Outline

- Project Contacts
- Introduction to Wakefield Lake
- ***Thoughts/Questions/Concerns***
- About TMDL Studies
- Lake Water Quality and Ecology 101
- Sources of Phosphorus to Wakefield Lake
- Wakefield Lake TMDL
- What are we going to do??
- ***Follow-up Questions***

Wakefield Lake Project Contacts

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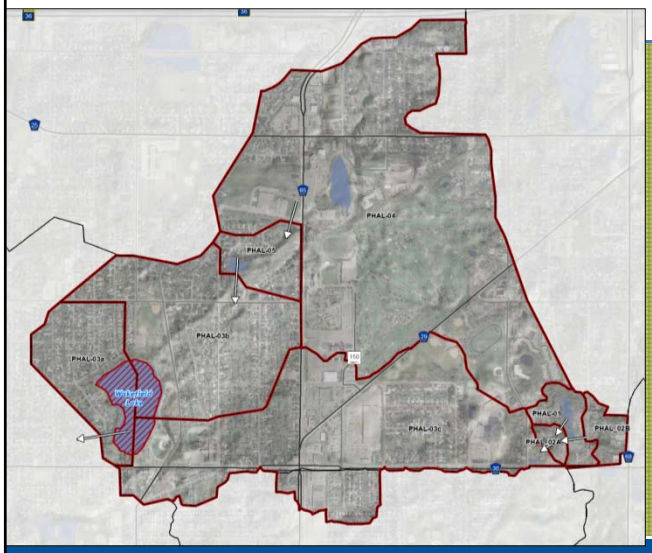
What is a watershed?

A watershed is an area of land from which all of the storm water that it drains flows to the same place—a river, stream or lake.

Source: MPCA

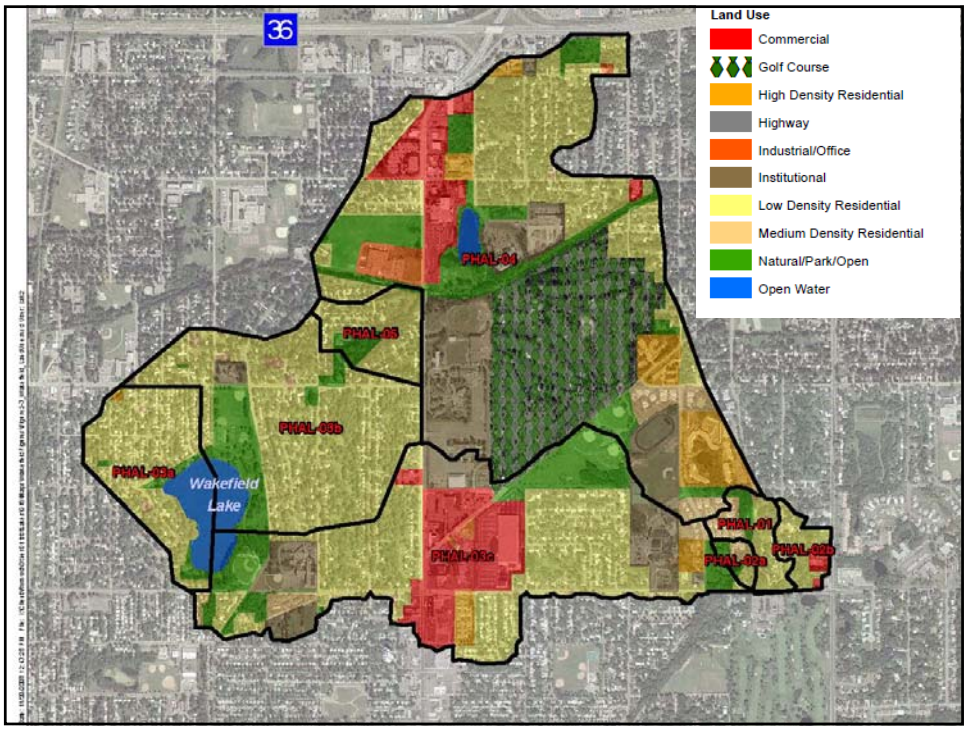
- Topography
- Storm sewer
- Other drainage features

Wakefield Lake Watershed



Watershed Characteristics

- Watershed Area = 944 acres
- Direct Watershed to Lake Surface Area = 43:1
- Varied Land Use – fully developed



Wakefield Lake Characteristics

- Surface Area = 22 acres
- Maximum Depth = 9 feet
- Average Depth = 5 feet
- MPCA – **Shallow Lake**
- Littoral Area (Area with enough light for plants to grow) = 22 acres (100%)
- Dominated by Aquatic Plants
- Mixes many times throughout the summer
- Primarily panfish; no carp observed to date
- Sediment Cores and Fossil Diatom Analysis

What are your thoughts and experiences in relation to Wakefield Lake?

- Do you have any past memories or experiences to share?
- What do you think of when you think of Wakefield Lake?
- What are your concerns?
- Do you have a vision for the lake?

Let's Clarify the Terminology…

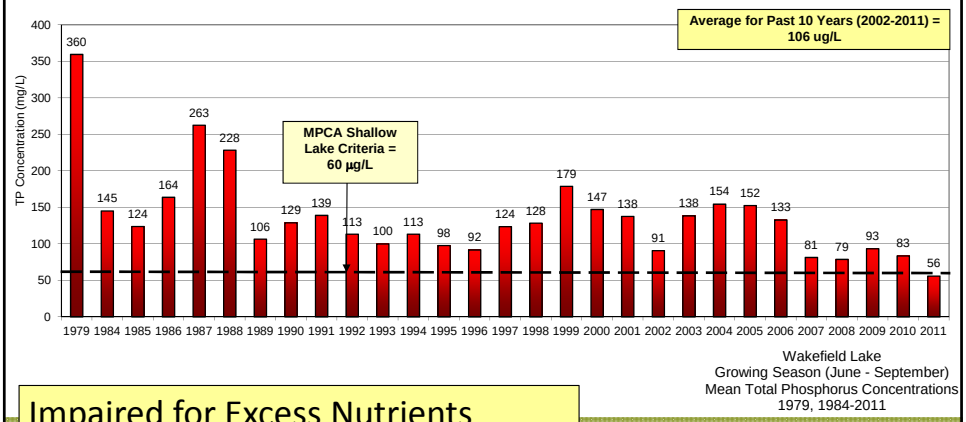
Impaired: When a water body fails to meet standards set by MPCA, it is listed as an impaired on the MPCA 303(d) Impaired Waters List and a Total Maximum Daily Load (TMDL) study is required

- Required by Section 303(d) of the Federal Clean Water Act

TMDL – Total Maximum Daily Load: Water quality study to determine allowable pollutant loading from point and nonpoint sources to lakes/rivers so as to achieve the water quality standards

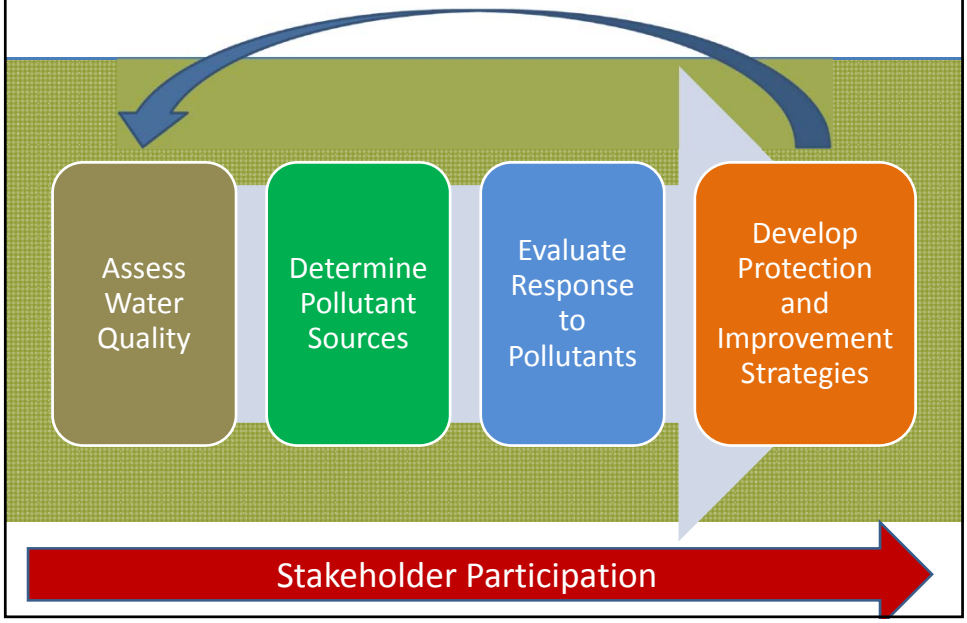
- Approved by both the MPCA and the USEPA

Wakefield Lake Historic Water Quality – Total Phosphorus



Impaired for Excess Nutrients
Listed in 2002

TMDL Study Process



Wakefield Lake TMDL MS4s & Stakeholders

- MS4s:
  - City of Maplewood
  - City of St. Paul
  - City of North St. Paul
  - Ramsey County

And ALL of you!!

- Technical Stakeholders (TAC):
  - MPCA
  - MDNR
  - BWSR
  - MetCouncil
  - RWMWD
  - Ramsey Conservation District

TMDL study focuses on excess nutrients

The Problem: Cultural Eutrophication

"The accelerated **increase in concentrations of nutrients, primarily phosphorus** and nitrogen, in a lake as a **result of human activities** in the watershed"

Water Quality Parameters:
- Total Phosphorus (TP)
- Chlorophyll a (Chl a)
- Secchi Disk Transparency (SD)

Where does the phosphorus come from?

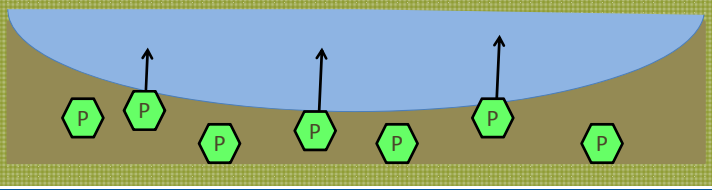
External Sources

- **Stormwater runoff from hard (impervious) surfaces**
- Soil erosion
- Pet/animal waste
- Leaves & grass clippings
- *Fertilizers*
- *Septic systems*
- *Point discharges*

Where does the phosphorus come from?

Internal Sources

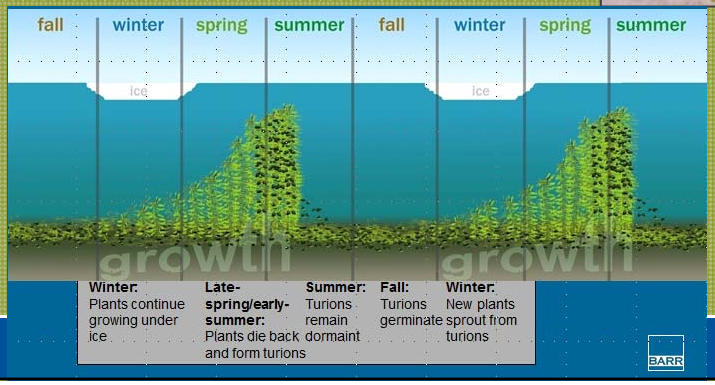
- Phosphorus can be stored in lake bottom sediments and released when oxygen levels are low
- Bottom sediment can also be re-suspended and bring phosphorus into the water column



Where does the phosphorus come from?

Internal Sources

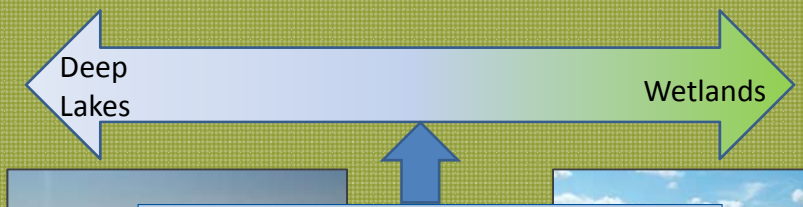
- Die-off of aquatic plants releases phosphorus to the lake water

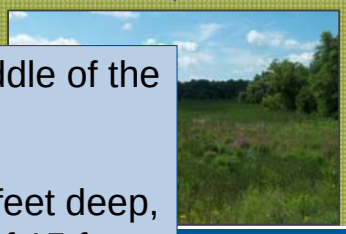


Lake ecology: Shallow vs. Deep Lakes

Lake ecology

There is a wide spectrum between deep lakes and wetlands



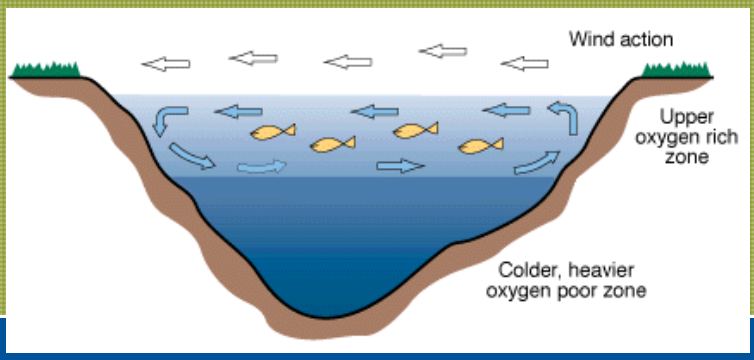


Shallow lakes fall in middle of the spectrum

Generally less than 10 feet deep, with maximum depth of 15 feet

Shallow versus deep lakes

During the summer, deep lakes thermally stratify, separating into layers based on temperature



Graphic from Fin Farm LLC (http://www.finfarm.com/aeration.php)

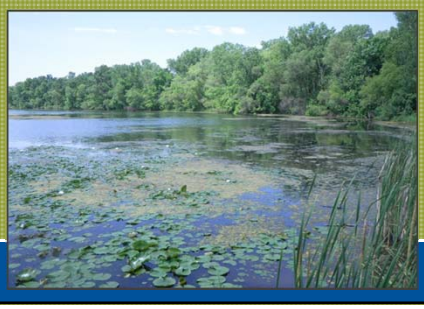
Shallow versus deep lakes

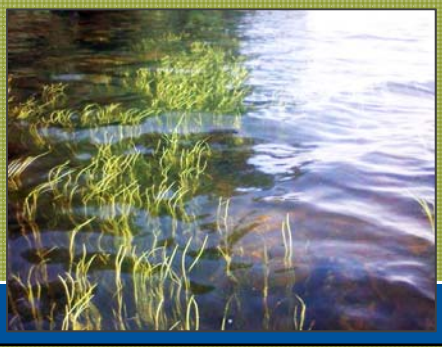
Shallow lakes do not form stable, distinct thermal layers

- Layers mix frequently throughout summer
- Phosphorus released from bottom sediments will mix throughout summer

Shallow lakes have two typical states

1. **Healthy, clear water state**
   - Lush and diverse aquatic plant population
   - Balanced, healthy ecosystem
   - Clear water



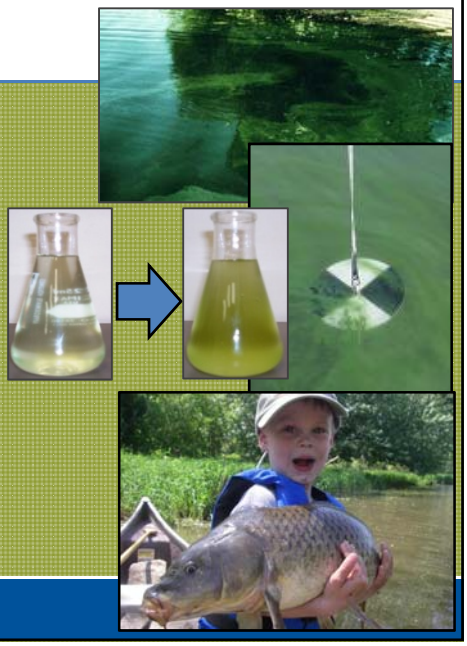


Shallow lakes have two typical states

2. **Turbid State (Algal-Dominated)**
   - Algae and sediment prevent aquatic plant growth
   - Without aquatic plants, water stays cloudy
     - Poor habitat for diverse fish & invertebrate population
     - Wind and bottom feeding fish re-suspend sediment

Excess phosphorus fuels Eutrophication

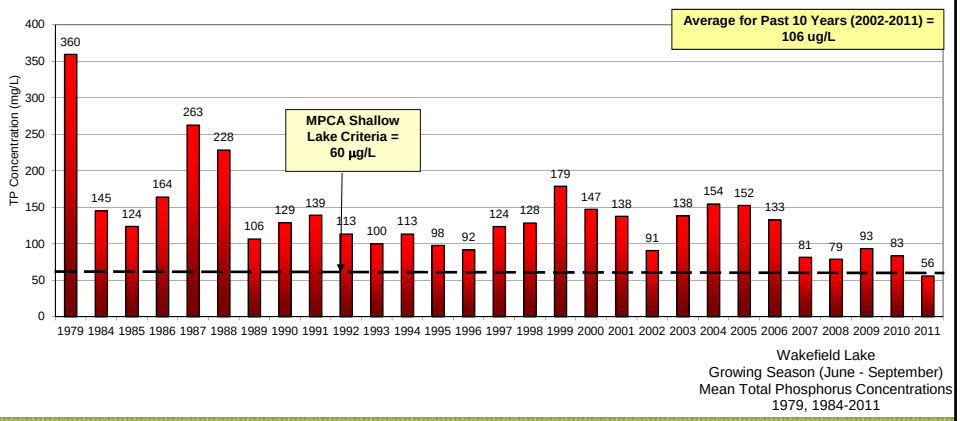
- Phosphorus feeds algae and causes **algal blooms**
- Algae **decreases water transparency (or clarity)**
- **Loss of dissolved oxygen** in water near the lake bottom
- **Shift in the lake ecosystem**
  - Fewer Plants
  - Impacts on Zooplankton
  - Shift in fish species from gamefish to fish species tolerant of low oxygen levels (carp & bullheads)



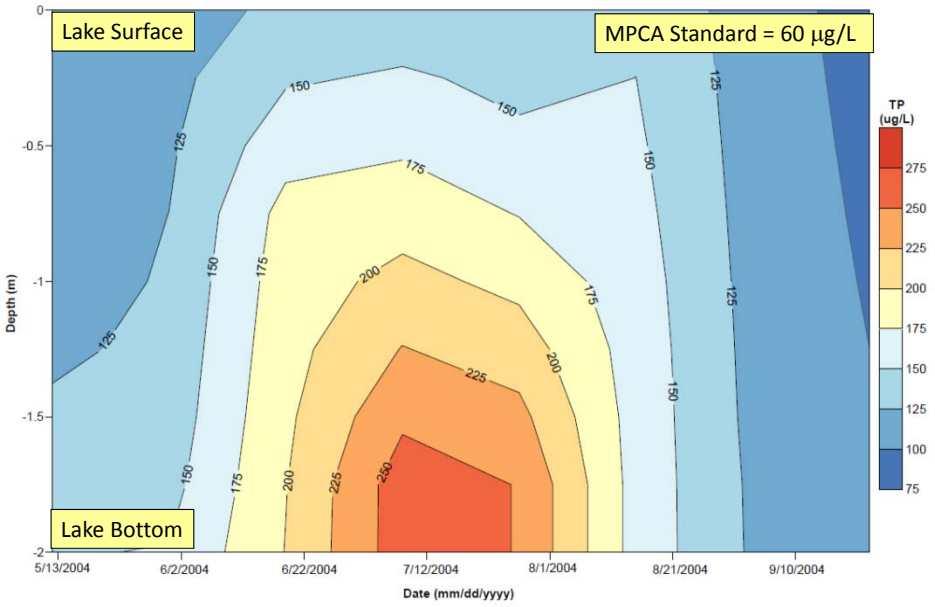
TMDL Estimation Methods – Data Review

- Review monitoring data – What does this data tell us?
  - Water Quality
  - Sediment Data
  - Aquatic Plants
  - Fishery

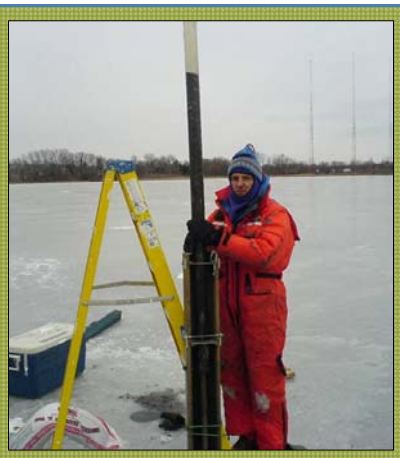
Wakefield Lake Historic Water Quality – Total Phosphorus



Total Phosphorus in Wakefield Lake (2004)



Sediment Cores



- Bottom Sediments - Potential to Release Phosphorus
- Fossil Diatom Analysis - Significant changes in sediment composition and rate since the early 1800's; transitions from mesotrophic to eutrophic since European settlement

Aquatic Plants

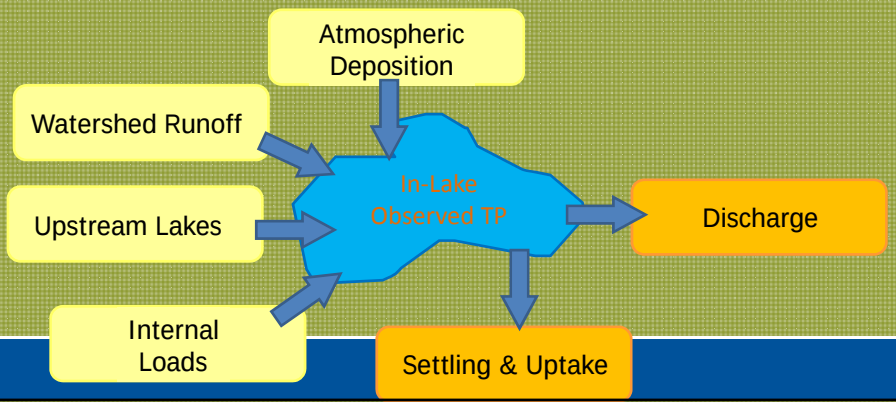
- Aquatic Plant Surveys – 2008 & 2012
  - Dominated by Aquatic Plants (96-99%)
  - Most Common:
    - Coontail
    - Filamentous Green Algae
  - Curlyleaf Pondweed is Present

Fishery

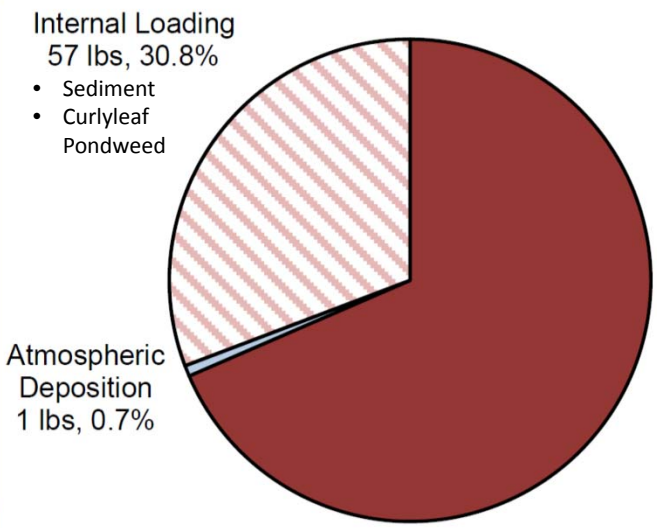
- Surveyed by the MDNR in 2006 & 2011
- Stocked by the MDNR
  - Fishing in the Neighborhood Program
- Primarily panfish species
- Black bullhead abundant
- No carp

TMDL Estimation Methods – Modeling

- P8 Modeling to estimate watershed runoff loads
- In-Lake Mass Balance Modeling calibrated to actual water quality (total phosphorus) data in the lake

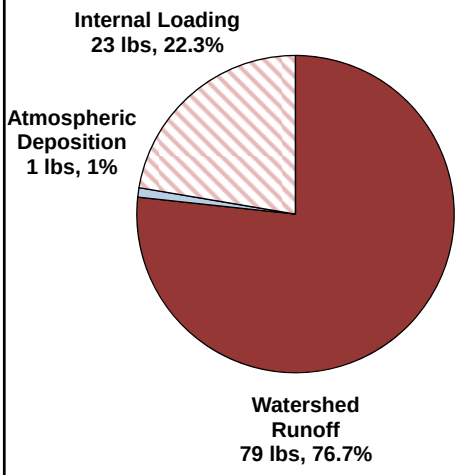


Wakefield Lake Existing Conditions Growing Season Phosphorus Budget



Existing Total Phosphorus Load (lbs)	186
Average TP Concentration (ug/L)	154
MPCA Standard (ug/L)	60

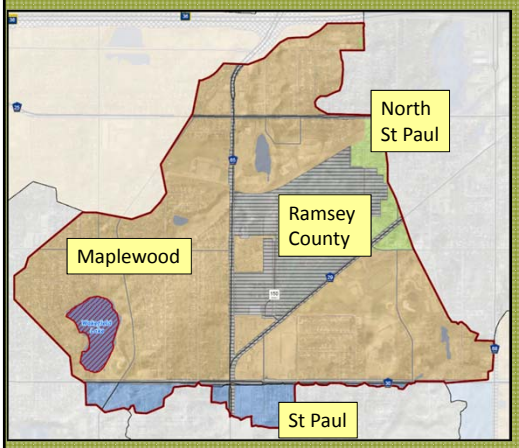
Wakefield Lake TMDL: Growing Season Phosphorus Budget to Meet Standards



Total Phosphorus Load (lbs)	186 →	103
Average TP Concentration (ug/L)	154 →	60
MPCA Standard (ug/L)	60	60

Source	Phosphorus Reduction Needed to Meet the MPCA Water Quality Standards
Watershed Load	38%
Atmospheric Deposition	0%
Internal Load	60%
Total Load	***45% (83 lbs)***

So what can we do to reduce the phosphorus load to Wakefield Lake?



RWMWD is taking the lead on Implementation (in partnership with the MS4s)

So what can we do to reduce the phosphorus load to Wakefield Lake?

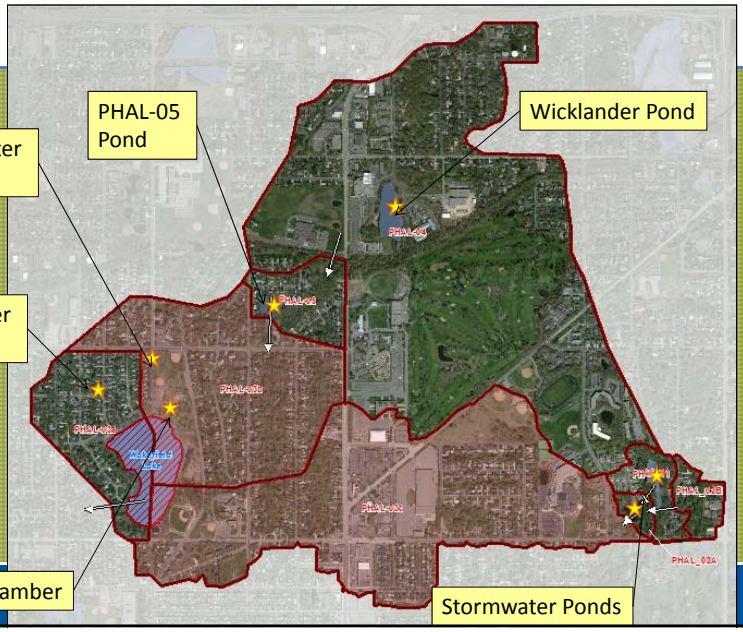
Preferred Implementation Approach:

- First, work on the watershed load
- Then, pursue the internal loading

Phased Implementation:

- Begin now…may take 20 years to complete
- Continue to monitoring water quality

Existing Watershed BMPs



Watershed BMP Maintenance Activities

Recently Completed Projects:

- Dredging of Wicklander Pond (Winter 2013-2014)
- Sediment Removal from Grit Chamber (November 2013)

Other Watershed Activities

Ongoing Activities:

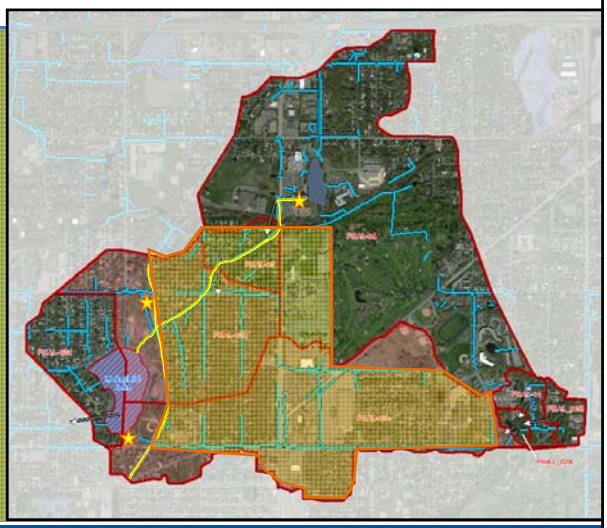
- Street Sweeping
- Public Education and Outreach
- Continued Maintenance of Existing BMPs
- RWMWD permit program – redevelopment and road reconstruction
- **RWMWD BMP incentive program (cost-share)**

RWMWD BMP Incentive Program

Residential Projects: 50-75% Cost Share

Other Potential Watershed BMPs

- Wicklander's Pond Outlet IESF Retrofit
- Inspections along County Ditch 17
- Subsurface infiltration in Wakefield Park
- Retrofits rainwater gardens at sites
- Redevelopment of Prosperity Avenue
- Expansion of the spent lime treatment system



Clean Water Fund Grants

- **2014 Clean Water Fund Grants:** Focus on retrofit opportunities and owner partnerships in commercial and school sites in TMDL watersheds
- Also working with churches

Internal Load Reductions

- Curlyleaf pondweed management
- Alum treatment

Implementation Summary

BMP	Estimated Phosphorus Reduction
Watershed (External) Load Reductions	
Dredging Wicklander Pond	Will achieve the required 38% watershed phosphorus load reduction
Grit Chamber Maintenance	
Wicklander IESF Retrofit	
Wakefield Park Infiltration	
Spent Lime Expansion	
Other Potential Retrofits (rainwater gardens, retrofits with churches, commercial properties, and schools)	
Redevelopment	
Internal Load Reductions	
Curlyleaf Pondweed Mgmt	Will achieve the required 60% internal phosphorus load reduction
Alum Treatment	

Estimated Cost = $1.6 million to $2.8 million

Questions?

Ramsey-Washington Metro Watershed District

resourceful. naturally.
engineering and environmental consultants
BARR