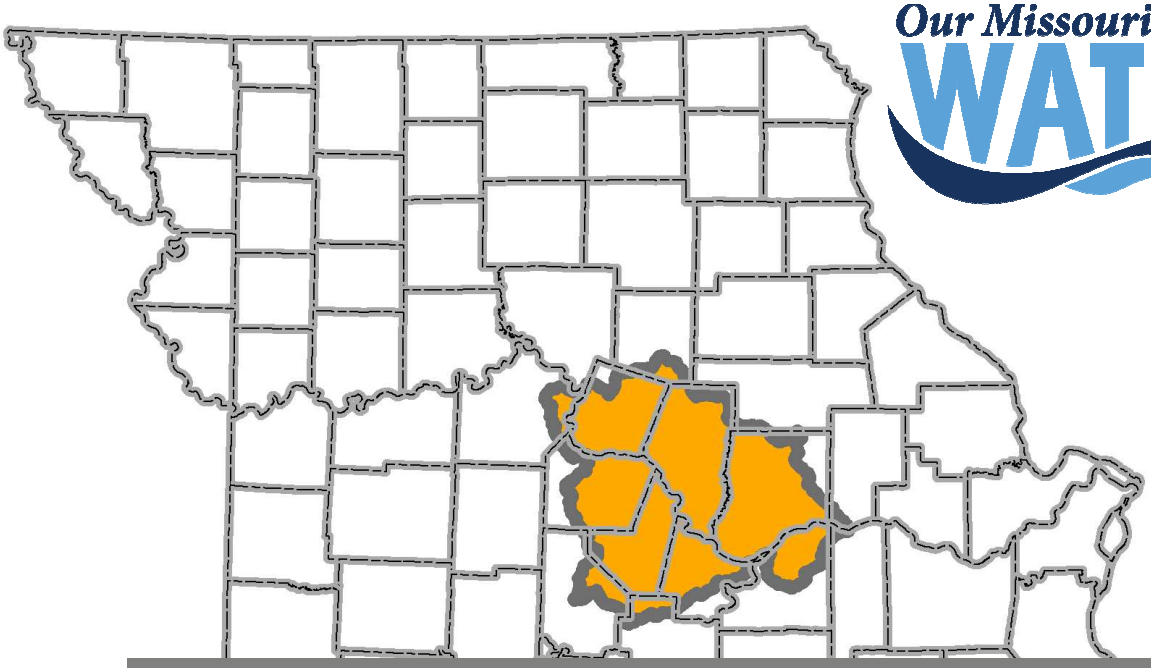
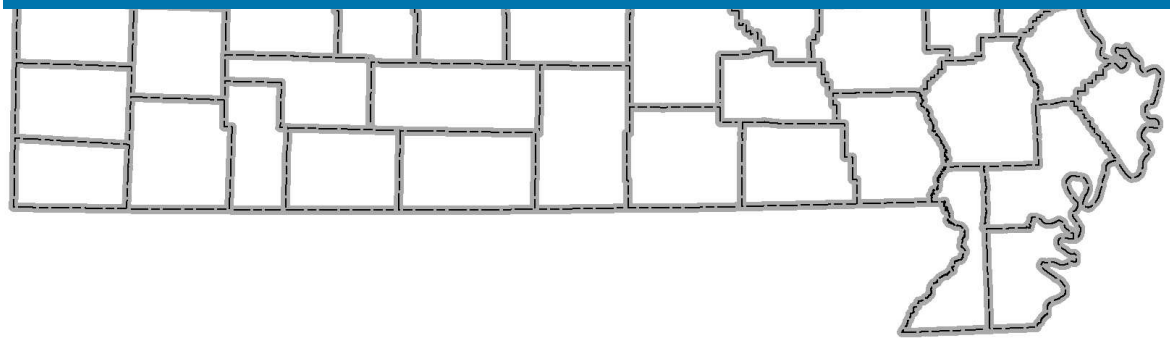


Our Missouri WATERS

The State of *Our Missouri Waters*

Lower Missouri-Moreau River Watershed



The Missouri Department of Natural Resources seeks to improve the availability of water resource information to communities where impact to these water resources is felt most. The information presented in this summary is intended to increase awareness of how activities on land and in water have an influence on water resource quality and quantity. The department greatly values local input and engagement regarding the mission of ensuring safe and ample water resources, and will continue to seek local guidance to further focus department efforts and funding strategies for the betterment of *Our Missouri Waters.*

MISSOURI DEPARTMENT OF NATURAL RESOURCES

HUC-8: 10300102
December 2014

Lower Missouri-Moreau River Watershed

The State of Our Missouri Waters

Importance of Water Quantity and Quality

Water shortages can have severe and expensive consequences. Adequate water supplies are vital not only to human health and safety, but also to the prosperity of our state. Whether it is for crop irrigation, industrial manufacturing or power generation, water is at the core of human existence and sustainability. A few decades ago, the supply of water in Missouri was considered virtually unlimited. As population and industry have increased, a need for statewide water planning has emerged.

Water quality impairments can also have severe impacts on human health and the environment and be extremely expensive. Unfortunately and more importantly, many water quality impairments are only discovered once the consequences of poor water quality have been realized. For this reason, it is important that locals are involved in the protection of their water quality and quantity so as to prevent irreversible consequences.

Key Points

This watershed is located in central Missouri and includes Boonville, Columbia, Jefferson City, Fulton and surrounding communities. This watershed includes the tributaries that flow into the Missouri and Moreau rivers. The Moreau River flows into the Missouri River just east of Jefferson City. Several streams within this watershed are impaired waters due to high bacteria levels and low dissolved oxygen levels. Acid mine drainage from historic coal mining has impacted several streams, including Upper Cedar, Manacle, Miller's and Hiller's creeks. The department has completed numerous projects over the last 30 years to improve the condition of abandoned mine land. Population increased by approximately 14 percent between 2000 and 2010, and continued growth is expected. Land use is dominated by grassland and forest, but 7 percent is in urban land use, which is expected to increase. Consequently, numerous construction activities are occurring, resulting in many land disturbance sites. In the rural portions, agricultural activities including row crop agriculture and livestock operations are present. There are also several confined animal feeding operations that conduct land application of their wastewater. Sedimentation, eroding streambanks, and lack of adequate riparian buffers have also been observed .

Groundwater is a significant source of public water supply as well as many private wells. Karst features including sinkholes, caves and springs are present in some portions of the basin, indicating that groundwater contamination is possible in these areas. The majority of surface water withdrawn is used by electrical power plants that withdraw water from the Missouri River.

Initiatives in local communities are working to control urban stormwater pollution and improve local streams. In Columbia, many partnering groups including city, county, state, federal, university and other groups are working together to improve the Hinkson Creek watershed. Missouri River Relief (Stream Team #1875) is headquartered in Columbia and works with communities along the Missouri River to conduct river cleanups and connect people to the Missouri River. Public recreation areas are plentiful, providing the people in this watershed an opportunity to enjoy the natural and historic resources that connect them as communities in the watershed.

Opportunities

Community Involvement

- Through education, advocacy and hands-on projects, communities, groups and individuals can be involved in and promote watershed improvement activities. Some examples include, watershed education for schools, litter control, tree planting, water quality monitoring and storm drain stenciling.

Education and Outreach

- Technical assistance providers are available for training and assistance regarding several topics such as source water protection, municipal drinking water loss, water main leak detection, asset management, water conservation planning and implementation, and I/I (inflow and infiltration) reduction.
- Training is also available to livestock operations and landowners regarding the benefits of alternate watering sources for livestock, improvements to land application practices, best management practices and associated cost-share programs.

Financial Assistance

- **Clean Water and Drinking Water State Revolving Funds** are available to build or improve municipal wastewater and drinking water infrastructure and support agricultural and urban projects such as improvements to urban runoff, wet weather flow, stormwater and sewer overflow issues, water reuse and conservation and alternative treatment projects.
- **319 Nonpoint Source Funds** are available to assist organizations with implementation of on-the-ground practices that control, reduce or manage nonpoint source pollution such as riparian buffer strips, detention ponds, limitation of animal waste to stream and sinkholes.
- **Source Water Protection Grants** and **Well Plugging Grants** are available to public water systems to support safe well abandonment procedures and source water protection implementation and planning efforts.
- A full list of department funding sources is available at http://dnr.mo.gov/financial.htm

Our Missouri WATERS

Lower Missouri-Moreau River Watershed

The State of Our Missouri Waters—Background

What is a Watershed?

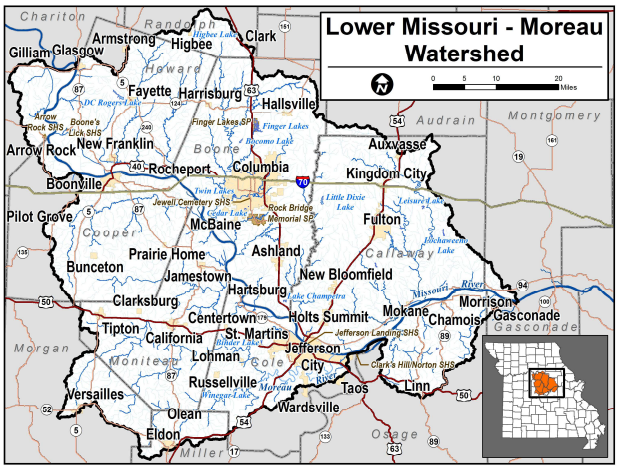
A watershed is an area of land defined by ridges, from which waters flow into a particular lake, river or wetland.

Lower Missouri-Moreau River Basin Characteristics

- Drainage area of 3,400 mi^2
- Includes portions of 14 counties
- Part of the Missouri River system
- Largest population centers include Columbia, Jefferson City and Fulton.
- Pop. was 289,254 people in 2000 and 329,758 people in 2010.
- Est. pop. between 2000 to 2030, 12 of the 14 counties will increase with the most growth occurring in Boone County by a projected 51 percent. Saline County and Montgomery counties are projected to decline.

Recreational Resources

Public lands are abundant with Mark Twain National Forest, Big Muddy Wildlife Refuge, state and local parks and conservation areas. Katy Trail State Park offers hiking and biking north of the Missouri River from Boonville to Portland and beyond. Fishing and boating opportunities are available on rivers, creeks, and small lakes throughout the basin.



Water Resources

Surface Water

There are 11 lakes ranging in size from 50 acres to 197 acres, totaling 1,014 lake acres. There are 3,445 miles of major streams. Some of the larger streams are Missouri and Moreau rivers, Moniteau, Petite Saline, Perche, Cedar, Hinkson and Auxvasse creeks. Surface water sources, including the Missouri River at Boonville and Jefferson City and Fayette Lake #3 provide drinking water supply. Surface water sources outside the watershed including Mark Twain Lake and Long Branch Lake also provide drinking water to people.

Groundwater

North of the Missouri River, there are no high-yield, potable bedrock aquifers available. Wells in alluvial deposits underlying the floodplains of the major rivers can produce several hundred gallons of water per minute, and are locally used for irrigation as well as public water supply. South of the Missouri River, there are two major aquifers that underlie the region, the St. Francois and Ozark aquifers. These aquifers range in thickness from less than 200 feet to more than 700 feet thick, and average about 500 feet in thickness. Most wells deep enough to produce from the St. Francois aquifer also produce from the shallower and more prolific Ozark aquifer. There are an estimated 5,191 private domestic wells that provide an estimated 1.5 million gallons of water annually for domestic uses.

Springs

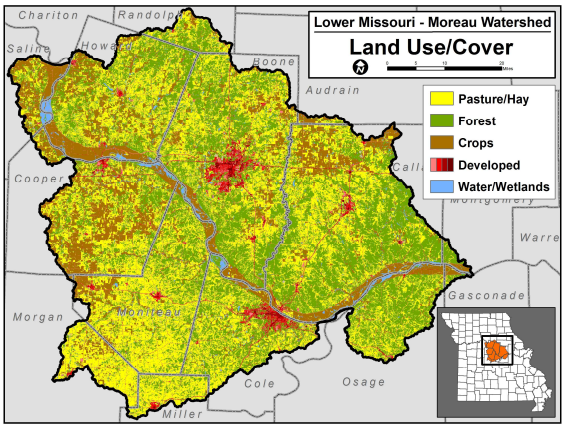
There are 52 mapped springs. Fourteen of these springs are named and 38 unnamed. Some of the named springs are Boone Cave, Rollins, Bruce Cave, Cook and Devils Ice Box Spring.

Geology/Hydrology

The geology consists of Pennsylvanian-age bedrock units found primarily in the northern portion of the basin and karst geology in some parts of the basin. Glacial till is generally lacking and streams incise late Ordovician dolomites overlain by 4 to 8 feet of loess. There 861 sinkholes that have been documented. Of streams evaluated for discharge, 9 percent have been found to be losing streams. Most water flow is confined to the surface network, and baseflows are poorly sustained in dry weather. Groundwater contamination potential is generally low. In the northern part of the basin but in some areas of the basin (portions of Boone, Cooper, Moniteau and Saline counties) there is significant potential for contamination of groundwater from surface sources.

Land Use

Land use is approximately 36 percent grassland, 17 percent cropland, 37 percent forest, 7 percent developed, 2 percent wetland and 1 percent water. Approximately 66,800 acres are publicly owned and managed by the U.S. Forest and Fish and Wildlife services, Missouri Department of Natural Resources, and Conservation. Recent population growth has led to development and urban sprawl. Projected future population growth will lead to additional urban development.



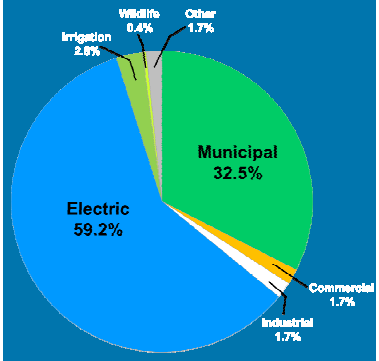
Lower Missouri-Moreau River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

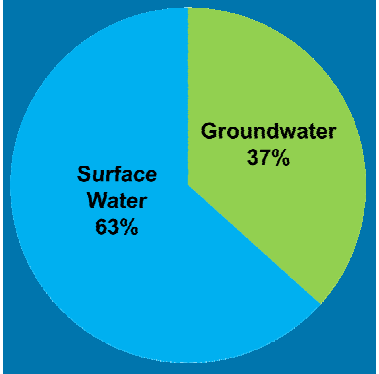
Climate and Water Availability

Estimated Water Use by Category

Drinking water supply sources in the watershed include the Missouri River, Fayette Lake #3, and several wells.



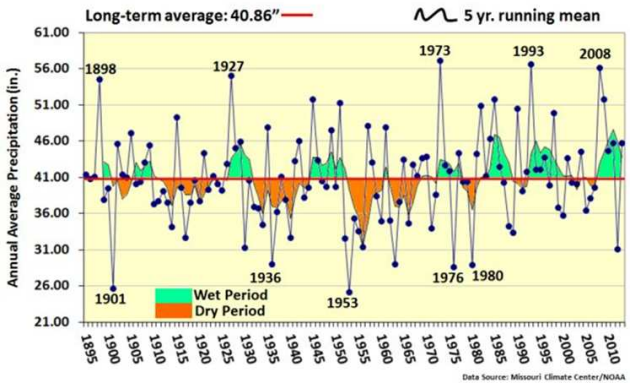
Estimated Water Use by Source



Precipitation

Annual average reveals several wet periods have dominated since the early 1980s. This wet pattern has also been accompanied by an increasing trend of heavy precipitation events. Severe drought occurred during 2012, but this drought was brief compared to major multi-year droughts that occurred in the 1930s and 1950s. Tree ring analyses conducted in Missouri and historic observation data show periods of multi-year severe droughts in Missouri's history, indicating that extended dry periods are likely to occur in the future.

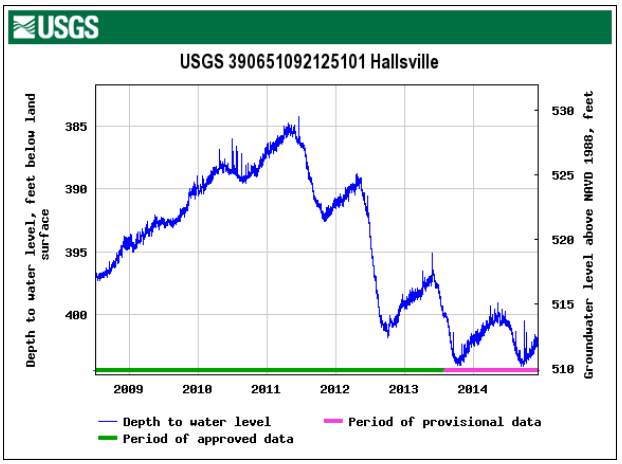
Missouri Annual Average Precipitation (1895-2013)



Groundwater and Stream Monitoring

There are 11 groundwater monitoring wells within the watershed. These observation wells are located near Arrow Rock, Tipton, Linn, Jefferson City (2 wells), Fulton, Reform, Columbia, Hallsville, Eagle Bluffs and Marion Bottoms. The chart on the right represents water levels at Hallsville. As shown, short periods of drought can cause groundwater levels to quickly change. In addition, water levels at this well haven't recovered to pre-2012 conditions. Eight stream gauges in the watershed measure average stream flow that varies from 4.7 to 26,370 million gallons per day.

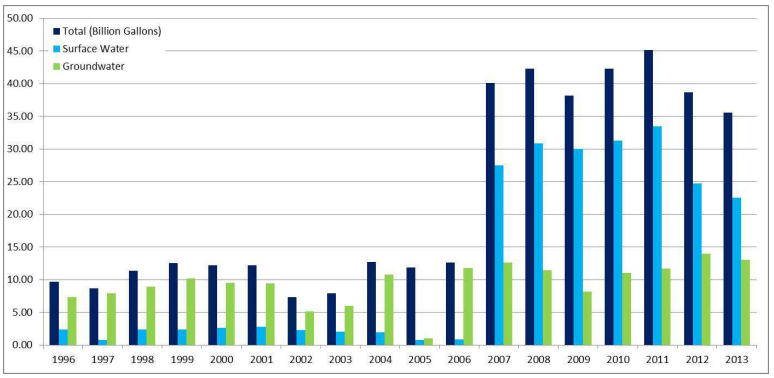
USGS Hallsville, MO Groundwater Monitoring Point



Major Water Use Characteristics

Sixty-two registered major water users, with at least a 100,000 gallons (70 gal per minute) per day withdrawal or diversion capacity, are present in the basin. The estimated annual water use of these major water users is 35.5 billion gallons, of which 63 percent is surface water and 37 percent is groundwater. Major water use categories are predominately electric (59 percent) and municipal (33 percent), with other uses including industrial, commercial, wildlife, and irrigation. There are 43 community public water systems. Thirty-one of these systems treat groundwater, six systems purchase treated groundwater, three systems treat surface water, and three systems purchase treated surface water. Groundwater and surface sources currently provide about 43 million gallons of water a day to 343,395 people, and these sources have a total capacity of 112 million gallons per day.

Historical Water Use - Lower Missouri-Moreau River Watershed



Our Missouri WATERS

Lower Missouri-Moreau River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

Watershed Protection

Protection of Our Natural Resources

The department exercises authority under Missouri's Clean Water Law to regulate point sources of pollution. When point sources are known or discovered, the department issues permits for these sources to limit the amount of certain water contaminants that may be discharged into the water body.

The department also has resources to help people proactively plan to protect water resources, such as:

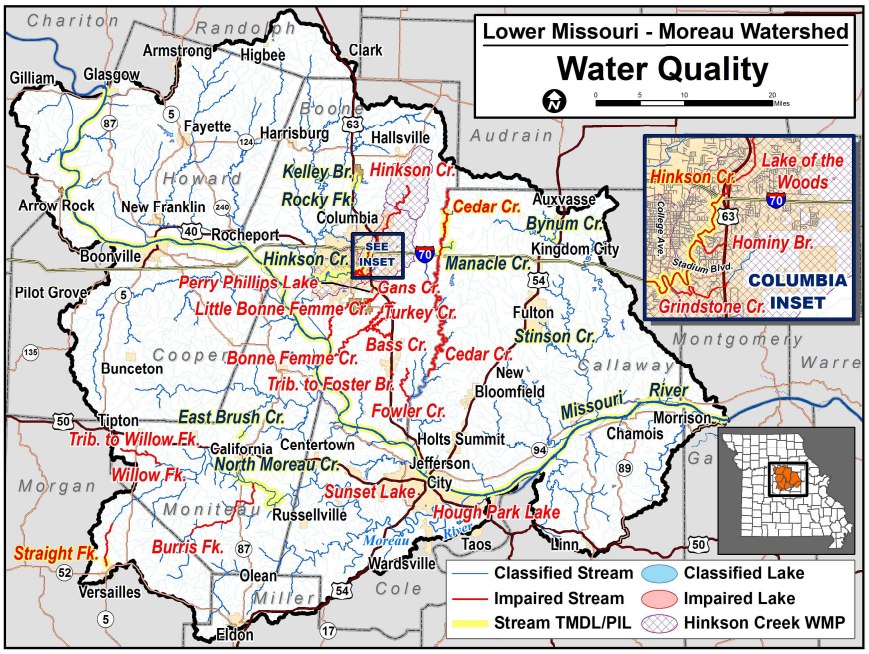
- Source Water Protection Plans for drinking water sources
- Section 319 funding for watershed planning and projects
- Funding to plan for source water protection
- Soil and Water Conservation funding
- State Revolving Fund grants and loans for community drinking water and wastewater improvements

A full list of department funding sources is available at dnr.mo.gov/financial.htm

It is important to note that resources are limited and local involvement, in determining most critical and effective focus areas, is invaluable.

Water Quality Impairments

Section 303(d) of the federal Clean Water Act requires each state identify waters that do not meet water quality standards and for which adequate water pollution controls are not in place. These identified waters are considered impaired. Water quality standards protect beneficial uses of water such as whole body contact (e.g. swimming), maintaining fish and other aquatic life, and providing drinking water for people, livestock and wildlife.



The following lakes and streams are listed on the 2014 list of impaired waterways and are presented on the adjacent map: **Bass Creek** (Bacteria), **Bonne Femme Creek** (Bacteria), **Cedar Creek** (Unknown), **Fowler Creek** (Low Dissolved Oxygen), **Gans Creek** (Bacteria), **Grindstone Creek** (Bacteria), **Hinkson Creek** (Bacteria), **Hominy Branch** (Bacteria), **Hough Park Lake** (Mercury in Fish Tissue), **Little Bonne Femme Creek** (Bacteria), **Lake of the Woods** (Mercury in Fish Tissue), **Perry Phillips Lake** (Mercury in Fish Tissue), **Straight Fork** (Low Dissolved Oxygen), **Sunset Lake** (Mercury in Fish Tissue), **Tributary to Willow Fork** (Low Dissolved Oxygen), **Turkey Creek** (Bacteria), **Willow Fork** (Low Dissolved Oxygen). Impairments can be caused by known sources like point or nonpoint source pollution, or may be unknown; however, identifying activities near impaired water bodies can provide key information in determining the sources of contamination as well as developing solutions for impaired waters.

Examples of **point sources** of pollution include municipal wastewater treatment plants, land disturbance sites, large confined animal operations, and treated industrial wastewater discharges. Common challenges for wastewater treatment include the limited contaminant removal capacity of certain types of treatment. When facilities experiences difficulty in providing the proper level of treatment and contaminant removal, the department often works with them to improve the treatment process and quality of the discharge. In the case that point source emitters are unwilling to improve the quality of their discharge, the department has regulatory authority to ensure that inappropriate discharges are discontinued in a timely manner.

Nonpoint pollution sources refer to contaminants that do not come from specific conveyances and may come from multiple sources, such as failing septic systems and contaminants carried in stormwater runoff from rural, urban, and agriculture lands. Other causes of water body impairments include natural causes like precipitation, climate, and drought which can alter stream flow and channel characteristics leading to changes in water quality.

Our Missouri WATERS

Lower Missouri-Moreau River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

General Water Quality Criteria

A water body is considered impaired if it does not meet water quality standards that specifically protect its beneficial uses, such as drinking water, recreational uses and fish or other aquatic life health.

Missouri's Process to Improve Water Quality

Monitoring – Lakes and Streams

↓

Assessment of Data

↓

Identification of Impaired Waters

↓

Corrective Plans (TMDLs) – MDNR Developed/ EPA Approved

NPDES:

National Pollutant Discharge Elimination System. In Missouri, NPDES permits are also known as Missouri State Operating (MSOP) permits.

Our Missouri WATERS

Watershed Protection

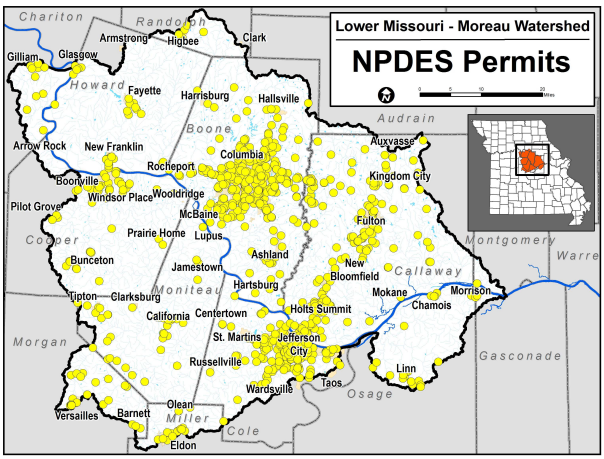
Total Maximum Daily Loads (TMDL)

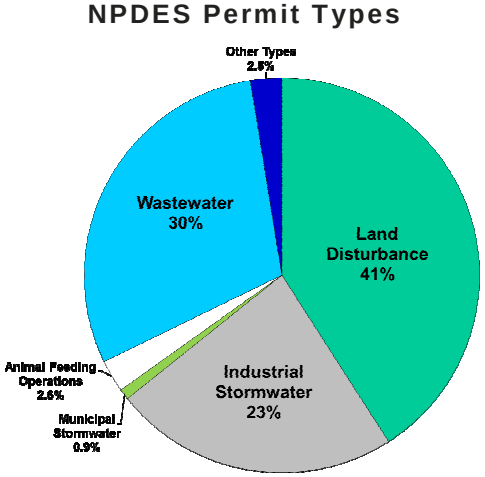
A TMDL is the mathematical calculation of the amount of a specific pollutant that a water body can absorb and still meet water quality standards. A TMDL study identifies the potential or suspected pollutant sources in the water and allocates the allowable pollutant load among these sources. It also includes an implementation plan to identify how the load will be reduced to a level that will protect water quality. In this watershed, six TMDLs and three permits-in-lieu of TMDLs have been written. The permits-in-lieu address specific facility discharges and have been implemented with stricter permit limits and conditions. Two TMDLs for **Cedar Creek** and **Manacle Creek** address impairments caused by acid mine drainage from historic coal mining sites. A TMDL for **Rocky Fork** and **Kelley Branch** addresses aquatic life impairments due to excess sedimentation. Practices implemented at Finger Lakes State Park have helped to eliminate these impairments. A TMDL for **Hinkson Creek** was written to restore aquatic life protections that are currently impaired by an unknown pollutant. A collaborative adaptive management approach with partners from the City of Columbia, Boone County, the U.S. Environmental Protection Agency, the Department of Natural Resources, and others is currently under way and is seeing improvement in the stream. TMDLs were also written for both **Stinson Creek** and **North Moreau Creek** to address negative water quality conditions resulting from point sources in those watersheds. Pollutant reductions and implementation plans vary by water body. While some address point sources of pollutants and others nonpoint sources, all are intended to restore these waters to a level that attains water quality standards and protects beneficial uses. In addition, a TMDL has been completed for the entire length of the **Missouri River** bordering Missouri that addresses water quality impairments caused by chlordane and PCBs in fish tissue. Since these chemicals have been banned and are no longer manufactured, no specific implementation plans have been established, other than continued collection and proper disposal of existing chemicals. Pollutant reductions are expected to occur naturally over time.

More information about these various TMDLs can be found online at dnr.mo.gov/env/wpp/tmdl/wpc-tmdl-EPA-Appr.htm

Regulated Point Sources

The department regulates point sources by issuing permits that prescribe conditions of operating the point discharge and limit the discharge of water contaminants. In addition, the department inspects regulated facilities and analyzes water samples to ensure the facilities are not polluting waters. It's also important that communities look to the future for watershed planning in order to maintain awareness of wastewater treatment types, their impacts and upcoming regulations. The following graphics illustrate the type and distribution of permitted sites in the Lower Missouri-Moreau River Watershed.





Lower Missouri-Moreau River Watershed

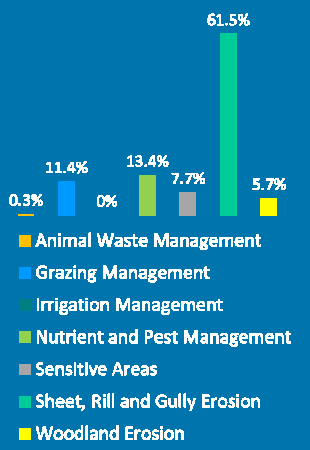
The State of Our Missouri Waters—Current Conditions and Trends

Local Awareness

Is it safe to fish or swim in the nearby stream? Does the stream provide habitat suitable for fish? What does it cost to make this water potable? Will I have enough water during a drought?

Impacts to water quality and quantity are most critical to local communities; however, impacts are often not realized until a dire situation arises as a result of poor water quality or quantity. Local awareness and involvement can lead to pollution prevention and reduction, water supply sustainability and can give communities the upper hand in protecting, preserving and enhancing local water supplies for generations to come.

2009-2014 Implemented Conservation Practices



Our Missouri WATERS

Local Watershed Improvements

Missouri Stream Team and Volunteer Water Quality Monitoring

Missouri Stream Teams strive to gain and share knowledge regarding the state's stream systems and the problems and opportunities they face. The Missouri Stream Team Program is a partnership between the departments of Natural Resources and Conservation as well as the Conservation Federation of Missouri and the citizens of Missouri. Besides improving stream conditions, Stream Teams often provide useful data in targeting areas that should be monitored more closely for impairments. The Missouri Stream Team Watershed Coalition has compiled and reported monitoring data which demonstrates the importance of watershed protection, preservation and enhancement by local communities. (image from http://mstwc.org/who-we-are/vision-mission-goals/)

The Volunteer Water Quality Monitoring Program is one of the most popular activities of the Missouri Stream Team Program. There are 108 Stream Teams in the Sac River basin that work to supply the department with water quality data.

Soil and Water Conservation & Non-point Source Grants (319 Grants)

Several watershed project grants have been provided by DNR to local communities to improve water quality. These projects have included watershed management planning, education and outreach activities such as watershed festivals, workshops, and demonstrations, installation of Best Management Practices including rain gardens and rain barrels, permeable pavement, bioswales, riparian buffers, grass filter strips, outreach about streambank stabilization and watershed friendly yard maintenance, and monitoring water quality and hydrology in project watersheds. Hinkson Creek, Bonne Femme Creek, and Stinson Creek are streams in the watershed that have had focused 319 projects in their watersheds.

Source Water Protection Projects and Grants

This voluntary program is designed to assist public water systems and the communities they serve with developing local voluntary source water protection plans to protect their source of drinking water from existing or additional contamination sources. Participating public water systems include: Boone County PWSD #4, Boone County Consolidated PWSD #1, and Cole County PWSD #3. Systems with active source water protection plans include: Boone County PWSD #9, Centertown, Columbia, and Pilot Grove, and systems with pending source water protection plans include Boone County Consolidated PWSD #1 and New Franklin. Systems with expired plans include Slater, Bunceton, California and Cole County PWSD #3.

Well Plugging Grants

As part of Source Water Protection, the department offers grants to plug abandoned wells. Inactive wells can act as a direct conduit for pollutants to enter our water sources. Safely closing these wells is another layer of protection for pollution prevention. Well plugging grants have been awarded recently to New Franklin, Cole County PWSD #4, Boone County PWSD #10, and Fulton.

Soil and Water Conservation Cost Share Programs

Soil and Water Conservation Districts set goals for conservation issue concerns. These practices are funded and implemented to help districts meet their resource conservation goals, which conserves soil and improves water quality by reducing sedimentation in our rivers and streams. The chart on the left illustrates the number of practices implemented for each concern in the watershed from 2009 to 2014, relative to the total number of practices for this watershed. No irrigation management practices were implemented during this time. District funding requests for FY15 show that grazing management and sheet, rill and gully practices are most prevalent.

Lower Missouri-Moreau River Watershed

The State of Our Missouri Waters

Contact Information for this Watershed

Missouri Department of Natural Resources

Northeast Region Watershed Coordinator
Mary Culler
1709 Prospect Drive
Macon, MO 63552
660-385-8000

Resources

Education and Outreach Resources include:
Missouri Department of Natural Resources' Our Missouri Waters dnr.mo.gov/omw

Missouri Department of Natural Resources Financial Assistance Opportunities http://dnr.mo.gov/pubs/financial-asst-brochure-2014.pdf)

Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/

Missouri Rural Water Association (MRWA) http://www.moruralwater.org/training.php; http://www.moruralwater.org/tools.php; http://www.moruralwater.org/dlcenter/

Missouri Public Utilities Alliance (MPUA) http://www.mpua.org/Training.php; http://www.mpua.org/Untitled_Page_4.php

EPA Region 7 Environmental Finance Center (EFC) http://webs.wichita.edu/?u=HUGOWALL&p=/Centers__Research/Environmental_Finance_Center/

Funding Resources include:
Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/

United States Department of Agriculture Rural Development (USDA-RD) http://www.rurdev.usda.gov/ProgramsAndOpportunities.html

Missouri Department of Economic Development (DED) http://www.ded.mo.gov/BCS%20Programs/BCSProgramDetails.aspx?BCSProgramID=10; http://www.ded.mo.gov/Community/InfrastructureAssistance.aspx

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U.S. Army Corps of Engineers, Southwest Missouri Water Resource Study—Phase I. Sept. 2012 (http://tristatewater.org/?page_id=12)

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