Phosphorus Treatment and TMDL Compliance

Utilities Committee Update

February 9, 2016

In Association with

CH2MHILL

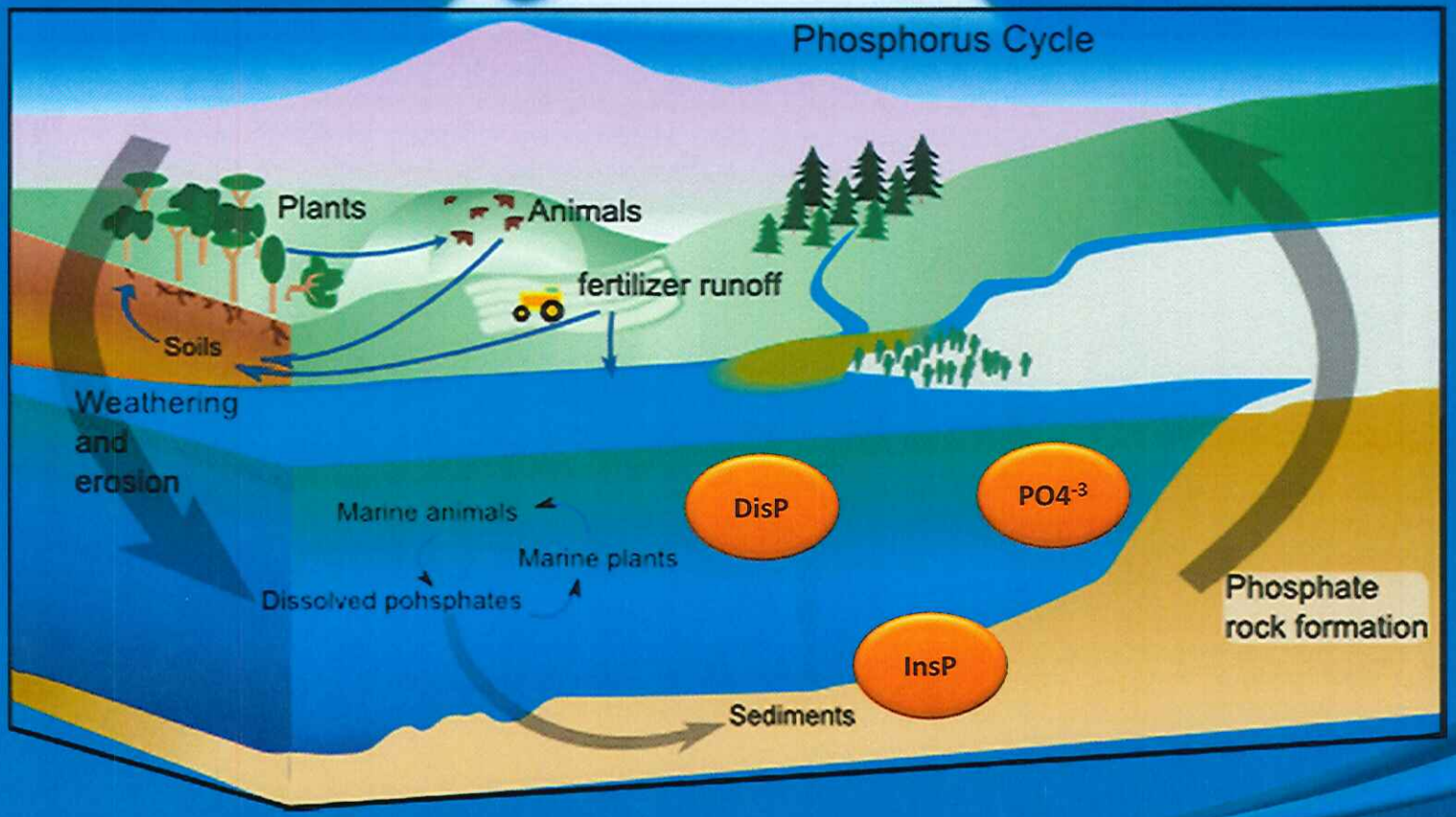
And

McMAHON
ENGINEERS | ARCHITECTS

Agenda

- Phosphorus and TMDL Overview
- AWWTP TMDL Project Overview
- Full Scale Demonstration Results
- Adaptive Management
- Water Quality Trading
- TMDL Compliance Alternatives Cost Summary

Phosphorus Cycle



TMDL = Total Maximum Daily Load

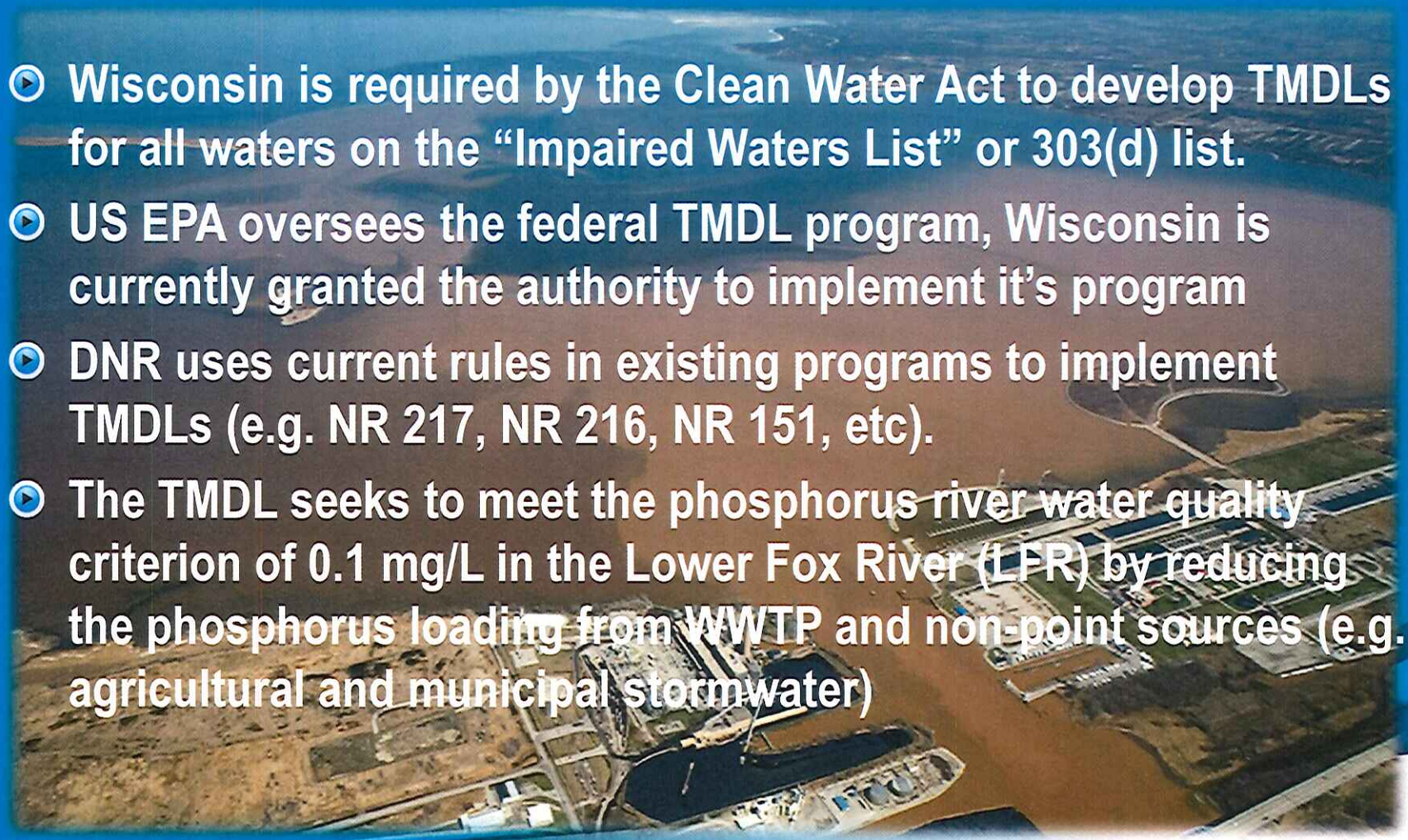
- Phosphorus as a nutrient
- The amount of a pollutant a waterbody can assimilate before exceeding water quality standards.
- Based on targets and allocations; reflects what is needed to meet water resource goals

TMDL – Water Quality Standards

- **Designated Uses**
  - Fish & Aquatic Life
  - Public Health
  - Recreational Uses
- **Water Quality Criteria**
  - Numeric (measured number)
  - Narrative

Rivers	Streams	Reservoirs	Inland Lakes	Lake Michigan
0.10 mg/L	0.075 mg/L	0.030-0.040 mg/L	0.015-0.030 mg/L	0.007 mg/L

TMDL Overview



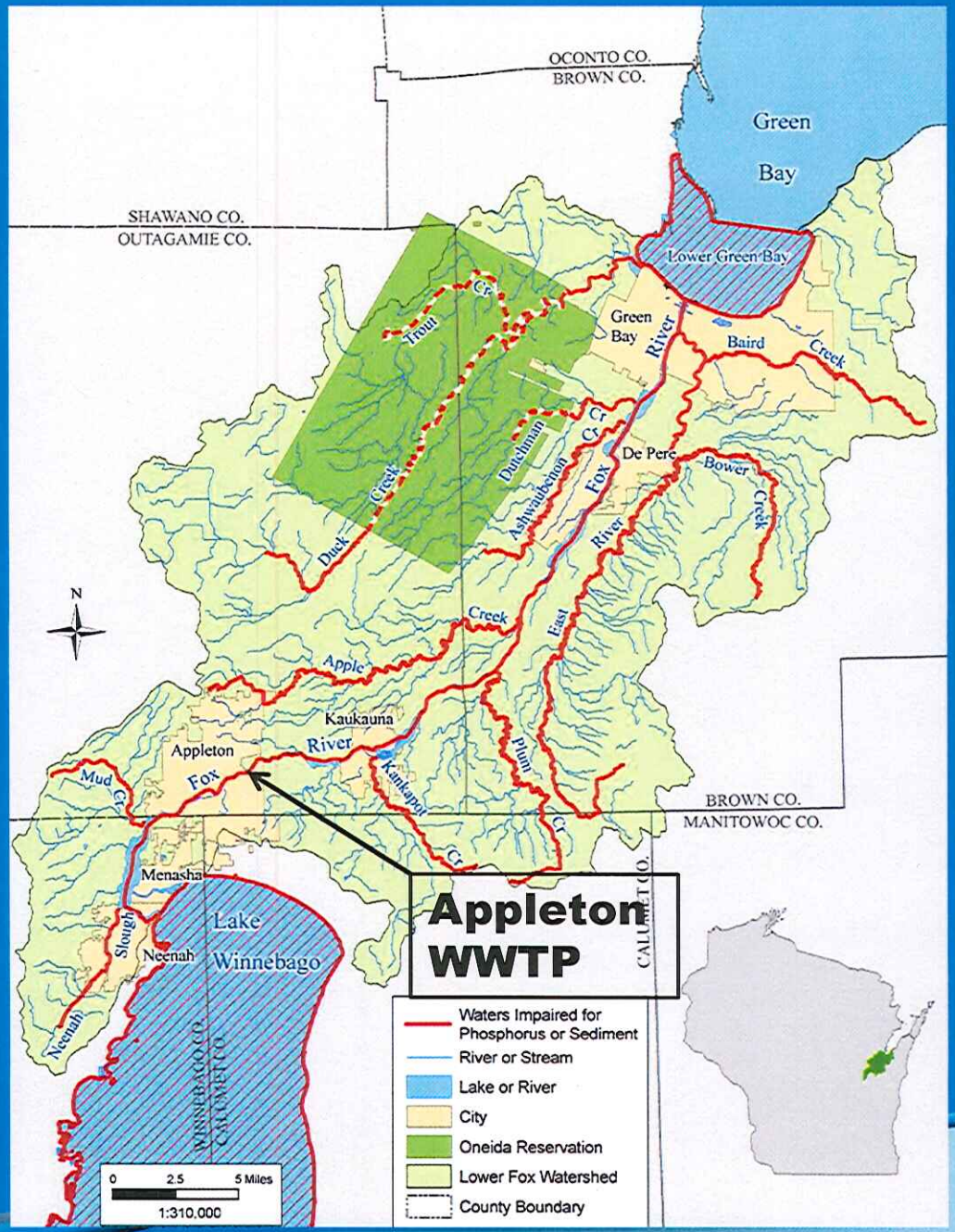
- Wisconsin is required by the Clean Water Act to develop TMDLs for all waters on the "Impaired Waters List" or 303(d) list.
- US EPA oversees the federal TMDL program, Wisconsin is currently granted the authority to implement it's program
- DNR uses current rules in existing programs to implement TMDLs (e.g. NR 217, NR 216, NR 151, etc).
- The TMDL seeks to meet the phosphorus river water quality criterion of 0.1 mg/L in the Lower Fox River (LFR) by reducing the phosphorus loading from WWTP and non-point sources (e.g. agricultural and municipal stormwater)

Compliance with TMDL

- **TMDL mass limits are equivalent to an average WWTP effluent phosphorus concentration of approximately 0.2 mg/L based on flows during the TMDL study period (2003-2007)**
- **If implementation of TMDL limits does not result in achieving the river phosphorus concentration of 0.1 mg/L within 15 to 20 years, WWTPs will be required to meet the WQBEL effluent limit of 0.1 mg/L.**
- **WPDES Permittee Options for Compliance**
  1. Operational changes
  2. Construction
  3. Adaptive management
  4. Water quality trading

  ***Or combinations of 1-4**

Impaired Waters in the Lower Fox River Basin



638 sq. miles

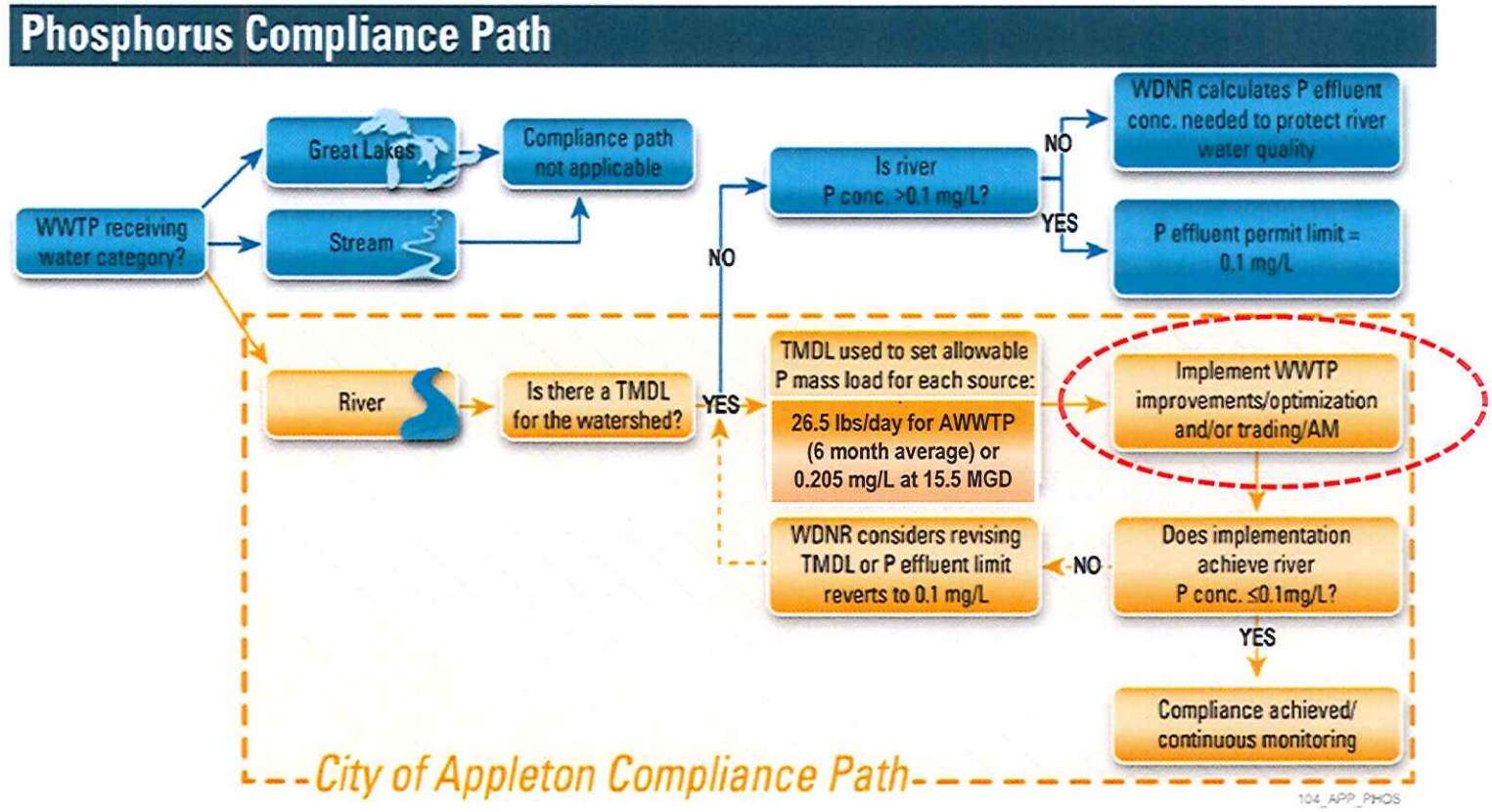
14 impaired waters listed for TSS and TP

AWWTP TMDL Project Approach (2013 – 2015)

- Provide the City with the information required to select the most beneficial compliance path
- Established goals of the City to integrate them into decision-making
- Frequent WDNR communication
- Build upon past and ongoing work for watershed evaluations
- Consider future regulations such as nitrogen
- Ensure maximum benefit from treatment optimization to reduce costs

Project Approach: Compliance Path

EXHIBIT 3-1



AWWTP WPDES Permit Today and Future -- Phosphorus Limits

- The current "Interim" WPDES limit for Phosphorus is 1 mg/L
- TMDL for Appleton WWTP is 26.5 lbs/day with a six-month period and 79.5 lbs/day monthly
- The LFR water quality standard or WQBEL is 0.1 mg/l Phosphorus
- Flow averaged 12.2 mgd in recent years
- Design average flow rating of plant is 15.5 mgd

NOTE: 26.5 lbs/day is equivalent to about 0.26 mg/L at 12.2 mgd or 0.205 mg/L at 15.5 mgd. ⬆ Flow ⬇ Concentration Limit = TMDL

Project Approach: Implement WWTP Improvements/ Optimization and/or Trading/Adaptive Management

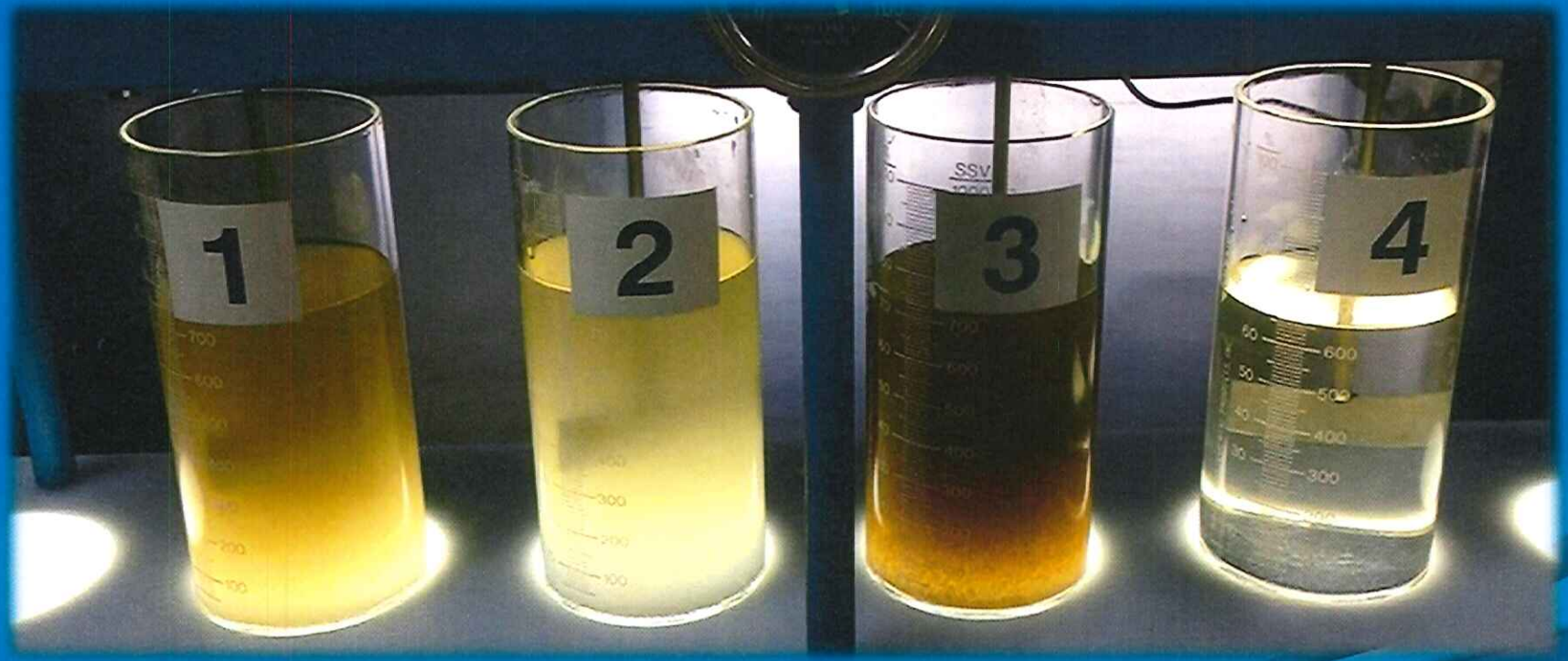
- Comprehensive evaluation of alternatives to ensure future compliance using the most cost effective approach
  - Source Reduction
  - Treatment Optimization
  - Higher Chemical Dose
  - Biological Phosphorus Removal
  - Tertiary Treatment
  - Water Quality Trading
  - Adaptive Management
  - Wisconsin Statewide Variance (*Outagamie Co. not eligible*)

Treatment Chemical Studies

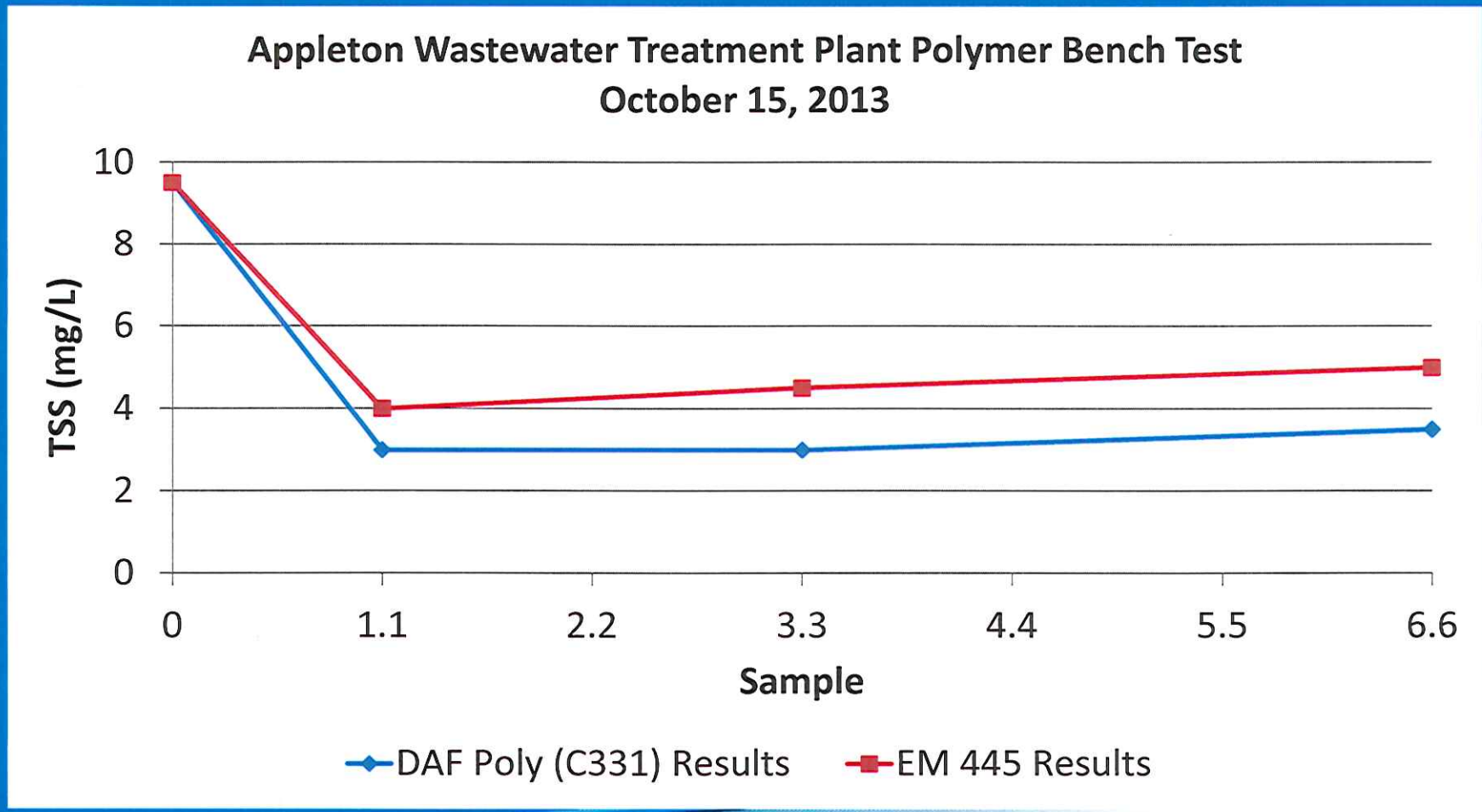
October 2013 Polymer Bench Study

2014 Iron Salt Demonstration Study

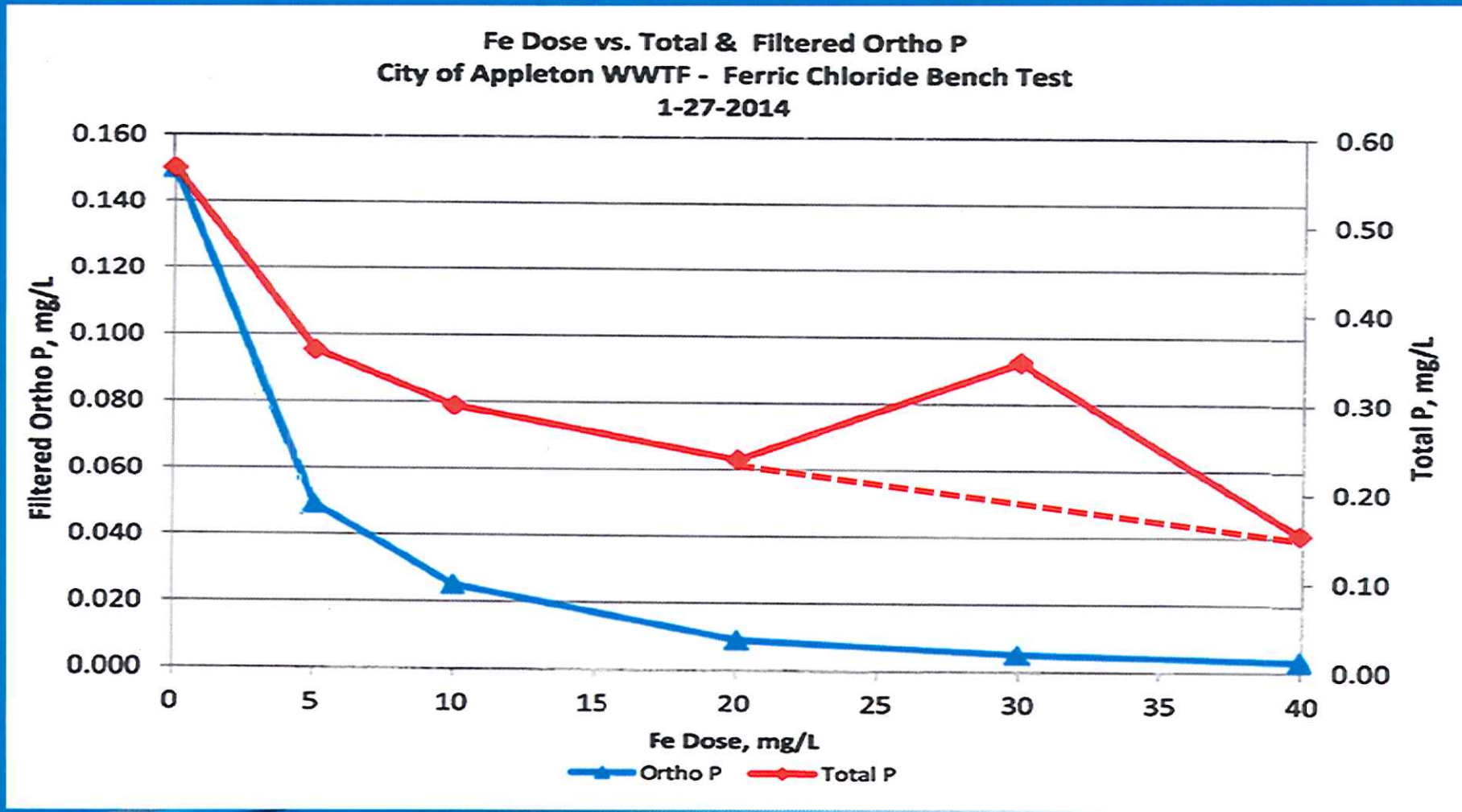
Chemical Treatment Jar Testing Trials



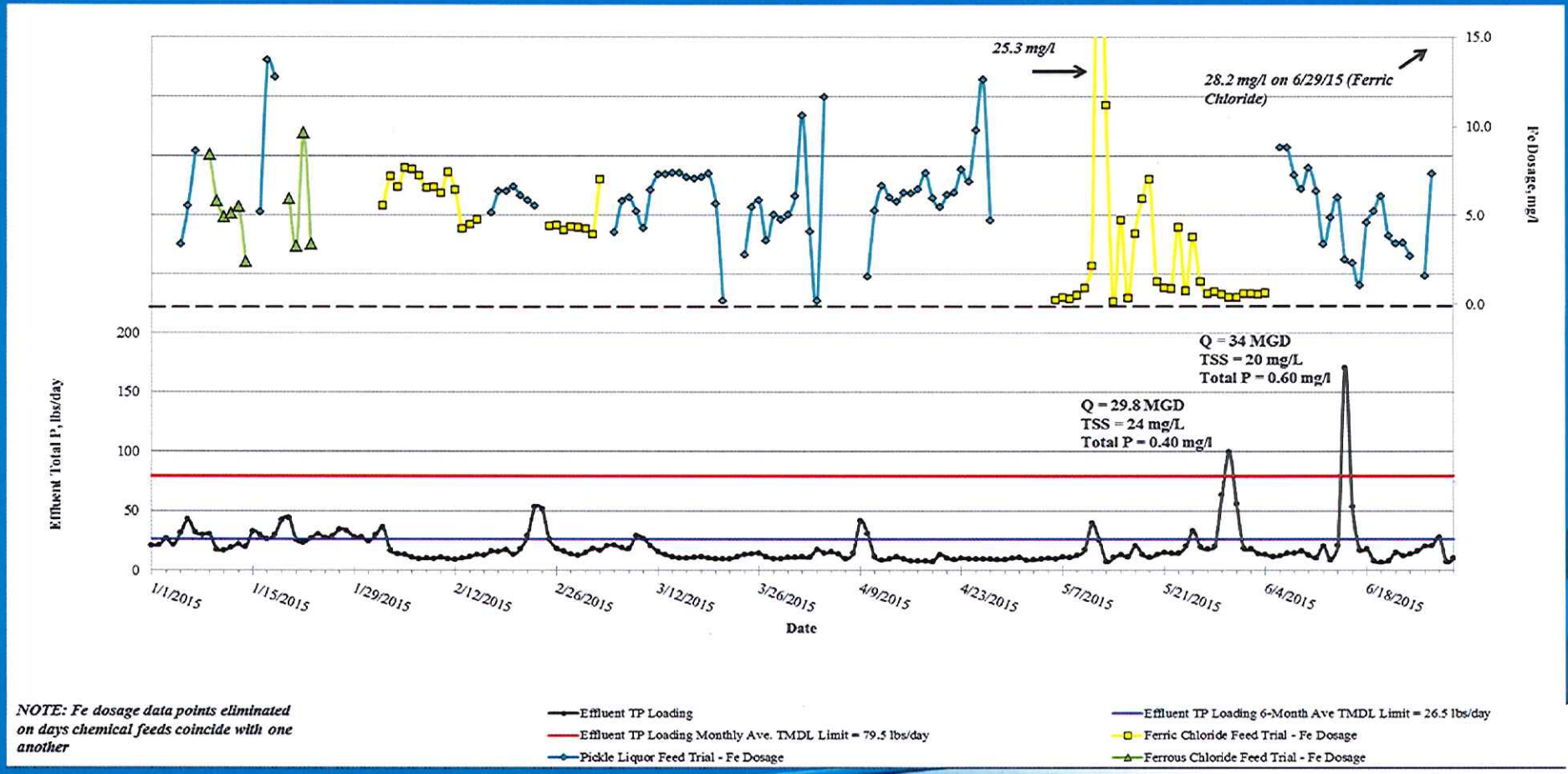
Polymer Bench Study Results: 10-15-2013



Iron Salt Bench Study
Results: 01-27-2014



High Chemical Dosing / Iron Salt Trial Summary
Results: 1/1/15 - 6/30/15



NOTE: Fe dosage data points eliminated on days chemical feeds coincide with one another

Estimated Ferric Chloride Costs Based on Full-Scale Trial with Hach Analyzer

- Assume Ave Influent Q = 12.2 MGD
- 38% Ferric Chloride (FeCl3)
  - $1.21 per gallon
  - 1.529 lbs Fe/gallon

Target Effluent Total P, mg/L	Estimated FeCL3 Dose as Fe	Estimated FeCL3 required	Estimated Annual Chemical Cost
0.30	0.5 mg/L	33.3 gpd	$14,700
0.26	1.2 mg/L	79.9 gpd	$35,300
0.18	2.4 mg/L	160 gpd	$70,700

Tertiary Treatment Option

- New pump station to tertiary treatment (assumed submersible pumps)
- Two 14.2 mgd Actiflo units for 28.4 mgd capacity (historical peak month flow)
- New FeCl3 storage and feed system
- New liquid polymer system

Adaptive Management/Trading

Adaptive Management/Trading Considerations

- Phosphorus offsets needed and where to find them
- Existing conditions and target soil P levels
- BMP and nutrient trading costs
- Rate of conservation practice implementation
- Partnerships
- Contracts
- Lake Winnebago impacts
- "Point of Compliance"
- DNR Guidance Interpretation and "Flexibility"

TMDL Compliance Alternatives Cost Summary

Alternative	Capital Cost	Annual Cost	20-yr Present Worth Annual Cost	Total 20-yr Present Worth
Ferric Dosing (Effluent P = 0.18 mg/L)	$0	$70,600	$1,158,000	$1,158,000
Bio-P plus Chemical Dosing	$1,884,000	$56,000	$924,200	$2,808,000
Tertiary Treatment (Actiflo)	$14,817,000	$319,000	$6,233,000	$20,050,000
Adaptive Management with AWWTP Optimization	-	-	-	$23,300,000 to $44,200,000
Trading with AWWTP Optimization (*preliminary costs*)	$49,000 to $117,000	$294,000 to $352,000	$4,822,000 to $5,773,000	$4,871,000 to $5,890,000

Anticipated Permit Timeline

2016
- **1st Permit Term:** Interim Limit = 1 mg/L

2021
- **2nd Permit Term:** TMDL Limit = 0.2 mg/L

2026
- **3rd Permit Term:** TMDL Limit = 0.2 mg/L

2031
- **4th Permit Term:** WQBEL = 0.1 mg/L

Additional Discussion