

OARS

Indicators, Drivers, and Effects of Eutrophication in a Sudbury River Tributary

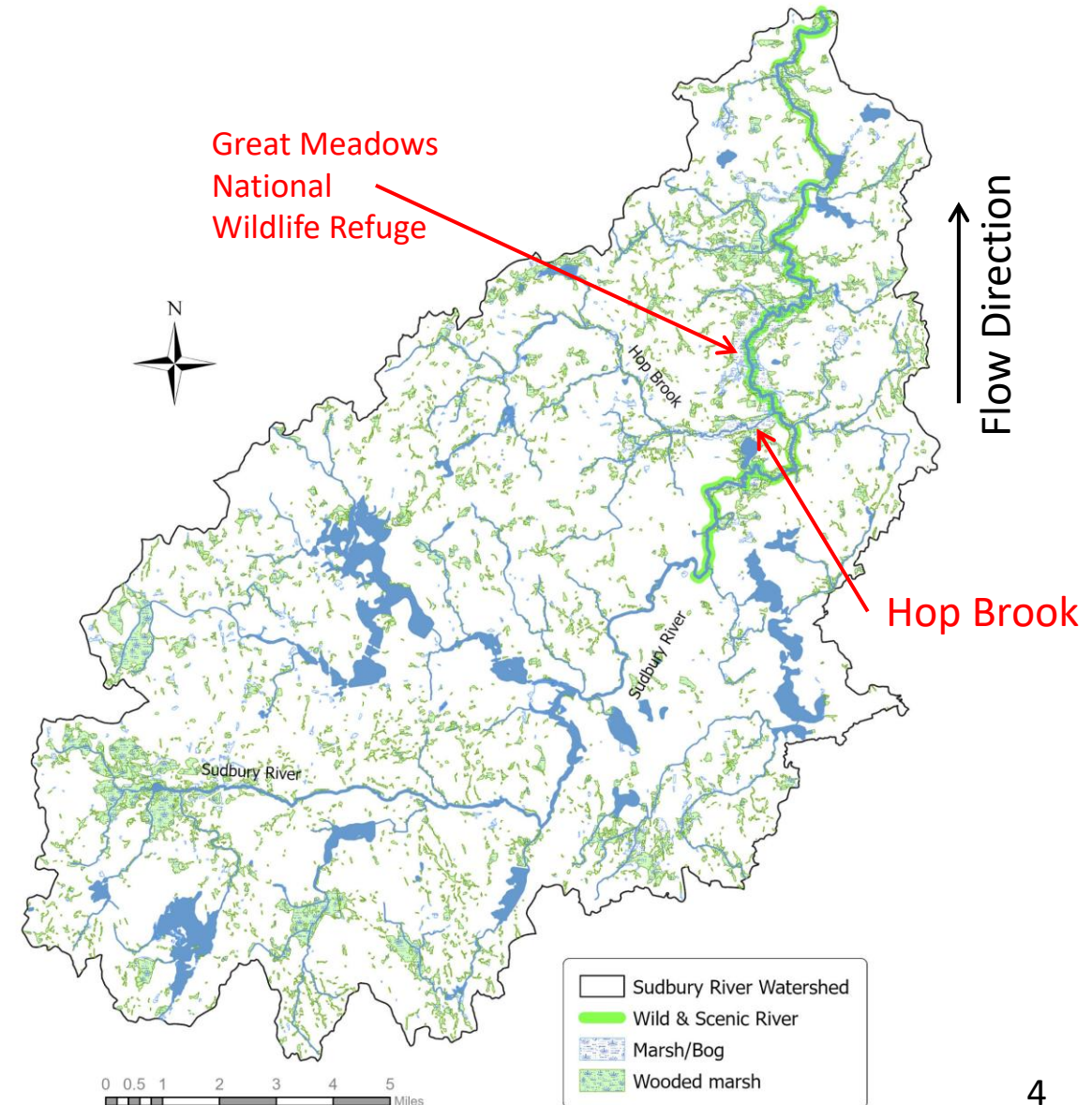
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OARS—for the Sudbury, Assabet, & Concord rivers

Northeast Aquatic Biologists (NAB) Conference
February 7, 2025

Sudbury River

- 33 miles long; 163 miles² drainage area
 - Joins Assabet to form Concord River
- Flow (40-800 cfs)
 - Manipulated by major upstream reservoirs
- Low gradient
- Hop Brook – major tributary
- Wild & Scenic River
 - Lower 16.8 miles

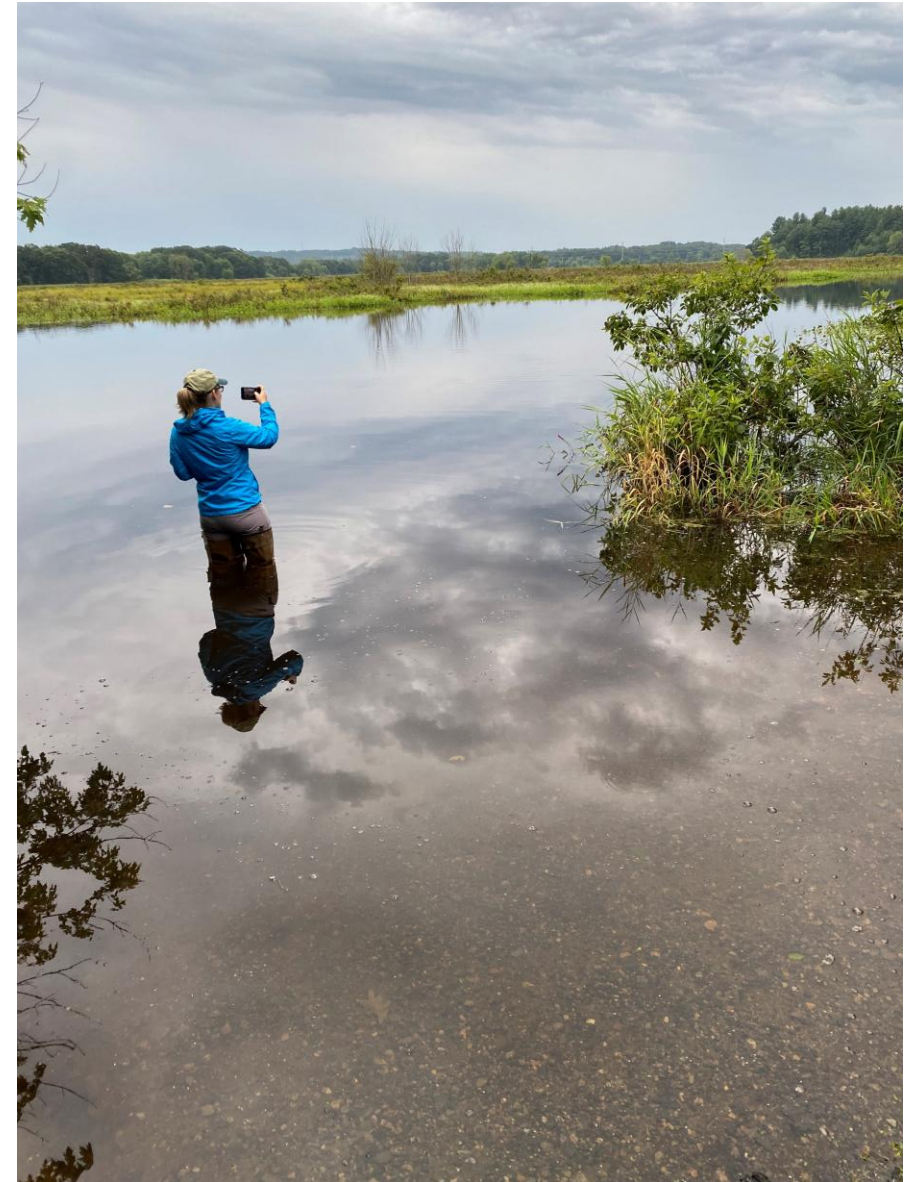


Sudbury River & Great Meadows

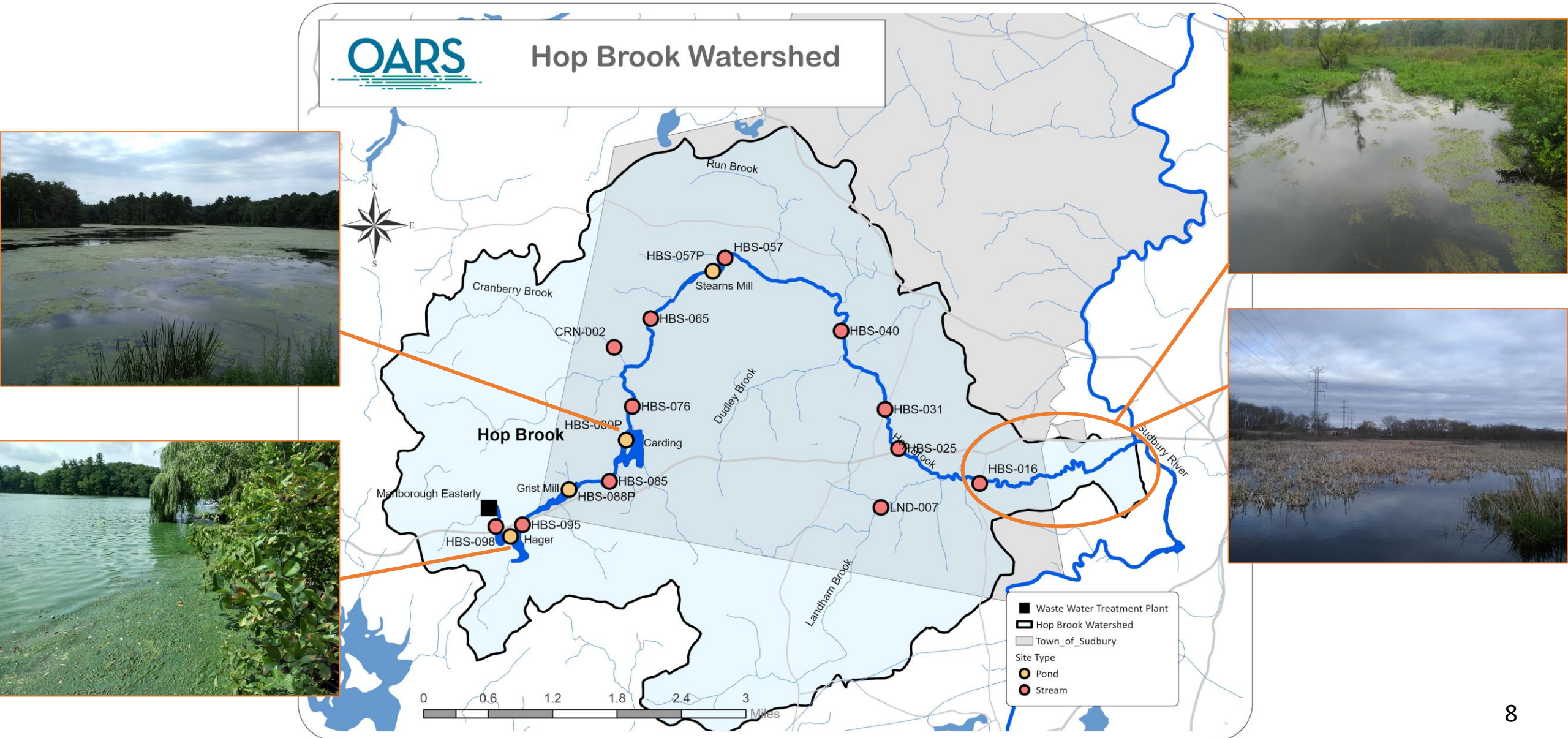


Great Meadows National Wildlife Refuge

Sudbury River & Great Meadows



Hop Brook Map



Hop Brook Studies

Most studied brook in New England?

- 2008 Hop Brook Sediment and Dam Removal Study
- **2006 Marlborough Easterly Wastewater Treatment Facility NPDES Permit**
- 2004 Supplemental Nutrient Loading Evaluation of Hop Brook
- 2000 Nutrient Impact Evaluation of Hop Brook
- 1999 Problems and Solutions for Hop Brook
- 1999 Effects of Phosphorus Contamination on Species Diversity in Hop Brook
- 1998 Remediation Options for Elodea Dominated Ponds along Hop Brook
- 1997—Assessing the Role of Sediments as a Phosphorus Source in the Eutrophication of Ponds Along Hop Brook
- 1997—Pilot Plant for Phosphorus Removal from the Effluent of the Easterly Wastewater Treatment Plant
- 1996 Mechanical Harvesting to Control Blooms of the Green Alga *Hydrodictyon reticulatum*, Grist Millpond
- 1996 EPA Swat Team Request for Hop Brook
- 1995 Algae Harvesting Experiment on Grist Millpond
- 1995 Marlborough/Sudbury Phosphorus Removal Project
- 1994 Shoreline Survey Summary, State of the Hop Brook
- 1994 Improving the Water Quality of the Hop Brook Watershed through Aggressive Algal Harvesting
- 1994 An Algae Harvesting System for the Hop Brook Protection Association
- 1994 A Natural History of the Hop Brook
- 1993 Marlborough Easterly WWTP Phosphorus Removal Study
- 1989 Hop Brook Ponds System Study
- 1984 Source, Movement, and Effects of Nitrogen and Phosphorus in Three Ponds in the Headwaters of Hop Brook



20 published
studies in 24
years

Hop Brook Impoundments

Marlborough
WWTP



300 kg
P/yr



Hager

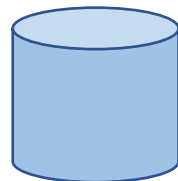
31 acres



Grist



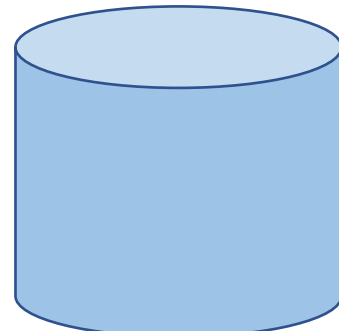
17 acres



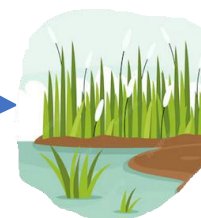
Carding



41 acres



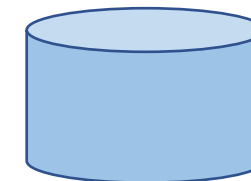
Large
wetland



Stearns



20 acres



All ponds average 2–
3 feet deep



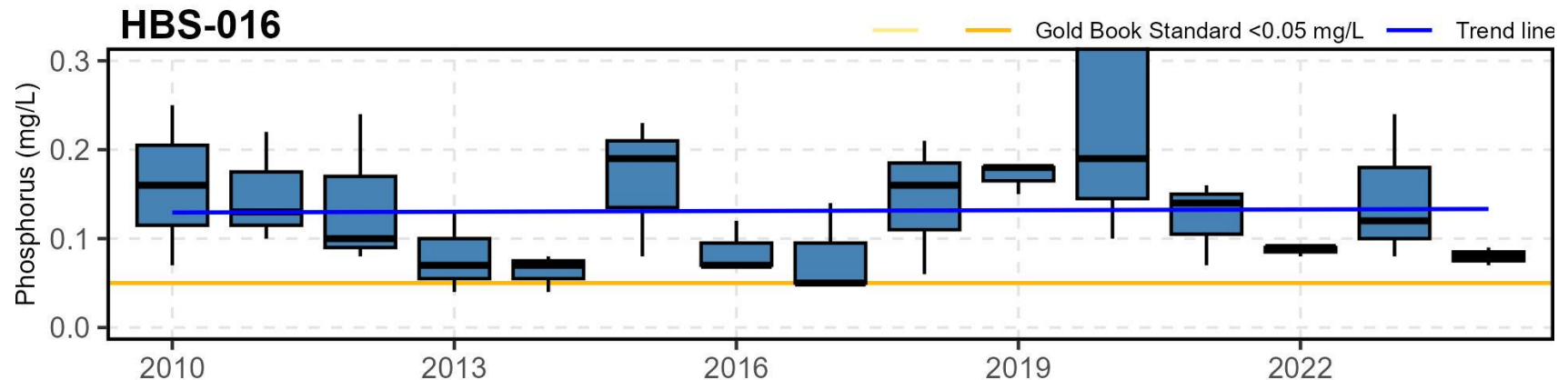
Graphic from Hop Brook
Protection Association

* Sediment measured in 2000

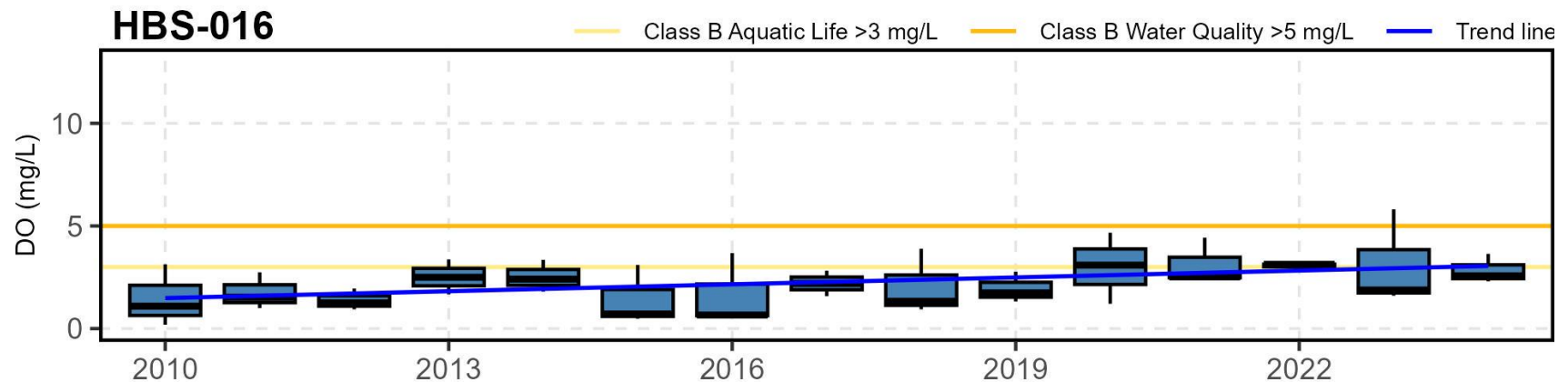
Hop Brook Phosphorus

- Mouth of Hop Brook
 - Very high Phosphorus concentrations
 - Very low Dissolved Oxygen concentrations

Phosphorus
(Jun/Jul/Aug)

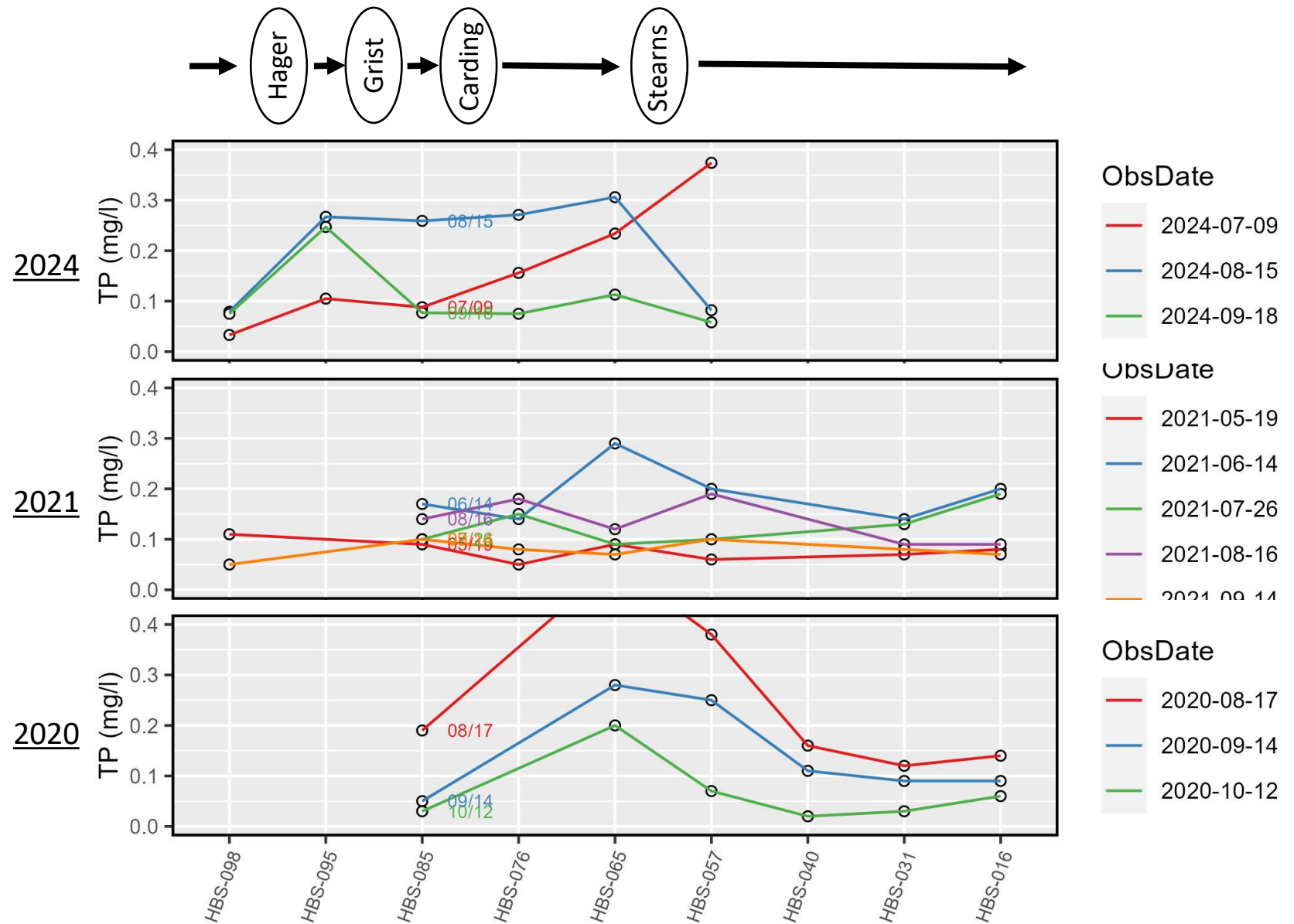


Dissolved Oxygen
(Jun/Jul/Aug)



Hop Brook Phosphorus

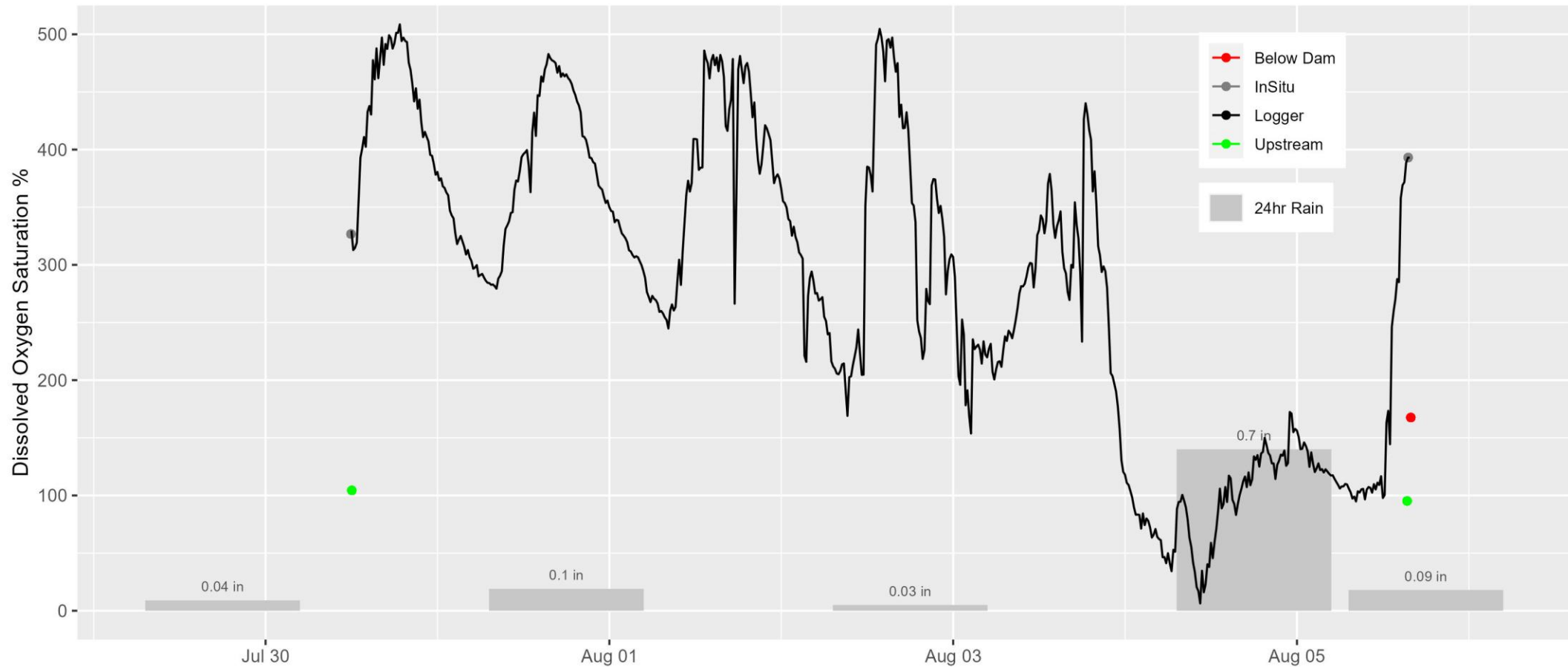
- Extremely high Phosphorus concentrations below impoundments
- Probably sourced from pond sediments



Hop Brook Dissolved Oxygen

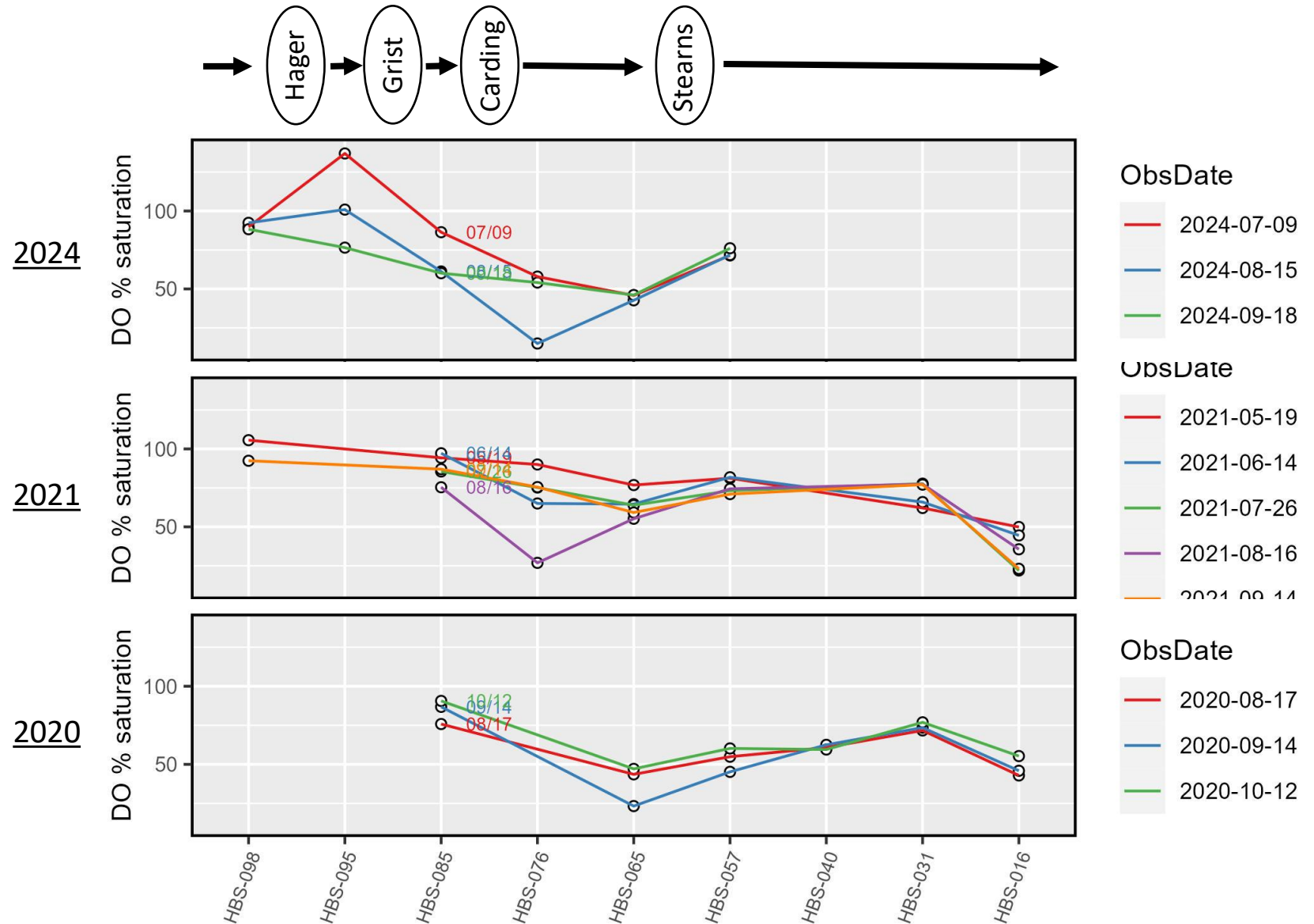
- Super saturation in Hager Pond
 - Often 200-500%

DO Logger Deployment in Hager Pond (2024)



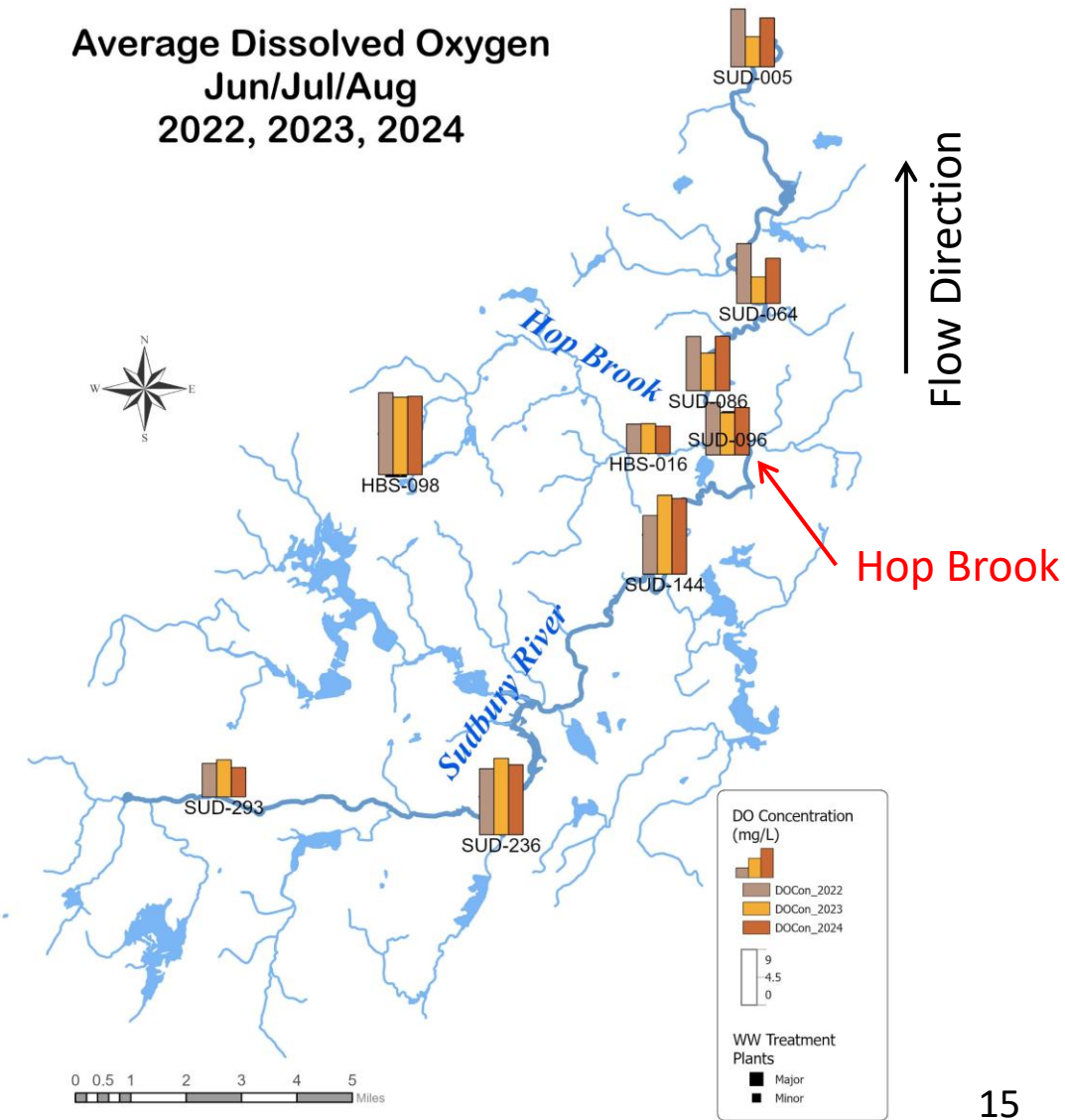
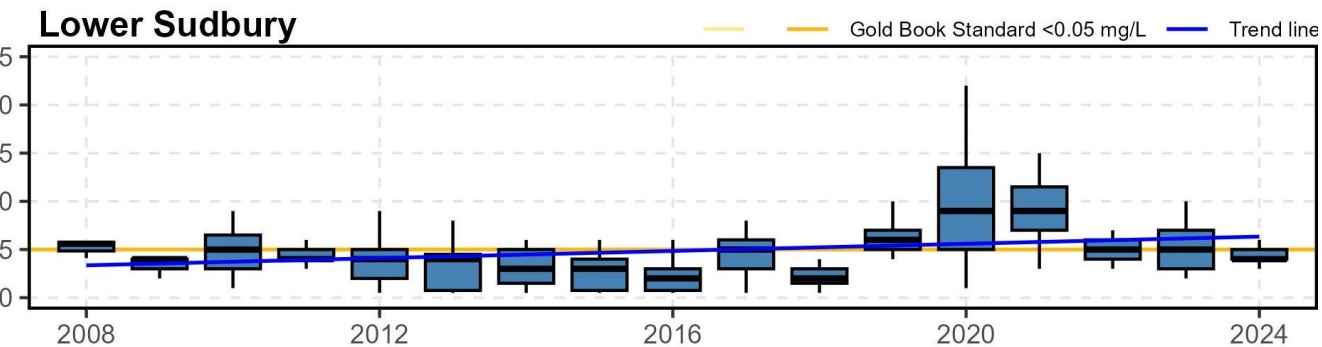
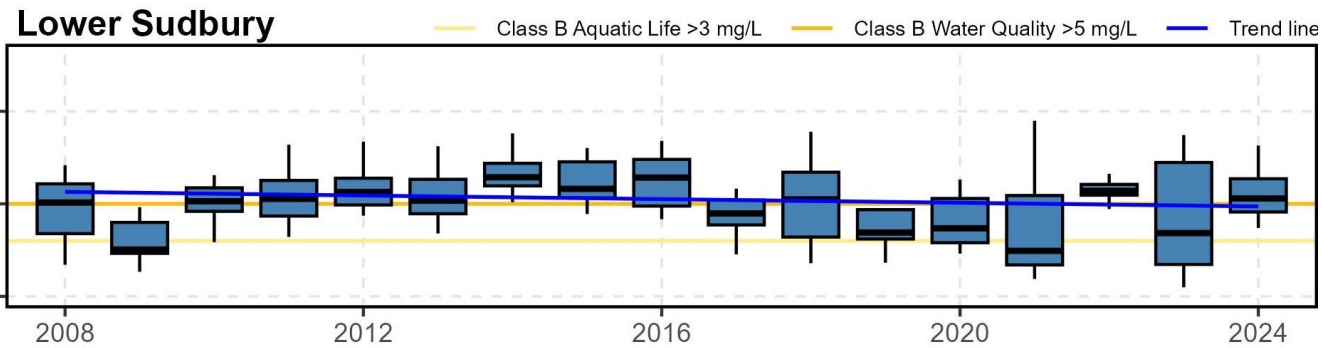
Hop Brook Dissolved Oxygen

- Dissolved Oxygen declines downstream
 - Often anoxic in Carding <30%
 - Low again at mouth
- Plenty of readily degradable organic matter in downstream reaches



Sudbury Dissolved Oxygen

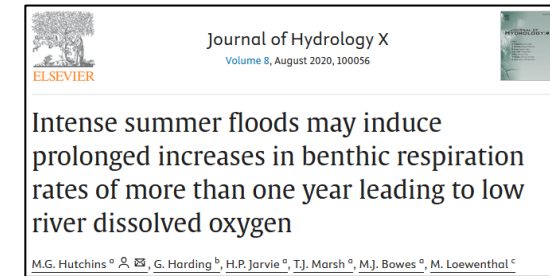
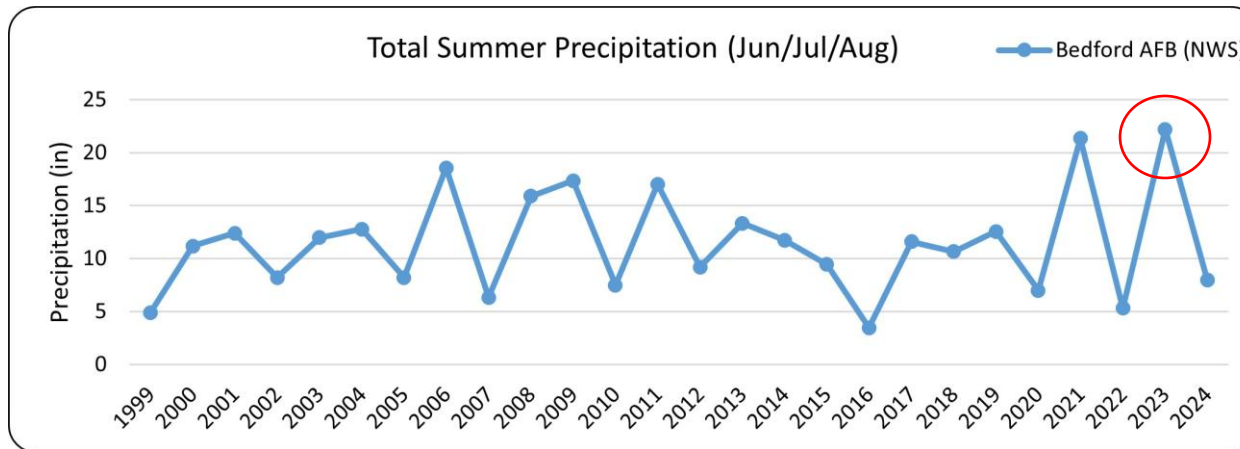
- Lower Sudbury
 - Dissolved Oxygen declining?
 - Phosphorus increasing?
 - Lower **DO** downstream of Hop Brook



Sudbury DO in High Flows

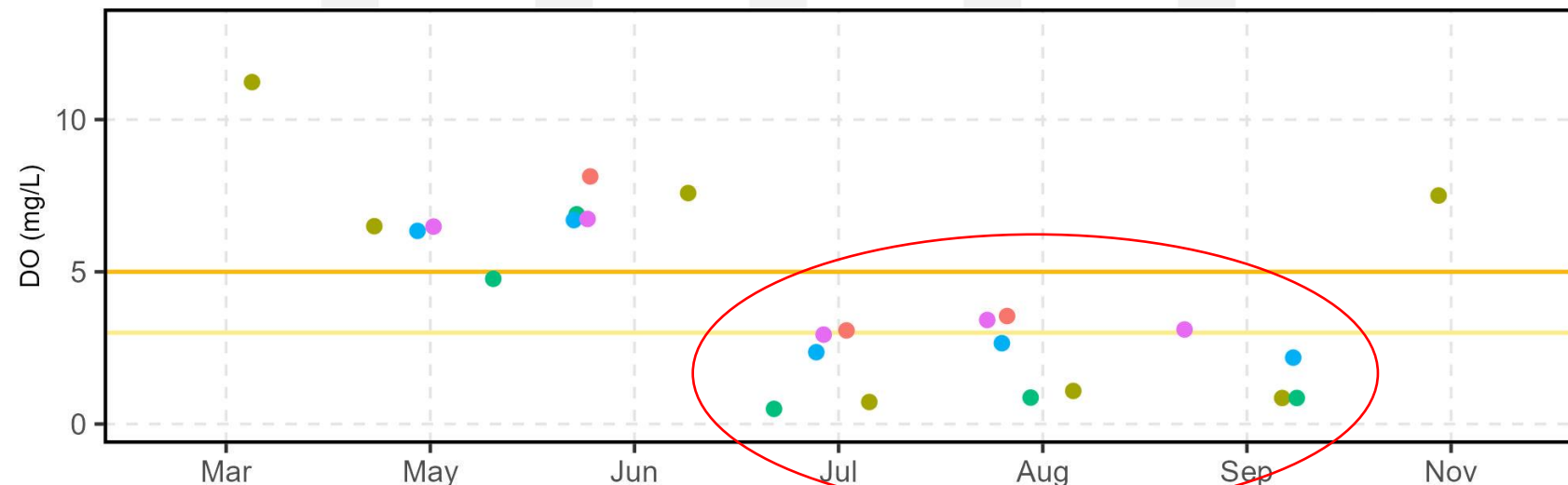
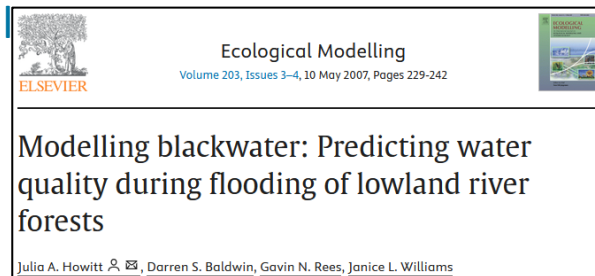
- 2023: extremely high flows, extremely low DO

The supply of readily-degradable organic matter to river systems can cause stress to dissolved oxygen (DO) in slow-flowing waterbodies.”



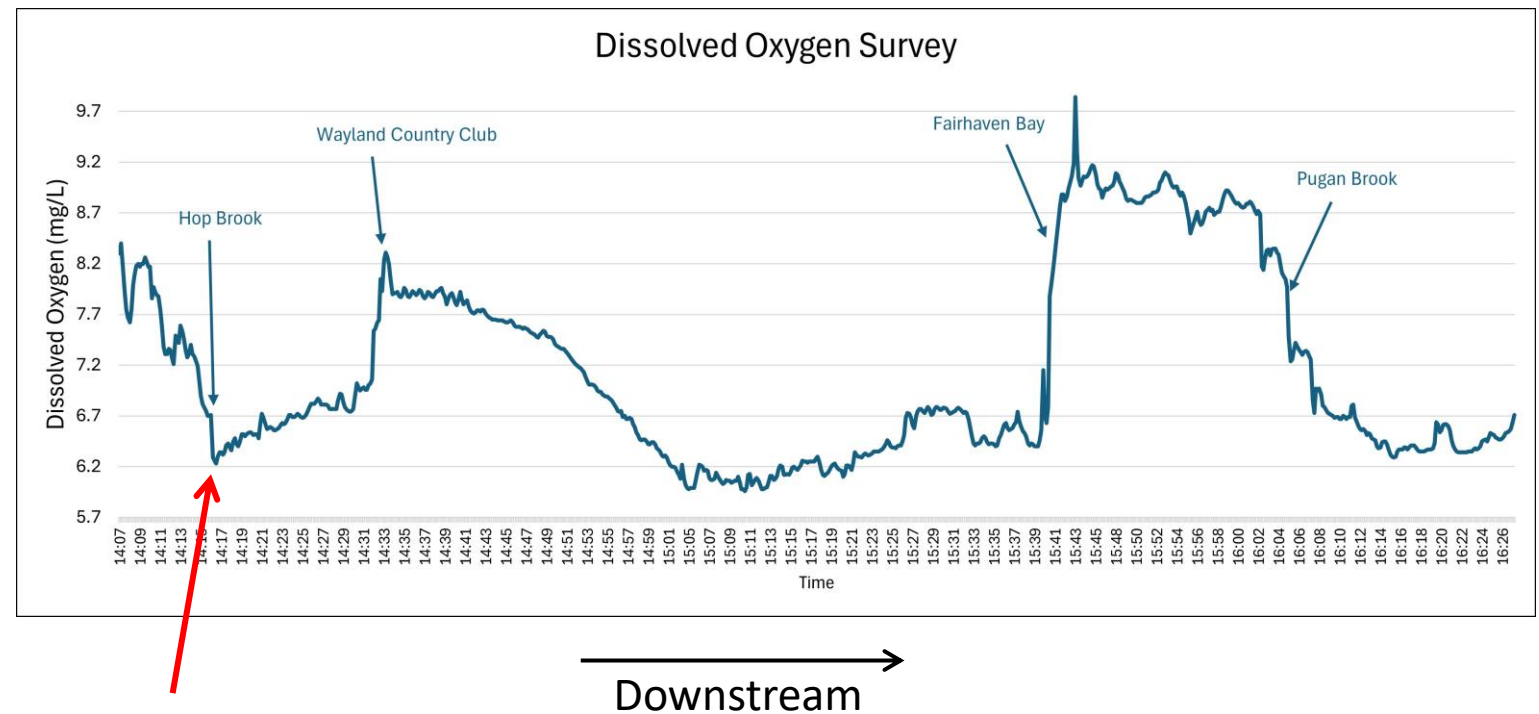
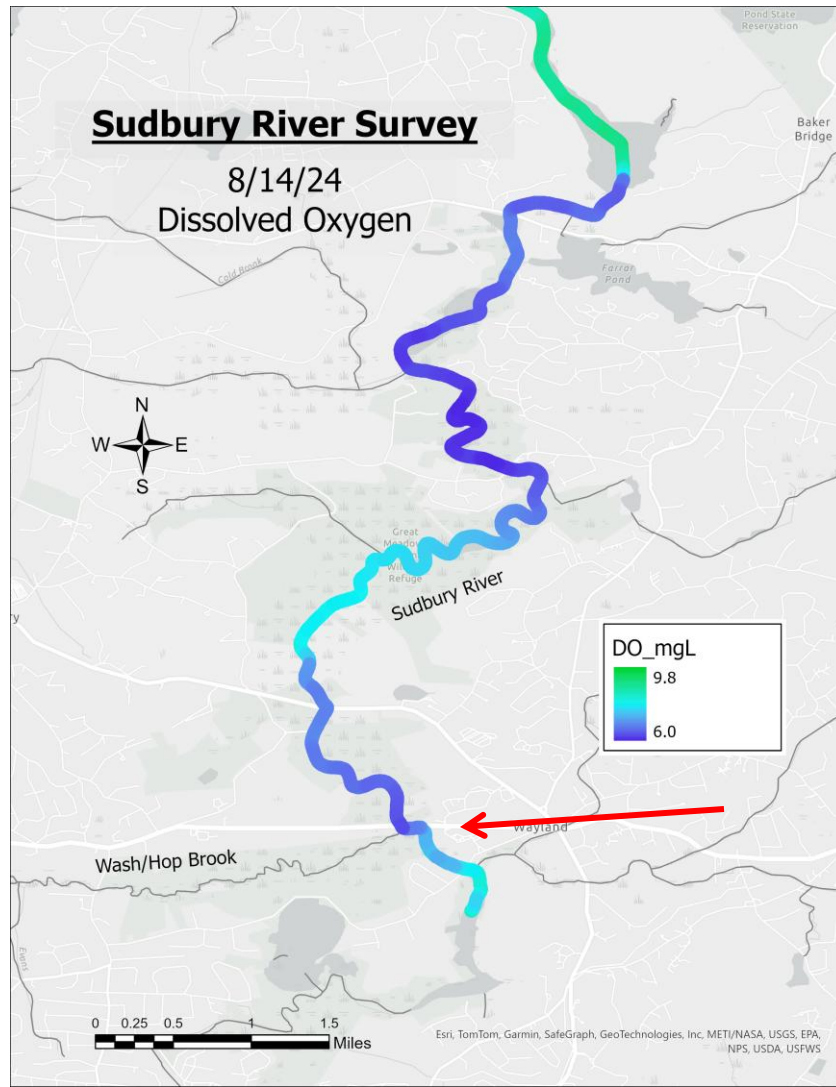
● CND-110 ● SUD-005 ● SUD-064 ● SUD-086 ● SUD-096

Pulse of dissolved organic matter released from floodplain during flooding associated with



Sudbury DO Survey

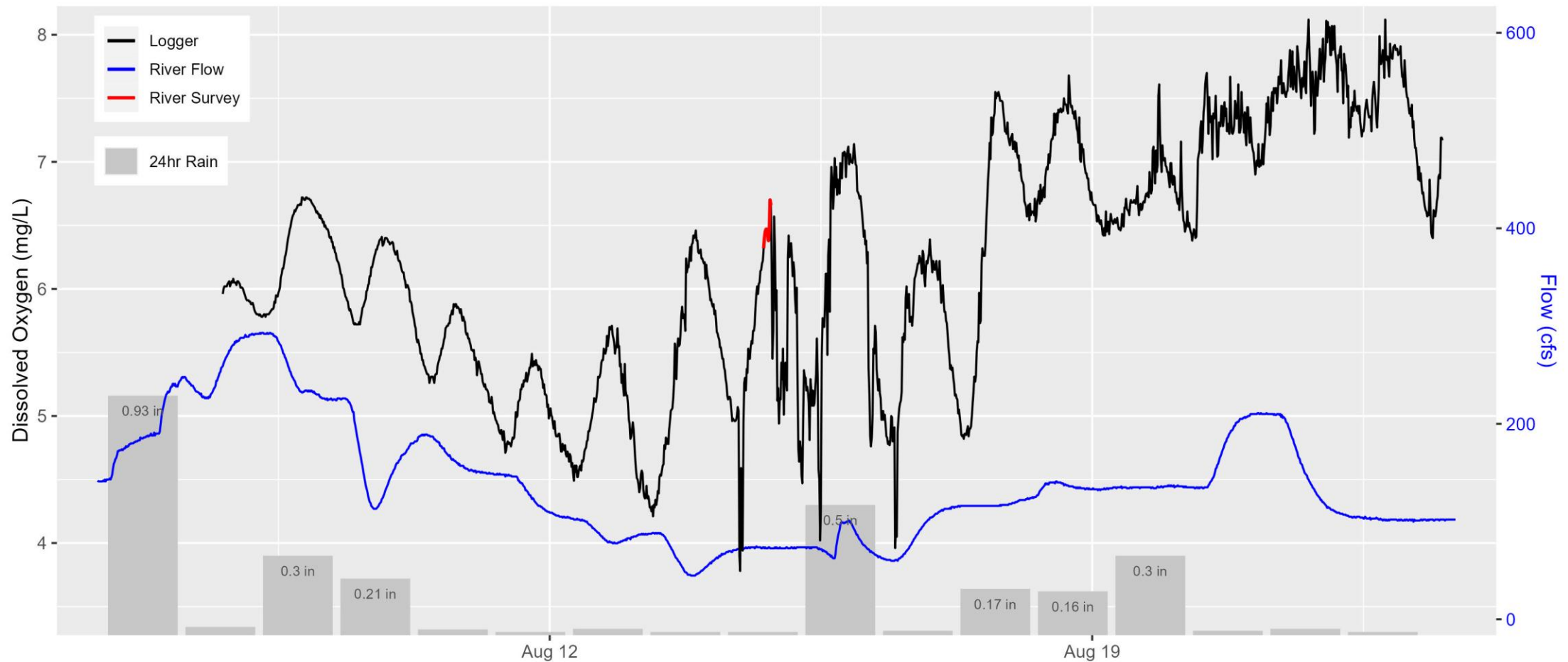
- Longitudinal Survey – significant **DO** drop at Hop Brook



Sudbury DO Logger

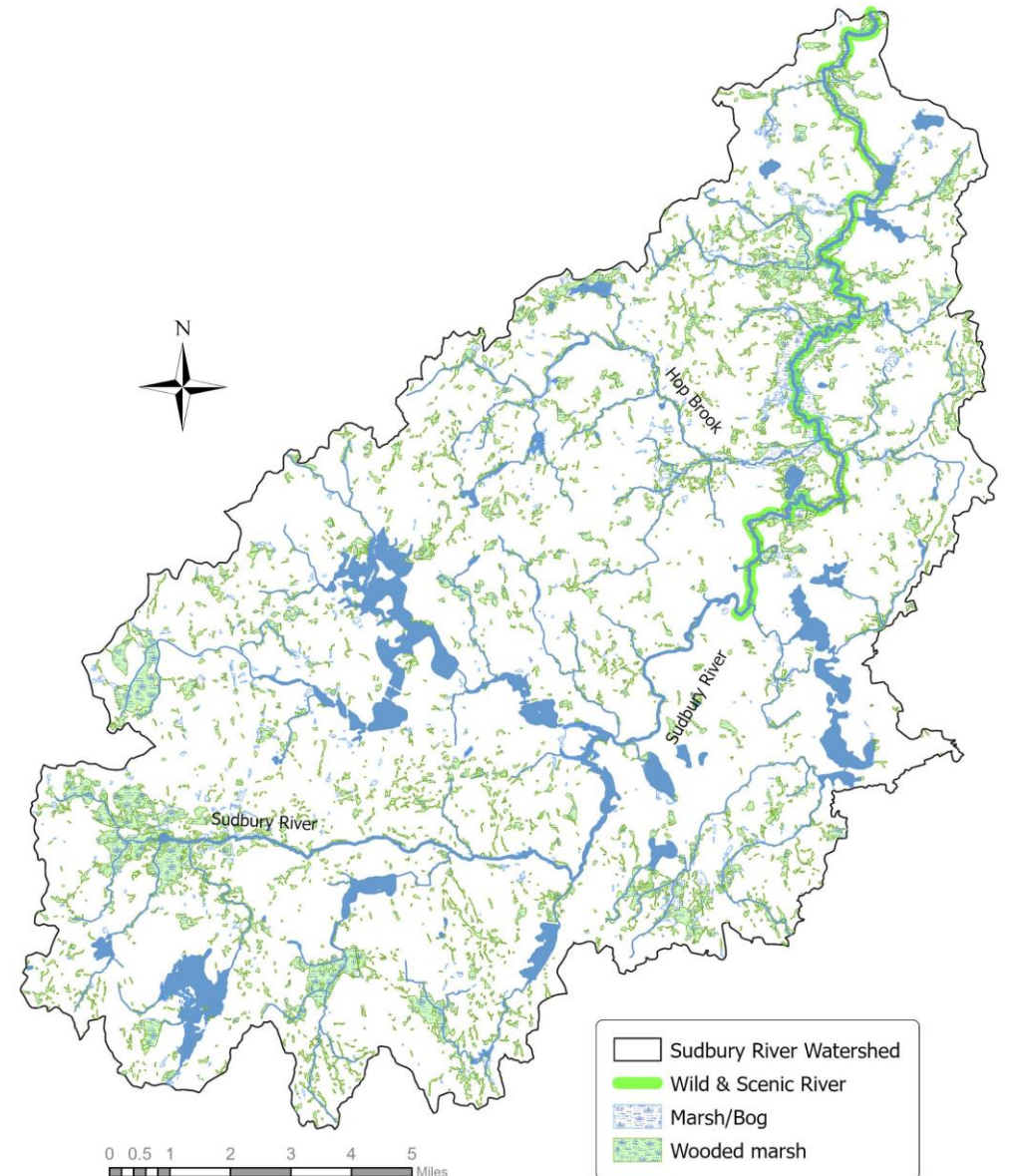
- Continuous Logger showed strong diel cycles (2 miles downstream of Hop Brook)

DO Logger Deployment at Sherman's Bridge (2024)



Study Findings

- Well-known eutrophic conditions in Hop Brook
 - Large **P** reservoirs in impoundments
 - Consistent high **P** concentrations
 - Consistent low **DO** downstream
- **DO** in Sudbury is chronically low and may be getting lower
 - Extremely low **DO** in floods
 - Sudbury **DO** is lower downstream of Hop Brook
 - Strong diel **DO** cycling in Sudbury



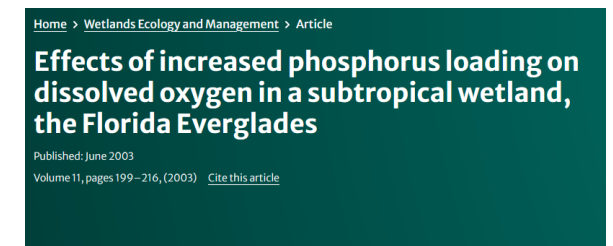
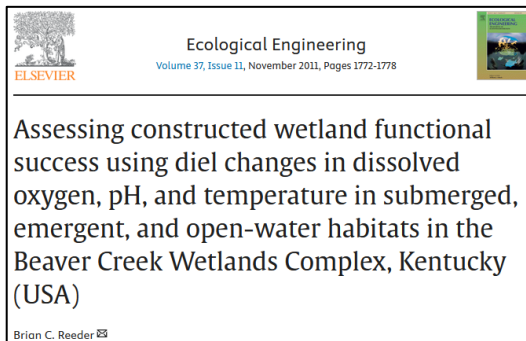
Hop Brook's Impact on Sudbury

- Natural conditions for meadow wetlands?
 - Wetlands along Hop Brook and along Sudbury
- Hop Brook as battery of high oxygen demand water?
 - High Biochemical Oxygen Demand (BOD) of water
- Long-term accumulation of phosphorus downstream of Hop Brook?
 - High BOD of sediments

“Wetland metabolism is defined by profound daily fluctuations in pH and dissolved oxygen

High SOD and low DO concentrations may be a natural phenomenon in instream blackwater swamps in Georgia.

High P concentrations in wetlands correlate with “dampened diel fluctuations and reduced DO”.



Paul V. McCormick & James A. Laing

Thank you!

Hop Brook Protection Association

- Glenn Pransky
- Terry Snyder
- Shannon Hache
- Jeff Winston
- Emanuel Eagle



OARS Volunteers and Staff



NOAA Fisheries

- Ben German



Adam Nolde
DO logging
kayaker



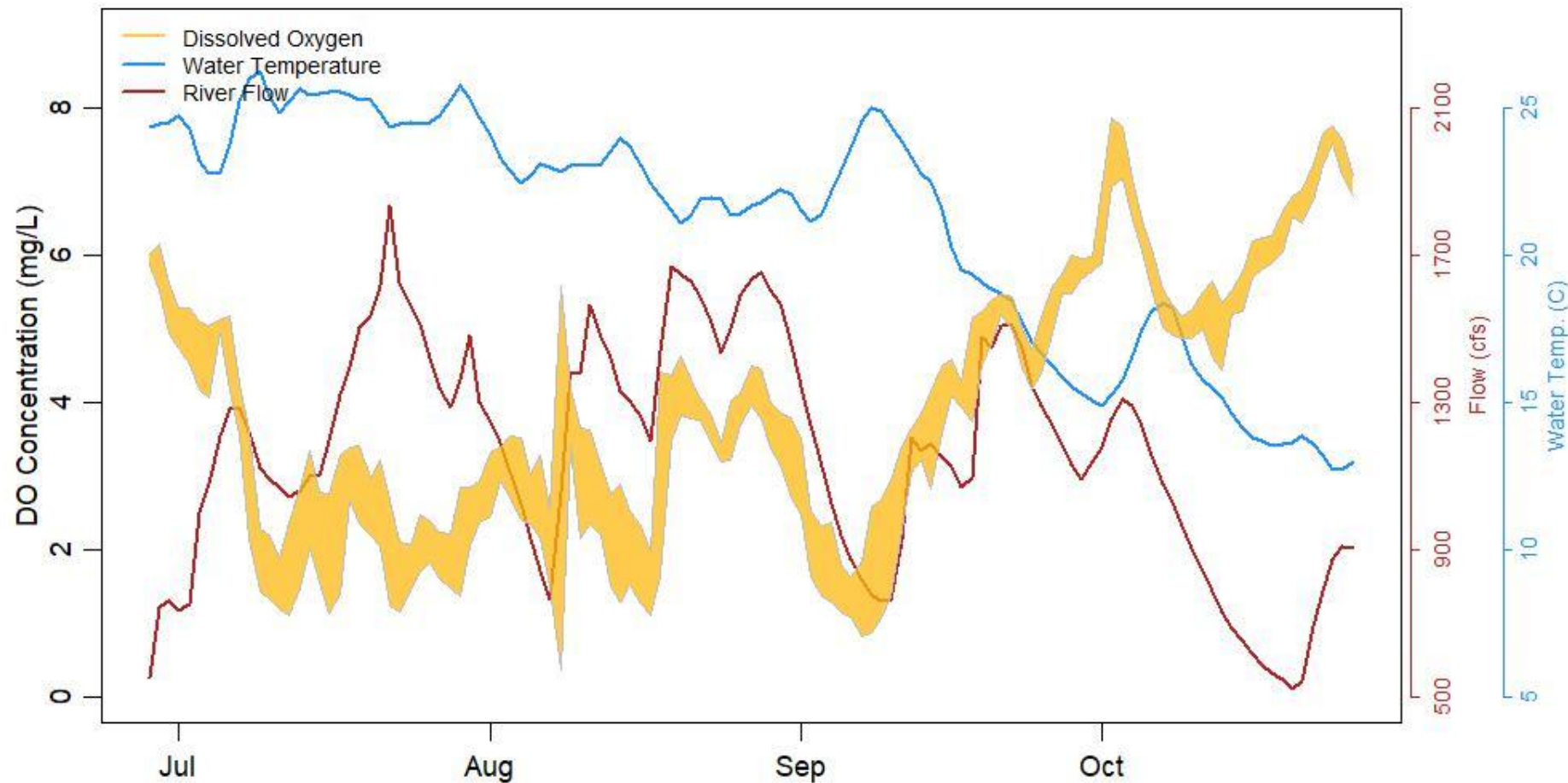
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QUESTIONS?

Downstream DO

- Logger in Concord River also showed very low DO levels in 2023

Talbot Mills Impoundment Daily Dissolved Oxygen (2023)



Sudbury DO Survey

- DO v PH v Temp

