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Environmental Solutions

March 31, 2021

Why Collect WATER QUALITY Data When All You Need is FLOW?

(*or Vice-Versa!*)

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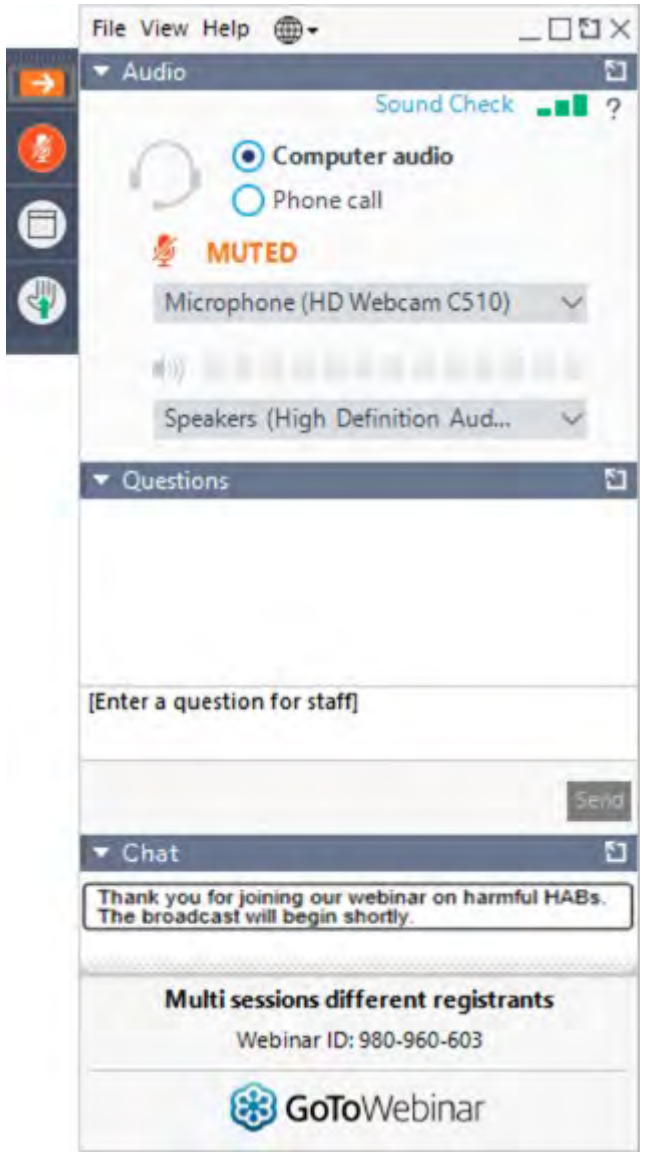
Welcome to Our Webinar!



Modify Audio Settings

Please Ask Questions!

Audio Settings
Make sure you can hear us loud and clear

Video Quality
If you are connected to a VPN, please disconnect for better video quality.

Ask Questions
We'll try to answer as many as we can during the presentation

Chat
You can also use the Chat panel to ask questions or contact us if you're having technical difficulties

Please Note: This live webinar will be recorded.

Your Host
Dr. Stephanie A. Smith, Product Segment Manager for Integrated Systems and Services

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Agenda

- Speaker Introductions
- Part I: Why look at both Water Quality and Flow?
- Part II: Protecting Indiana’s Natural Resources from Nutrient Pollution
- Part II: Nutrient Loading and Nutrient Flux
- Final Q&A

Nate Bosch, PhD

Environmental Science Professor, Grace College

- Director, Lilly Center for Lakes & Streams
- Published limnologist focused on Great Lakes and smaller inland lakes and streams

Adrienne Daeger

Lilly Center Research Program Specialist

- Leads student research, program ops, public outreach
- B.S. Biology, Huntington University, Indiana with focus on Environmental Studies

Stephanie A. Smith, PhD

YSI Integrated Systems and Services Segment Manager

- Oversees new product development, engaging customers for defining requirements and after-market support
- Core expertise in microbiology, esp. Harmful Algal Blooms and monitoring technologies

Xue Fan, PhD

SonTek Senior Application Engineer

- Field testing and customer training for new SonTek technologies
- Collaborates with world's leading scientists to define requirements for new products in development

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Flow & Water Quality: Why Both Matter

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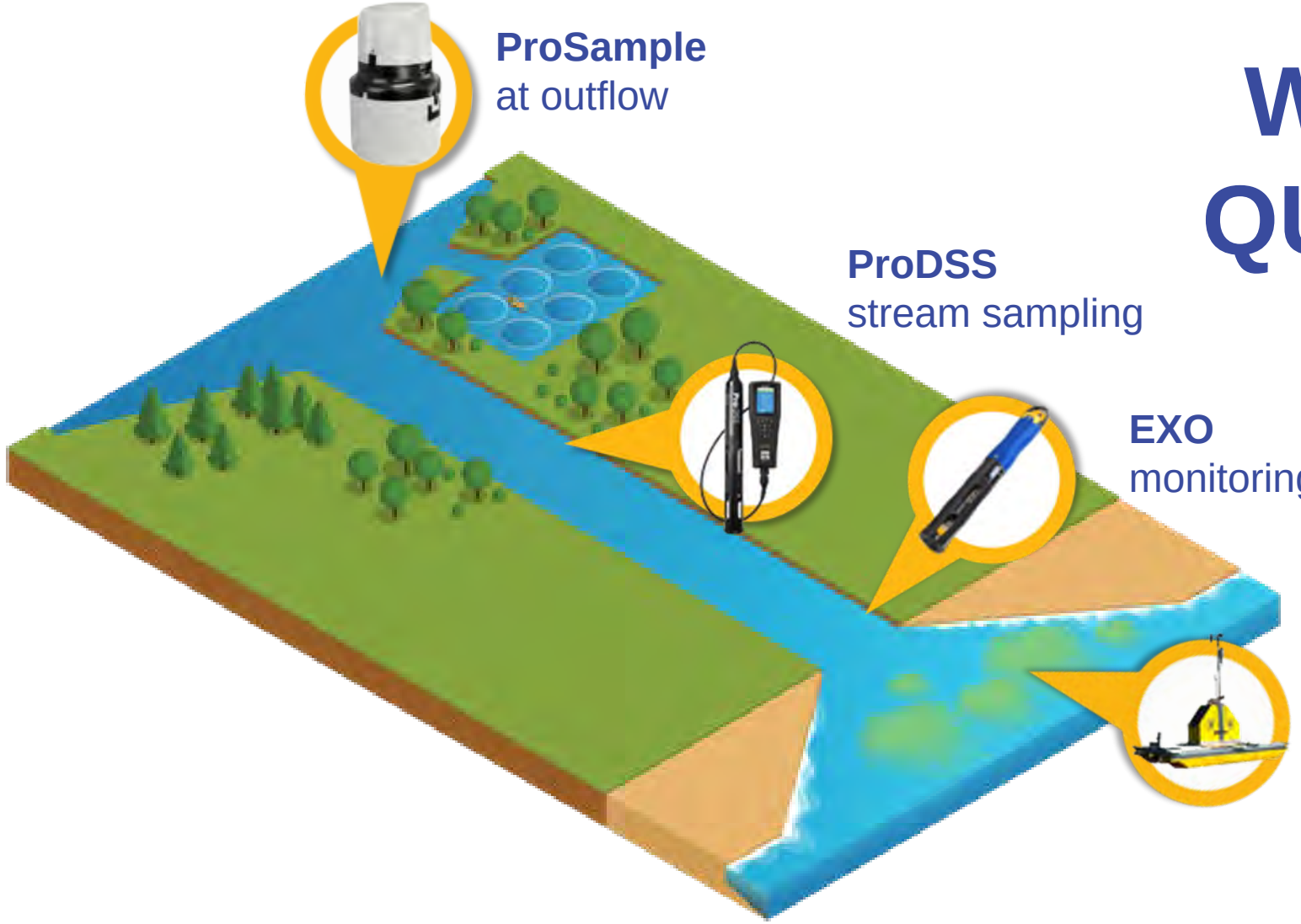
Which Side of the Stream Are You On?



ProSample
at outflow

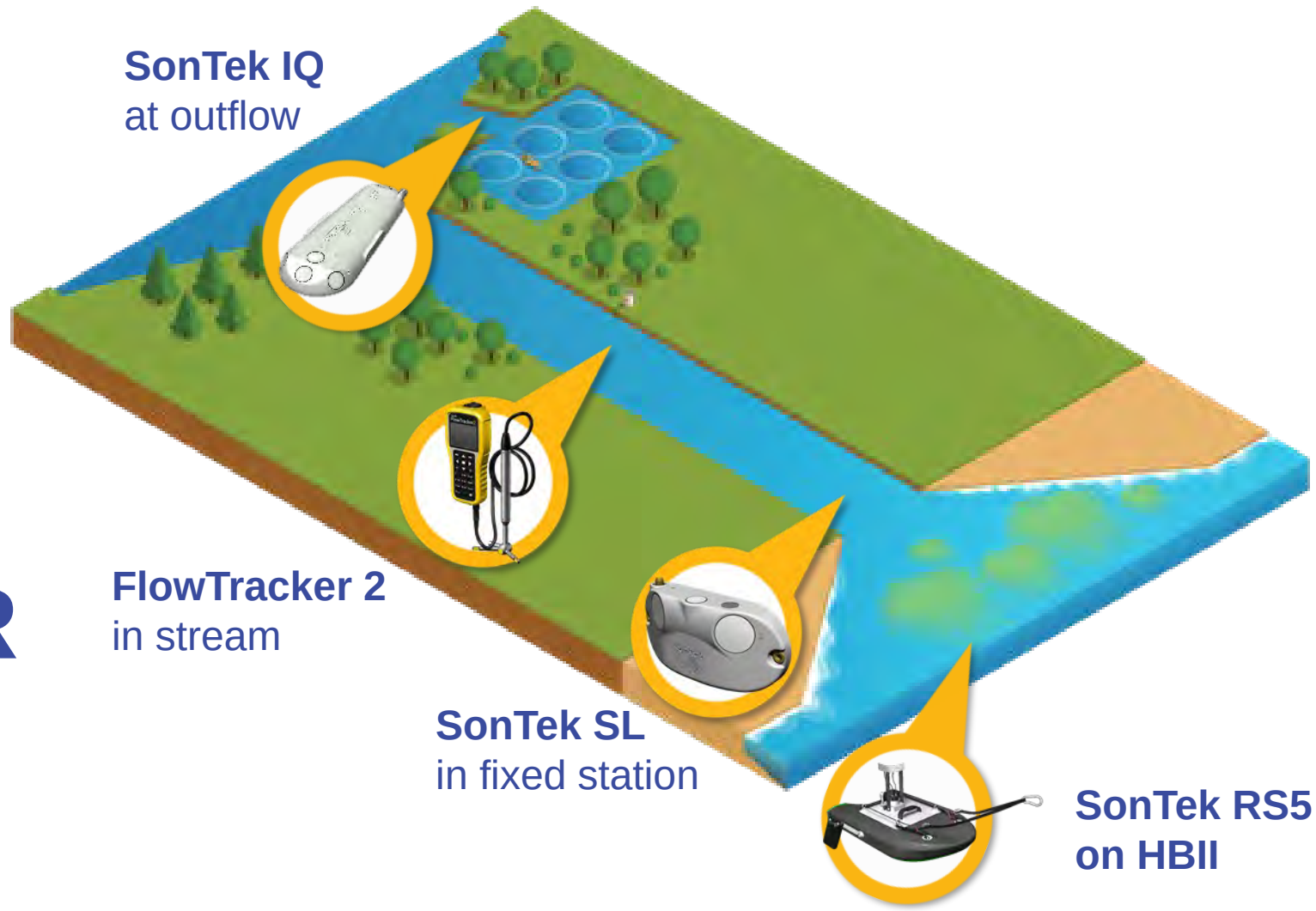
ProDSS
stream sampling

EXO
monitoring station

Vertical Profiler

WATER QUALITY

Which Side of the Stream Are You On?

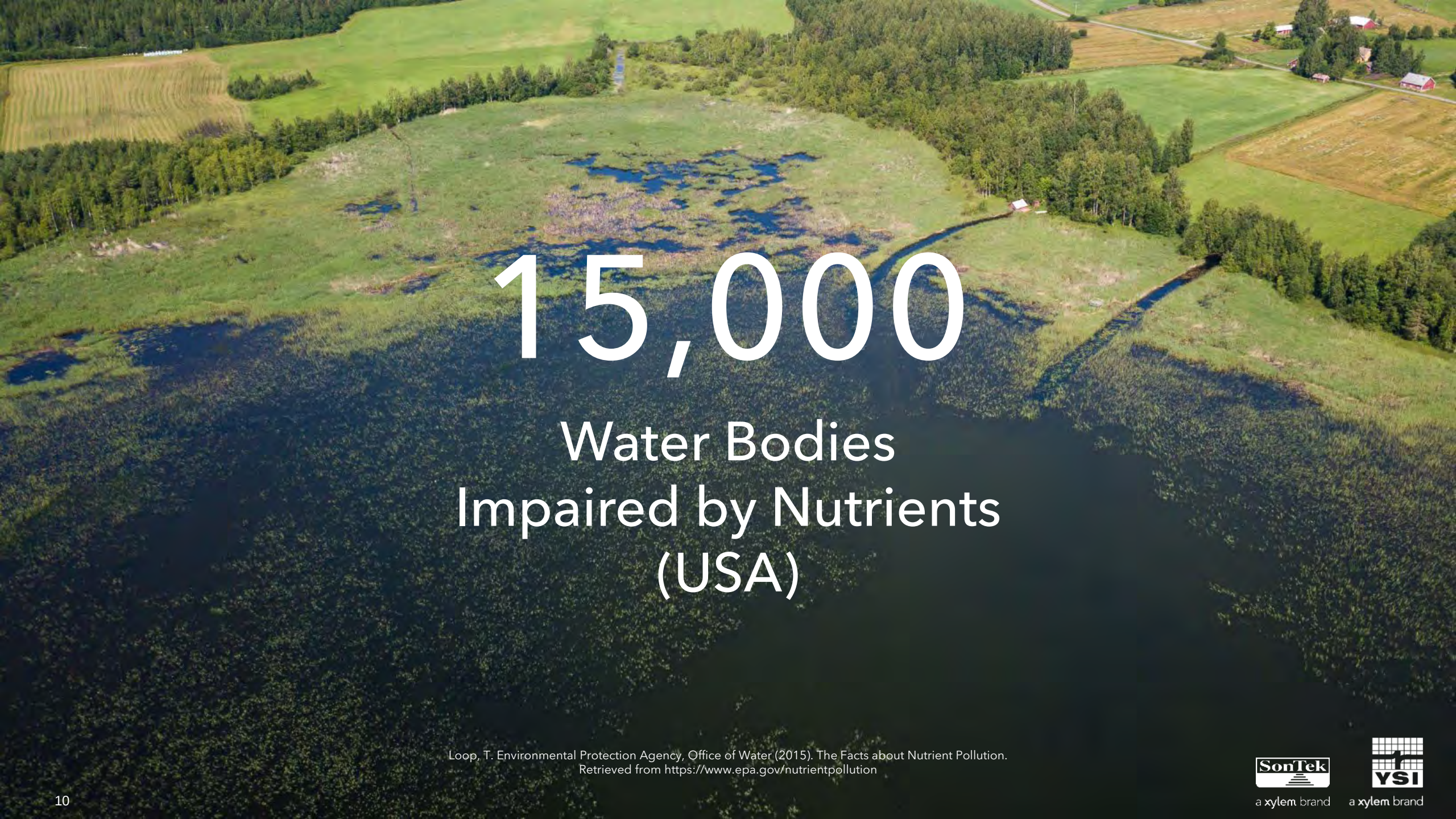


WATER FLOW

Why Monitor Both Water Quality and Water Flow?

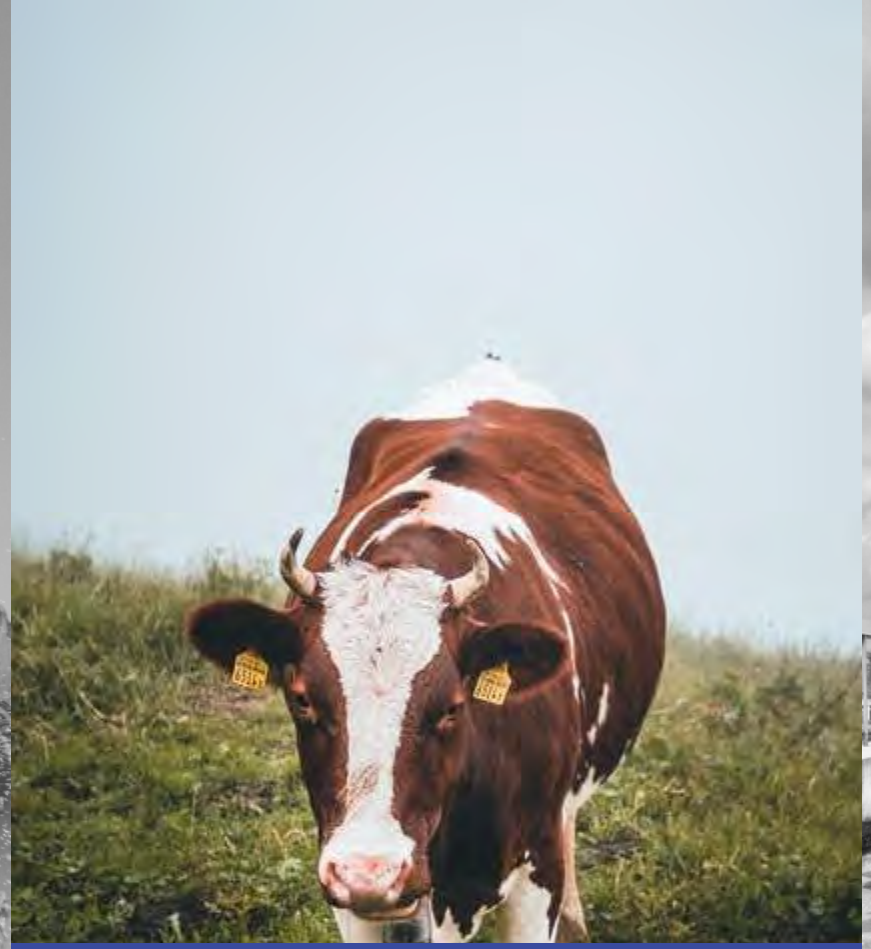
WATER QUALITY

WATER FLOW

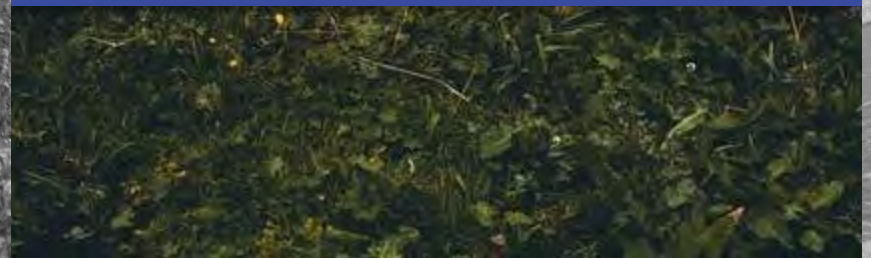


Loop, T. Environmental Protection Agency, Office of Water (2015). The Facts about Nutrient Pollution. Retrieved from https://www.epa.gov/nutrientpollution

Fertilizers



Animal Manure



Wastewater Effluents

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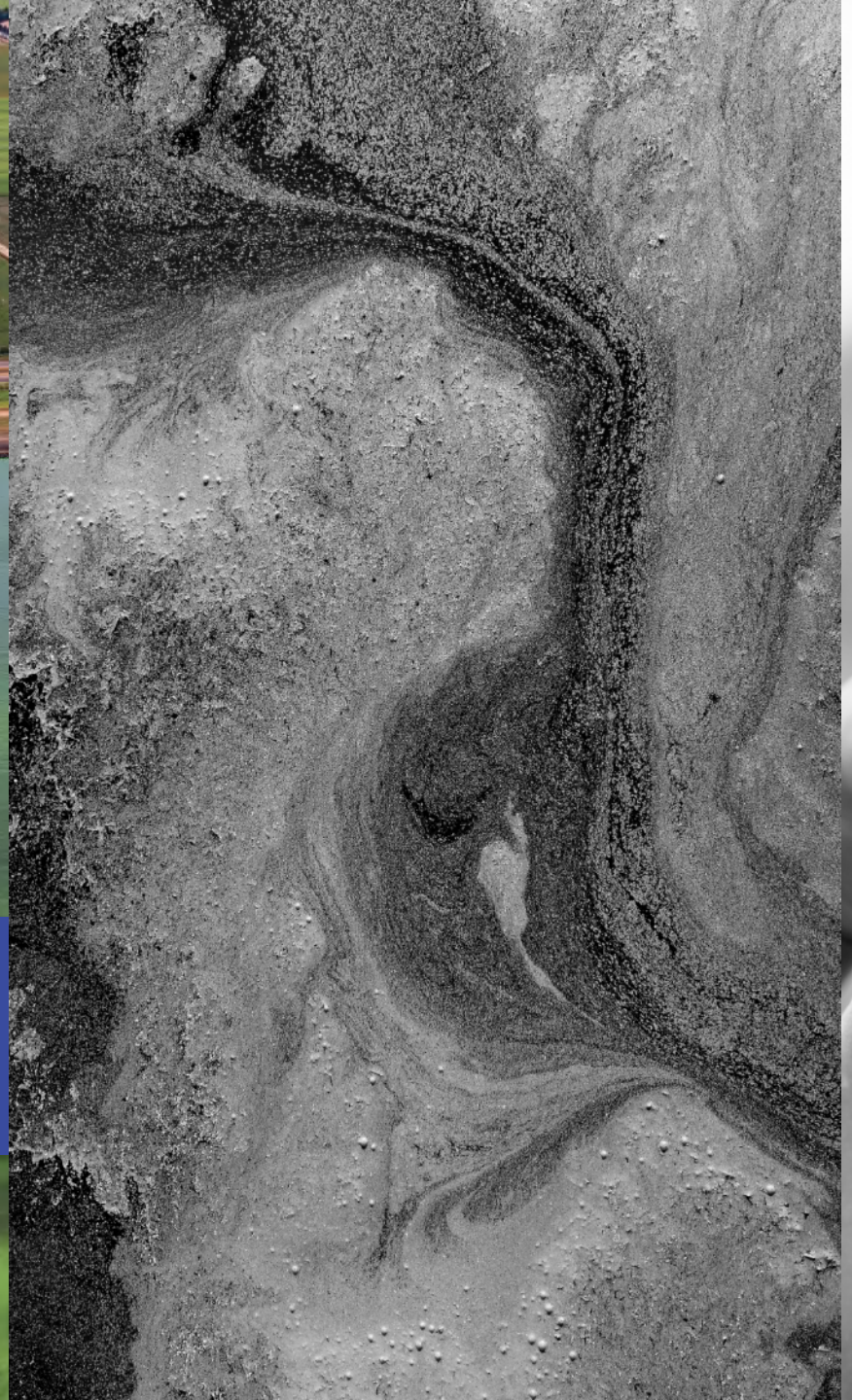
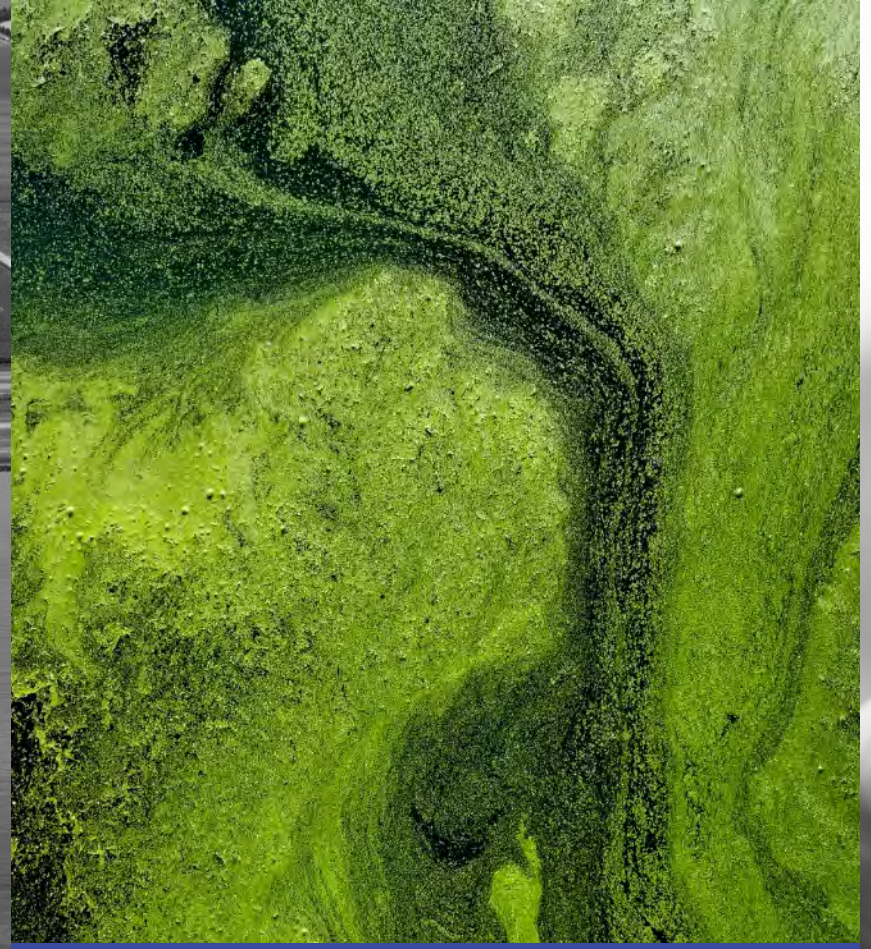
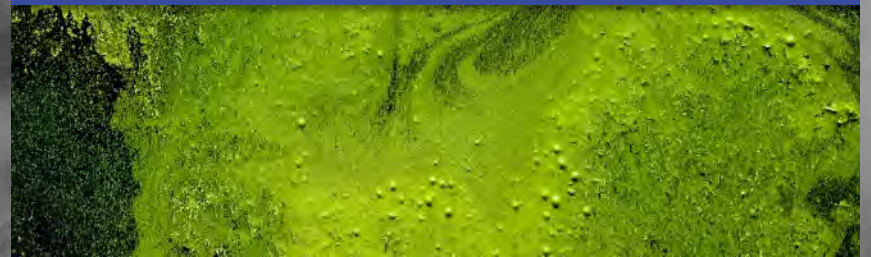
Eutrophication





Harmful Algal Blooms



Health Impacts

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Harmful Algal Blooms

REMEDIATION

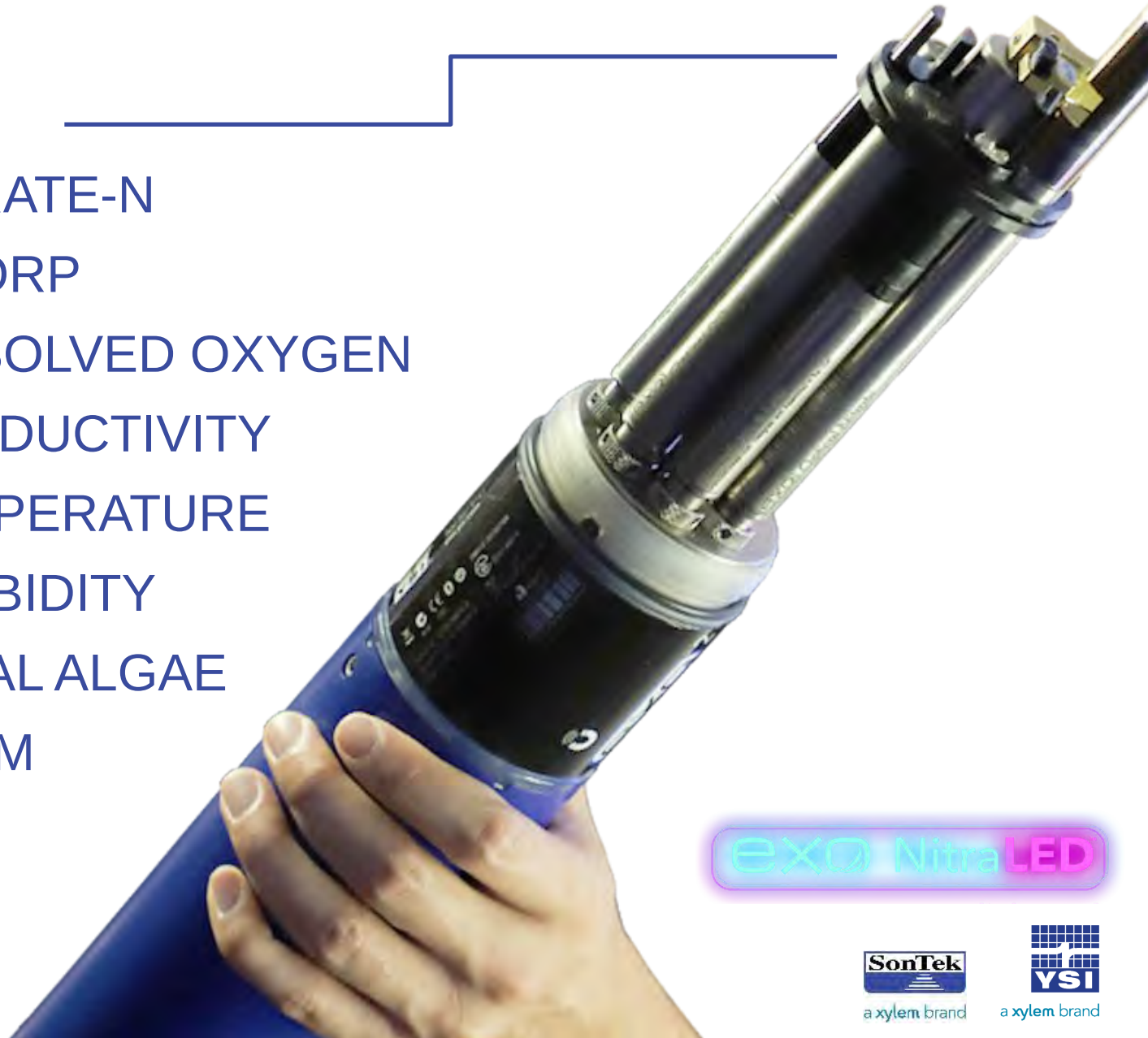
$1.1

BILLION

https://smartwatermagazine.com/news/environmental-working-group-ewg/us-preventing-and-treating-algae-blooms-has-cost-least-11

Is Water Quality Enough?

- NITRATE-N
- PH/ORP
- DISSOLVED OXYGEN
- CONDUCTIVITY
- TEMPERATURE
- TURBIDITY
- TOTAL ALGAE
- FDOM



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Flow & Water Quality in the Real World

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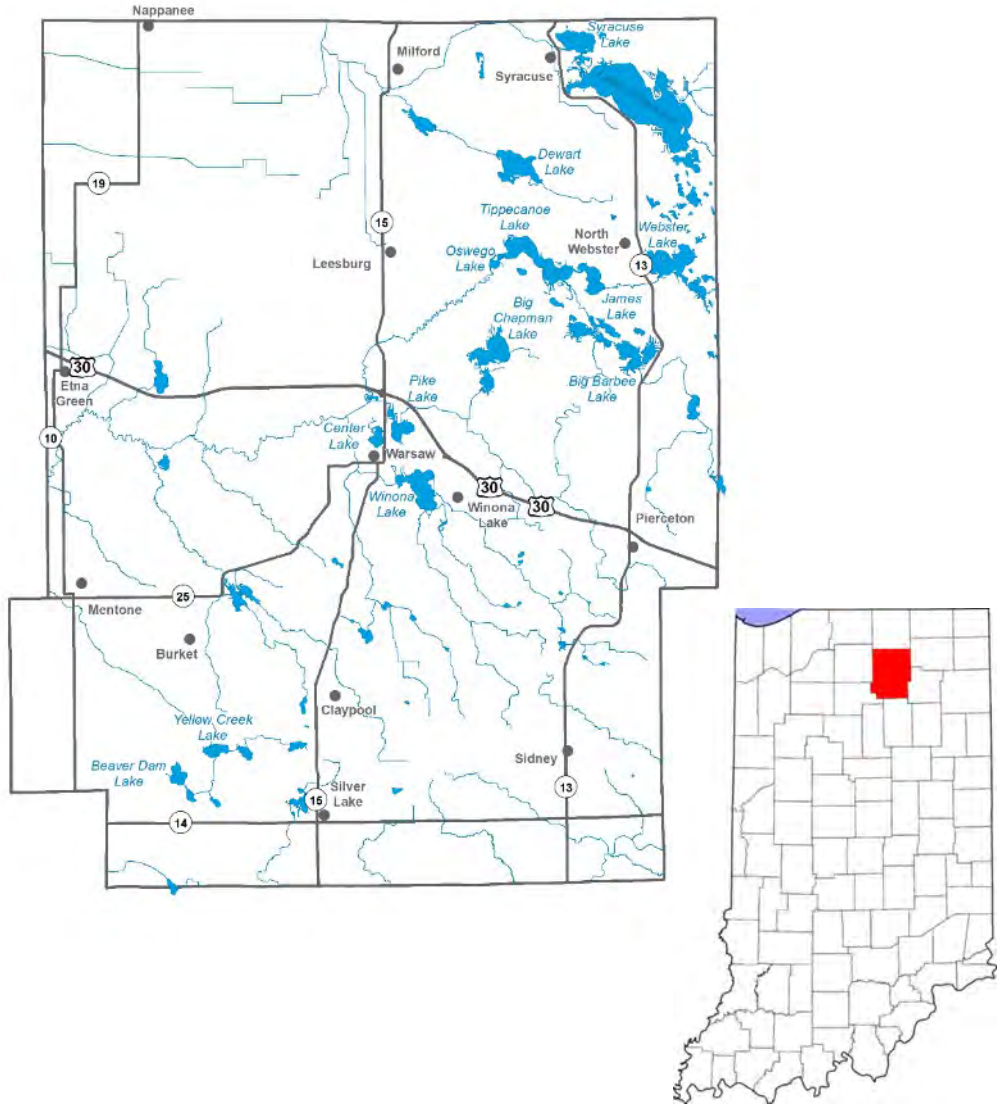
Sensors and Samples

Stream network for informed lakes research

Dr. Nate Bosch, Director
Adrienne Daeger, Research Program Specialist
March 31, 2021

Context

- Kosciusko County, Indiana
- Lakes
  - Over 100 lakes
  - Lake Wawasee
  - Lake Tippecanoe
- Streams
  - Almost 600 miles of streams
  - Tippecanoe River
- Continental divide



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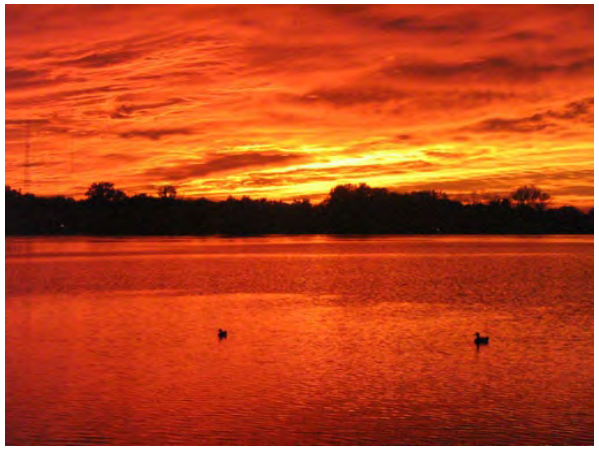
Context

Research

Education

Collaboration

Next Steps



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Context

Research

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Next Steps

LILLY CENTER FOR
LAKES & STREAMS

LILLY CENTER FOR LAKES & STREAMS

Our Mission

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

Our Strategy

- Research
  - Solving problems strategically
  - Identifying emerging threats
- Education
  - Inspiring the next generation
  - Changing behavior now
- Collaboration
  - Effectiveness
  - Efficiency

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Research

- Lake and **stream sampling**
- Economic impact of lakes
- Trends analysis
- Lake water levels
- Public sewers around lakes
- Blue-green algae toxins
- Boating and zebra mussels
- Weed control in lakes and shoreline vegetation around lakes

Context

Research

Education

Collaboration

Next Steps

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Research activities:

- Lakes weekly in summer
- Streams biweekly year-round
- Undergraduate student team

Research foci:

- BGA & toxins
- Nutrient budgets

Context

Research

Education

Collaboration

Next Steps

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Streams:

- 6 lakes, 3 lake chains
- 12 stream sites
- 9 yrs of biweekly stream flow and quality data

Goals:

- Nutrient budgets for lakes
- Daily mean flows for inflows/outflows
- Public visibility

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- Diverse streams
  - Outflows dam controlled
  - Between 0.062 cms and 4.27 cms springtime averages
- Diverse weather

Context

Research

Education

Collaboration

Next Steps

Sensors

- 11 of 12 privately funded
- 2018-2019
- Private and public sites
- 5 “sidelooking,” 5 bottom-mounted, 2 bubblers

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Context

Research

Education

Collaboration

Next Steps

LILLY CENTER FOR LAKES & STREAMS

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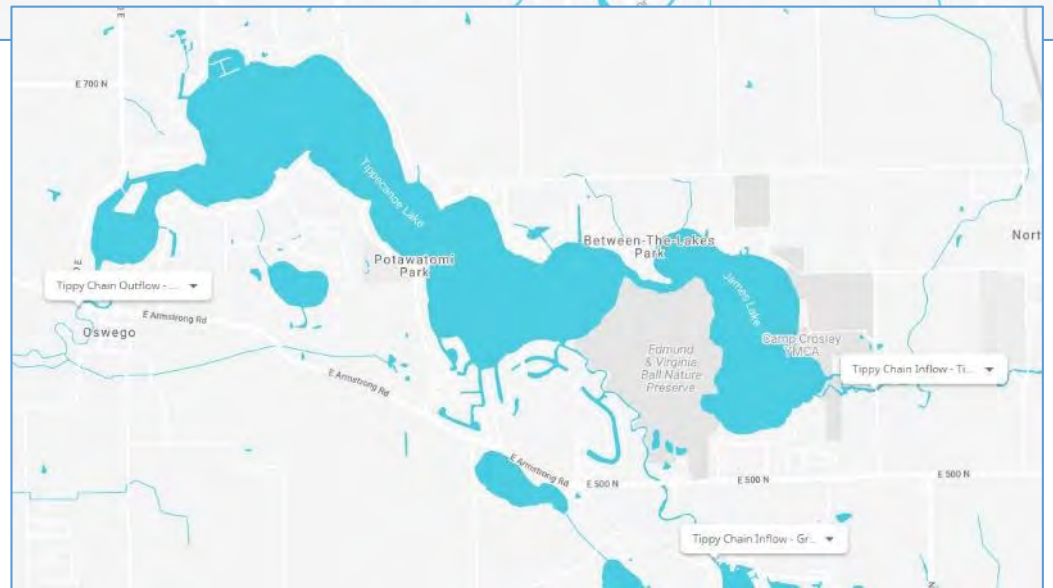

https://lakes.grace.edu/live-data/

- All running over 1 yr
- High community engagement
- Easy to initiate storm sampling
- Higher resolution of flow data

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HydroSphere

Context

Research

Education

Collaboration

Next Steps

- Upkeep
- Vandalism

Stolen solar panels/batteries, broken locks

- Large datasets!

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& STREAMS

Context

Research

Education

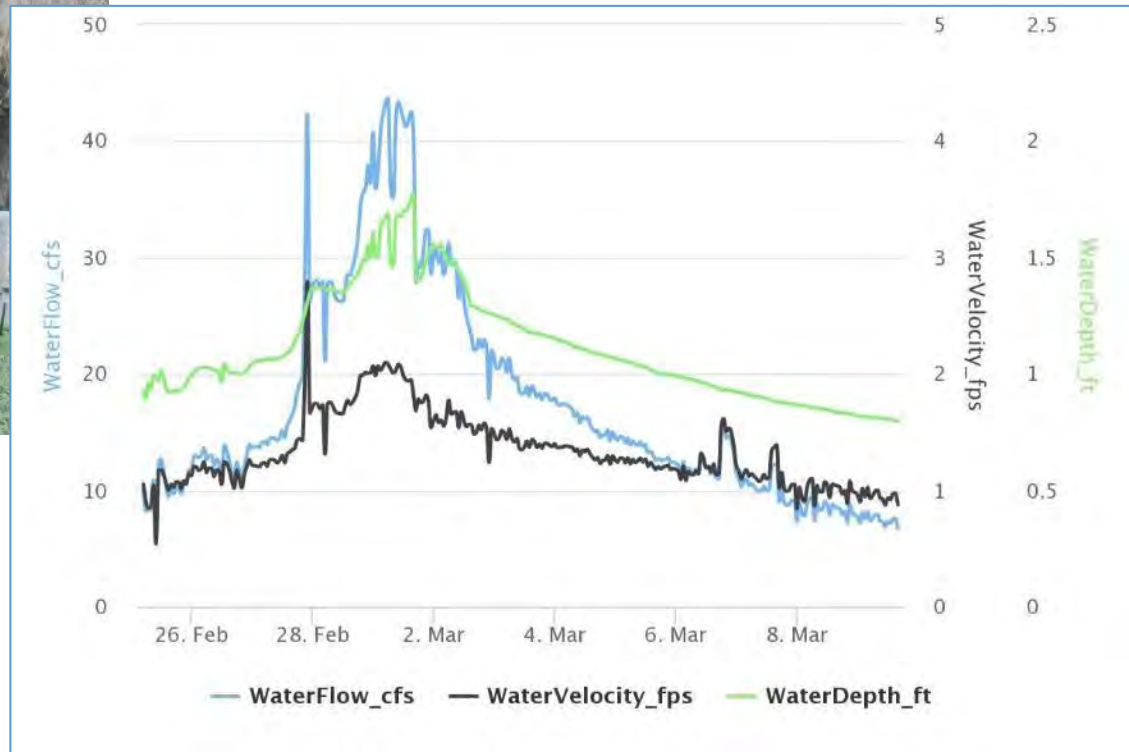
Collaboration

Next Steps

Next steps

- Calculate stream loads using new dataset
- Educational signage for the most visible sites
- Ongoing sensor maintenance

HydroSphere



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Thank you!

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Nutrient Loads, Flux, and Pollutant Monitoring

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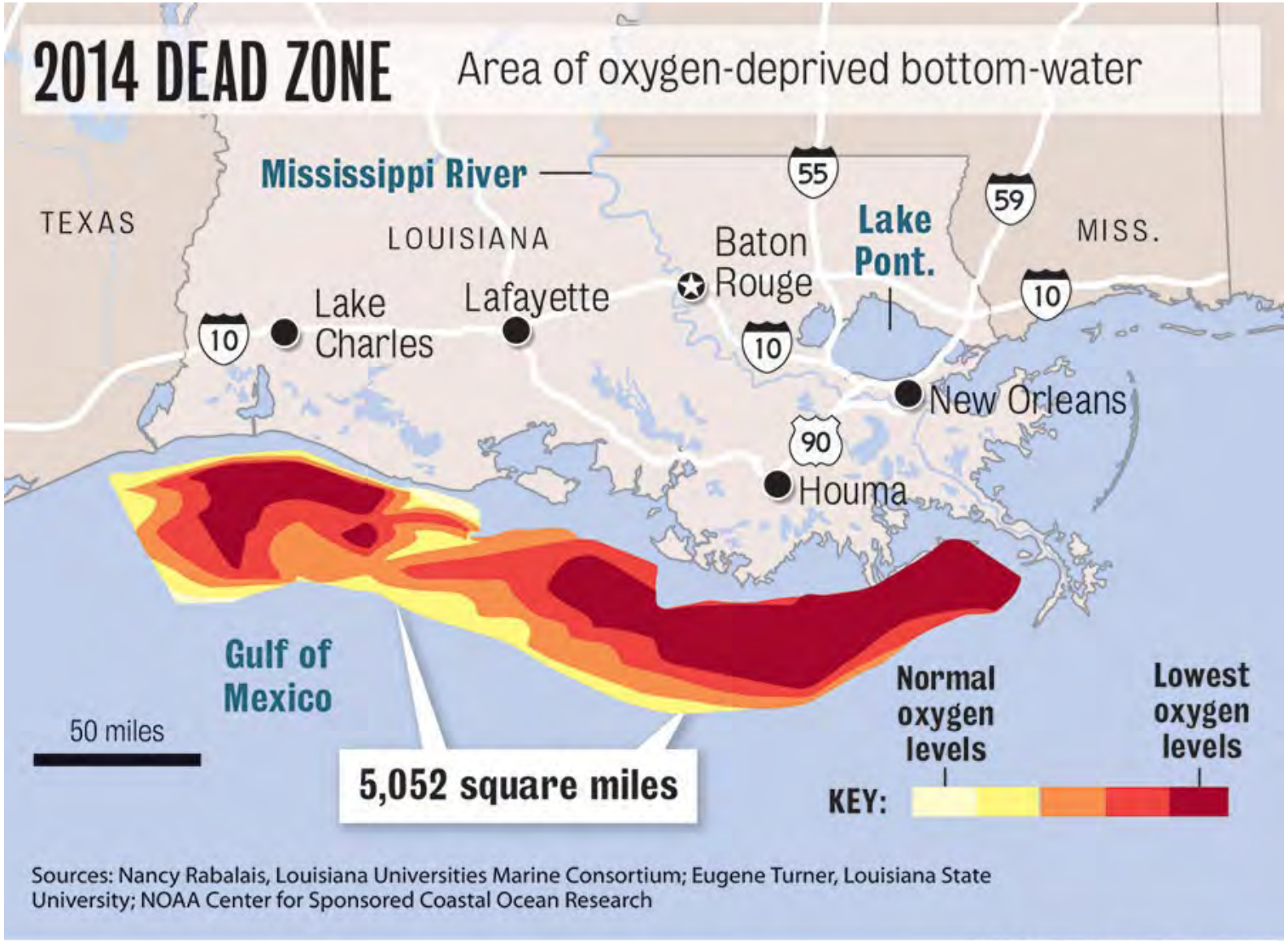
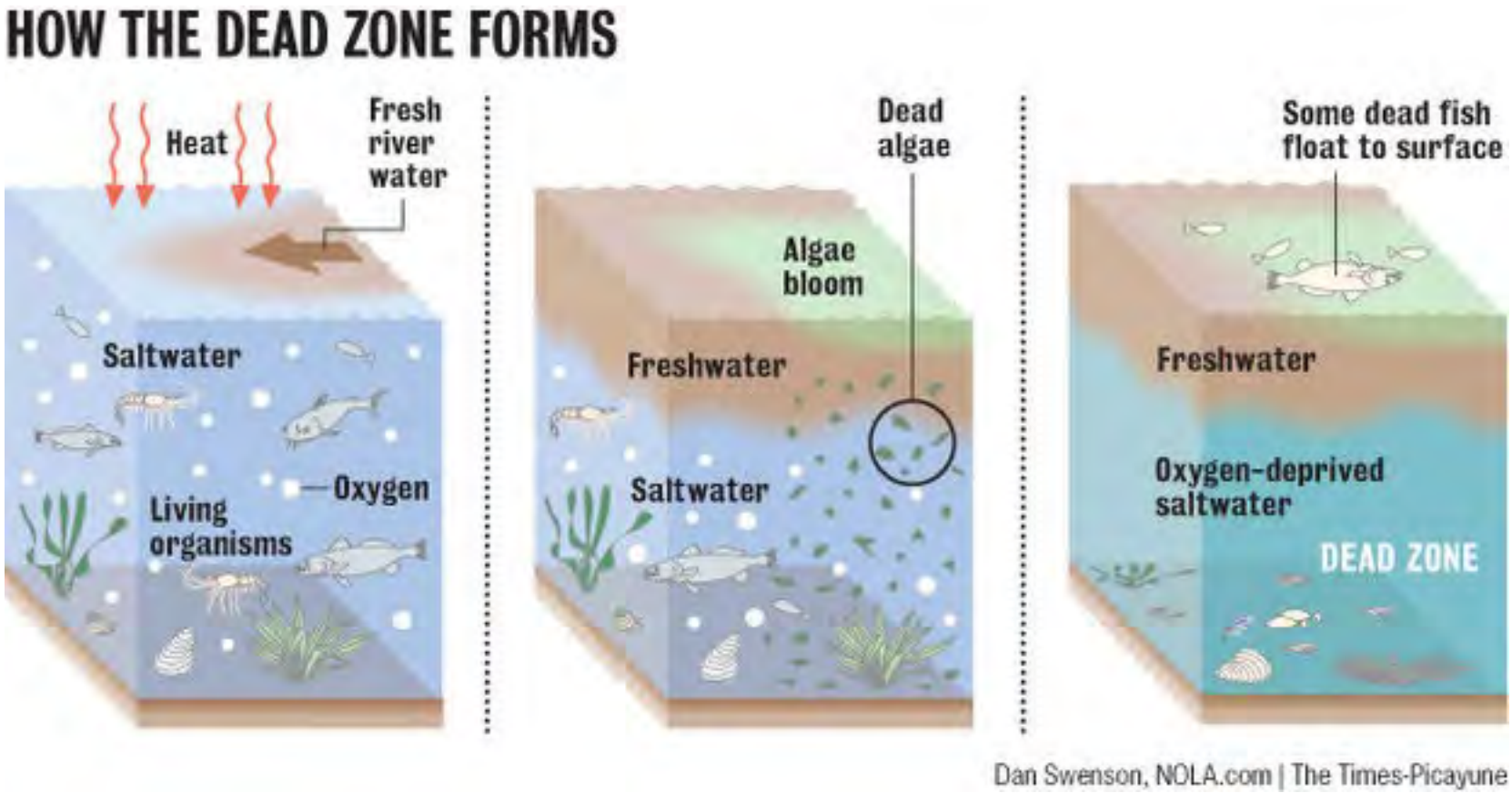
Hypoxia - Dead Zones



Hypoxia - Dead Zones

Where nitrogen-rich rivers enter the sea:



What is Causing the Dead Zone?

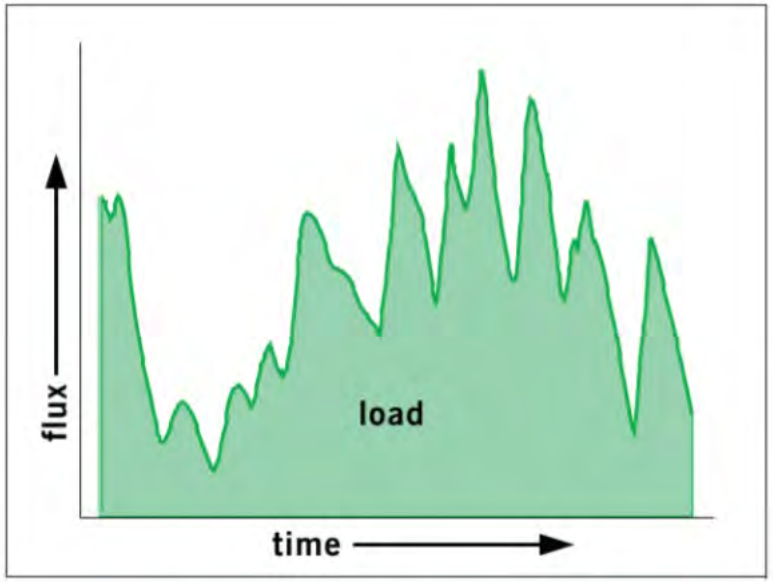
Mississippi Basin (USA)

https://commons.wikimedia.org/wiki/File:Mississippirivermapnew.jpg

Nutrient Concentration vs. Nutrient Flux, Load

Concentration

Flow



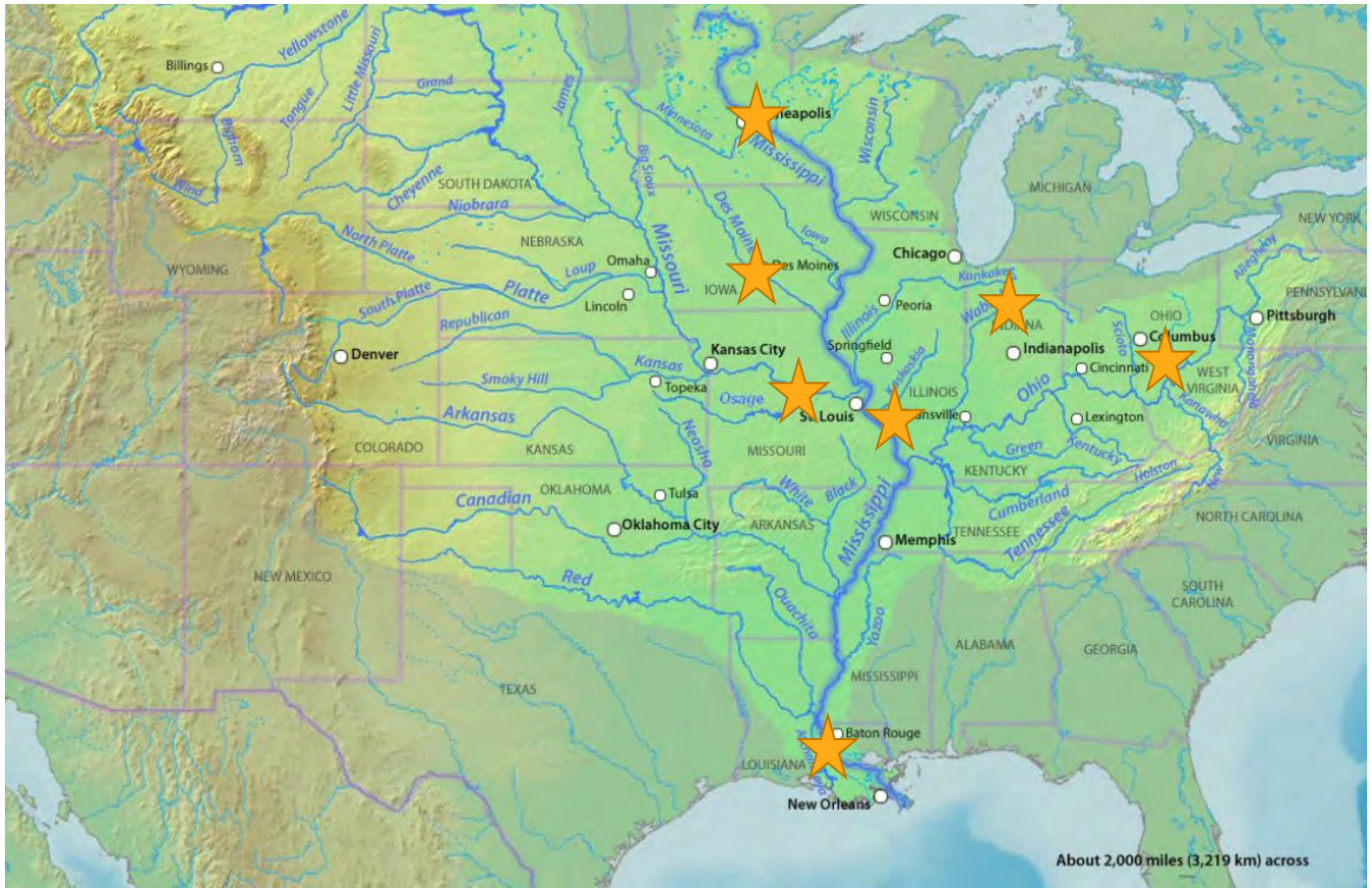
https://www.epa.gov/sites/production/files/2016-05/documents/tech_notes_8_dec_2013_load.pdf

Nutrient Flux = **Concentration** x **Flow**

Nutrient Load = Integral of Nutrient Flux

TOTAL AMOUNT OF NUTRIENT OVER TIME PERIOD

Nutrient Parameters – Is a Nutrient Concentration Enough?



https://commons.wikimedia.org/wiki/File:Mississippirivermapnew.jpg

USGS Fact Sheet. 2000. Nitrogen in the Mississippi Basin – Estimating sources and predicting flux to the Gulf of Mexico
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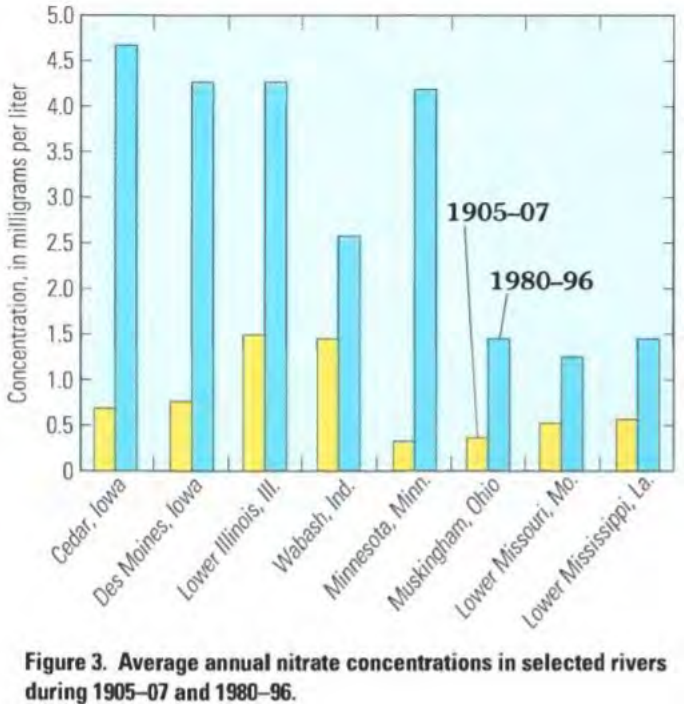
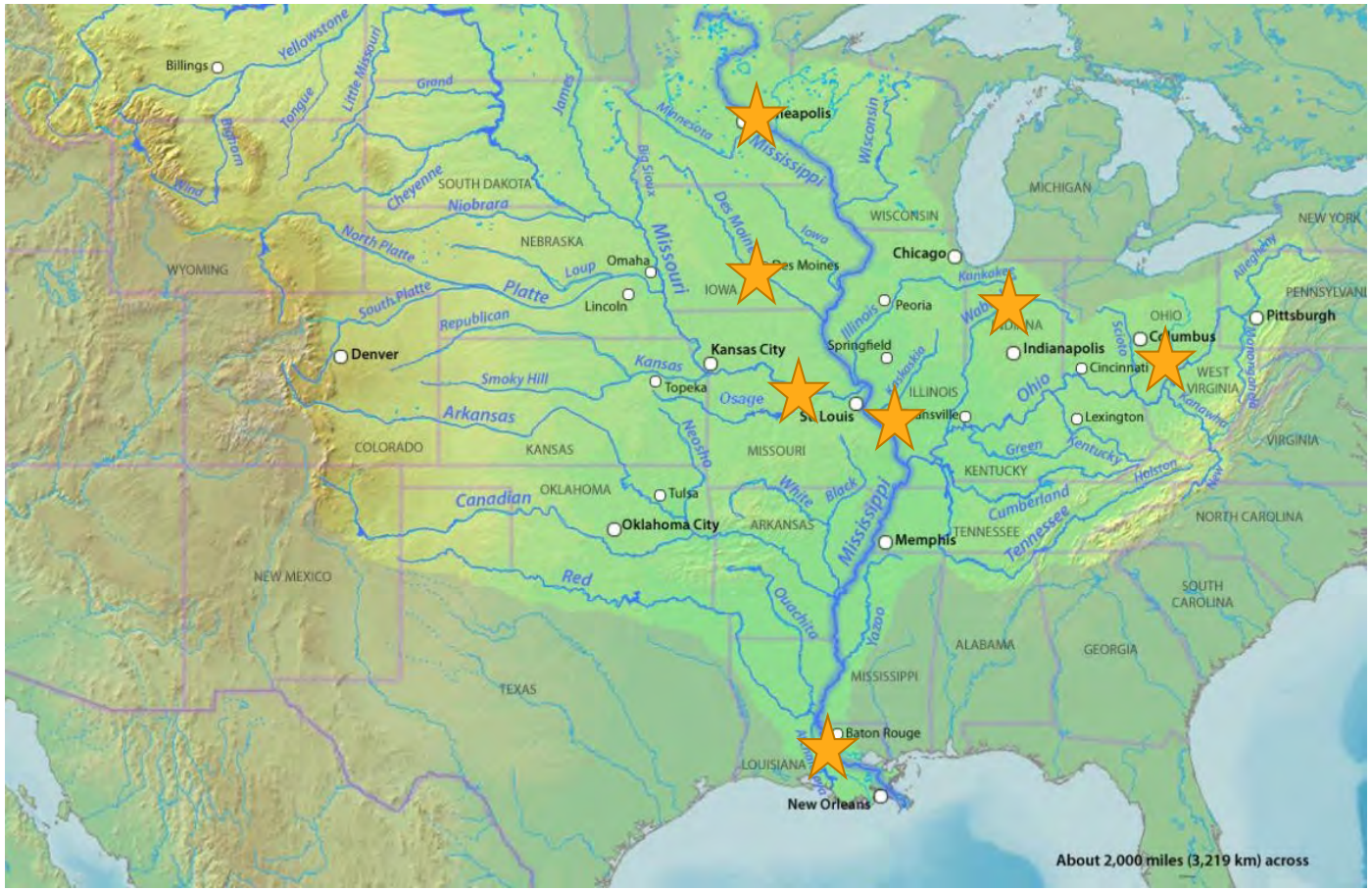


Figure 3. Average annual nitrate concentrations in selected rivers during 1905–07 and 1980–96.

Nutrient Parameters – Is a Nutrient Concentration Enough?



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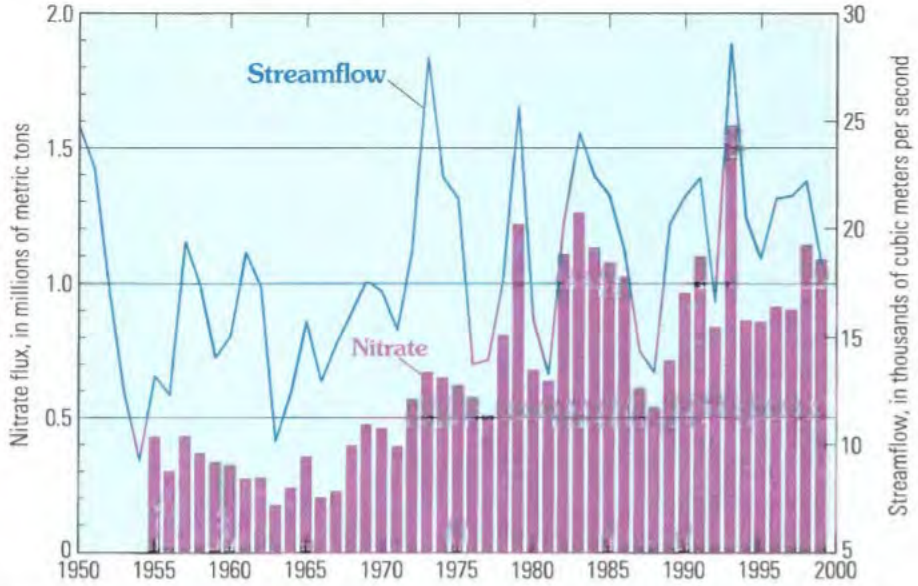


Figure 4. Annual nitrate flux and mean annual streamflow from the Mississippi River Basin to the Gulf of Mexico.

Combining Nitrogen Concentration and Flow

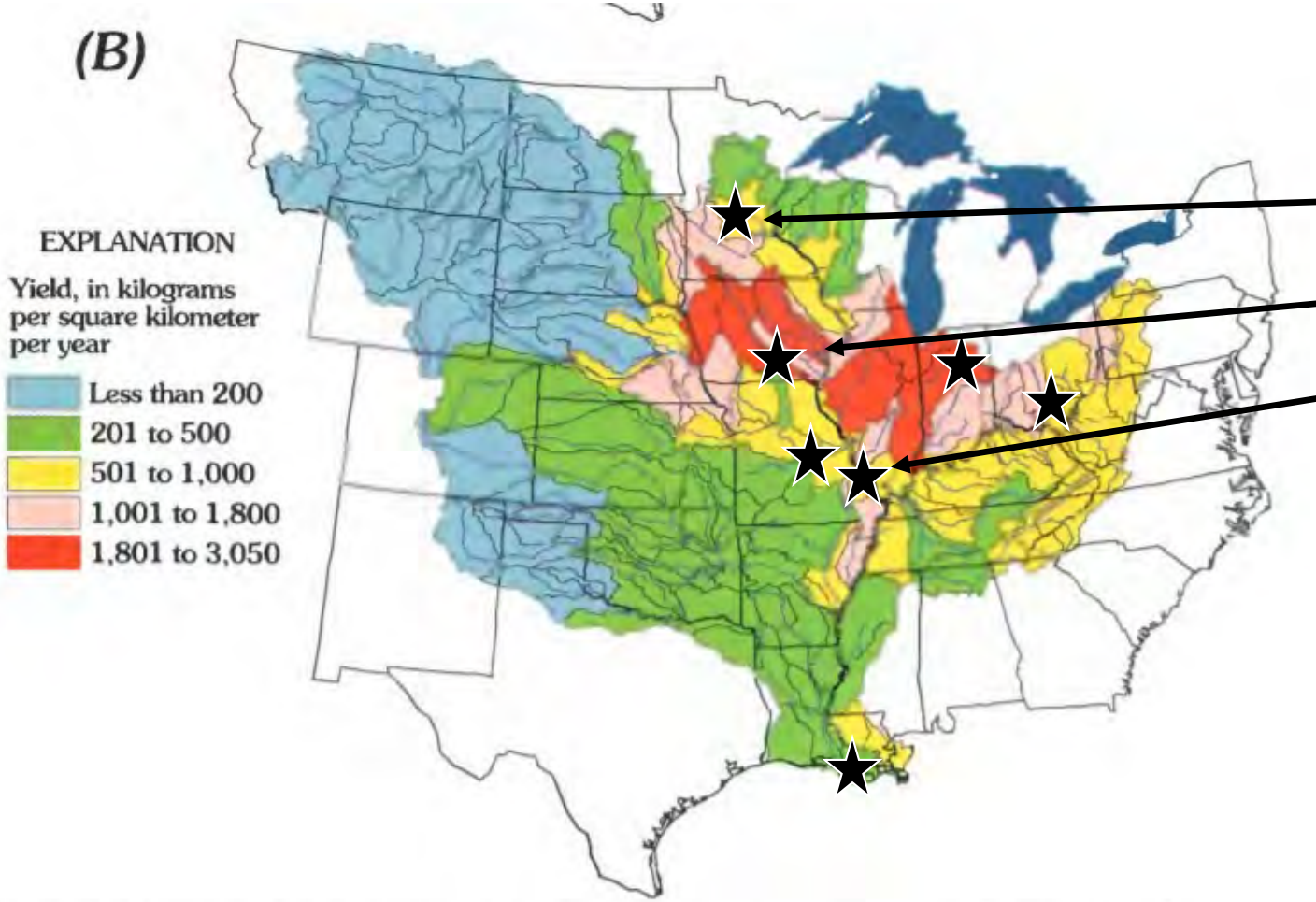
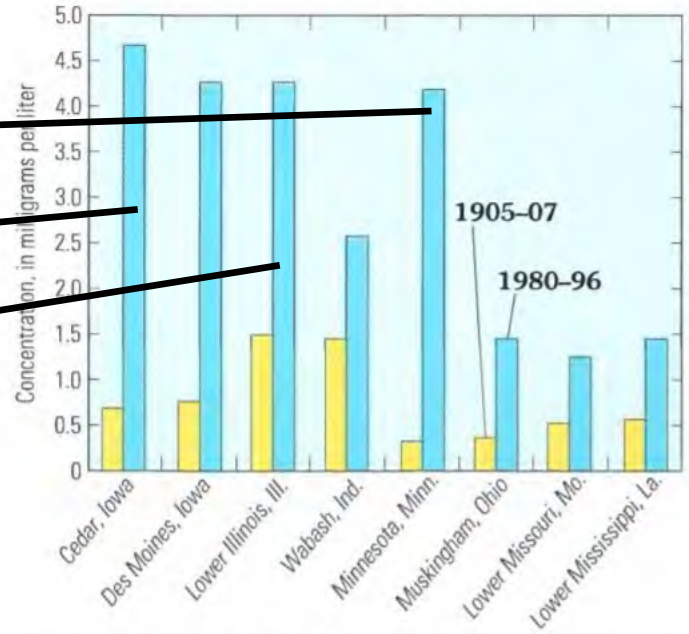


Figure 6. *(A)* Nitrogen inputs during 1992 and *(B)* average annual nitrogen yields of streams for 1980–96 (modified from Goolsby and others, 1999).



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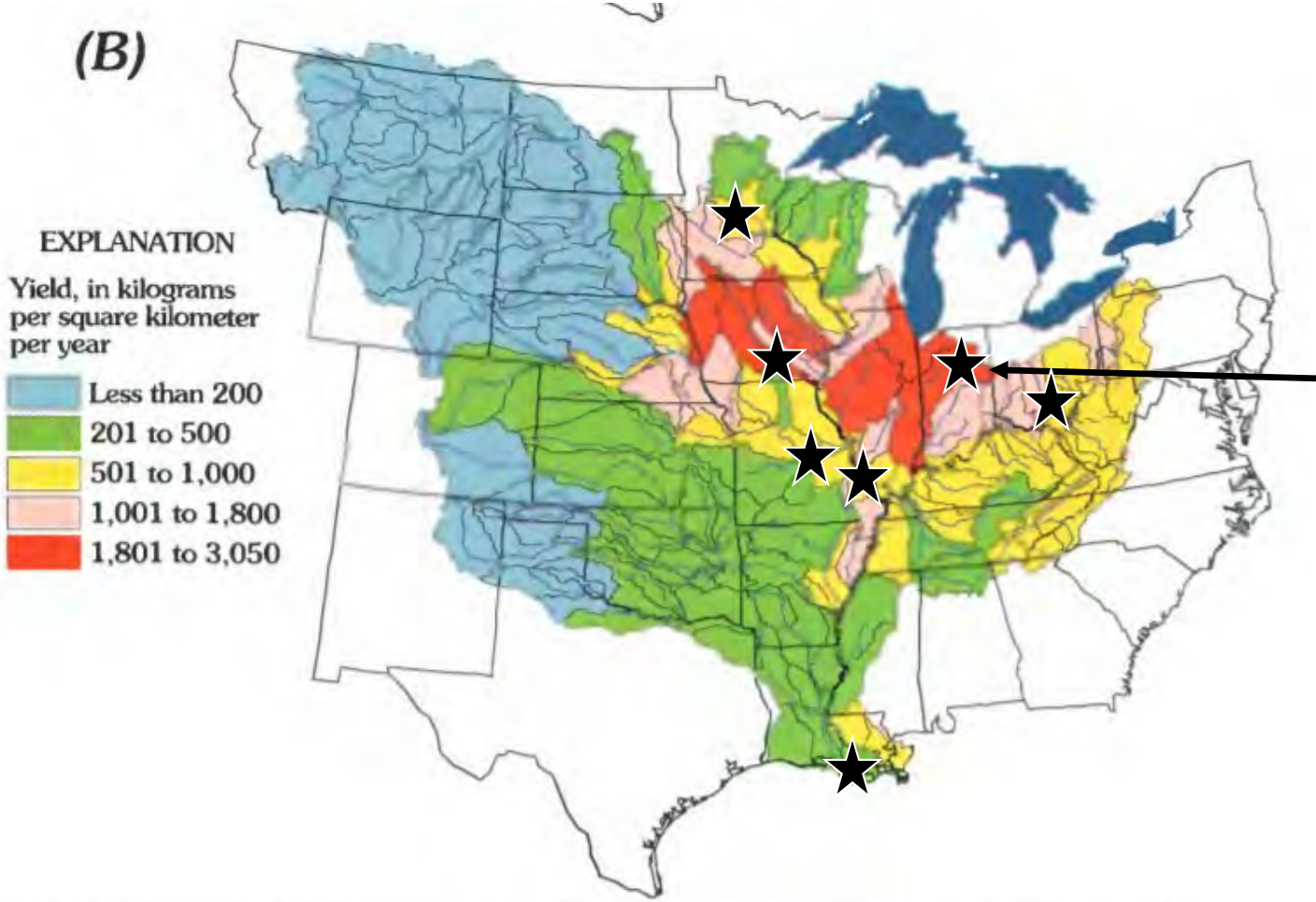

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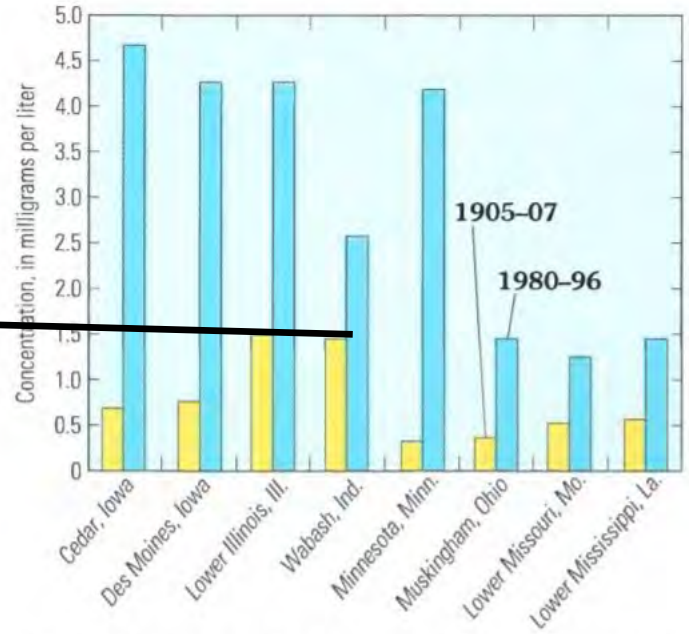

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Summary

- The aim of nutrient monitoring should be to understand both **flux** and **loading**
- Measurement of flux and loading requires both **water quality** and **flow** data
- **Manual** sample collection, **portable** and **continuous monitoring** instruments can be combined to obtain nutrient data

A Complete Solution

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Questions?

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Acknowledgments

Courtney Sutherland
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Communications Manager

Kyle Kaminski
Xylem Analytics Regional
Representative

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