

# Monitoring and Assessment

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## Virtual WQS Academy

U.S. EPA Office of Wetlands,  
Oceans, and Watersheds

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# Disclaimer

- This Presentation does not:
  - Impose any binding requirements
  - Determine the obligation of the regulated community
  - Change or substitute for any statutory provision or regulatory requirement
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# What Does This Session Cover?

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- Brief intro to monitoring and assessment
  - Who monitors water quality?
  - How are monitoring data used?
  - What are different types of monitoring designs?
- What are critical components of a monitoring program needed to generate data of documented quality?
- What tools are available to assist with assessments?



# Introduction to Monitoring and Assessment

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- Water quality monitoring is a crucial aspect to protecting water resources.
- State, Tribal and Federal agencies have primary responsibility to monitor lakes, streams, rivers and other types of water bodies to assist them in managing water quality.
- Water resource managers use data to determine where pollution problems exist, where to focus pollution control energies or where progress is being made to improve water quality.

# Who Monitors Water Quality?

- **States, Tribes, Territories, and interstate organizations** implement monitoring programs under CWA 106.
- **Federal agencies** monitor to support their management and research needs.
- **Volunteer and citizen groups** monitor to understand local conditions.
- **Other organizations** include local government and academic organizations.





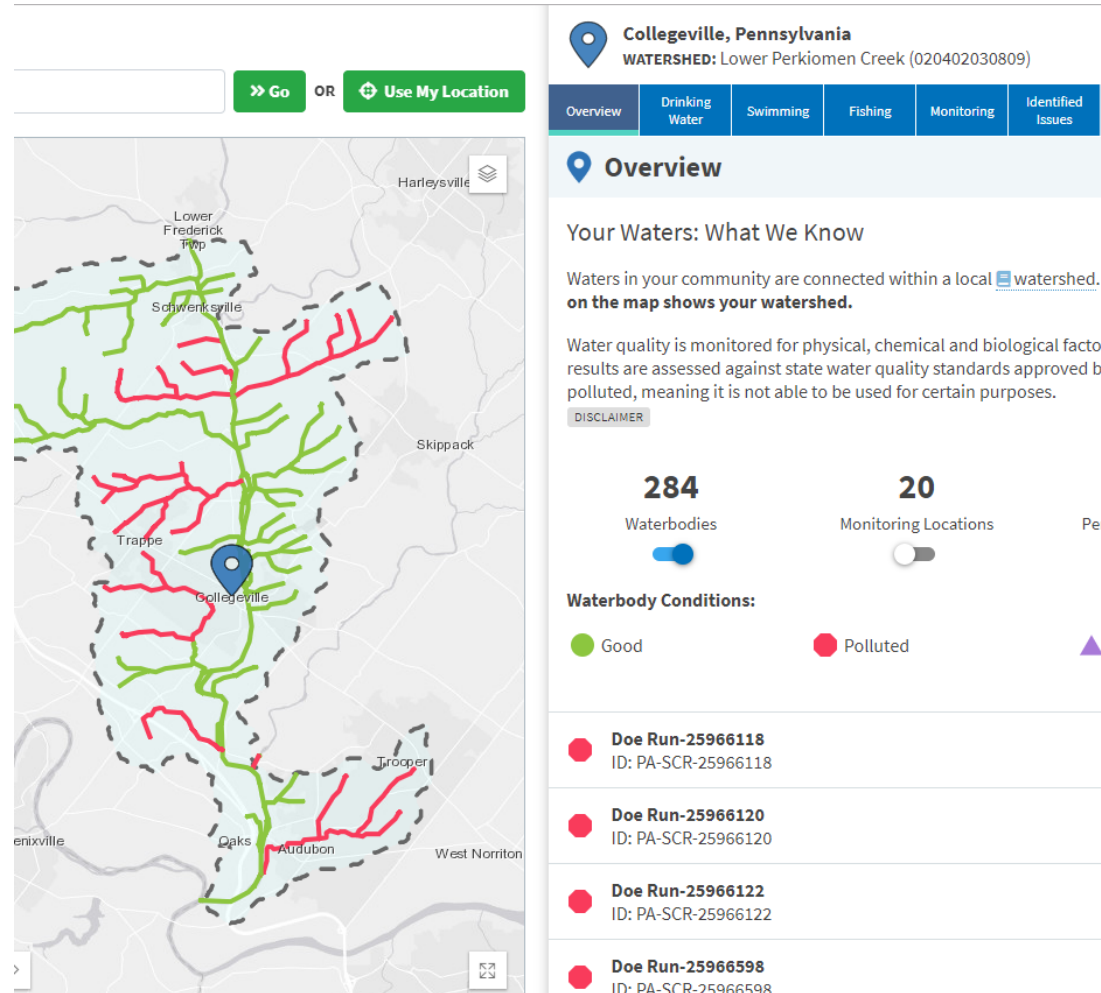
# Case Study: Proctor Creek

- Downtown Atlanta, GA waterway polluted by stormwater flooding and CSOs
  - Runs through economically depressed portion of city (4 Superfund sites in area)
- *Neighborhood Water Watch Program* expanded by Urban Waters Federal Partnership grant
- Residents near Creek trained to monitor streams and collect samples
  - 288 samples in 2010 → 6,000+ in 2015
  - Data reviewed by an approved Quality Assurance Project Plan developed by EPA under the grant
  - Used to clean up Creek and remove it from impaired waters list



# Monitoring Data To Tell the Water Story

- Monitoring Data is a part of the story that we can tell about water.
- It feeds into assessment decisions and can inform on-the-ground actions for water quality restoration and protection.



# How Are Monitoring Data Used?

- Assess extent of our Nation's waters meeting CWA goals: 305(b)
- Identify impaired waters: 303(d)
- Set protection and restoration priorities
- Identify emerging problems
- Support Reasonable Potential Analysis for NPDES permits
- Develop and implement TMDLs and watershed plans
- Develop models to understand ecosystem processes and predict problems and solutions
- Identify high quality waters for protection and as reference
- Determine the effectiveness of water pollution controls and actions
- Determine change in water quality conditions over time



**Understanding  
Our Water  
Resources**



# Types of Monitoring Designs

- We can't monitor everywhere, so we must monitor "smart." Types of monitoring designs include:
  - Statistically-valid surveys.
  - Targeted monitoring.
  - Fixed Site Network.
  - Rotating basin.
- EPA recommends that States/Tribes integrate a variety of designs to best meet the range of monitoring objectives and multiple decision needs.



# Statistically-Valid Surveys

- Site selection and data analysis are based on well developed and documented statistical methods.
  - Generate unbiased, representative assessment of target population.
  - Balanced spatially across area of interest (e.g., U.S.).
  - Balanced across sub-classes of target population (e.g., lake size).
  - Data are used to produce scientifically-valid reports on the condition of all waters of the U.S., state, watershed, or region.
- Focus is usually on key, broad, questions:
  - What extent of our Nation's waters support healthy ecosystems, recreation, fish consumption?
  - What key stressors are associated with poor conditions?
  - Is water quality improving?



# Targeted Sampling

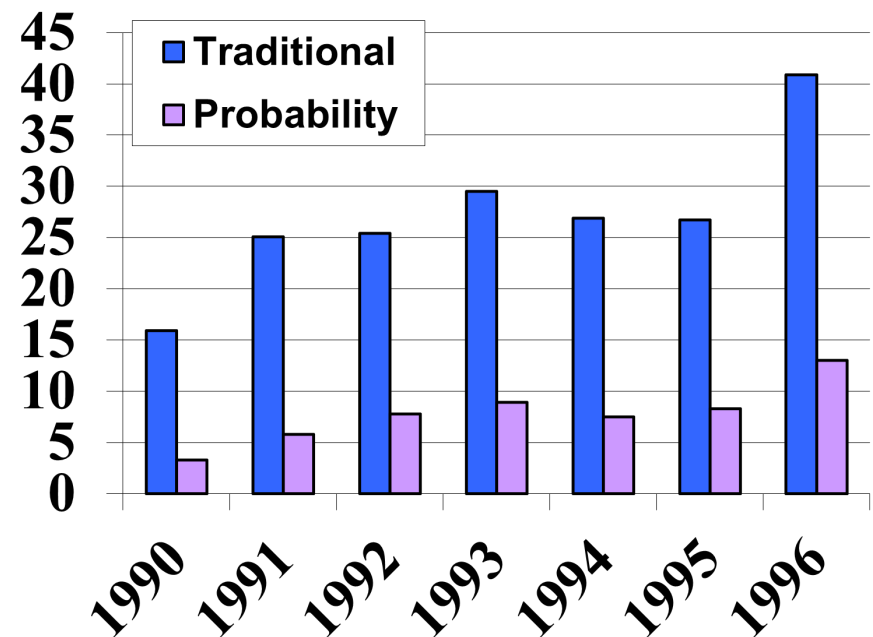
- Intentional selection of locations and parameters to inform a particular issue or question
- Allows for detailed analysis of cause and effect, fate and transport, seasonal variation
- Often targeted towards areas of concern. For example, targeted designs might:
  - Confirm 303(d) listing needed
  - Confirm and supplement information on pollutants/sources
- Used to develop site-specific controls
  - TMDL
  - NPS management measures
  - WQ-based NPDES permits

# Case Study on Sampling Design

## Improved Estimates of Population Size Oregon Coastal Coho Salmon

- Historic long term, targeted monitoring of spawning suggests minimal problem.
- Targeted sample locations were biased toward productive areas.
- Statistical (probability) survey results more accurately reflect populations.
- Survey sites selected using randomized design were more representative of conditions.
- State program modified based on statistical design.

## Estimated No. of Fish Per Mile



# Fixed Site Network

- Set of sites that stay in place and are monitored over many years – a type of targeted sampling.
- Provides information on water quality conditions for individual sites, can provide flux at the outlet of a catchment.
- Results aren't representative beyond sampling area but can be useful input to models.
- Provides status and trends information that can be used to make assessment decisions and examine long-term, in-depth changes for individual sites or parameters.







# Rotating Basin – More an Implementation Approach than a Design

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- State or region is divided into several geographic or hydrologic areas that are assessed on a rotating basis (commonly 5-year rotation).
  - Sampling design within basins may include statistical surveys, fixed station, targeted designs.
- Typically informed by discussion across programs to address range of program decision needs, like TMDL development, permit renewal.
- 5-year return cycle supports tracking changes and trends over time.

# Indicators Often Monitored

	Aquatic Life	Recreation	Drinking Water	Fish/Shellfish
<b>C O R E</b>	<ul style="list-style-type: none"> <li>• Biological communities</li> <li>• Basic chemistry (e.g., DO, pH)</li> <li>• Nutrients</li> <li>• Flow</li> <li>• Habitat assessment</li> <li>• Landscape condition</li> </ul>	<ul style="list-style-type: none"> <li>• Pathogen indicators (<i>E. coli</i>, enterococci)</li> <li>• Nuisance plant growth</li> <li>• Nutrients</li> <li>• Chlorophyll</li> <li>• Flow</li> <li>• Landscape condition</li> </ul>	<ul style="list-style-type: none"> <li>• Trace metals</li> <li>• Pathogens</li> <li>• Nitrates</li> <li>• Salinity</li> <li>• Sediments/TDS</li> <li>• Flow</li> <li>• Landscape condition</li> </ul>	<ul style="list-style-type: none"> <li>• Pathogens</li> <li>• Mercury</li> <li>• Chlordane</li> <li>• DDT</li> <li>• PCBs</li> <li>• Landscape condition</li> </ul>
<b>O T H E R</b>	<ul style="list-style-type: none"> <li>• Ambient toxicity</li> <li>• Sediment toxicity</li> <li>• Health of organisms</li> <li>• Other chemicals of concern in water or sediment</li> </ul>	<ul style="list-style-type: none"> <li>• Hazardous chemicals</li> <li>• Aesthetics</li> <li>• Other chemicals of concern in water or sediment</li> </ul>	<ul style="list-style-type: none"> <li>• VOCs</li> <li>• Hydrophilic pesticides</li> <li>• Algae</li> <li>• Other chemicals of concern in water or sediment</li> </ul>	<ul style="list-style-type: none"> <li>• Other chemicals of concern in water or sediment</li> </ul>

# National Aquatic Resource Surveys: A Partnership among EPA, States and Tribes



*Coastal*



*Streams and Rivers*



*Wetlands*



*Lakes*

1. Assess biological and recreational condition and changes over time of the nation's waters using indicators of condition and stress.
2. Rank stressors based on the relative associations between indicators of condition and indicators of stress.
3. Build/enhance state and tribal monitoring and assessment capacity.

# What is NARS Telling Us?

*What is NARS telling us?*

What percent of our nation's waters are in good condition based on biological indicators?

**Coastal waters and lakes have the most in good condition while rivers and streams have the fewest**



Coastal Waters  
**56%**



Lakes and Reservoirs  
**56%**



Rivers and Streams  
**28%**



Wetlands\*  
**48%**

Coastal waters, rivers and streams based on benthic macroinvertebrates; lakes and reservoirs based on plankton; wetlands based on plants.

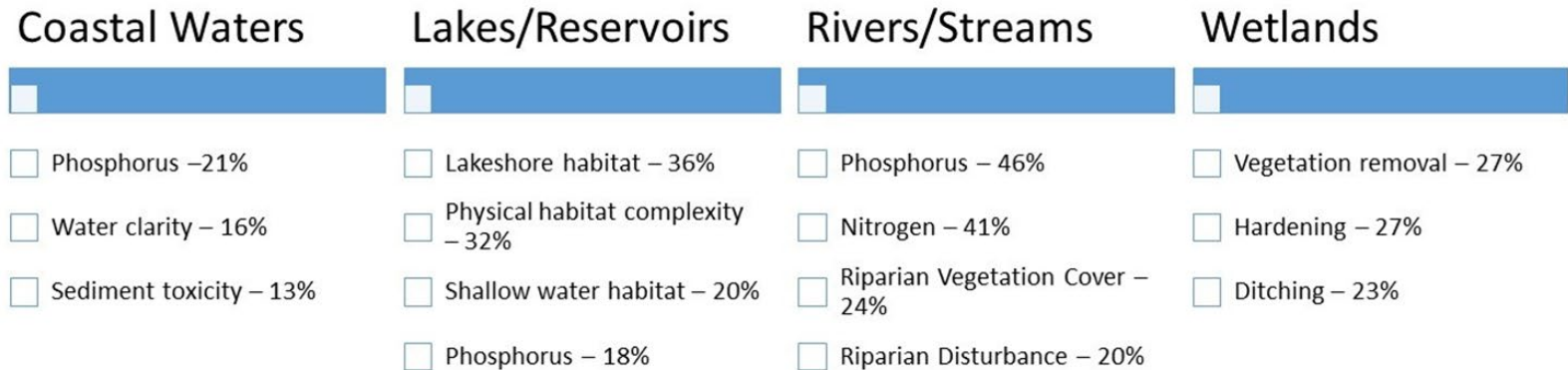
\* Draft Results



# What is NARS Telling Us?

*What is NARS telling us?*

## What stressors are impacting our waters? Nutrients and Habitat are problems across our waterbody types



Percent of waters rated poor or high



# What is NARS Telling Us?

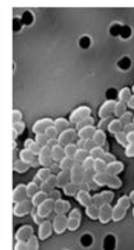
*What is NARS telling us?*

## What is the recreational condition of our nation's waters?



### Algal Toxins

- Microcystins were detected in 1/3 of lakes and at were at levels of concern in 1%.
- Microcystins were detected in 12% of wetland area and were at levels of concern in <1%



### Enterococci

- Enterococci were found at levels exceeding a human health threshold in 4% of lakes and 23% of rivers/streams.



### Fish Tissue - Mercury

- 13,144 river miles have fish with mercury concentrations above the human health criterion.

# Project Design

- Approach for answering the questions:
  - The **who**, **what**, **how**, and **where** of monitoring
- Sampling locations based on spatial and temporal representativeness
- Core indicators
- Data quality objectives and methods
- Quality Assurance
- Data management and interpretation
- Are existing data suitable
- Costs are a major consideration.





# Laboratory and Field Protocols

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- To ensure quality data are generated:
  - Use existing protocols to the extent possible
  - Develop Quality Assurance Project Plans (QAPPs) and other quality-related references
  - Document that laboratory methods meet data quality objectives
  - Document sample collection procedures for water, biology, tissue and habitat data indicators
  - Train and assess performance of all field crew personnel
  - Evaluate lab competency

# Approximate Costs

**Many factors influence field sampling costs per site**

- **Lab costs (per sample):**
- Water (basic, e.g. nutrients): \$70 to \$160
- Water (Metals): \$25 to \$115
- Water (Priority pollutants): \$100 to \$200
- Water (Indicator bacteria): \$20 to \$50
- Fish Tissue Contaminants: \$60 to \$1200
- Macroinvertebrates (identification & counting): \$350 to \$500

Site Cost \$1,000	Site Cost \$6,000
Seasonal employees	Permanent Staff
2-person field crews	3-to-4-person field crews
Consumables	Consumables + equipment
Sites close-by, easy access	Remote sites, difficult access
Simple reporting	Glossy reporting



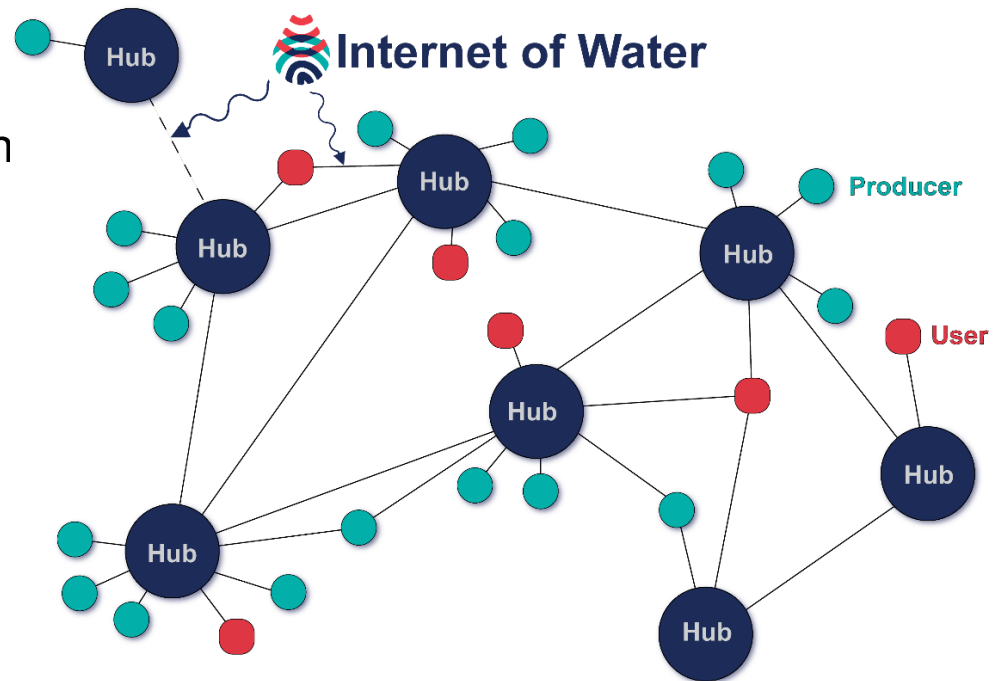
What tools are available to assist with  
assessments?



# Internet of Water

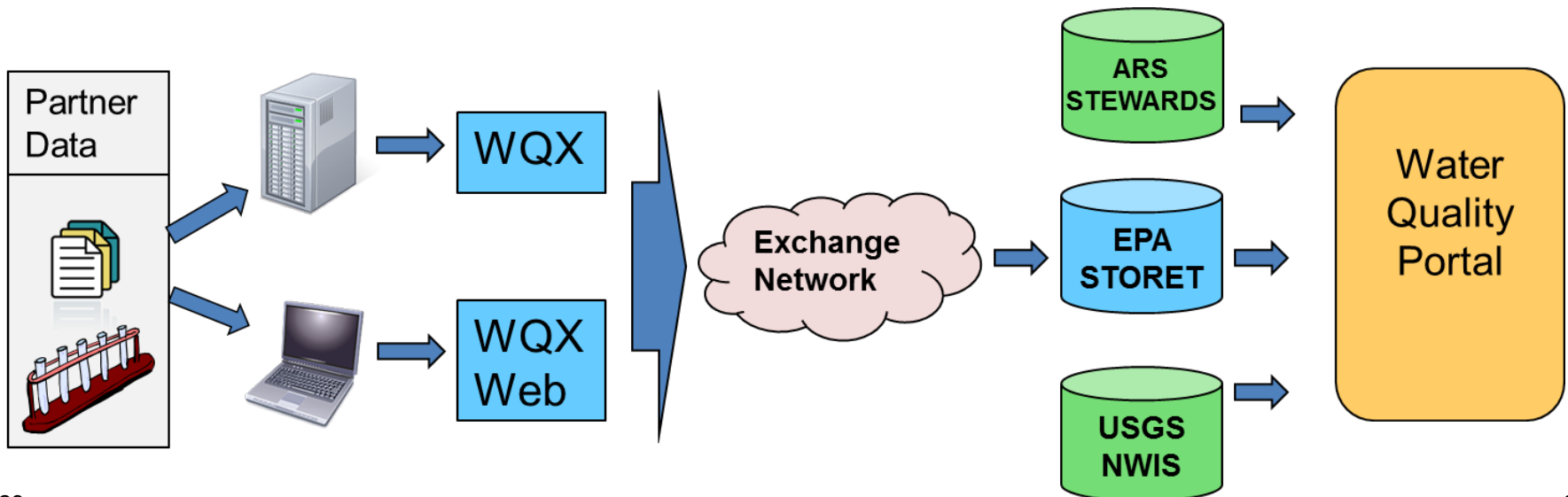
The IoW envisions a world engaged in sustainable water resource management and stewardship enabled by open, shared, and integrated water data and information

- **Data Producers:** Generators of data
- **Data Hubs:** Collections of data sets in standard formats
- **Data Users:** Create value by using data



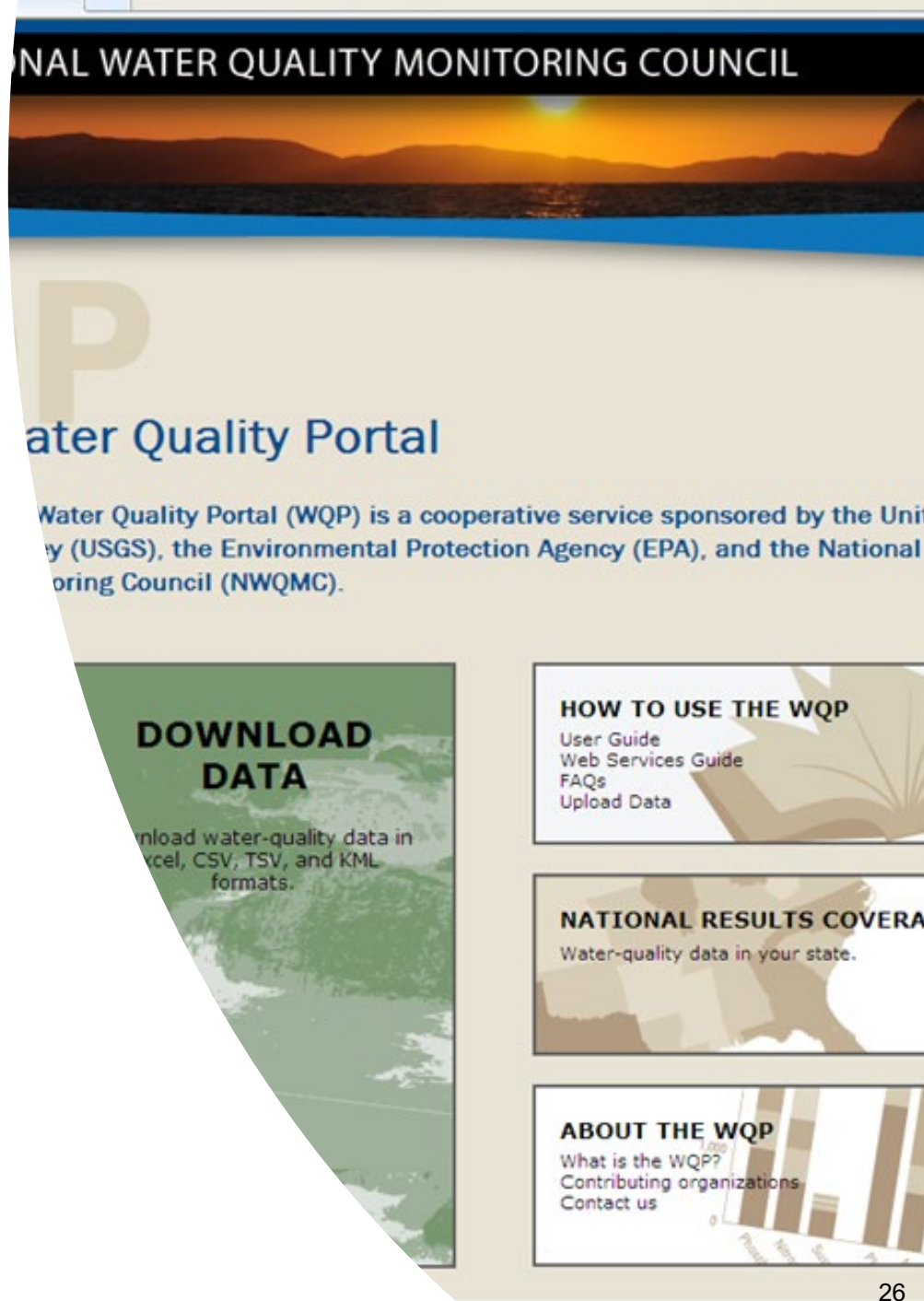
# The Role of WQX in Data Sharing

- The water quality data portal (an EPA/USGS partnership) provides access to ~ 375 million water quality results.
- These data are all available via web services which can be incorporated into any other third-party application.



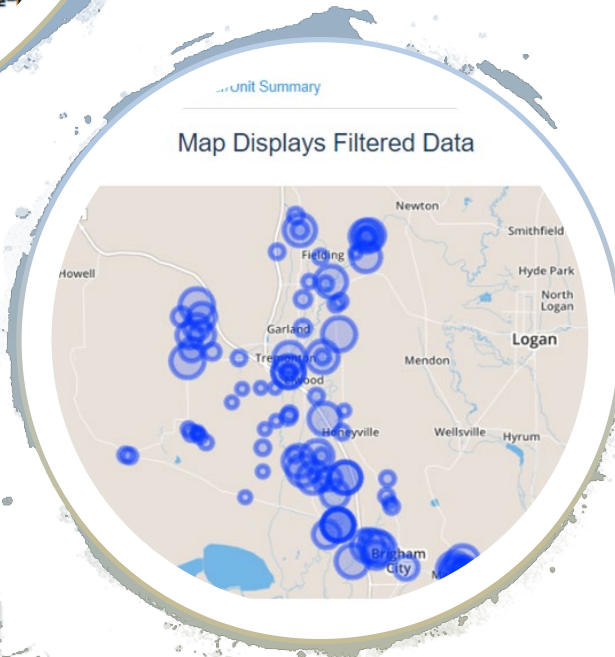
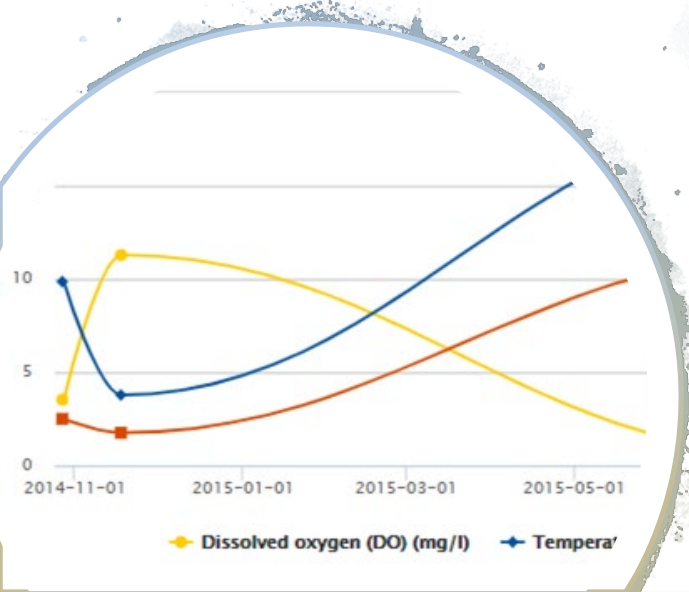
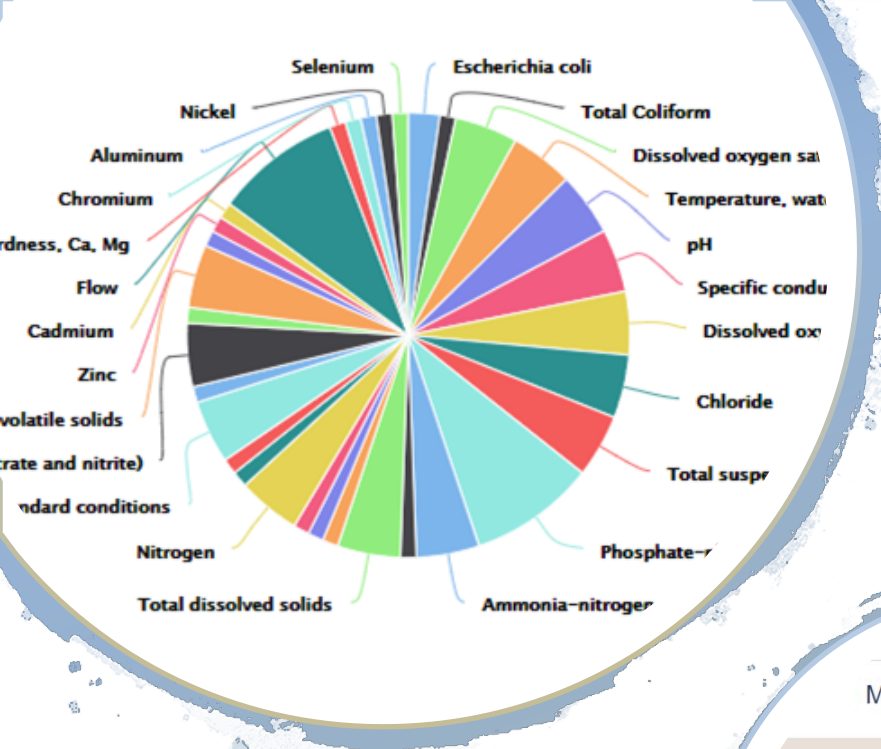
# Accessing Water Quality Data

Integrates publicly available water quality data from the USGS National Water Information System (NWIS) the EPA Water Quality Exchange (WQX), and the USDA ARS Sustaining The Earth's Watersheds - Agricultural Research Database System (STEWARDS)



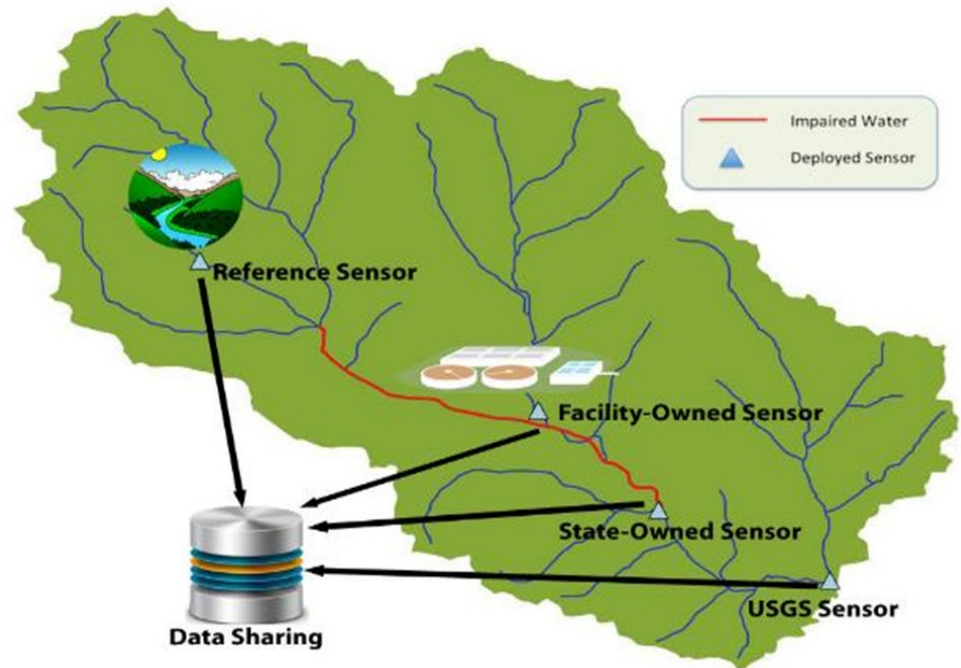
# Open Source / Data Discovery

- [Data Discovery Tool](#) is an R tool which helps user's identify available monitoring data for different parameters.



# A New Approach for Continuous Data Streams - An Interoperable Sensor Network

- Sensors are owned/operated by diverse organizations.
- Use data standards to promote data interoperability.
- Data can be available real-time and also archived for future reference.





# Accessing Geospatial Data

Water geospatial data layers can be downloaded at EPA's WATERS website and linked to NHD

- Permitted Dischargers
- Fish Consumption Advisories
- Fish Tissue Data
- Impaired Waters with TMDLs
- Sewage No Discharge Zones
- Nonpoint Source Projects
- Water Quality Standards
- Listed Impaired Waters
- Assessed Waters
- Beaches
- Clean Watershed Needs
- Combined Sewer Overflows
- CWSRF Benefits Reporting

# Geospatial Services

## ATTAINS\_Assessment

### ATTAINS Assessment Lines

- Unassessed
- Good
- Polluted

### ATTAINS Assessment Areas

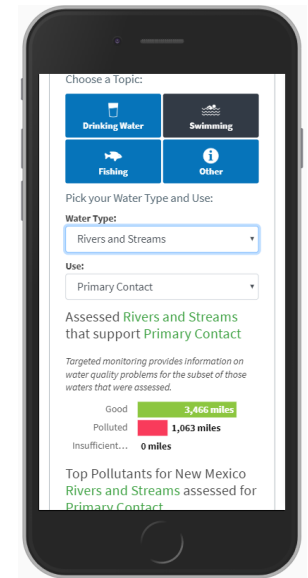
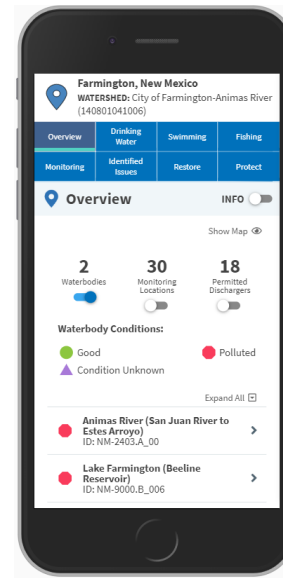
- Unassessed
- Good
- Polluted



# How's My Waterway

EPA's Office of Water designed ***How's My Waterway*** to help the public get answers about their community's waterways:

- ***easy***
- ***local***
- ***fast***
- ***map or list format***
- ***in plain English***
- ***provides state-reported assessments, TMDLs, monitoring, permitted facilities, drinking water, and non-point source projects***



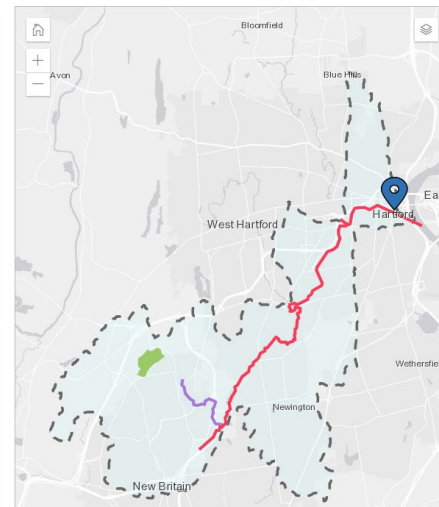
Let's get started!

Hartford, ct

Go

OR

Use My Location



Fishing

INFO

EPA, states, and tribes monitor and assess water quality to determine the impact of pollutants on plants and animals living in the water. They also monitor and assess if fish and shellfish are safe to eat.

Can I eat the fish?

What is the status of aquatic life?

Plants and animals depend on clean water. Pollutants can affect the quality of water, which can have adverse effects on plants and animals living in the water.

DISCLAIMER

6 waterbodies have been assessed for aquatic life

1

Good

5

Polluted

2

Condition Unknown

Waterbody Conditions:

Good

Polluted

Condition Unknown

Expand All

Bass Brook (New Britain)-01

ID: CT4401-00\_01

Batterson Park Pond (Farmington/New Britain)

ID: CT4401-00-1-L1\_01

Mill Pond (Newington)

ID: CT4402-04-2-L1\_01

Park River (Hartford)-01

ID: CT4400-00\_01



# Summary on Water Monitoring



Summary  
Monitoring  
and  
Assessment

CWA Product	Objective
Criteria/ Standards	Set measures and levels which allow desired uses
305(b) Reporting	Describe extent of waters supporting CWA goals and contribution of point and Nonpoint sources
303(d) List	List all impaired waters that need a TMDL to meet WQS
TMDLs	Determine loadings which allow desired use
Permit/ Remediation	Take appropriate actions to limit loadings to achieve desired uses

Integrate  
Monitoring  
for these  
Programs