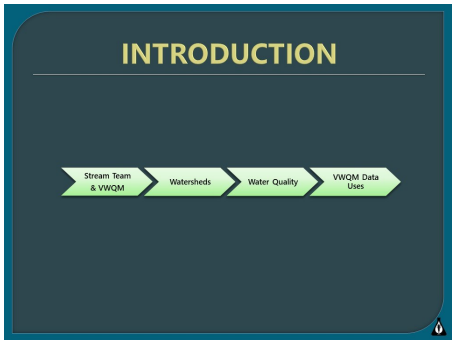
Chapter 1

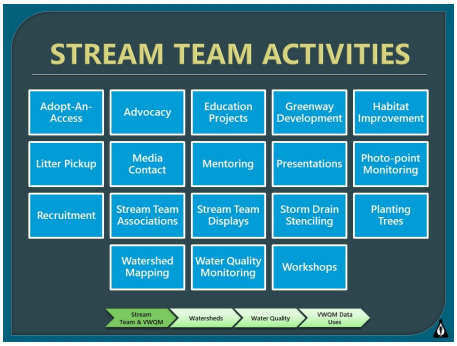
Introduction to Volunteer Water Quality Monitoring Training: Level 1



Welcome to Missouri Stream Team! This program is made possible by a strong partnership between the citizens of Missouri and the following organizations:

Since you are participating in a training on water quality monitoring, you likely have an interest in clean water and protecting our state's waterways. This chapter will explain the Missouri Stream Team and Volunteer Water Quality Monitoring programs. The following will also be covered:

- Requirements for VWQM certifications
- Define watersheds and how streams affect a watershed's overall health
- Completing Stream Team Activity Reports



Missouri Stream Team Program and Goals

Beginning in 1989, the Missouri Stream Team provides opportunities for all citizens to get involved in river and stream conservation. The program has three main goals:

- ***Education:*** Learning about Missouri's 110,000 miles of flowing water enables volunteers and their communities to better understand stream systems and the challenges faced conserving them.
- ***Stewardship:*** Becoming good stewards of our natural resources ensures future generations will enjoy the benefits of Missouri's streams.
- ***Advocacy:*** Citizens who have gained firsthand knowledge of stream needs, problems, and solutions are best equipped to speak out on behalf of Missouri's stream resources. Stream Teams United is a program partner that assists with advocacy. For more information on advocating for Missouri waterways, visit StreamTeamsUnited.org.

Whatever your ambitions, the Missouri Stream Team program has many opportunities for you to get involved. We welcome your volunteer efforts and sincerely appreciate the work you do to protect and conserve Missouri's streams.

VWQM Program and Goals

One of the most popular Stream Team activities is the Volunteer Water Quality Monitoring (VWQM) program. This activity was added in 1993 at the request of Stream Team volunteers who wanted to participate in stream monitoring.

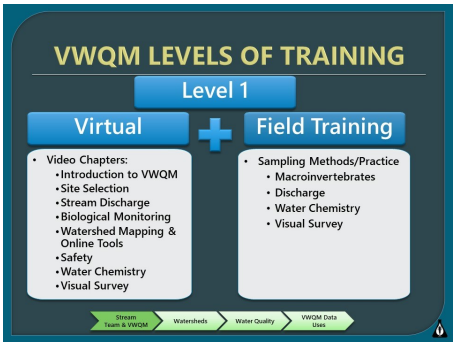
The VWQM Program provides volunteers with training and equipment to monitor the quality of Missouri's rivers and streams. The VWQM Program was established to achieve four goals:

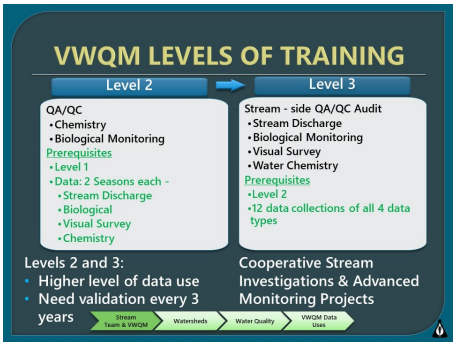
VWQM Program Goals			
Inform and educate about the conditions of Missouri's rivers and streams	Establish a network of trained volunteers to monitor the quality of Missouri's rivers and streams	Enable citizens to help local, state, and federal leaders make informed decisions about Missouri's waterways	Halt water quality degradation of Missouri's water resources

VWQM Levels of Training and Requirements

To become a water quality monitor, volunteers engage in training to acquire the knowledge and skills they need to evaluate water quality accurately. Currently, there are four levels of training. Each level of training is a prerequisite for the next. Structuring the training in this way allows volunteers to choose their own level of participation and commitment in monitoring activities.

Volunteers who wish to advance from one level to the next must meet certain requirements. The table below describes the content of each training level and the requirements that allow you to advance to the next level.



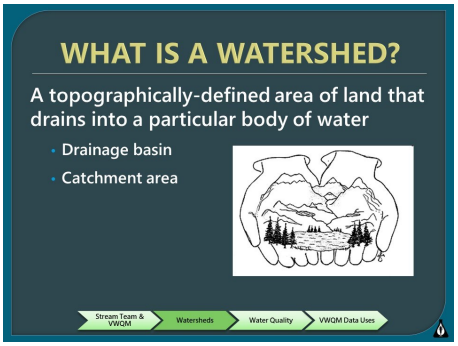


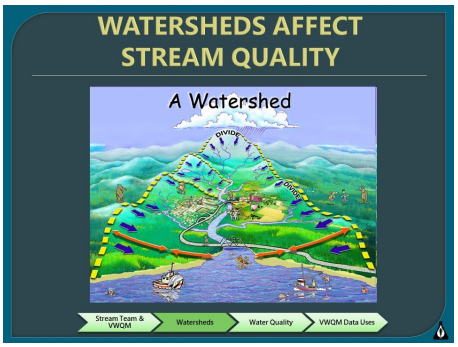
VWQM Levels of Training and Prerequisites

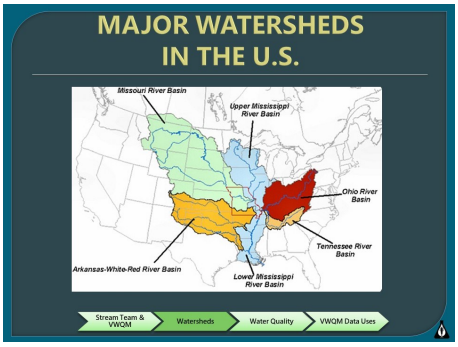
Level 1	
Content Site Selection, Stream Discharge, Biological Monitoring, Visual Survey, Water Chemistry	***Prerequisite*** None

Level 2	
Content Quality Assurance/Quality Control (QA/QC) of chemical monitoring and macroinvertebrate identification	***Prerequisite*** Level 1 certification and submission of 2 seasons of all data

Level 3	
Content Stream-side QA/QC of all data collection methods	***Prerequisite*** Level 2 certification and submission of 12 seasons of all data

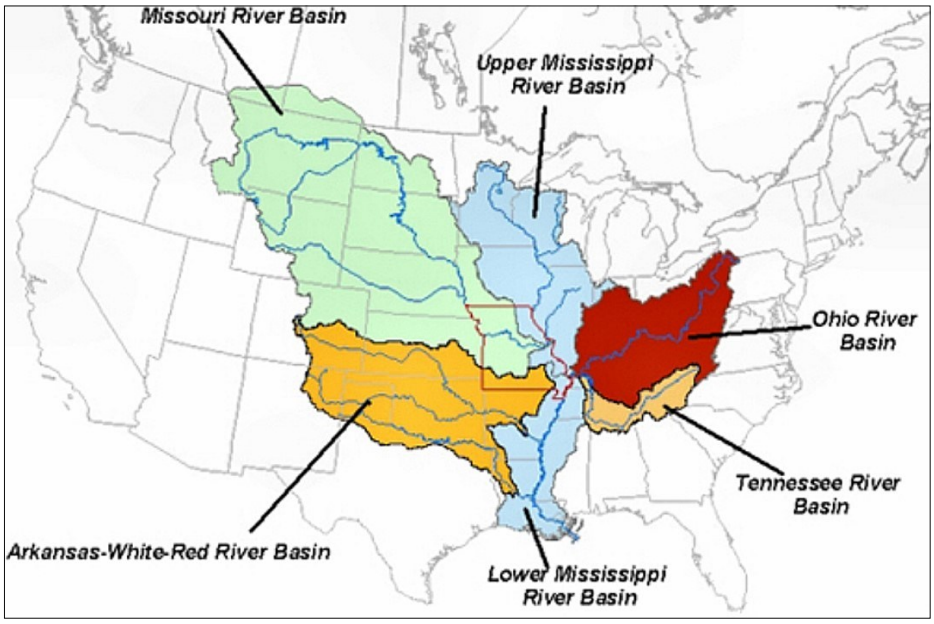




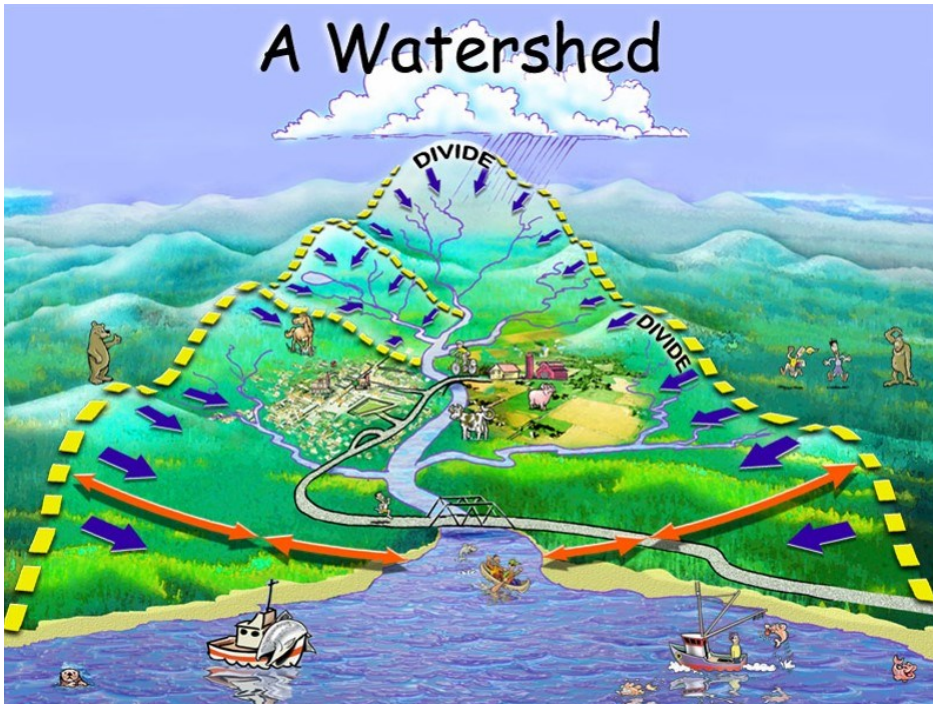


What is a Watershed?

A watershed is a topographically defined area of land that drains into a particular body of water. Watersheds are interconnected. For example, the Mississippi Watershed includes the Missouri, Mississippi, Ohio, Tennessee, Arkansas, White, and Red river basins.

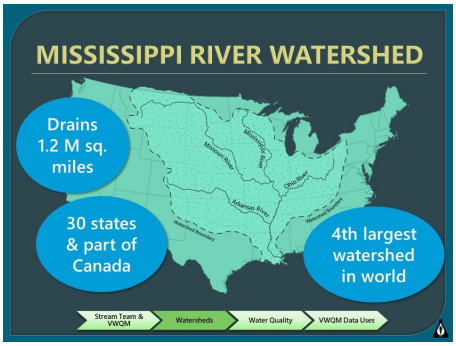


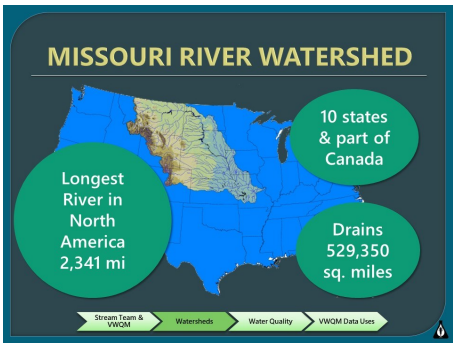
As shown in the diagram below, the quality of a stream is a direct reflection of its watershed. Since humans live, work, and play in watersheds, we directly and indirectly alter them and our water resources. As water flows across urban areas or pastures, it picks up sediment, pollutants, and even heat. These



Mississippi River Watershed

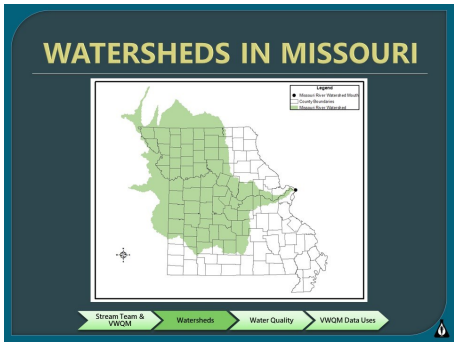
Watersheds range in size from less than an acre to millions of square miles. The Mississippi River watershed is the fourth largest in the world, covering 1,247,000 square miles. It crosses many political boundaries too. For example, the Mississippi River watershed includes portions of 30 states and a small part

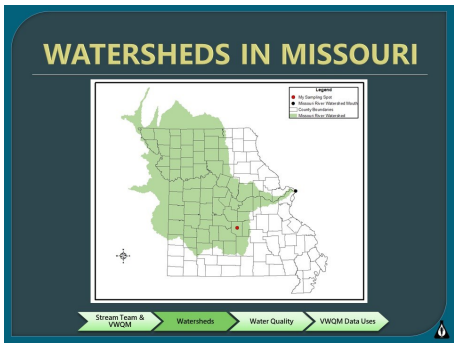


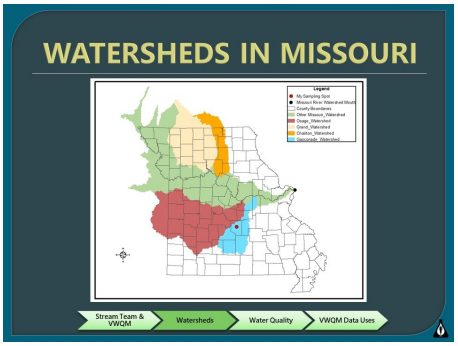


Missouri River Watershed

The Missouri River is the longest river in North America, stretching 2,341 miles. As the largest tributary to the Mississippi River, it has the largest reservoir system in North America. At normal water levels, this system stores approximately 55 times the amount of water stored in Truman Reservoir. With its channelization, major reservoirs, and systems of levees, it is also one of the most altered rivers in the world. More than half of Missourians get their drinking water from the river or its underground aquifer. The Missouri River watershed is actually a sub-watershed of the Mississippi. It covers 529,350

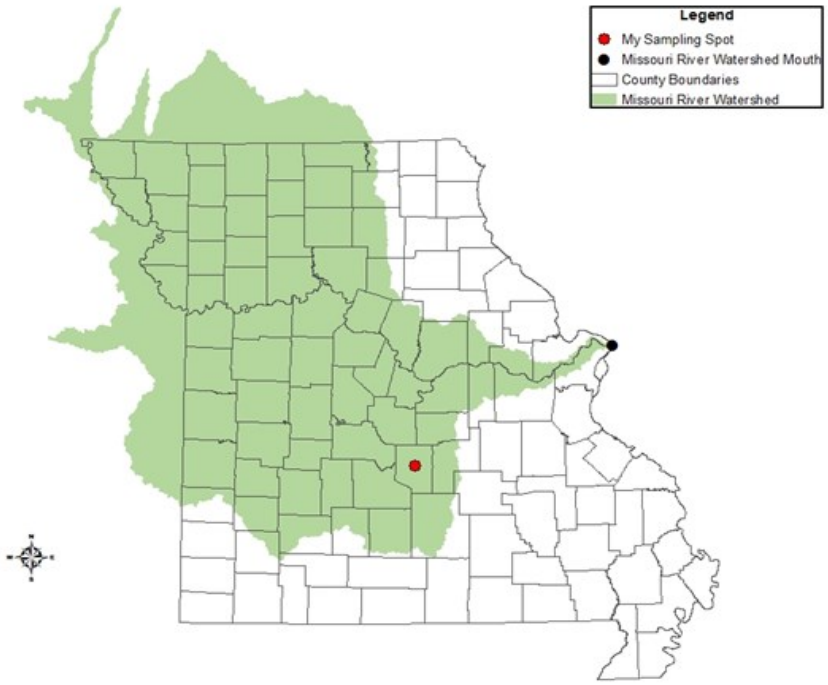




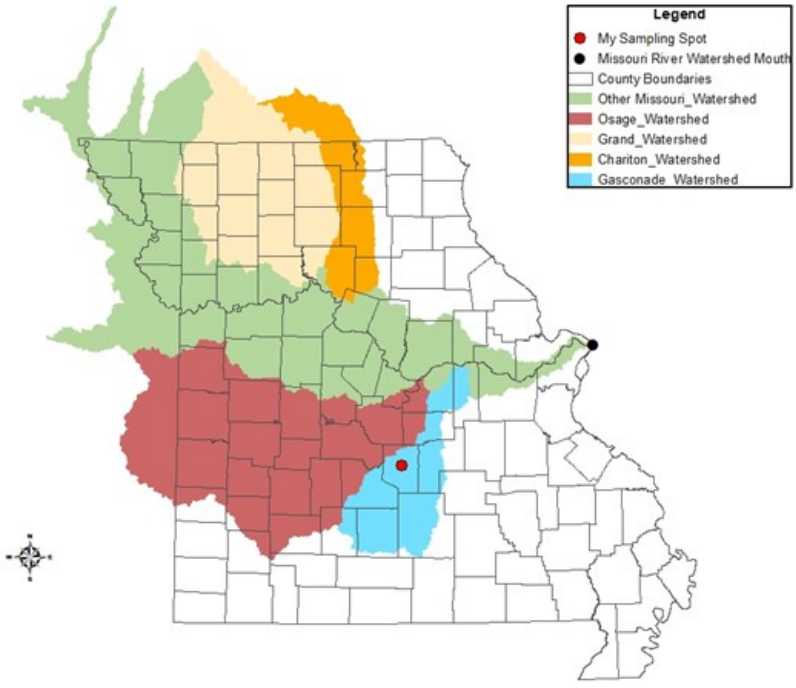


Watersheds in Missouri

The image below depicts the portions of the Missouri River watershed in the State's boundaries. To give a point of reference, the mouth of the Missouri River is indicated by the black dot on the map, and the sampling location is indicated by the red dot.



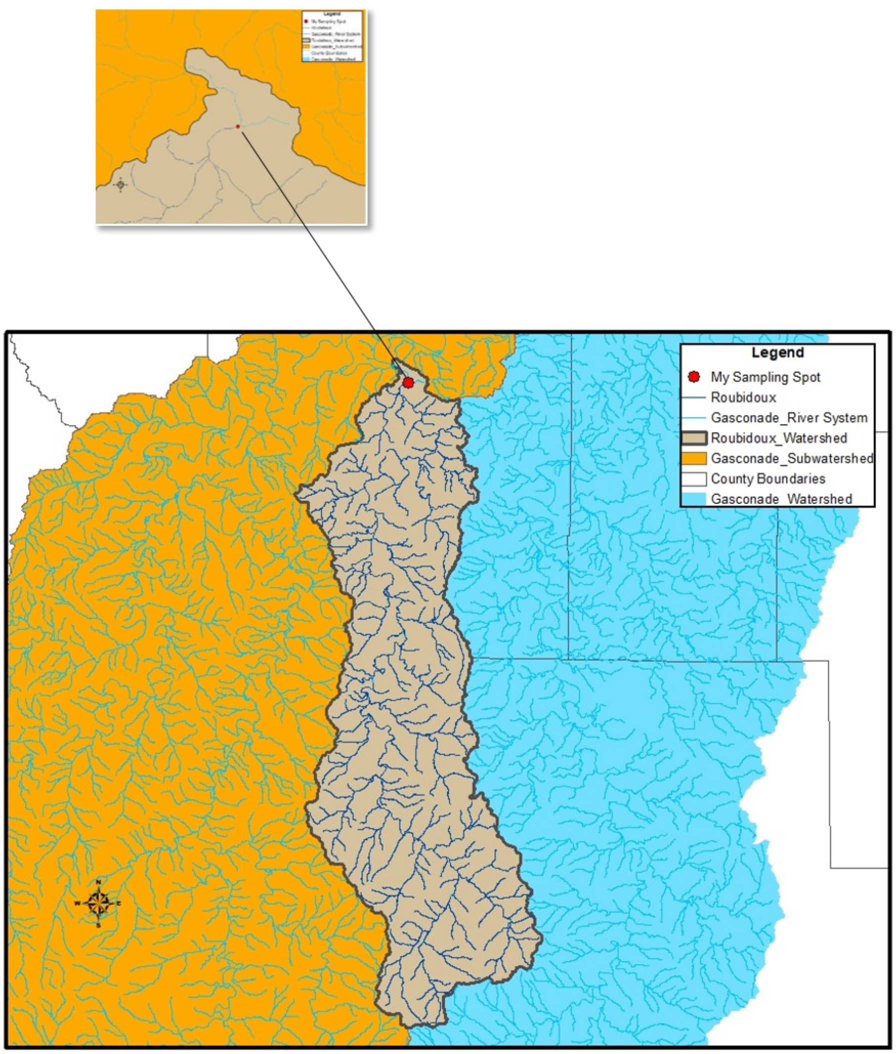
The Missouri River has many tributaries including the Gasconade, Grand, Chariton, and Osage rivers. The image below illustrates these tributaries' watersheds within the Missouri River watershed. The watershed influences from these tributaries will affect the water quality of the Missouri River.

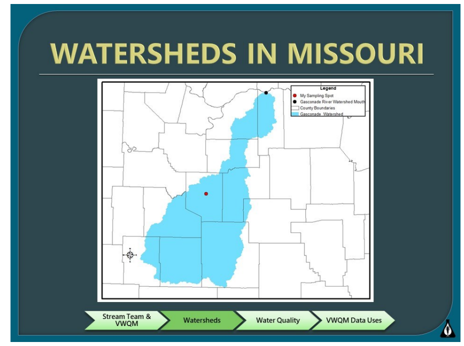


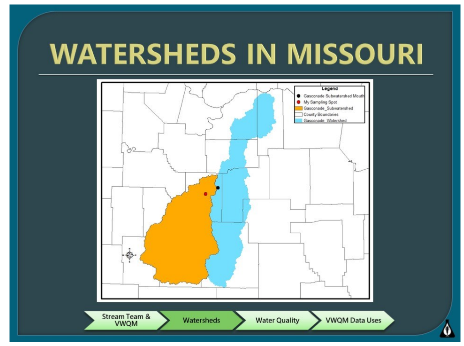
Watersheds in Missouri

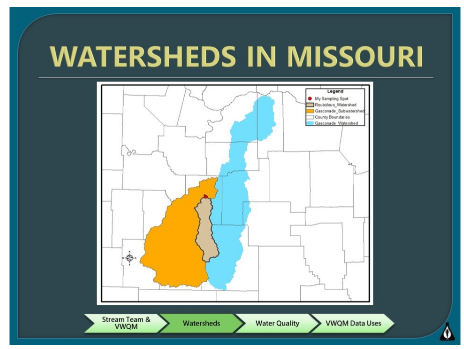
The red point indicating a sampling location is along the Roubidoux Creek in Pulaski County. The Roubidoux watershed is a subwatershed of the Gasconade River watershed. The water quality at the mouth of the Roubidoux watershed reflects the influences of its entire drainage area and show what is entering the larger watershed in the Gasconade River. When selecting a monitoring location, think of how it fits in the local watershed.

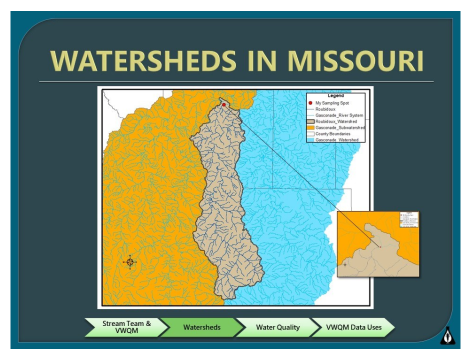
Conditions of watersheds directly affect the quality of water resources where we live, work, and play. If we are able to keep our watersheds healthy, it's likely the streams within those watersheds will remain healthy as well. It is important to protect local waterbodies for a healthy regional watershed and to help with national or even global water quality concerns.

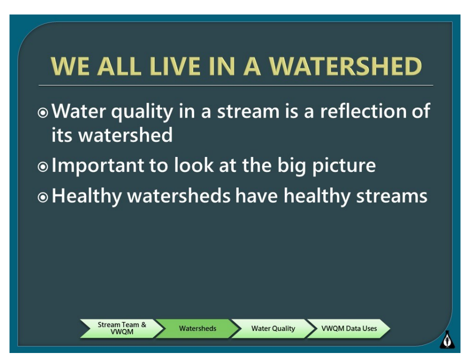


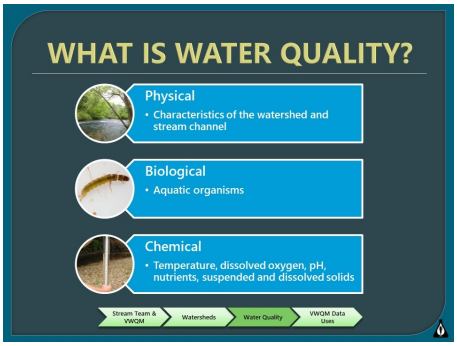


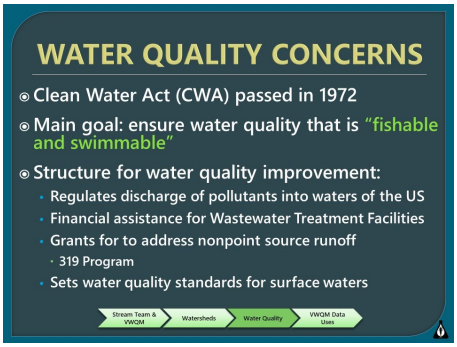


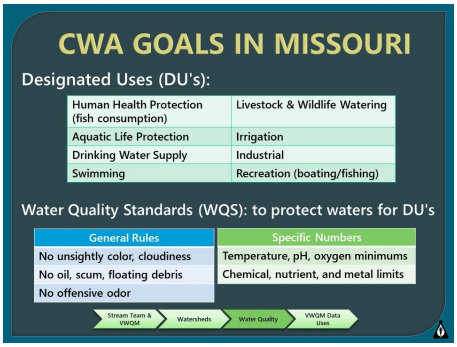












What is Water Quality?

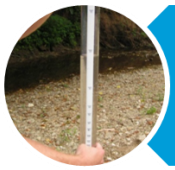
The quality of Missouri's water resources is reflected in the physical, chemical, and biological characteristics of our rivers and streams. Today's training will introduce you to the physical and biological components of a stream. Chemical characteristics will be covered in the VWQM Level 1 training.

Physical

- Characteristics of the watershed and stream channel

Biological

- Aquatic organisms



Chemical

- Temperature, dissolved oxygen, pH, nutrients, suspended and dissolved solids

Clean Water Act Goals in Missouri

The primary goal of the Clean Water Act is to ensure water quality that is fishable and swimmable. This means aquatic life can thrive, fish from waters can be consumed without harming human health, and people can swim without negative affects.

All waters in Missouri have presumptive uses of human health protection, swimming, and aquatic life protection. Water quality standards are established to protect waters for their designated uses. These standards provide protection with narrative and numeric criteria.

Designated Use

- Human Health Protection
- Aquatic Life Protection
- Drinking Water Supply
- Swimming
- Livestock and Wildlife Watering
- Irrigation
- Industrial
- Recreation

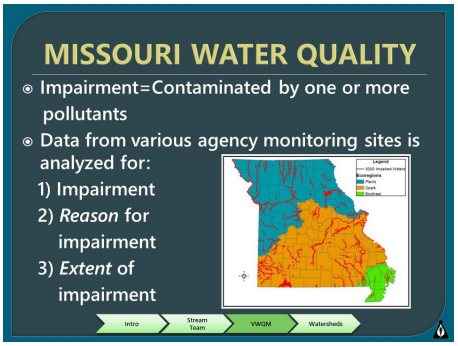
WQS General Rules

- No unsightly color, cloudiness
- No oil scum, floating debris
- No offensive odor

WQS Specific Numbers

- Temperature, pH, oxygen minimums
- Chemical, nutrient, metal limits

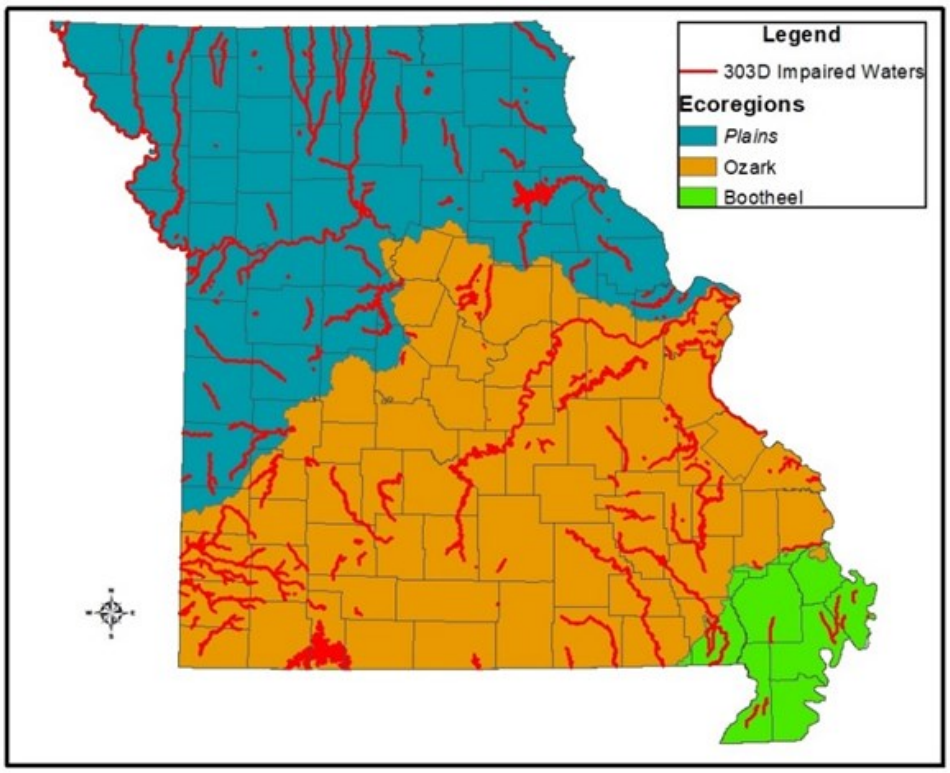
Missouri Water Quality



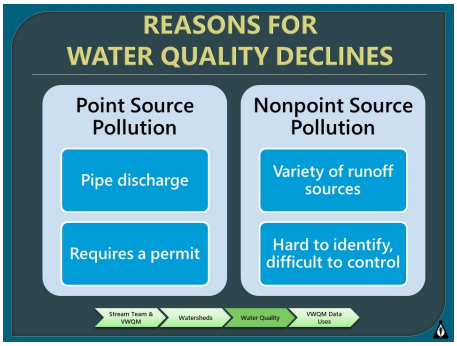
Here is another way to look at water quality in Missouri. The red on this map outlines the streams, rivers, and lakes listed as impaired on Missouri's 2016 303(d) Impaired Waters listing.

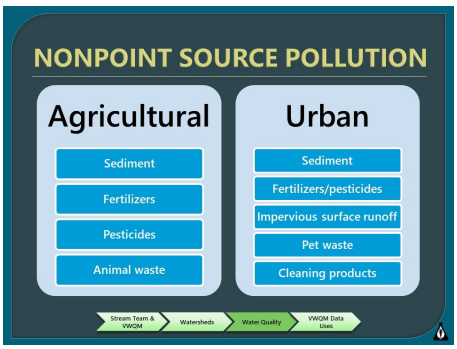
Impaired means that the waterbody is contaminated by one or more pollutants.

When an agency assesses water quality data for an impairment they look for 1) Is there contamination and what are the contaminants 2) the reason for the impairment and 3) the extent of the impairment.



This map illustrates the stream sections listed as impaired. Once a stream is listed as impaired, a Total Maximum Daily Load (TMDL) is developed for a watershed based plan to improve water quality. For more information on Missouri's waters you can check out the 305 (b) report which provides an overview of waterbodies in Missouri, the 303 (d) report which lists impaired waters, and TMDL's which outline watershed based improvement plans at: dnr.mo.gov/env/wpp/





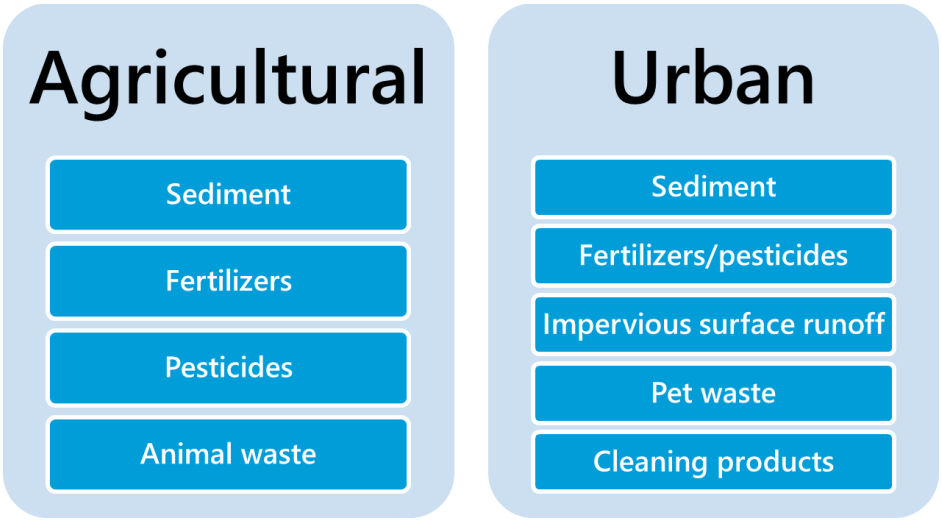
Reasons for Water Quality Declines

The Clean Water Act mandates how our nation must manage the two major types of water quality pollution:

- ***Point Source Pollution*** is characterized by an entry point or source, such as a pipe. This type of pollution requires a permit, so it can usually be identified and regulated through the permitting process.
- ***Nonpoint Source Pollution*** refers to contaminants that do not come from specific conveyances, such as pipes or other permitted sources. It includes contaminants carried in runoff from fields, roads, parking lots, etc., as well as more specific sources such as improperly functioning septic systems. Nonpoint source pollution is much more challenging to identify and control than point source pollution.

Nonpoint Source Pollution

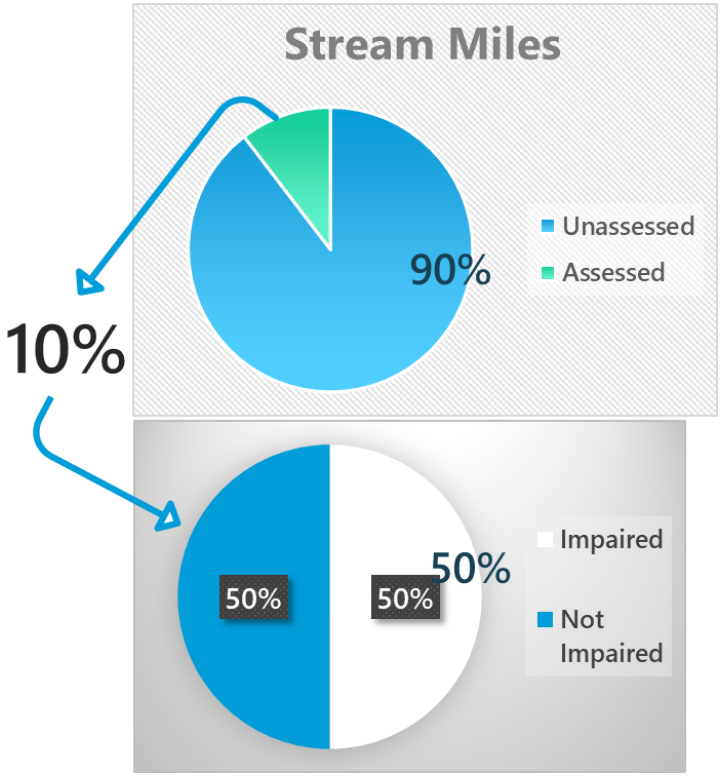
Nonpoint source pollutants come from a wide variety of land uses across a landscape and can cause water quality degradation. The following are examples of nonpoint source pollutants from two broad types of land use:

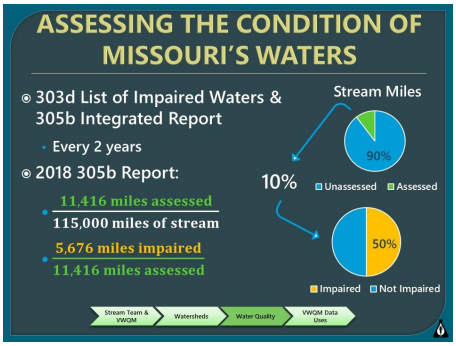


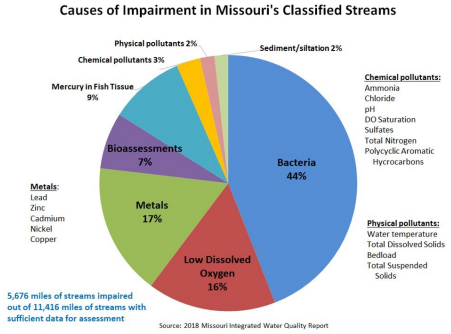
Assessing the Condition of Missouri Waters

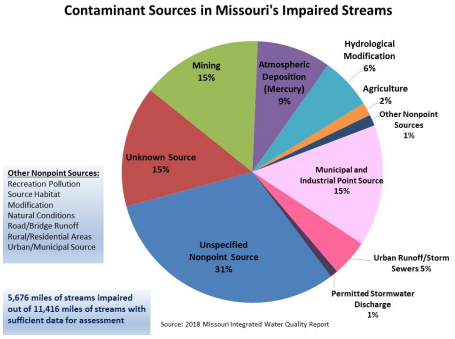
The Clean Water Act requires states to assess their waters every two years and report findings to the Environmental Protection Agency (EPA) in the form of the 305(b) Integrated Report that describes the overall status of the state's waters and includes the 303(d) list of impaired waters.

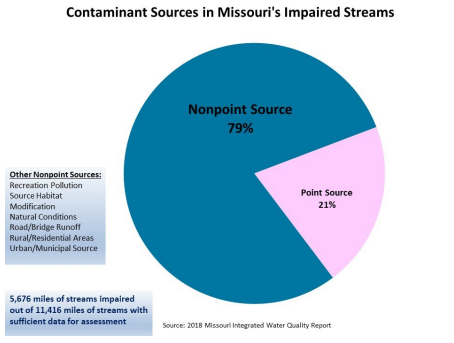
The 303(d) list is developed by using available data collected using EPA approved methods to assess the state's waters against specific Water Quality Standards (WQS). Only about 10% of streams in Missouri have enough data to be eligible for assessment. VWQM data is not used for the 305 (b) report, but can be used for screening data for agency staff to follow-up on.









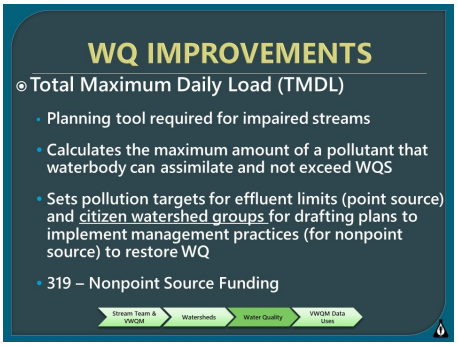


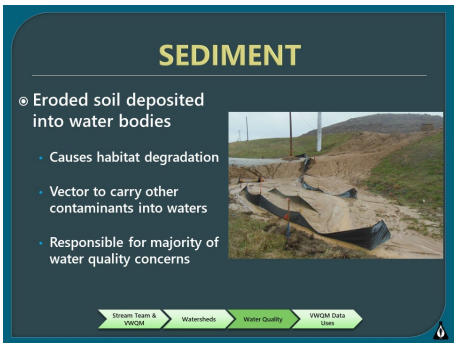
Causes of Impairment in Missouri's Streams

Impaired streams on the 303(d) list are unable to meet the Water Quality Standards for their designated uses. Rather than an entire stream being impaired, only segments of a stream that are non-supporting of its designated use is considered impaired.

Top causes of impairment in Missouri's classified steams are bacteria, low dissolved oxygen, and metals. Contaminants originate from numerous sources. More than three-quarters of contaminant sources are nonpoint source. This means that its caused by stormwater runoff and a discrete source is difficult to identify — and harder to address.

More information on Missouri's impaired waters and Water Quality Standards can be found on Missouri Department of Natural Resources website.





Water Quality Improvements

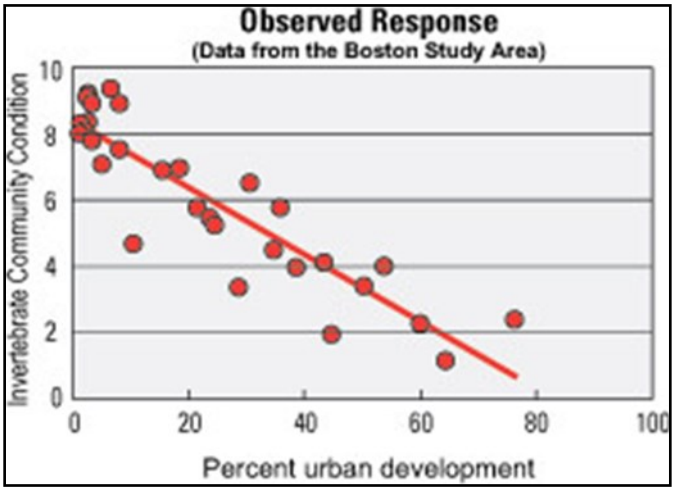
Once a stream is listed as impaired, a total maximum daily load (TMDL) is written to provide a framework for identifying and improving impaired waters. TMDLs will include allocations of the acceptable load for all sources of the pollutant. It will also include an implementation plan to identify how the load will be reduced to a level that will protect water quality.

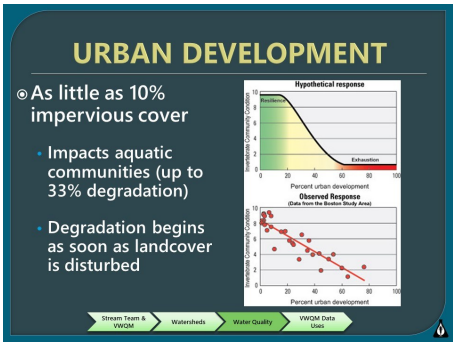
Sediment

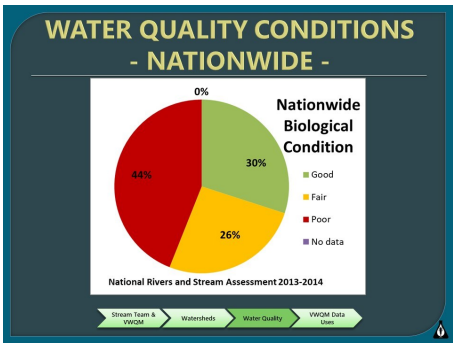
Sediment is eroded soil that is deposited into water bodies. Sediment enters water bodies from improperly managed crop, forest lands and construction sites, and eroding streambanks. But sediment has a significant role in a majority of water quality impairments because it acts as a vector to carry other contaminants into receiving water bodies – including pesticides, fertilizer, bacteria, and others. This shows that even though pollutants and stressors are listed separately on the impaired waters list, in reality, water quality suffers from the combined effects of several pollutants and processes.

Urban Development

A United States Geological Survey (USGS) study assessed the physical, chemical, and biological responses of stream systems to a gradient of increasing urban intensity. Results showed benthic macroinvertebrate communities experienced degradation as soon as land cover was disturbed. By the time a watershed reaches 10% impervious cover in urban areas, aquatic invertebrate communities degrade by as much as 33% compared to those in forested watersheds.

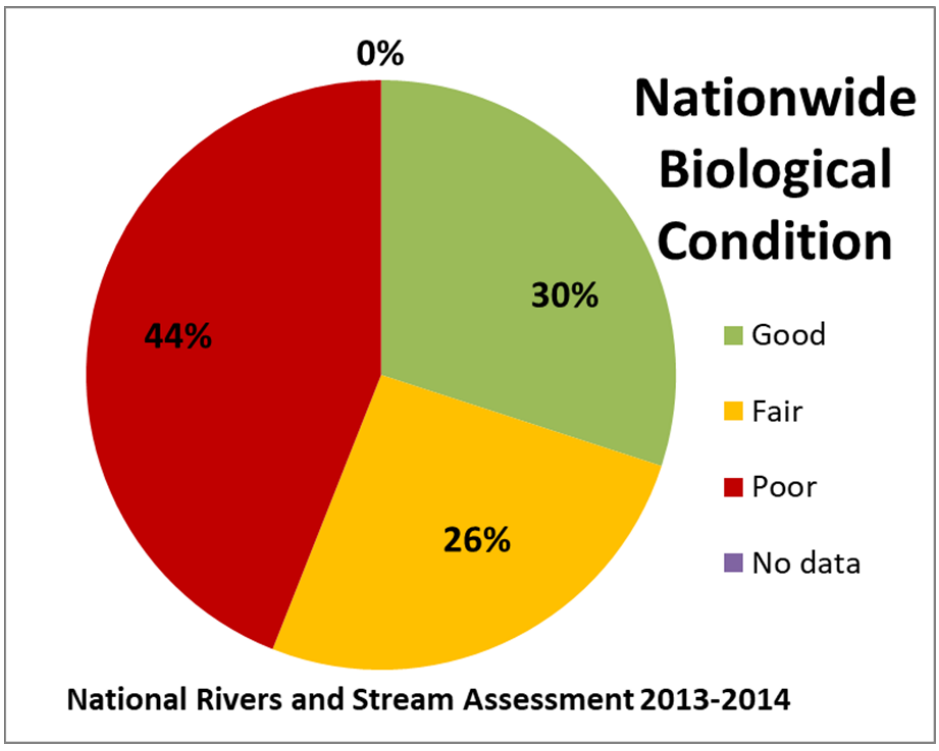


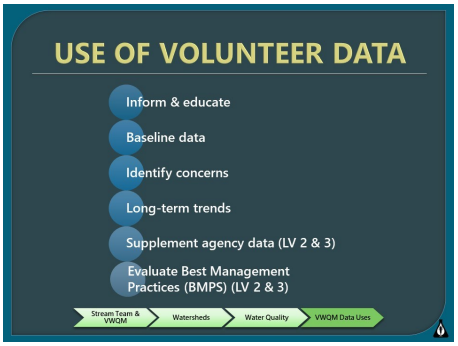


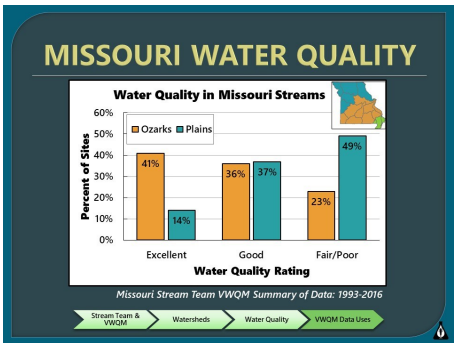


Water Quality Conditions Nationwide

A National Rivers and Streams Assessment found that 44% of rivers and streams nationwide were in poor biological condition. This data suggests there is room for water quality improvement in the United States.







Uses of Volunteer Data

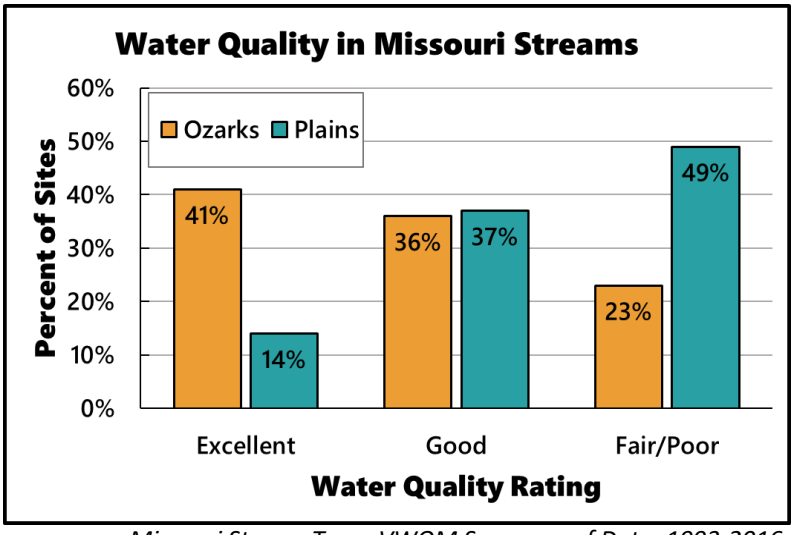
Volunteer data has several uses:

- Inform & educate
- Baseline data
- Identify concerns
- Long-term trends
- Supplement agency data (LV 2 & 3)
- Evaluate Best Management Practices (BMPS) (LV 2 & 3)

VWQM Summary of Data

Missouri is divided into 3 broad ecoregions: the Plains region in the north, the Ozarks in the south, and the Mississippi Alluvial Basin in the bootheel. These ecoregions are determined based on topography, soils, geology, and many other factors.

Stream Teams United compiled a summary report of VWQM data from 1993-2016. The graph of volunteer data below illustrates that there are some differences in water quality in the different ecoregions of Missouri. There was not enough data from the Mississippi Alluvial Basin to be included in this graph. The rankings of excellent, good, and fair/poor water quality are based off of the VWQM biological ranking system.



Missouri Stream Team VWQM Summary of Data: 1993-2016

VWQM data shows that the water quality for the majority of streams in the Ozark region have excellent to good biological water quality rating and majority of the streams in the Plains region have fair/poor and good ratings. The differences in ratings for these ecoregions are in part due to natural resources as well as anthropogenic, or human-made, alterations.

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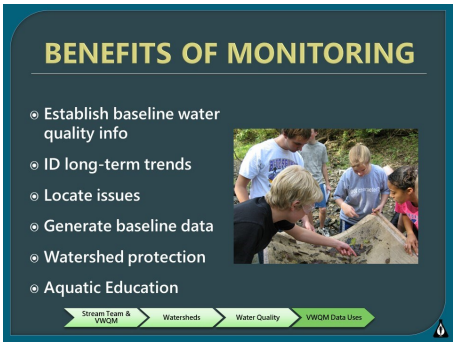
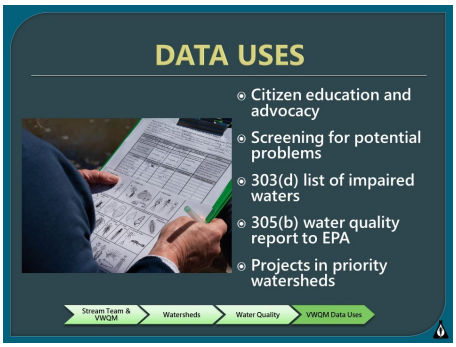


Benefits of Monitoring

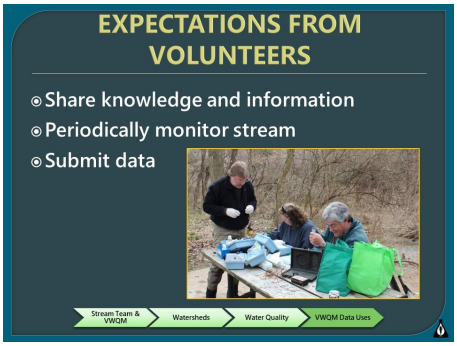
There are several benefits to monitoring the water quality of our streams:

- ***Establish Baseline Water Quality Information:*** Missouri has nearly 110,000 miles of classified streams. Many of these streams have little or no information about water quality. If a pollution event should occur, a baseline of information serves as a comparison to what conditions were like before the incident.
- ***Identify Long-Term Trends:*** Submitting consistent data over a span of many years reveals if the stream conditions are improving, declining, or staying the same.
- ***Locate Issues:*** With over 9,000 trained volunteers, there are numerous examples of volunteers who discover pollution events and alert the appropriate authorities.
- ***Watershed Protection:*** Monitoring your stream gives you a richer understanding and appreciation of our waterways. This allows for better decision making regarding the protection of your local watershed.



Data Uses

- VWQM data can be used by monitors to educate themselves and their community, and advocate for improvements in their local watershed.
- All VWQM data is used by DNR and MDC to establish baseline information about streams in the state, screen for and locate any potential problems, and educate the public about water quality. Data collected for at least 5 years can be used to begin to identify long -term water quality trends.
- Higher levels of VWQM data can be used to help prepare two reports that the DNR submits to the Environmental Protection Agency (EPA) every two years: the Missouri Water Quality 305(b) Report and the 303(d) List of Impaired Waters.
- Citizen data can be used to identify projects needed in MDC priority watershed areas.



Expectations from Volunteers

- Share knowledge about water quality with others
- Periodically monitor a stream
- Submit data

NOTES