USGS Water Quality Monitoring

Briefing to
ACWI Workgroup
How to Sustain and Enhance High Quality Water Monitoring under Constrained Budgets
February 25, 2013
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Monitoring Networks Outline

- Background: Relevant Water Quality Concepts
- Supporting Infrastructure
- Quality Assurance
- Existing and Proposed Networks
- Q & A

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Why do we need to monitor Water Quality?

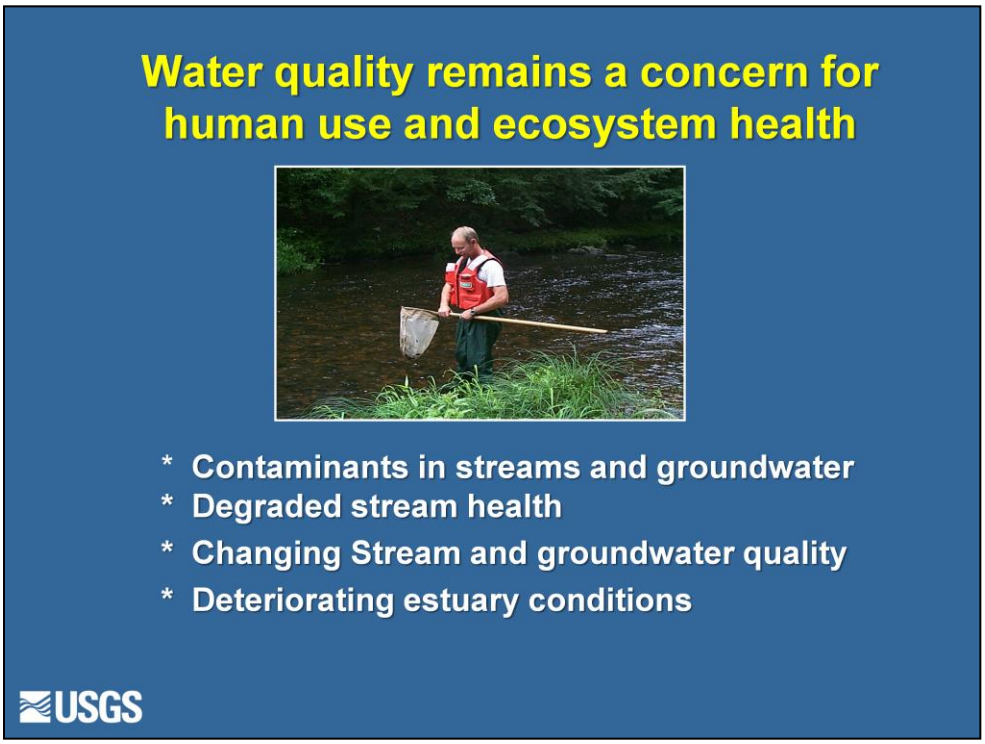
- "*Without measurement, there is no basis on which to evaluate whether policies are effective, no foundation on which to build water management decisions, and no vantage point from which to foresee and forestall water resource challenges*"
  (National Research Council, 2012)

USGS

Throughout our history, the Nation has made major investments in assessing natural resources, such as soils, minerals, oil and gas, and human resources in terms of the health, education, employment and economic status of the population. The reason for these investments in information is that decisions our society makes about using or conserving these resources , investing in their improvement, or regulating their use will be better if they are based on sound information.

Twenty-six years ago, Congressman Sid Yates (Chairman of the House Interior Appropriations Committee) asked the USGS a simple question—What is the status of the Nation's water quality and is it getting better or worse? Do we have any information on whether the funds spent since implementation of the Clean Water Act have accomplished what was intended? How much more will be needed?

Similarly, during the Clinton Administration, Vice President Gore asked Federal agencies to develop an environmental report card to serve as a guide for public and private decisions at all levels and an accounting of the effects of decisions for our citizens." To be completed by the year 2001, the report card would establish an environmental baseline to evaluate the status of our ecosystems. It will assess trends in key and seek to determine whether the laws to protect the health of the environment are working.



The number and complexity of water-quality issues facing the Nation are significant, and solutions are becoming more challenging and costly. The U.S. Census Bureau projects that our population will increase 25 percent by 2050 to almost 400 million people. Increases in population will be accompanied by expanded development of land for urban and non-agricultural uses, increased use of fertilizers and pesticides for food production on remaining cropland, and greater pressure on existing resources to supply water for energy development, drinking water, and ecosystem needs. These factors, alone or in combination, can degrade stream and coastal ecosystems, the quality of drinking water supplies, and ultimately, the Nation's economy. Current and future challenges include:

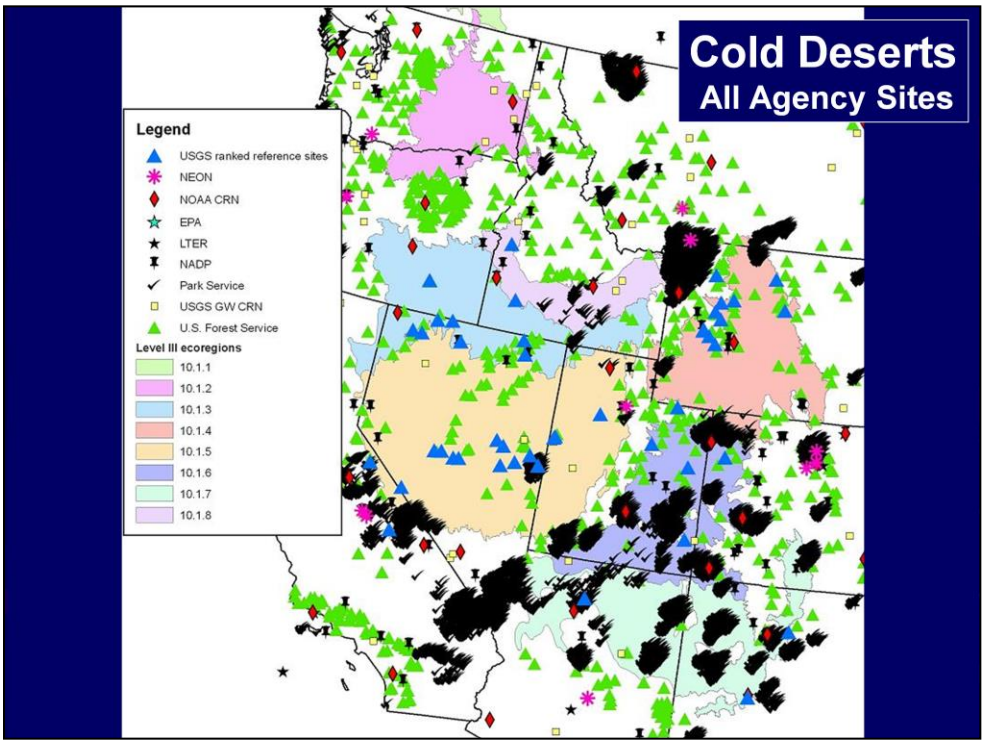
• ***Contaminants in Streams and Groundwater***—Eighty percent of streams in urban areas were found to have at least one pesticide that exceeded criteria set to protect aquatic life (Gilliom and others, 2006). Of our public and domestic wells—which serve more than 150 million people—more than 20 percent contain at least one contaminant at levels of potential health concern (DeSimone and others, 2009; Toccalino and Hopple, 2010).

• ***Degraded Stream Health***—Forty-two percent of wadeable stream miles in the United States are in poor or degraded condition (U.S Environmental Protection Agency, 2006). Widespread causes include excess nutrients and sediment, habitat disturbance, and altered streamflow. Minimum and maximum stream flows were found to be altered by human activities at 86 percent of almost 3,000 streams assessed across the nation and the likelihood of biological impairment increased with the severity of flow alteration (Carlisle and others, 2010).

• ***Changing Stream and Groundwater Quality***—Despite major efforts to reduce sources of nitrogen and phosphorus contaminating streams and rivers, analysis of trends in concentrations from about 1993 to 2003 show minimal changes at the majority of sites monitored and most sites with significant change show more upward trends than downward. During the same period, the percentage of wells with nitrate concentrations greater than the drinking water standard increased from 16 to 21 percent (Dubrovsky and others, 2010).

• ***Deteriorating Estuary Conditions***—Almost two-thirds of the Nation's major estuaries are degraded by excess nutrients and the resulting "dead zones" (areas of low dissolved oxygen) that no longer support economically important fisheries. The spread of dead zones are projected to worsen through 2020 in 48 of these estuaries as population growth, agricultural production, and other development increase the amount of nutrients flowing into coastal waters (Diaz and Rosenberg, 2008).

Aging Infrastructure: In 2002, EPA estimated that, over the next two decades, the United States needs to spend nearly $390 billion to replace existing wastewater infrastructure systems and to build new ones. Funding needs for operation and maintenance (not eligible for Clean Water Act funding) are an additional $148 Billion



This slide shows USGS and other agency water-quality monitoring sites in the Arid west. One look at the large number of monitoring sites and it would be hard not to conclude that the amount of monitoring is quite large and should be more than sufficient to meet our information needs. But, looking at numbers of sites only tells a very small part of a water-quality monitoring story

The issue isn't that we necessarily need more sites to address the questions and issues of the day (although, there will always be additional stream segments and water bodies that have not been measured. A more important question is what is being measured at these sites? How frequently? and for how long?

Water-quality monitoring efforts may vary a lot depending on the question being asked

- Mission, goals, objectives, and desired outcomes
- Spatial and temporal scales of interest
- Which component(s) of the hydrologic cycle are of interest?
- Which media?
- Which type of sample?
- Which measurements?
- What are the analytical requirements?
- What is the frequency?
- What is the length of Record?

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Water-quality monitoring efforts—the measurements that are made, the frequency of monitoring, and the duration of monitoring may vary quite a bit depending on the question being asked.

While knowing the primary purpose and questions to be asked as part of monitoring is crucial—we need to be careful to recognize that we are not able to anticipate the questions that may be asked of our data in the future. For example, during the 1980's when it was discovered that selenium in irrigation drainwater from parts of the Central Valley was contributing to deformities in the bird population of Kesterson National Wildlife refuge, an astute reporter from the Sacramento Bee asked the question; "could this also be occurring at other irrigation projects throughout the west? Fortunately, selenium was one of the trace elements analyzed in samples collected by USGS as part of the National Stream Quality Accounting Network. At that time, NASQAN consisted of almost 500 stream sites across the country—and it helped provide the Department of the Interior with an initial perspective on which irrigation projects might be most vulnerable to this type of issue.

Similarly, during the 80's data from the Hydrologic Benchmark Network—a monitoriing network established in the 60's by USGS to provide long-term measurements of streamflow and water quality in areas that are minimally affected by human activities-- were the only long-term, nationally consistent data available to help answer questions from the Administration as to the efficacy of the Clean Air Act on reducing sulfate emissions. Answering this specific question was not anticipated by Luna Leopold when he established the network within USGS; but, he was wise enough to know that there would be questions in the future that we wouldn't be able to anticipate. This is also one of the reasons why USGS monitoring includes methods that have low detection levels—so that they are sensitive to change and will be broadly applicable to a wide array of questions.

Continuation from previous slide.

Examples of other factors that need to be considered in the design of a water-quality monitoring network include:

Spatial and temporal scales of interest: compliance monitoring of specific point sources vs. regional-scale assessments,

Which components of the hydrologic cycle are of interest?: streams, rivers, lakes and reservoirs, groundwater, atmospheric precipitation

Which environmental media are we analyzing? Water, suspended sediment, streambed sediment, fish tissue

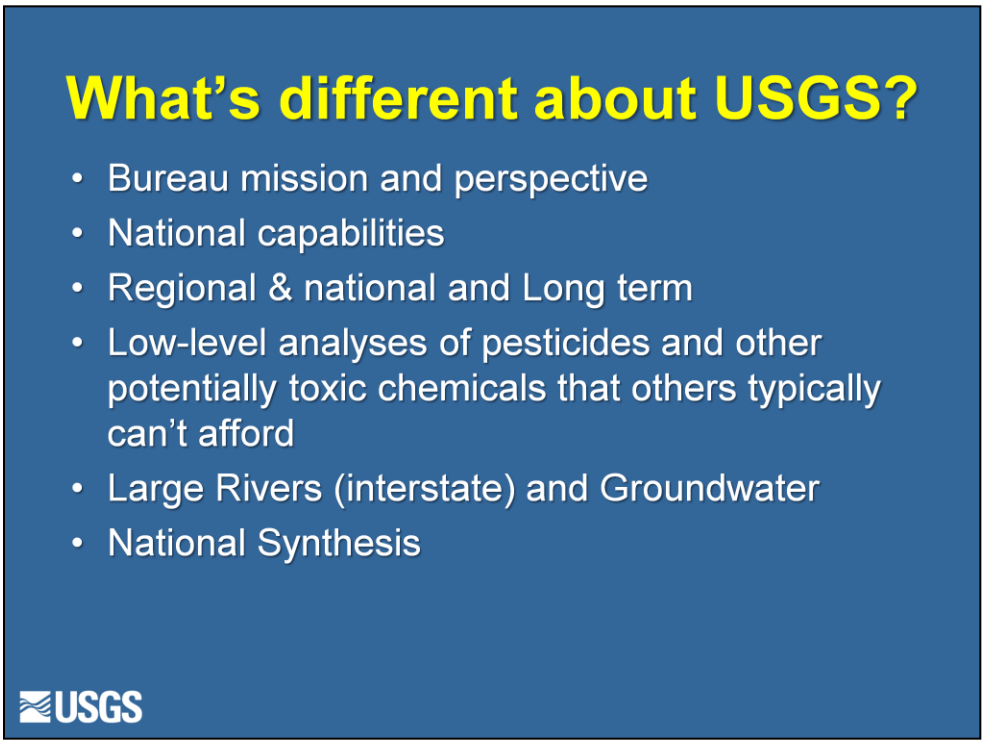
What type of sample? Instantaneous-discrete, continuous, time- or flow-weighted composite; depth and width integrated etc

Which measurements? Temperature, pH, Specific conductance, major ions, nutrients, organic carbon, trace elements, pesticides, other trace organics, microbes, algae, invertebrates, fish.

What are the analytical requirements?

What is the frequency of sampling?

What length of record is required? Instantaneous, monthly or seasonal, annual, decadal



USGS has no management or regulatory responsibilities which allows the bureau to provide objective perspective

Strong reputation for leadership in data collection at national, State, and local levels. USGS has been collecting and interpreting water quality since the latter part of the 19th century

Water Science Centers located in every State and Puerto Rico provide a critical connection to other federal, State and local agencies—so that we stay aware of the issues; and national capability.

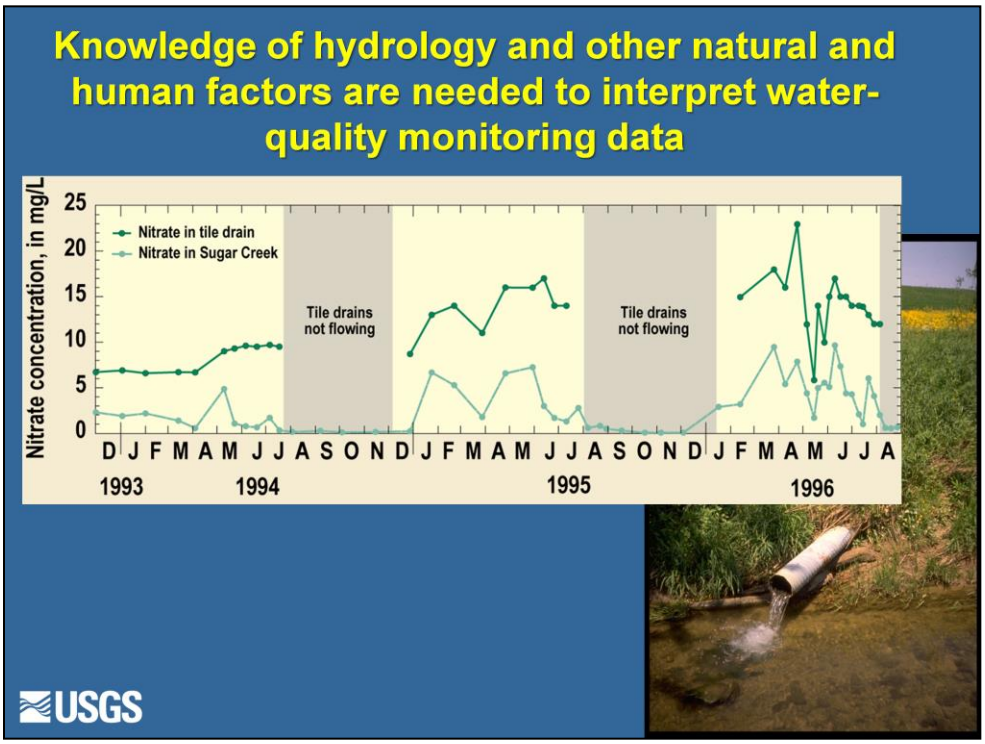
USGS monitors water quality at all scales; but, what is unique is our attention to regional and national scales and long term

Lower detection levels for pesticides and other potentially toxic contaminants? Why? USGS analytical methods are designed to measure concentrations as low as economically and technically feasible. These types of data help identify emerging issues and provide the ability to track changes in concentrations over time.

What is the value of long-term data? To provide temporal context for individual measurements made over a short period of time; and also because we cannot always anticipate what questions and issues will arise in the future. Example use of HBN data to evaluate the effectiveness of the Clean Air Act.

Large Rivers and groundwater—USGS provides most of the water-quality data for the Nation for large rivers,--particularly those that are interstate. Similarly, USGS provides most of the Nation's data on the quality of ambient groundwater.

USGS is unique in providing national synthesis of water quality of streams and groundwater : pesticides, nutrients, volatile organic compounds, source water for domestic and public supply



One feature that often distinguishes USGS water quality monitoring efforts from other monitoring efforts is our desire to provide a hydrologic, geologic and land use context to our data. Bill Cunningham discussed the importance of thinking in 3 dimensions and knowledge of the aquifer stratigraphy or geology when interpreting groundwater levels.

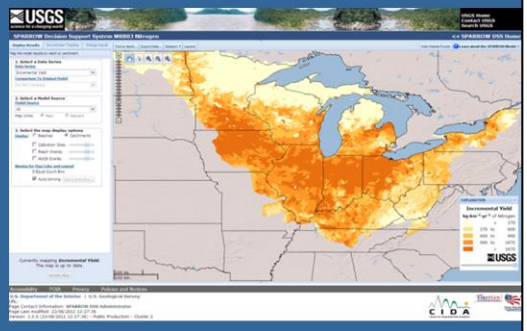
The same is true for water quality measurements made in surface and groundwater.

Knowledge of the hydrology, geology, land and water use—is important for converting monitoring data to information.

This slide shows the influence of tile drains on seasonal changes in nitrate concentrations in an agricultural stream in Indiana. In this example, nitrate concentrations ranged from near zero to almost 10 mg/L. Depending on what season of the year samples are collected and whether the tile drains are flowing has a large influence on water quality conditions. One of the reasons why USGS places a lot of emphasis on sampling at streamgages—is so that we can place the sample in a hydrologic context—and why sampling at different times of the year is so important for characterizing water-quality conditions, to describe trends, and to compute loads.

Outcomes from USGS Water-Quality Monitoring and Modeling

- Investments in USGS water-quality monitoring and modeling have resulted in outcomes that have evolved from providing data and trend analysis to those that include the potential to predict and forcast contaminant occurrence and trends under multiple scenarios at nationally significant scales



- Successful management of our Nation's water resources requires a commitment not only to monitoring but also to the development of predictive tools such as models. Such tools are needed to extrapolate measured water-quality conditions to unmonitored areas.

- This ability to extrapolate or make predictions is critical for cost-effective assessment of our Nation's streams and groundwater, which requires more information than can be measured directly in all places and at all times. The expense of monitoring limits thte number of stream miles that can be assessed. For example, the most recent 305 (b) reports indicate that States have assessed less than one-sixteenth (or only about 20 percent) of the more than six million stream miles in the Nation.

- Models are powerful tools. They can be used to assess water quality over broad regions and the Nation. In addition, models can establish linkages between water-quality conditions and contaminant sources on land; track contaminants from their upstream origins to downstream destinations; and simulate changes in water quality resulting from management actions or trends in human activities. Such information provides estimates of conditions that often cannot be directly measured, such as the percentage of contamination in a stream that originates from different sources or the effects of specific pollution controls.

- Models are incomplete tools without monitoring. Model predictions are only reliable and successful if they are developed and verified on the basis of credible, comparable, and

comprehensive data from “on the ground” monitoring, assessment, and research.

Supporting Infrastructure is provided at several different levels within the USGS—Bureau, Water Mission Area, Office of Water Quality and Science Field Teams and Water Science Center

Bureau--Fundamental Science Practices: USGS provides unbiased, objective, and impartial scientific information. Fundamental Science Practices describes how USGS science is carried out and how the resulting information products are developed, reviewed, approved, and released.

For example, I mentioned before that USGS has a legacy as the producer of long-term datasets for multiple uses, many of which are geographically extensive. Part of the value of these datasets is dependent on USGS scientists describing and documenting the methods used to collect data and making these data accessible in information products. Proper documentation (including appropriate metadata) and broad dissemination ensure that USGS data

Water Mission Area:

Water Science Field Team: Four field teams provide specialized support to the Water Science Centers—including review of project proposals; special trouble shooting and work with the 3 Technical Offices on triennial technical reviews of each Water Science Center

Hydrologic Instrumentation Facility (HIF) provides hydrologic instruments, equipment, and supplies for USGS as well as Other Federal Agencies and USGS Cooperators. They also test, evaluate, repair, and calibrates equipment and instruments. The HIF provides training and technical support for the equipment it stocks. (for example, water quality probes).

The Office of Water Quality :includes the staff of the NAWQA Program and is responsible for managing the National water quality Monitoring Networks—NASQAN, Hydrologic Benchmark, National Monitoring Network, National Atmospheric Deposition Program, and NAWQA

Water Quality Technical Memoranda;: Provide national-level guidance and communication to USGS hydrologists across the Nation and are a key mechanism for ensuring national consistency. Examples of the types of memoranda include:

Guidance for the fiscal year for Water quality sampling of National networks

Policy on the review and publication of discrete data

Application of "v" codes to qualify and remark certain organic data from the NWQL

Triennial Reviews: The Office of Water Quality, Office of Groundwater, and Office of Surface Water collaborate to assemble multidiscipline teams to conduct technical reviews of Science Center water activities within USGS. These technical reviews are scheduled onsite at approximately 3-year intervals. The purposes of technical reviews are to: 1) ensure that all offices produce hydrologic data and information that meet USGS standards, 2) assess overall strengths and weaknesses of the technical program, and 3) make recommendations for improvement.

Training: The Office of Water Quality supports several courses offered at the National Training Center including:

- Water Quality Field Techniques
- Quality Assurance/Control Design
- Statistics

Branch of Quality Systems : Series of 8 projects that provide data to estimate bias and variability within the field, analytical and measurement processes. (See background information)

Continued on next page.

National Water Quality Laboratory (NWQL)

Located in Denver Colorado, the National Water Quality Laboratory provides routine inorganic, organic and radiochemical analyses as well as taxonomic identification and quantitation of benthic invertebrates. The lab specializes in trace- and ultratrace-level analyses of water, sediment, and tissue—a niche we can't fill elsewhere.

NWQL is certified by the National Environmental Laboratory Accreditation Conference

Provides About 80% of USGS water quality samples analyzed for inorganic, organic and radiochemical constituents by the NWQL

• Annual budget about $21 million

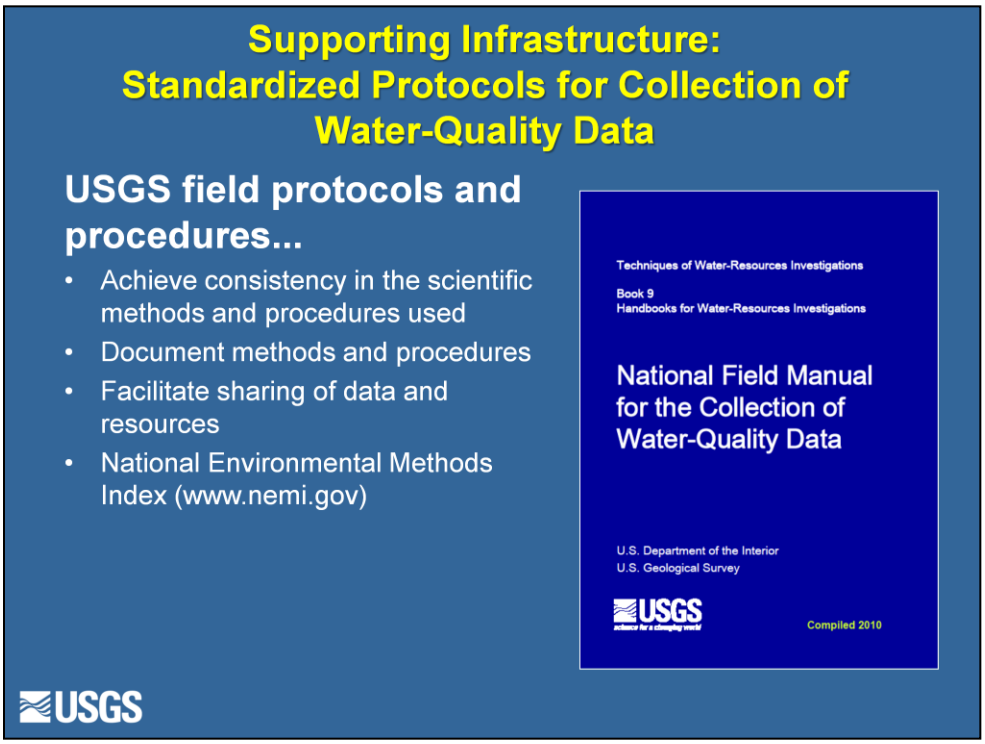
• About 105 employees; professional chemists, physical scientists

• 35,000 samples per year

Methods Research and Development

The ability to monitor and detect pesticides and other contaminants at concentrations as low as economically and technically feasible is critical to identify emerging issues and to track changes in concentrations over time. For example, beginning in 2013, new laboratory instrumentation and analytical methods for pesticides used by the National Water Quality Laboratory are expected to result in as much as a 70 percent increase in the number of analytes that can be measured (from 143 to 242); while reducing the time required by the chemists for analysis and, thus the total costs of analysis by about 40 percent. Because the new methods requires less water for analysis, additional cost savings are achieved because less time is needed to process samples in the field and because costs to ship samples to the laboratory are lower.

Similarly, a new analytical method for measuring the concentration of nitrate in water is more automated and thus is expected to reduce costs by as much as 30 percent. Equally important, the new procedure supports the Administration's emphasis on use of green technology by eliminating the use of toxic cadmium as a reagent in the method.



The development and use of a ***National Field Manual*** is necessary to :

- Ensure that data collected by USGS personnel are of the quality required to fulfill our mission.

- Achieve consistency in the scientific methods and procedures used, and

- Document those methods and procedures

These methods also help facilitate sharing data and resources and avoid costly duplication of effort.

The methods are included in the National Environmental Methods Index (www.nemi.gov).

Protocols for assessing the condition of aquatic communities, developed as part of the NAWQA Program, provide detailed procedures for use by trained biologists in evaluating stream fish communities.

These procedures allow standardization of collection methods and descriptions of fish, algae, and invertebrate communities to facilitate unbiased evaluations of relations among physical, chemical, and biological components of water-quality conditions.

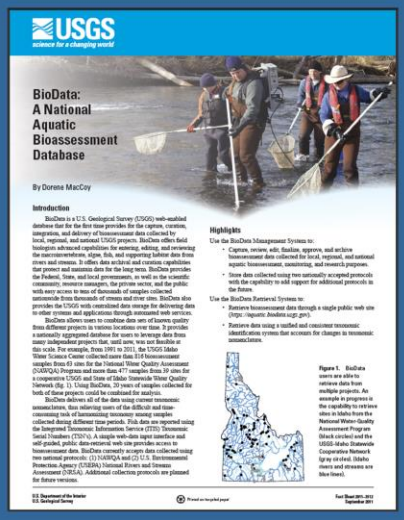
Supporting Infrastructure to Disseminate Data and Information

New Aquatic Biological Data-base System - an authoritative source for USGS data

National Water Information System

Decision Support Systems

NAWQA Data Warehouse



USGS
science for a changing world

BioData:
A National
Aquatic
Bioassessment
Database

By Dorene MacCoy

Introduction

BioData is a U.S. Geological Survey (USGS) web-enabled database that for the first time provides for the capture, curation, integration, and delivery of bioassessment data collected by local, regional, and national USGS projects. BioData offers field biologists advanced capabilities for entering, editing, and reviewing the macroinvertebrates, algae, fish, and supporting habitat data from rivers and streams. It offers data archival and curation capabilities that protect and maintain data for the long term. BioData provides the Federal, State, and local governments, as well as the scientific community, resource managers, the private sector, and the public with easy access to tens of thousands of samples collected nationwide from thousands of stream and river sites. BioData also provides the USGS with centralized data storage for delivering data to other systems and applications through automated web services.

BioData allows users to combine data sets of known quality from different projects in various locations over time. It provides a nationally aggregated database for users to leverage data from many independent projects that, until now, was not feasible at this scale. For example, from 1991 to 2011, the USGS Idaho Water Science Center collected more than 816 bioassessment samples from 63 sites for the National Water Quality Assessment (NAWQA) Program and more than 477 samples from 39 sites for a cooperative USGS and State of Idaho Statewide Water Quality Network (fig. 1). Using BioData, 20 years of samples collected for both of these projects could be combined for analysis.

BioData delivers all of the data using current taxonomic nomenclature, thus relieving users of the difficult and time-consuming task of harmonizing taxonomy among samples collected during different time periods. Fish data are reported using the Integrated Taxonomic Information Service (ITIS) Taxonomic Serial Numbers (TSN's). A simple web-data input interface and self-guided, public data-retrieval web site provides access to bioassessment data. BioData currently accepts data collected using two national protocols: (1) NAWQA and (2) U.S. Environmental Protection Agency (USEPA) National Rivers and Streams Assessment (NRSA). Additional collection protocols are planned for future versions.

Highlights

Use the BioData Management System to:

- Capture, review, edit, finalize, approve, and archive bioassessment data collected for local, regional, and national aquatic bioassessment, monitoring, and research purposes.
- Store data collected using two nationally accepted protocols with the capability to add support for additional protocols in the future.

Use the BioData Retrieval System to:

- Retrieve bioassessment data through a single public web site (http://aquatic.biodata.usgs.gov).
- Retrieve data using a unified and consistent taxonomic identification system that accounts for changes in taxonomic nomenclature.

Figure 1. BioData users are able to retrieve data from multiple projects. An example in progress is the capability to retrieve sites in Idaho from the National Water-Quality Assessment Program (black circles) and the USGS-Idaho Statewide Cooperative Network (gray circles). (Idaho rivers and streams are blue lines).

U.S. Department of the Interior
U.S. Geological Survey

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You will hear more about our National Water Information System (NWIS from Susan Trapanese.

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Primary spatial and temporal scales of USGS water-quality monitoring programs and networks

Temporal Scale	Spatial Scale		
	Local	Regional	National
Short Term (1 year)	CWP	NAWQA	NAWQA TOXICS
Multi Year (2-5 Years)	CWP NPS Partnership	CWP Toxics NAWQA	NAWQA
Decadal	WEBB	CWP UMRR	HBN NASQAN NAWQA NMN NADP

USGS Program or Network Name
HBN--Hydrologic Benchmark Network
NASQAN--National Stream Quality Accounting Network
NAWQA--National Water Quality Assessment Program
NMN--National Monitoring Network
NPS--National Park Service
TOXICS--Toxic Substances Hydrology Program
WEBB--Water, Environment and Biogeochemical Budgets
UMRR--Upper Mississippi River Restoration
CWP – USGS Cooperative Water Program

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Water quality data are collected to address issues and questions that occur at a wide range of spatial and temporal scales. This slide attempts to show the primary spatial and temporal scales addressed by USGS Monitoring Programs—in order to help distinguish them from one another.

Notes on individual programs:

Fed: State Coop—Federal State Cooperative Program (Since 1895)—Surface water and Groundwater; predominantly local and short-term scales; but does include some regional and long term monitoring—for example: Chesapeake Bay (85 sites) , San Francisco Bay Delta, and Great Lakes,

Hydrologic Benchmark Network--(Since 1963) At its peak, water quality was measured at 58 basins in 39 States; Today, QW measured at 17 of 37 sites for continuous temp, major ions, nutrients at some sites, and stream ecology

National Stream Quality Accounting Network (NASQAN)--(Since 1972) Surface water--Large Rivers; National, long term Annually monitor and assess concentrations and loads of selected constituents delivered by major rivers to coastal waters of the U.S., and to monitor and assess selected inland sub-basins in priority river basins that contribute significantly to adverse conditions in receiving waters. At its peak ~500 sites. Currently monitoring at 32 sites for the same schedules as NAWQA

National Water Quality Assessment Program (NAWQA) (Since 1991 Riversa nd streams, shallow and deep Groundwater; Regional and National, Multi year and long term

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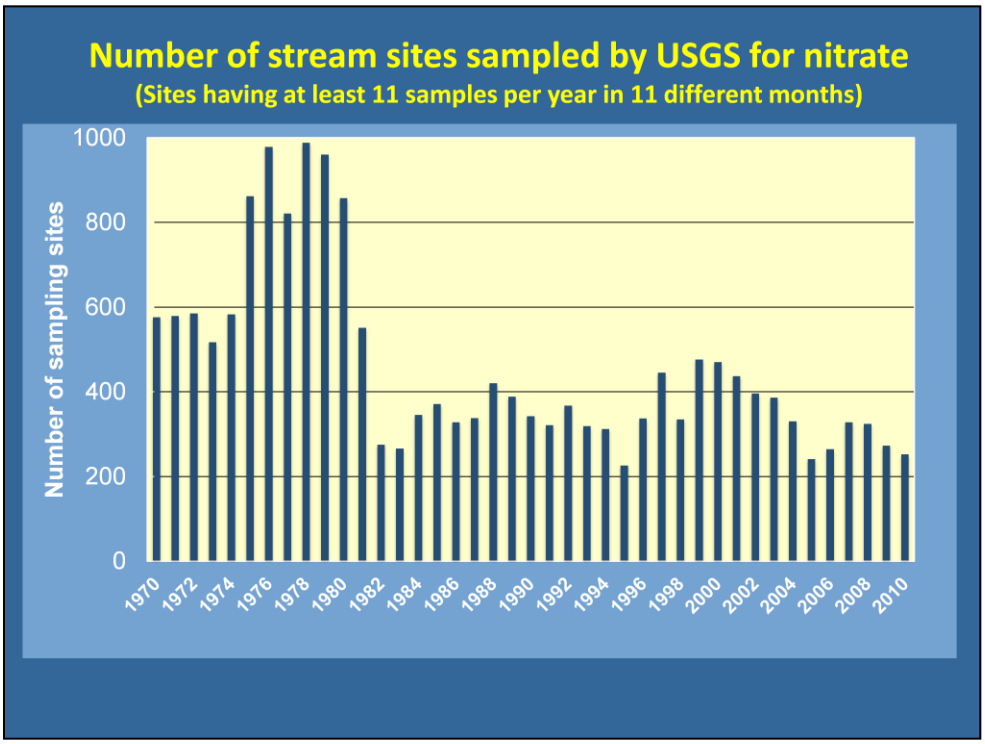
National Monitoring Network (NMN)- (Since 2007) 5 sites are monitored as part of NMN: Brazos River near Rosharen, TX; Mississippi R. above Vicksburg, MS (at mile 438) ; Apalachicola R near Sumatra, FL ; Delaware R. at Trenton, NJ and Hudson River below Poughkeepsie, NY

National Park Service Partnership-- (Since 1998) To date, 173 partnership projects have been implemented in 115 national park units. The program supports a range of science activities ranging in scope from basic technical assistance to fixed station monitoring to intensive/synoptic projects.

TOXIC Substances Hydrology Program- (Since 1982)—Research and methods development on new and emerging contaminants (e.g. new pesticides, hormones and pharmaceuticals)

Upper Mississippi River Restoration (UMRR)—(Since 1989 at 6 study reaches supported by Corps of Engineers

Water, Environment and Biogeochemical Budgets (WEBB) (Since 1991) to understand the processes controlling water, energy, and biogeochemical fluxes over a range of temporal and spatial scales and to understand the interactions of these processes, including the effect of atmospheric and climatic variables 5 sites at: Loch Vale, CO, Panola Mt. GA, Sleepers River, VT, Laguillo Expt. Forest, PR, Trout Lake Forest, WI



The following slides provide some characteristics of the aforementioned USGS water quality monitoring efforts over time.

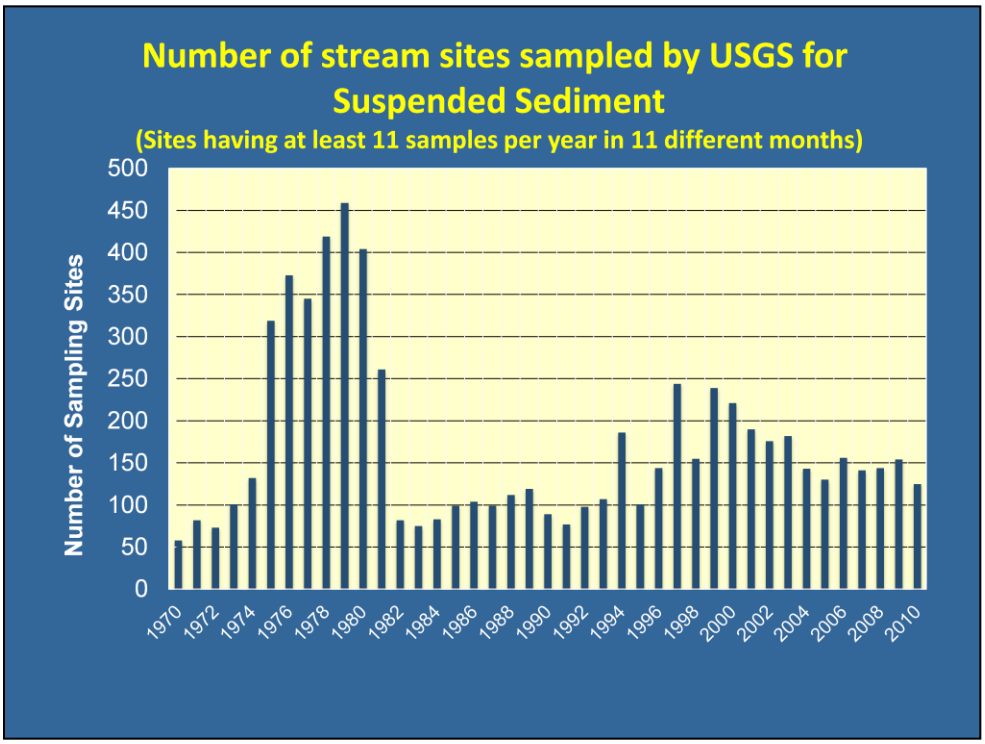
The information from these slides is all from NWIS. In these examples, we've retrieved data for all USGS monitoring sites that were sampled for nitrate at least 11 different times in 11 different months.

At its peak between 1976 – 1978 almost 1000 USGS monitoring sites met this criteria. More than half of the sites shown were sites that were part of the Natioinal Stream Quality Accounting Network and Hydrologic Benchmark Network.

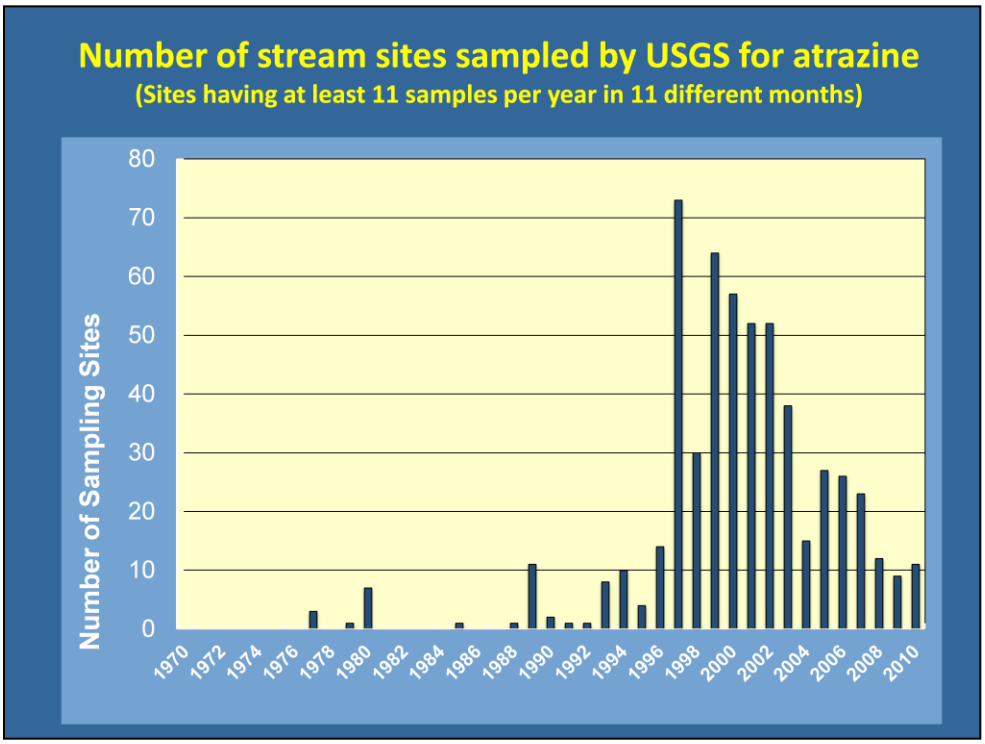
There was a precipitous drop off in sampling in the early 80's. Followed by small increase in the 90's resulting from the NAWQA Program

The decrease in sites is explained by a combination of factors including:

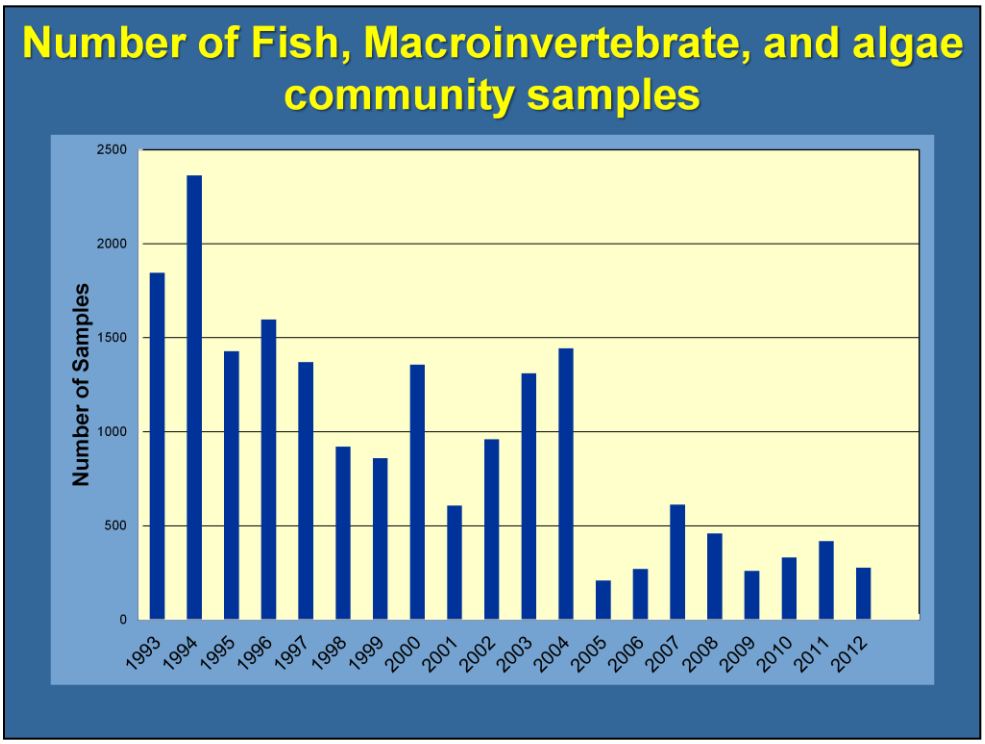
- Stable to declining resources for monitoring
- Questions about the value of fixed site monitoring vs other design approaches
- Interest in other contaminants that are more expensive to measure.



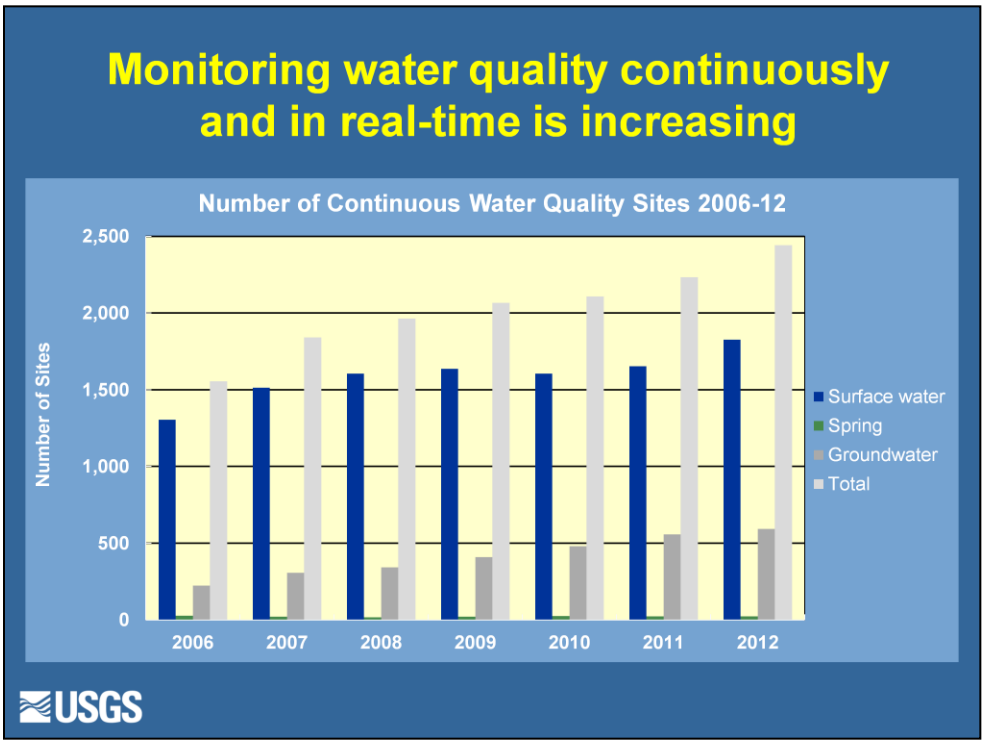
This slide shows the same type of information and a similar pattern for suspended sediment-- except the number of sampling sites each year is about half the number for nitrate.



This slide shows the distribution of sites that included atrazine as part of the monitoring effort. The different pattern reflects the rising concern over pesticides as well as the decision by USGS to form a small Methods Development and Research Team at the National Water Quality Laboratory to develop new methodology and capability to analyze for these types of contaminants at meaningful levels. Note that the number of sites sampled at the peak in 1998 is about 1/3 the number of sites sampled for suspended sediment and about 20 percent of the number of sites sampled for nitrate.



Finally, this slide shows the number of sites sampled for fish, invertebrates, and algae. The number of sites is relatively large compared to the previous slides reflecting the fact that only one sample is typically collected at a site each year.. But, still the declining trend over time is the same as for the other parameters.



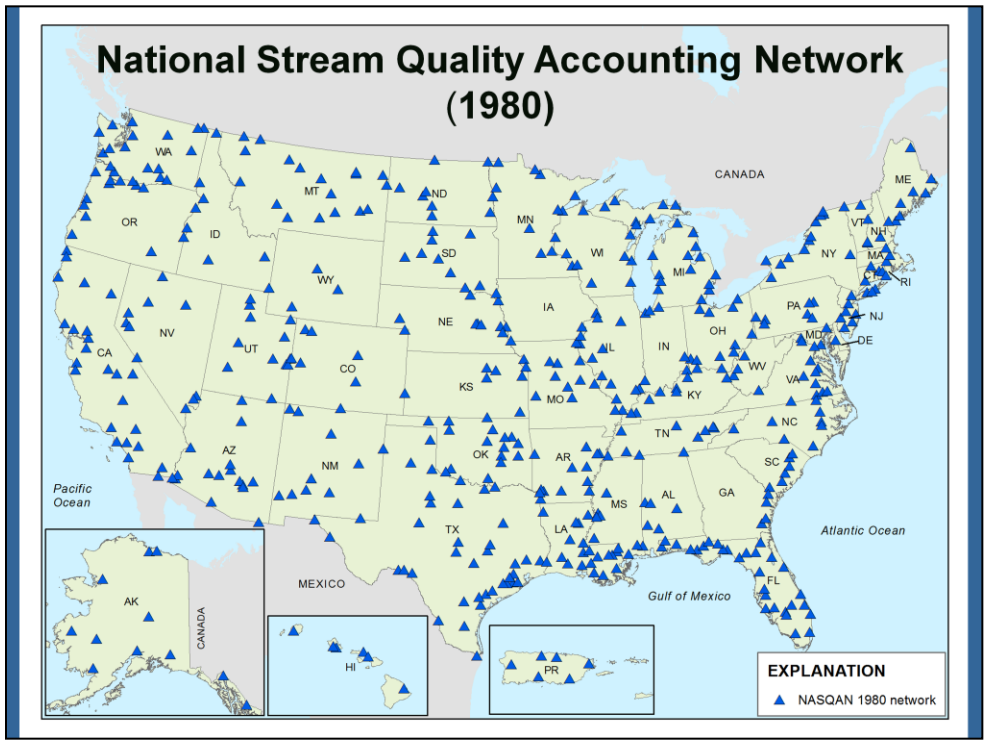
The number of sites USGS is monitoring to provide "real time, continuous water quality data is increasing.

Whereas, the time required to provide results from discrete samples analyzed at a laboratory may be hours to weeks, continuous water quality data can be provided typically at 15 minute increments. While not truly "continuous" captures most natural variability

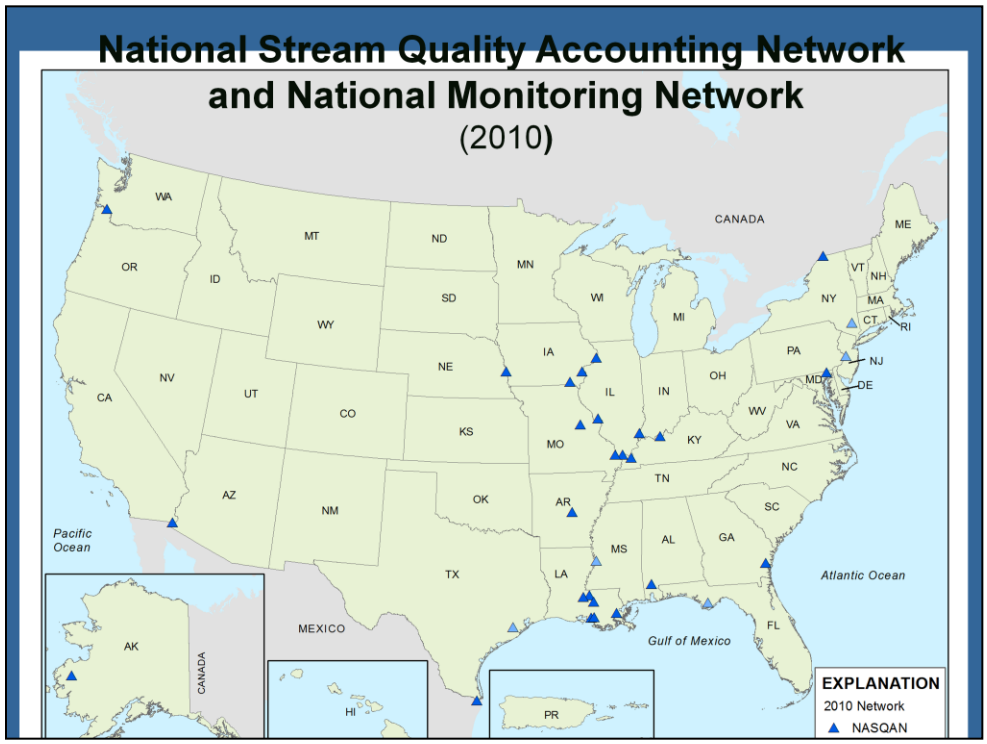
Adding telemetry improves response time from weeks to hours.

Most common sensors include: Water temperature, pH, Specific Conductance dissolved oxygen, turbidity, and nitrate

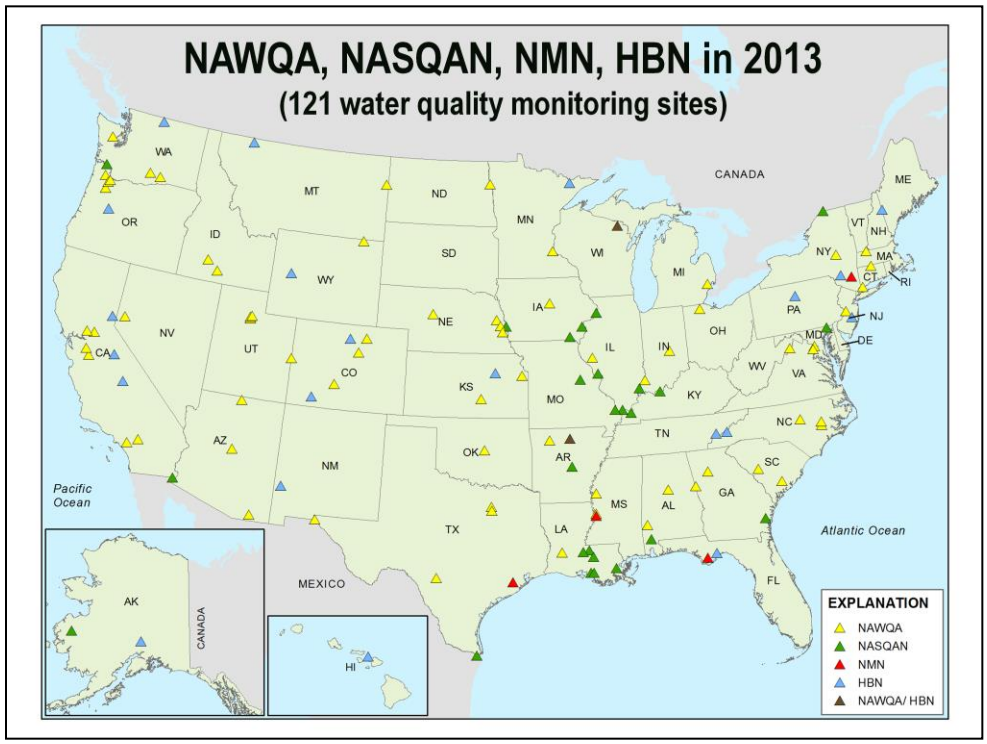
Many new types of sensors being developed (e.g. UV absorption, toxicity)



What do these numbers of sites look like on a map? Recall that at its peak—almost 1000 stream sites were sampled for nitrate 11 times in 11 months; and about 500 sites were sampled at this frequency for suspended sediment. This map shows the number of sites that were part of the NASQAN program in 1980 (575 sites)



This map shows the spatial coverage of the 26 National Stream Quality Accounting Network (NASQAN) and 5 National Monitoring Network sites in 2010.
http://water.usgs.gov/nasqan/



This map shows the 121 long term, water quality monitoring sites supported by USGS Federal programs in 2013. The sites on the map include:

40 Undeveloped Reference sites (including 21 from the Hydrologic Benchmark Network)

10 Agricultural (24 samples per year)

10 Urban sites (24 samples per year)

61 Large Coastal River and large inland rivers (7 (Yukon)- 18 (sites < 30,000 sq mi) samples/year)

Analytes include: suspended sediment, nutrients, organic carbon, pesticides, major ions, inorganic carbon, field parameters. Pesticides are not collected at reference sites.

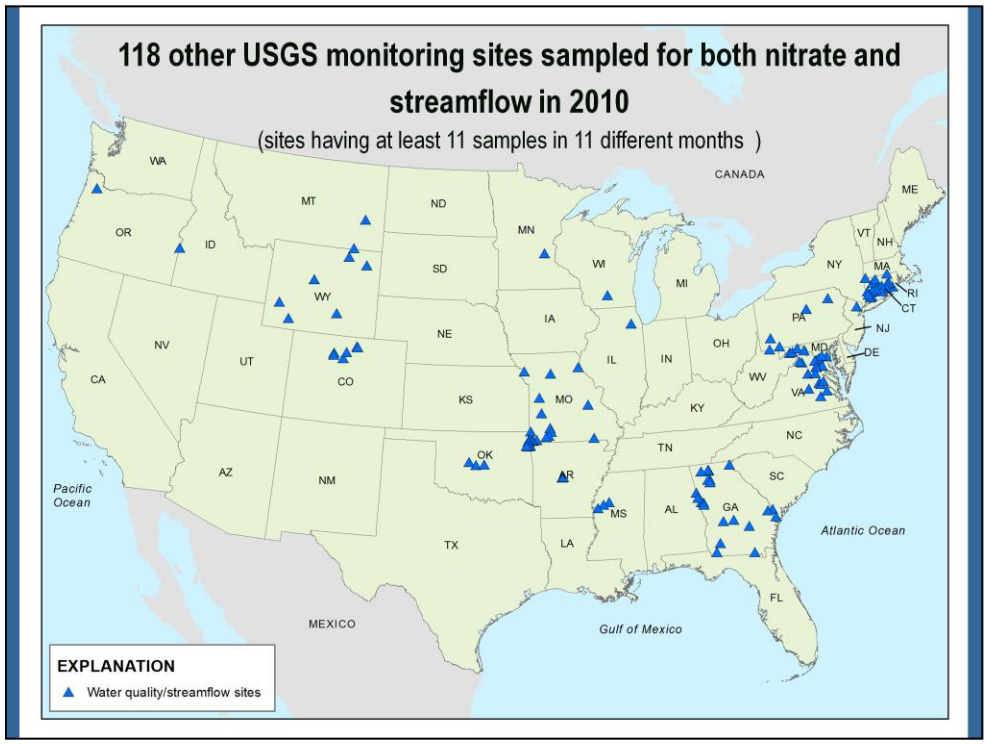
Real time monitors for temperature, dissolved oxygen, pH, specific conductance, nitrate, dissolved organic matter, and turbidity will be included at 5 sites.

Initial emphasis is to better identify the timing and magnitude of nitrate loads.

Criteria used in selecting sites:

Objectives, stream size, period of record, geographic representation, historical constitutent coverage; opportunities to leverage efforts.

This is about 1/3 the number of sites (313) that was recommended as part of NAWQA's Cycle 3 effort that was recently reviewed by the National Research Council.

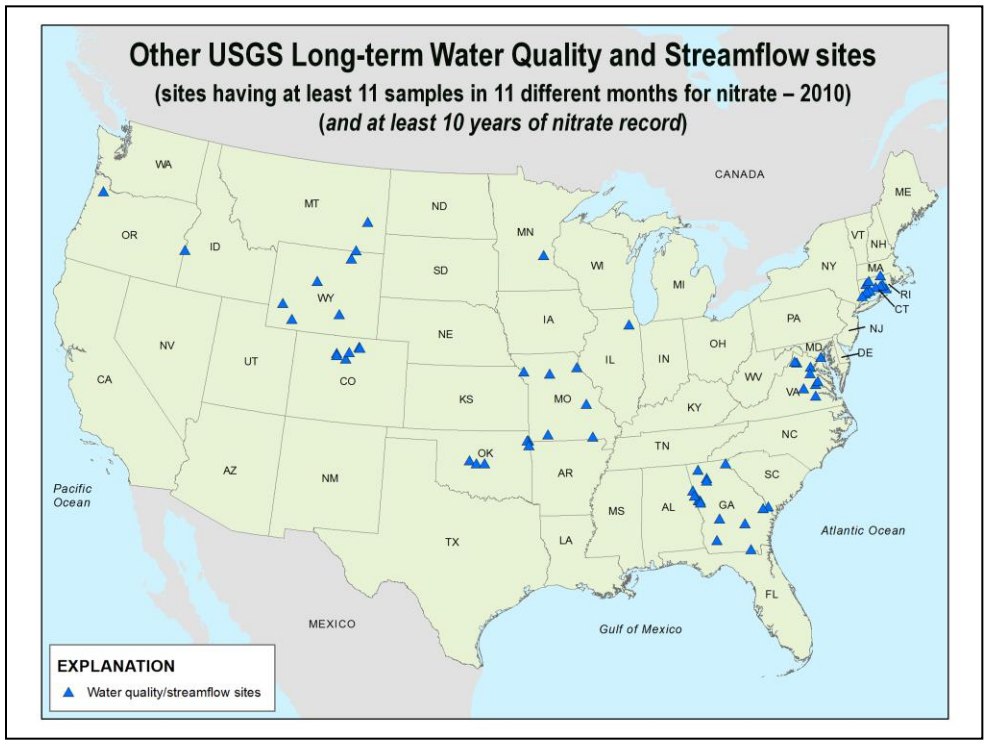


The last three slides showed the locations of water-quality monitoring sites that are part of networks supported solely by federal appropriations. Are there long-term water-quality monitoring sites that are supported by reimbursable funding through the Cooperative Water Program and other agencies? The short answer is "yes".

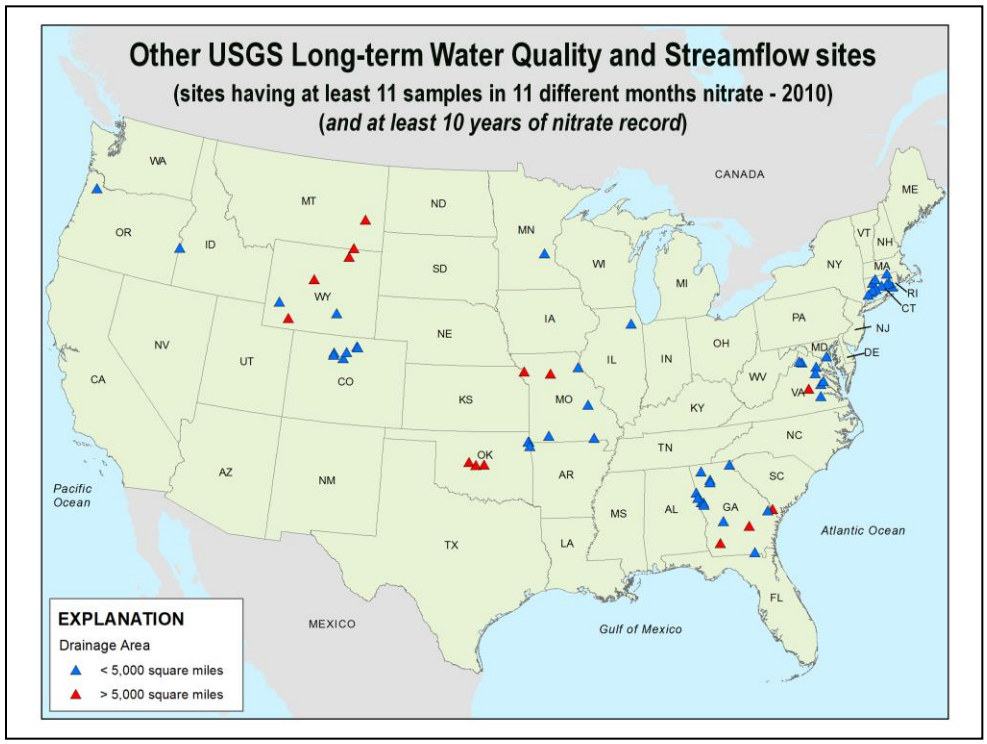
Using the same criteria as before—at least 11 samples in 11 different months—there were 226 additional monitoring sites sampled for nitrate in 2010. The sites include about 85 sites supported by the Cooperative Water Program in the Chesapeake Bay Region. T

Of these sites, 118 were also located at a streamgage—important for interpretation of water quality measurements. This number is probably "low" as it doesn't include sites that may have been close to a streamgage; but, not located at the same exact location.

Most of these sites were monitored for one or two parameters. None of these sites were sampled for three or more parameters; so, we wouldn't expect these sites to provide the same level of broad analyte coverage as some of the other networks. But, they do provide potential opportunities worth considering to leverage existing funding.



Of the 118 sites on the previous map (those sites with at least 11 samples in 11 different months and co-located with a streamgage), 64 have been sampled 10 or more years and would be considered “long term”.



Out of the 64 sites on the previous map (those sites with at least 11 samples in 11 different months, co-located with a streamgage, and have 10 or more years of nitrate) there are 14 sites with drainage area greater than 5,000 square miles that might be considered “large river” sites. .

Proposed: Restoration of Surface-Water-Quality Network

NAWQA Cycle 2		NAWQA Cycle 3
150 sites	⇨	~313 sites
Most only sampled every 2 or 4 yrs	⇨	All sites sampled all years
No continuous monitors	⇨	Most with real-time monitoring
58 ecological sampling sites	⇨	88 ecological sites (add 30 reference)
Single-year intake sampling	⇨	25 stream or river DW intake sites
No lake or reservoir sites	⇨	50 lake or reservoir DW intake sites
Existing contaminant analyses	⇨	Expanded contaminant coverage
Minimal suspended sediment	⇨	Expanded suspended sediment with turbidity monitoring

USGS

Restoration of the water-quality monitoring networks was the highest priority recommendation resulting from the recent two year review of the National Water Quality Assessment Program by USGS stakeholders and the National Research Council.

This slide summarizes some of the key changes that were proposed to restore the surface water quality network. In fiscal year 2013, NAWQA will be able to start every year monitoriing at only 100 of the 313 recommended surface water monitoring sites and only 79 of 100 groundwater networks recommended for trend monitoring over the next decade.

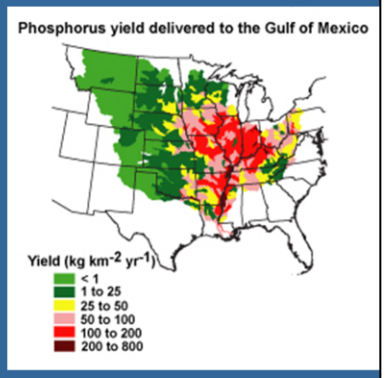
A combination of funding growth and extensive partnering and collaboration with other USGS Programs and with other Federal, State, and local agencies, public interest groups, professional and trade associations, academia, and private industry will be needed to fully realize these monitoring goals.

Proposed: Improved Models for Decision Making

From modeling average-annual conditions to "time varying": monthly, seasonal, and annual

Requires:

- More frequent monitoring (e.g. real time, continuous)
- Improved ancillary data over time (e.g satellite imagery)



Expanding development of NAWQA modeling tools was the second priority of stakeholders and the National Research Council during the recent review.

The more frequent monitoring at stream water quality monitoring sites will be used along with updated contaminant source data to improve the temporal resolution (shorter time scales) of the models, facilitating simulation of seasonal to annual variations in streamflow, contaminant concentrations, and loads. The improved models will be used to develop more effective decision support tools to forecast how nutrient and sediment loads will change in response to changes in climate, land use, or management practices.

Discussion and Questions