# Lake Lawrence Cyanobacteria Management Plan

July 25, 2024; 6:30-8:30 pm

Lake Lawrence Community Club

THURSTON COUNTY
WASHINGTON
SINCE 1852

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# Agenda


1. Project Overview
2. Lake and Watershed Monitoring Plan
3. Lake Cyanobacteria Management Plan
4. Schedule Overview
5. Questions and Discussion

# Project Goals and Objectives

***Project Goal***

Develop a comprehensive, science-based plan to guide public and private investment for the benefit of human recreation and environmental health in Lake Lawrence.

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# Project Goals and Objectives

***Project Objectives***

- Develop management goals
- Evaluate current conditions and causes of impaired human and ecological uses.
- Identify actions (e.g., projects, policies) to support achieving management goals.

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# Scope of this Plan

***The Plan focuses on Surface Water Quality***

***The Plan does not focus on…***

- Fisheries
- Aquatic Plants
- Drinking/Ground Water Quality
- Flooding

We will consider co-benefits/consequences of surface water quality management strategies for those endpoints.

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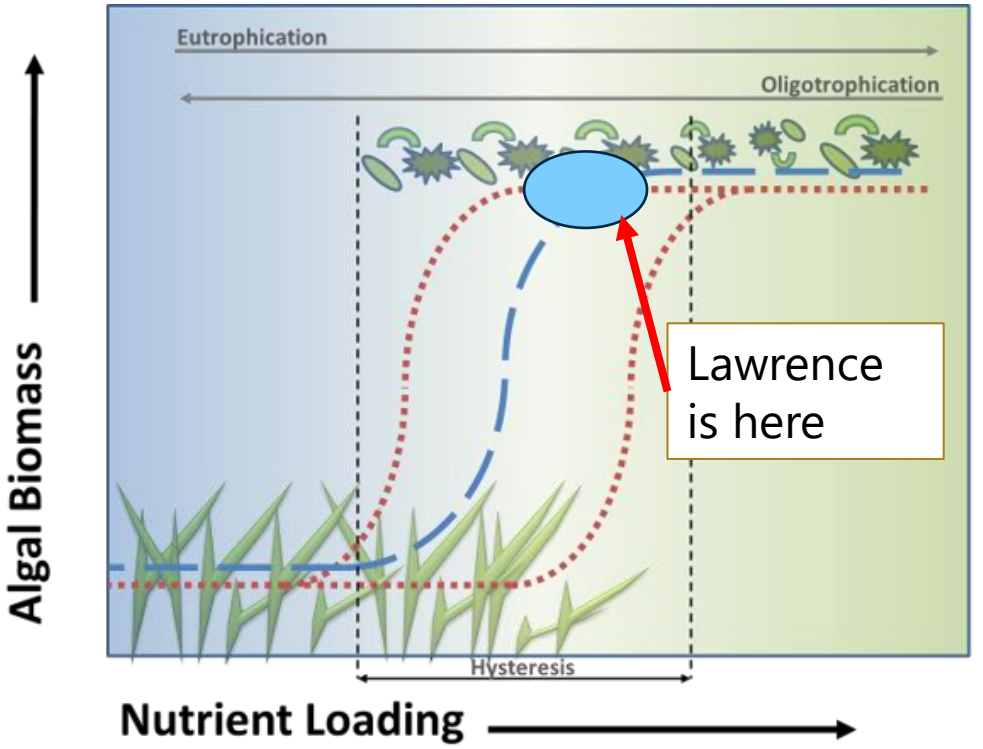
# Lake Eutrophication:

nutrient-induced increase in algae productivity and biomass

Nutrients

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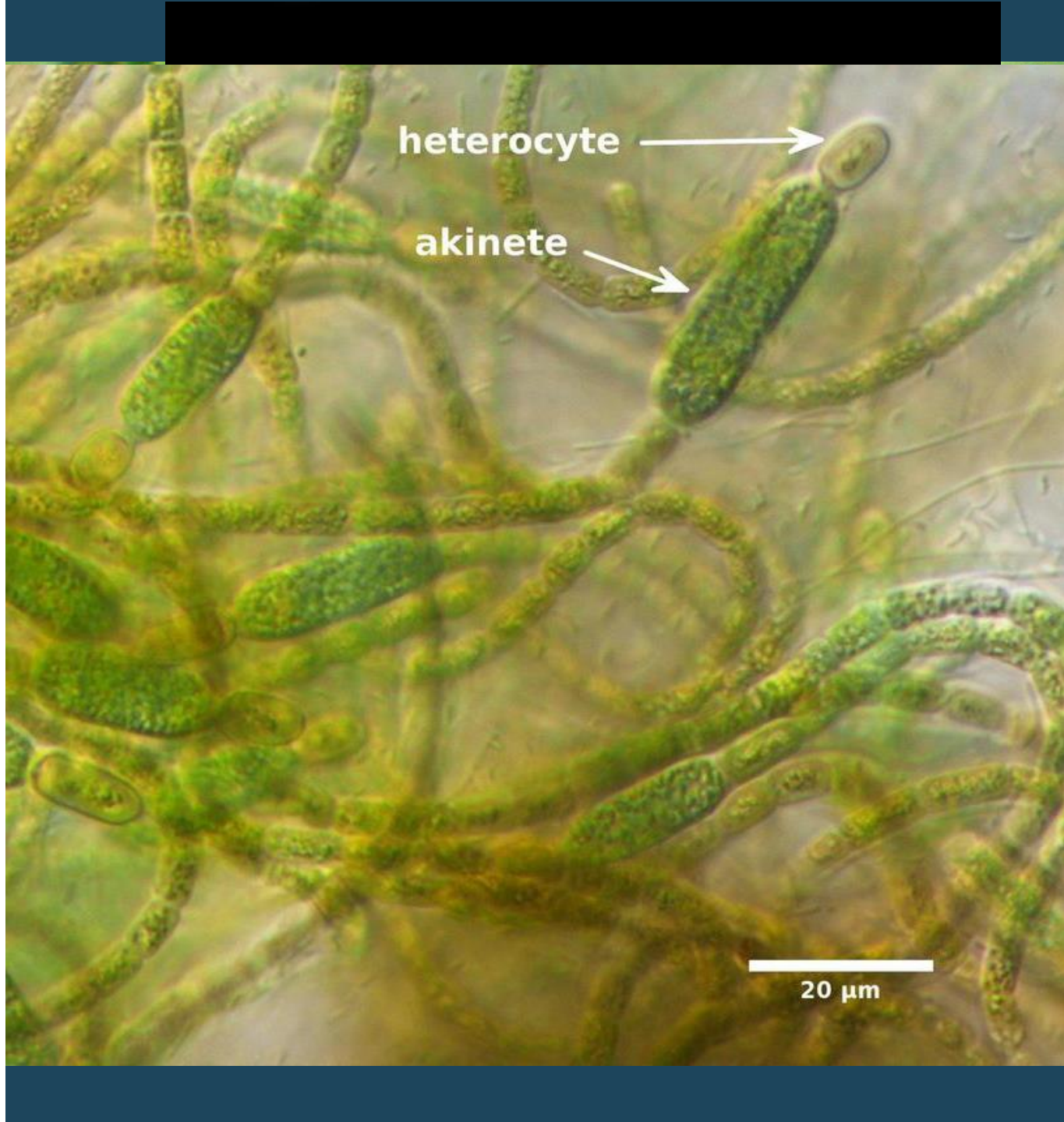
# Cyanobacteria Competitive Advantages

- Vertical migration
- Phosphorus hoarding (luxury uptake)
- Non-preferred food for grazers
- Some can fix nitrogen gas
- Lower energy needs – can grow under lower light conditions

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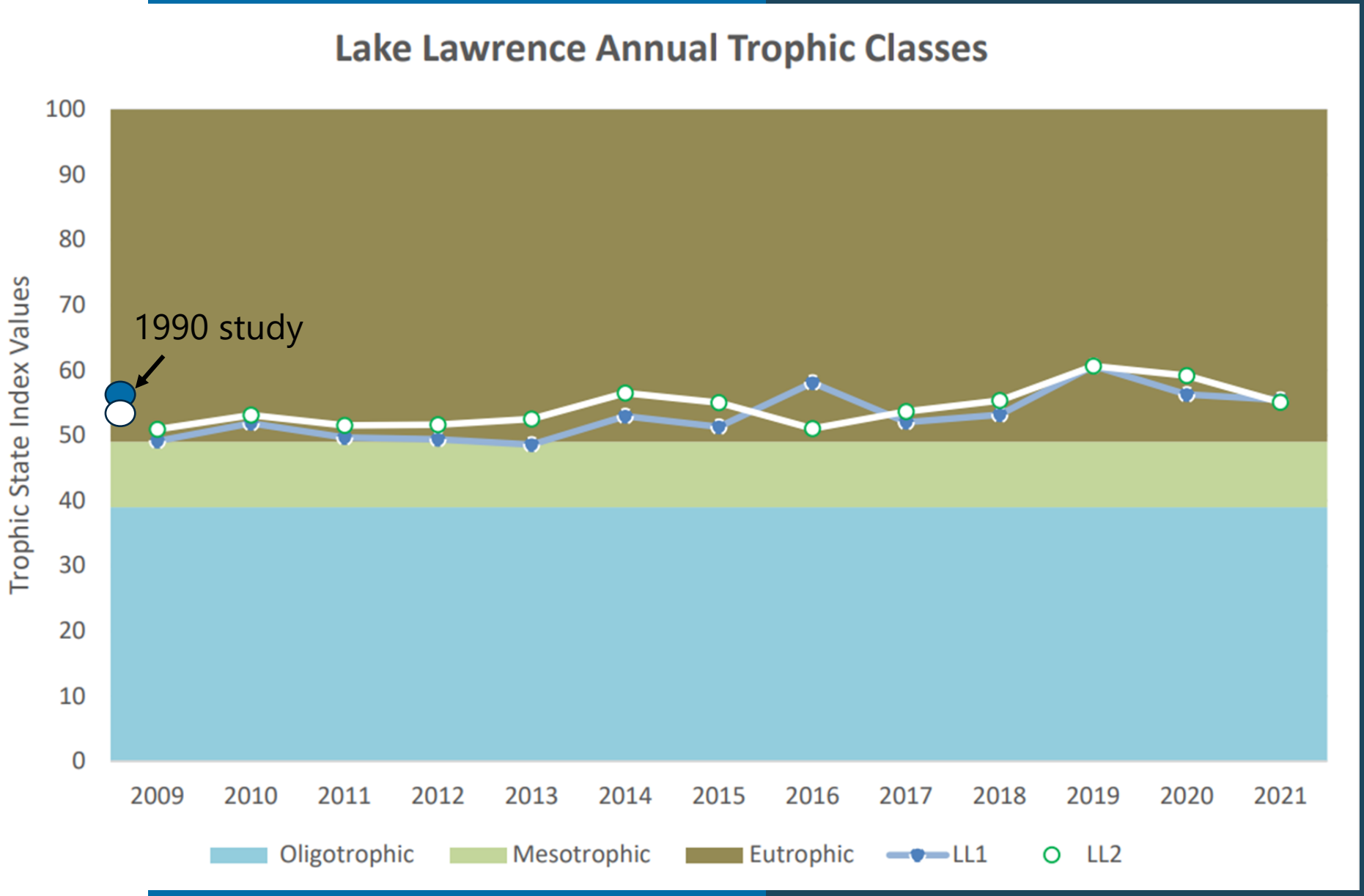
# Lake Trophic State

Classes
- Oligotrophic
- Mesotrophic
- Eutrophic

Indices
- Total Phosphorus
- Chlorophyll-a
- Secchi Depth

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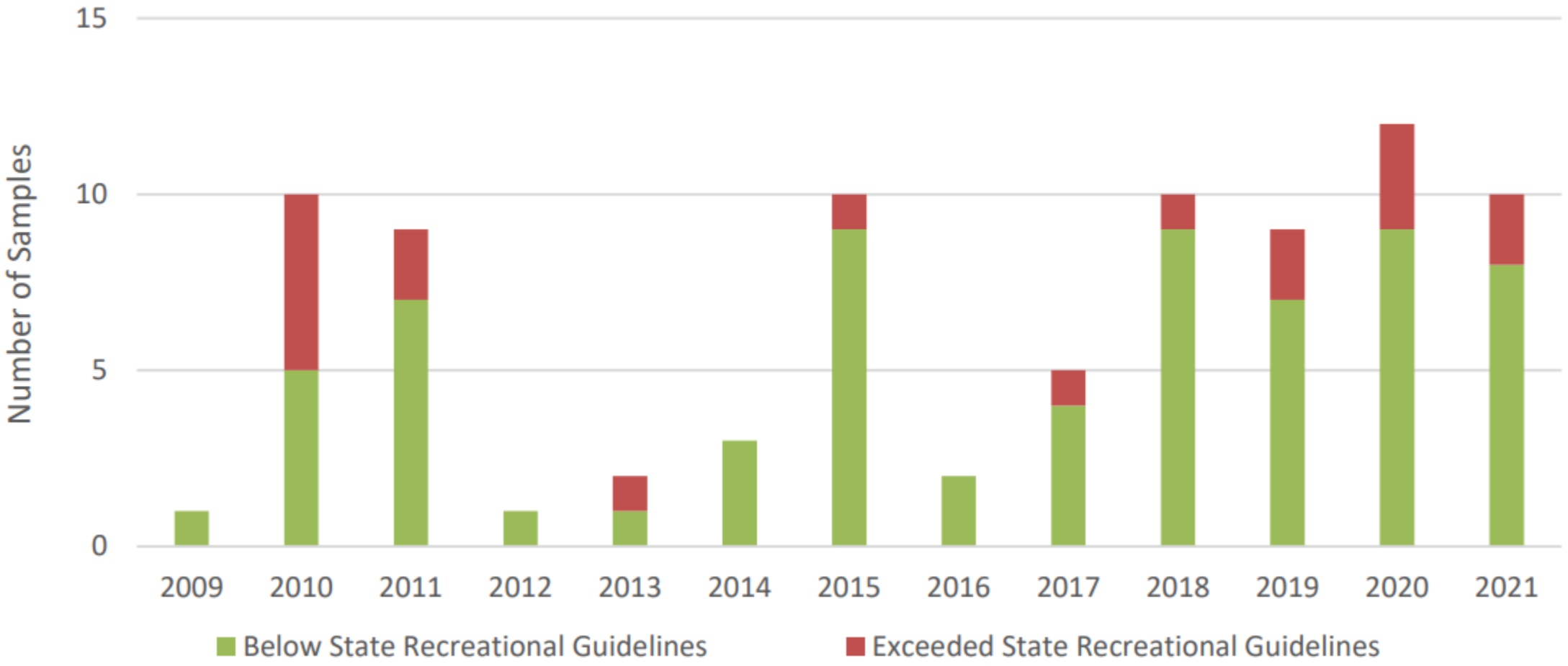
# Lake Lawrence Algae Samples

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# Lake Lawrence – A History

## Pre-Colonization

- Inhabited by Cowlitz, Nisqually, and Cayuse, Umatilla, & Walla Walla peoples

## 1873

- First survey of the lake
- 25-30 settlers
- "Kandel Lake"

## 1880s-1890s

- Renamed to "Lake Lawrence"
- Two small sawmills along the lakeshore
- Sawdust and wood waste discarded in lake

## 1908-1928

- Lake used as a reservoir for Tumwater Power Plant
- Deschutes River diverted into lake
- Lake outlet dammed; lake level raised

## 1920s-1940s

- Edwards Resort popular for recreation
- Lake became fishing destination

## 1951

- WDFW started rotenone treatments lake to remove bass, perch, etc.
- WDFW started rainbow trout stocking

## 1960s-1970s

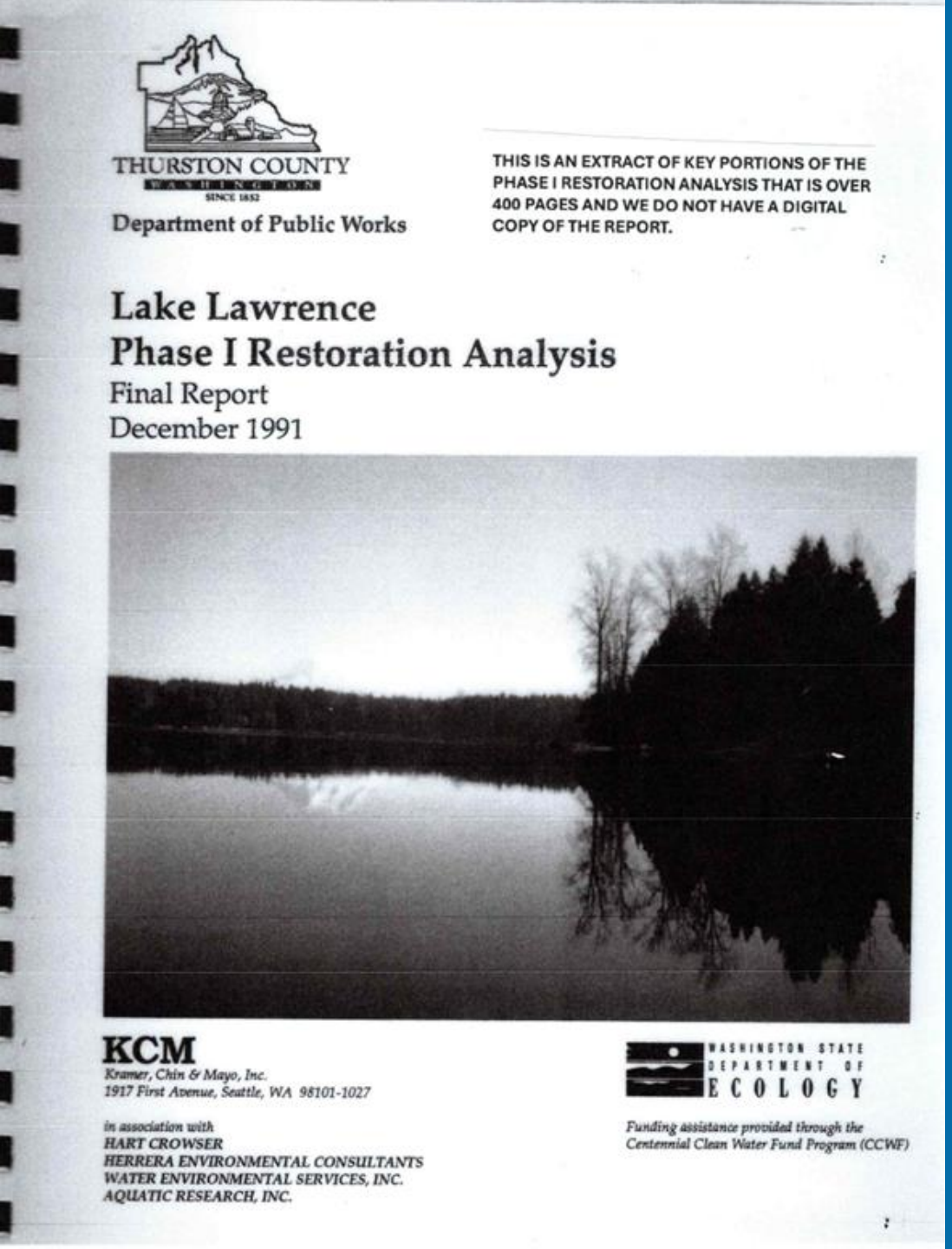
- 1960's- Shoreline and watershed was subdivided and became residential
- Lee Edwards dug canal around 5-acre lot to form "Goat Island"
- Edwards Resort closed in 1973, property divided to private homes and LL Community Club

## 1980s

- WDFW stopped removing bass
- LMD formed in 1986!

## 1990s-2000s

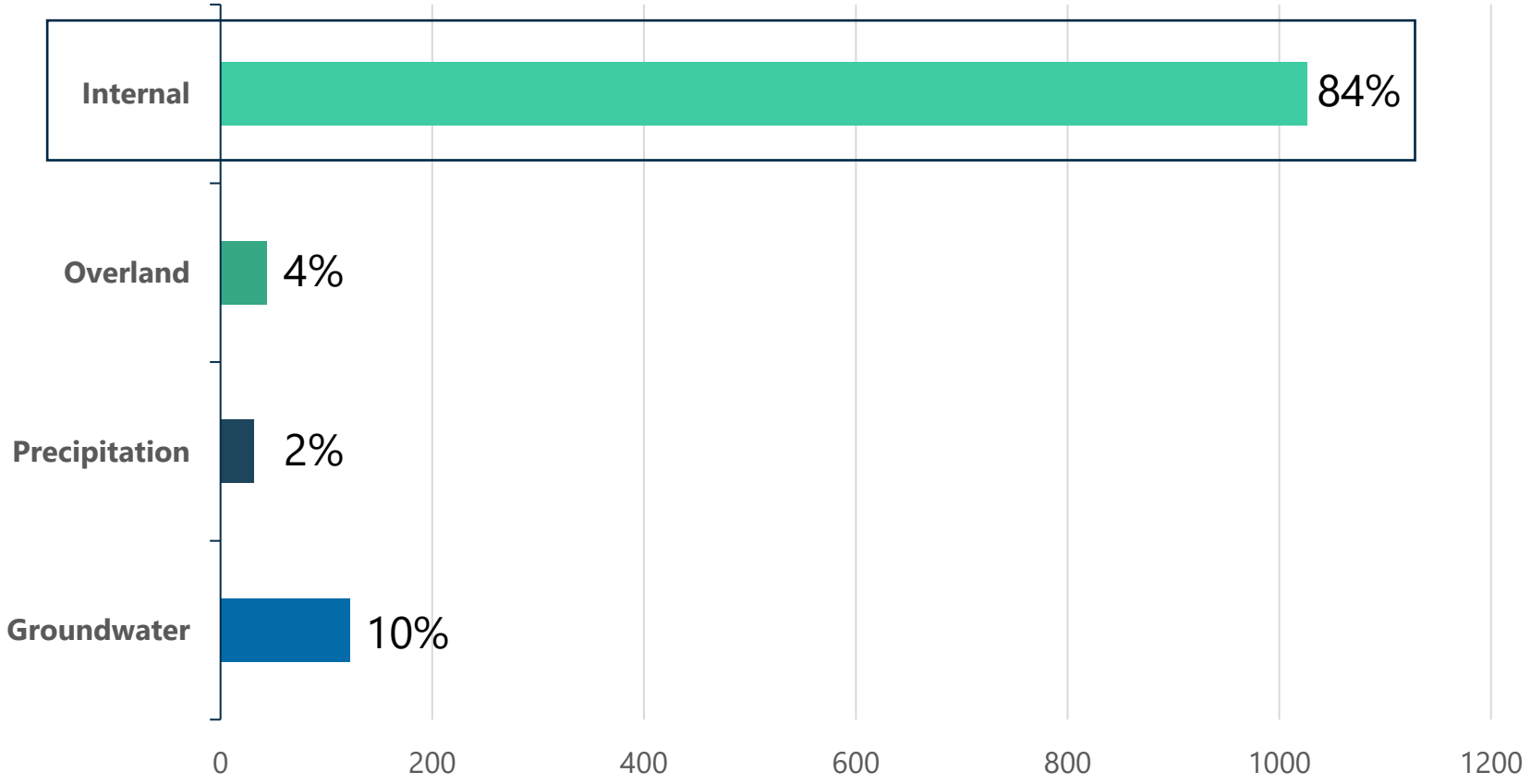
- KCM study 1990-1991
- Dredge & design report, 1995
- IAVMP, 2004
- LLCC + WDFW raised rainbows in net pens


# KCM Findings

1. Lake Lawrence is eutrophic, and algae is dominated by cyanobacteria
2. Water enters the lake via groundwater and precipitation. There are no perennial tributaries.
3. Lake Lawrence is stratified from April through October and is hypoxic near the bottom.
4. Phosphorus comes from lake sediment release (84%) and naturally enriched groundwater (10%). Release is more pronounced in the east basin.
5. Algae are limited primarily by phosphorus, especially in the west basin.

# Phosphorus Load (kg) (KCM 1991)

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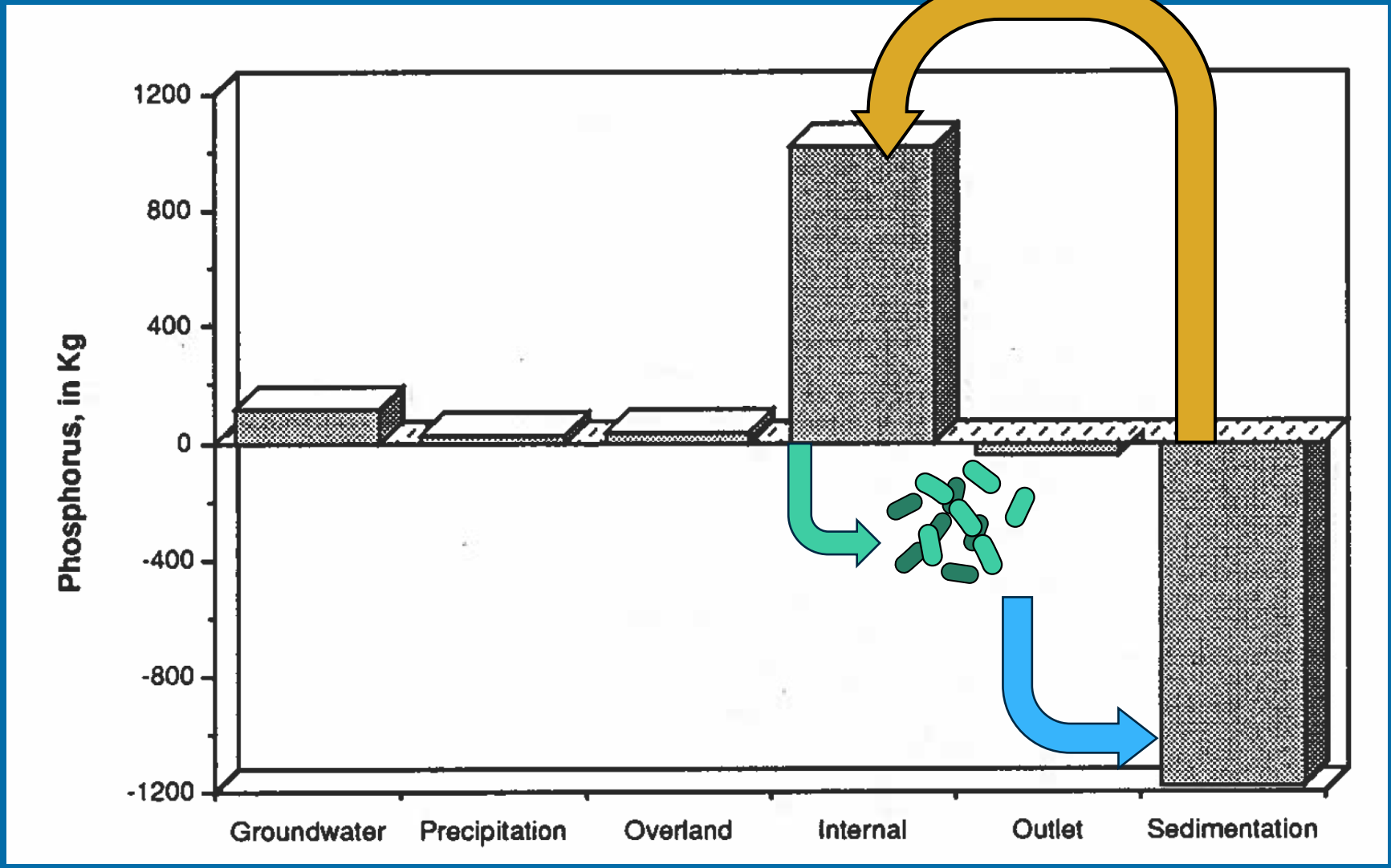
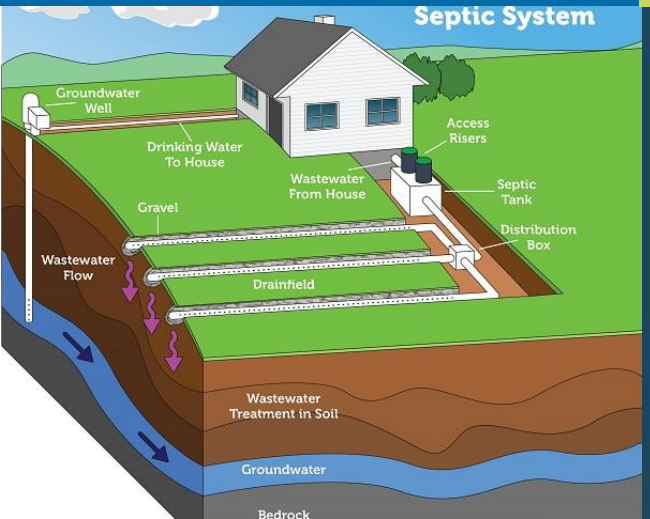



**Figure 7-3**
**PHOSPHORUS LOADING AND LOSSES BY CATEGORY DURING 1990**

# Potential Phosphorus Sources (KCM 1991)

## On-Site Septic Systems

>80% on highly permeable soils

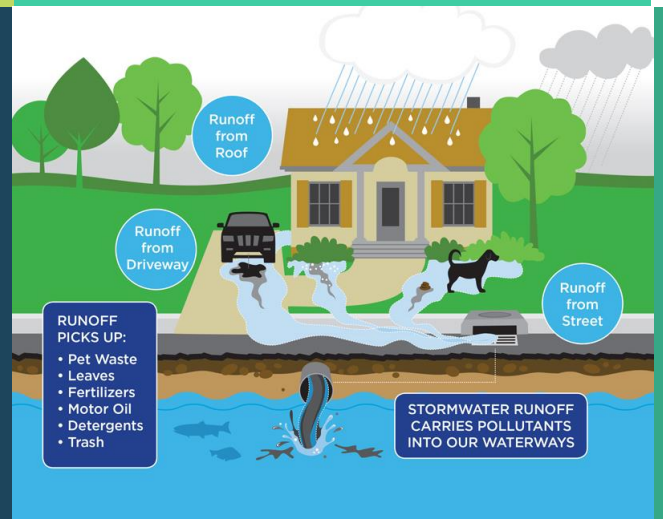


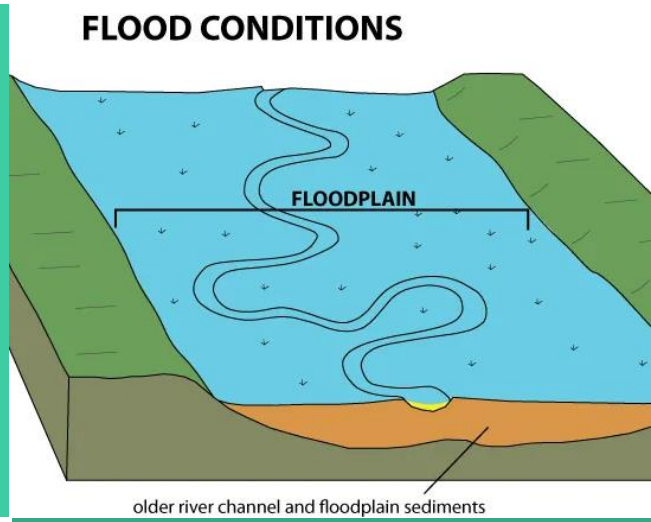

## Legacy Farming & Logging

Historical inputs from dairy farms, chicken farms, logging/milling (slabs & sawdust)

## Shoreline Runoff

Fertilizers, pesticides, etc. from residences and recreational facilities

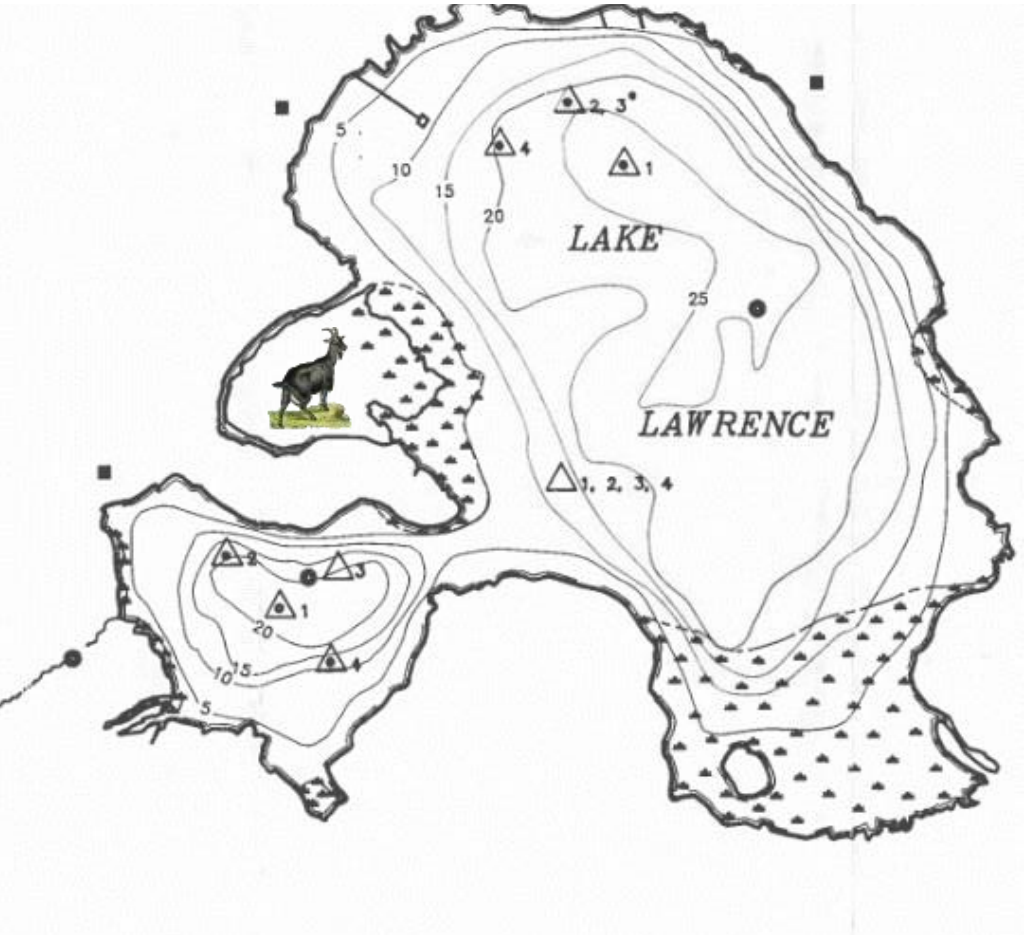



## Deschutes River Flooding & Sedimentation

Diversion dam allowed river sediment to settle in the lake & lake levels to rise (inundate shores) for >20 years

Inputs from historical river flooding into lake




# KCM Recommendations

1. Dredging in both basins*
   - Prohibitively high cost ($250M in 2022 USD)
2. Harvesting of aquatic plants
3. Sediment covers & grass carp for additional aquatic plant control, as desired
4. Watershed pollution control (education, treatment, BMPs)

*Other measures (e.g., alum treatment) were estimated to be less effective at meeting lake use goals and would not last as long.

# What Are We Going to Do?

# Water Quality Monitoring Goals

1. ***What are the current water quality conditions and plankton dynamics in Lake Lawrence?***

2. ***Have the water and phosphorus budgets changed since 1990? (particularly sediment release)***

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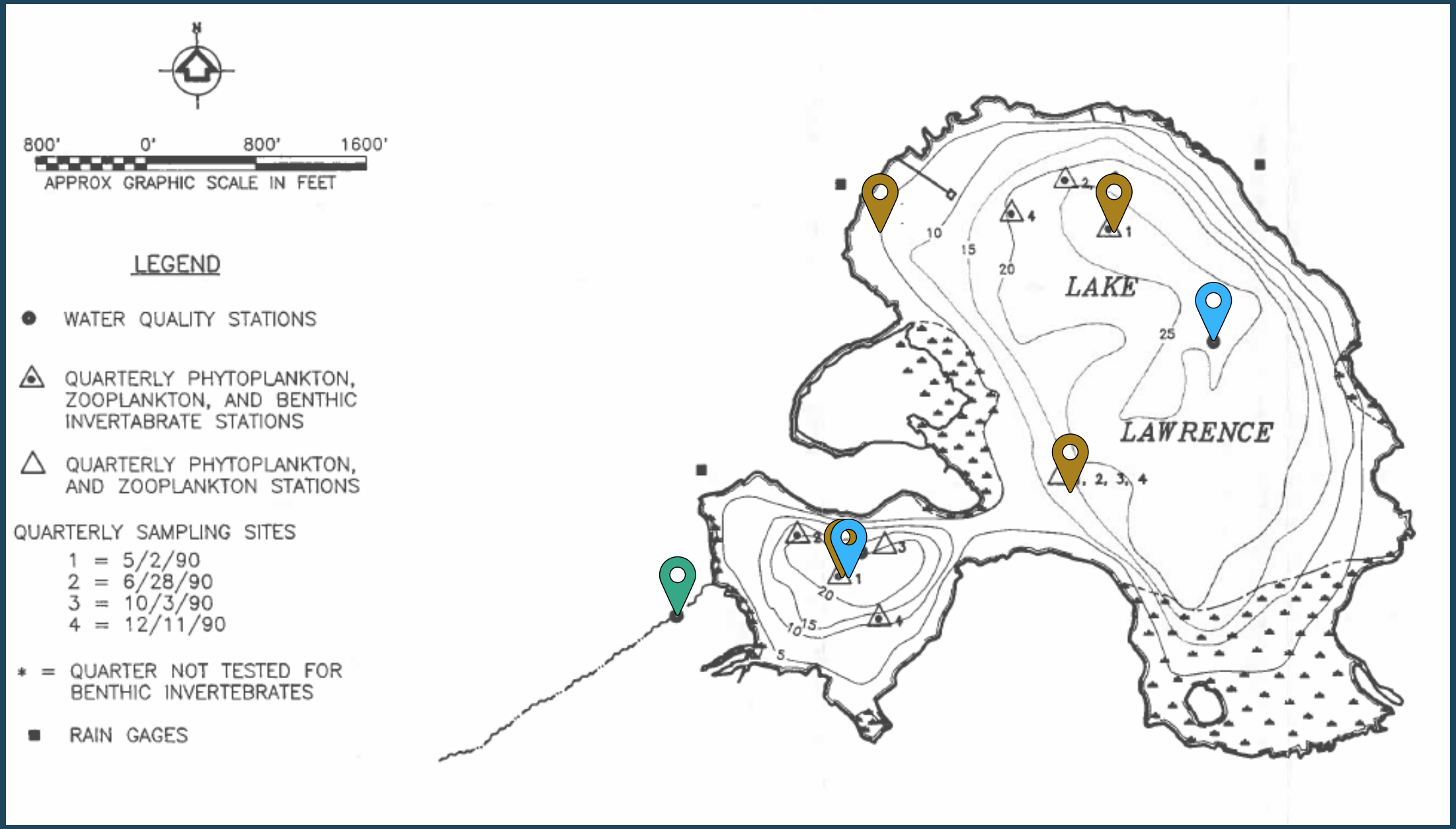
# Water Quality Monitoring Draft Plan

1. ***Revisit KCM (1991) Monitoring Sites or similar***
2. ***Lake water quality monitoring, in both basins, October 2024-October 2025***
   - *Profiles (temperature, dissolved oxygen, pH, conductivity)*
   - *Total and dissolved Phosphorus and Nitrogen at lake surface and bottom*
   - *Chlorophyll-a at lake surface*
   - *Algae ID at lake surface*
   - *Lake use observations (swimmers, anglers, waterfowl)*
3. ***Lake level monitoring***
4. ***Lake inlet + outlet monitoring Oct 2024-Oct 2025***
   - *Total Phosphorus*
   - *Discharge*
5. ***Lake sediment sampling Sept 2024***
   - *Phosphorus fractions, iron, solids*

Have a boat? Willing to volunteer it? Let us know!


800' 0' 800' 1600'
APPROX GRAPHIC SCALE IN FEET
LEGEND
WATER QUALITY STATIONS
QUARTERLY PHYTOPLANKTON, ZOOPLANKTON, AND BENTHIC INVERTABRATE STATIONS
QUARTERLY PHYTOPLANKTON, AND ZOOPLANKTON STATIONS
QUARTERLY SAMPLING SITES
1 = 5/2/90
2 = 6/28/90
3 = 10/3/90
4 = 12/11/90
* = QUARTER NOT TESTED FOR BENTHIC INVERTEBRATES
RAIN GAGES
LAKE
LAWRENCE
10
15
20
25
5

Or similar

# Water Quality Monitoring Plan

***What will this tell us?***

- *Have there been any substantial changes in water quality in the lake or watershed?*
- *Has the internal phosphorus load changed?*
- *Which management methods are likely to be effective?*
- *Where are further investments necessary?*

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# Lake Cyanobacteria Management Plan

9/22/2023 Sentinel-2

# Lake Cyanobacteria Management Plan

***Near- and long-term actions to manage water quality in line with identified goals and objectives.***

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# Watershed Management Strategies

1. OSS Inspections, repair, replacement
2. Pollution reduction (e.g., pet waste, fertilizers)
3. Agricultural and forestry BMPs (erosion control)


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Healthy Shore

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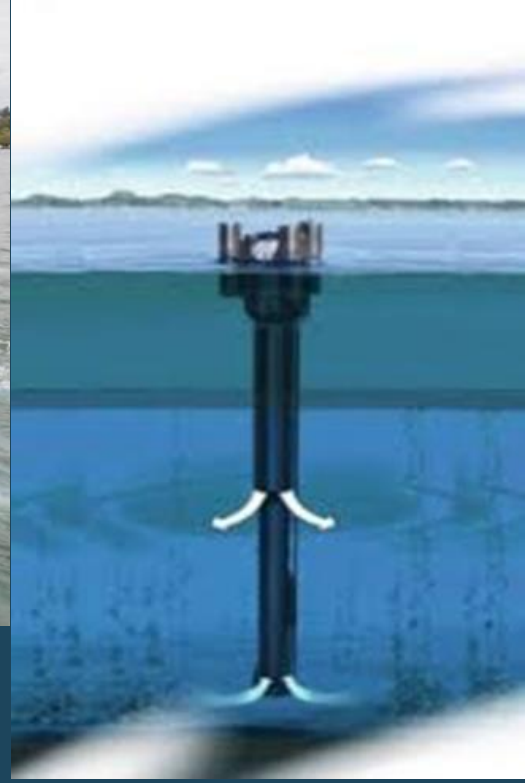
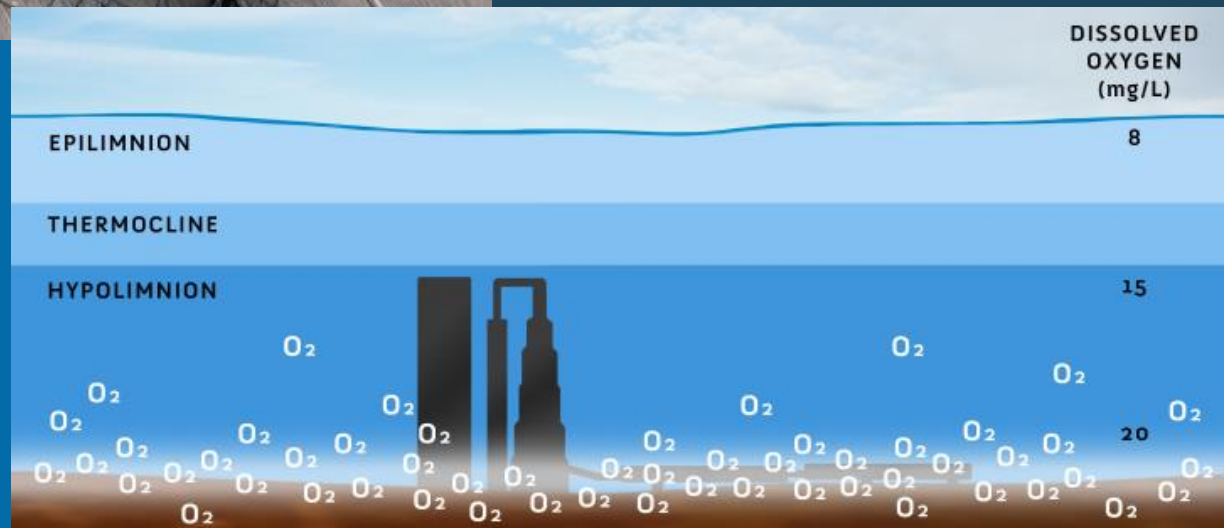
# In-lake Management Strategies

1. Phosphorus Inactivation
   - Alum
   - Lanthanum
2. Hypolimnetic oxygenation
3. Biomanipulation
   - Fish removal
4. Lake Circulation
   - Surface or whole
   - Aeration



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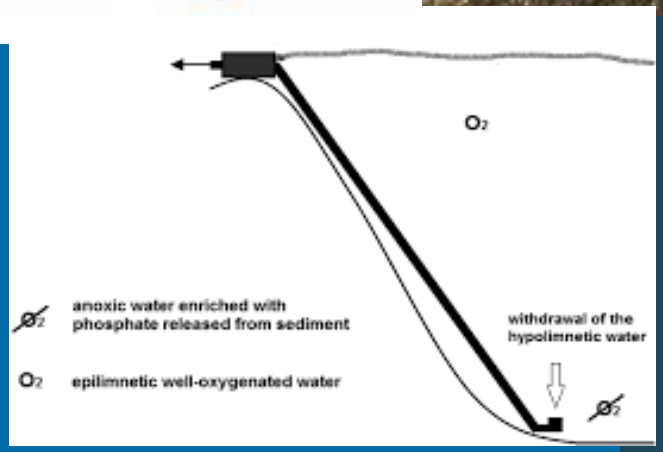
# In-lake Management Strategies

5. Dilution/Flushing
6. Hypolimnetic withdrawal
7. Drawdown
8. ~~Dredging~~
9. Algaecides
10. Other Experimental Approaches:
    - Microbes/Enzymes
    - Barley Straw
    - Dye
    - Nanobubbler

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# Lake Cyanobacteria Management Plan

*Plan Components:*

1. **Background Information**
   - Lake Lawrence and Watershed History
   - Current Management Actions
   - Current Water Quality Conditions
2. **LCMP Goals, Objectives, and Success Measures**
3. **Monitoring Study Findings**
4. **Water and Phosphorus Load Models**
5. **Recommended Management Actions and Sequencing** *(including costs)*
6. **Adaptive Management Framework**
7. **Appendices**

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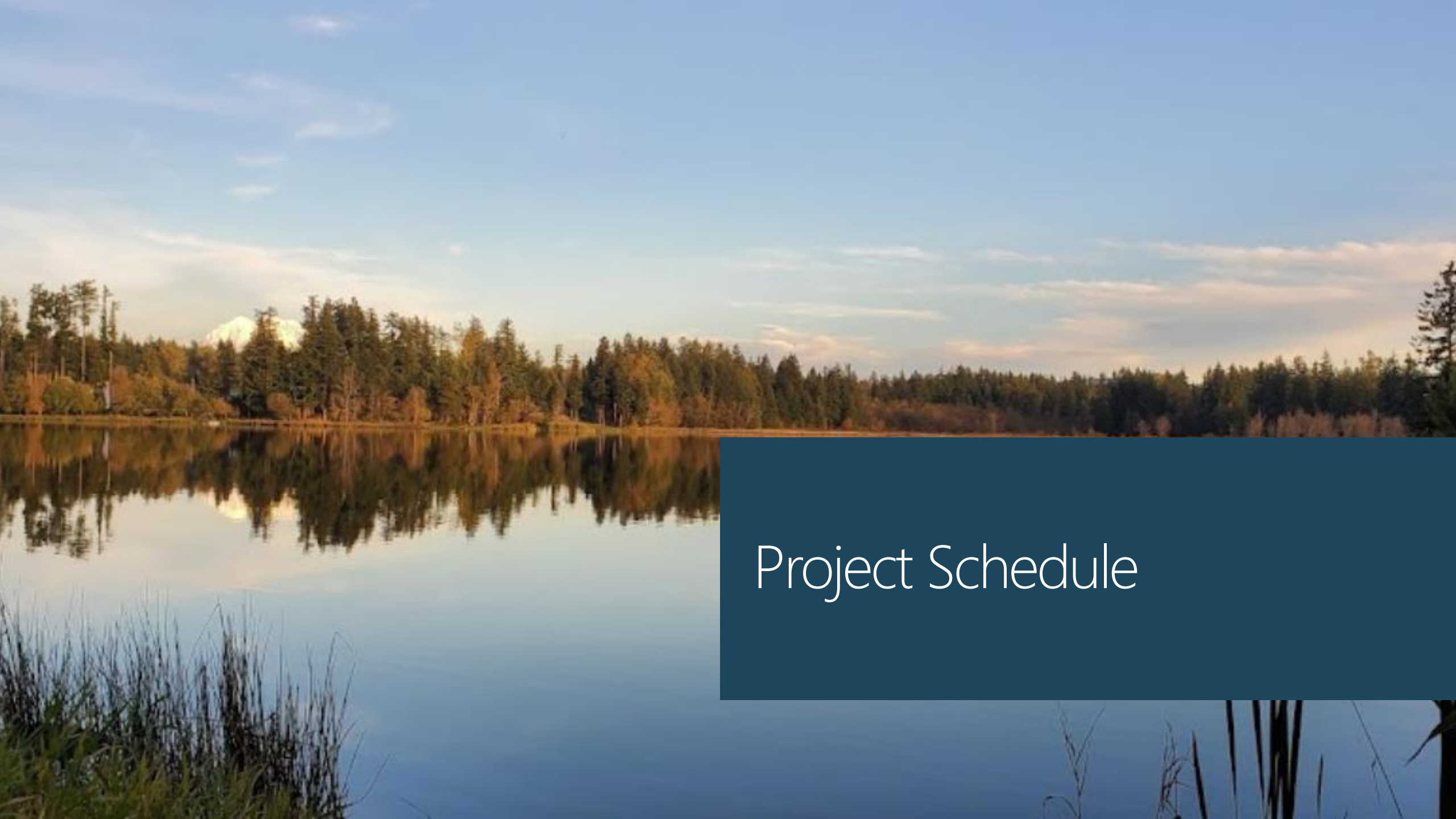

# Project Schedule

# Project Schedule

| Project Step | Action | Period |
|---|---|---|
| **Lake and Watershed Monitoring** | Develop Monitoring Plan (QAPP) | October 2024 |
| | **Public Meeting**: Project Overview and Monitoring Plan | Today! |
| | Lake and Watershed Monitoring | Oct 2024 to Oct 2025 |
| | **LMDSC/TC Meeting**: Monitoring Update with LMDSC | May 2025 |
| **Lake Cyanobacteria Management Plan** | **LMDSC/TC Meeting:** P Budget Results, Potential Management Actions | December 2025 |
| | Pre-Draft Plan for County & LMDSC review | March 2026 |
| | **Public Meeting**: Present Draft Plan | April 2026 |
| | Draft Plan for Ecology & Public review | April 2026 |
| | **Final Meeting**: Present Final Plan | June 2026 |
| | Deliver Final Plan | June 2026 |

# Thank you!

## Questions? Ready to Volunteer?

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