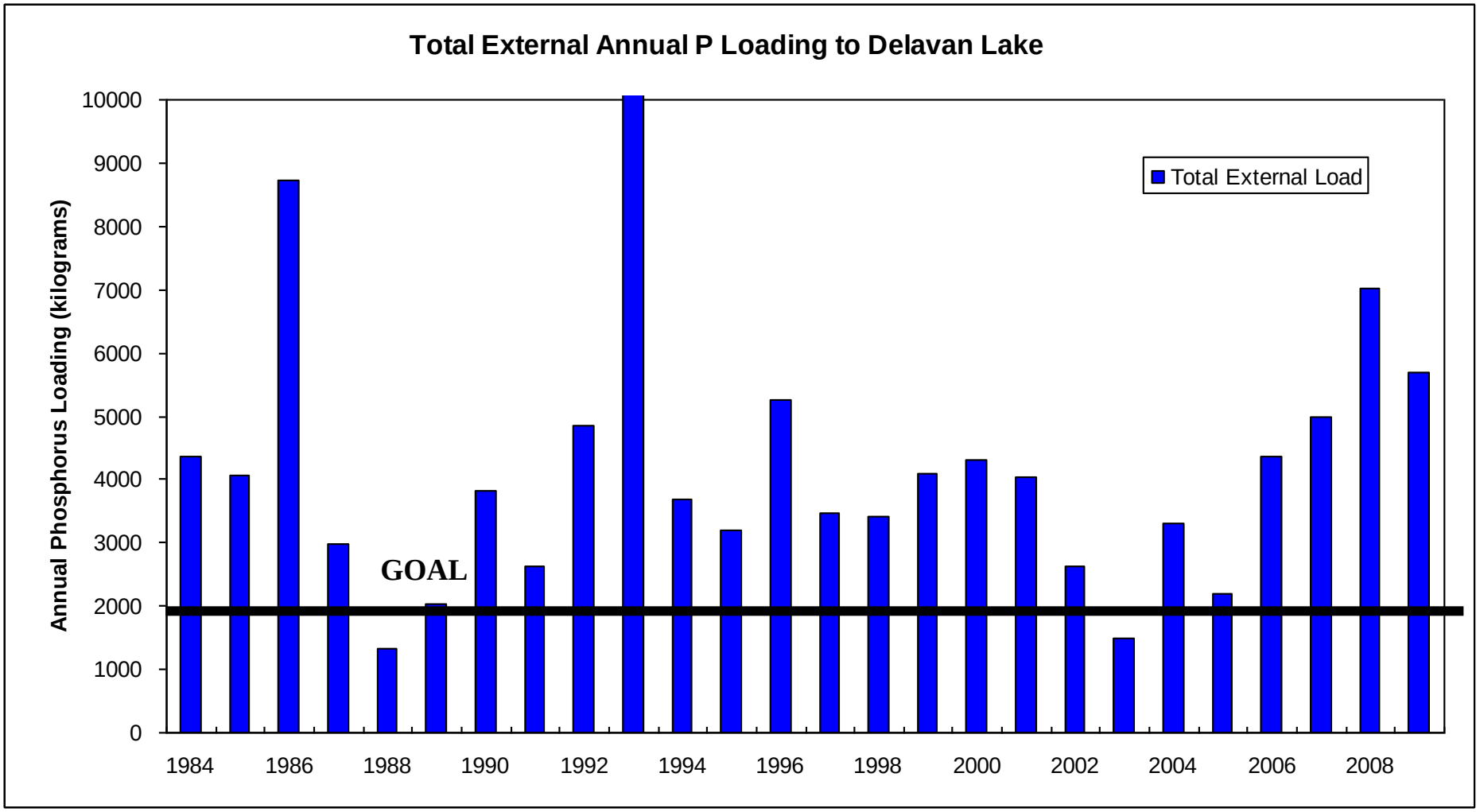


science for a changing world

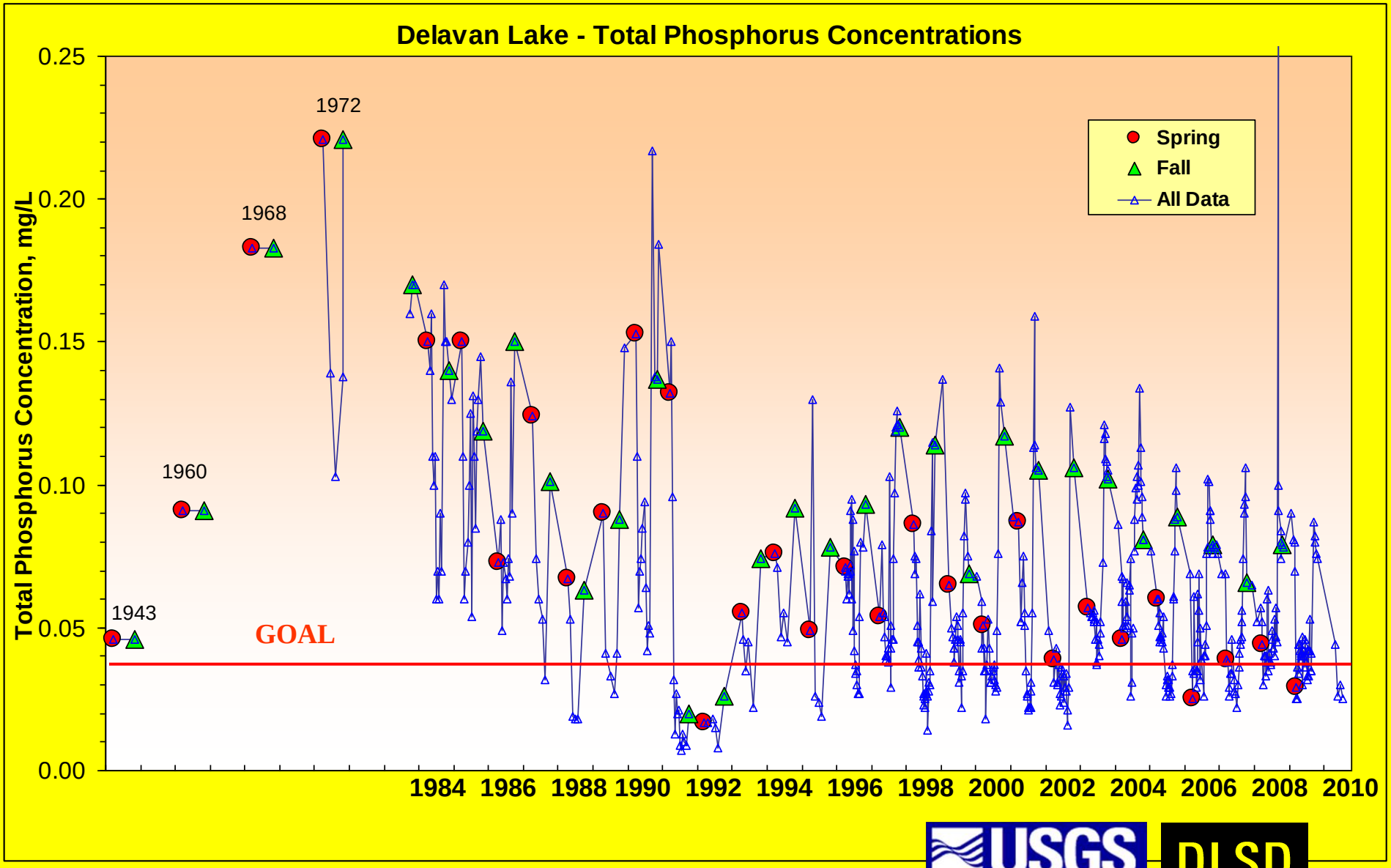
Delavan Lake
1994



But, where have things gone since 1994??



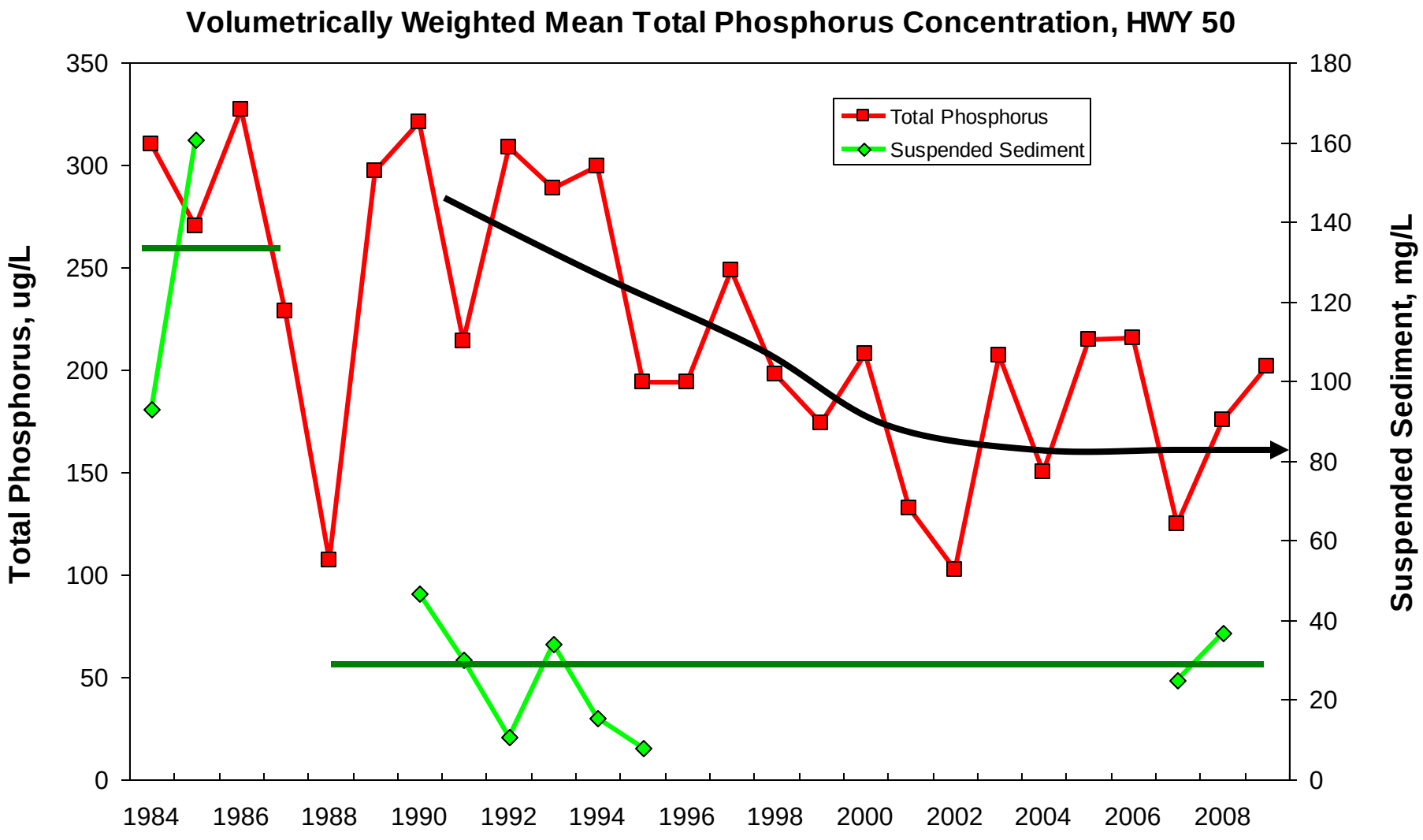
USGS
science for a changing world



USGS science for a changing world

DLSD

Has there been changes in the Watershed??

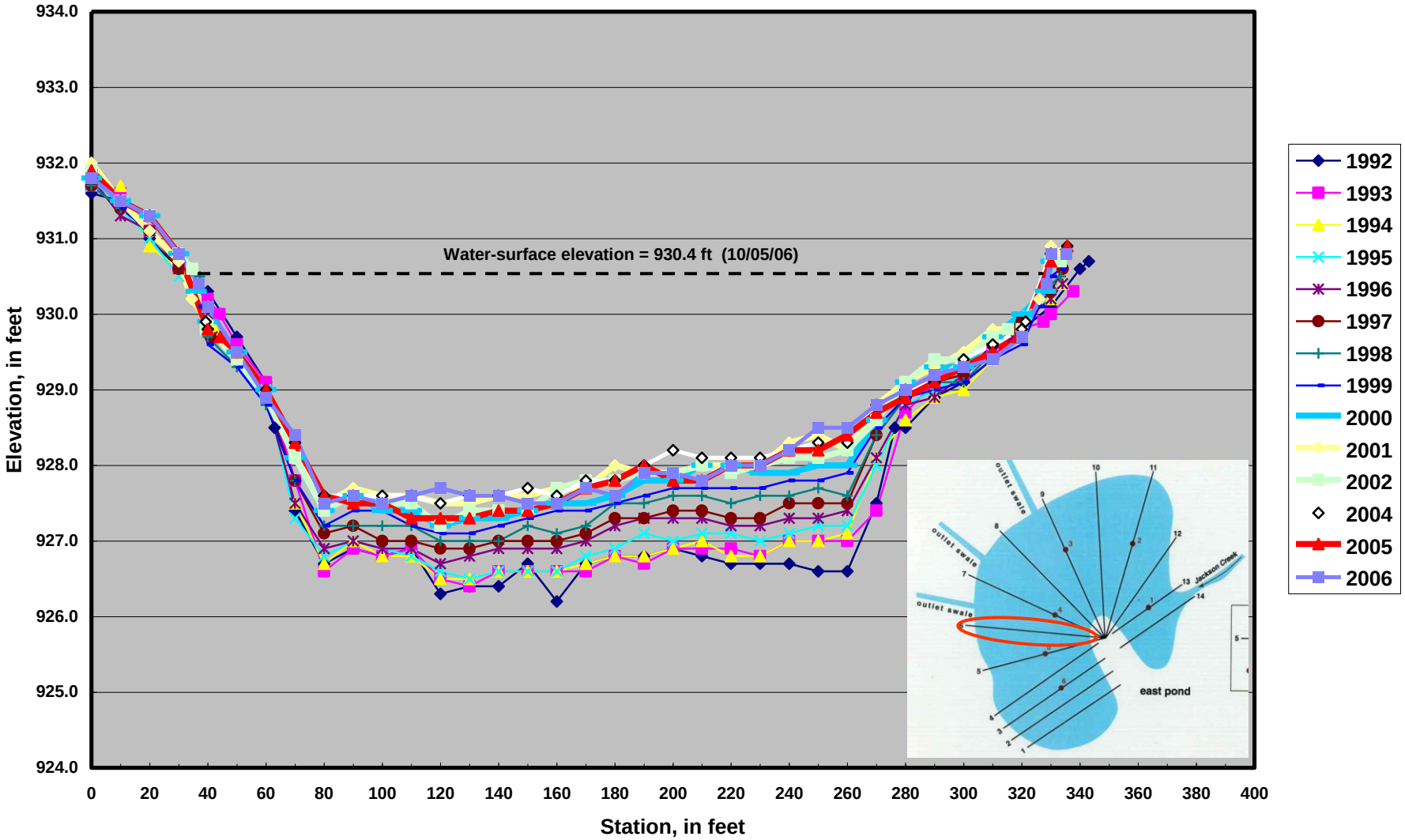


USGS science for a changing world

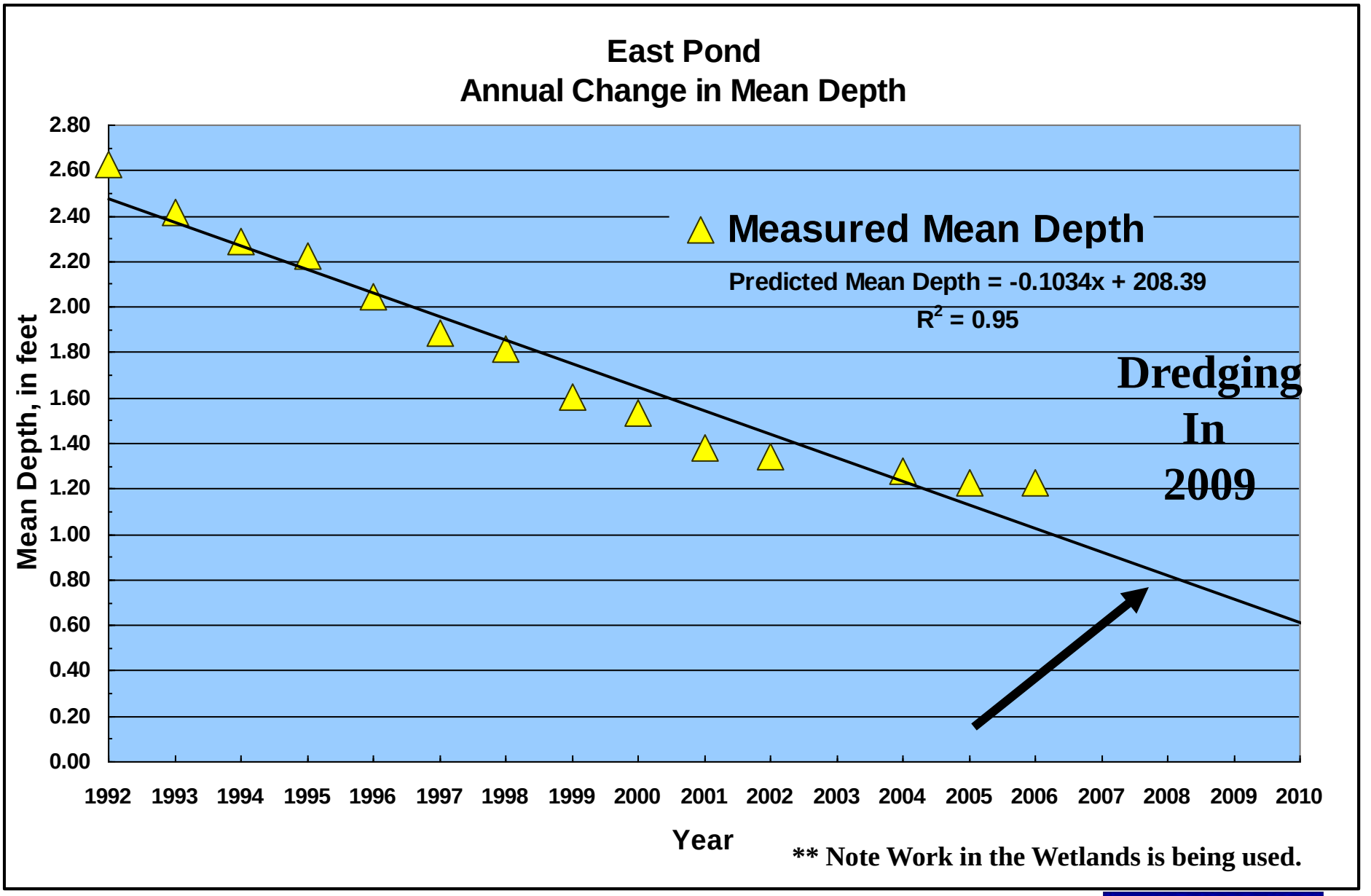
Are the Wetlands Still Working

Jackson Creek Wetland

East Pond, Cross Section Number 6

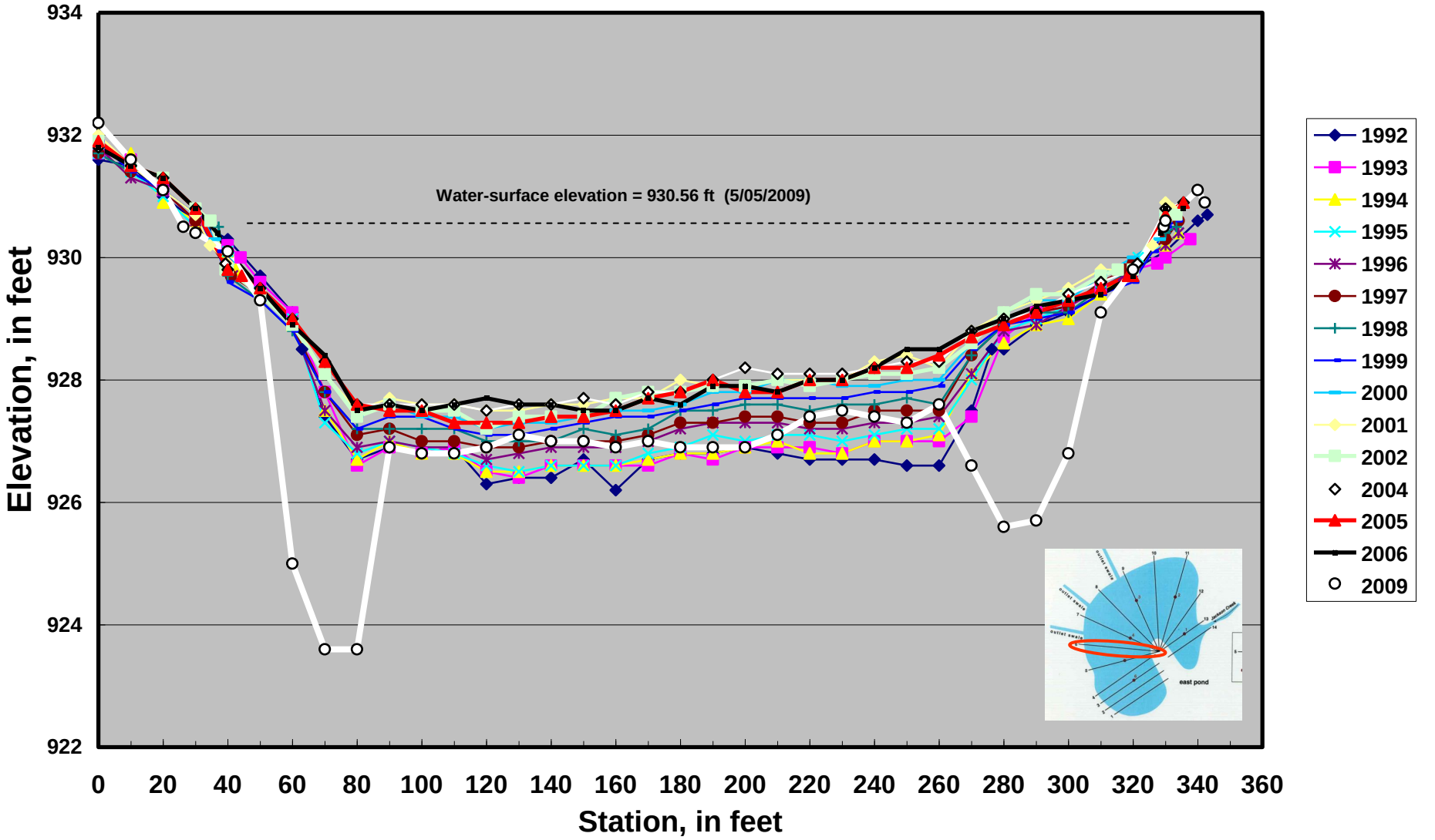


USGS science for a changing world



USGS science for a changing world

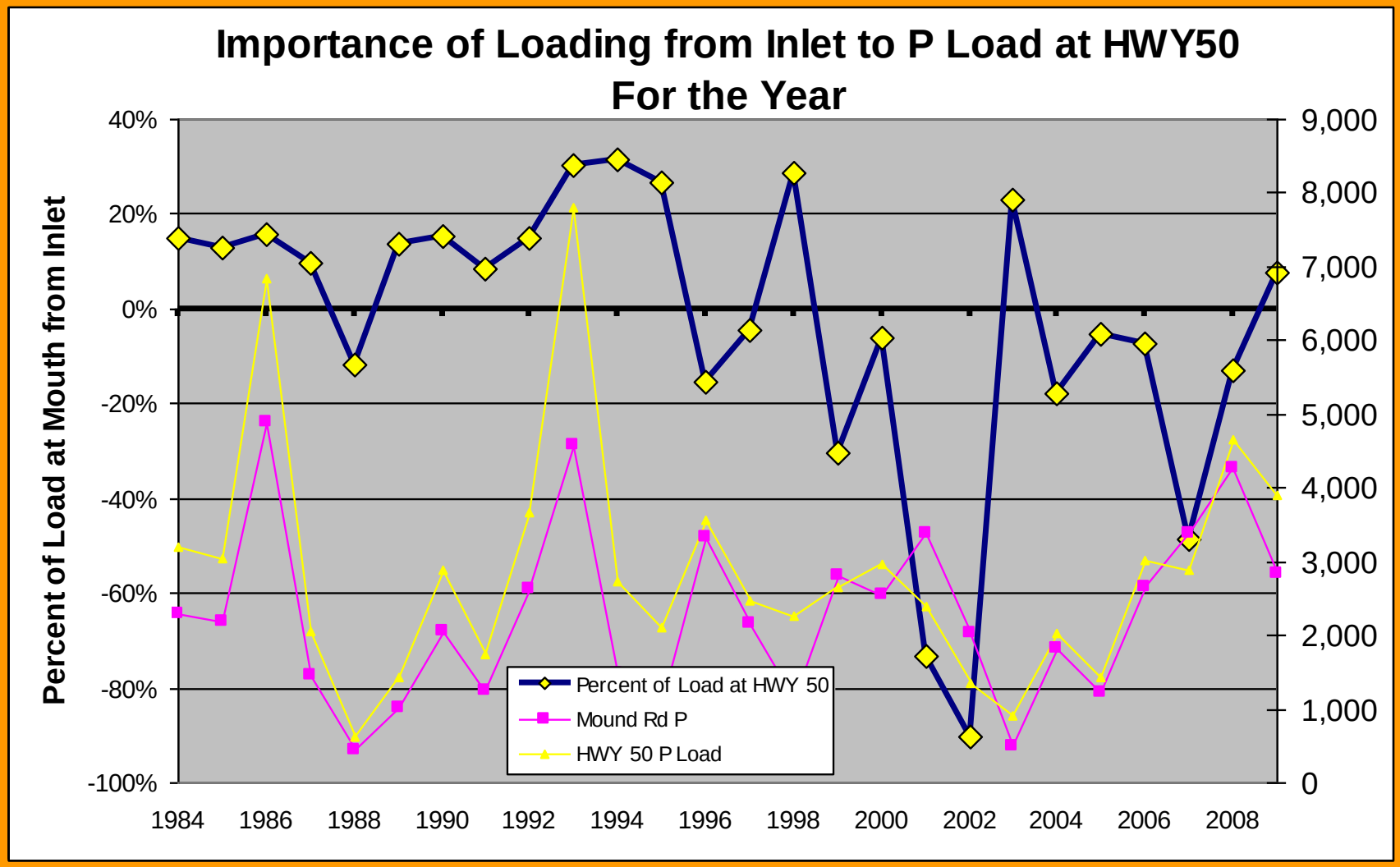
East Pond, Cross Section Number 6



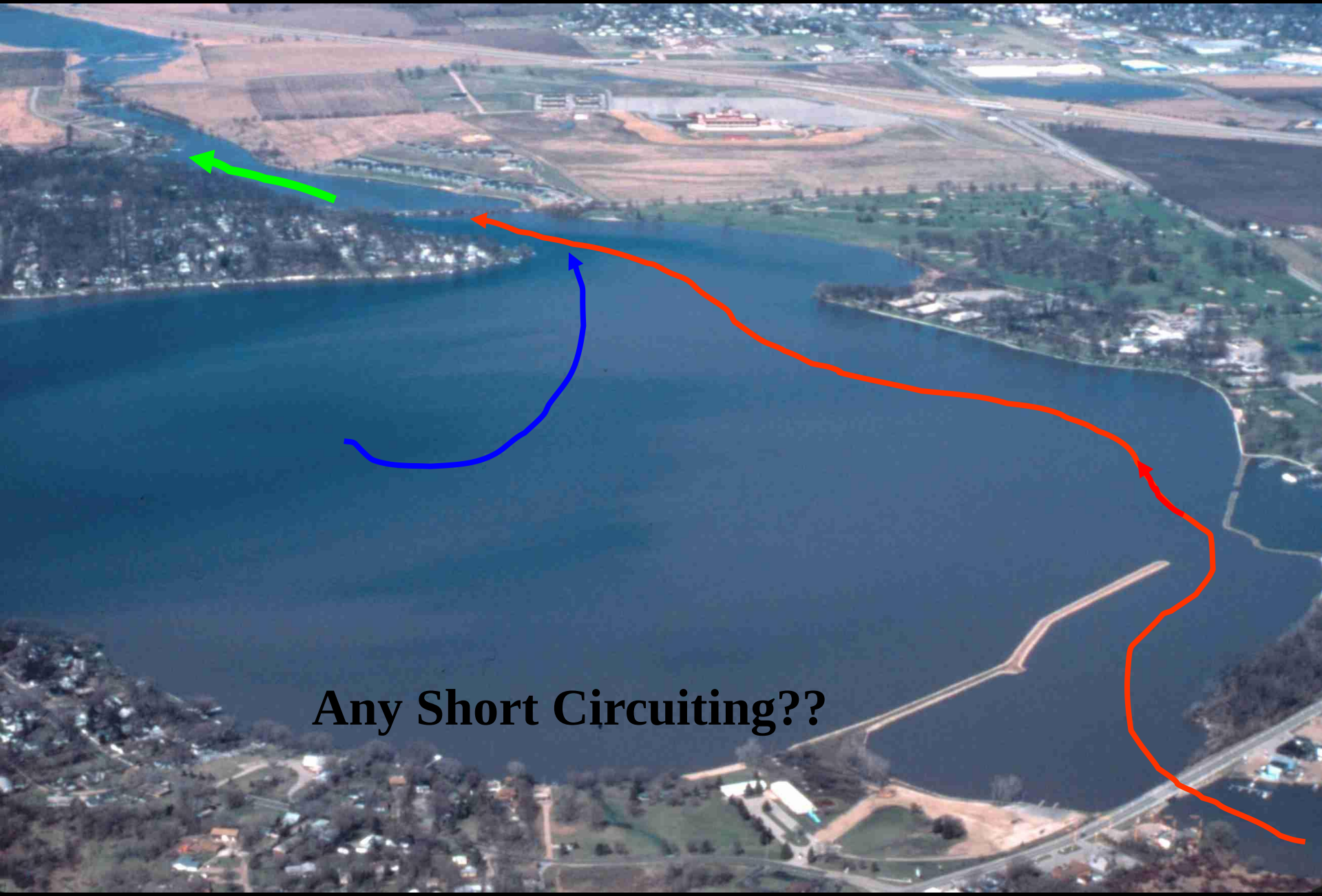
To extend the life of the Wetlands – Dredging was conducted in 2009

USGS science for a changing world

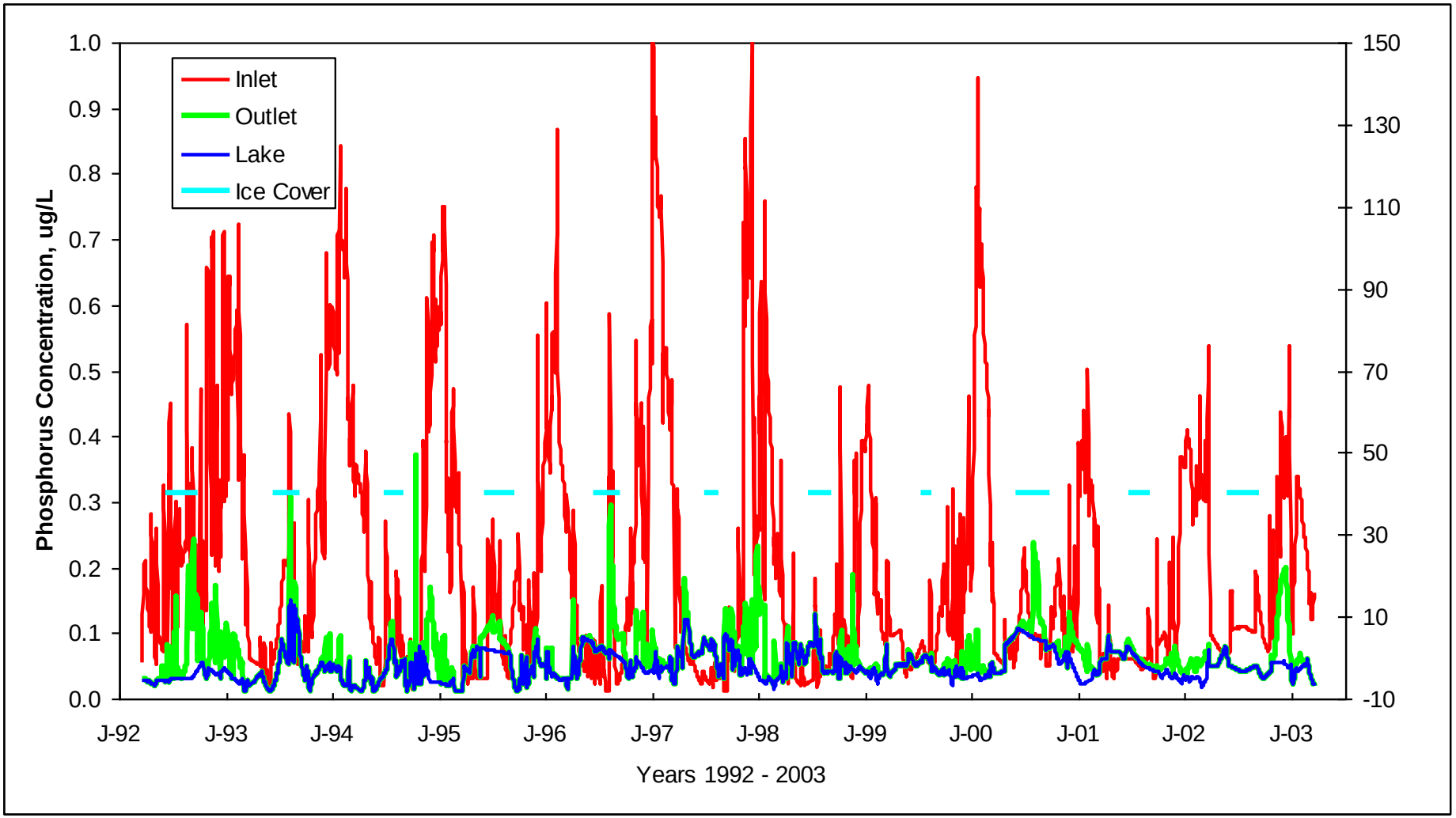

How has the Inlet been affecting the Phosphorus loading to the lake in recent years??



USGS science for a changing world


Any Short Circuiting??

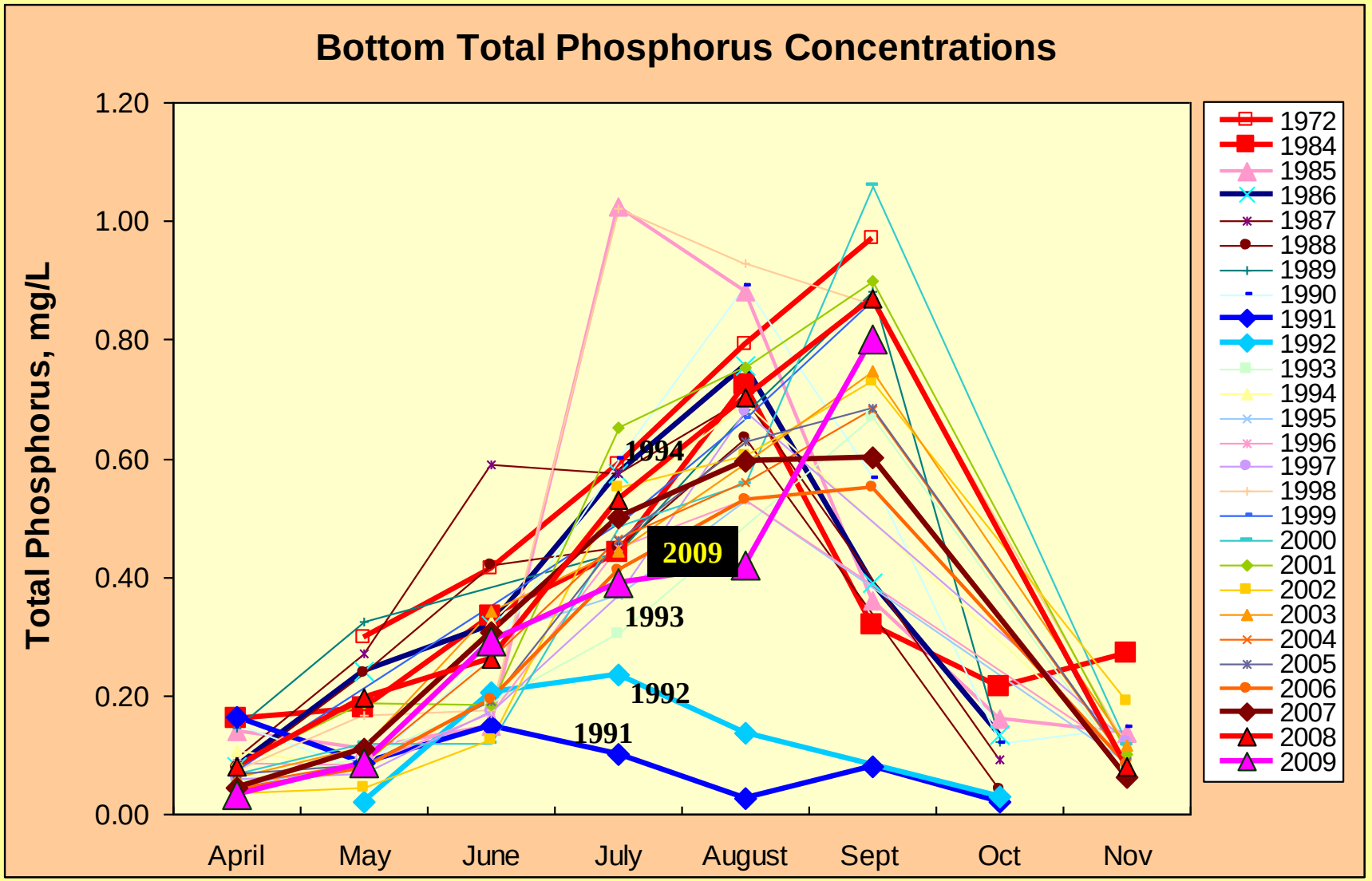
Short-Circuiting



USGS science for a changing world

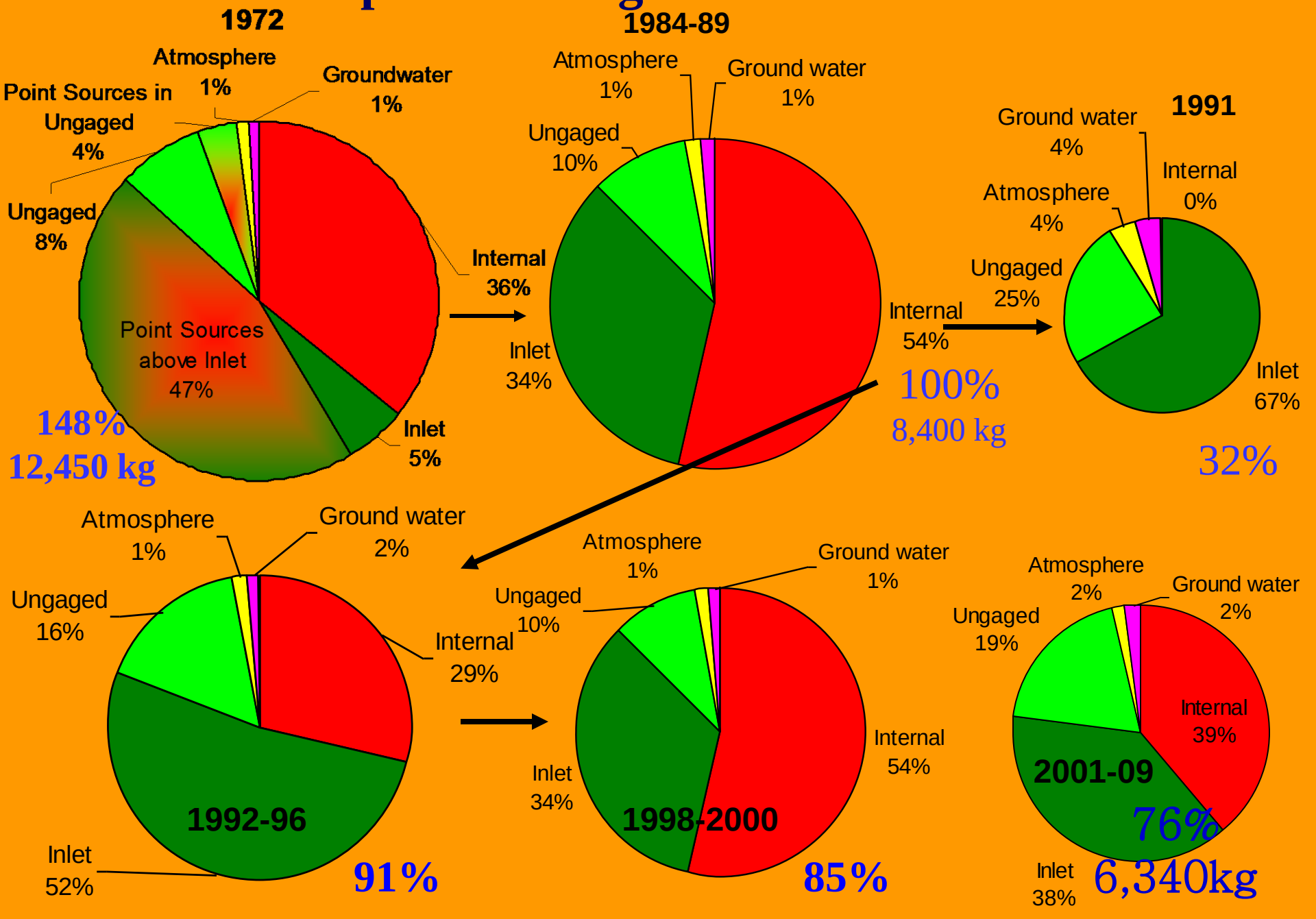
Internal Sources Chemical Application of Alum

Internal Loading



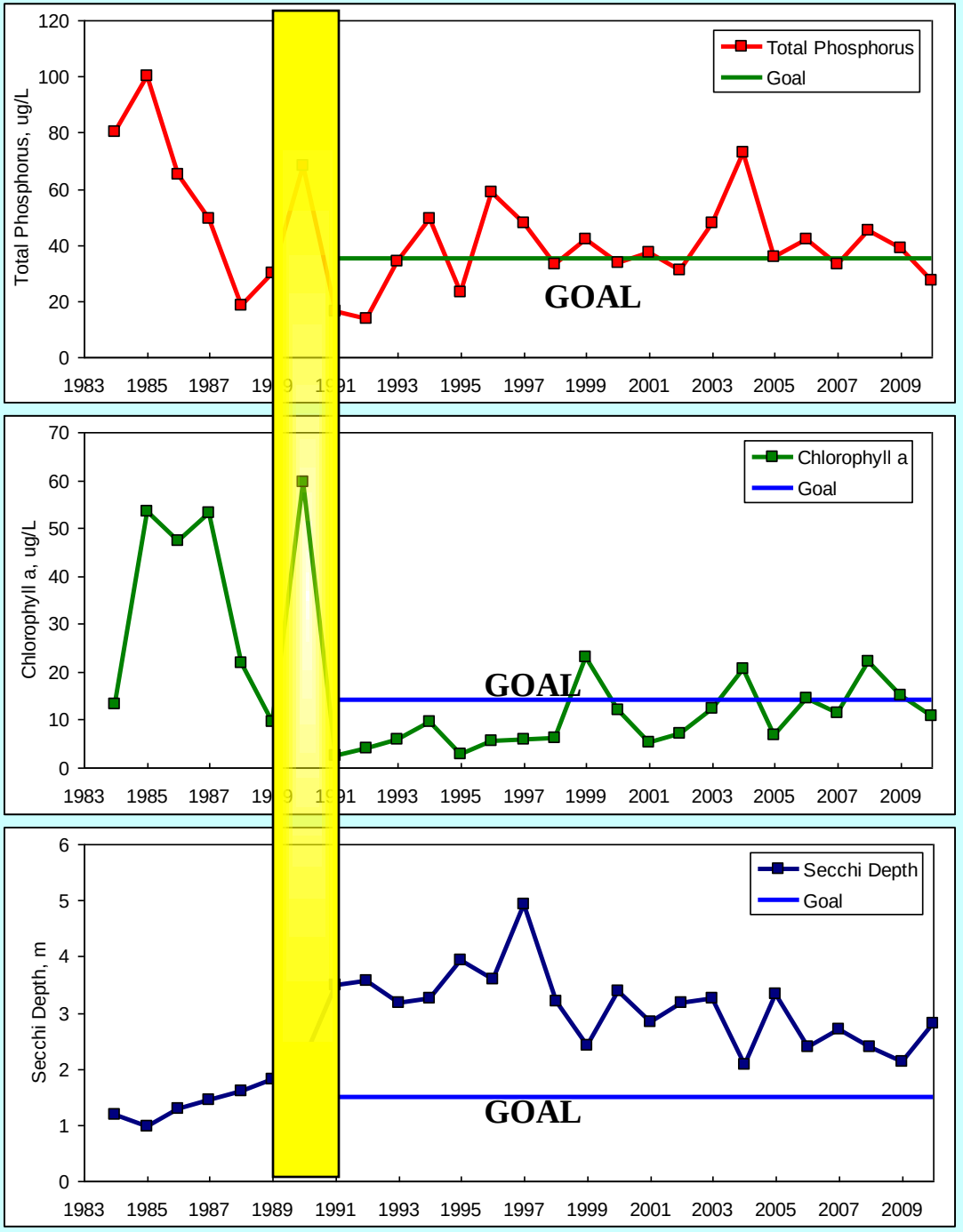
USGS science for a changing world

Phosphorus Budgets For Delavan Lake



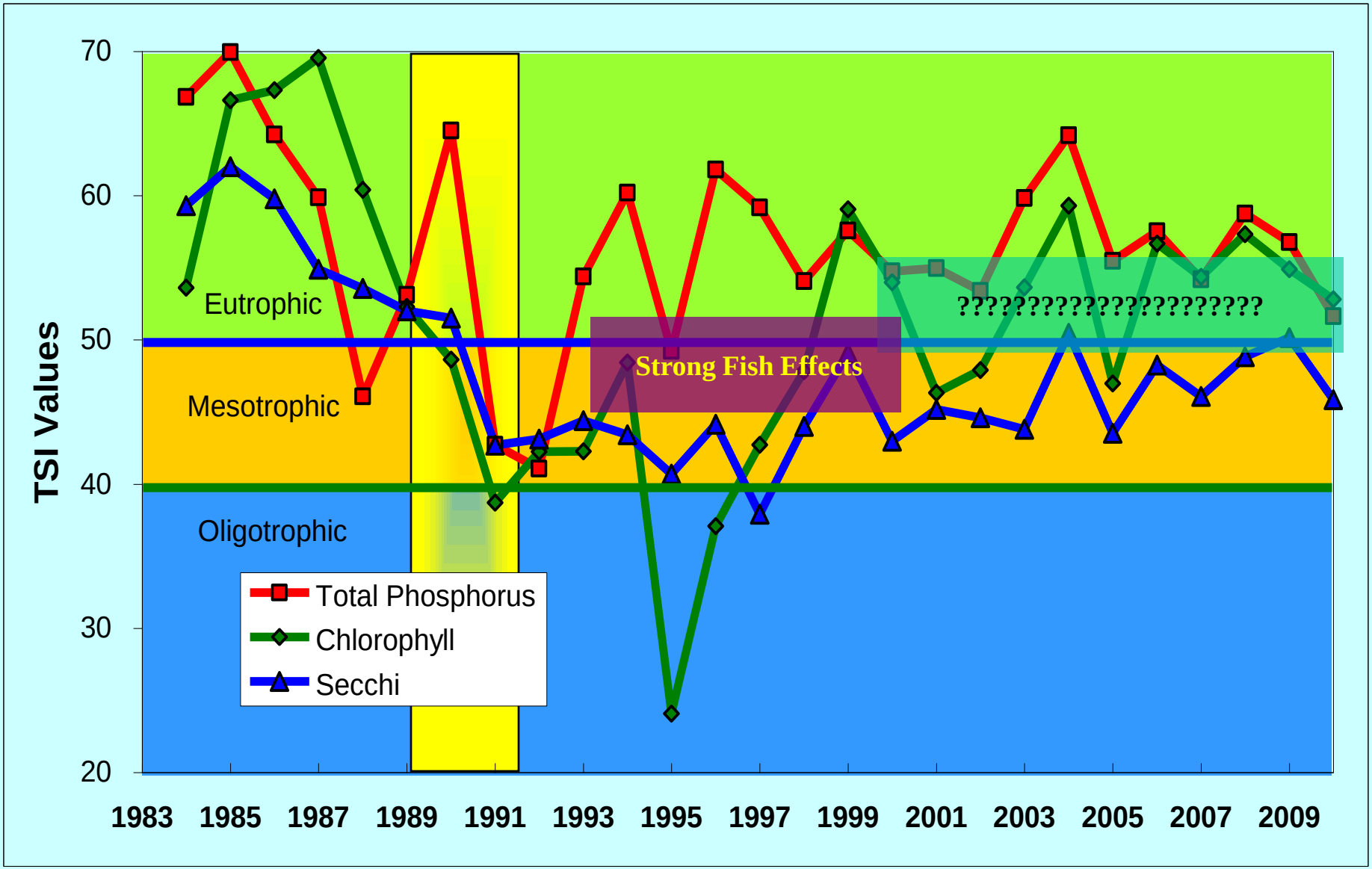
In-lake Water Quality

Summer Average
June - August



USGS science for a changing world

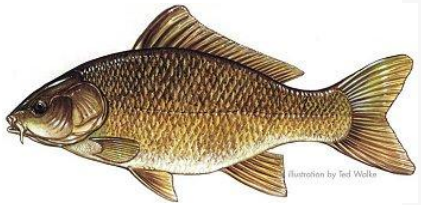
Trophic State of Delavan Lake

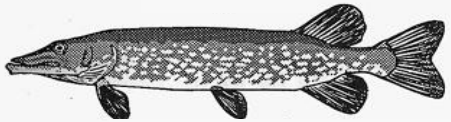


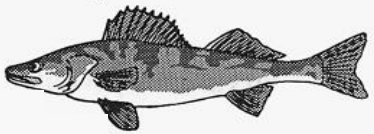
USGS science for a changing world

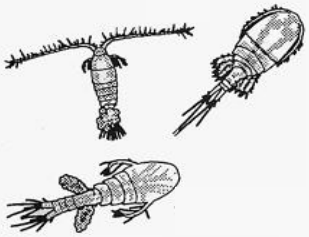
Manipulated

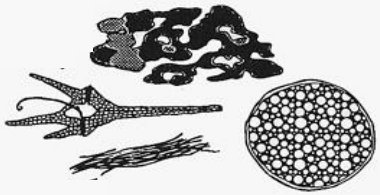
Post-Manipulated



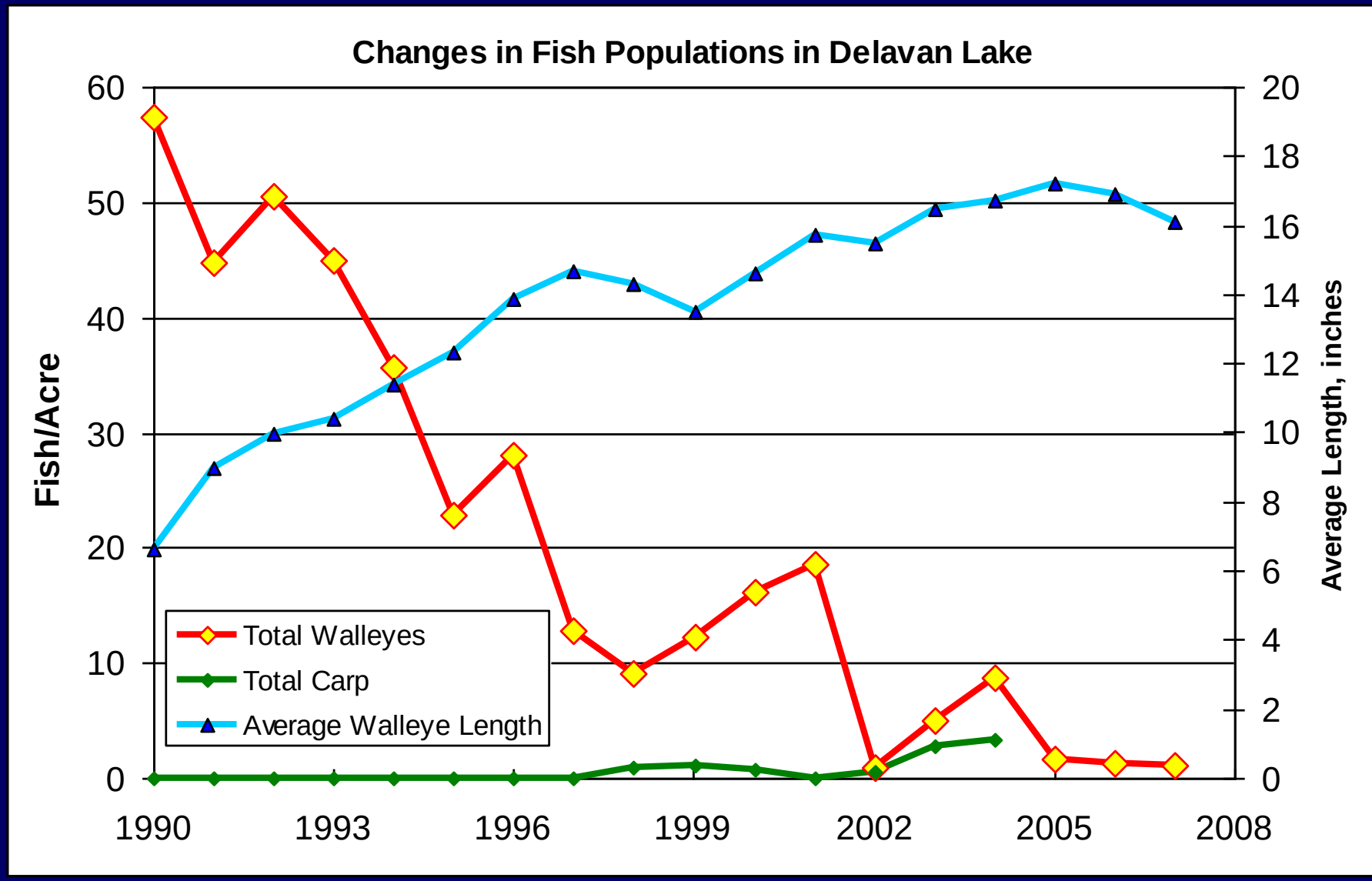




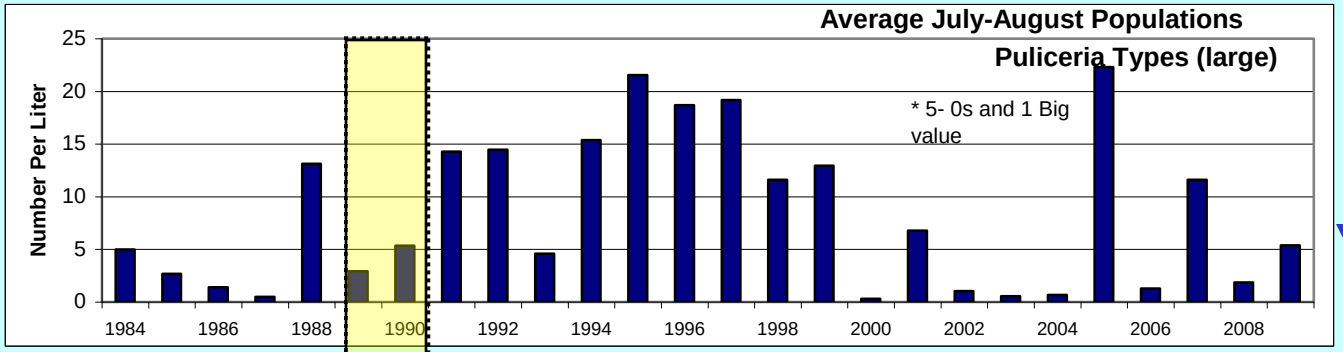


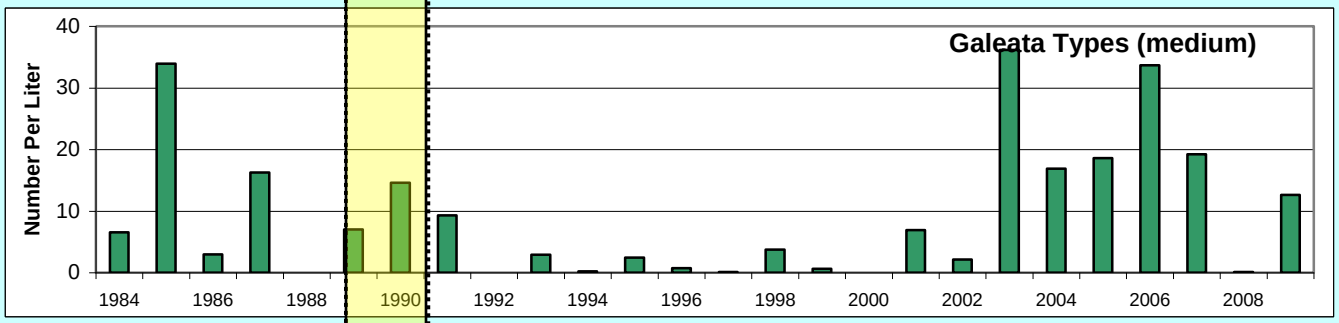


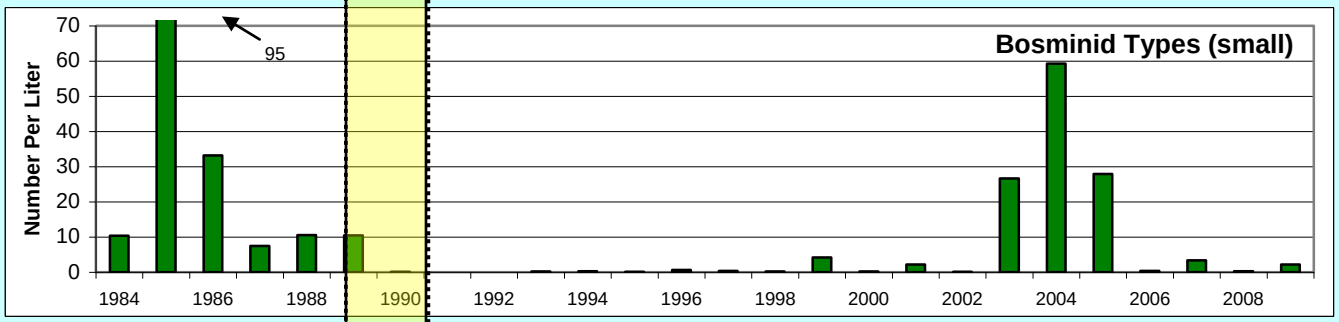
NUTRIENTS

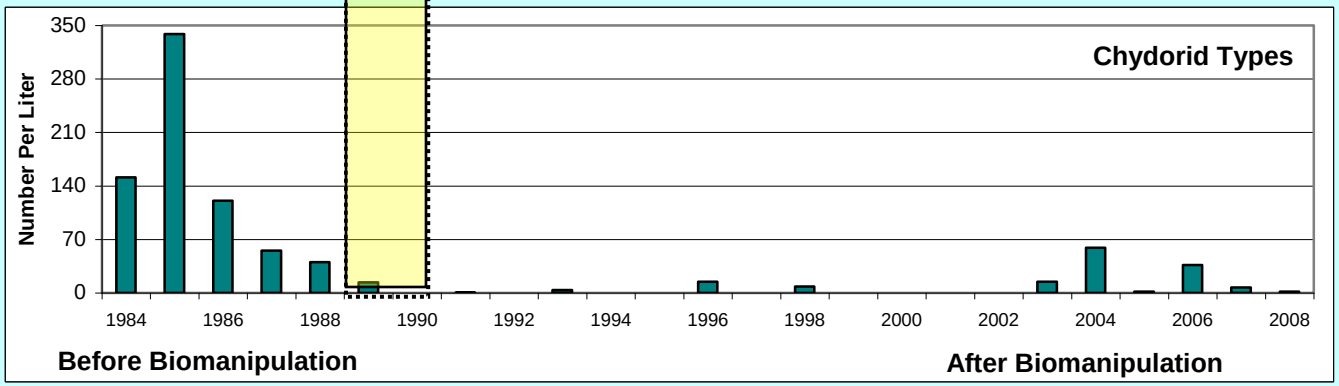

Changes in Fish Populations in Delavan Lake
Fish/Acre
Average Length, inches
60
50
40
30
20
10
0
20
18
16
14
12
10
8
6
4
2
0
1990
1993
1996
1999
2002
2005
2008
Total Walleyes
Total Carp
Average Walleye Length

Zooplankton Populations



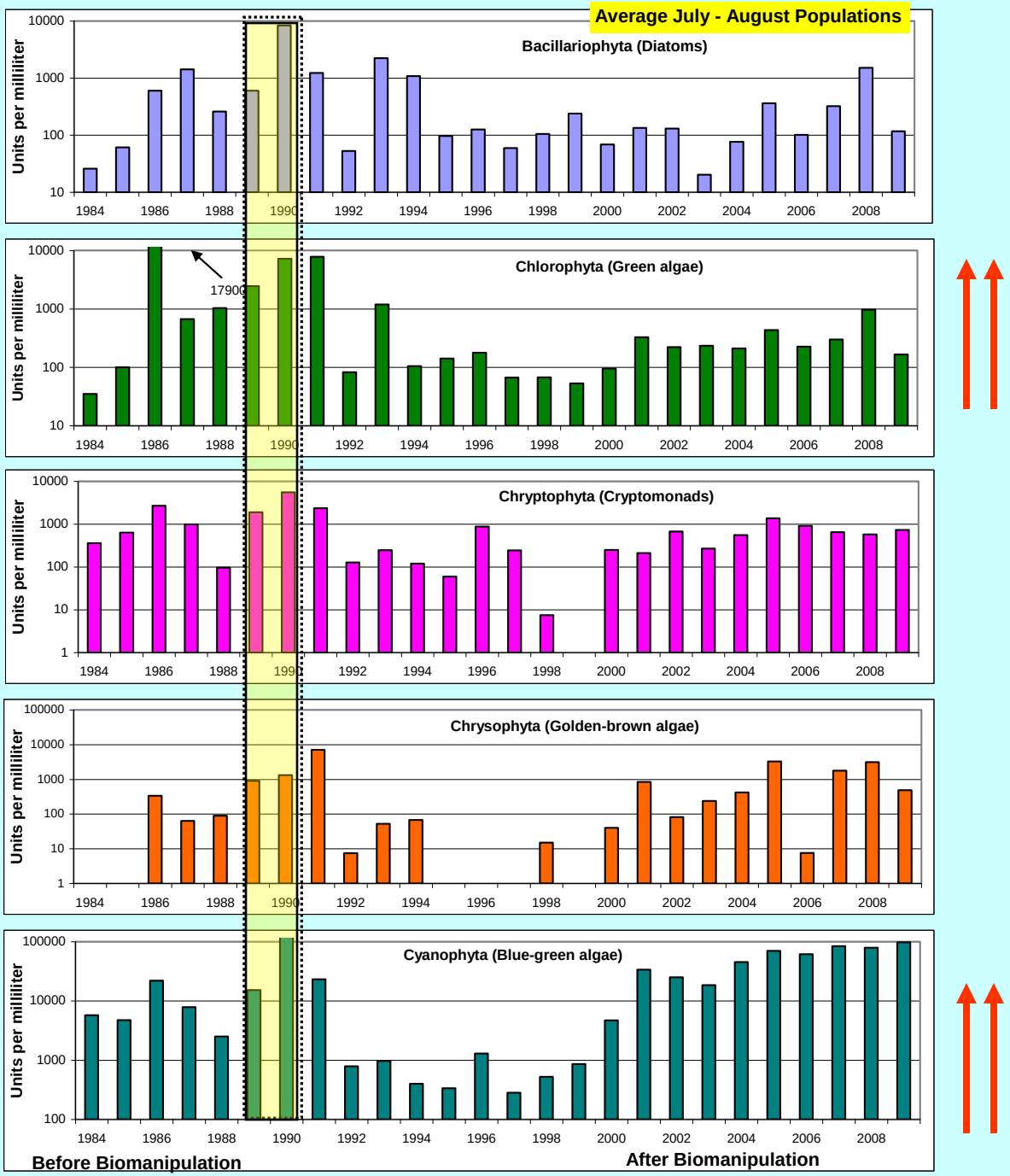




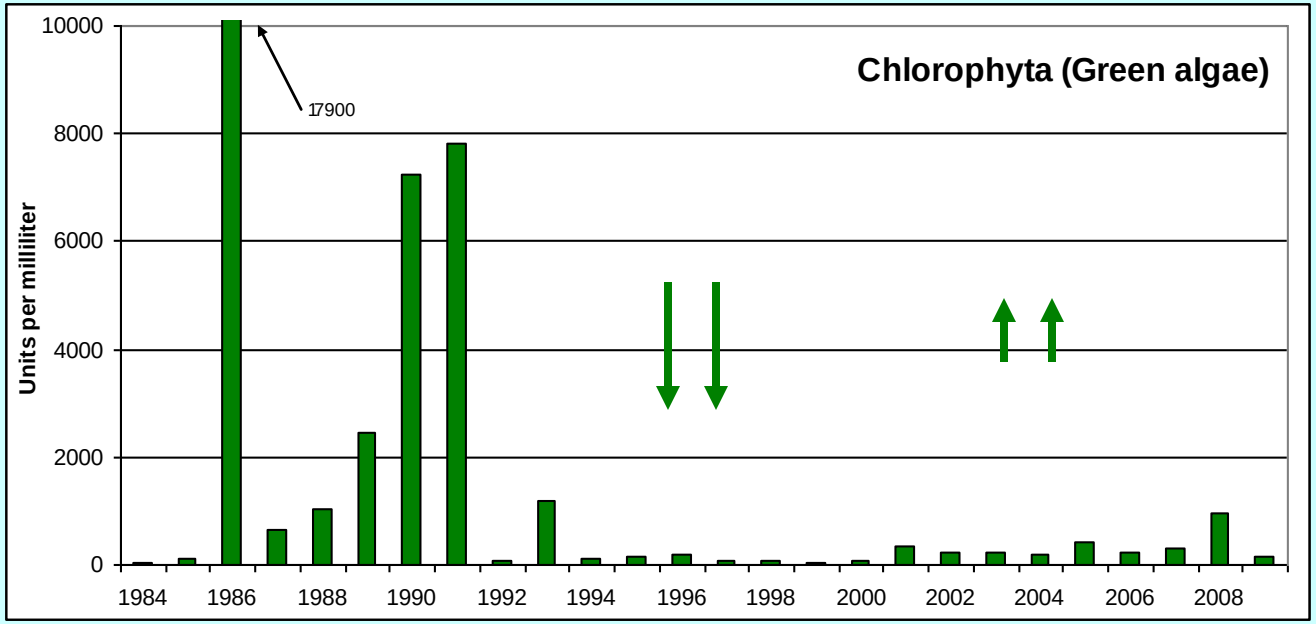


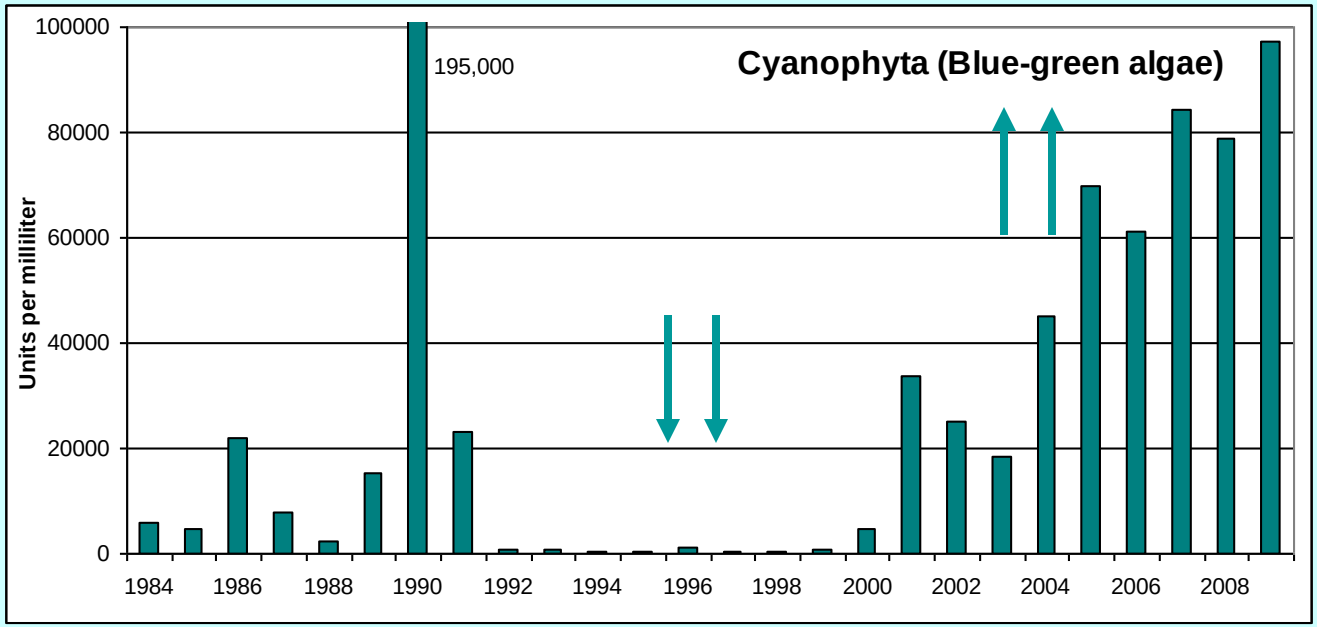
USGS science for a changing world

Phytoplankton Populations



USGS science for a changing world





USGS science for a changing world

LAKE DELAVAN
A FISHERY ON THE MOVE

■ *Geremachek Johnson*

FISHING HAS SLOWED SOMEWHAT RECENTLY ON THIS 2,000-ACRE SOUTHEASTERN WISCONSIN LAKE. HOWEVER, DELAVAN STILL PROVIDES EXCELLENT ACTION ON WALLEYES, BASS, PANFISH, NORTHERN PIKE AND EVEN SOME MUSKIES.

A strange thing happened in April 1998, when workers removed walleyes from Lake Delavan. What's going on? Is Lake Delavan's well-publicized late-1980s restoration project still working?

Yes, according to biologists, who are just fine-tuning the lake's management. And although fishing has slowed somewhat since the glory days immediately after the rehabilitation project, Delavan still provides excellent action on walleyes, bass, panfish, northern pike and even some muskies.

New Age, New Strategies

In one of Wisconsin's largest, most expensive lake rehabilitation projects, Lake Delavan was drawn down and treated in the late 1980s. Fishing was closed for two years. When the lake reopened, anglers found numerous species willing to bite.

In those days, fishing was sensational, which isn't unusual with newly restored lakes. Bluegill anglers caught buckets of big fish, walleye anglers had great catch-and-release action, and fishermen caught nice northerns, legal bass and even muskies. The lake gained a reputation as a sure bet. Almost any lure would work.

Fishing on Delavan has slowed since then, but biologists believe the lake is still on the right track.

A Fall 1998 survey revealed one surprise, though. Carp, which hadn't been seen since the restoration project, have returned to Delavan. Twelve carp between 14 and 20 inches were caught during the survey, although biologists had installed fish barriers to prevent this. However, Doug

covers about 2,000 acres and has a maximum depth of about 50 feet. It's narrow, and has dropping northern and southern shorelines like Geneva.

Jackson Creek flows into the shallow northern end near the park and public boat launch at Highway 50. On the northern shoreline, the lake's outlet flows toward Turtle Creek in the city of Delavan. This shallow area holds several bays. The outlet forms a bay and channel. Also, Lake Lawn Resort has a harbor on the lake's northeastern end, and a rock-bordered peninsula shapes a huge channel at the boat launch.

Delavan's far southwestern end has two shallow bays and some channels. The bays are separated by a peninsula called The Island. Another inlet, called Brown's Channel or Brown's Market, lies just north of The Island.

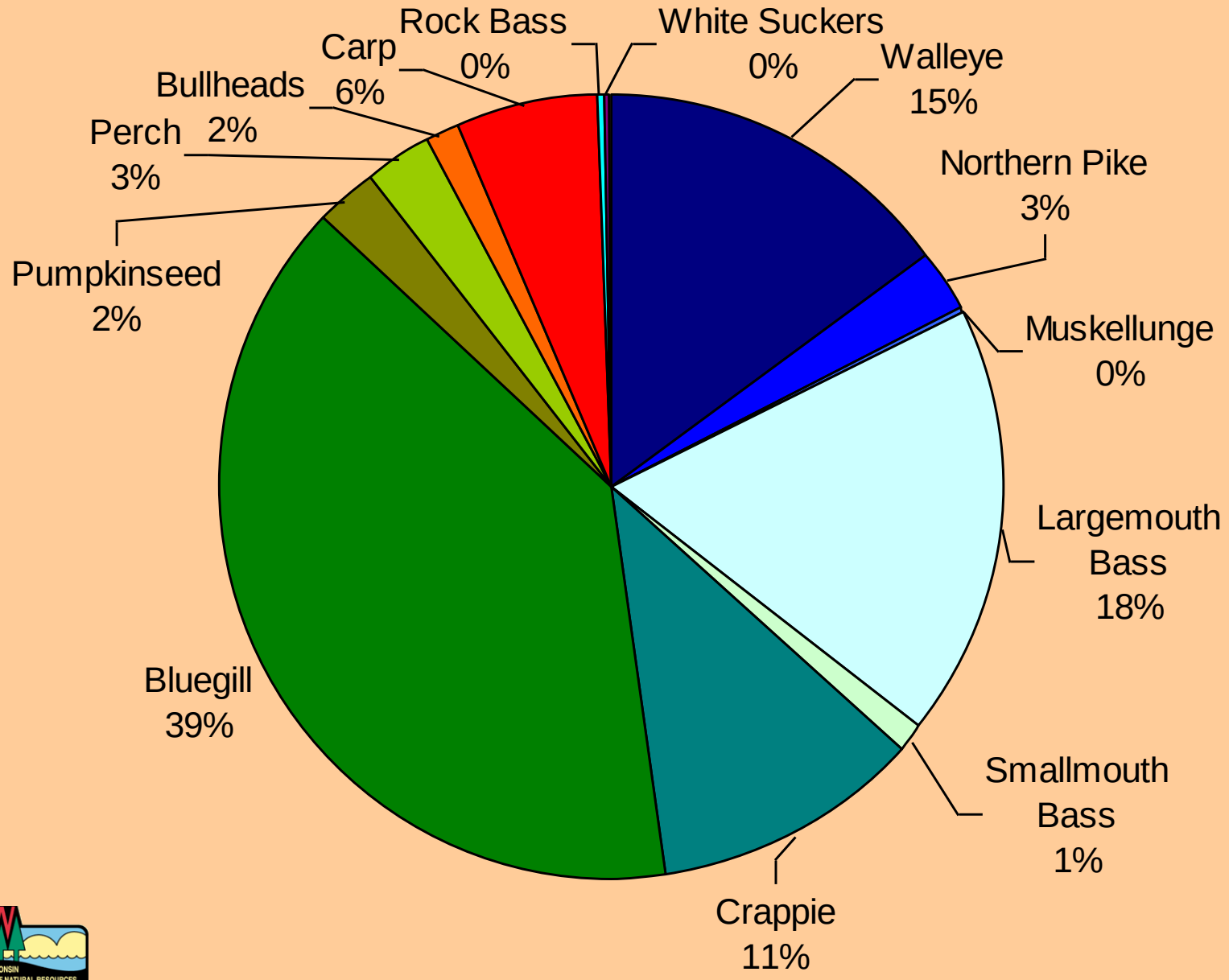
The lake also features several points. Cedar Point, or Yacht Club Point, juts out from the northern shoreline and creates the narrowest part of the lake. Willow Point sticks out from the lake's southwestern end, and an unnamed point juts out from South Shore Drive.

Walleyes Abound

In April 1998, biologists removed about 5,500 walleyes from Delavan and stocked them in other area lakes. They might remove more fish to further reduce Delavan's walleye population.

Why? A Fall 1998 survey indicated Delavan held too many walleyes. The survey catch rate was 72 fish per hour. Walleyes ranged from 5.9 to 19.9 inches, and the

FISH DISTRIBUTION, 2004



Badger State Crappie Hotspots

Do you have an itchin' for some open-water fishin'? The crappies in these waters can fill your needs.

by Dan Small

Wisconsin anglers itching for some open-water action would do well to plan an outing or two for crappies this spring. Hundreds of lakes throughout the Badger State offer good fishing for crappies, which in many cases are the most abundant panfish available. Abundant does not always mean easy to catch, however. These speckled panfish can be downright closed-mouthed at times, refusing even the most delicious morsel presented oh-so delicately on light tackle. At other times, they will bite anything you throw at them and do it so fast that you have a hard time keeping a line in the water.

Both black and white crappies inhabit Wisconsin waters. Black crappies have dark specks scattered all over a white body in uneven rows that thin out from the top of the fish to the bottom. White crappies look paler and bleached out by comparison, with distinct dark vertical bars over a creamy background. They frequent the same habitat and can be caught by the same methods. Most anglers can't tell them apart.

In winter, crappies often suspend at middepth in the water column, either in the middle of a lake or adjacent to a steep dropoff or other deep structure. In spring, as spawning time approaches, they gradually move shallower until they are in a few feet of water in reeds, over a marl or hardpan bottom, or along rock riprap.

Crappie populations are cyclical on most lakes, with a couple boom years followed by three or four bust years before their numbers rebuild. The lakes detailed here are waters where crappie numbers are currently high, or where consistent natural reproduction sustains them at high levels for years at a time. In other words, these are some of the very best crappie hotspots in the Badger State.

DELAVAN LAKE

Delavan Lake is one of our state's great fish-management success stories. In 1989, this 2,072-acre Walworth County lake was drawn down, poisoned to remove carp, then refilled and stocked with a variety of game fish and panfish. The result has been a tremendous fishery that has stayed strong for well over a decade, according to Department of Natural Resources fisheries biologist Doug Welch.

Crappies are abundant here, and there are several strong year-classes currently available. In winter, they suspend over deep water. When the ice goes out, you'll still find them suspended, where jigging spoons will take them.

When the water begins to warm, look for papermouths on shallow bars, along deep weed edges and around emergent bulrushes. Good spring spots include the mouth of Brown's Channel and near the public landing off Highway 50 on South Shore Drive, the best landing on the lake.

Anglers do well with small minnows and tiny jigs tipped with small plastic tails or Berkley Gulp baits. Scale down your offerings and your line diameter when crappies are shallow, because they often bite very lightly during this pre-spawn period.

For bait, tackle, guide service and fishing information, try Brian Gates at Geneva Lake Bait & Tackle in Williams Bay, (262) 245-6150.

BEAVER DAM LAKE

Located in western Dodge County, this 6,500-acre lake is my favorite for spring crappies. There is little structure in this shallow, sprawling lake, so crappies roam the open water most of the year. In spring, though, they move onto the flats along the north shore where they will spawn in a month or so.

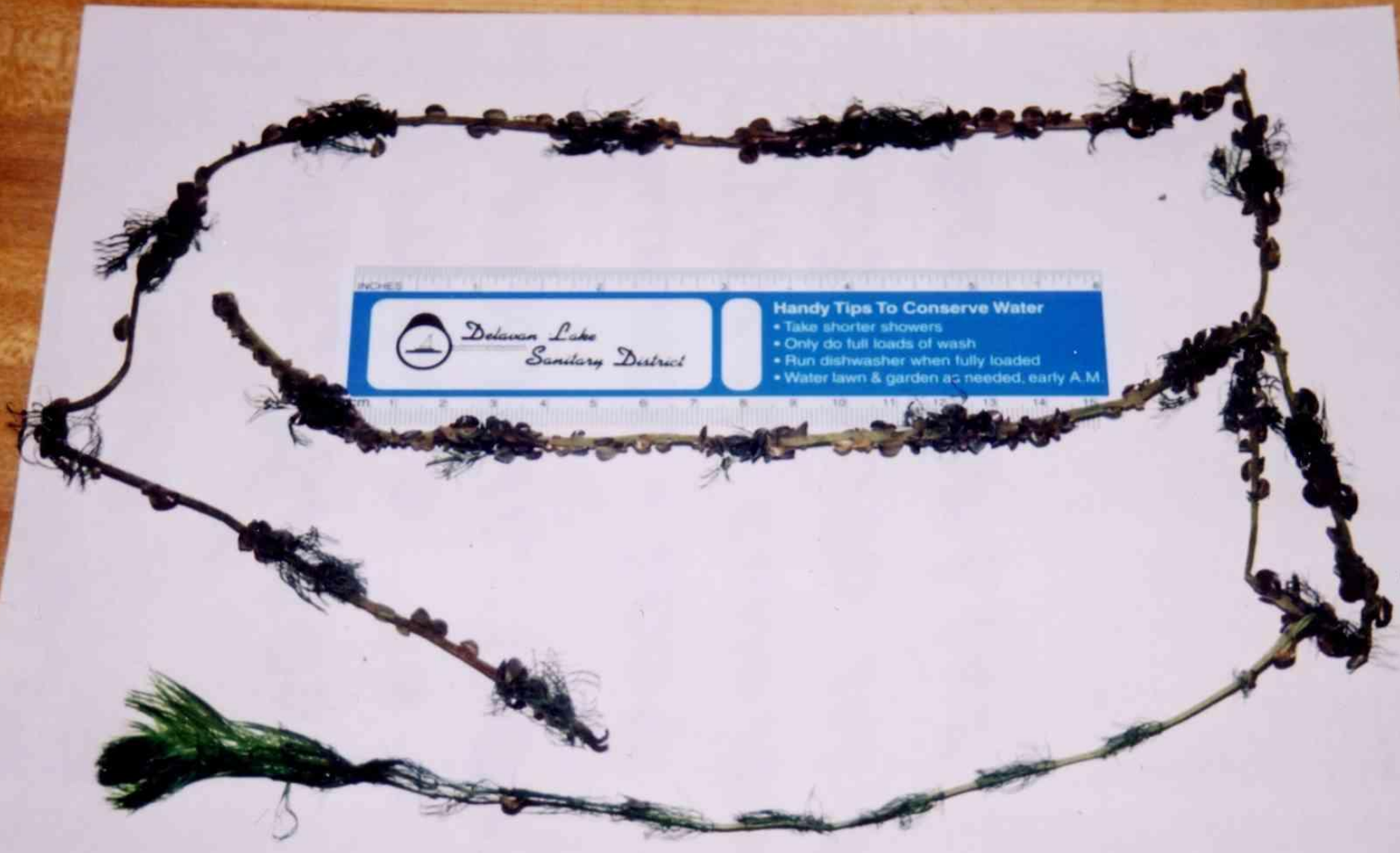
DNR fisheries biologist Laura Stremick-Thompson surveyed the crappies there last October. She found

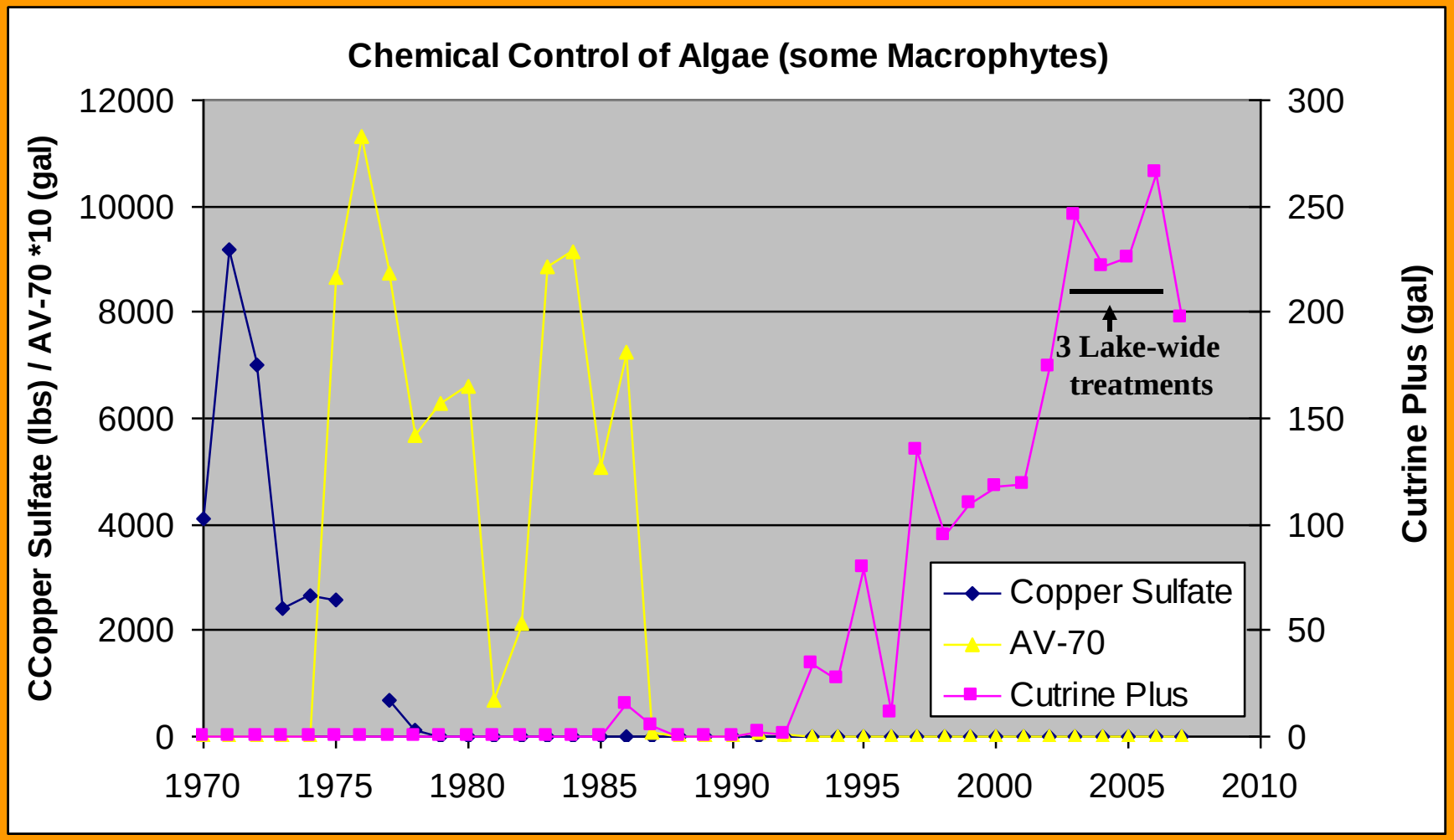
Increased Macrophyte Production

Filamentous Algae Growth

- Growth high in all shallow regions without macrophytes


Introduction of Zebra Mussels

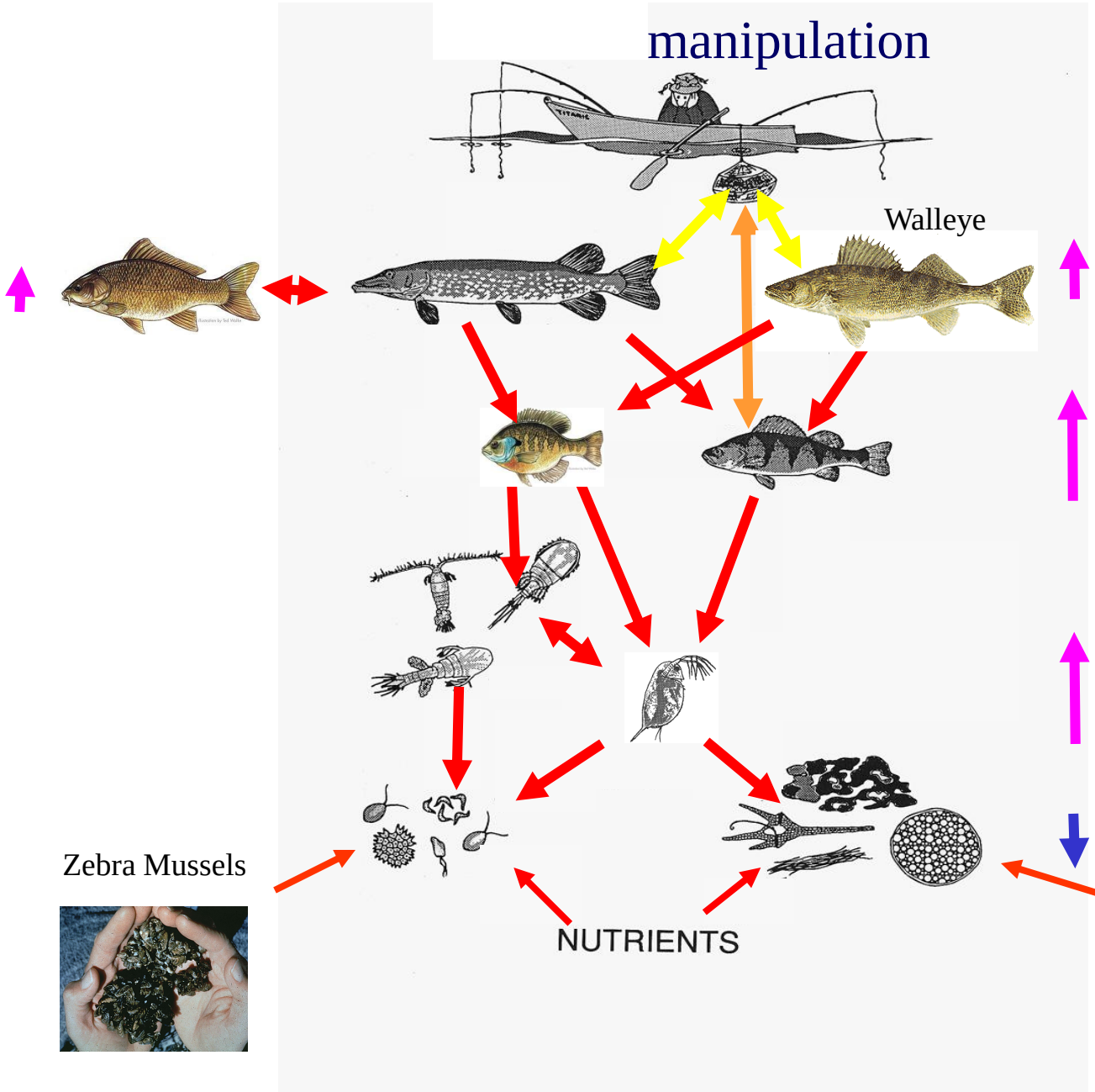

Delaware Lake
Sanitary District
Handy Tips To Conserve Water
• Take shorter showers
• Only do full loads of wash
• Run dishwasher when fully loaded
• Water lawn & garden as needed, early A.M.



USGS science for a changing world

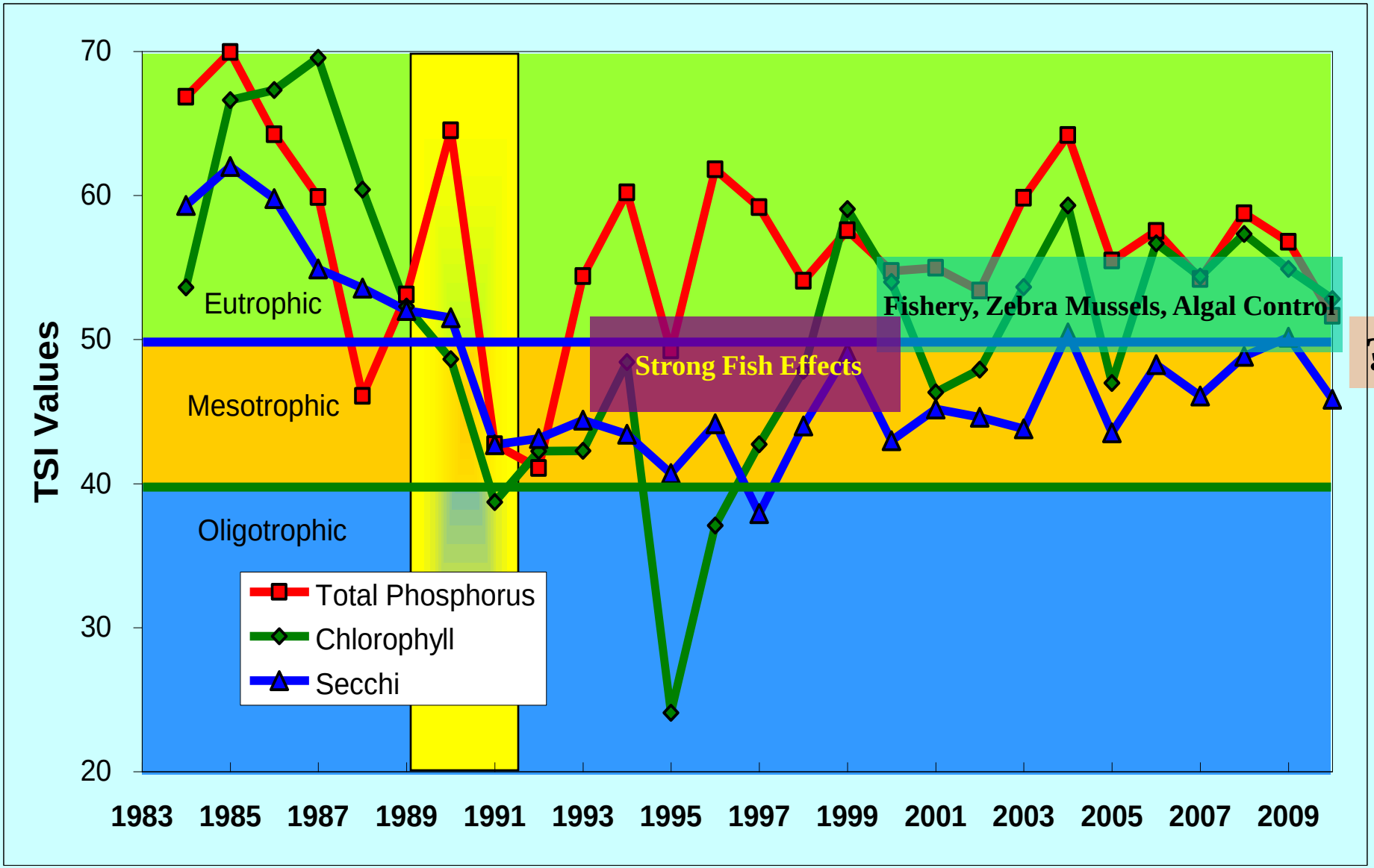
DLSD

Biomanipulation in Delavan Lake



Zebra Mussels

Trophic State of Delavan Lake



USGS science for a changing world

DLSD

Conclusions

Rehabilitation Program

1. Success depends on what part is examined.

2. Water clarity and fish populations remain good but decreasing, especially late in the summer.

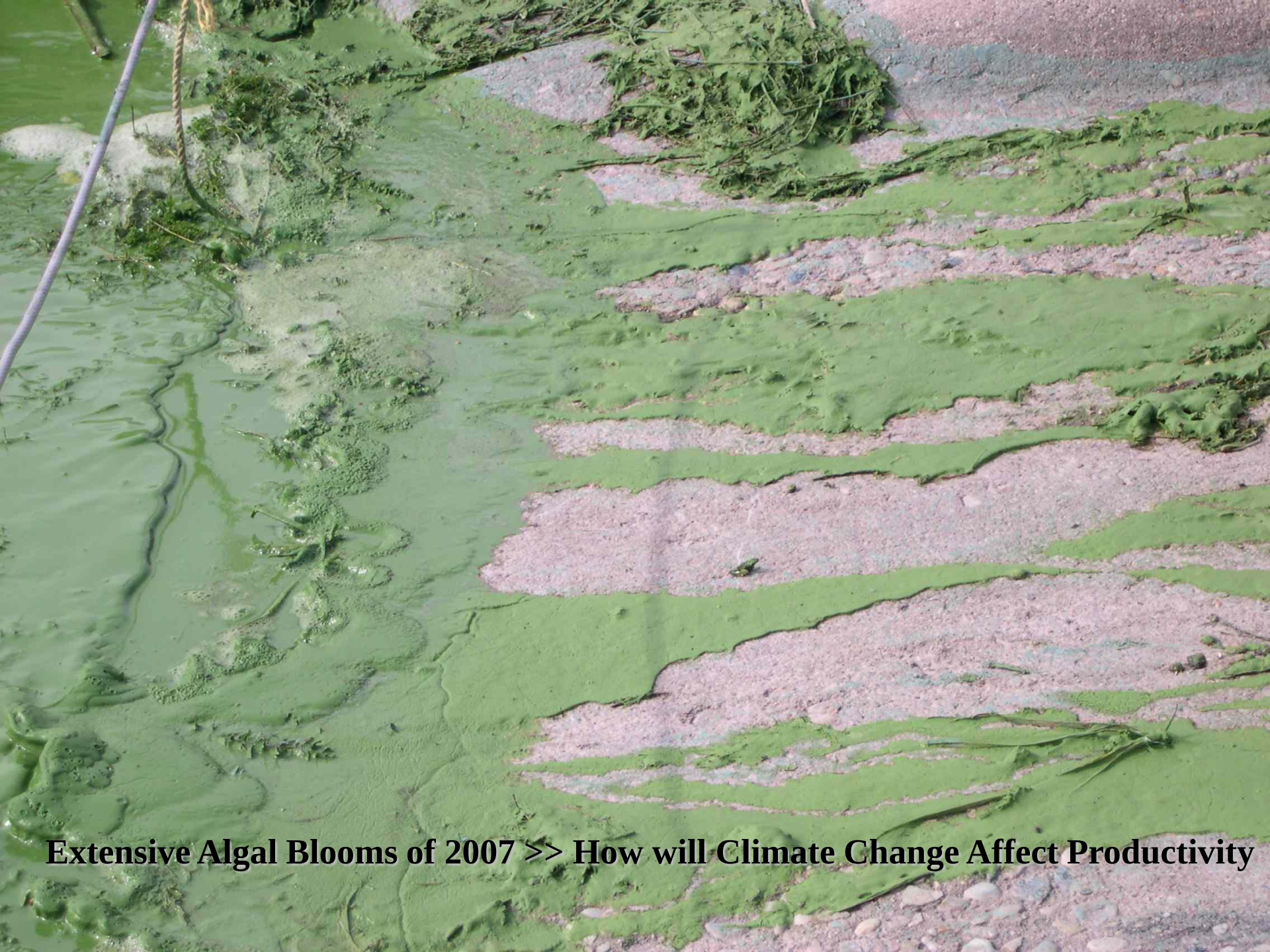
3. Macrophyte and filamentous algae growth very high, now mid- and late-summer algal blooms.

4. Walleye populations have declined and carp populations have increased but strong fishery and possibly the effects of zebra mussels maintain a weak trophic cascade.

5. If you don't eliminate the source of the problem (phosphorus loading), any action will be a temporary fix.

Extensive Algal Blooms of 2007

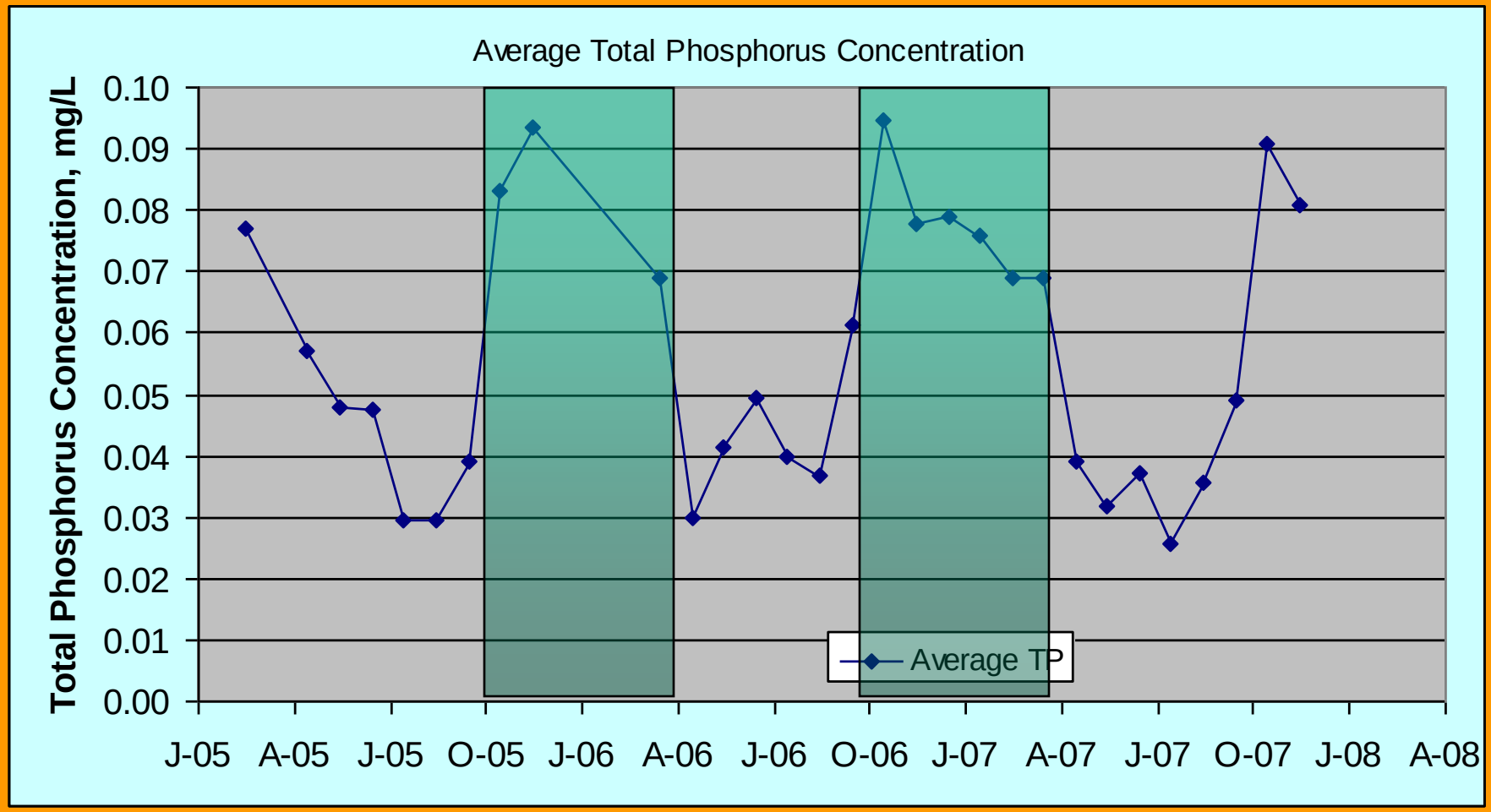
Delavan Lake, Wisconsin



Extensive Algal Blooms of 2007 >> How will Climate Change Affect Productivity

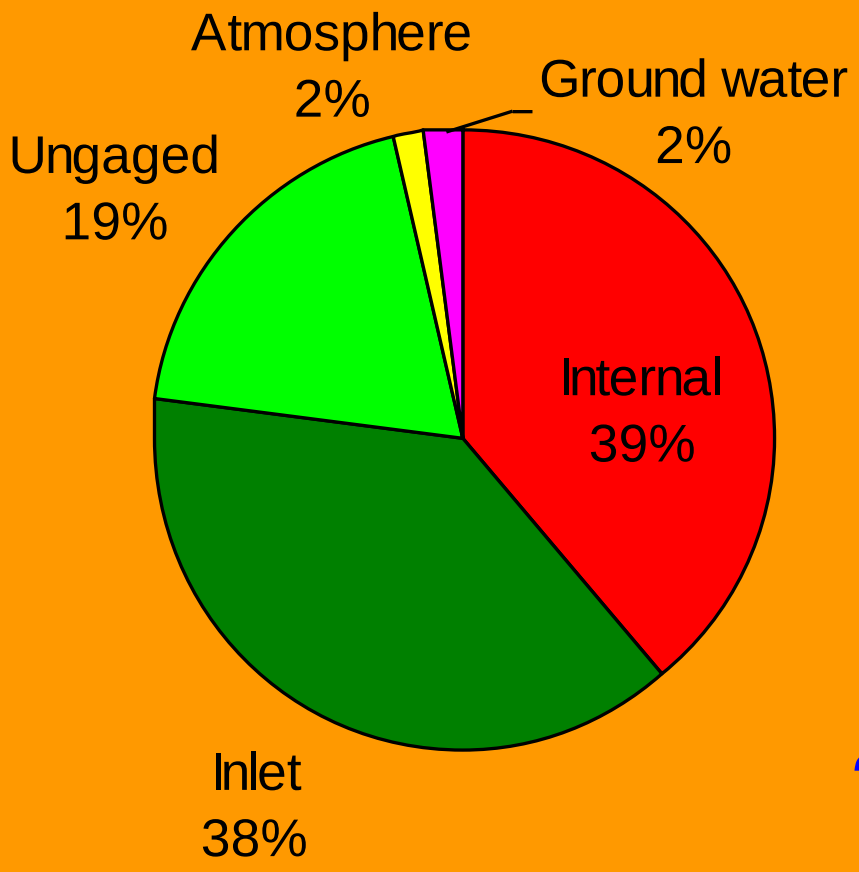

How will the Inlet and potential future development affect the Phosphorus loading to the lake??


What can be done to protect the lake??



Considering modifications to lake withdrawal patterns

Total Phosphorus Loading in 2001-09

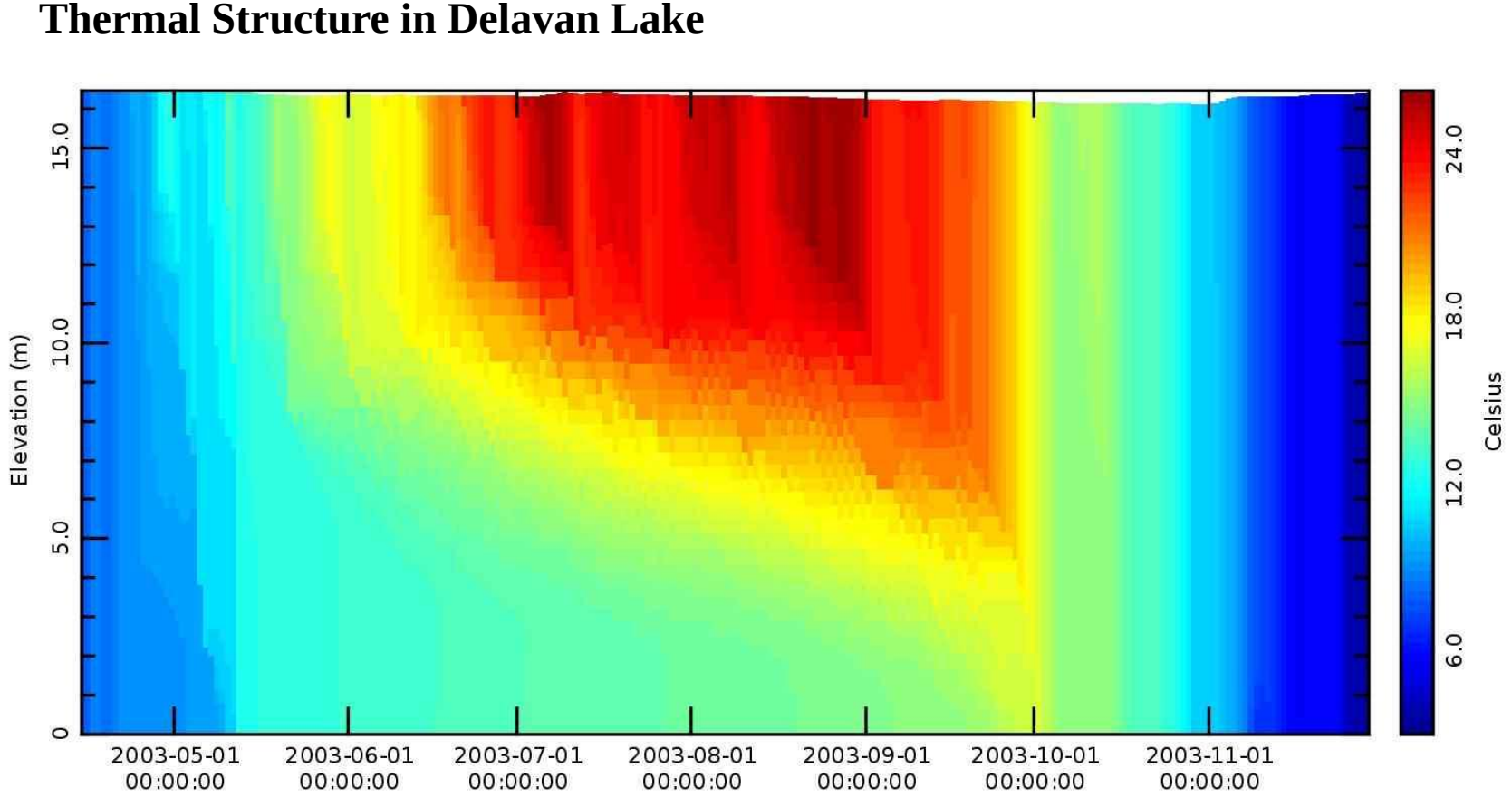


Is another Alum Treatment the ANSWER?

~25% Reduction So Far

Present Loading ~6,000 kg

Evaluation of the Importance of Internal Phosphorus Loading with DYRESM-CAEDYM



USGS science for a changing world

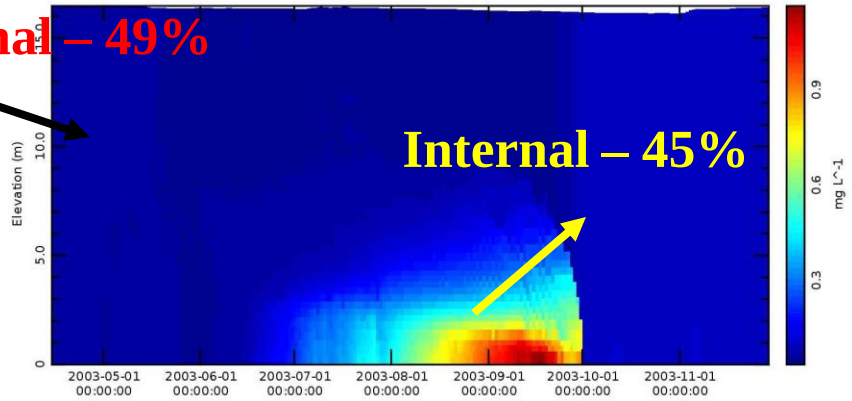
THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Evaluation of the Importance of Internal Phosphorus Loading with DYRESM-CAEDYM

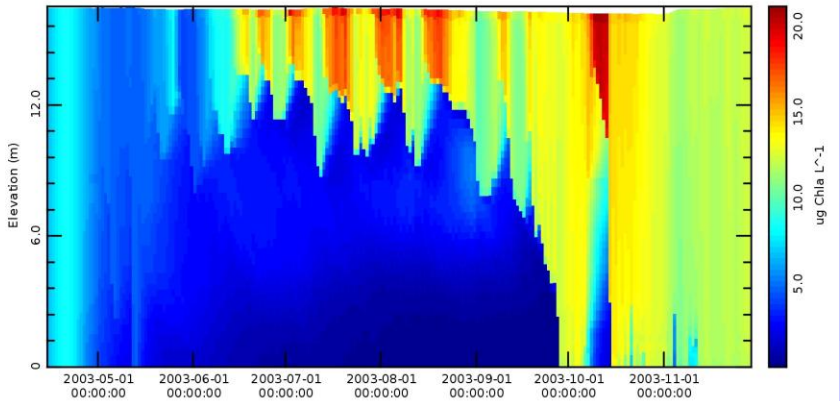
Total Phosphorus Concentrations - NOW

External – 49%

Internal – 45%



Chlorophyll a (Algae)

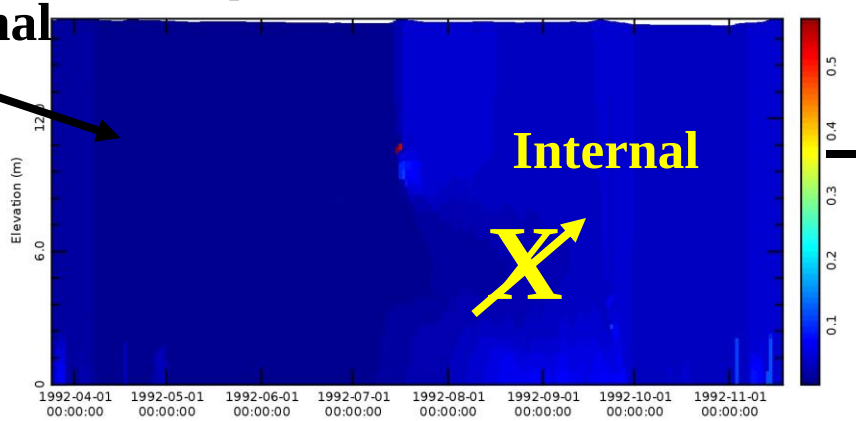


Total Phosphorus Concentrations – With Alum

External

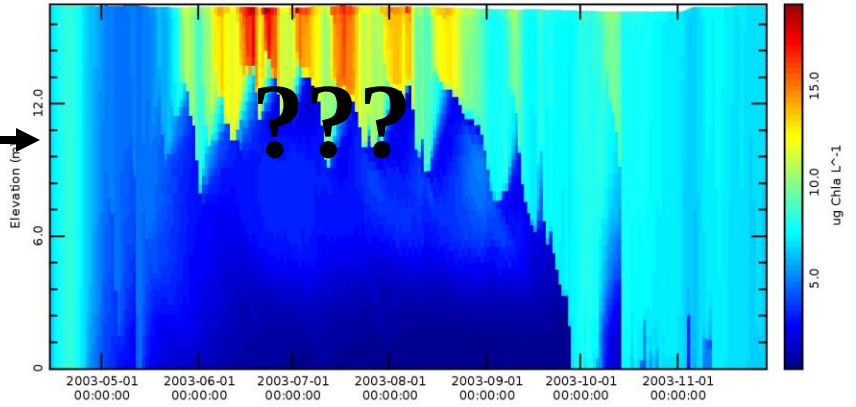
Internal

X



Chlorophyll (Algae)

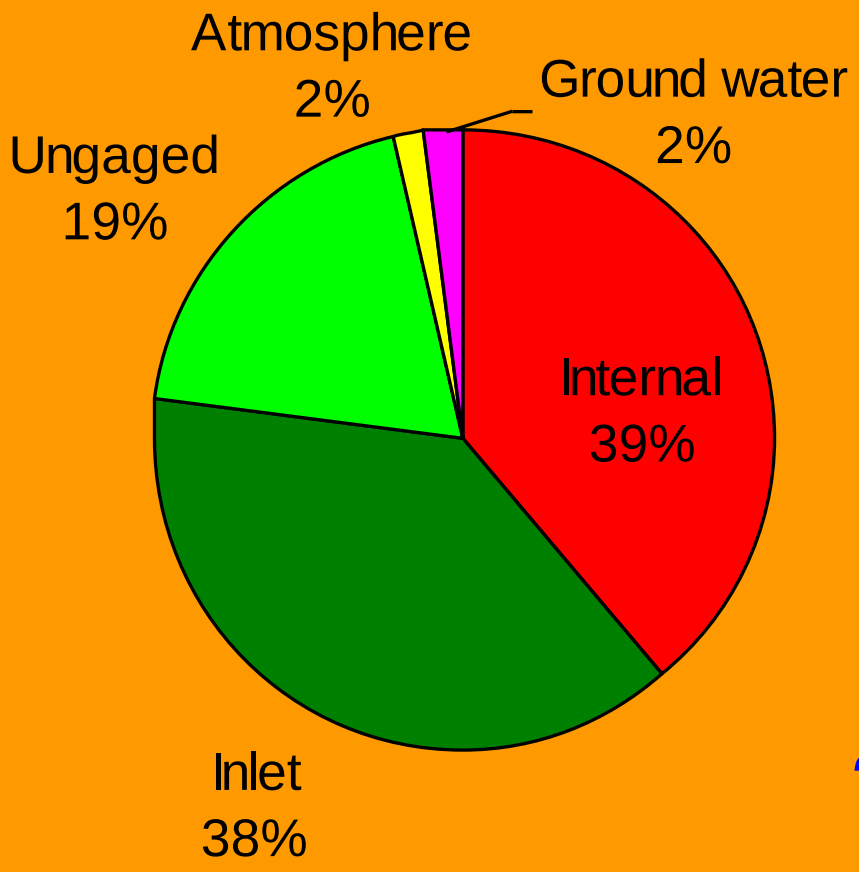
???



USGS science for a changing world

THE UNIVERSITY OF WAIKATO Te Whare Wānanga o Waikato

Total Phosphorus Loading in 2001-09



Is another Alum Treatment the ANSWER?

More Dredging?

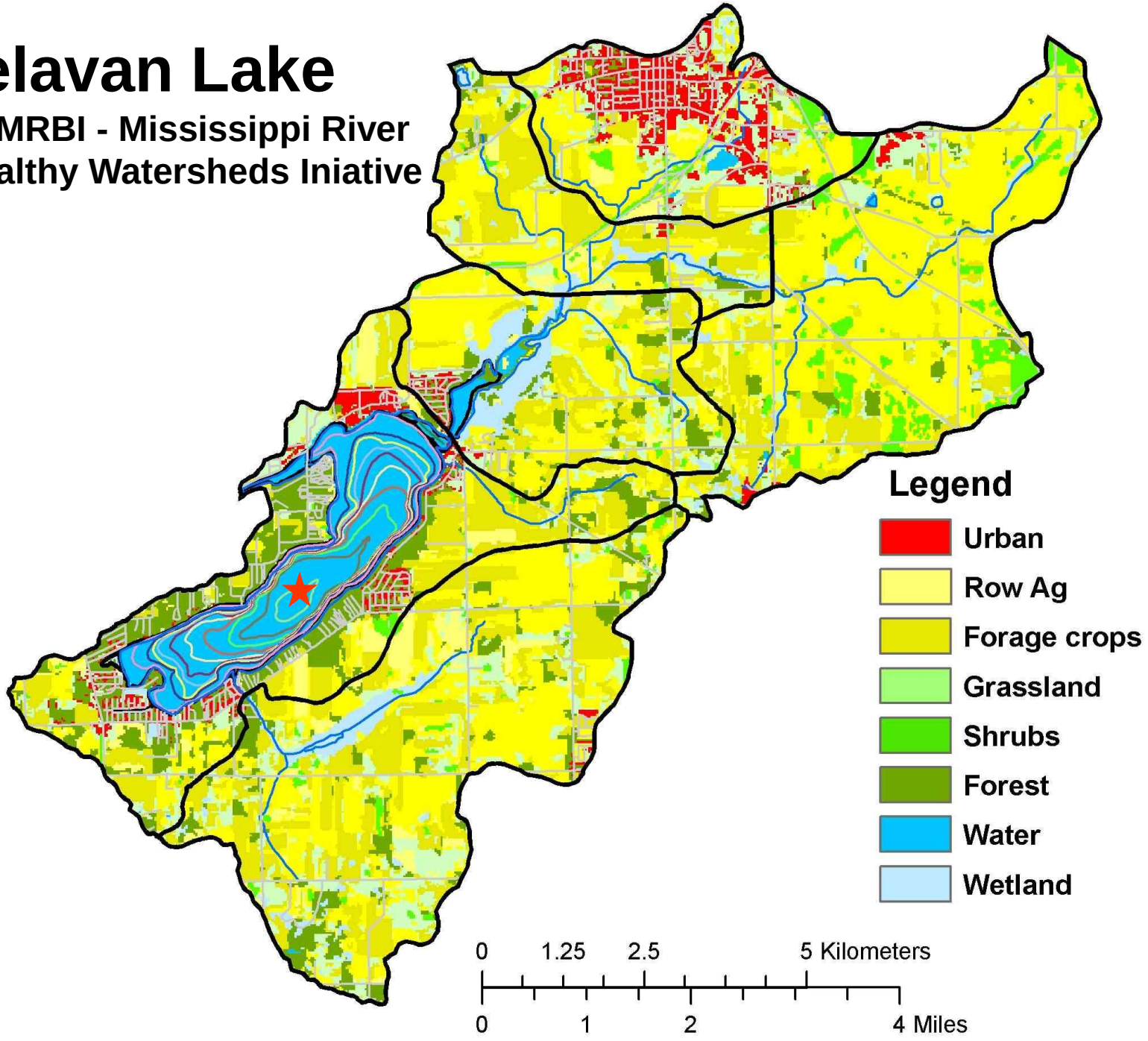
Biomanipulation?

~25% Reduction So Far

Present Loading ~6,000 kg

Delavan Lake

USDA – MRBI - Mississippi River Basin Healthy Watersheds Iniative



Goal: Use Scientific Information in the Long-term Maintenance of Delavan Lake, Wis.

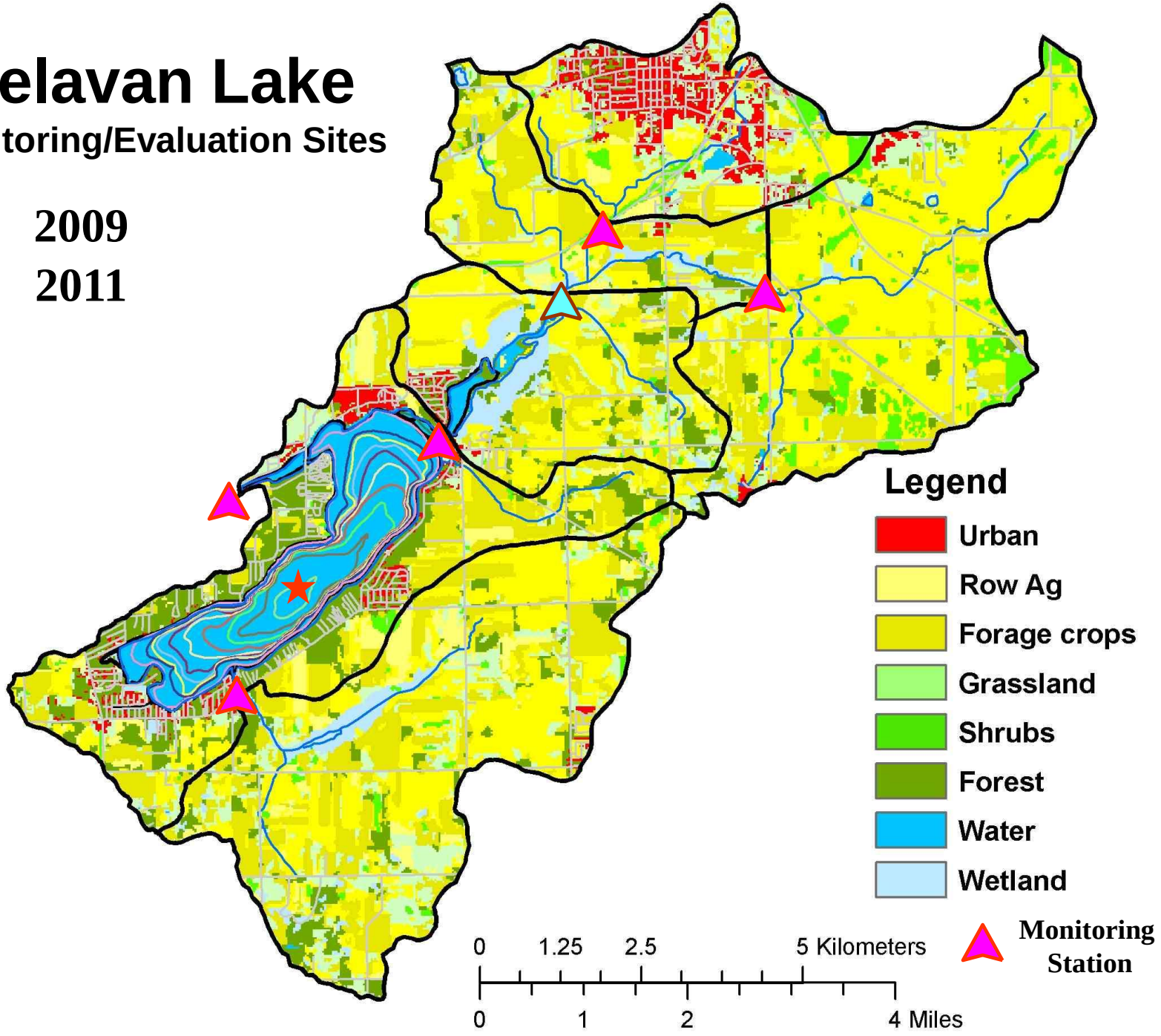
Don’t waste money on inefficient or short-lived projects (alum without stopping the source, short-circuiting without barriers)

Delavan Lake

Monitoring/Evaluation Sites

2009

2011



Publications:

Robertson, D.M., Goddard, G.L., Helsel, D.R., and MacKinnon, K.L., 2000, Rehabilitation of Delavan Lake, Wisconsin, Lake and Reservoir Management, v. 16, no. 3. p. 155–176.

Panuska, J.C., and Robertson, D.M., 1999, Estimating phosphorus concentrations following alum treatment using apparent settling velocities, Lakes and Reservoir Management, v. 15, no. 1, p. 28-38.

Robertson, D.M., Elder, J.F., Goddard, G.L., and James, W.F., 1998, Dynamics in phosphorus retention in wetlands upstream of Delavan Lake, Wisconsin, Lakes and Reservoir Management, v. 14, no. 4, p. 466-477.

The Role of Science in the Long-Term Rehabilitation of Delavan Lake, Wis.

Questions??

Dale Robertson
U.S. Geological Survey
Contact Information
Email: dzrobert@usgs.gov
Tele: 608-821-3867