

# MassDEP's Surface Water Monitoring Program

Wastewater Advisory Committee, October 7, 2016

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**Bureau of Water Resources**

**Division of Watershed Management**

**Watershed Planning Program**

**Worcester, MA**

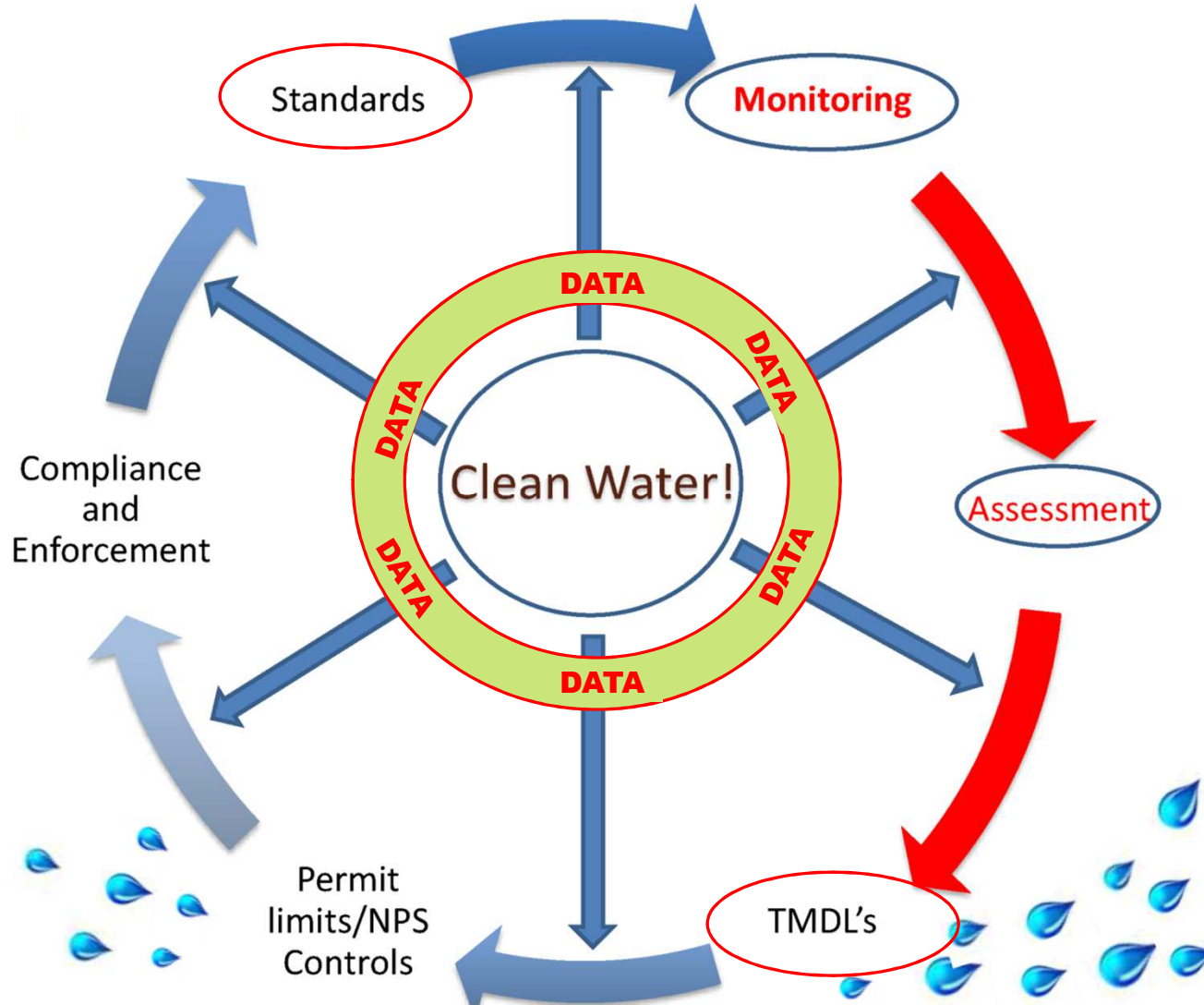
# Outline

- \* Background CWA
- \* Monitoring Networks
- \* Probabilistic Monitoring
- \* Water Resource Management Trends

# Background

- \* CWA goal to restore and maintain integrity of Nation's waters
- \* MassDEP administers a multi-faceted water quality management program
- \* Program relies on credible water monitoring data to inform decision-making
- \* States allowed flexibility to design and carry out water monitoring programs

# MassDEP Watershed Planning Program Scope



# Monitoring Program Objectives

- \* Assess the status or condition of Massachusetts' waters:  
*Water is the current condition relative to management goals?*
- \* Develop, implement and evaluate pollution control strategies: *Watershed plans, total maximum daily loads (TMDL), wastewater permit effluent limits*
- \* Review standards: *cold water fisheries, EPA Guidance toxics (cadmium (2016); EPA Recreation Criteria (2012)*
- \* Measure the effectiveness of water quality management programs – *Are we meeting water Quality Standards?*

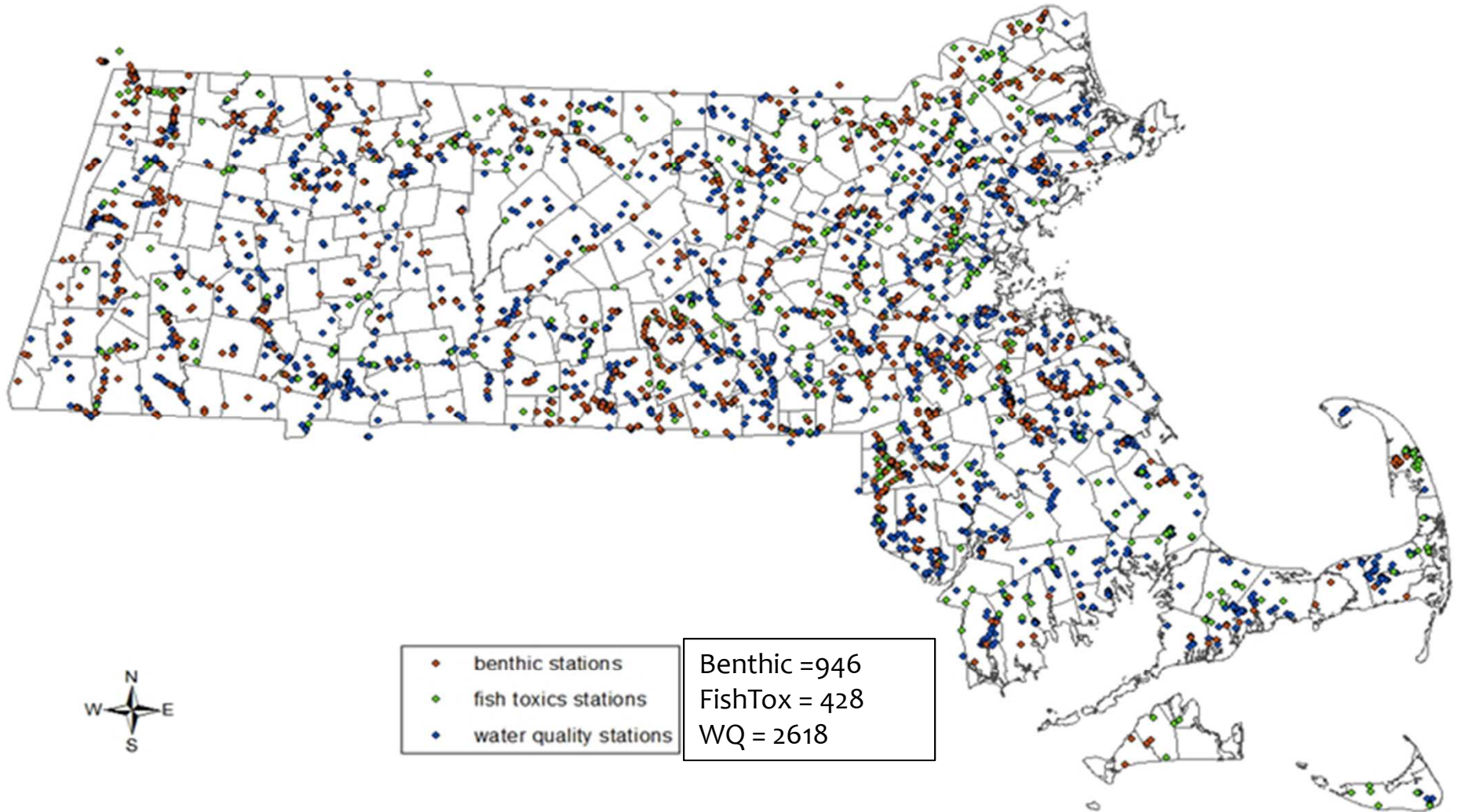
# Monitoring Networks

- \* **Deterministic** (“Targeted”) Site- or Issue-specific Networks implemented on rotating watershed or priority-driven schedules
- \* **Fixed-site Networks** of strategic sites sampled long-term at regular intervals to assess loadings and trends
- \* **Statistically-valid** (“Probabilistic”) Networks employ randomly selected sites to provide unbiased assessments to be applied at larger scales (state-wide)

# Monitoring Networks

- \* Deterministic – “Targeted” [1994-2011]:
  - 5-year rotating basin
  - Location specific assessment
  - Condition of surface water
  - Many locations Co-located with WWTP discharges

### MassDEP-DWM-WPP Historical Water Quality, Benthic and Fish Toxics Sampling Stations 1994-2013

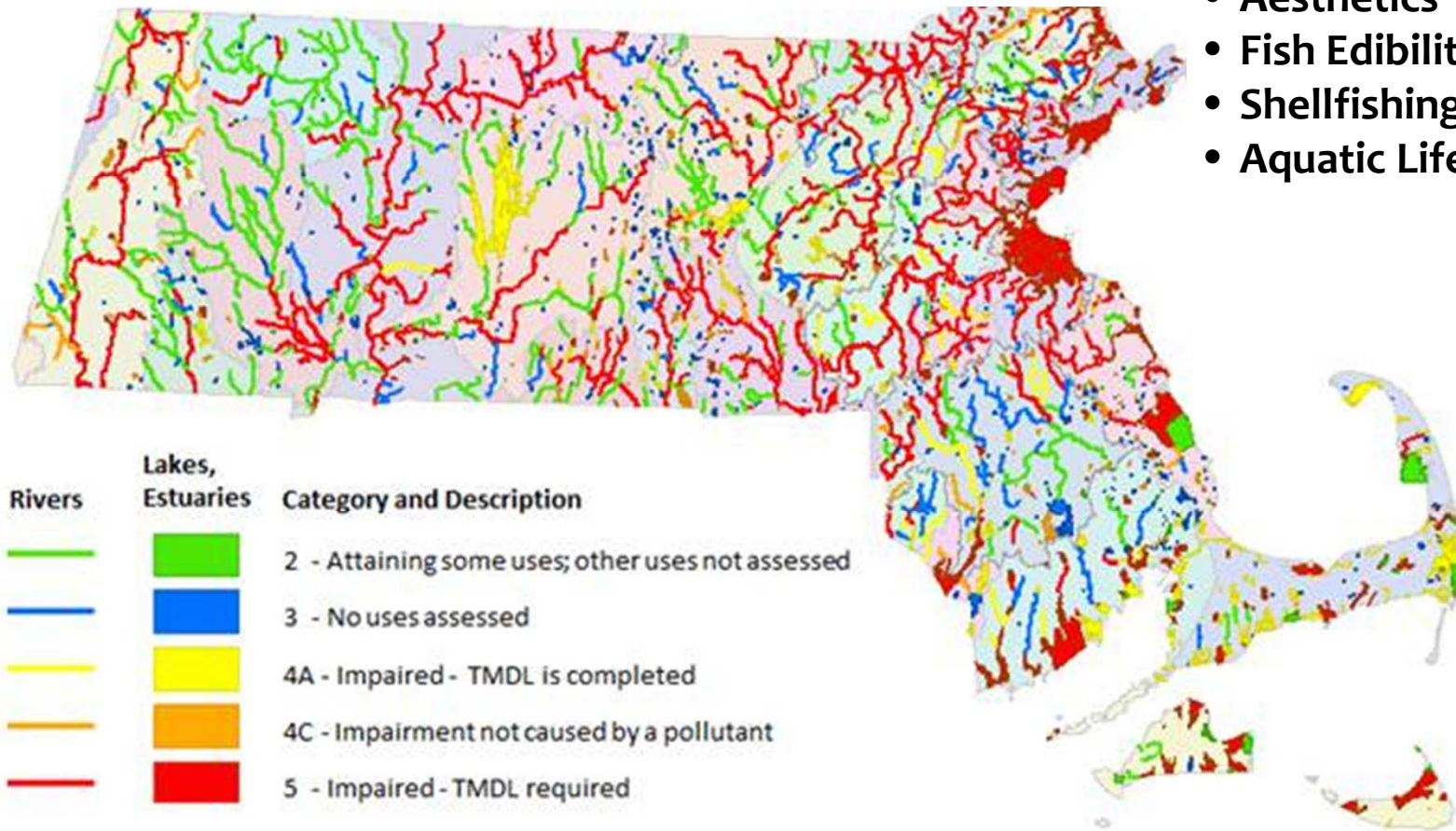




# Water Quality Assessment

## MassDEP Integrated List of Waters

- Primary Contact
- Secondary Contact
- Aesthetics
- Fish Edibility
- Shellfishing
- Aquatic Life

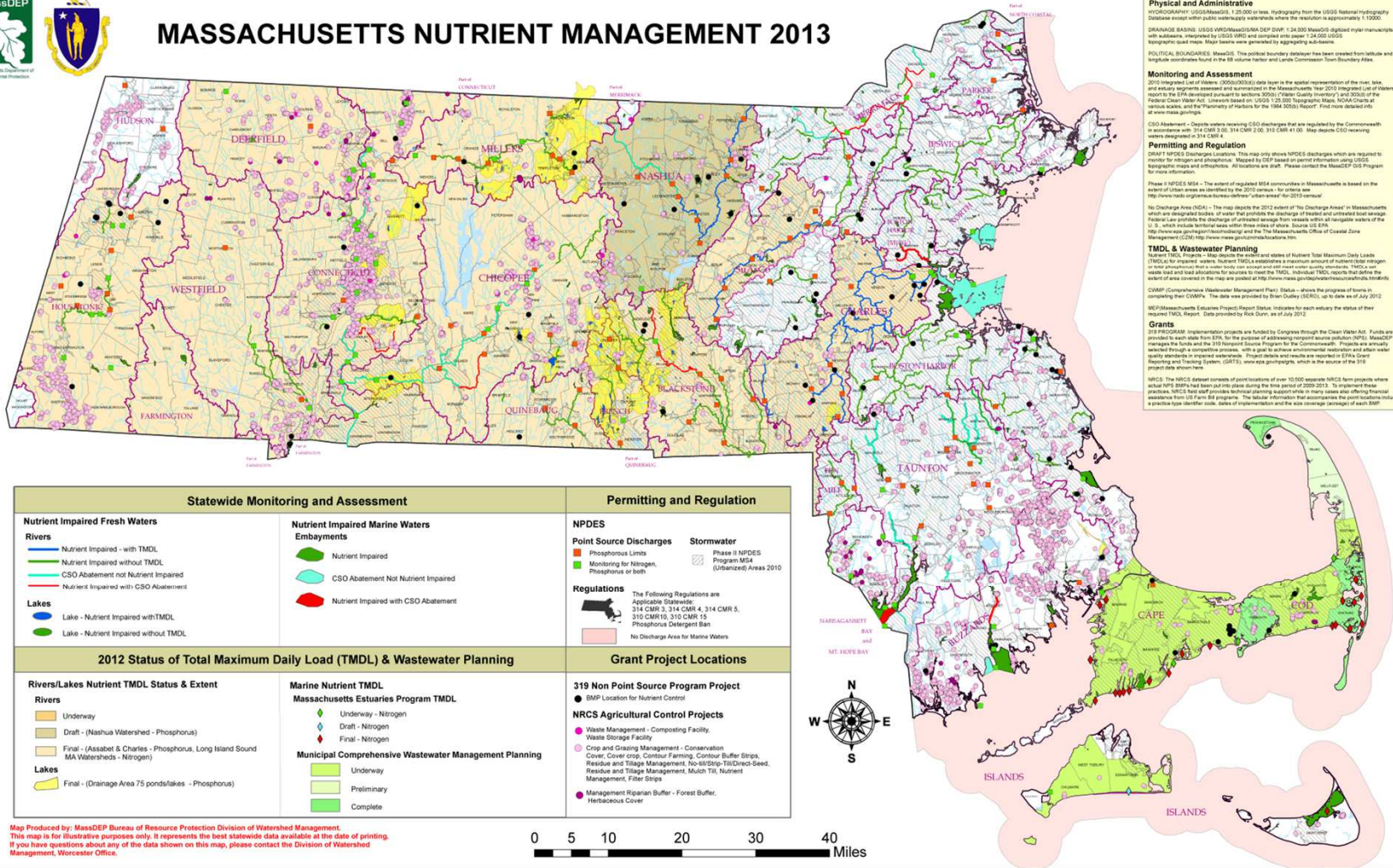


# Pollution Control Nutrient TMDLs

<http://www.mass.gov/eea/agencies/massdep/water/watersheds/massachusetts-nutrient-management-report-2013.html>



## MASSACHUSETTS NUTRIENT MANAGEMENT 2013



**Data Sources**

**Physical and Administrative**

**HYDROGRAPHY:** USGS/MADEP: 1:25,000 or less. Hydrography from the USGS National Hydrography Dataset except where public waterways watersheds exceed the resolution approximately 1:50,000.

**DRAINAGE BASINS:** USGS/MADEP/MA DEP DWP: 1:24,000 VectorGIS digitized vector manuscripts with address, imported by USGS/MADEP and compiled into page 1:24,000 USGS hydrographic land mass. Most basins were generated by aggregating sub-basins.

**POLITICAL BOUNDARIES:** MADEP. The political boundary dataset has been created from latitude and longitude coordinates found in the 88 volume parcel and Land Commission Town Boundary Files.

**Monitoring and Assessment**

**CSO Assessment:** Depthwise waters receiving CSO discharges that are regulated by the Commonwealth in accordance with 314 CMR 3.00, 314 CMR 2.00, 310 CMR 41.00. Map depicts CSO receiving waters designated by 314 CMR 4.

**Permitting and Regulation**

**CSO/ NPDES Discharges Location:** This map only shows NPDES discharges which are required to monitor for nitrogen and phosphorus. Mapped by DEP based on permit information using USGS hydrographic maps and orthophotos. All locations are exact. Please contact the MassDEP GIS Program for more information.

**Phase II NPDES MS4:** The extent of regulated MS4 communities in Massachusetts is based on the extent of urban areas as identified by the 2005 census. For criteria see: <http://www.mass.gov/eea/npdes/phase2/> for 2013 census.

**The Discharge Area (DMA):** This map depicts the 2012 extent of the Discharge Area in Massachusetts which are designated bodies of water that prohibits the discharge of treated and untreated boat sewage. Federal Law prohibits the discharge of untreated sewage from vessels within all navigable waters of the U.S., which include territorial seas within three miles of shore. Source: US EPA. <http://www.epa.gov/gis/npdes/dma/> and The Massachusetts Office of Coastal Zone Management (OCZM). <http://www.mass.gov/oczm/locations.htm>

**TMDL & Wastewater Planning**

**CSO/ NPDES:** MassDEP has identified and states of Existent Total Maximum Daily Loads (TMDLs) for nitrogen and phosphorus. These TMDLs require a permit to discharge. NPDES permits are issued to point sources which discharge into water bodies and are used to monitor water quality standards. TMDLs are used to establish total and load allocations for sources to meet the TMDL. Individual TMDL reports detail the extent of area covered in the map are posted at <http://www.mass.gov/eea/npdes/tmdl/>

**CSO/ NPDES (Comprehensive Wastewater Management Plan) Status:** shows the progress of towns in completing their CSO/ NPDES. The data was provided by Clean Outlets (CSO), as of July 2012.

**MS4 (Massachusetts Estuaries Project) Status:** indicates for each estuary the status of their current TMDL report. Data provided by Rick Burn, as of July 2012.

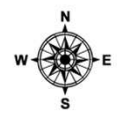
**Grants**

**319 PROGRAM:** Implementation projects are funded by Congress through the Clean Water Act. Funds are provided to each state from EPA, for the purpose of addressing nonpoint source pollution (NPDES). MassDEP manages the funds and the 319 Nonpoint Source Program for the Commonwealth. Projects are annually ranked through a competitive process, with grant for those environmental projects and other water quality activities in critical watersheds. Project details include the required 319 CSO/ NPDES Reporting and Training System (SRTS). [www.mass.gov/npdes/](http://www.mass.gov/npdes/), which is the source of the 319 project data sheet.

**NRCS:** The NRCS dataset consists of point locations of over 10,000 separate NRCS farm projects where actual NPS BMPs had been put into place during the time period of 2009-2013. To implement these practices, NRCS field staff provides technical guidance support which in many cases also allows financial assistance from US Farm Bill programs. The tabular information that accompanies the point locations includes a precise farm identifier code, dates of implementation and the size coverage (percentage) of each BMP.

Statewide Monitoring and Assessment		Permitting and Regulation	
<p><b>Nutrient Impaired Fresh Waters</b></p> <p><b>Rivers</b></p> <ul style="list-style-type: none"> <li>Nutrient Impaired - with TMDL</li> <li>Nutrient Impaired without TMDL</li> <li>CSO Abatement not Nutrient Impaired</li> <li>Nutrient Impaired with CSO Abatement</li> </ul> <p><b>Lakes</b></p> <ul style="list-style-type: none"> <li>Lake - Nutrient Impaired with TMDL</li> <li>Lake - Nutrient Impaired without TMDL</li> </ul>	<p><b>Nutrient Impaired Marine Waters Embayments</b></p> <ul style="list-style-type: none"> <li>Nutrient Impaired</li> <li>CSO Abatement Not Nutrient Impaired</li> <li>Nutrient Impaired with CSO Abatement</li> </ul>	<p><b>NPDES</b></p> <p><b>Point Source Discharges</b></p> <ul style="list-style-type: none"> <li>Phosphorus Limits</li> <li>Monitoring for Nitrogen, Phosphorus or both</li> </ul> <p><b>Stormwater</b></p> <ul style="list-style-type: none"> <li>Phase II NPDES Program MS4 (Urbanized) Areas 2010</li> </ul> <p><b>Regulations</b></p> <p>The Following Regulations are Applicable Statewide:</p> <ul style="list-style-type: none"> <li>314 CMR 3.0, 314 CMR 4, 314 CMR 5, 310 CMR 10, 310 CMR 15</li> <li>Phosphorus Detergent Ban</li> <li>No Discharge Area for Marine Waters</li> </ul>	<p><b>Grant Project Locations</b></p> <p><b>319 Non Point Source Program Project</b></p> <ul style="list-style-type: none"> <li>BMP Location for Nutrient Control</li> </ul> <p><b>NRCS Agricultural Control Projects</b></p> <ul style="list-style-type: none"> <li>Waste Management - Composting Facility, Waste Storage Facility</li> <li>Crop and Grazing Management - Conservation Cover, Cover crop, Contour Farming, Contour Buffer Strips, Residue and Tillage Management, No-Till/Strip-Till/Direct-Seed, Residue and Tillage Management, Mulch Till, Nutrient Management, Filter Strips</li> <li>Management Riparian Buffer - Forest Buffer, Herbaceous Cover</li> </ul>
<p><b>2012 Status of Total Maximum Daily Load (TMDL) &amp; Wastewater Planning</b></p> <p><b>Rivers/Lakes Nutrient TMDL Status &amp; Extent</b></p> <p><b>Rivers</b></p> <ul style="list-style-type: none"> <li>Underway</li> <li>Draft - (Nashua Watershed - Phosphorus)</li> <li>Final - (Assabet &amp; Charles - Phosphorus, Long Island Sound MA Watersheds - Nitrogen)</li> </ul> <p><b>Lakes</b></p> <ul style="list-style-type: none"> <li>Final - (Drainage Area 75 ponds/lakes - Phosphorus)</li> </ul>		<p><b>Marine Nutrient TMDL Massachusetts Estuaries Program TMDL</b></p> <ul style="list-style-type: none"> <li>Underway - Nitrogen</li> <li>Draft - Nitrogen</li> <li>Final - Nitrogen</li> </ul> <p><b>Municipal Comprehensive Wastewater Management Planning</b></p> <ul style="list-style-type: none"> <li>Underway</li> <li>Preliminary</li> <li>Complete</li> </ul>	

Map Produced by: MassDEP Bureau of Resource Protection Division of Watershed Management. This map is for illustrative purposes only. It represents the best statewide data available at the date of printing. If you have questions about any of the data shown on this map, please contact the Division of Watershed Management, Worcester Office.



# What is Probabilistic Monitoring?

***Uses a randomly selected subset of a defined target population to provide an unbiased estimate on the condition of the target population along with a statement on the uncertainty of the estimate.***

- \* Randomly selected subset – ensures “representativeness” or unbiased estimate
- \* Target populations – Lakes, wetlands, wadeable streams, cold water fisheries, large rivers, marine and coastal etc.
- \* Uncertainty statement – ex. 53% +/- 3% of lakes support aquatic life

# EPA Rationale for Probabilistic Monitoring

- \* Clean Water Act (CWA) Section 305(b) – condition of all waters
- \* Cost-effectiveness – Census vs. Probability surveys
- \* Provides a more complete and less biased assessment of water quality condition in the state (**sample clean and dirty**)
- \* Potential to improve resource allocation among competing monitoring objectives
- \* Potential to streamline CWA Section 305(b) reporting
- \* Encouragement from EPA to include statistical surveys in the state monitoring strategy = **Funding**
- \* **National Assessment of Water Quality**

# Massachusetts Probabilistic Monitoring and Assessment Program (streams)

- \* Objectives

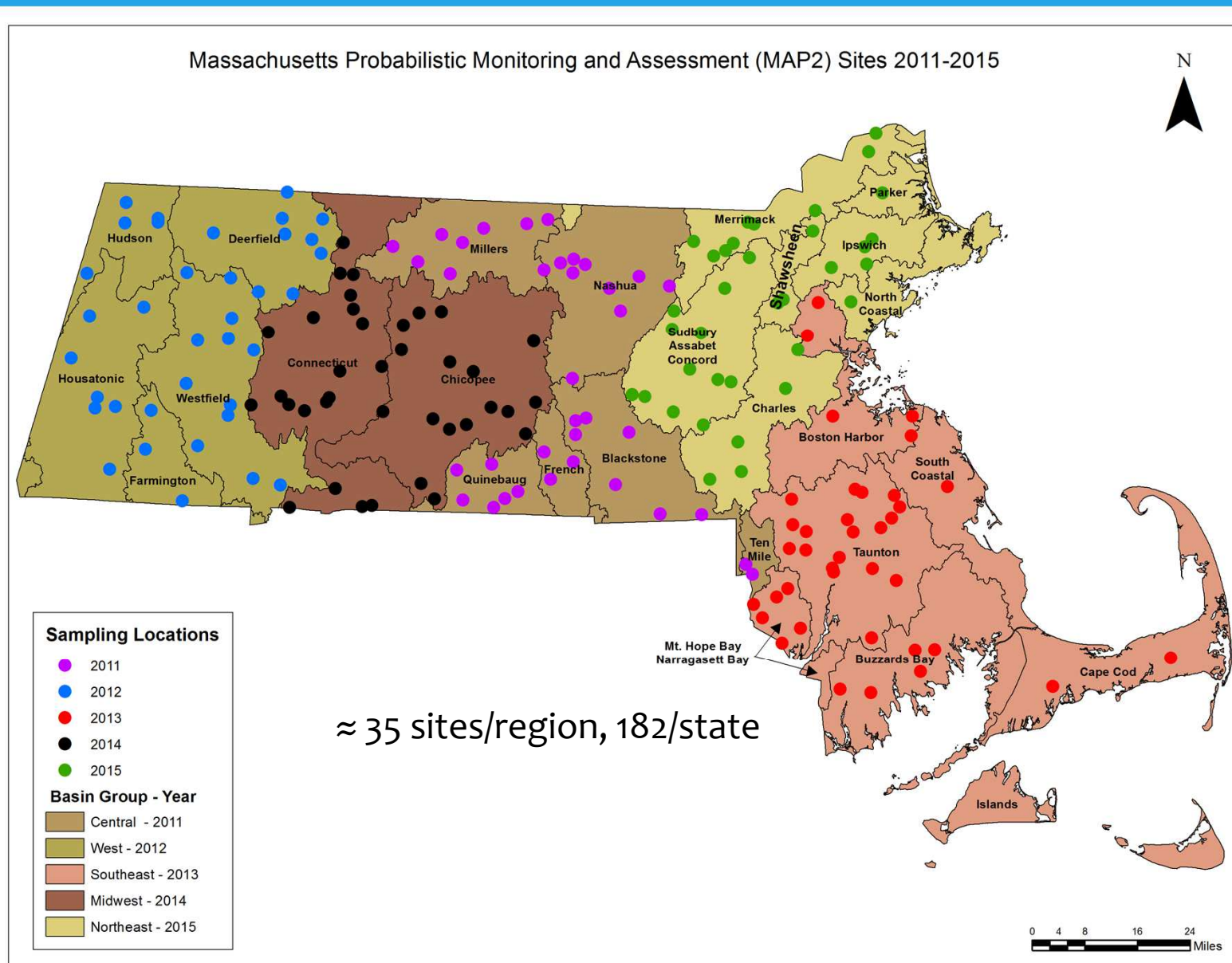
- \* Provide an unbiased assessment (Support/Impaired)
- \* Provide an unbiased estimation of the major causes & sources of impairments
- \* Potential to provide an analysis of trends (repeat sampling of random sites)
- \* Continue to explore opportunities for other data analysis that will provide insight into the water quality condition of the target population (e.g. biological criteria development)

# Wadeable Streams (2011-2015)

- \* Design

- \* **Target Population:** All wadeable 1<sup>st</sup> – 4<sup>th</sup> Strahler Order non-tidal perennial rivers and streams within MA
- \* **Sample Frame:** National Hydrography Dataset (NHD) (1:24,000)
- \* **Stratification:** Sites stratified by 5 basin groups
- \* **Sites Selected:**
  - \* 35 base and 128 oversample per basin group
  - \* 182 base sites statewide

# Wadeable Stream Sites Sampled (2011-2015)



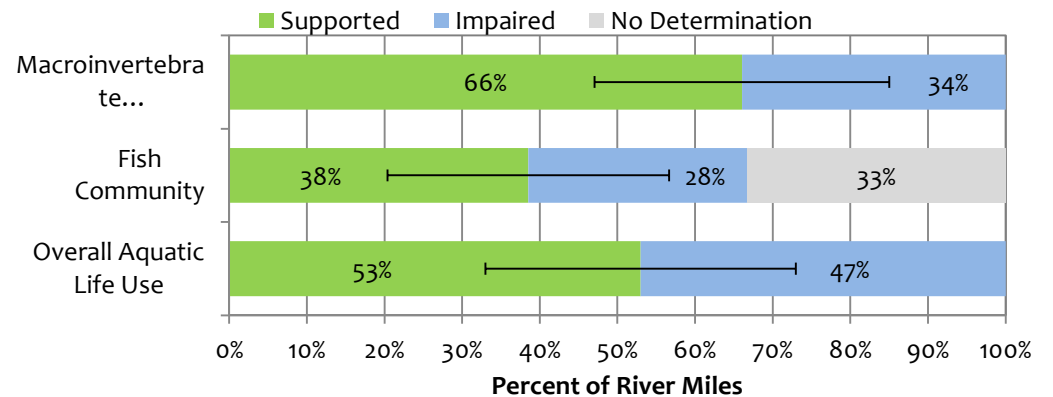
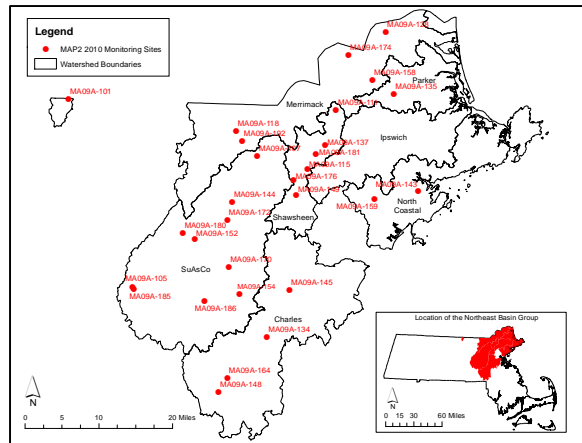
# MA Wadeable Streams (2011-2015)

## Sampling Plan

- \* Water Quality: monthly (May - September)
  - \* E. coli, total phosphorus, total nitrogen, ammonia, chloride, color, turbidity
- \* Dissolved metals: monthly (June - August)
- \* Deployed multi-probes: variable (May - Sept)
  - \* Continuous dissolved oxygen and temperature
- \* Macroinvertebrate community: once (July - August)
- \* Fish community: once (August – September)



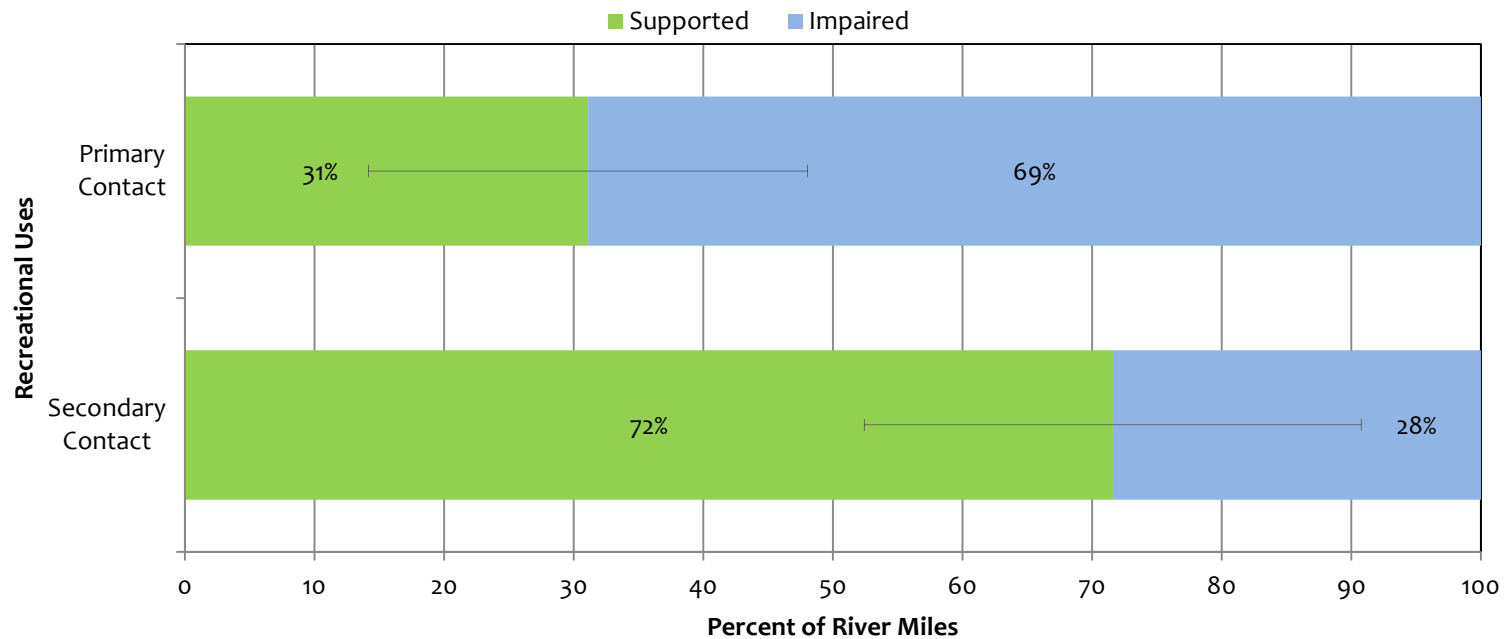
# Example Results



Extent of *Aquatic Life Use* stressors violating water quality criteria or guidance values in the target population. Error bars represent the 95% confidence interval.

# Example Results

Percentage of river miles in the target population supporting *Primary Contact Recreational Use and Secondary Contact Recreational Use*. Error bars represent the 95% confidence intervals.

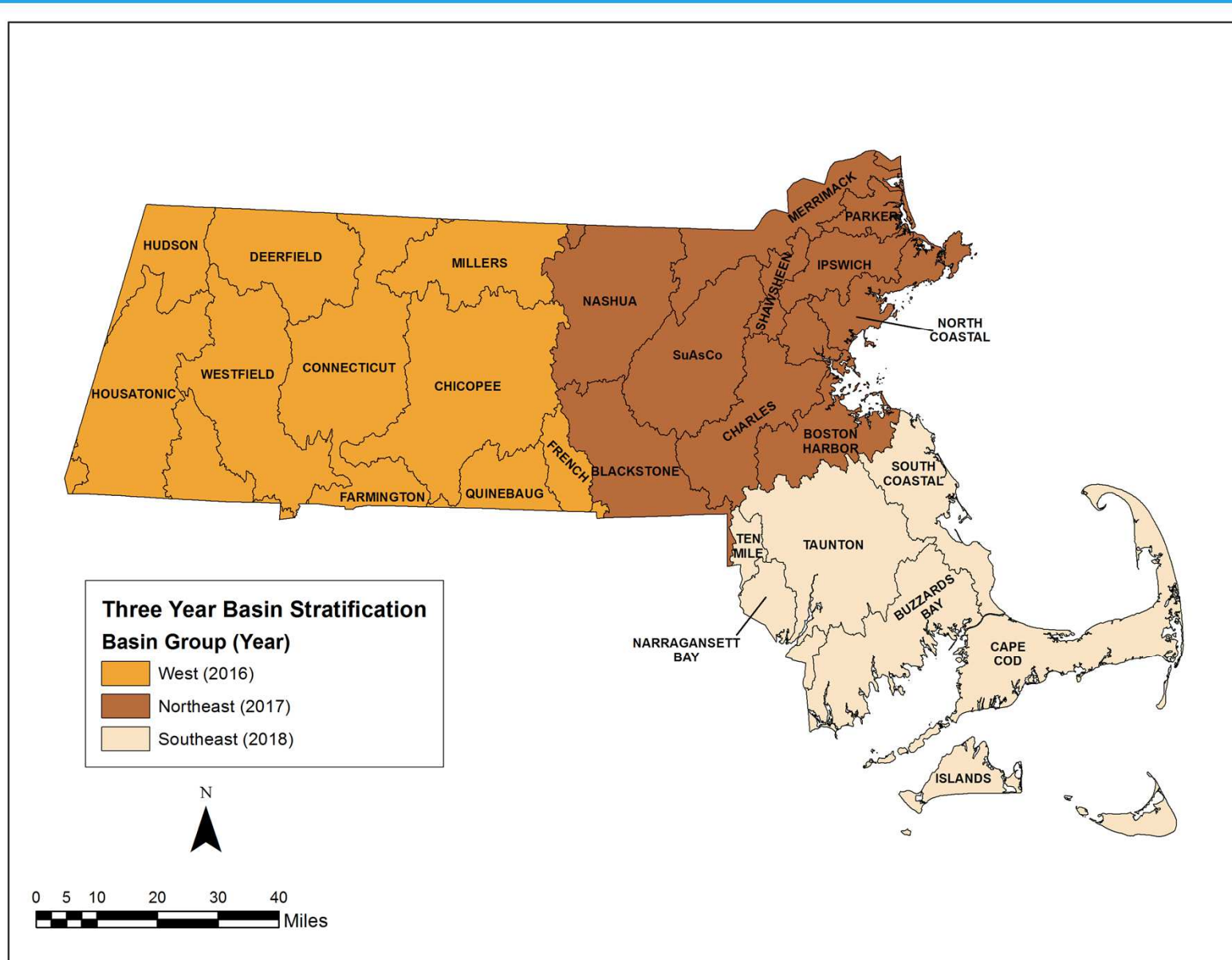


# Lakes (2016-2018)

## Design

- \* **Target Population:**
  - \* All permanent freshwater lakes, reservoirs, & ponds in MA
  - \* > 2 hectares in surface area and > 2 meters at max depth
- \* **Sample Frame:** National Hydrography Dataset (NHD)  
(1:24,000)
- \* **Stratification:** Sites stratified by 3 basin groups
- \* **Sites Selected:**
  - \* 25 base and 100 oversample per basin group
  - \* 75 base sites statewide

# Lakes Three Year Basin Stratification



# Lakes (2016-2018)

## Sampling Plan

Index Site (max lake depth)

- \* Frequency - every 6 weeks (June - September)
- \* Secchi disk
- \* Depth profiles - dissolved oxygen, temperature, pH, and specific conductivity
- \* Epilimnion – total phosphorus, total nitrogen, chloride, alkalinity, hardness, dissolved organic carbon, dissolved silica, color and turbidity
- \* Hypolimnion – total phosphorus and total nitrogen
- \* Photic zone composite – chlorophyll a, phytoplankton community

# Lakes (2016-2018)

- \* Sampling Plan (Continued)
  - \* Shoreline Site - site of probable public recreation (e.g. beach, boat ramp)
    - \* E. coli: monthly (May - September)
    - \* Algal toxins (microcystin and anatoxin a): monthly (July – September)
    - \* Phytoplankton community: monthly (July – September)
  - \* Whole Lake
    - \* Fish tissue – mercury, organochlorine pesticides, and metals
    - \* Littoral macroinvertebrate community
    - \* Macrophyte – biovolume, percent cover and non-natives
    - \* Bathymetry

# Water Resource Management Trends:

- \* Solving Water quality problems expensive
- \* Requires science-driven solutions
- \* Technology allows for data sharing
- \* Increasing number of data collectors (federal, state, NGO, regulated, private)
- \* Increasing need to leverage partnerships in data collection
- \* Data collection is expensive, get it right to optimize usability

# Water Quality Data Sources

## **Massachusetts State Agencies**

- Department of Environmental Protection - Drinking Water Program, Wetlands and Waterways Program, Watershed Planning, Wastewater Management Program and Permitting
- Department of Environmental Protection/UMass Dartmouth - Massachusetts Estuaries Project (MEP)
- Office of Coastal Zone Management (CZM)
- Department of Conservation and Recreation (DCR)
- Department of Fish and Game - Division of Marine Fisheries
- Department of Fish and Game - Division of Fisheries and Wildlife
- Department of Public Health (DPH)
- **Massachusetts Water Resources Authority (MWRA)**
- MassGIS data layers pertaining to land use, percent impervious cover, pollution sources, etc.

## **Federal Agencies**

- U.S. Geological Survey
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- National Oceanographic and Atmospheric Administration

## **Other Sources**

- Massachusetts Water Resources Research Center
- Colleges, Universities and associated academic institutions
- Watershed and lake associations
- Citizen monitoring programs
- Municipal Conservation Commissions (nonpoint source assessment)
- WWTPs- NPDES Permit Monitoring Requirements
- Municipal Facilities Plans
- Environmental consultants



# Questions?

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**MassDEP, Watershed Planning  
Program**

**Worcester,. MA 01606**

## **Data Submission Guidelines**

[www.mass.gov/eea/agencies/massdep/water/watersheds/external-data-submittals-for-the-wpp.html](http://www.mass.gov/eea/agencies/massdep/water/watersheds/external-data-submittals-for-the-wpp.html)

[WPP-Guidance\\_external data guidance sheets\CN000.72a - Guidance\\_External Data Submittal & Review\\_1-29-14.doc](#)