



Connecticut Department of Energy and Environmental Protection



Scientific Methods to Measure Phosphorus in Freshwaters and Approaches for Towns to Comply with Clean Water Act Requirements



06 December 2012

PA 12-155 Open Collaboration Meeting

Phoenix Auditorium - Hartford, CT



Connecticut Department of Energy and Environmental Protection

Agenda

Opportunities & Next Steps

Clean Water Act Requirements

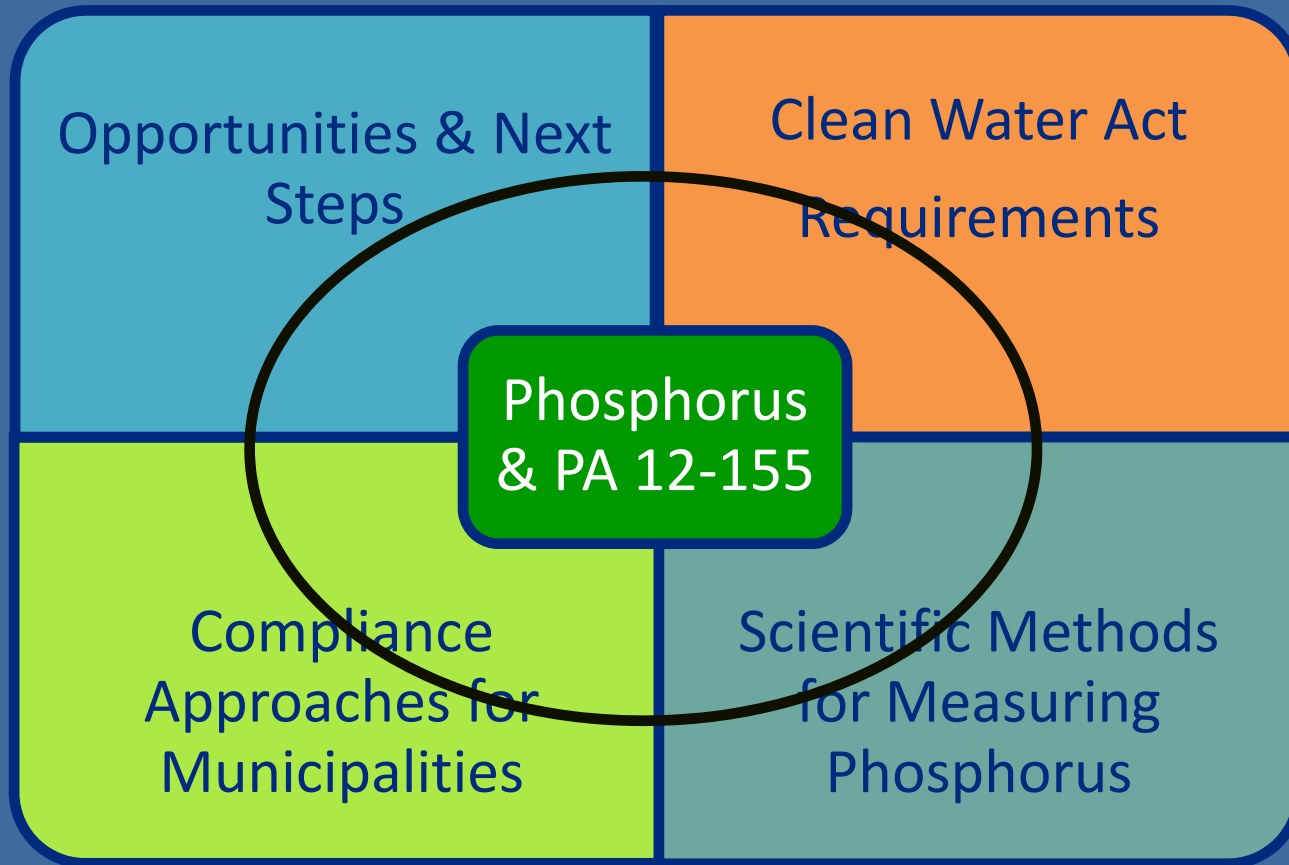
Phosphorus
& PA 12-155

Compliance Approaches for Municipalities

Scientific Methods for Measuring Phosphorus



Agenda



Overview of PA 12-155

1. Collaboration & Recommendations

- Statewide response to NPS phosphorus
- Approaches for towns to comply with EPA standards, WWTP treatment & upgrade guidance
- Scientific methods to measure phosphorus in freshwaters

2. Phosphorus Limits in Lawn Fertilizer

3. Clean Water Fund Eligibility for Phosphorus Treatment at WWTP



Phosphorus

- Element essential for plant and animal life
- Used in fertilizer, detergents, food additives, pesticides, plasticizers, metallurgy, water softeners
- Ecological- excess amounts cause eutrophication in the freshwater



Phosphorus the Pollutant

- **Nutrients are one of the leading causes of water quality impairment**
- **Phosphorus is naturally occurring however, excessive human inputs results in increased growth of algae (eutrophication) in freshwaters**
- **Excessive amounts of algae can:**
 - **decay and decompose, removing oxygen**
 - **impair or kill fish and other aquatic life**
 - **inhibit recreation**
 - **be harmful to human health**
 - **have economic impacts**



Types of Sources

- Point Source

- Wastewater treatment plants
- Industrial discharges

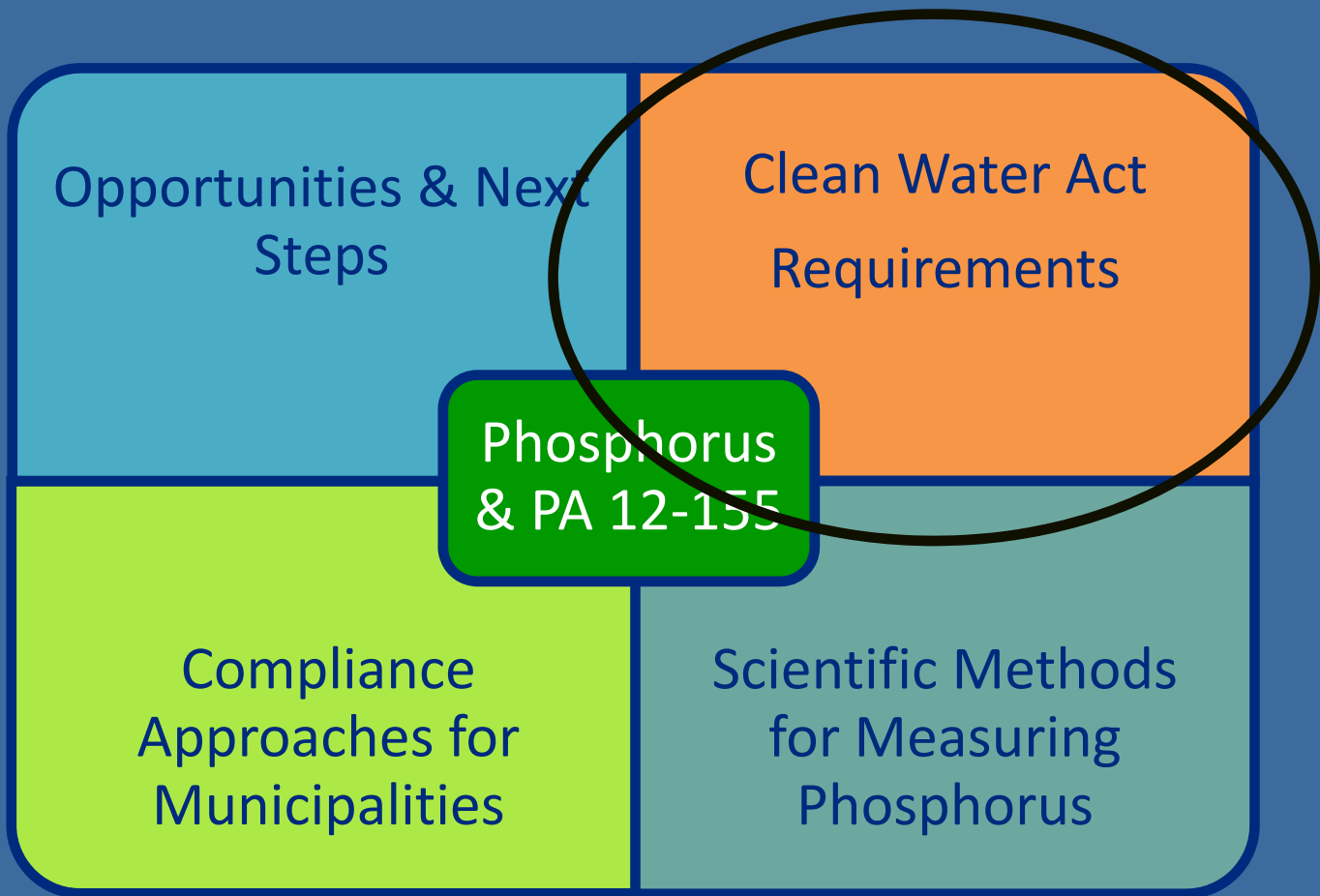


- Nonpoint Source

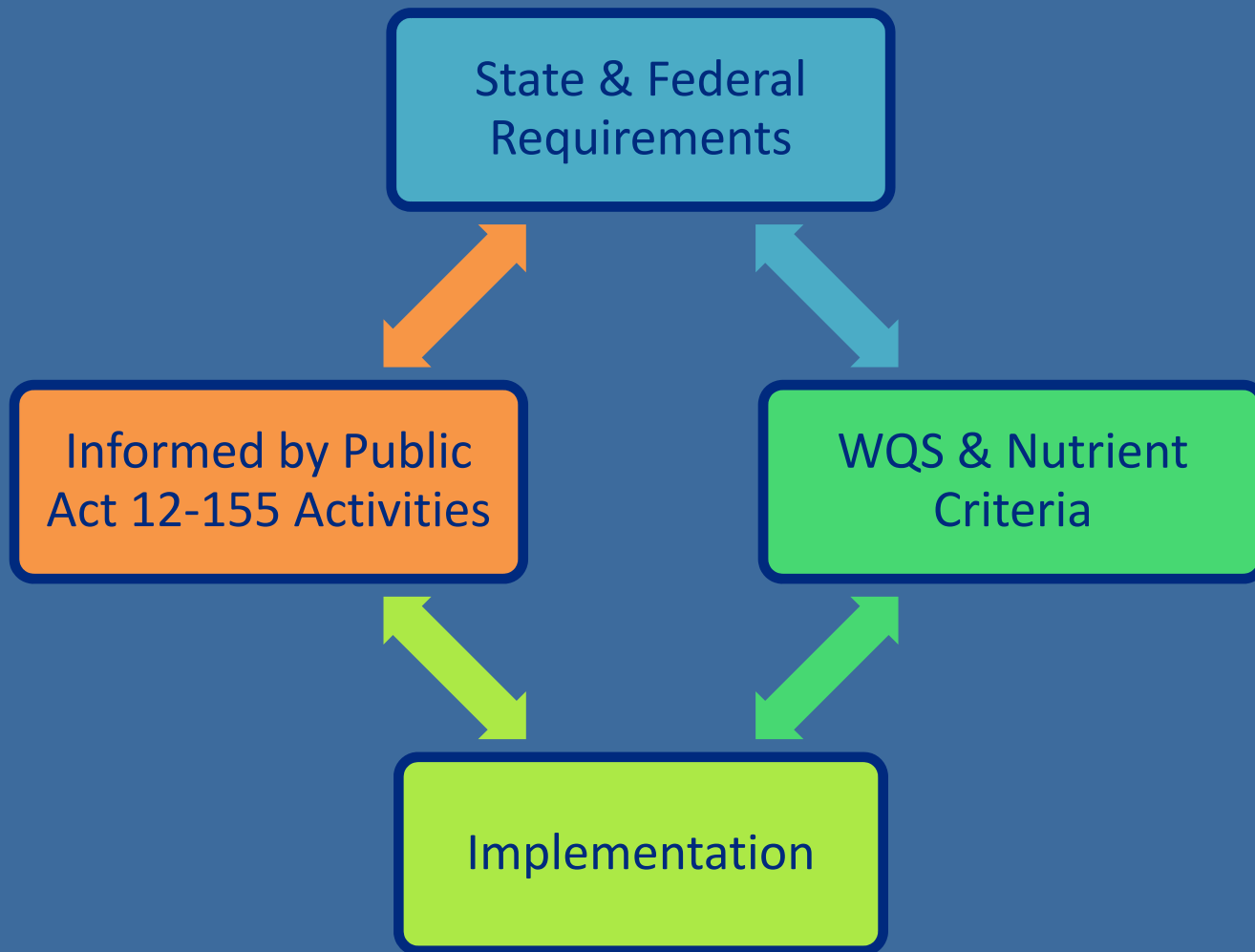
- Agriculture
- Urban stormwater

CWA





CT Statewide Nutrient Strategy



Federal and State Requirements

State & Federal Requirements

Federal
Clean
Water
Act

State
Statutes

- Key Components
 - WQ Standards
 - Implementation Regs
- CT is delegated State
 - Fulfill Federal responsibilities
 - Provide for CT-specific approaches

Fishable &
Swimmable
Goals Met



Water Quality Criteria

WQS & Nutrient Criteria

Existing

- Narrative criteria focused on anthropogenic sources and meeting water body uses

On-Going

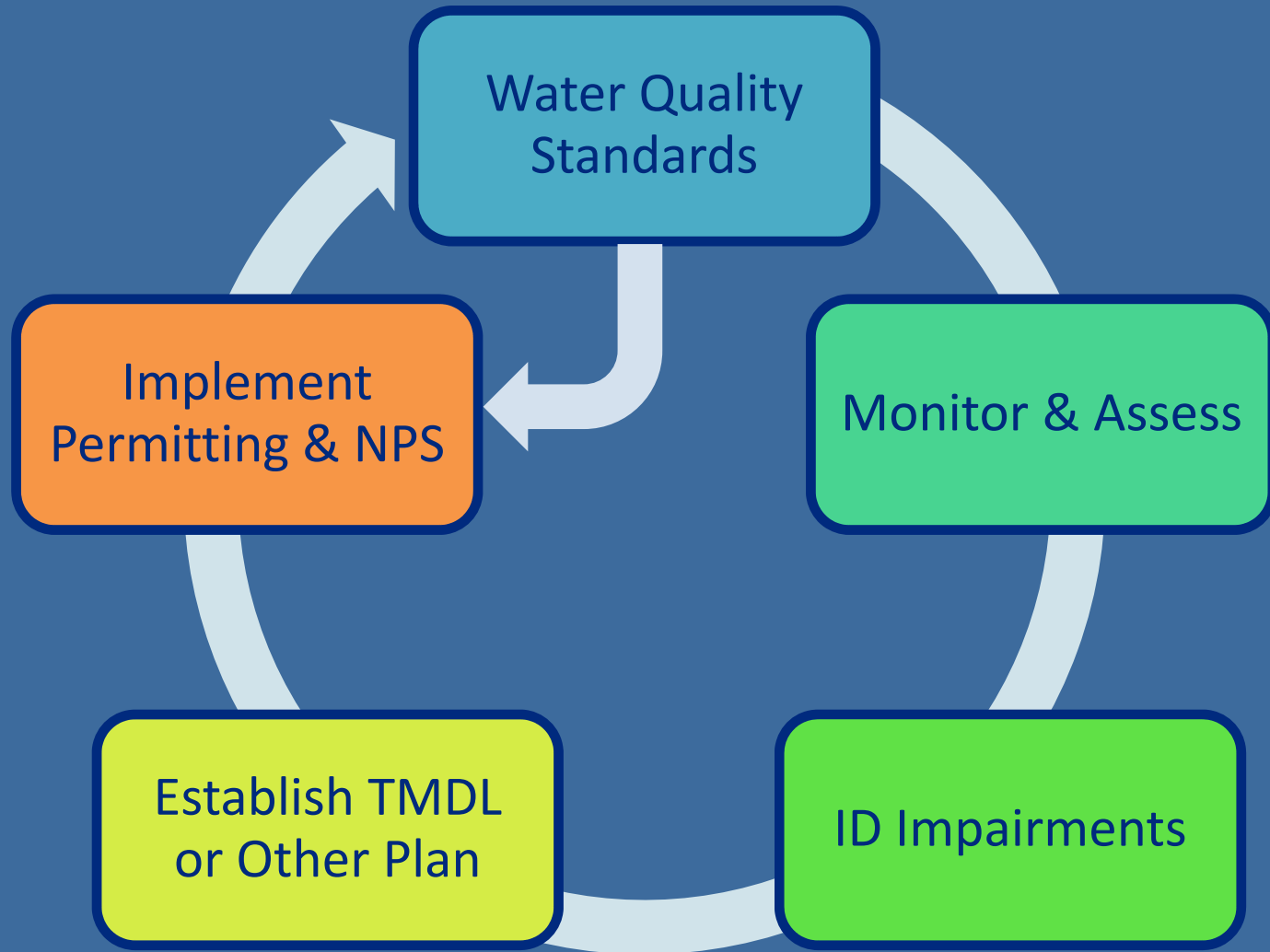
- Development of biologically based numeric criteria for phosphorus in freshwater streams

Future

- Evaluate need for other types of nutrient criteria



Water Quality Driven Activities



EPA Recommendations



Prioritize Watersheds



Set Watershed Load Reduction Goals



Ensure Effective Point Source Controls



Partner with Agricultural Stakeholders



EPA Recommendations



Address Storm Water and Septic Systems



Establish Accountability and Verification Procedures



Report on Implementation Activities and Load Reductions



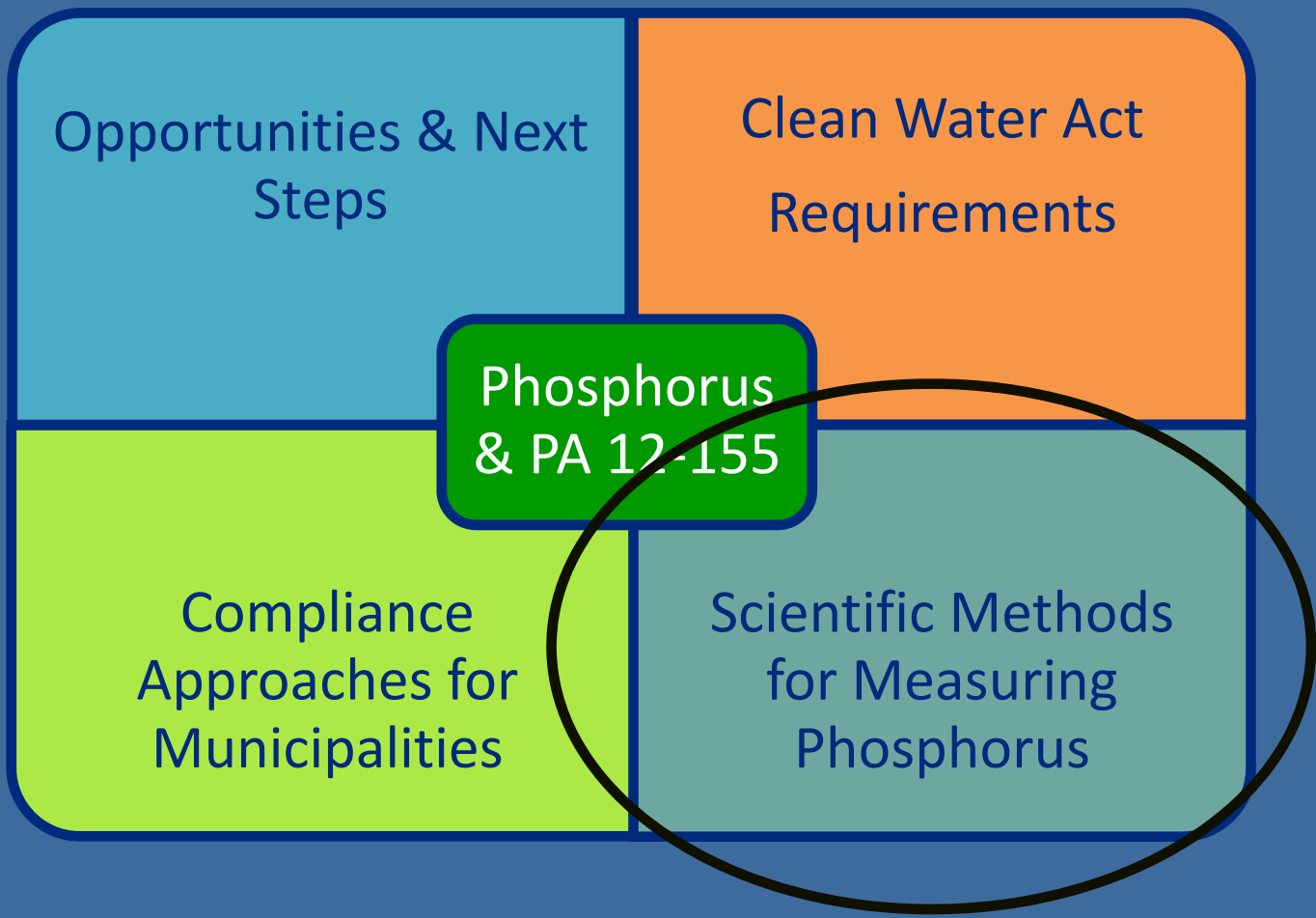
Develop work plan & schedule for criteria development



EPA REGION 1 Perspective



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USGS - PHOSPHORUS IN CT STREAMS



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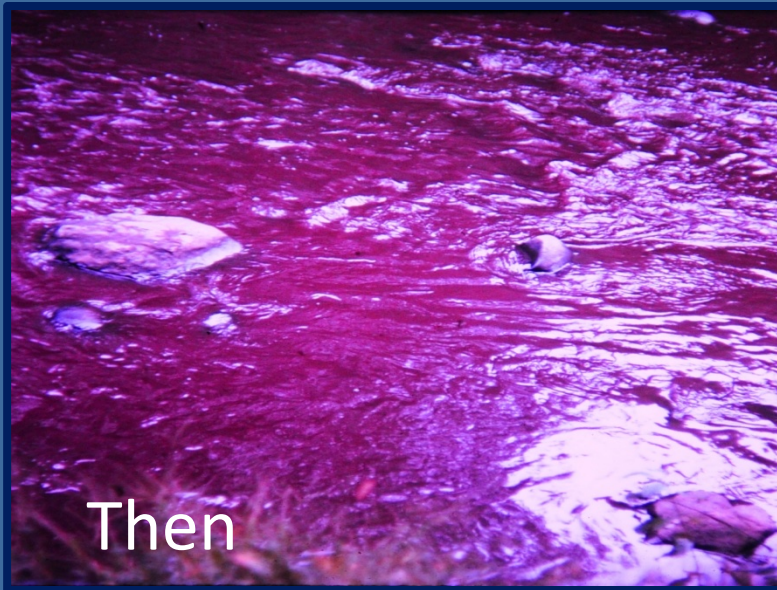
CURRENT MANAGEMENT EFFORTS IN WASTE RECEIVING STREAMS AND ON-GOING MONITORING EFFORTS



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Significant Water Quality Improvements in CT Since The 1960s

Collective Efforts by Stakeholders Throughout the State
Has Resulted in Vast Improvements to Water Quality



Willimantic River in Stafford



Water Quality Improvements Are Still Needed

Collective Efforts by Stakeholders Throughout the State are Still Needed To Meet Clean Water Act Goals and Protect CT Rivers and Streams



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Excess Phosphorus Identified As A Serious Issue Over Time

1969

National Science Academy holds a symposium on impacts of nutrients to water bodies



1970s

Eutrophication Identified as Issue in CT Water Quality Report to Congress. Phosphorus ban in Laundry Detergent



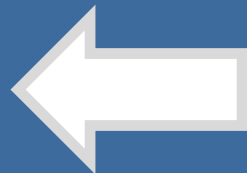
1987

WWTPs cited as contributors to eutrophication issues in Lake Lillinonah



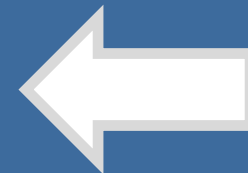
2011

EPA issued memo by Nancy Stoner to accelerate the reduction of nutrient pollution



2001

EPA issued memo on the development and adoption of nutrient criteria into State WQS



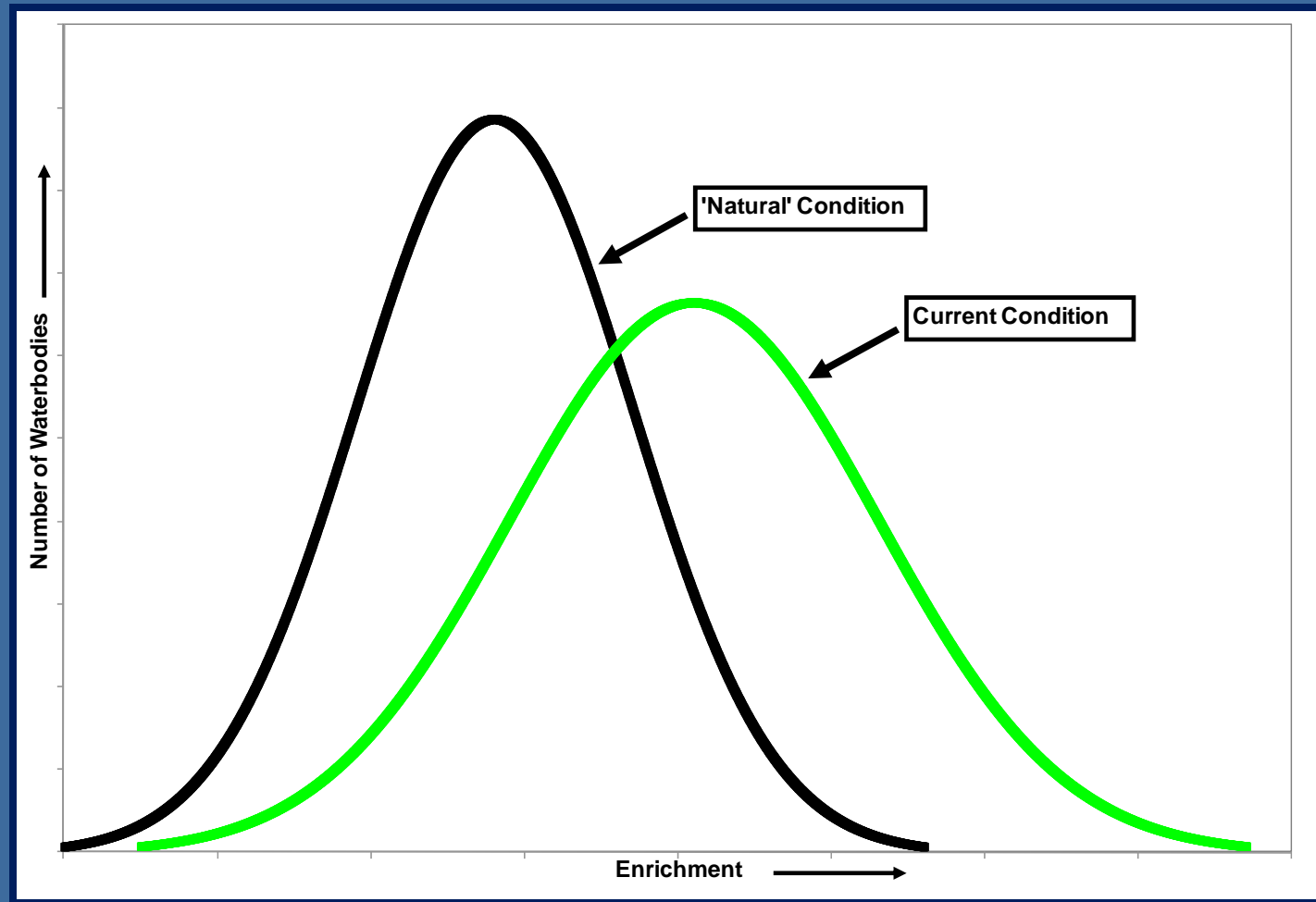
1998

Federal Clean Water Action Plan identified nutrient pollution as a significant problem across the nation



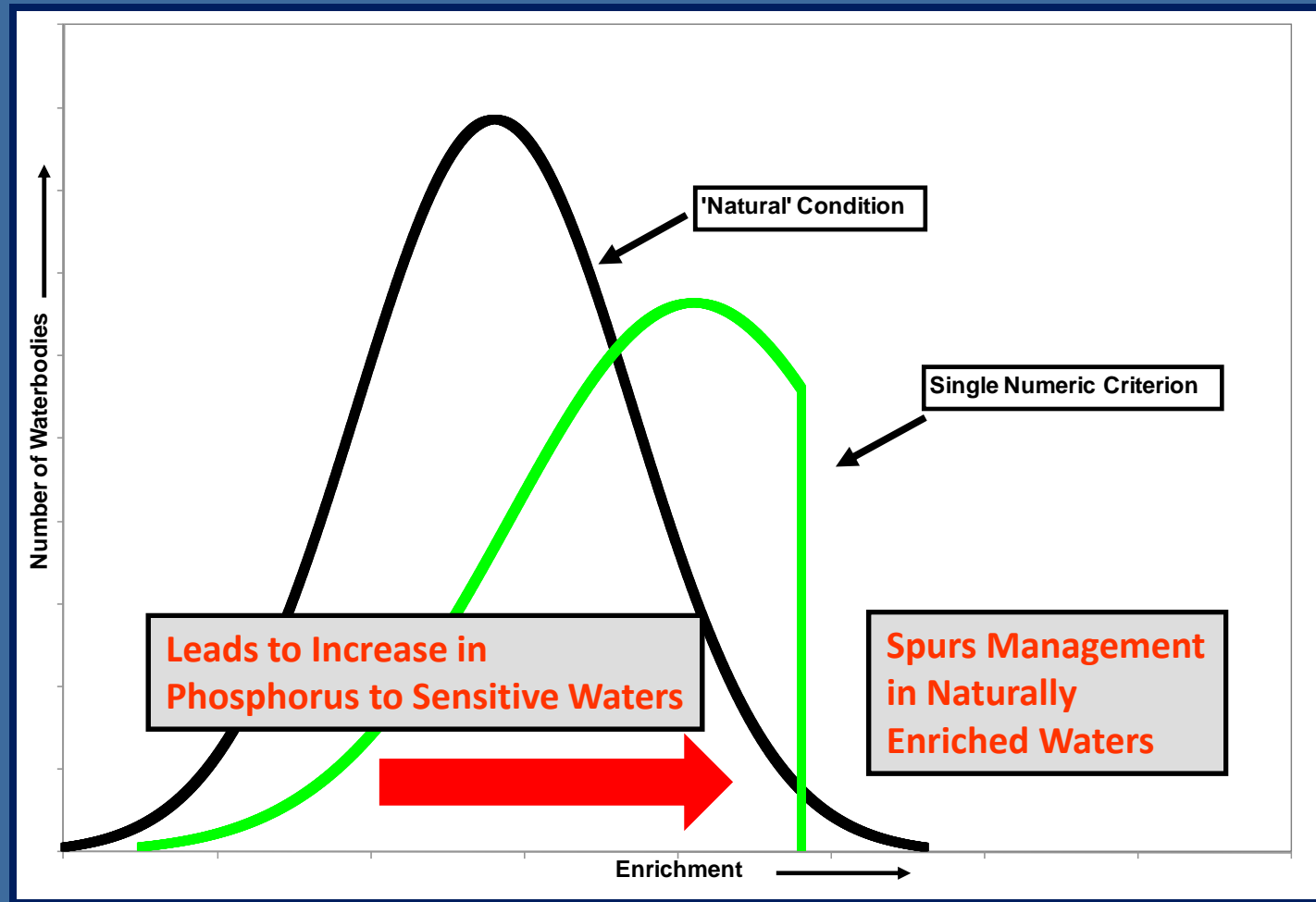
Phosphorus is a Complex Pollutant

Unlike Toxic Pollutants, Phosphorus Levels Vary Naturally In Streams



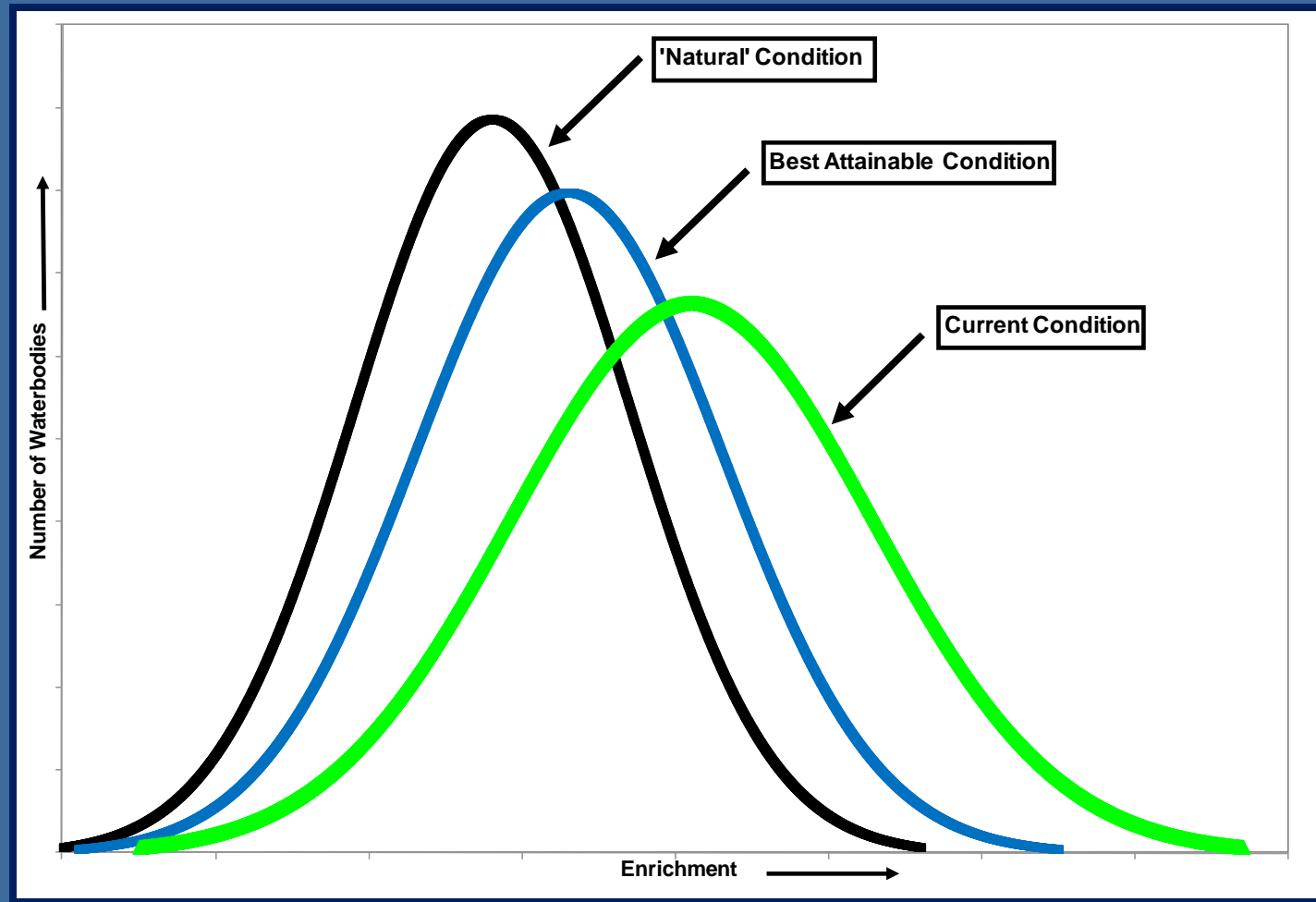
Phosphorus is a Complex Pollutant

Application of a threshold concentration like toxic pollutants could create a truncated distribution



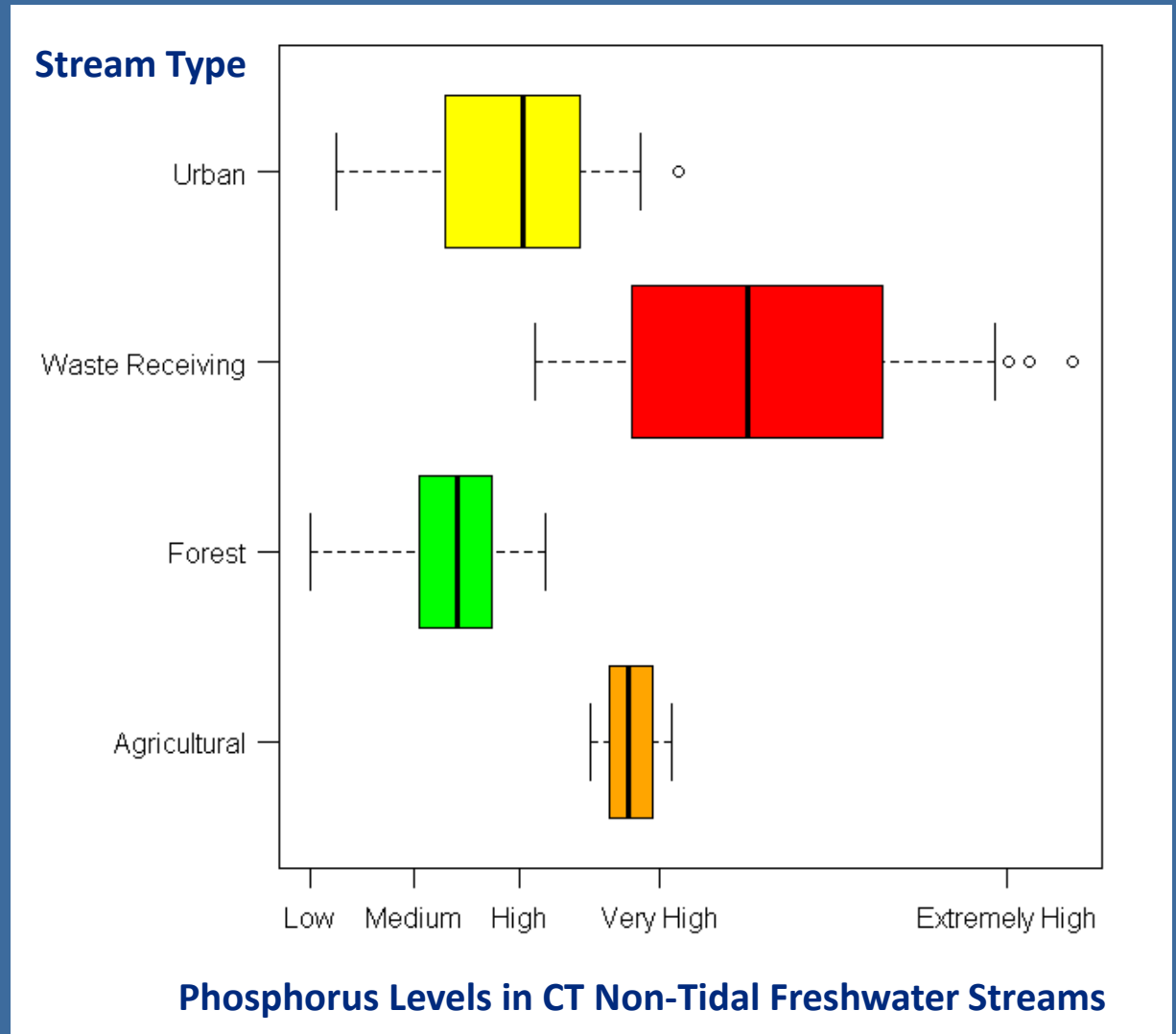
Phosphorus is a Complex Pollutant

Management Goal in CT is to maintain varying enrichment conditions

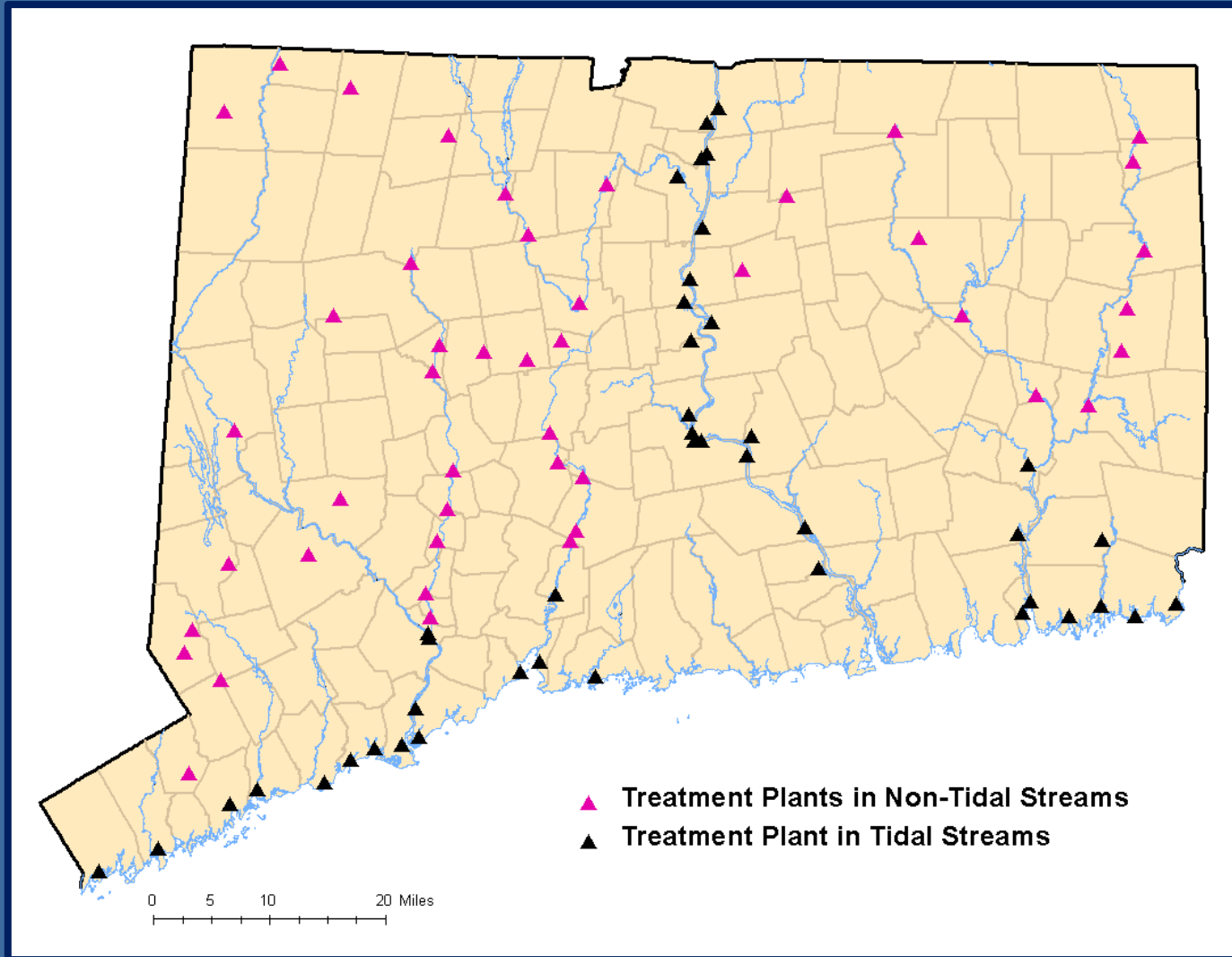


Current Management Efforts in Non-Tidal Waste Receiving Streams

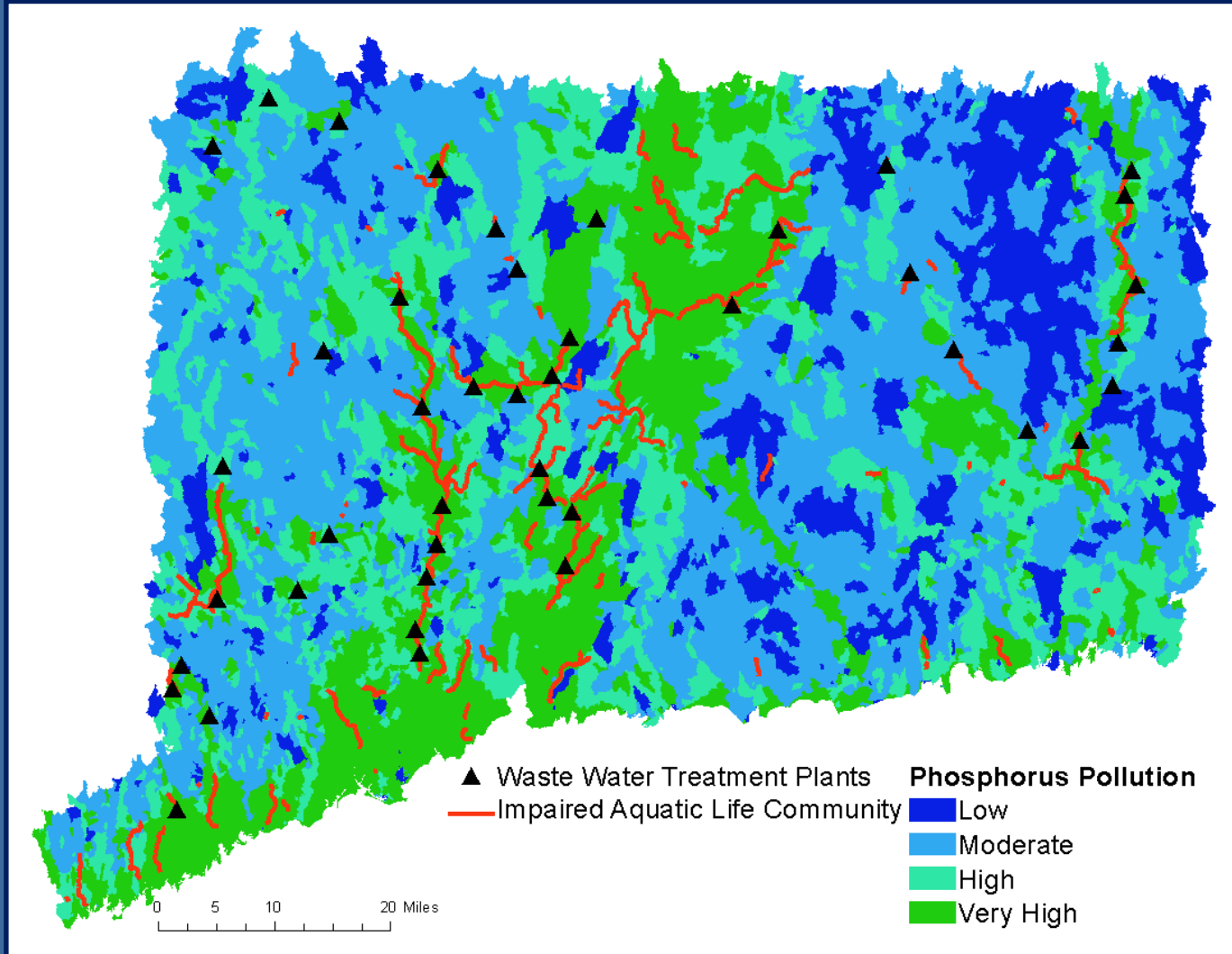
Identified Excessive Levels of Phosphorus in Waste Receiving Streams



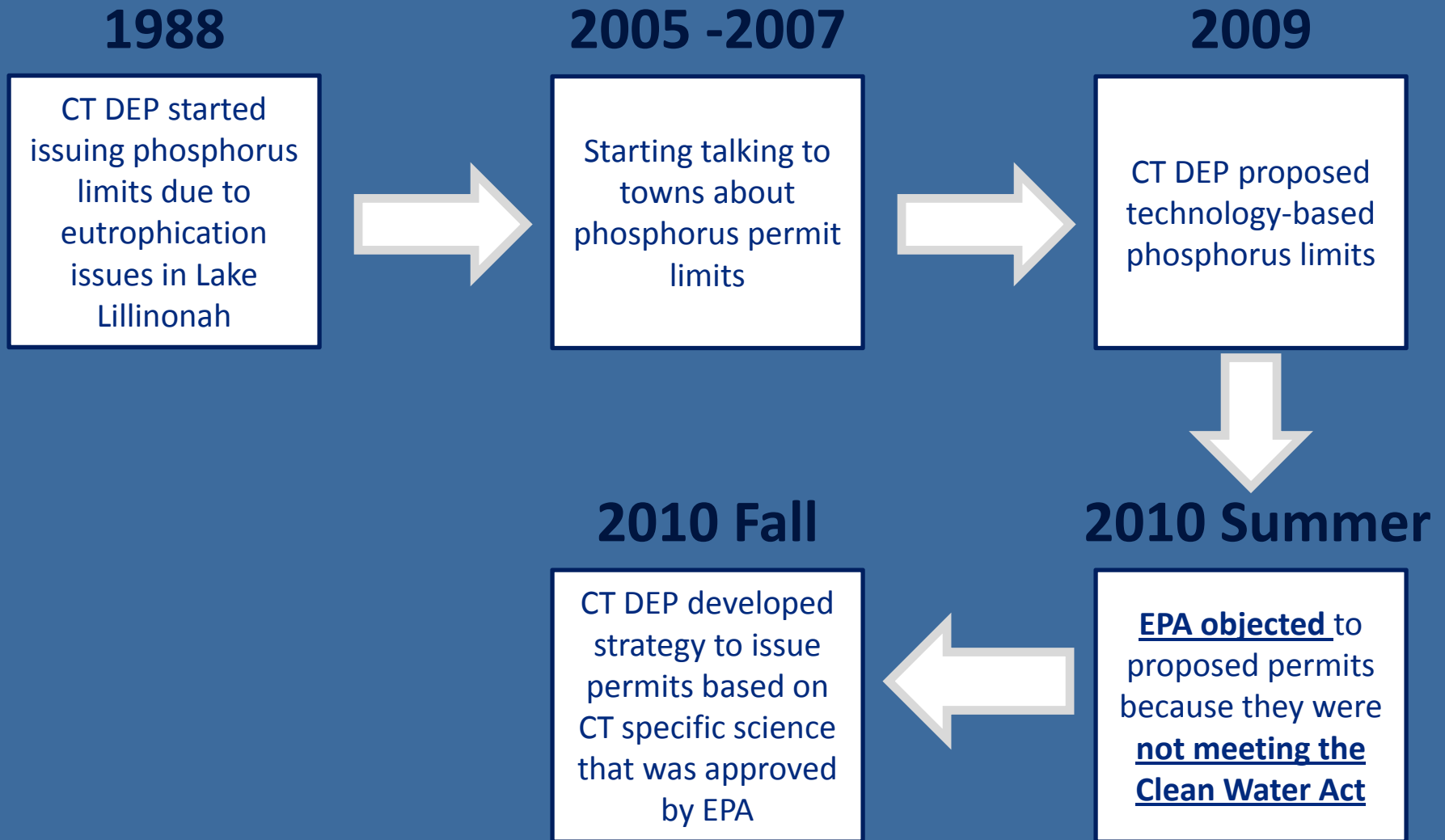
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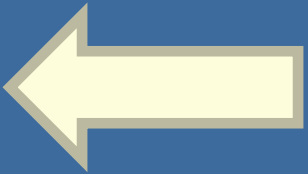
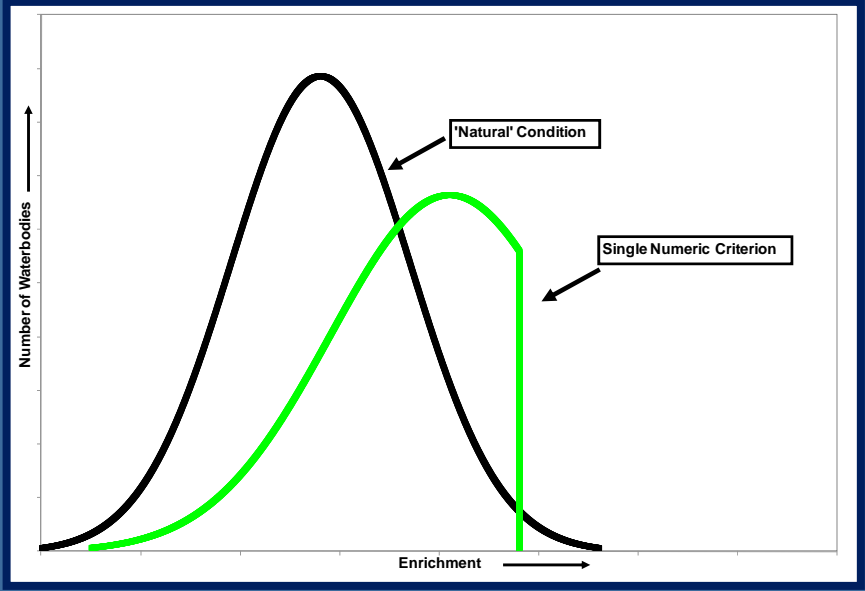
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Management Efforts in Non-Tidal Waste Receiving Streams

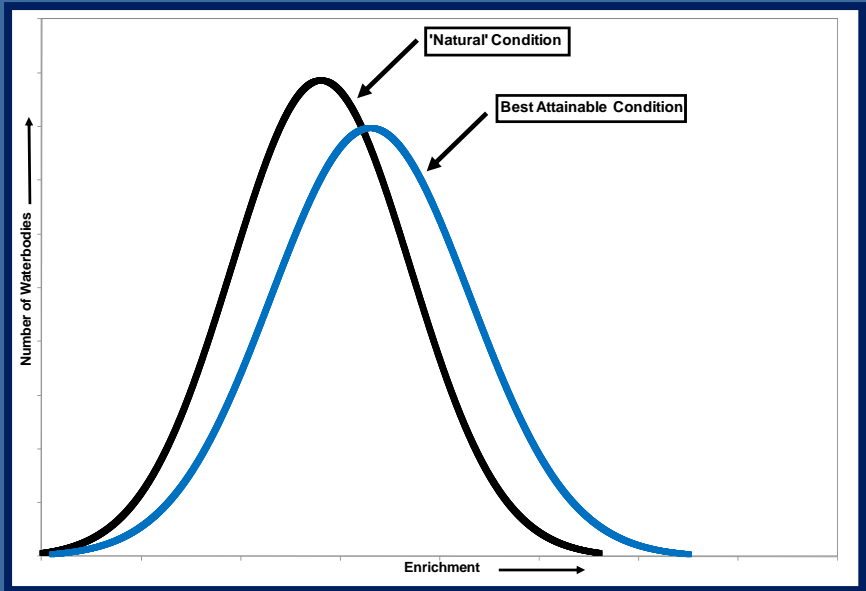
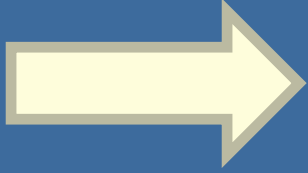


EPA Acceptable Scientific Methods To Issue CT Permits

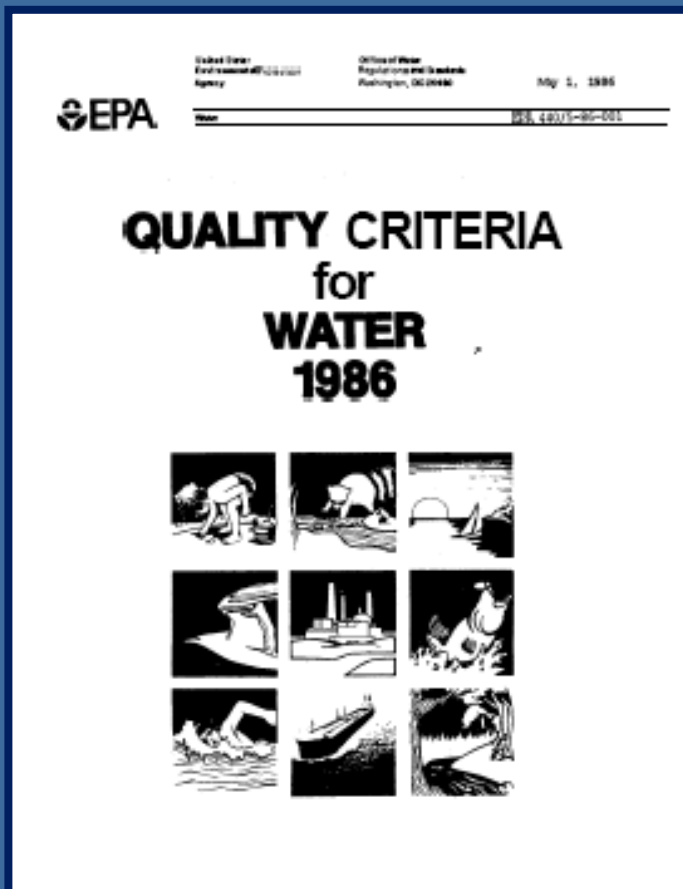


U.S. EPA National
Guidance Values

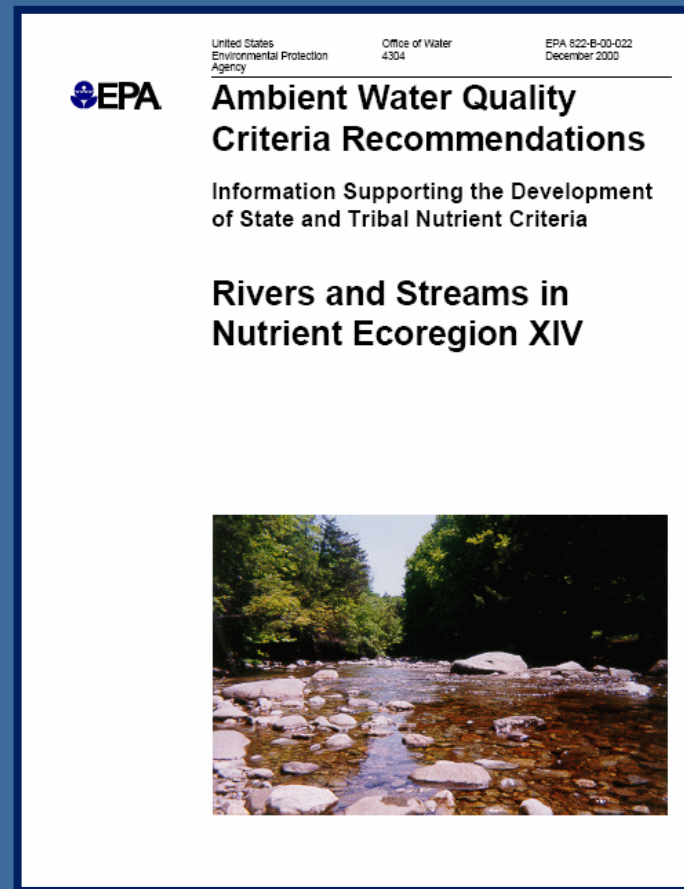
CT DEEP
Watershed
Specific Values



EPA Recommended TP Criteria



0.1 mg/L
at low flow

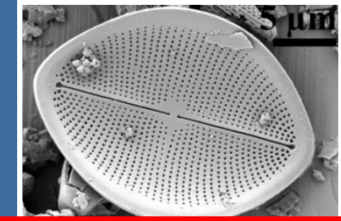


0.031 mg/L
at average summer flow



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CT Approach to Phosphorus Management



Human Sources

NPDES Discharges, Urban and Agricultural Runoff

Habitat Conditions

Canopy Cover, Flow, Temperature, Natural Nutrient Loading

Algal Response

Increases and Changes in Algal Communities

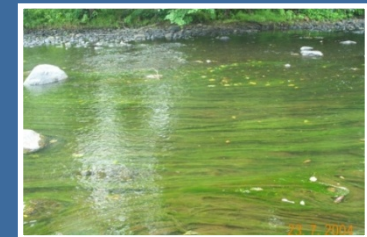
Changes in Fish and Other Aquatic Life Communities or Fish Kills

Aquatic Life Response



Changes in Habitat Structure and Water Chemistry

Physical / Chemical Changes



CT Approach to Phosphorus Management

Algae is like weeds in the garden. The more you feed them fertilizer the more they will grow and overtake your plants. In streams this is called eutrophication.



In Your Garden



In Your Stream



CT Approach to Phosphorus Management

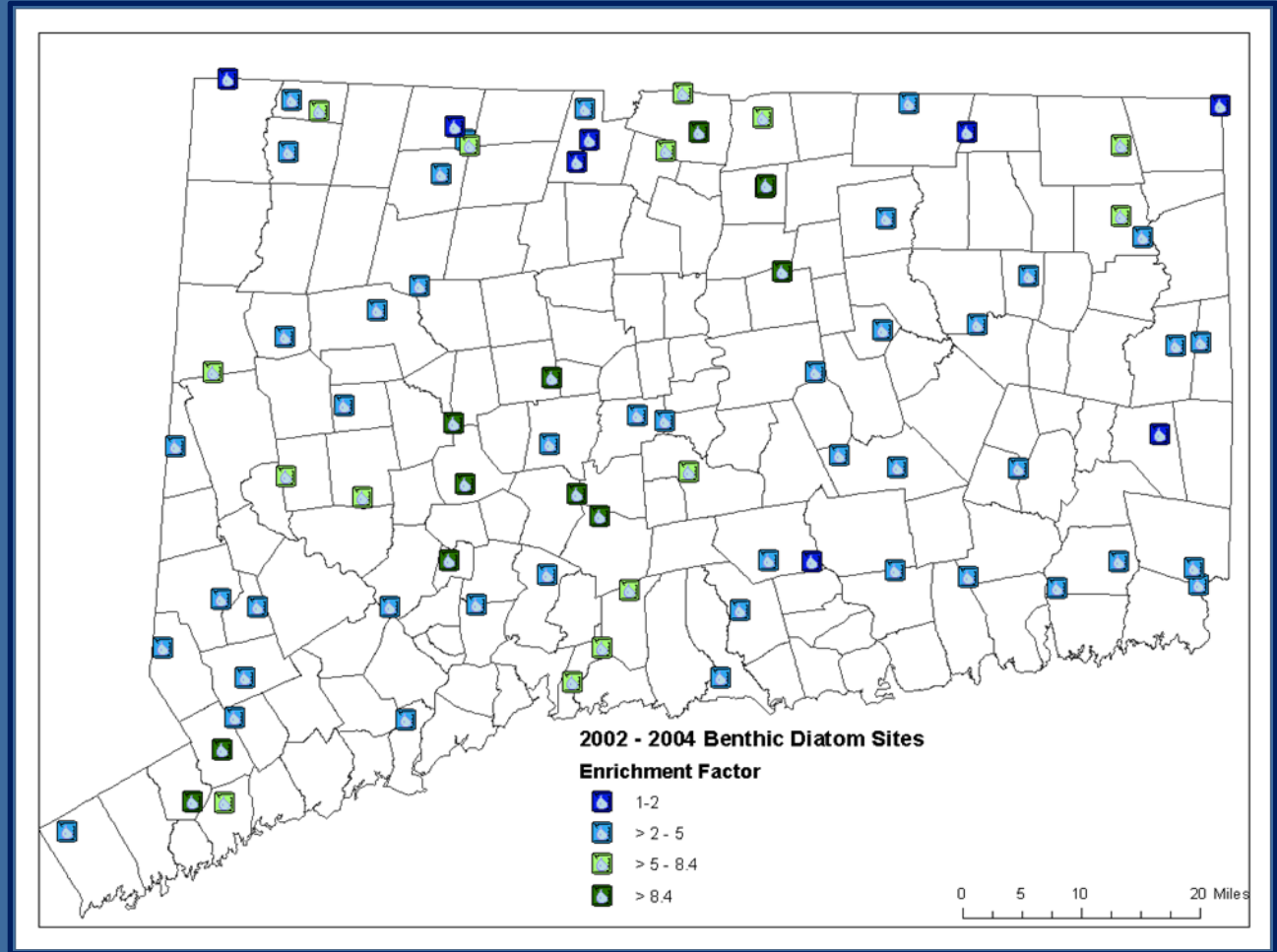
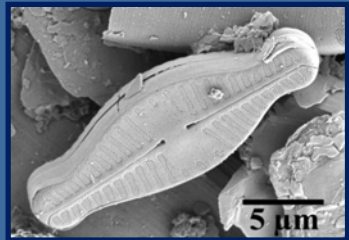
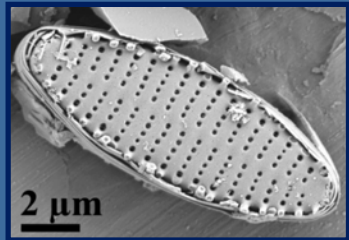
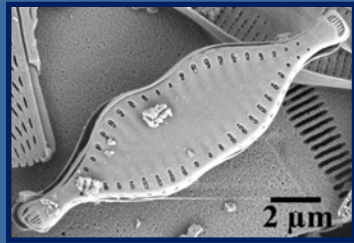
STEP 1: Calculated the Export of Phosphorus to Streams From Human Sources

- Estimated point sources phosphorus contribution to streams using facility data
- Estimated phosphorus contribution from non-point sources using CT stream data



CT Approach to Phosphorus Management

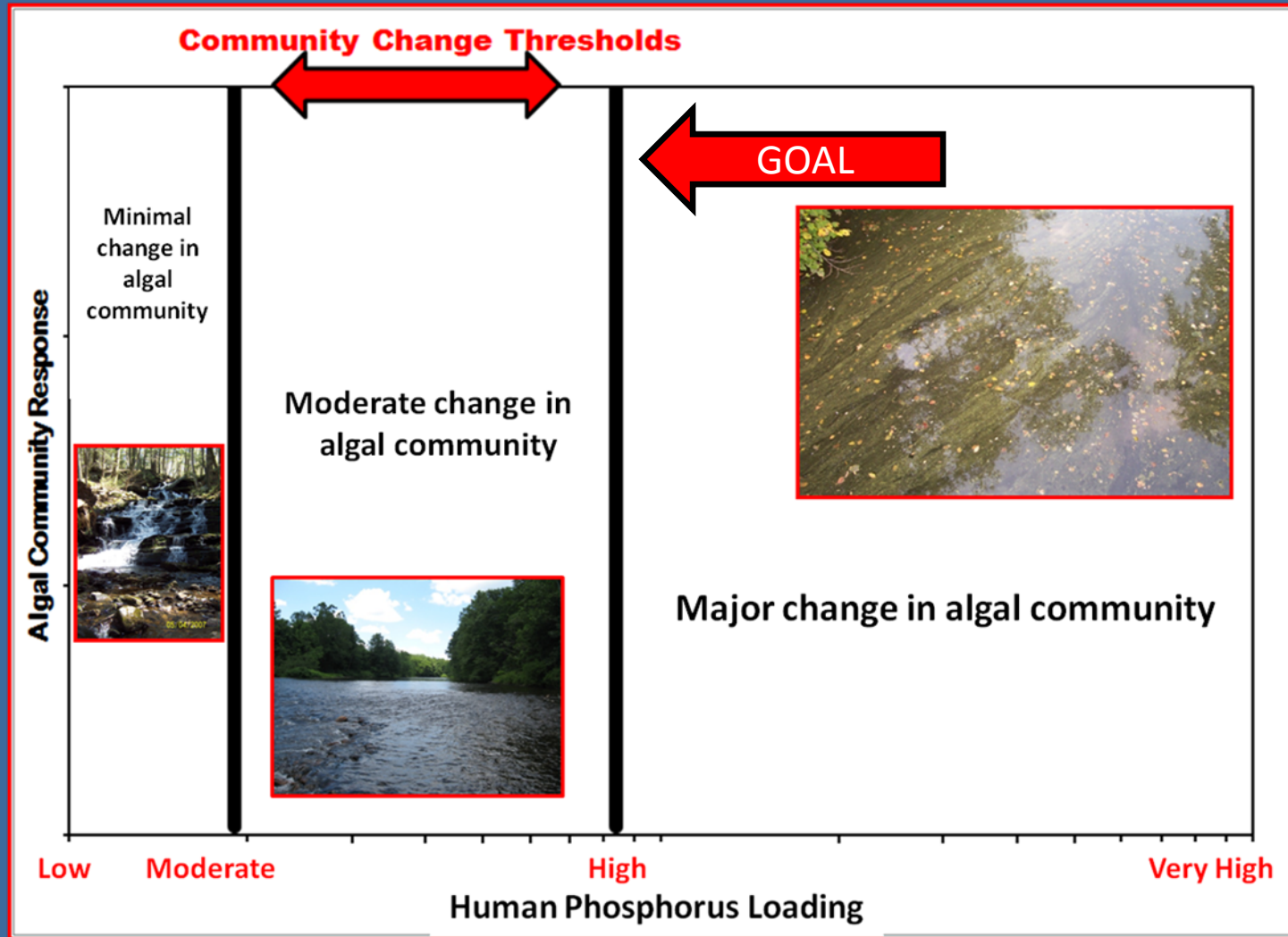
STEP 2: Identified What Types of Algae Were Growing in CT Streams



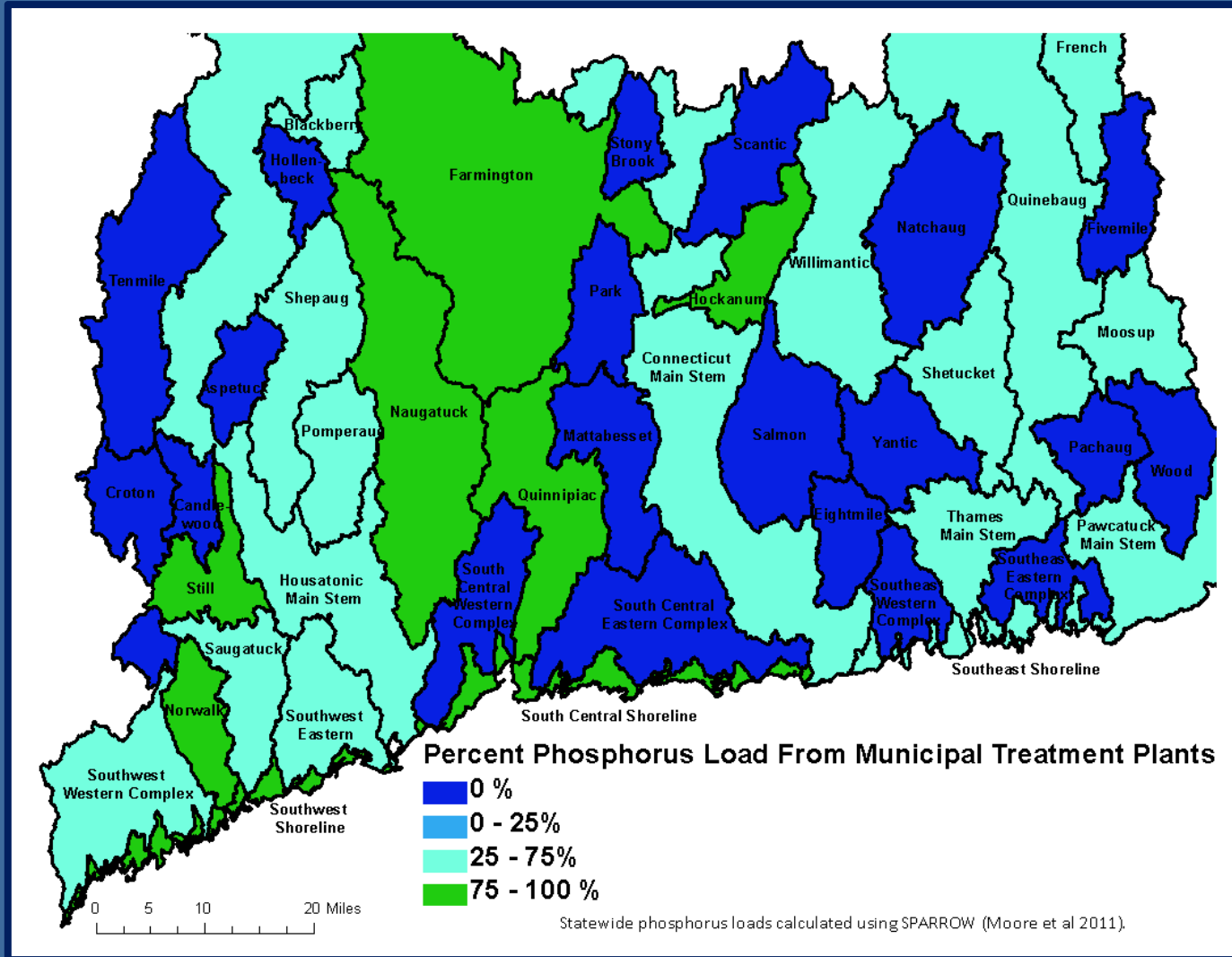
CT Approach to Phosphorus Management

STEP 3: A water body is considered impaired for aquatic life when major ecological changes occur

Conducted a statistical analysis to identify algae response to excess phosphorus

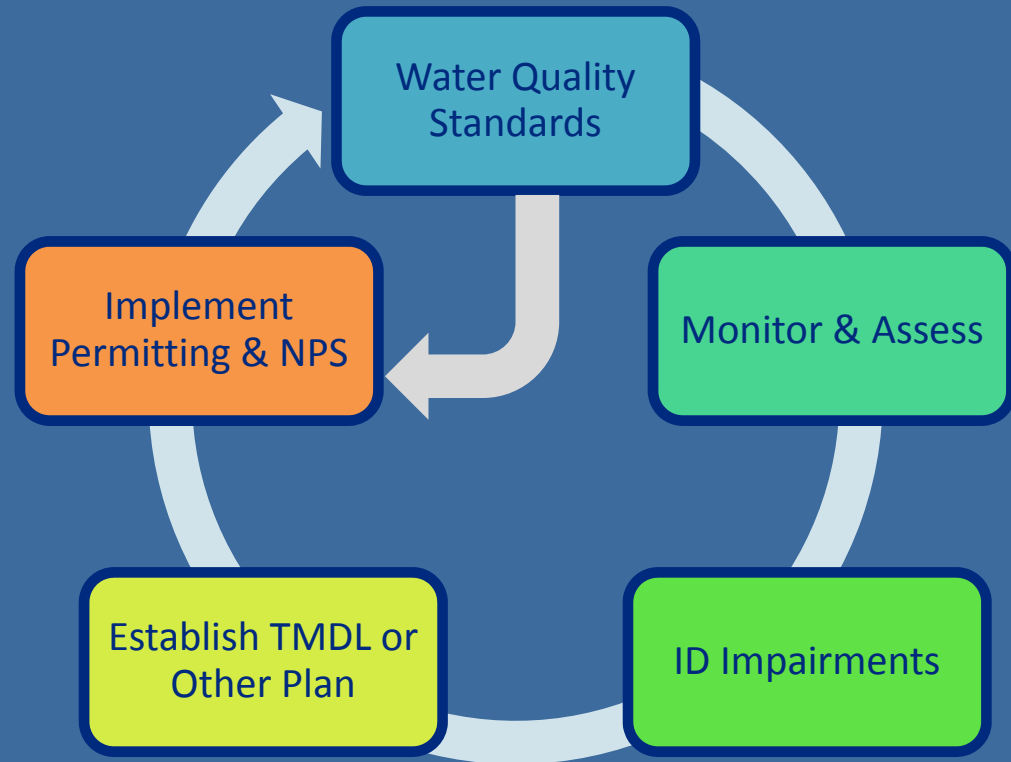


Current Management Efforts in Non-Tidal Waste Receiving Streams

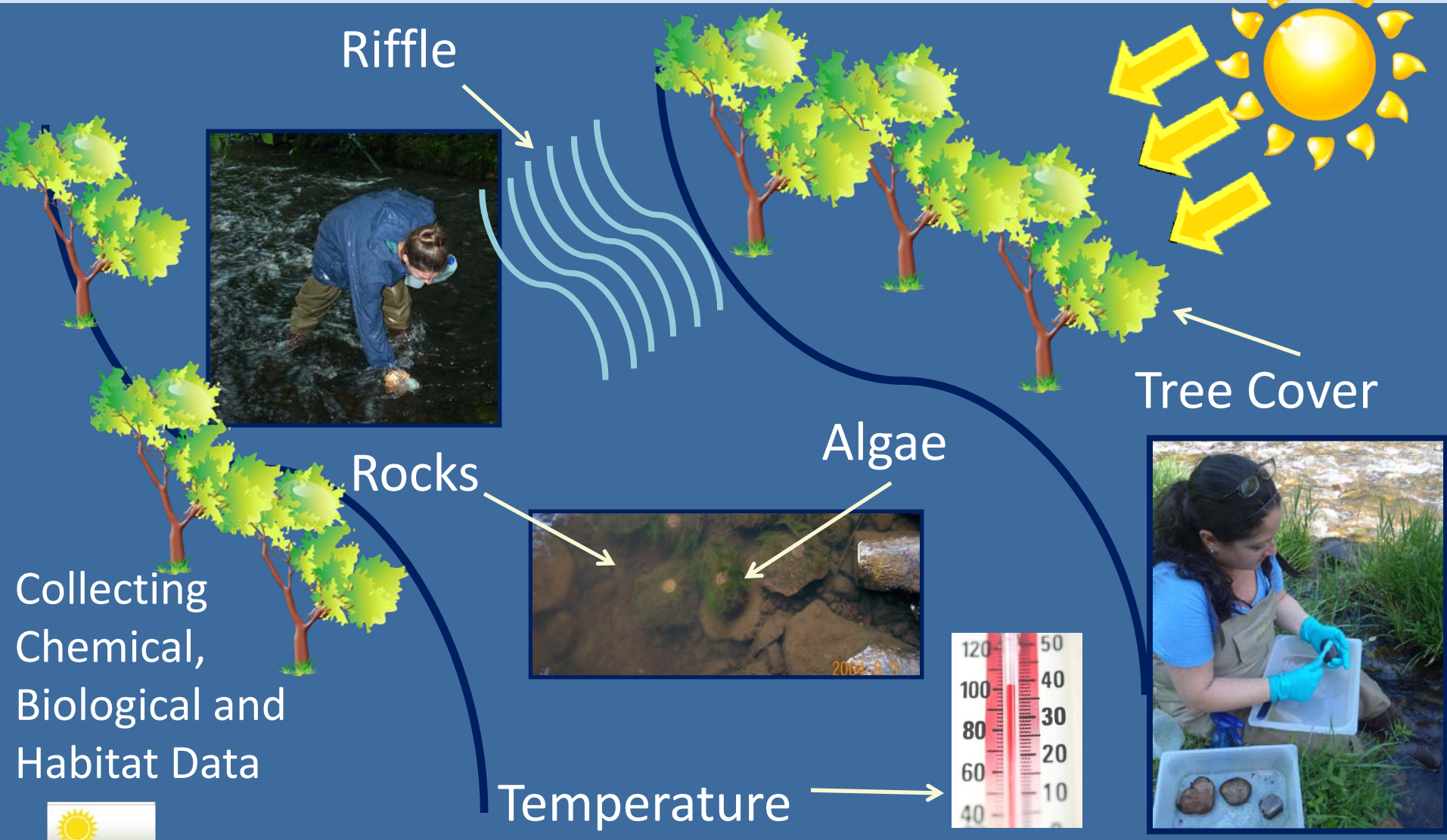


Monitoring to Support Nutrient Management

- Building on our current monitoring network in rivers and streams
- Expanding approach to non-waste receiving streams
- CT DEEP developed a Quality Assurance Project Plan (QAPP) approved by U.S. EPA

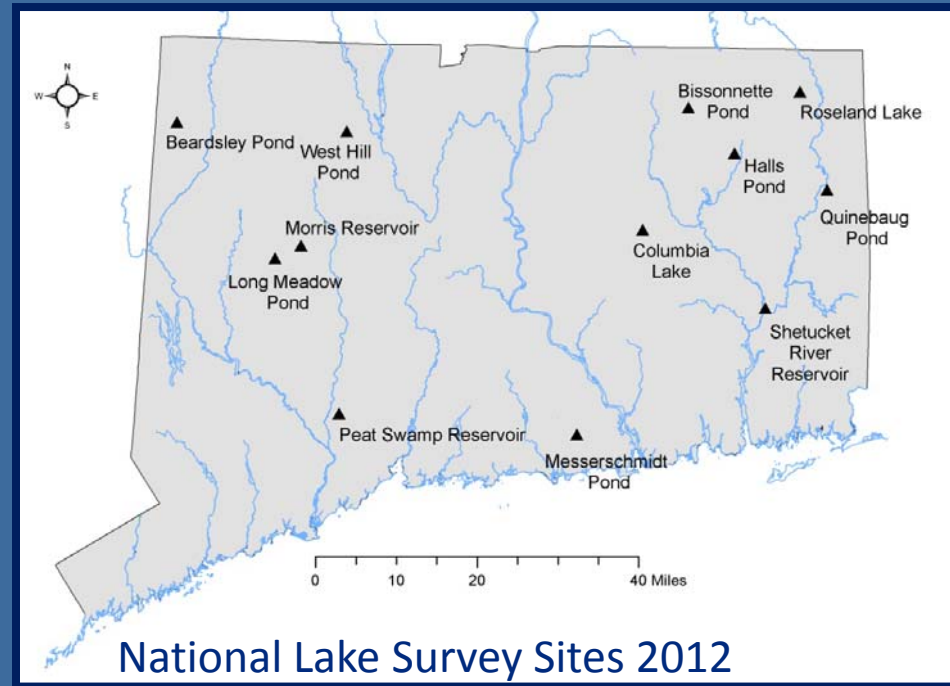


Monitoring to Support Nutrient Management



Lake Work

- Participated in EPA National Lake Survey Studies in 2007 and 2012
- Reviewing available data on lakes and impoundments



Further Information

CT DEEP QAPP is posted on website:

www.ct.gov/deep/phosphorus



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Opportunities & Next Steps

Clean Water Act Requirements

Phosphorus
& PA 12-155

Compliance Approaches for Municipalities

Scientific Methods for Measuring Phosphorus



Options for Phosphorus Controls at Wastewater Treatment Facilities



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Sources of Phosphorus in Wastewater

- Phosphorus enters the sanitary sewer system from several sources:
 - Human waste
 - Automatic dishwashing detergents
 - Corrosion inhibitors in water supply system
 - Industrial discharges
- The concentration of phosphorus in untreated wastewater ranges from 3 to 12 mg/l, with an average of approx 5 mg/l



Potential Source Control

- Legislation requiring elimination phosphorus from dishwasher detergents
- Work with water utilities to find phosphorus-free corrosion inhibitors
- Minimize phosphorus discharges from industries through pre-treatment



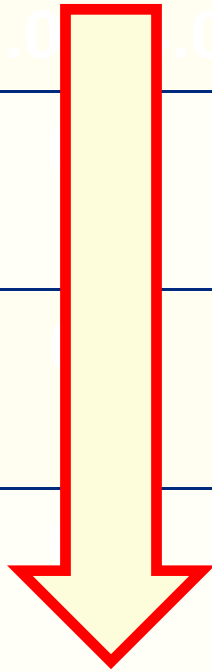
Phosphorus Removal at Wastewater Treatment Plants

- Phosphorus removal technology will vary based on the level of reduction needed
- In general, the more stringent the effluent limit, the higher the costs.
- Costs of phosphorus removal include both capital and operational components.

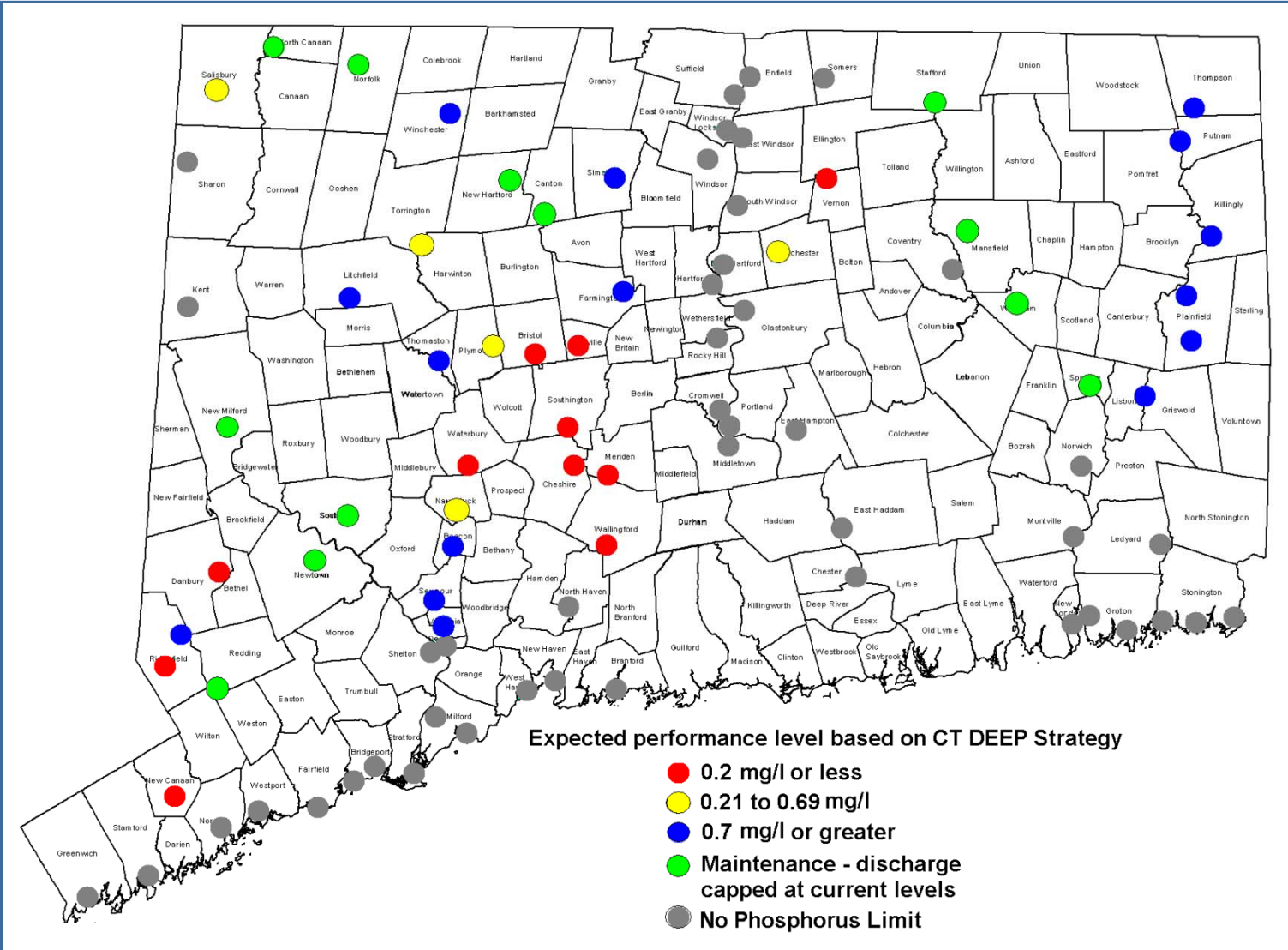


Phosphorus Treatment Technologies

As required effluent phosphorus levels decrease...	...Treatment technology changes:
2.0 → 1.0	Secondary treatment
	Biological treatment with anaerobic zones
	Chemical precipitation with iron or alum compounds
	Ultra-filtration or ballasted flocculation



Phosphorus Strategy for CT WPCFs



Connecticut's tiered approach

- Of the 43 municipal treatment facilities included in the strategy:
 - **12** are currently capped at their existing phosphorus load
 - **15** are anticipated to meet limits with biological treatment with anaerobic zones
 - **5** are anticipated to meet limits with chemical precipitation
 - **11** are anticipated to meet limits with ultra-filtration or ballasted flocculation



Capital Investment

- Preliminary estimates of the capital investment necessary to implement CT DEEP phosphorus control strategy over the next 10 years is \$180 to \$250 Million



FY2012 –13 Clean Water Fund Priority List

- PA 12-155 made phosphorus components of a construction project eligible for 30% grant
- Status of current projects with phosphorus control components
 - Manchester (under construction)
 - Bristol (under design)
 - Cheshire (under design)
- Reserve for facilities planning (which may include phosphorus reduction) still available

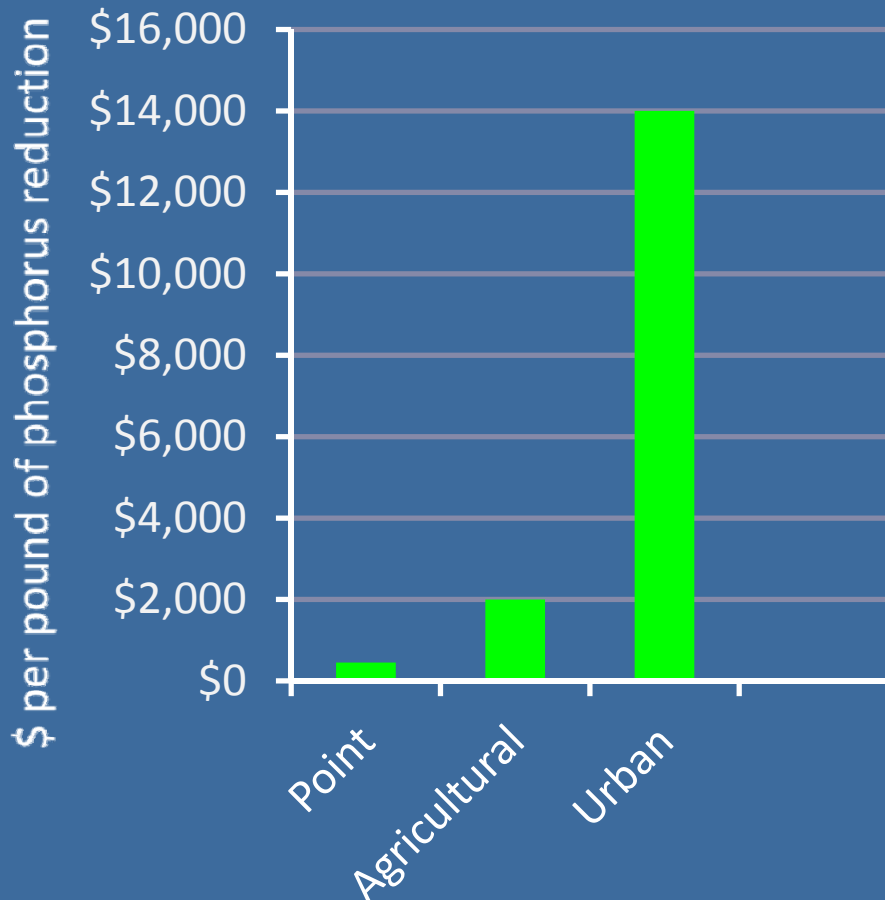


FY 2014-2015 CWF Capital Budget Request

Reserves	\$M
Planning Grants	10.00
Small Community	46.00
CSO Design	40.00
WPCF Design	16.00
Pump Station	20.00
WPCF Generators	20.00
Infiltration/Inflow	90.00
Sewers	60.00
Construction	
WPCF Upgrades	686.30
CSO	560.00
Total	1,548.30



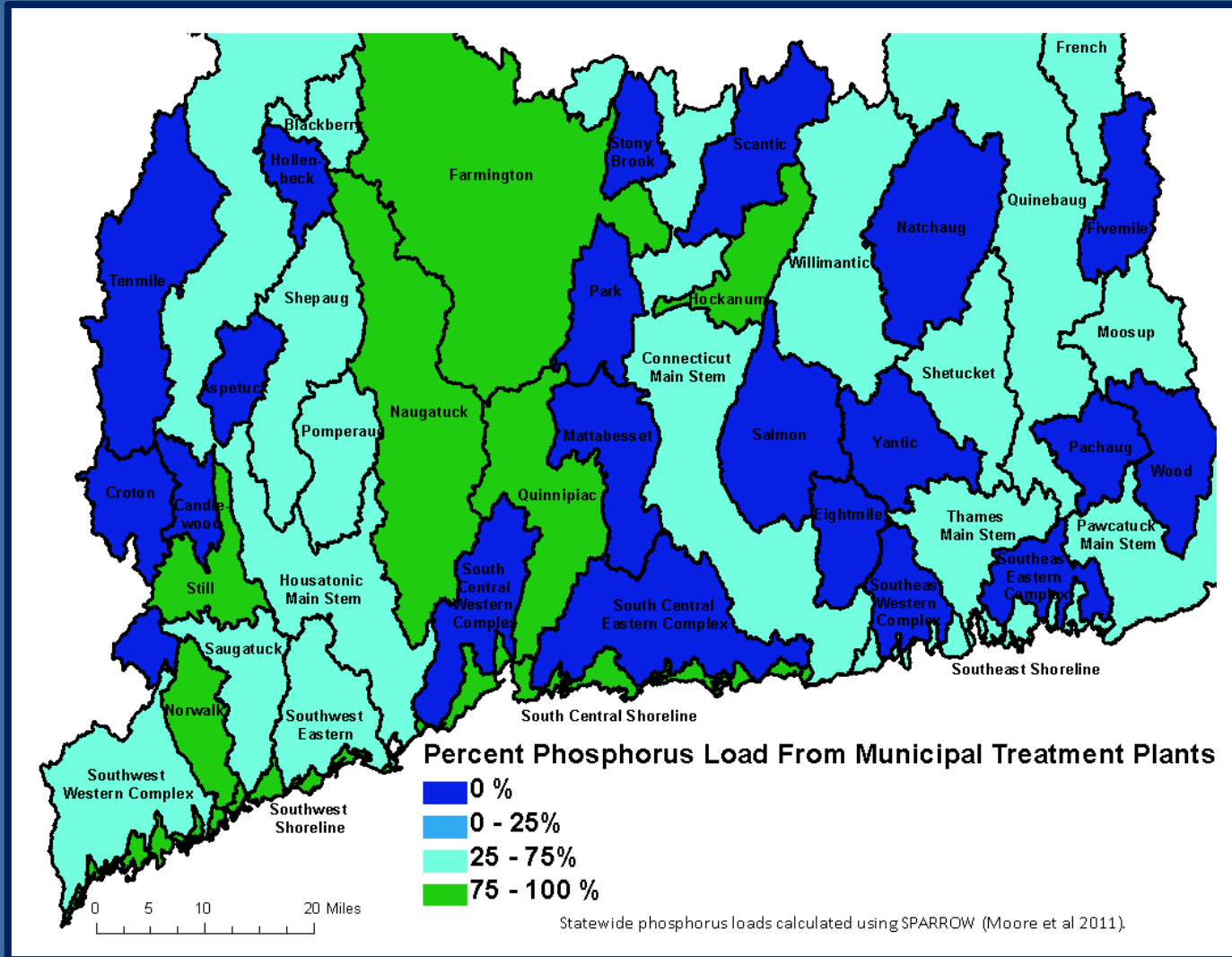
Estimated Capital Cost per lb removed



- Capital cost of removing **point** source phosphorus, based on CT DEEP strategy, is from **\$450** to \$620 per pound.
- Capital cost of removing **agricultural** phosphorus is from **\$2,000** to \$10,000 per pound (EPA)
- Capital cost of removing **urban stormwater** phosphorus in Charles River Basin ranges from **\$14,000** to \$32,000 per pound (EPA)



Current Management Efforts in Non-Tidal Waste Receiving Streams



NEXT STEPS



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Next Steps

- Compiling of today's and website comments
- Analysis of comments
- Consider recommendations
 - Alignment with existing efforts
 - Potential topical workgroups to study further



Collaboration Suggestions

- Website to receive comments:
DEEP.Phosphorus@ct.gov
- Please submit comments by December 28, 2012

