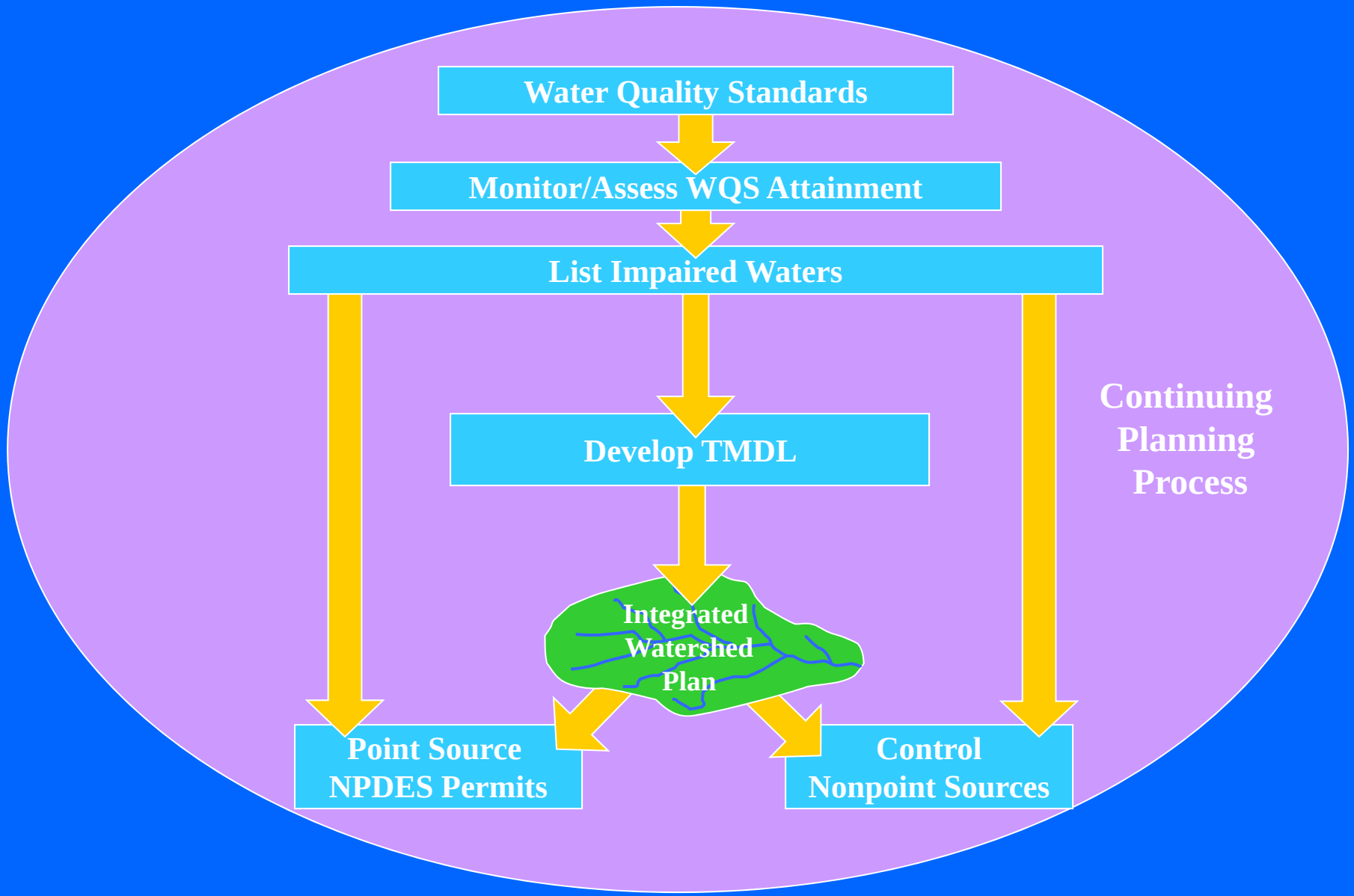
Tribal Monitoring and Assessment

Clean Water Act Framework



What is the cause of impairment?

…depends on which indicators the tribe has chosen to assess

Water chemistry – which constituents?

Bacteria?

Periphyton?

Toxicity testing?

Tissue chemistry?

Fish assemblage?

Benthos assemblage?

Sediment chemistry?

CWA Biological Monitoring

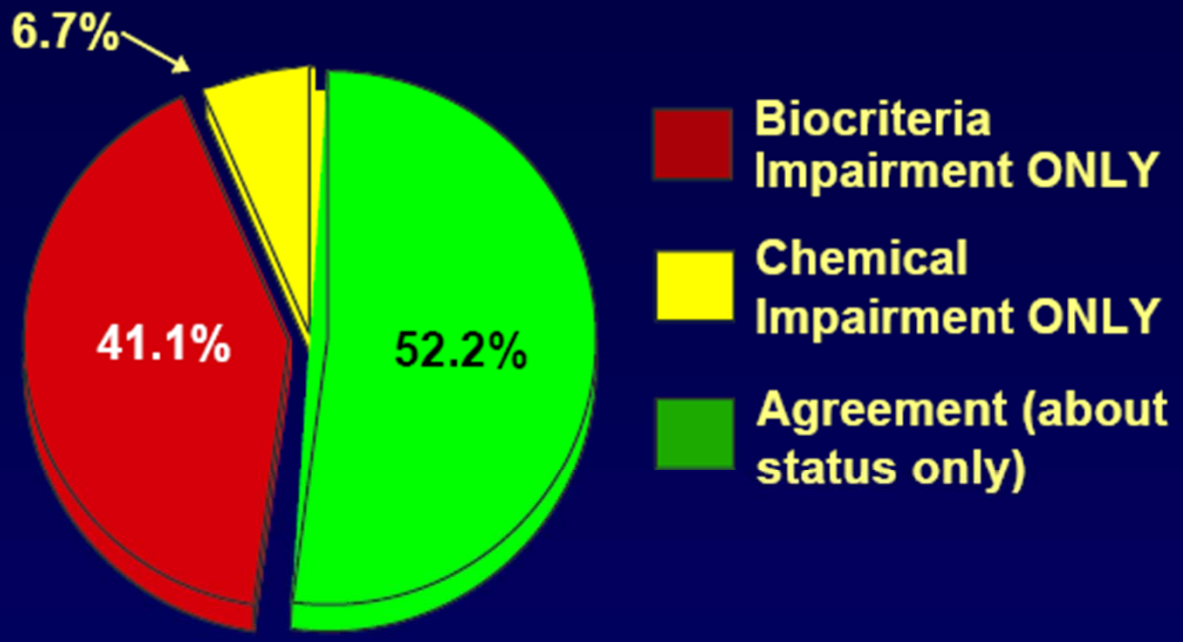
- 106(e) including biological monitoring (for funding eligibility)
- 303(c)(2)(B) criteria based on biological monitoring and assessment methods
- 305(b) extent that water quality protects balanced populations of fish, shellfish, and wildlife

Section 502(15) defines Biological Monitoring

…determination of the **effects on aquatic life**, including **accumulation of pollutants in tissue**, in receiving waters due to the discharge of pollutants (A) by techniques and procedures, including **sampling of organisms representative of appropriate levels of the food chain** appropriate to the volume and the physical, chemical, and biological characteristics of the effluent, and (B) at appropriate frequencies and locations.

Chemical vs. Biological Indicators of Aquatic Life Impairment:

Relative performance of chemical water quality criteria compared with biological criteria in detecting aquatic life impairments:



2543 Sampling Sites
(1994 Ohio 305b Report)

Tribal Assessment Report Prequel

- Description of your monitoring strategy
- Water quality assessment
- Electronic copies of surface water quality data a STORET-compatible format

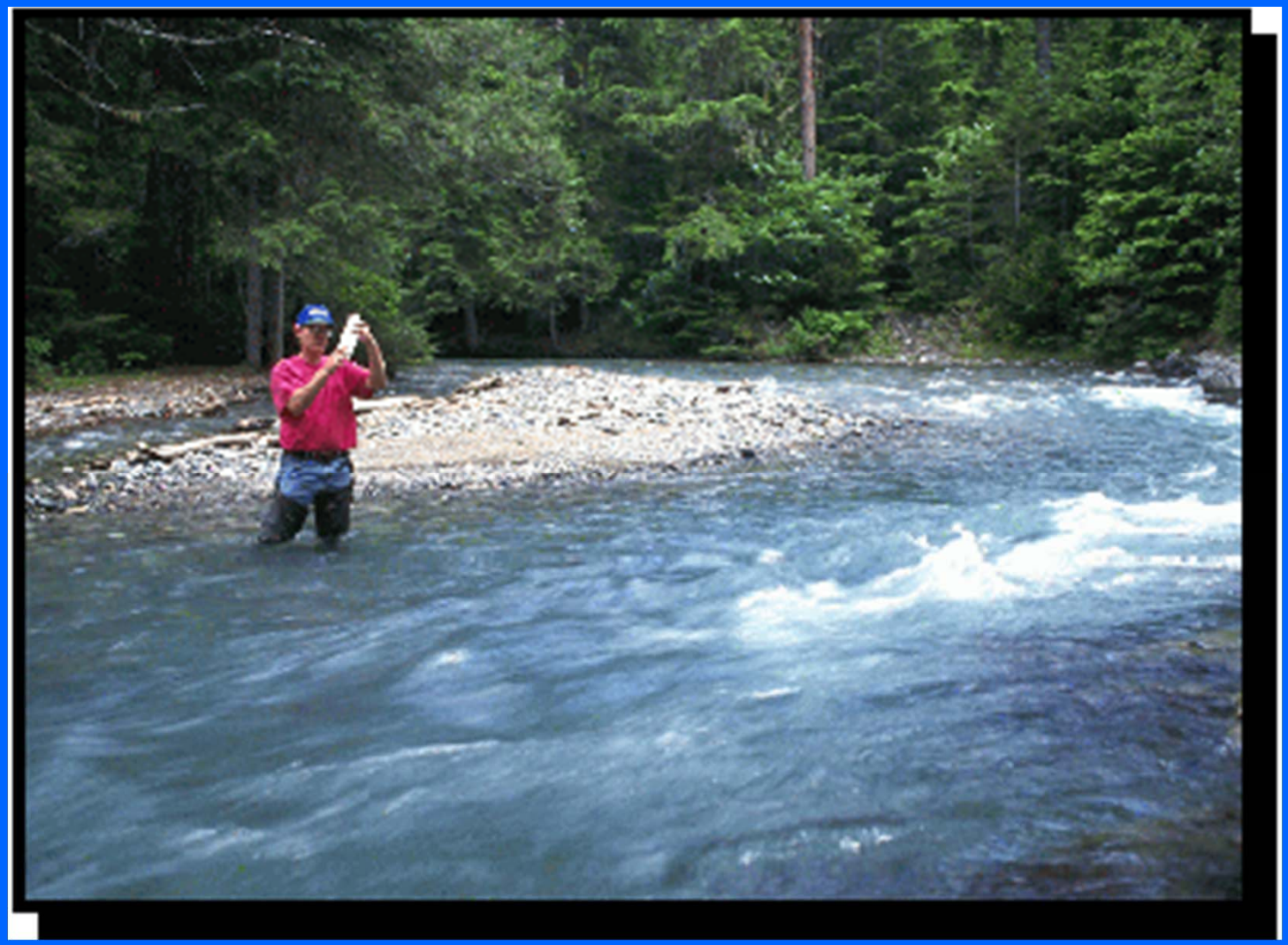
Section 305(b)

- States submit a report on the quality of all waters on a Biennial basis
- Describe extent that water support fish, shellfish, and wildlife
- Describe policies or management activities needed to meet CWA goals
- Estimate economic & social costs of implementing the Act
- Describe extent of NPS pollution problems & estimate costs to fix

Section 303(d)

- States submit a list of waters that do not meet water quality standards on a biennial basis
- Identifies impaired waters that require development of a Total Maximum Daily Load (TMDL)

Integrated Water Quality Assessment Report



Integrated Report

- Combines § 305(b) Report and § 303(d) List
- States submit a single integrated assessment of water quality
- Creates five categories of water quality

Integrated Report Objectives

- Strengthen State monitoring programs
  - Full accounting of all waters and uses
  - Timely monitoring to support decision making
  - More waters monitored
- Strengthen State assessment methodologies
- Encourage watershed/rotating basin approach
- Ensure 305(b) and 303(d) consistency
- Track water quality program performance
- Improve public confidence - Public Participation CWA Section 101(e)

Integrated Report Categories

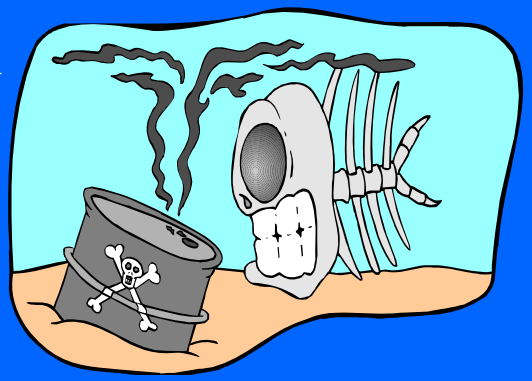
305 (b) Report

1) Attaining water quality standards
2) Attaining some designated uses, and insufficient or no data and information to determine if remaining uses are attained
3) Insufficient or no data and information to determine if the standard is attained
4) Impaired or threatened for one or more designated uses but not needing a TMDL
5) Impaired or threatened by pollutant(s) for one or more designated uses and requiring a TMDL

303(d) List

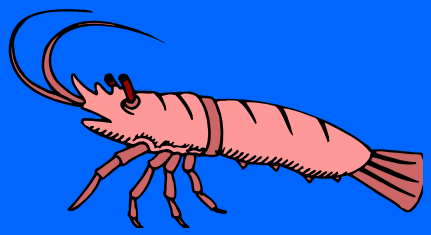
State Water Monitoring

- Elements of a State Monitoring and Assessment Program (March 2003)
  http://water.epa.gov/type/watersheds/monitoring/index.cfm
  - Identifies the ten elements for an effective State monitoring program
  - EPA expects that State water monitoring programs can be strengthened to include all ten elements within the next ten years

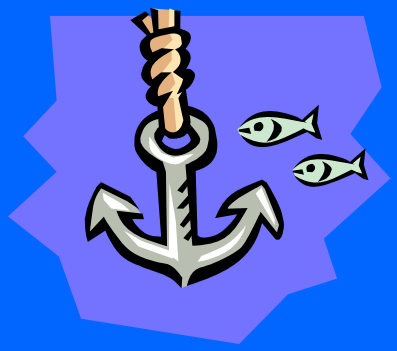


Ten Elements

- Monitoring Program Strategy
- Monitoring Objectives
- Monitoring Design
- Core & Supplemental Water Quality Indicators
- Quality Assurance

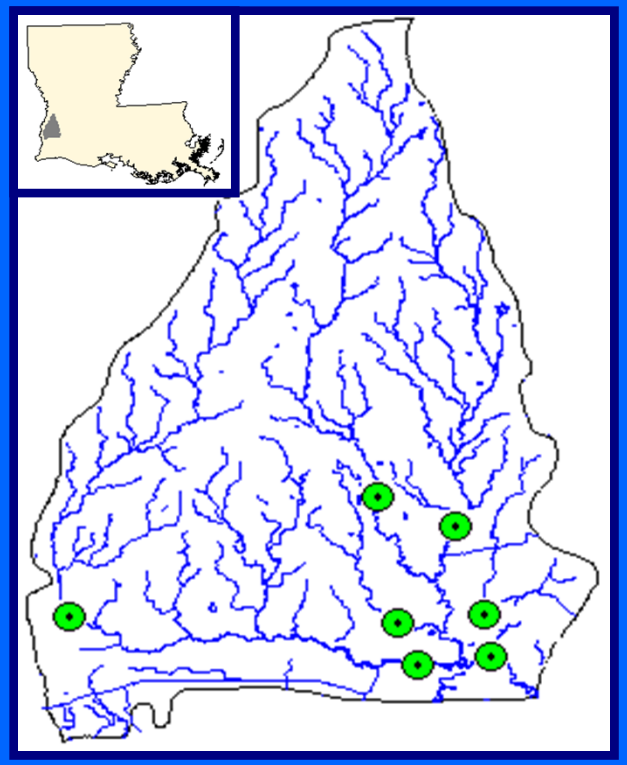


- Data Management
- Data Analysis / Assessment
- Reporting
- Programmatic Evaluation
- General Support & Infrastructure Planning



Section 305(b) Report "Issues"

- **Site selection bias**
  - States target "worst" sites and make untested assumptions about extent of waterbody represented by individual sites
- **Indicator selection bias**
  - neighboring states reach different conclusions about the status of the same waterbody

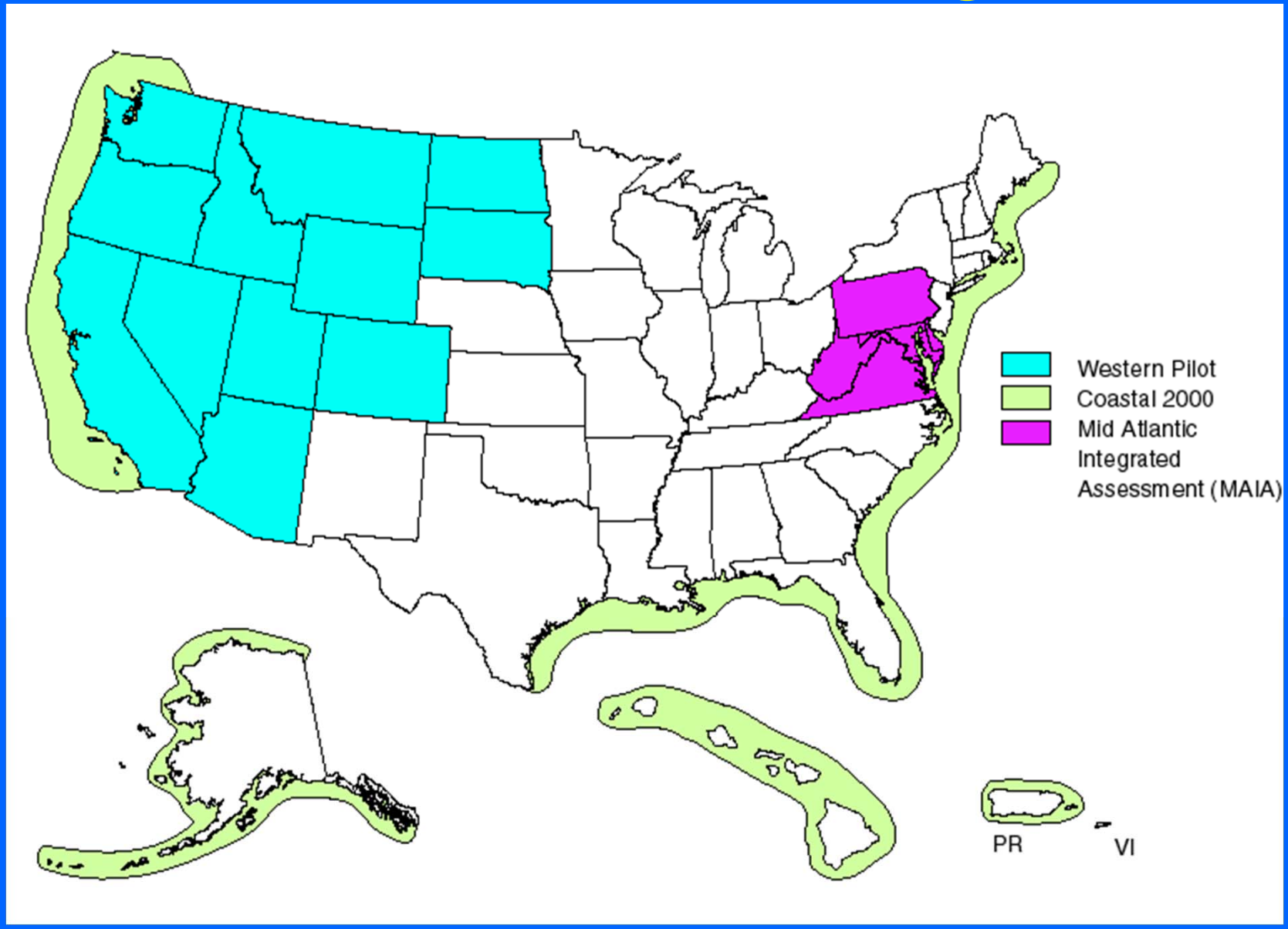


Environmental Monitoring and Assessment Program (EMAP) Goals

- Develop the scientific basis for consistent measurement of the status of waters
- Assist in building state capacity for monitoring for Sections 305(b) and 303(d)
- Provide design/analysis support so states and tribes can implement more cost-effective monitoring

http://www.epa.gov/emap/

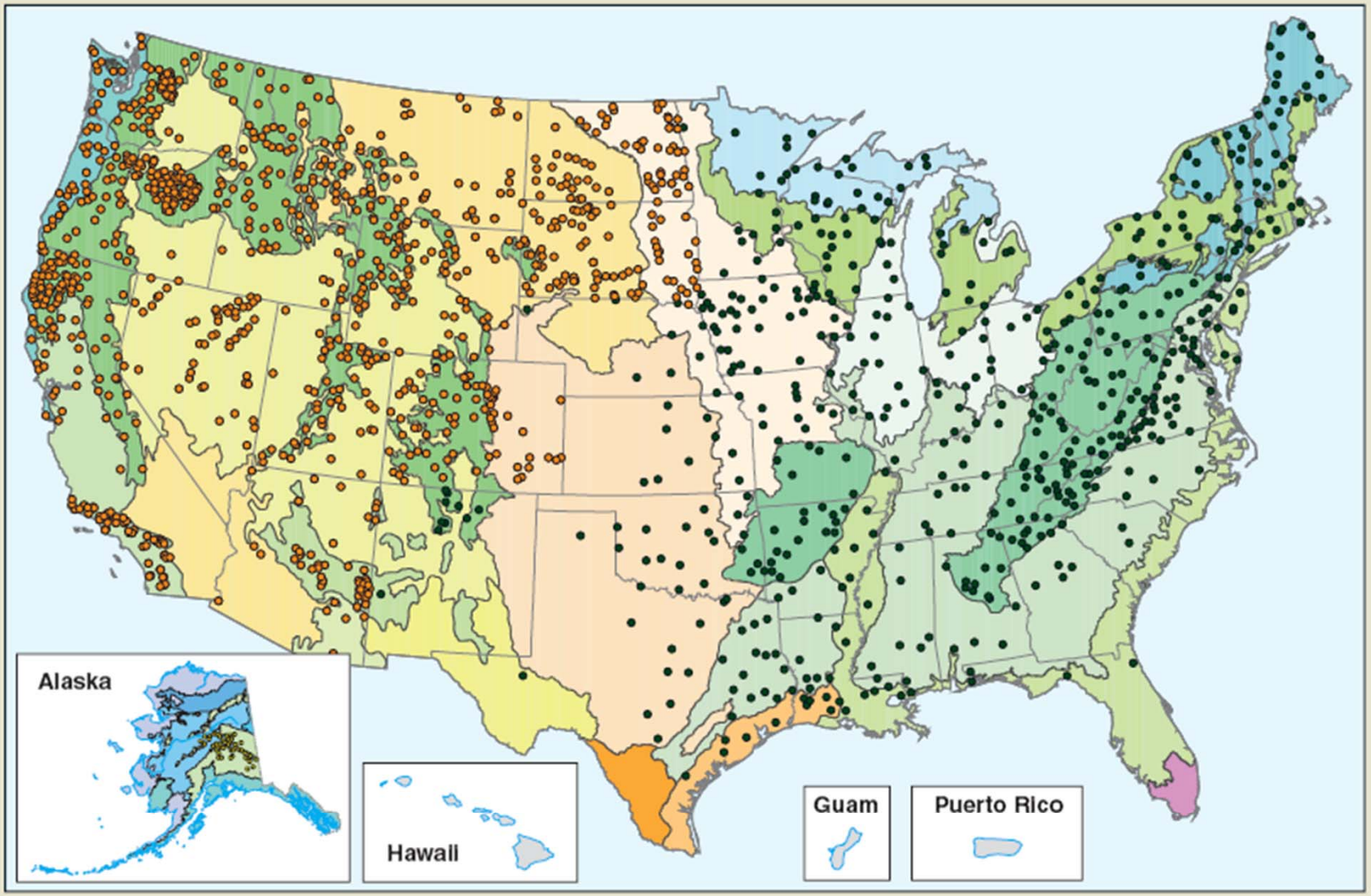
EMAP Monitoring



National Aquatic Resource Surveys Goals

- States and tribes are conducting a series of surveys of the nation's aquatic resources
- Provide nationally consistent and scientifically-defensible assessments of our nation's waters and can be used to track changes in condition over time.
- Each survey uses standardized field and lab methods and is designed to yield unbiased estimates of the condition of the whole water resource being studied (i.e., rivers and streams, lakes, wetlands, or coastal waters).

Sites for Wadeable Streams Assessment

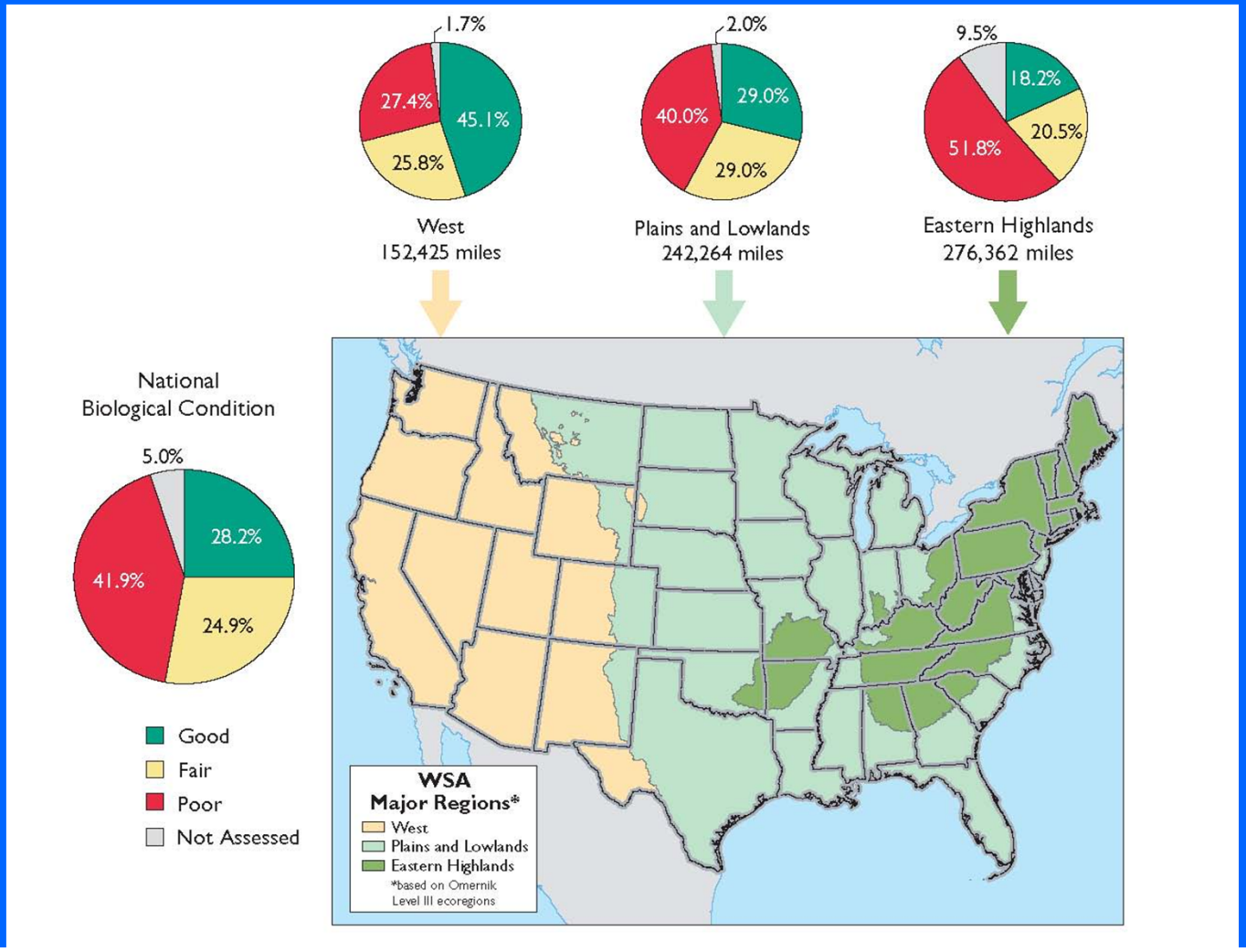


- 5.2 Mixed Wood Shield
- 5.3 Atlantic Highlands
- 6.2 Western Cordillera
- 7.1 Marine West Coast Forest
- 8.1 Mixed Wood Plains
- 8.2 Central Plains
- 8.3 Southeastern Plains
- 8.4 Ozark, Ouachita-Appalachian Forests
- 8.5 Mississippi Alluvial / Southeast Coastal Plains
- 9.2 Temperate Prairies
- 9.3 West-Central Semi-Arid Prairies
- 9.4 South-Central Semi-Arid Prairies
- 9.5 Texas-Louisiana Coastal Plain
- 9.6 Tamaulipas-Texas Semi-Arid Plain
- 10.1 Western Interior Basins and Ranges
- 10.2 Sonoran and Mohave Deserts
- 10.4 Chihuahuan Desert
- 11.1 Mediterranean California
- 12.1 Western Sierra Madre Piedmont
- 13.1 Upper Gila Mountains
- 15.4 Everglades

- Sites sampled, 2004
- Sites sampled, 2000–2004
- Alaska Pilot Project

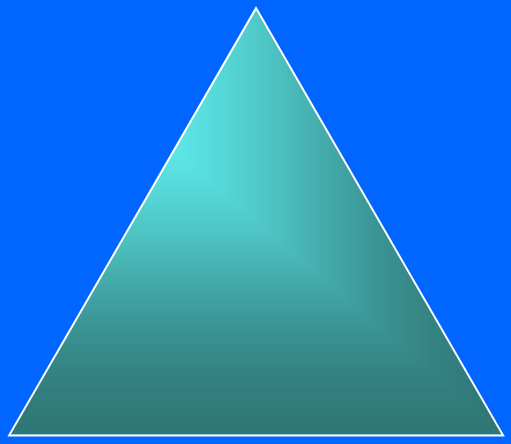
Ecoregions (North America Level II)

National Wadeable Streams Survey Results



Data Information Management

TRIBAL ASSESSMENT REPORT



STORET
(WQX)

NHD

Data Management Tools

- STOrage & RETrival System (STORET)/Water Quality Exchange
  - a common data repository
- National Hydrography Database (NHD)
  - a common geo-referencing tool
- Central Data Exchange (CDX)
  - EPA's new information management system

STOrage and RETrieval System (STORET)

- Is a repository for water quality, biological and physical data
- Is used by tribal and state environmental organizations, EPA and other federal agencies, universities, …
- Will be incorporated into Central Data Exchange (CDX)

Data types managed in STORET

- More than 300,000 taxa with full hierachy for benthic macroinvertebrates, fish species, and periphyton
- Thousands of chemical parameters, including dissolved oxygen, pH, salinity, and conductivity
- Physical characteristics, including measurements of substrate, stream canopy, and habitat
- Field sampling and monitoring methods (quantitative and qualitative)
- Graphics and text documents

Monitoring Activities

Samples

- Routine
- Field Replicate
- Depletion Replicate
- Created from Sample
  - Composite- with Parents
  - Sample from Sample
- Composite- W/O Parents
- Integrated Time Series
- Integrated Flow Proportioned
- Integrated Horizontal Profile
- Integrated Vertical Profile

Field Measurement/Observations

- Replicate Measurement
- Habitat Evaluation
- Observation
- Measurement

Sampling Profiles

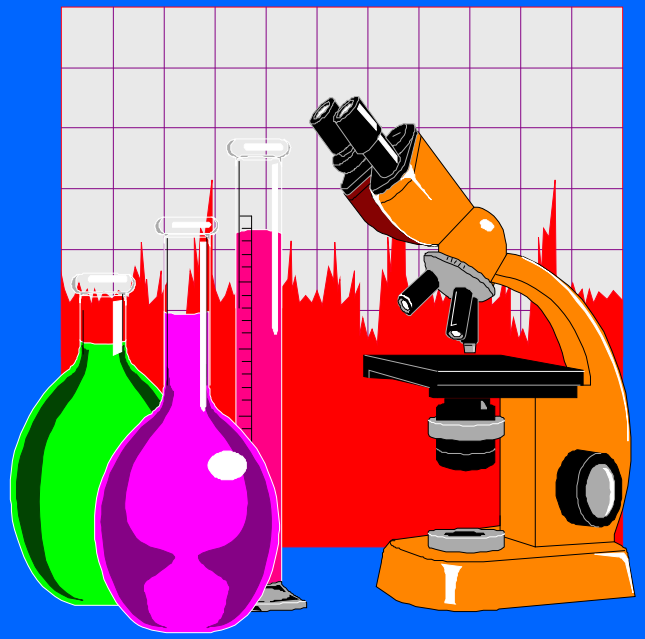
Sample Medium

- Air
- Bottom Sediment
- Soil
- Water
- Biological
  - Individual
    - Subject Taxa
  - Tissue
    - Subject Taxa
    - Bio- Part
  - Species Abundance
    - Aquatic Vegetation
    - Terrestrial Plants
    - Benthic Macroinverts
    - Birds
    - Reptiles
    - Amphibians
    - Bacteria/Viral
    - Phytoplankton/Zooplankton
    - Fish/Nekton

Medium

Intent

Community



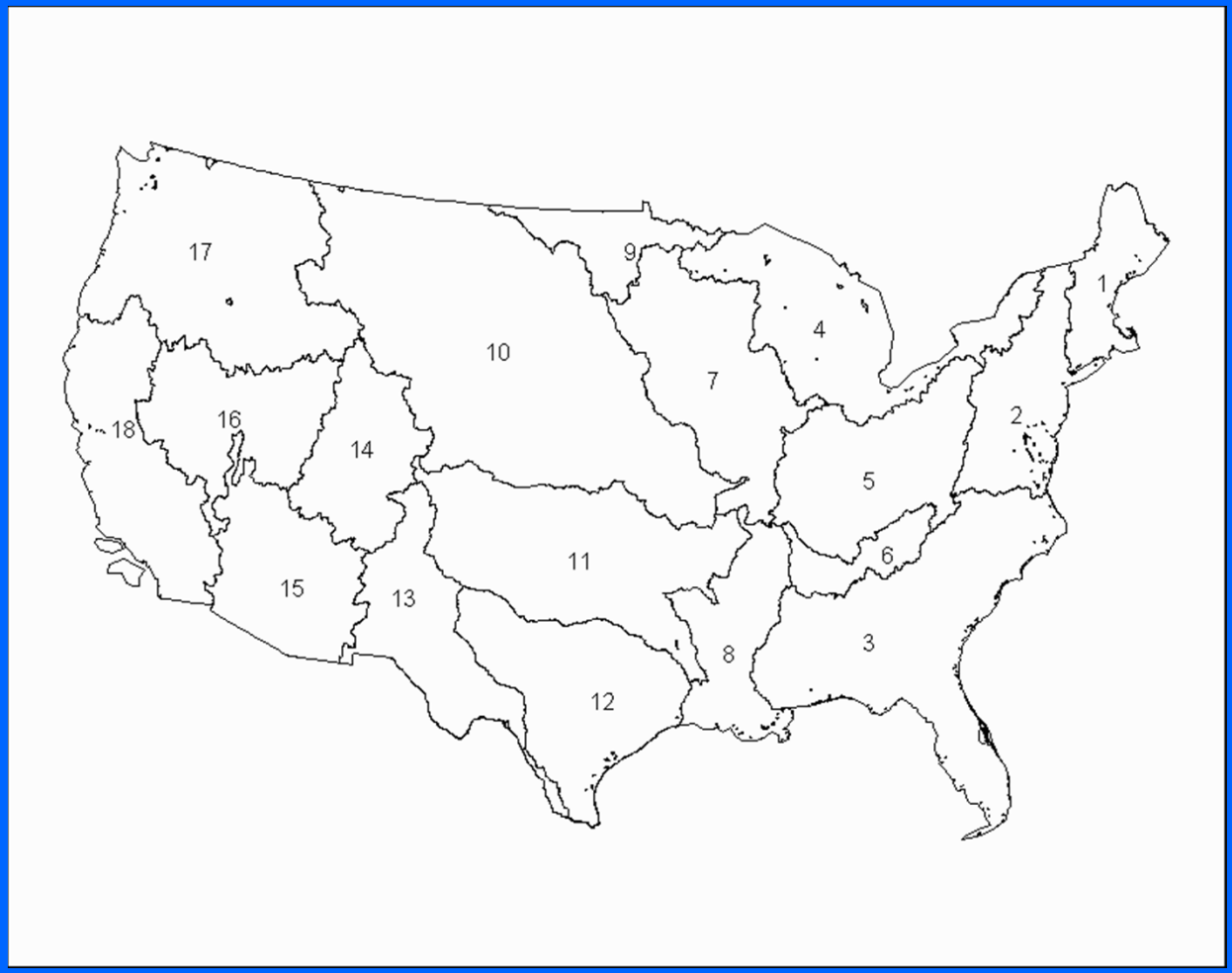
The National Hydrography Database (NHD)

Why Is the NHD Needed?

We need a detailed, nationally standardized and hydrologically sound system of streams, lakes, wetlands and watersheds.

Without such standardization it is impossible for the scientific and engineering communities to transfer information.

18 Basins



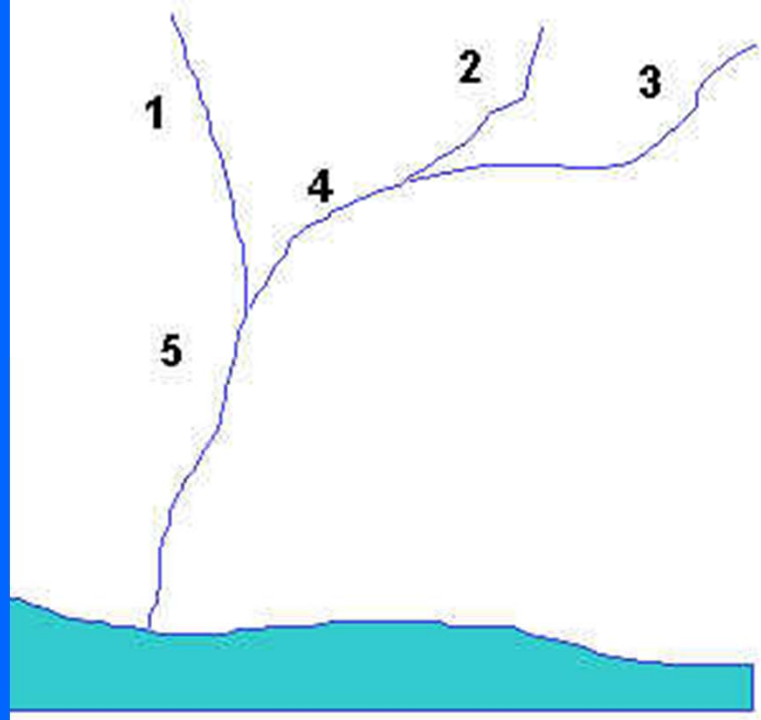
2,106 Catalogue Units

The NHD

- Provides a standard unique identifier for each surface water feature
- Contains a tabular navigation network of these features
- Includes a digital map representation of these features

NHD Reach Numbers

Watershed 02050701



NHD Reach Numbers

Watershed 02050701 contains five reaches, known as:

- 02050701000001
- 02050701000002
- 02050701000003
- 02050701000004
- 02050701000005

NHD Coverage

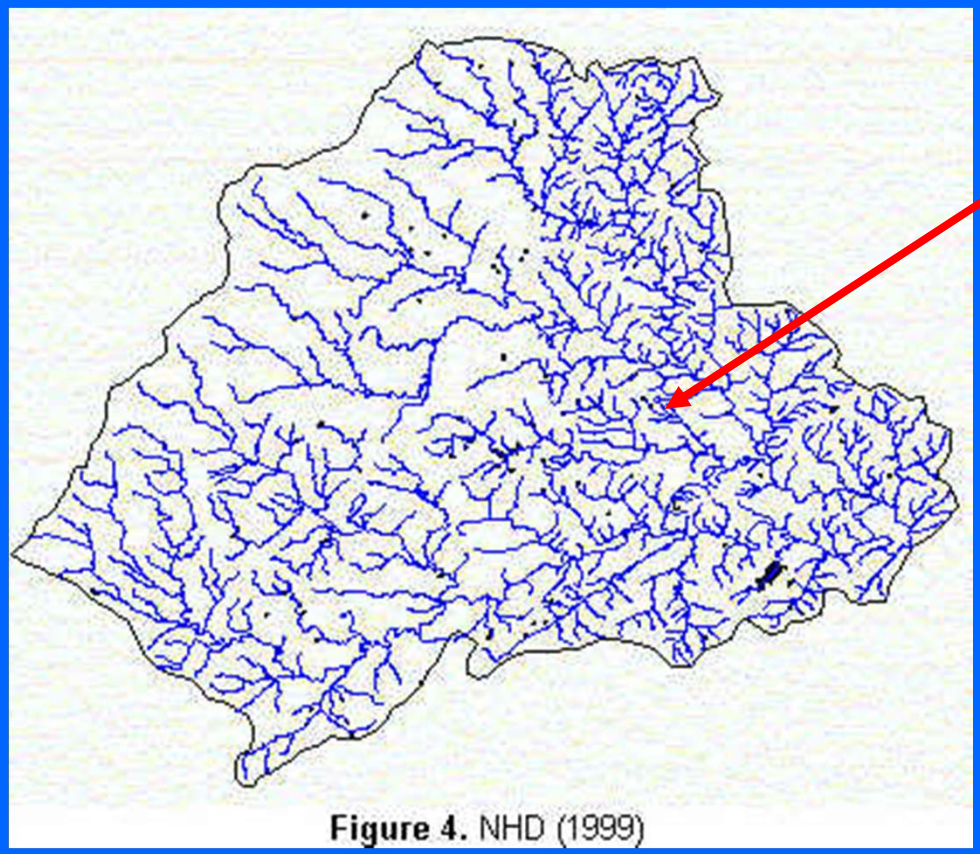


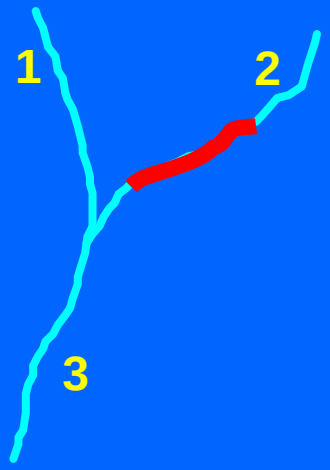
Figure 4. NHD (1999)

Rch#	46
Rch-id	47
Com_id	21907731
Rch_code	08080103000071
Rch_date	19970707
Level	1
Meters	6742
Gnis_id	01628426
Name	Vermilion River

What is Georeferencing?

Uses the NHD framework dataset that includes:

- Hydrographic features for making maps
- A national stream addressing system
- A modeling network for navigating upstream/downstream
- A maintenance infrastructure



Data Analysis

describes the *process* used to look for meaning in data - usually involving simple or advanced statistics and/or graphing of the data

Data Assessment

Typically used by monitoring/assessment staff as the *process* through which a decision about the condition/quality of water is made - this usually involves interpreting the data against some societal value or goal.

Making Assessment Decisions

Table 2 Making Assessment Decisions	
Designated Use or Tribal Goal	Parameter(s) to be Measured to Determine Support of Use or Goal
Contact recreation/swimming/cultural uses	*E. coli* or enterococci, nitrogen, phosphorus
Aquatic life and wildlife	DO, temperature, pH, turbidity, macroinvertebrates, habitat, nitrogen, phosphorus
Drinking water	*E. coli* or enterococci, nitrates, turbidity
Shellfish/fish consumption	*E. coli* or enterococci

Example Assessment Approach Exact Binomial Test

The baseline condition assumed that no more than 10% of the samples had DO values <4.9 mg/L. The alternative condition was that more than 10% of the samples failed to attain this DO criterion. Therefore, the null hypothesis (H_0) and the alternative hypothesis (H_a) are:

H_0: the proportion of the X samples with DO < 4.9 mg/L is < 0.10

H_a: the proportion of the X samples with DO < 4.9 mg/L is > 0.10

Furthermore, both the Type I and Type II statistical errors were balanced giving equal weight for the listing/de-listing decisions with an allowable exceedance of 10 percent. The following table outlines the minimum number of exceedances to reject H_0 for the anticipated range of sample sizes.

Exact Binomial Test

Sample Size	Minimum No. to Reject Ho	Type I Error	Type II Error	Power(%) 1- Type II Error
4 – 9	1	0.34	0.32	68.4
10 – 15	2	0.26	0.24	75.6
16 – 21	3	0.21	0.2	80.3
22 – 27	4	0.17	0.16	83.8
28 – 33	5	0.14	0.14	86.5
34 – 39	6	0.12	0.11	88.6
40 – 45	7	0.1	0.1	90.4
46	8	0.08	0.08	91.8

Exact Binomial Test Calculations

Please note that the minimum numbers of exceedances for assessing a waterbody as impaired can be generated by a number of statistical packages. In this instance, the Microsoft Excel function CRITBINOM (trials, probability_s, alpha) calculates the smallest number of successes out of “n” trials. The statistical power for each sample size was calculated using the Microsoft Excel function BINOMDIST (number_s, trials, probability_s, cumulative).

Example Summary Table of the Extent Waterbody Types Meet Uses

Table 3 Use/Goal Support in Tribal Streams				
Designated Use or Tribal Goal	No. of Stream Miles Monitored/ Assessed	No. of Stream Miles Fully Supporting Use or Goal	No. of Stream Miles Supporting Use or Goal but Threatened*	No. of Stream Miles Not Supporting Use or Goal
Swimming	50	40	5	10
Aquatic life	45	20	20	25
Cultural	30	30	5	0
Fish consumption	20	10	5	10
*Note: Threatened miles are a subset of those miles fully supporting the use or goal.