



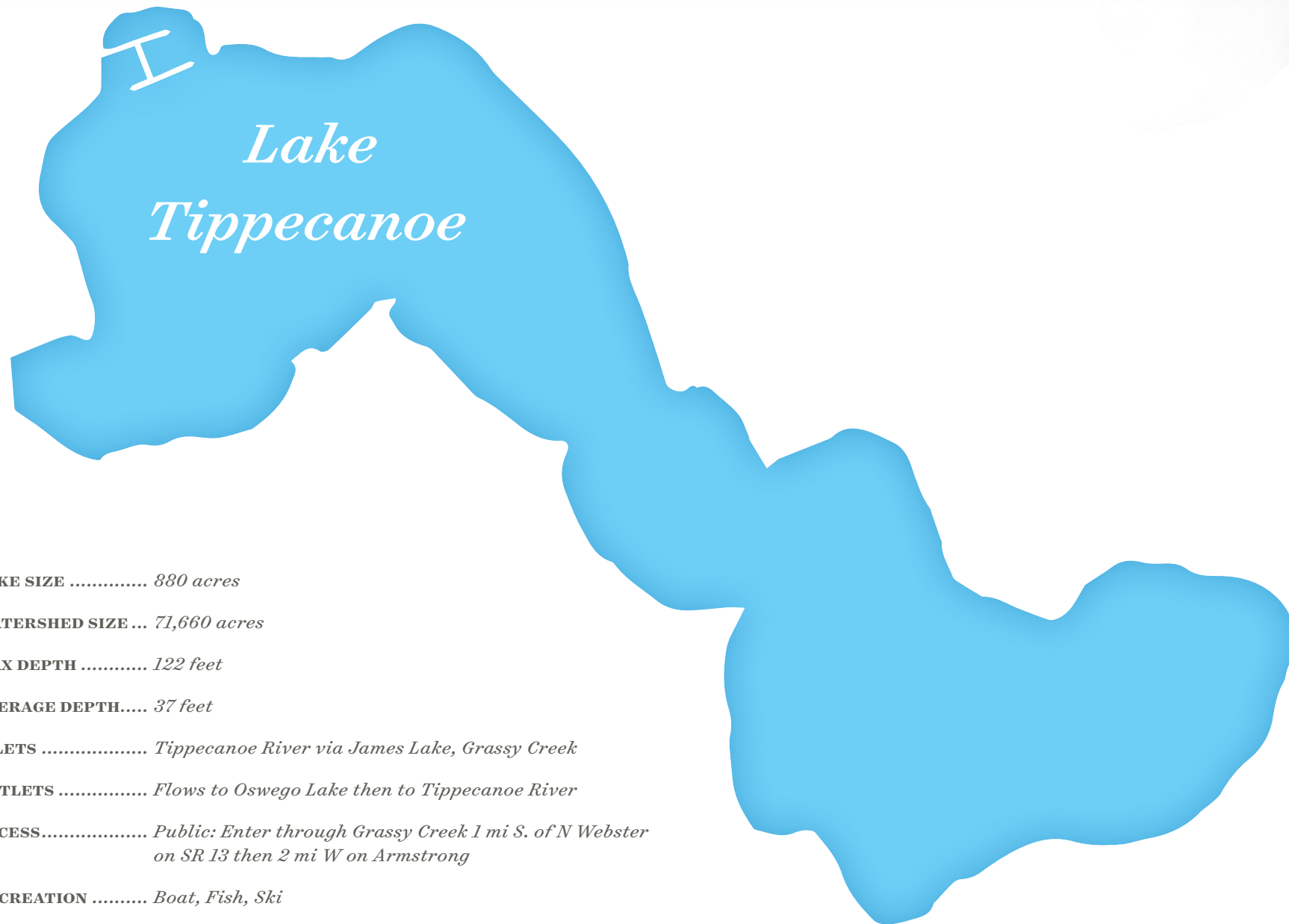
Lake Tippecanoe: Beneath the Surface

an investigation into your lake's health

CENTER FOR
**LAKES &
STREAMS™**



GRACE
COLLEGE



Lake Tippecanoe

LAKE SIZE 880 acres

WATERSHED SIZE ... 71,660 acres

MAX DEPTH 122 feet

AVERAGE DEPTH..... 37 feet

INLETS Tippecanoe River via James Lake, Grassy Creek

OUTLETS Flows to Oswego Lake then to Tippecanoe River

ACCESS..... Public: Enter through Grassy Creek 1 mi S. of N Webster
on SR 13 then 2 mi W on Armstrong

RECREATION Boat, Fish, Ski

LAKE BOTTOM..... Clay, Gravel, Muck, Sand

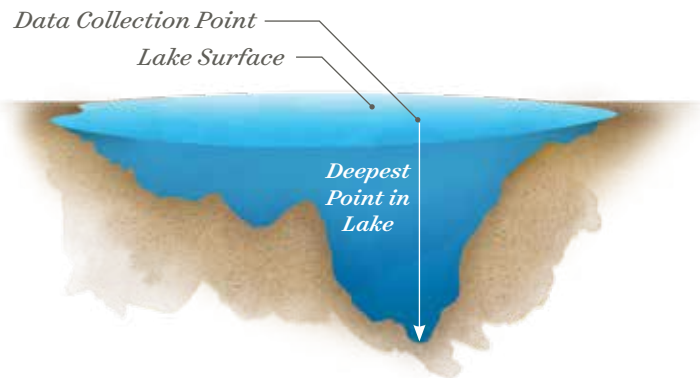
BEST FISHING Bluegill, Redear, Catfish, Black Crappie, Largemouth Bass,
Northern Pike, Rock Bass, Yellow Perch

Your Lake, Your Home

At the Center for Lakes & Streams, we know that Lake Tippecanoe isn't just any body of water. It's part of your everyday life. It's where you share memories. It's where your kids (and their kids) play. In other words, it's home. For that reason, we committed to gathering important information to help keep your home safe. This report is a summary of that information, collected over our four-year study.

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Our Study

In 2010, the Center for Lakes & Streams launched an ambitious research project: Studying 44 of Kosciusko County's largest lakes to assess blue-green algae toxins. As we investigated, we collected data on water clarity, nutrients, dissolved oxygen and other parameters. After four years of research, this left us with a wealth of valuable information.

This is a summary of our results specific to your home: Lake Tippecanoe. It uses data collected in open water above the deepest point in the lake and compares Lake Tippecanoe to other Kosciusko County all-sports lakes.

A technical report of this data is available online at lakes.grace.edu.

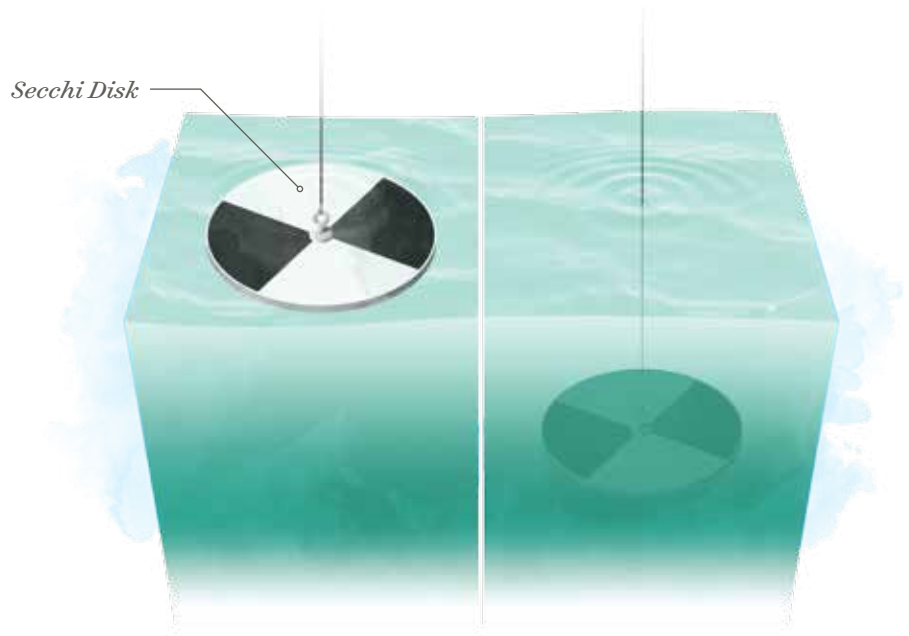
This research was funded by the K21 Health Foundation, Grace College and private donors.

WATER CLARITY

a measure of how far down light penetrates through water

How clear is your water? Measuring water clarity is the first step in assessing the health of a lake. A clear lake is generally a healthy lake, but murky water is a sign that something may be wrong — such as too much sediment, pollution or an overgrowth of algae. Once the clarity of water is assessed, it is important to conduct more tests to find out what is affecting the lake's water.

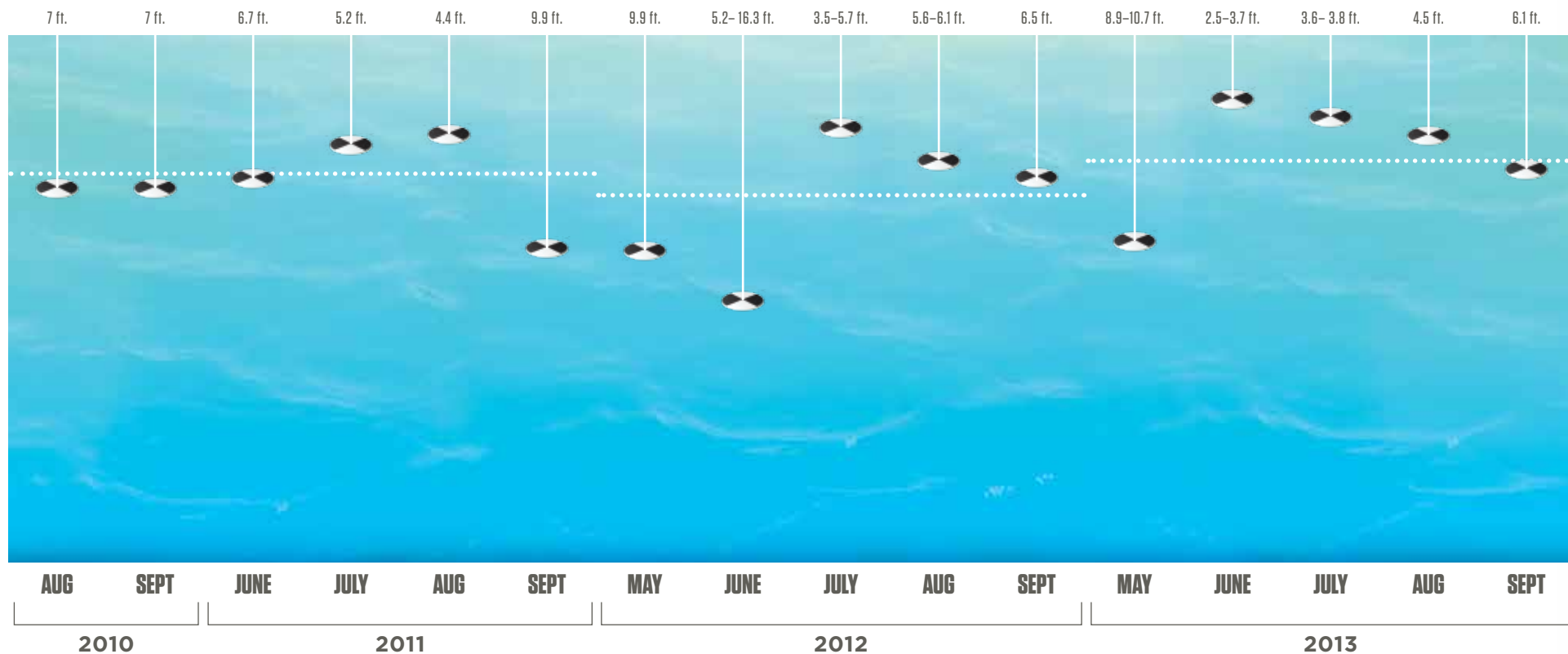
How is water clarity measured? Water clarity is measured with a tool called a Secchi disk. A Secchi disk is a frisbee-sized metal disk that is painted with a black and white pattern. The disk is attached to a string and lowered into the lake water until the black and white pattern is no longer visually distinct. The depth of the disk is recorded as a measure of the water's clarity.



WATER CLARITY *in* LAKE TIPPECANOE



Lake Tippecanoe All-Sports Lakes in County (yearly average)



Observations:

- Water clarity was often lowest in the middle of the summer
- Lake Tippecanoe's water clarity was similar to other all-sports lakes in the county

DATA SUMMARY: Lake Tippecanoe's water clarity was typically worse in the middle of the summer. This decreased clarity is partially caused by nutrients (phosphorus and nitrogen) making more algae grow in the middle of summer. Additional factors might include increased boat activity in shallow areas stirring up the lake bottom or dirty stream water coming into the lake after summer thunderstorms.

MICROCYSTIN TOXIN

a common toxin produced by blue-green algae that primarily targets the liver but is also a skin, eye and throat irritant

Blue-Green Algae and Toxin Levels

Blue-green algae is distinguishable from other algae by its paint-like or “pea soup” appearance in the water. It is also the type of algae that produces a variety of health-threatening toxins. At this time, it is not clear what causes blue-green algae to produce these toxins. We focused our research on one specific type of toxin, microcystin, because it is the most commonly studied blue-green algae toxin.



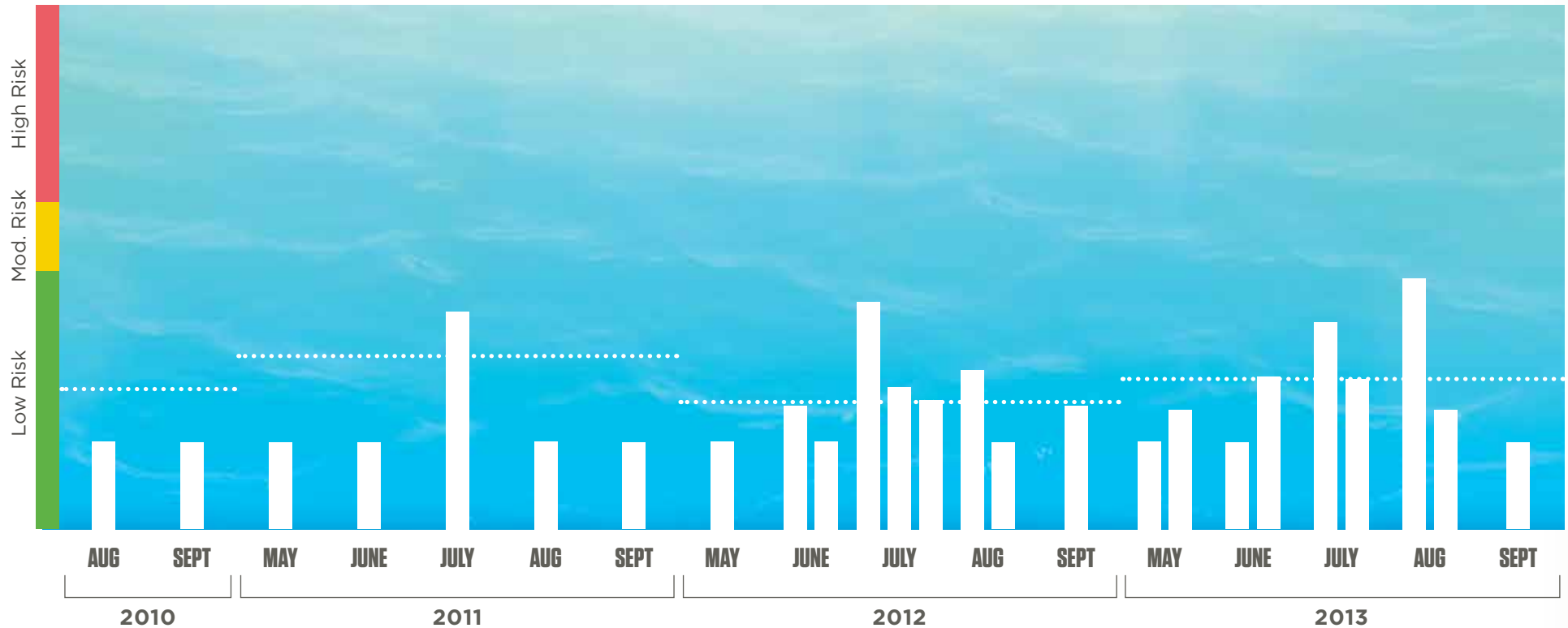
HEALTH RISKS BASED ON MICROCYSTIN LEVELS

*For recreational
waters as outlined
by the World Health
Organization*

	LOW RISK LEVELS	MODERATE RISK LEVELS	HIGH RISK LEVELS
Possible Health Problems	Short-term adverse health outcomes, e.g., skin irritations, gastrointestinal illness	Potential for long-term illness Short-term adverse health outcomes, e.g., skin irritations, gastrointestinal illness	Potential for acute poisoning Potential for long-term illness Short-term adverse health outcomes, e.g., skin irritations, gastrointestinal illness
Typical Actions	Post on-site risk advisory signs Inform relevant authorities	Watch for scums or conditions conducive to scums Discourage swimming and further investigate hazard Post on-site risk advisory signs Inform relevant authorities	Immediate action to control contact with scums; possible prohibition of swimming and other water contact activities Public health follow-up investigation Inform public and relevant authorities

TOXIN LEVELS *in* LAKE TIPPECANOE

■ Lake Tippecanoe All-Sports Lakes in County (yearly average)



Observations:

- Microcystin levels were consistently in the "low risk" zone but highly variable
- Lake Tippecanoe's microcystin levels were similar to other all-sports lakes in the county

DATA SUMMARY: Even though Lake Tippecanoe's microcystin toxin levels were consistently below guidelines for human health, the high variability of these levels indicates strong potential for future risk. Under the right conditions, such as high nutrient levels and warm temperatures, blue-green algae could produce microcystin toxin levels above human health guidelines in Lake Tippecanoe.

E. COLI

Escherichia coli (E. coli) is a bacteria that normally lives in the intestines of people and animals

You have probably heard of public beaches being shut down because of *E. coli*. This bacteria is closely monitored by health officials and others because it is a common problem with water. There are many pathways through which *E. coli* can enter and contaminate lakes, including combined sewer overflows, neglected septic systems, wildlife, and urban/agricultural runoff.

Beach Closure. In public health, *E. coli* levels are used as an indicator of fecal pollution in water. If the levels of *E. coli* in water are too high, the beach is deemed unsafe and the beach is closed. The public beach closure guideline for *E. coli* is established by the Indiana Department of Environmental Management and enforced by local health departments.

E. COLI AND YOUR HEALTH

Why monitoring E. coli levels is important

If *E. coli*-contaminated water is ingested, it can cause infections and various other health issues:

UNSAFE E. COLI LEVEL

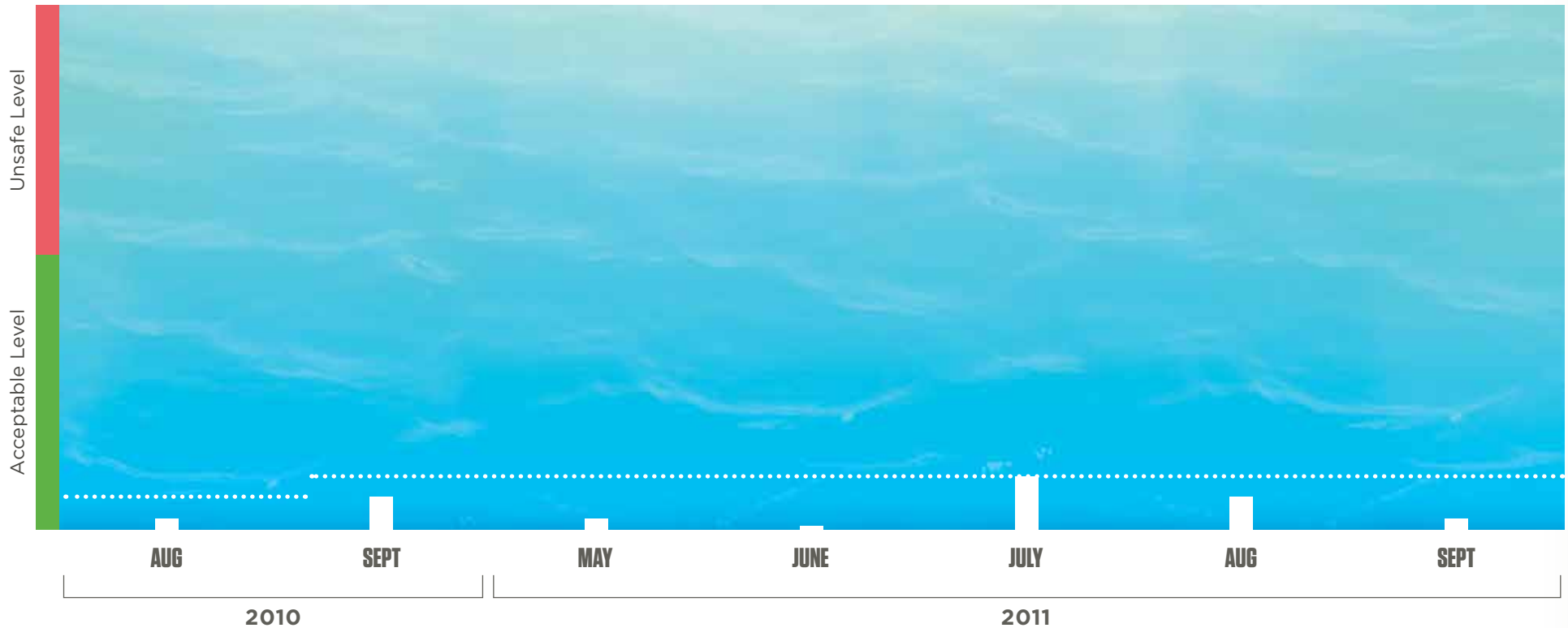
Possible Health Problems	Gastroenteritis, which can cause a variety of symptoms, including nausea, vomiting, abdominal cramps and pain, diarrhea, headache and fever
	Ear, eye, nose and throat infections
Typical Actions	Close beaches



E. coli
Bacteria

E. COLI LEVELS *in* LAKE TIPPECANOE

■ Lake Tippecanoe All-Sports Lakes in County (yearly average)



Observations:

- E. coli levels were well below the health guideline
- Lake Tippecanoe's E. coli levels were similar to other all-sports lakes in the county

DATA SUMMARY: In the open lake areas of Lake Tippecanoe, *E. coli* levels were well below the health guideline, though this study did not include extensive sampling of various shoreline areas, where *E. coli* levels are often higher.

NUTRIENTS

soluble minerals plants need to grow

Too Much of a Good Thing. Nutrient-packed fertilizers are good for lawns and gardens. But when they enter the lake in the form of fertilizers, human and animal waste, or yard waste, they make aquatic plants and algae grow too much.

Two of the most important nutrients to study are phosphorus and nitrogen. They are responsible for a majority of plant and algae growth in the lake.

NUTRIENTS, PLANTS AND ALGAE

*This figure shows
how nutrients affect
a lake's plant life*

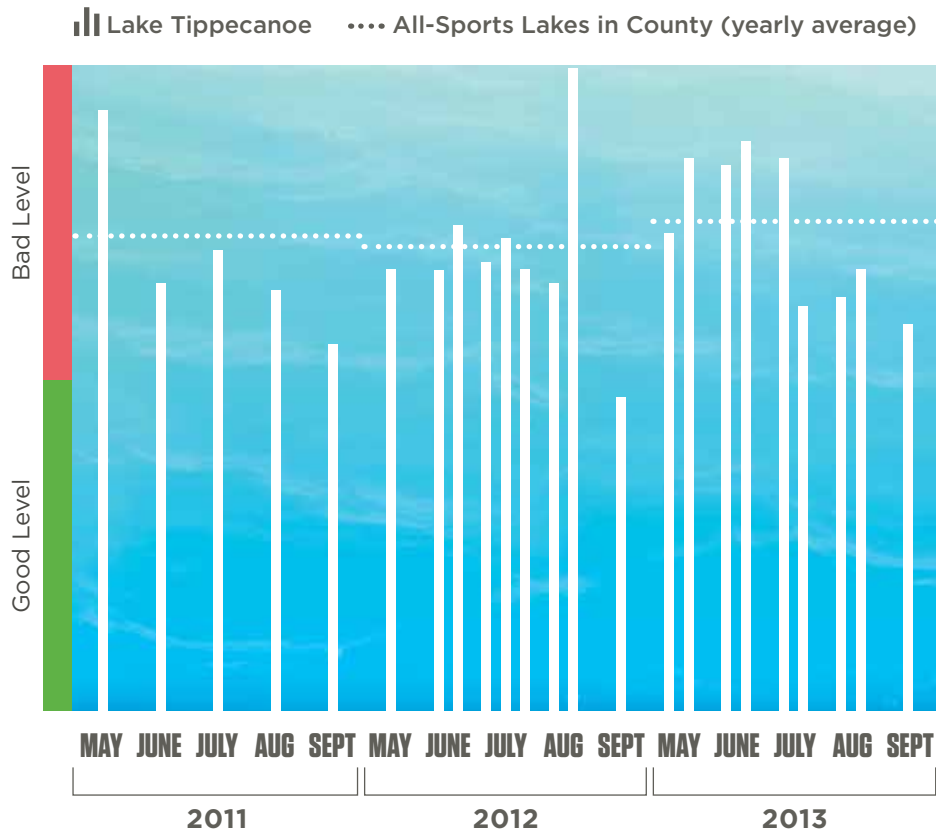


Few Nutrients

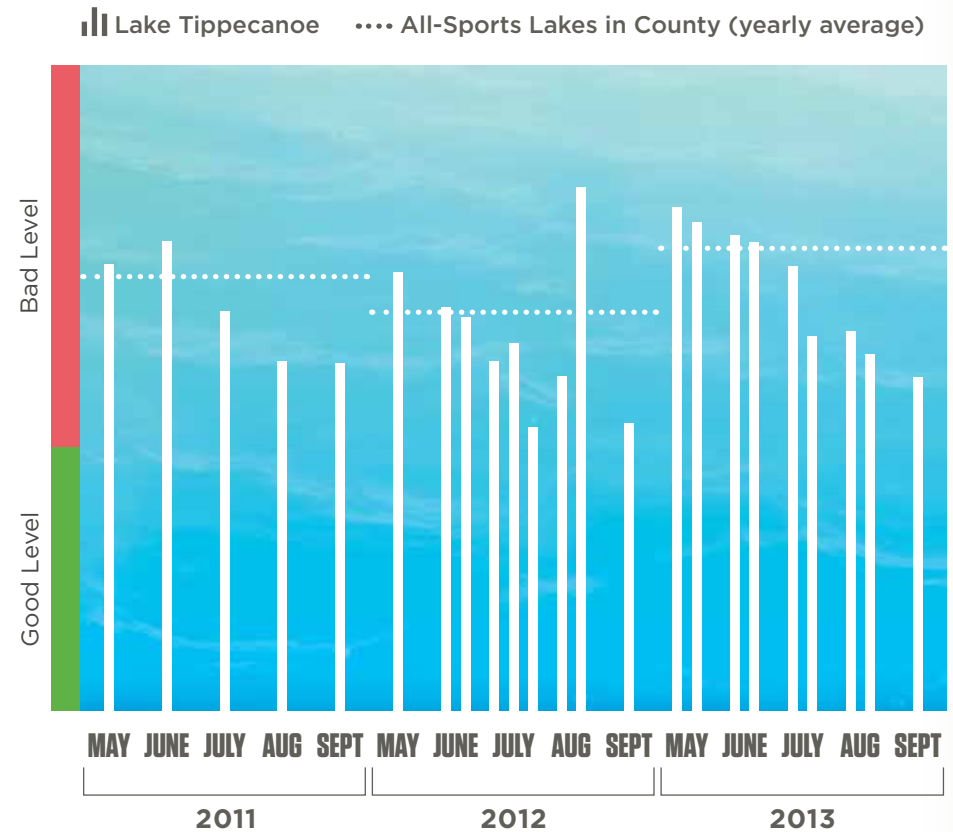
Optimum Nutrient Levels

Nutrient Overload

PHOSPHORUS LEVELS *in* LAKE TIPPECANOE



NITROGEN LEVELS *in* LAKE TIPPECANOE



Observations:

- Phosphorus and nitrogen levels were consistently higher than the recommended guidelines
- Lake Tippecanoe's phosphorus and nitrogen levels were similar to other all-sports lakes in the county

DATA SUMMARY: Both phosphorus and nitrogen levels in Lake Tippecanoe were consistently well above the Environmental Protection Agency recommended guidelines. Nutrients feed harmful algae and reduce water clarity. These high levels often decreased over summer months, indicating nutrients sinking to the lake bottom.

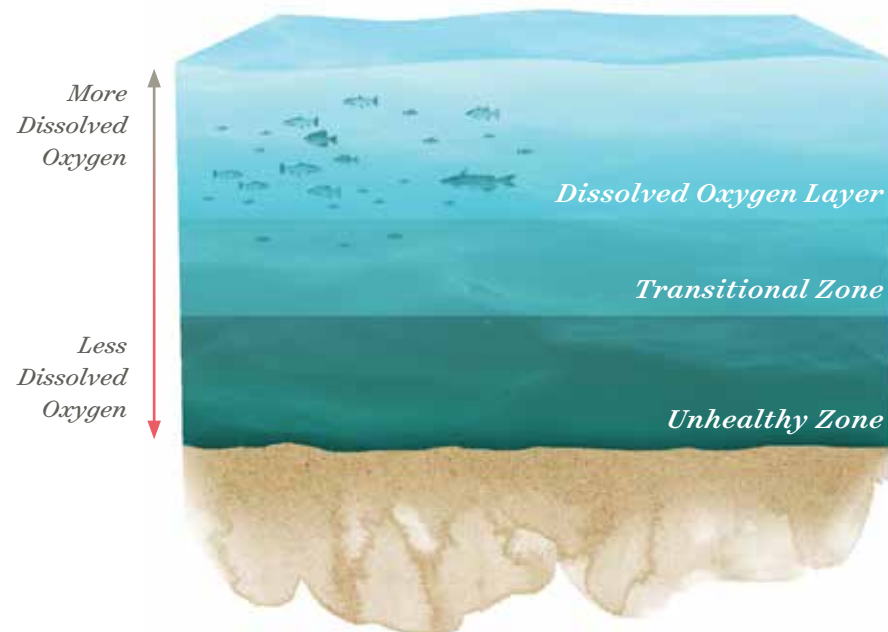
DISSOLVED OXYGEN

gaseous oxygen in water and available to aquatic organisms for respiration

The Effects of Dissolved Oxygen. Dissolved oxygen is the major factor that determines where organisms can survive in an aquatic system. During the summer, many lakes become layered based on temperature — and the bottom layer is often depleted of oxygen. This is because of chemical reactions that occur when dead plants decay on the bottom. Since this layer does not mix with the other layers, it is not able to replenish its oxygen through mixing of lake waters. Oxygen depletion also occurs in the winter when surface ice keeps oxygen from entering the water from the atmosphere.

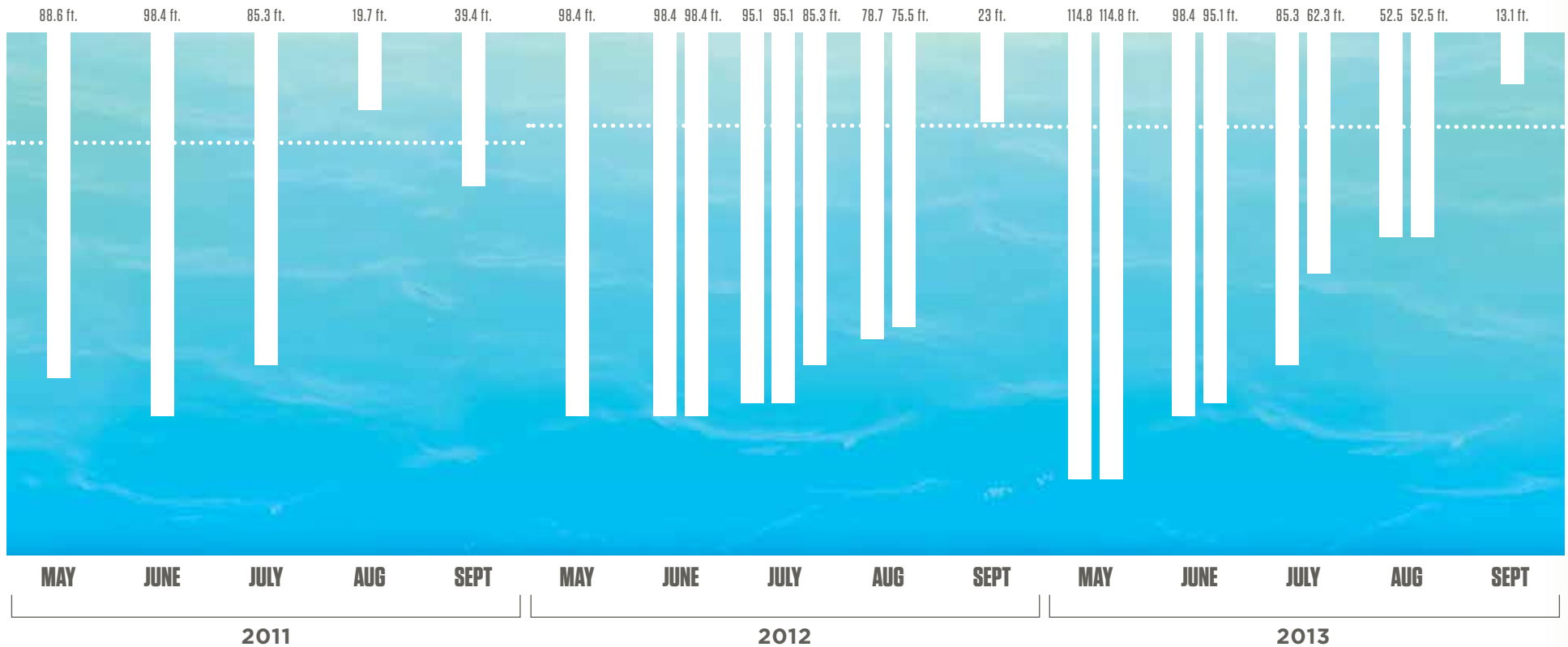
DISSOLVED OXYGEN LAYER

How far down fish and other aquatic species have enough oxygen to survive



OXYGEN LAYER DEPTH *in* LAKE TIPPECANOE

|| Lake Tippecanoe All-Sports Lakes in County (yearly average)



Observations:

- The oxygen layer got thinner through the summer
- The oxygen layer varied widely among the all-sports lakes (partially depending on lake depth), but Lake Tippecanoe's was usually thicker

DATA SUMMARY: When Lake Tippecanoe's oxygen layer gets thinner through the summer, fish get squeezed into a warmer and smaller area. The resulting lack of oxygen makes it difficult for these fish and their food sources to survive. This lack of oxygen is caused by too many nutrients in the lake.



TAKE ACTION

Help Keep Lake Tippecanoe a Great Place to Live. Research is a great start, but we need your support to keep the waters of Lake Tippecanoe at healthy and safe levels. Here are a few of the most effective ways that we can all do our part.

What you can do to help

Reduce fertilizer usage on your lawn and garden (especially close to the lake) to save yourself some money and keep extra nutrients out of Lake Tippecanoe. If you want to know exactly how much nutrients your lawn or garden needs, the Center for Lakes & Streams can help you with soil testing resources.

Add beautiful vegetation along your shoreline to filter out nutrients as water carries them toward the lake. Native plants (those plants that occur naturally in our region) are best because they cut down on your maintenance costs and provide the best filtration. The Center for Lakes & Streams has information to help you get started.

Avoid yard waste entering the lake. Leaves, grass clippings or other yard waste have nutrients which increase algae growth, reduce water clarity and lead to less oxygen for fish. Use this yard waste as compost in your garden to further reduce your fertilizer use or have it removed from your property. If you would like to start composting and need some direction, the Center for Lakes & Streams can help.

What we can do together

Expand collaborative relationships and projects with non-lake residents. Water flows downhill, so neighborhoods, industries, farmers and businesses in areas surrounding Lake Tippecanoe all influence the lake. Your support and participation has allowed the Center for Lakes & Streams to pursue these efforts, and we look forward to working with you to expand them.

Provide financial support toward research to solve the identified challenges facing Lake Tippecanoe. Our center samples inflowing and outflowing streams and can use this data to start quantifying nutrient sources. This will help us navigate future efforts toward efficiently reducing these nutrient sources. We could also study boating activities and additional algae toxins to make appropriate recommendations based on science.

Engage our lake neighbors and our non-lake community members in educational programs that inform them about how to best take care of Lake Tippecanoe. You might consider helping as a volunteer for the Northern Indiana Lakes Festival or financially supporting one of our K-12 programs.



Making our lakes and streams clean, healthy, safe and beautiful

The Center for Lakes & Streams at Grace College conducts important research, engages and educates residents, and collaborates with other organizations to make the lakes and streams of Kosciusko County cleaner.



Led by a professor of freshwater science and outfitted with the necessary equipment, our center can perform high-quality research at a local level, focusing on the lakes and streams of Kosciusko County. Our staff is experienced at national and local levels with operating K-12 and community outreach programs.

Our Grace College facilities accommodate meetings, workshops and other gatherings. With countywide perspective we help create working partnerships and facilitate exchanges of knowledge and expertise.

By supporting the Center for Lakes & Streams you're ensuring that every effort is being made to make the lakes and streams of Kosciusko County cleaner.



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200 Seminary Drive | Winona Lake, IN 46590

574-372-5100, ext. 6445

lakes.grace.edu