



Medicine Lake TMDL Status Assessment



Prepared for Bassett Creek Watershed Management Commission

April 17, 2025



Outline



- TMDL assessment study overview
- TMDL summary—expectations for internal and external TP load reductions
- Updated water quality monitoring comparison to MPCA standards
- Aquatic invasive species monitoring/control
- Completed BMPs and TP reductions
- Identified gaps between expected and required TP load reductions
- Recommendations for remaining needed water quality improvements



TMDL Assessment Overview

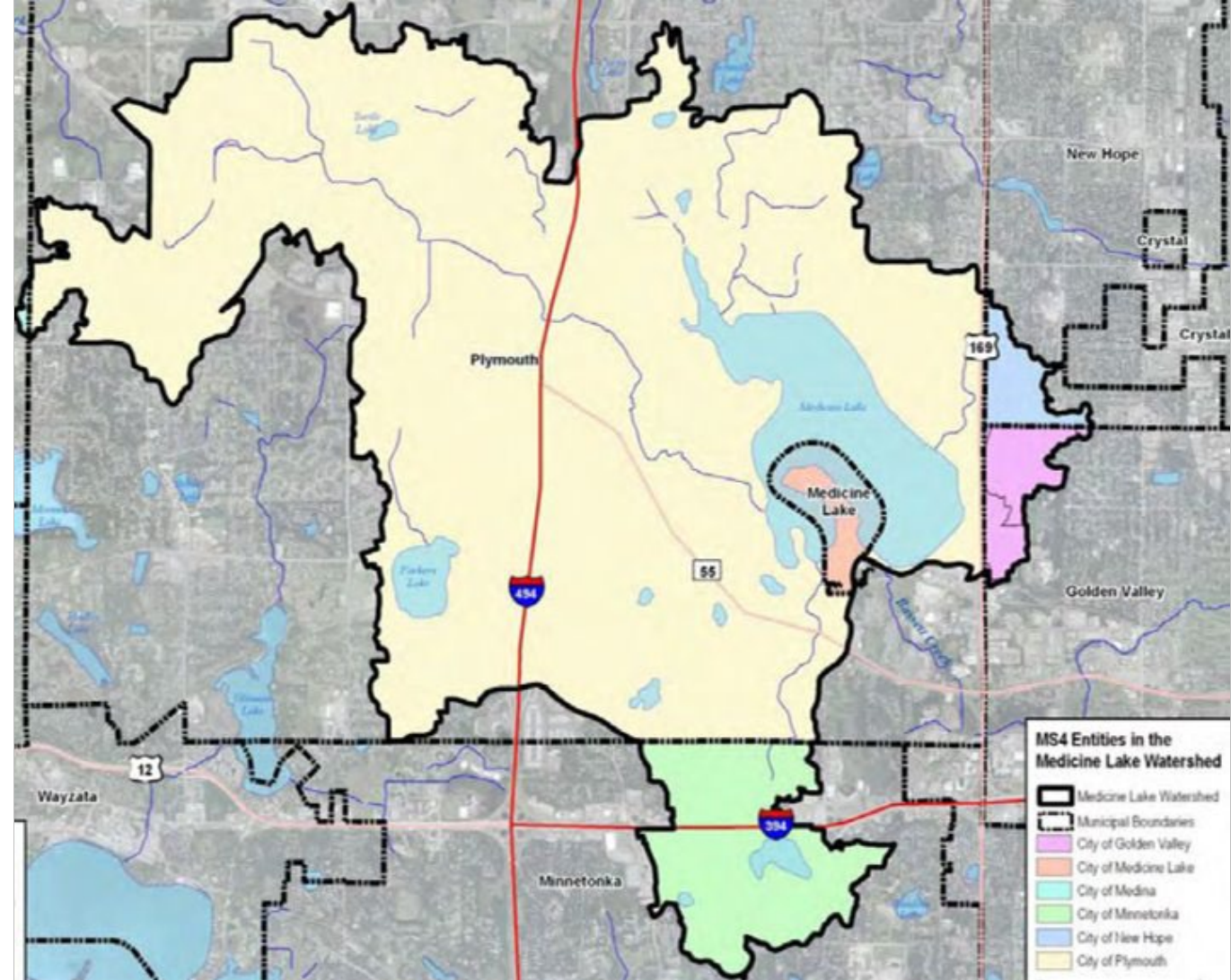


Watershed

- Seven MS4s
- Plymouth and Medicine Lake are direct; rest indirect
- Plymouth represents 83% of watershed area

Total Maximum Daily Load (TMDL)

- Maximum allowable pollutant load that meets water quality standards
 - Pollutant loads assigned to each MS4 (Wasteload Allocation)
 - Internal load and atmospheric deposition



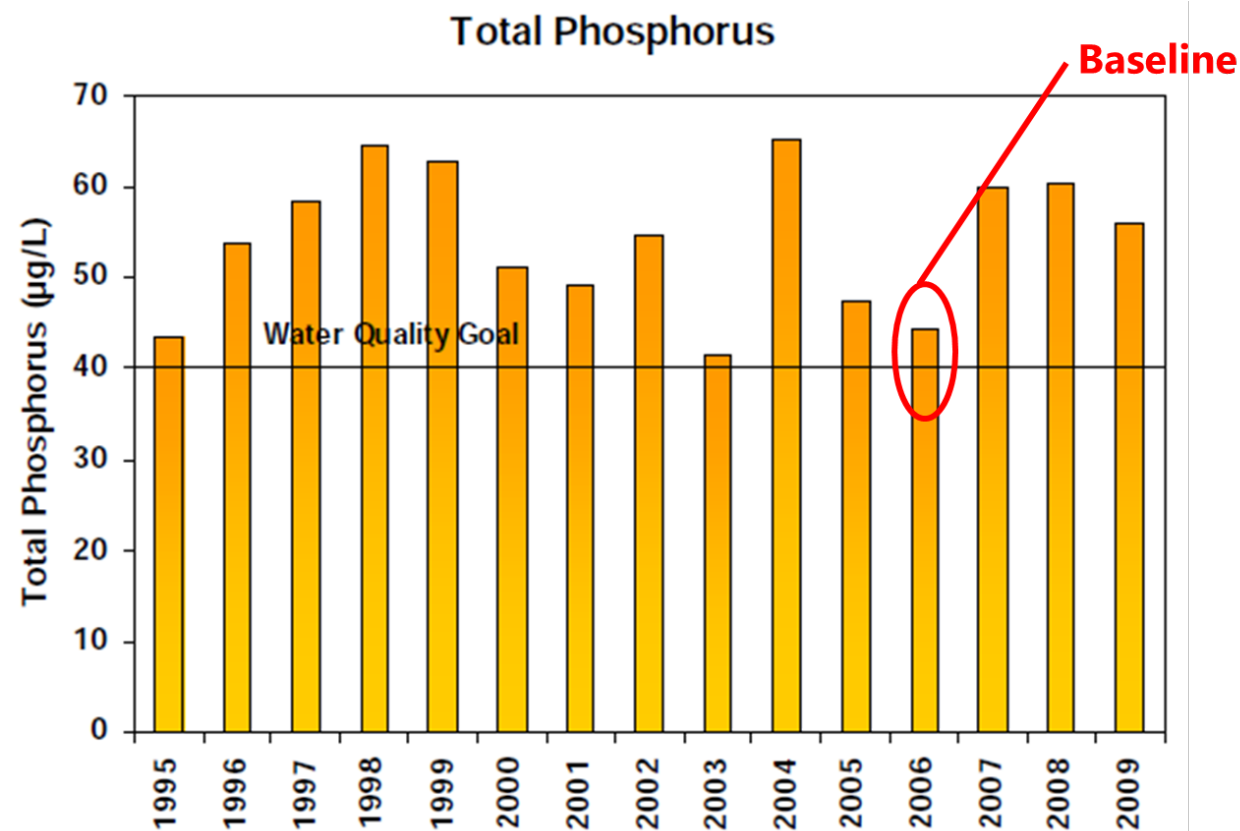
TMDL Summary—expectations for internal and external TP load reductions



TMDL calls for 28% TP load reduction from watershed sources

- Translates to required TP reduction of 1,287 lbs/yr

Internal TP load needs to be controlled at level consistent with 2006



Water Quality Monitoring Comparison to MPCA Standards

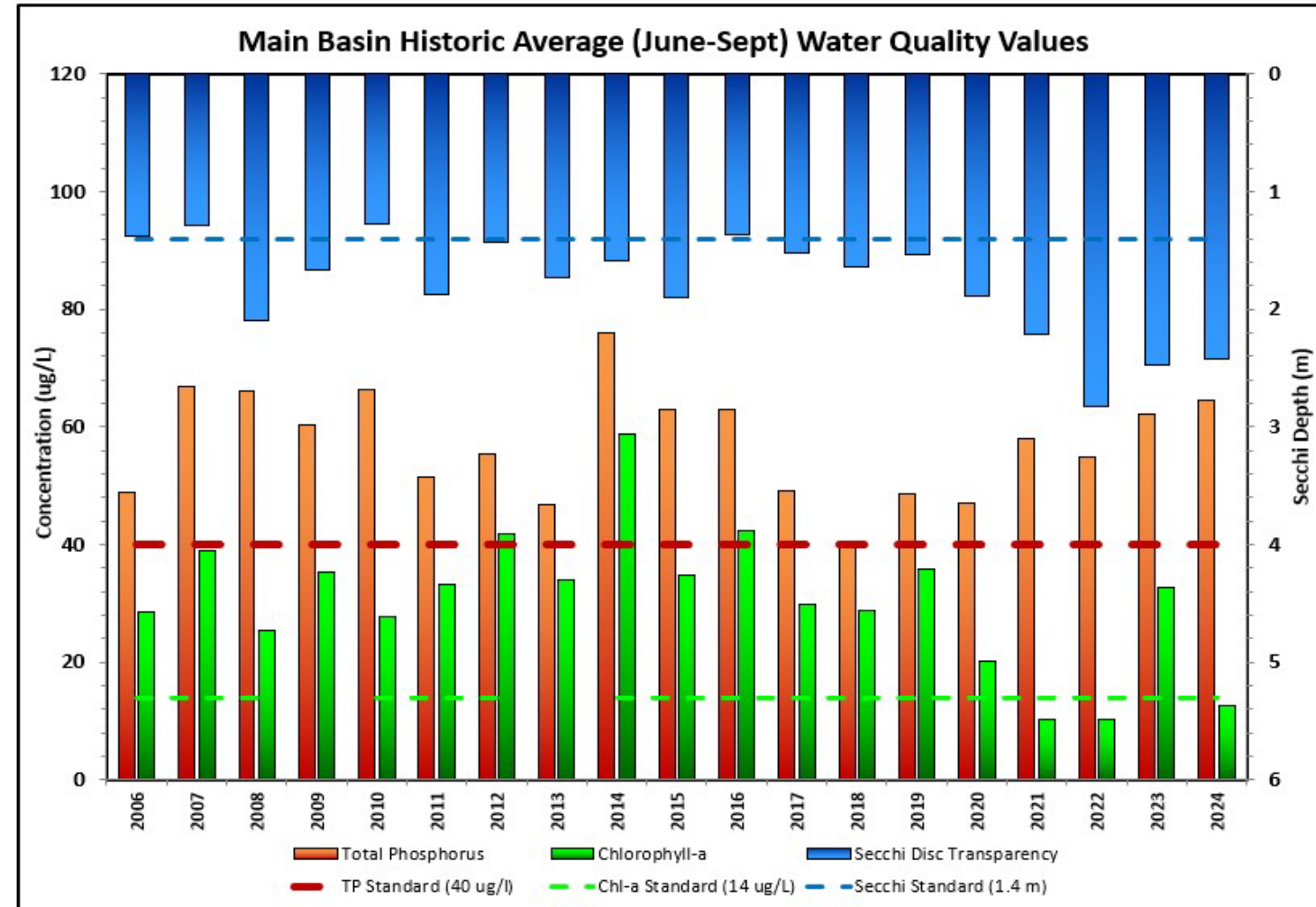


10-Year Averages

- TP
 - 55 µg/L
 - Third higher than 40 µg/L standard
- Chl-a
 - 26 µg/L
 - Almost twice as high as 14 µg/L standard
 - Significant improving trend last 8 years
- Secchi disc transparency
 - 1.98 meters
 - Meets 1.4-meter standard
 - Significant improving trend last 8 years

Most likely delisting scenario

- TP and Secchi disc transparency meet standard

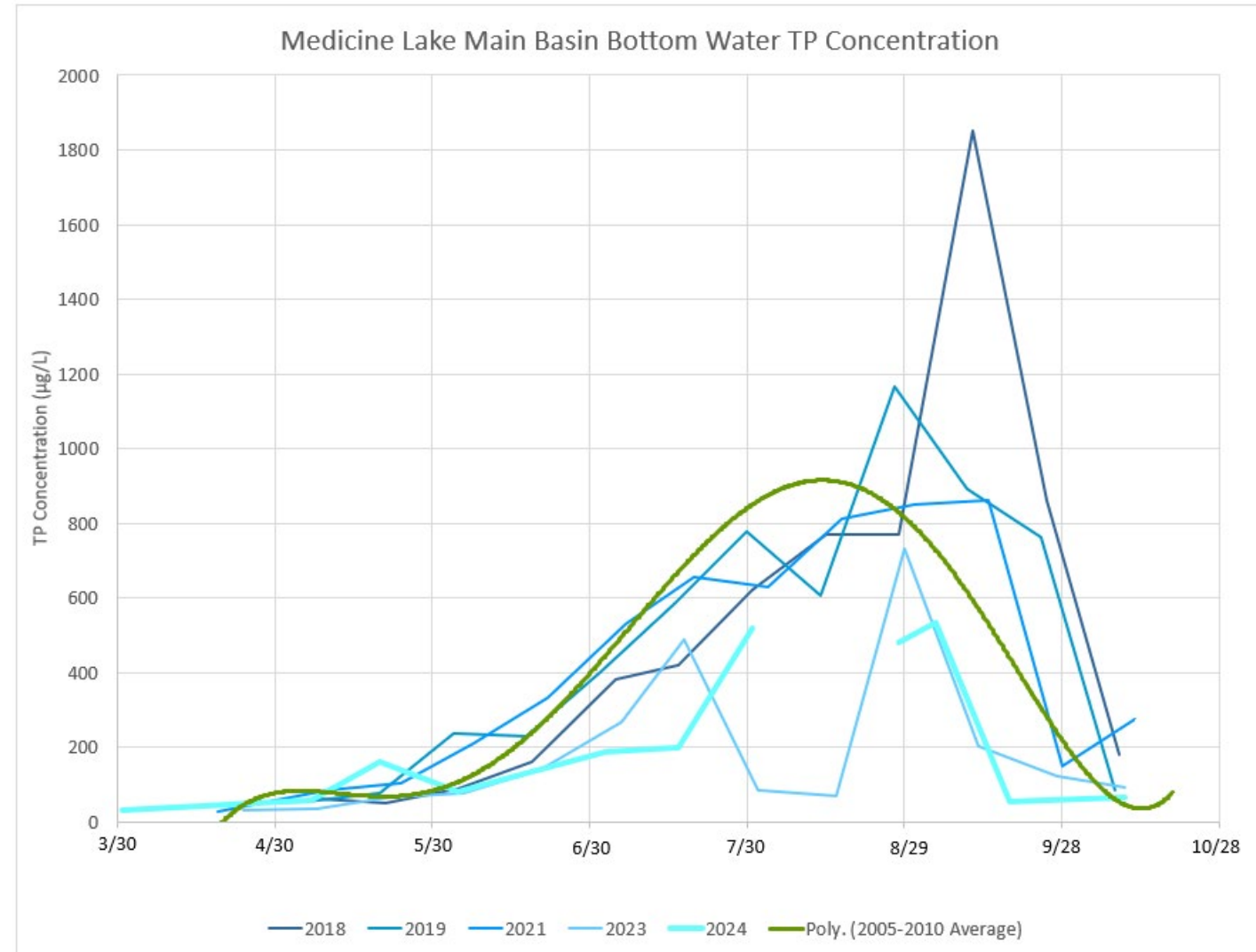


Water Quality Monitoring Comparison to MPCA Standards



Hypolimnetic (bottom-water) TP concentrations are indicator of internal load potential

- Hypolimnetic TP concentrations have not changed since the TMDL was completed
- TP concentrations typically increase during the summer, then drop between late-August and early September as lake starts to mix
 - Contributes to deteriorating surface water quality during latter half of summer
- 2023 had two lower TP concentrations in early August, likely in response to weaker stratification and lower lake levels that led to wind mixing and bottom-water entrainment



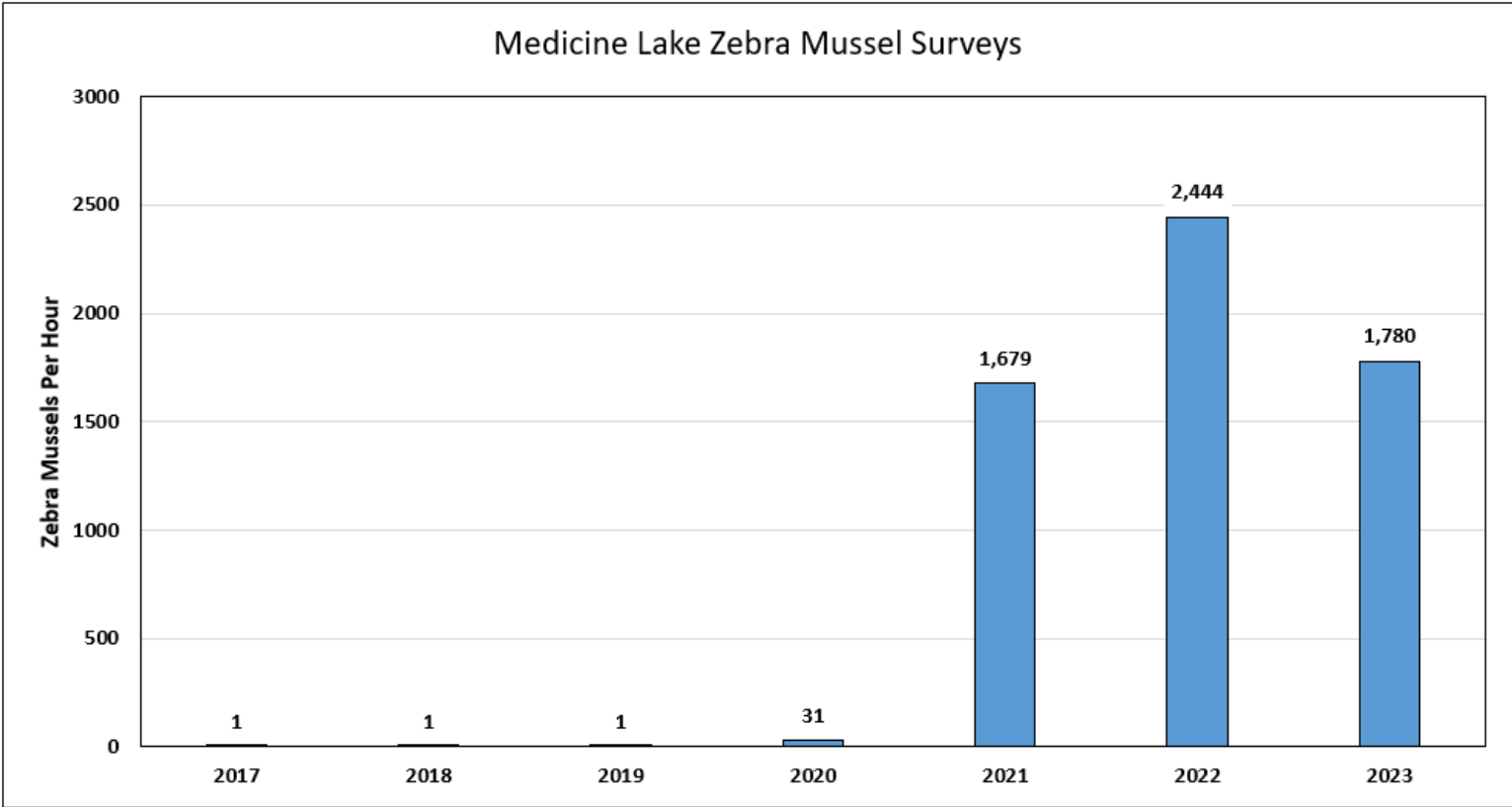
Water Quality Monitoring—Relationship with Aquatic Invasive Species



Curly-leaf pondweed and Eurasian watermilfoil—presence predates TMDL; CLP coverage is typically > than TMDL threshold

Starry stonewort—discovered in 2018; 13% coverage in 2024

Zebra mussels—discovered in 2017; significant impact since 2020



Water Quality Monitoring—Relationship between AIS and Plankton

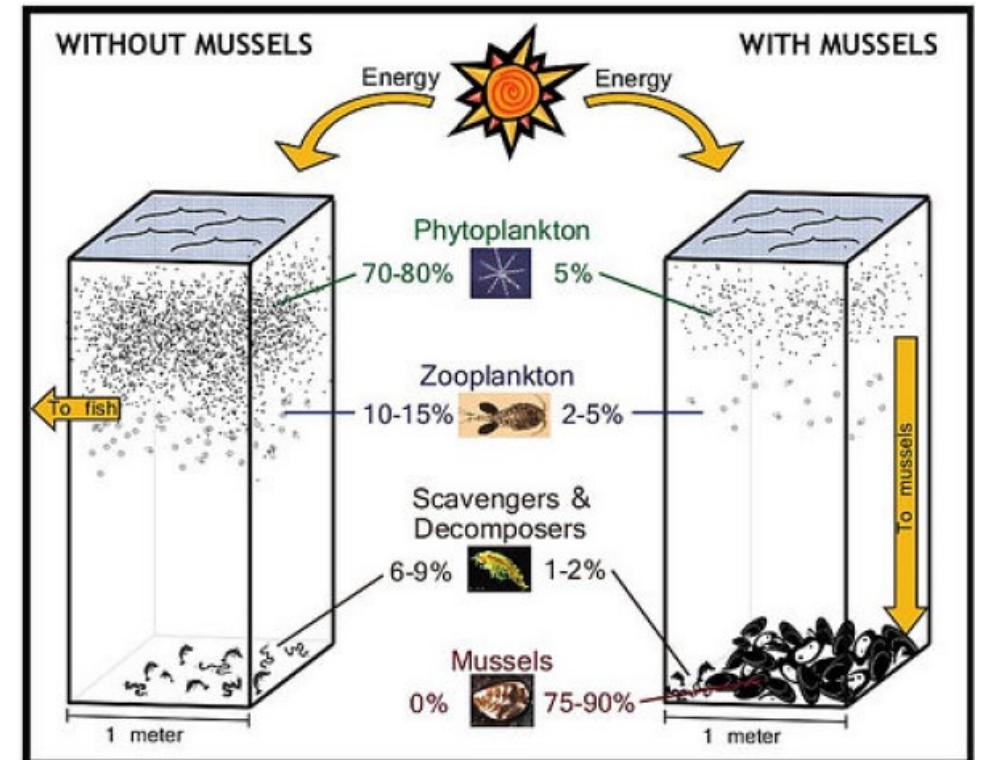


Phytoplankton numbers have been trending down

- Consistent with lower Chl-a concentrations
- Green algae more than order of magnitude lower
- Blue-green algae increase later in summer as TP increases

Zebra mussels consume algae and smaller zooplankton; prefer diatoms, green algae, cryptomonads

Zebra mussels are leaving fewer algae for large-bodied zooplankton, the preferred food for fish



Completed BMPs and TP Load Reductions [P8 Modeling]



Water quality (P8) modeling of post-2006 projects/practices indicates

- Overall TP load reduction is about 400 lbs short of 1,287 lbs per year TMDL requirement
- Combined TP treatment efficiency of all BMPs exceeds 70%, which limits attainability of additional treatment
- BMP TP load reductions are less than monitoring indicates



Table 5-1 Modeled BMP TP Treatment Summary by Watershed Area

Watershed	Total TP Removed by BMPs (lbs/yr) ^[1]	Current Overall TP Treatment Efficiency (%)
Plymouth Creek ^[2]	649.4	71
Ridgedale Creek	47.3	70
Medicine Lake Direct	114.0	71
Medicine Lake NE	18.1	76
Medicine Lake North	60.0	74
Total	888.8	72

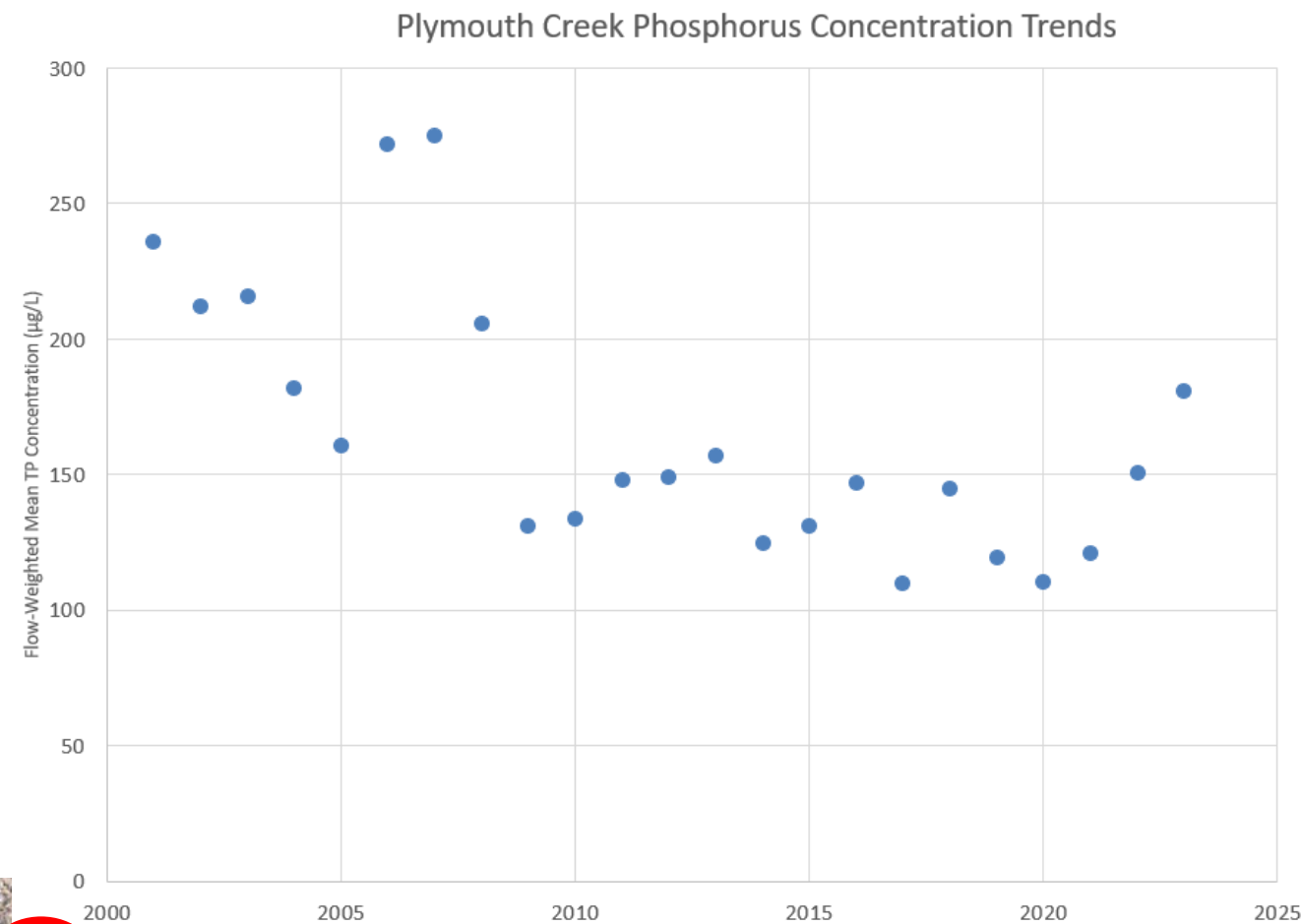
[1] Increased removal based on model changes documented since 2006 TMDL baseline year
[2] Includes Parkers Lake and Parkers Lake East Area watersheds.

Gaps Between Expected and Required TP Load Reductions [Monitoring]



Plymouth Creek tributary

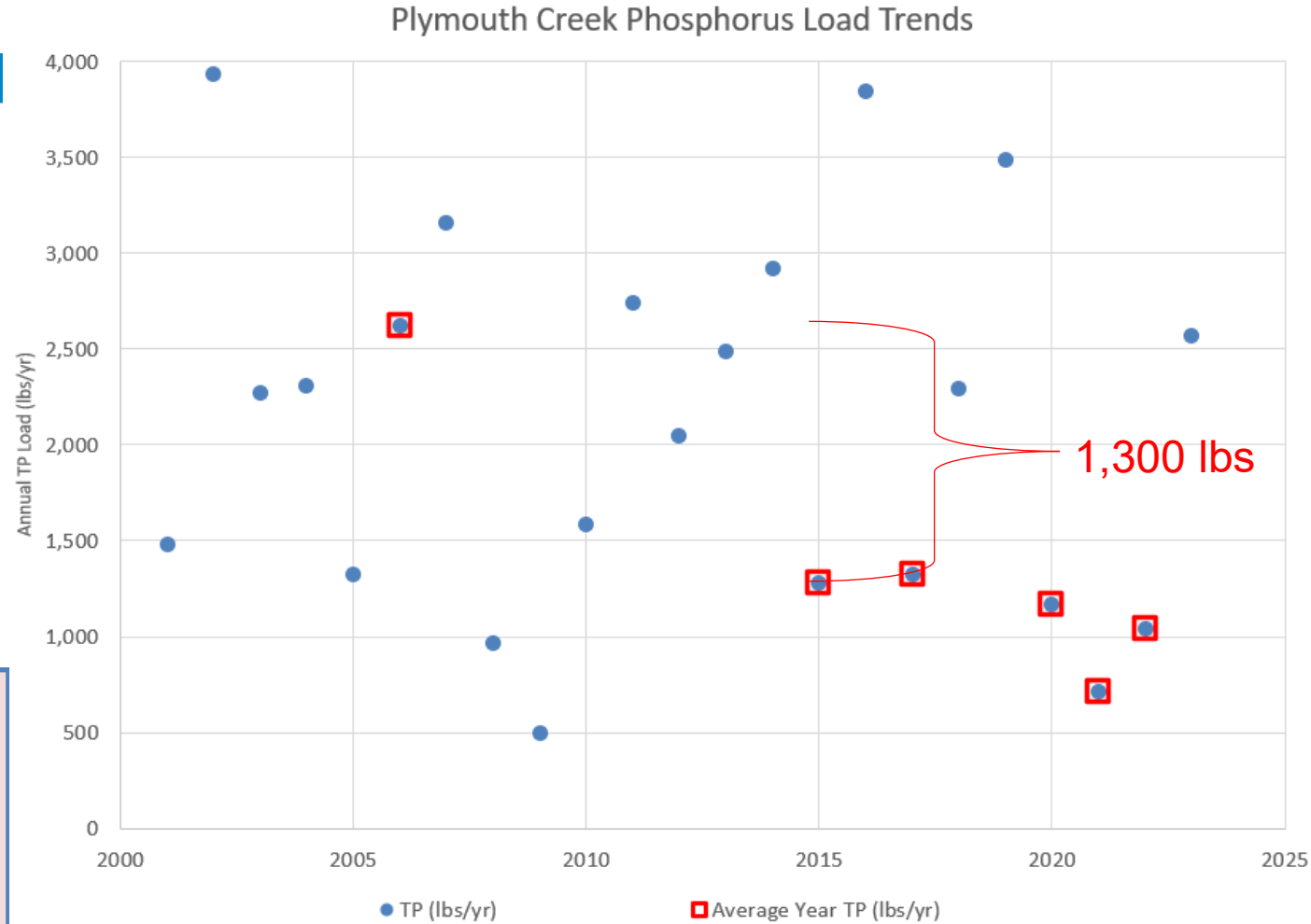
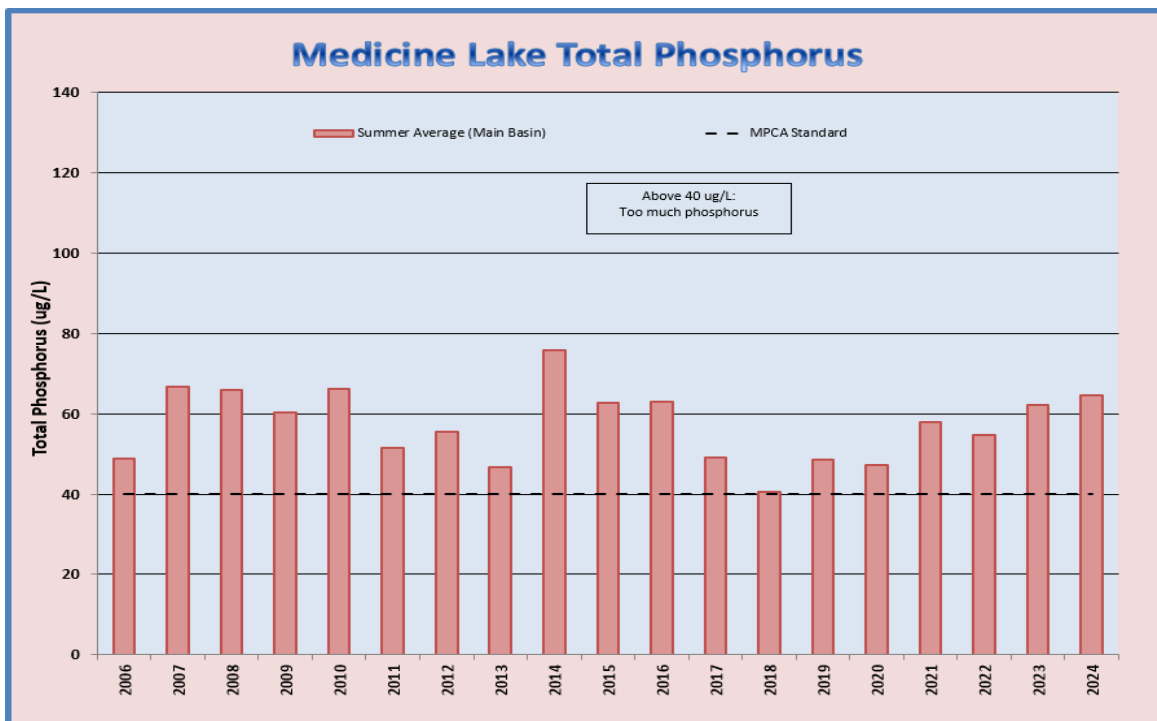
- Contributes more than 50% of the watershed TP load, based on TMDL modeling
- Station has 23 years of monitoring data
- West Medicine Lake Park Ponds project implemented/functioning by spring of 2010
- Recent monitoring shows significantly improved water quality since BMP implementation



Gaps Between Expected and Required TP Load Reductions [Monitoring]



- Flow and TP loads vary more than TP conc.
- “Average” years compared to 2006
- Recent TP loads are 1,300 lbs/yr (or 50%) lower than 2006—both meet TMDL reduction
- Despite watershed BMPs, lake TP hasn’t improved since 2006



Recommendations for Remaining Needed Water Quality Improvements



Are more watershed BMPs needed?

- Significant number and scale of BMPs have been implemented since 2006; maintain existing BMPs
- Street sweeping and some BMPs suitable for direct drainage

Lake water quality is unchanged

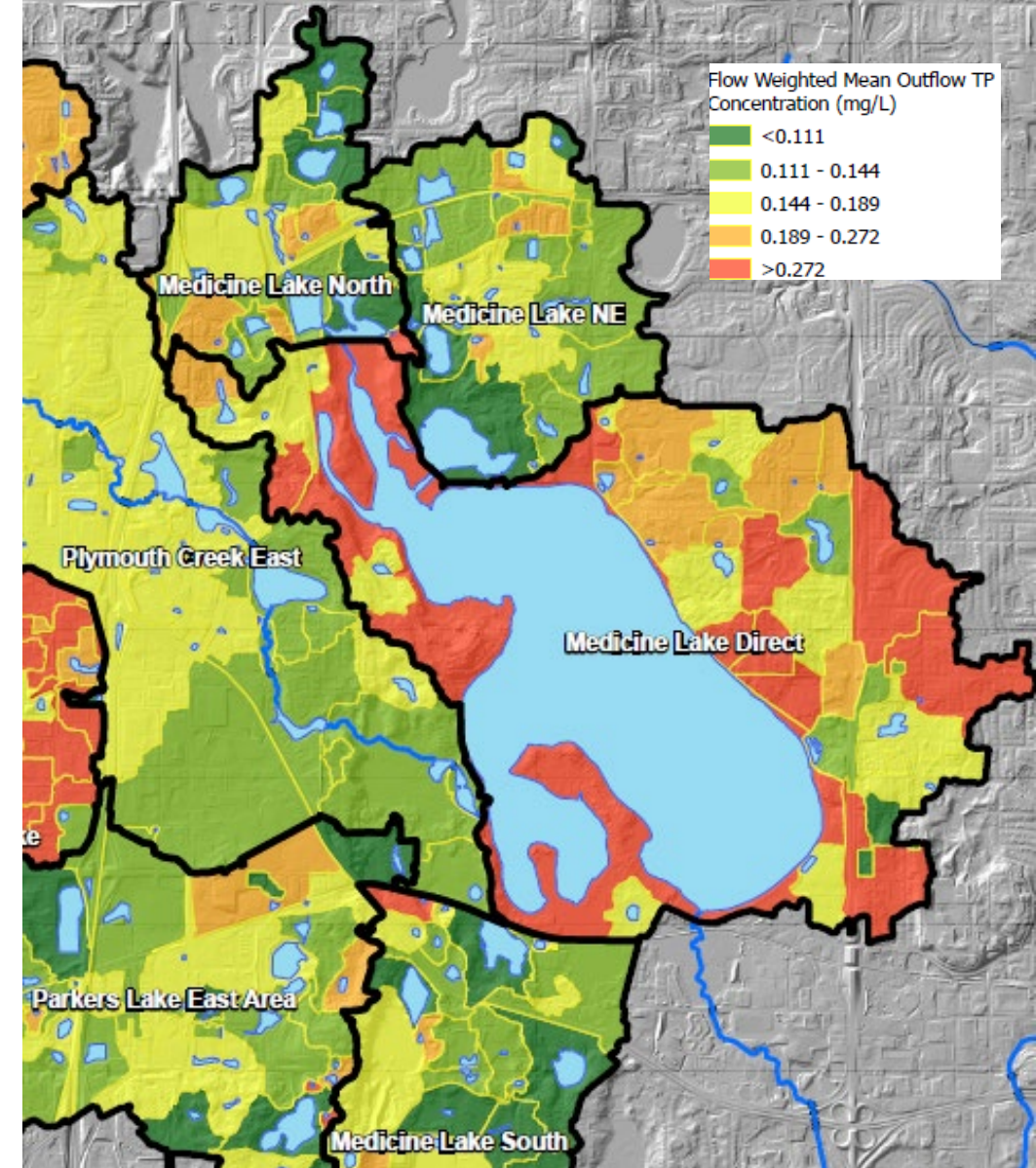
- Internal phosphorus load is primary cause

Alum treatment is recommended

- Plan for 3 phases; costs likely ranging from \$1.5 to \$2 million
- Perform carp study and feasibility study in advance

Adaptive management recommended for

- Curly-leaf pondweed control—Lake Vegetation Management Plan
- Starry stonewort—continued treatment to minimize spread
- Zebra mussels—currently lacking proven/cost-effect product



Questions??



Greg Wilson

gwilson@barr.com

4300 MarketPointe Drive
Minneapolis, MN 55435

Phone: 952.832.2672



TMDL toolkit for MS4 permit compliance

- Overview of models used to meet MS4 TMDL permit requirements
- P8
 - Recommendations and guidance for utilizing P8 to meet TMDL permit requirements
 - Case study for using P8 to meet TMDL permit requirements
 - U of MN P8 training on the use of the P8 software. P8 is a free software package for modeling stormwater runoff. For more information on training, go to this link.
- WINSLAMB
 - Recommendations and guidance for utilizing WINSLAMB to meet TMDL permit requirements
 - Case study for using WINSLAMB to meet TMDL permit requirements
- MIDS (Minimal Impact Design Standards calculator)
 - Recommendations and guidance for utilizing the MIDS calculator to meet TMDL permit requirements
 - MIDS calculator
 - Case study for using the MIDS calculator to meet TMDL permit requirements
- MPCA Simple Estimator
 - Recommendations and guidance for utilizing the MPCA Simple Estimator to meet TMDL permit requirements
 - Guidance and examples for using the MPCA Estimator
 - Case study for using the MPCA Simple Estimator to meet TMDL permit requirements
 - MPCA review of submittals using the MPCA Simple Estimator
 - Default TSS and TP loads for different land use scenarios using the MPCA Simple Estimator
- Monitoring
 - Recommendations and guidance for utilizing monitoring to meet TMDL permit requirements
 - Recommendations and guidance for utilizing lake monitoring to meet TMDL permit requirements
 - Recommendations and guidance for utilizing stream monitoring to meet TMDL permit requirements
 - Recommendations and guidance for utilizing major stormwater outfall monitoring to meet TMDL permit requirements
 - Recommendations and guidance for utilizing stormwater best management practice monitoring to meet TMDL permit requirements
- Quick guides for using models to meet MS4 TMDL permit requirements
- Case studies for monitoring to meet TMDL permit requirements

MPCA’s MS4 Guidance for Assessing TMDL Compliance

P8 Modeling (Section 5)
Monitoring (Section 6)

Water Quality Monitoring—Relationship with Aquatic Invasive Species

