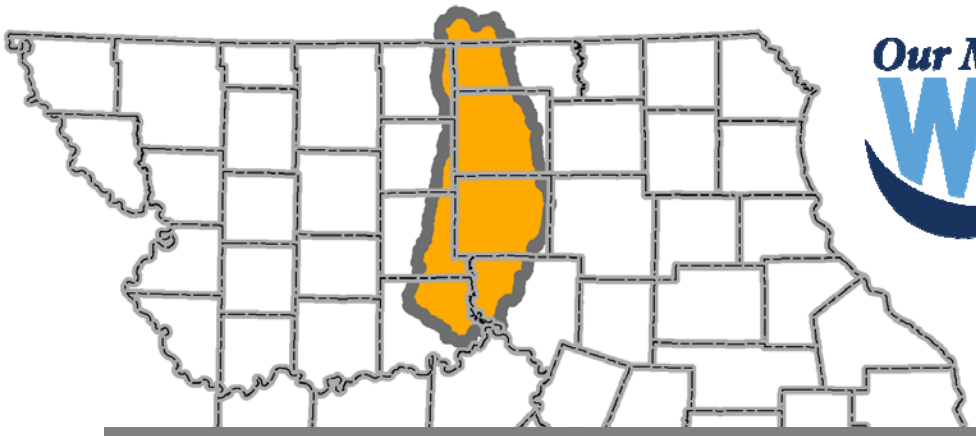
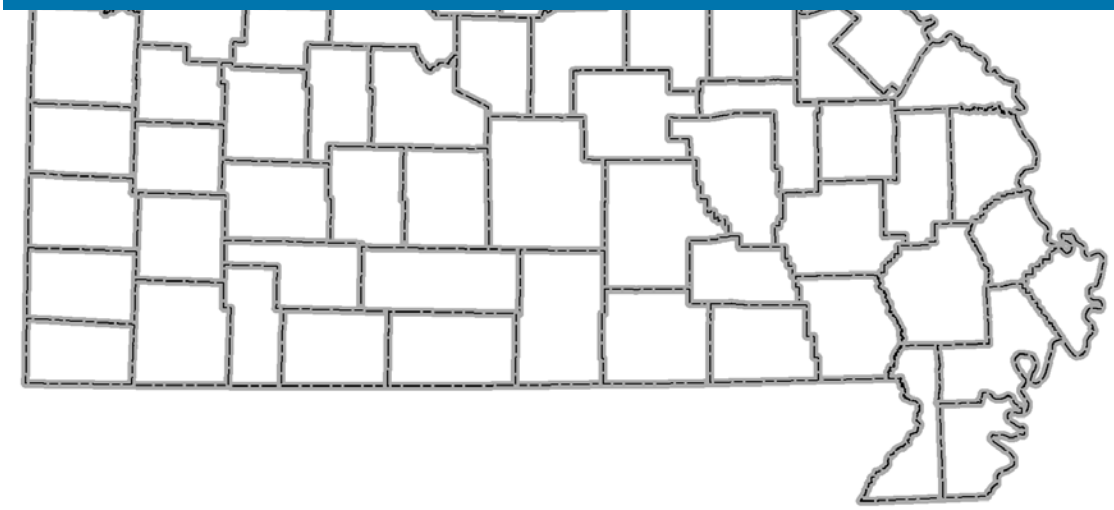


Our Missouri WATERS

The State of *Our Missouri Waters*

Lower Grand 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: 10280103
December 2014

Lower Grand 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

Erosion of sediment from streambanks and fields is prevalent in the Lower Grand River watershed. Stream flows are naturally very high during wet weather due to the clay soil in the region that naturally reduces water infiltration to the subsurface. Replacement of deep rooted native plants with short rooted non-native plants and compaction of soil by land use practices have made the landscape even less like a sponge and more like a parking lot. This has led to more intense runoff and flood events that carry sediment into downstream areas.

Channelization of streams began in the late 1800s and early 1900s as a method to reduce flooding, allow for cultivation of floodplains, and improve navigation in streams. However, channelization reduces the length of a stream, therefore increasing the slope of the channel and the velocity of water in that channel. A stream that is channelized will deepen until the banks become tall and unstable, then the stream channel will erode outward and widen. In addition to channelization of streams, large levees were also constructed in the early 1900s and private levee were constructed in the 1970s and 1980s. While levees do reduce flooding to adjacent floodplains, the reduction of the size of the floodplain constricts floodwaters within the channel and causes floodwaters to flow downstream with greater erosive power. Erosion from streambanks results in loss of property and damage to infrastructure such as bridges, while erosion from fields carries away productive soil from the landscape. Input of sediment into the stream channel causes loss of pool habitat for fish and other aquatic species and results in deposits of sediment and nutrients in downstream areas.

Water quality monitoring indicates there are elevated *E.coli* levels, high suspended solids, high nutrients (nitrogen and phosphorus), and low dissolved oxygen in some streams. These water quality impairments can affect the designated beneficial uses of the streams.

Population is projected to decline in this watershed over the next 15 years, and communities will be faced with challenges for maintaining and operating wastewater and drinking water infrastructure. During periods of drought, lack of water is an issue for several communities that rely solely on surface water supplies (creeks and lakes) for their public water supply. Regional water planning and water conservation efforts will be important for future sustainability and opportunity for growth of communities in this watershed.

Opportunities

Community Involvement

- Communities, groups and individuals can help with watershed improvement activities through education, advocacy and hands-on projects. Examples include, watershed education for schools, litter control, tree planting, water quality monitoring and storm drain stenciling.

Education and Outreach

- Assistance is available for training and assistance regarding several topics such as source water protection, municipal drinking water loss, water main leak location, asset management, water conservation planning and implementation and I/I onsite assistance.
- 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 Grand 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.

Characteristics

- Drainage area of 2,360 mi^2
- Includes portions of eight counties
- Part of the Grand River system
- Largest population centers in the watershed consist of the towns of Brookfield, Marceline, Milan and Brunswick
- The estimated population of the Lower Grand River watershed was 28,506 people in 2000 and decreased to 26,515 in 2010.
- Estimates show population declines ranging from 2 to 27 percent from 2000 to 2030.

Recreational Resources

Hunting for deer, turkey, and waterfowl are top recreational activities. Public areas including Pershing State Park, Fountain Grove and Locust Creek conservation areas and Swan Lake National Wildlife Refuge provide habitat for wildlife and migrating waterfowl and various opportunities for people to enjoy the outdoors.

Water Resources

Surface Water

There are 14 lakes ranging in size from 58 acres to 1,806 acres, totaling 3,967 lake acres. Four of these lakes serve as public water supplies: Elmwood Lake, Milan City Lake, Marceline City Lake (New Reservoir) and Brookfield Lake. There are 760 miles of major streams in the watershed. Some of the larger streams are Locust Creek, Medicine Creek, Yellow Creek and the Grand River. Locust and West Yellow creeks are both utilized for public water supply. Surface water sources in the watershed provide 3.5 million gallons per day to about 24,000 people. Surface water sources outside the watershed including Lake Thunderhead, Unionville Lake, Rathbun Lake, the Thompson River, Old Marceline Reservoir and Mussel Fork also provide drinking water.

Groundwater

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 and public water supply.

Springs

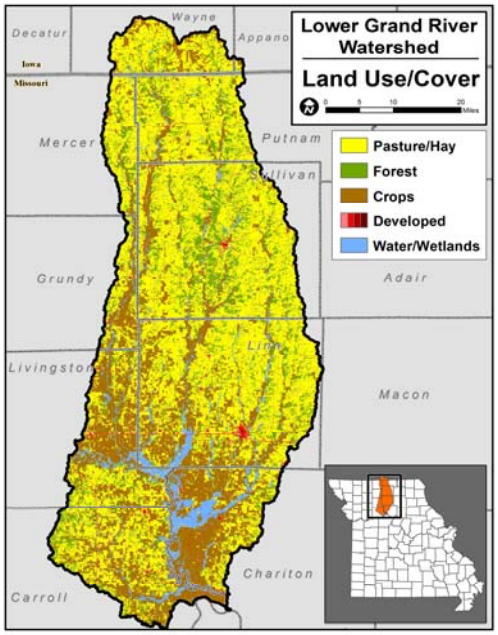
There are two unnamed springs in the watershed, located in northern Carroll County.

Geology/Hydrology

The geology of the area consists of cyclic deposits of Pennsylvanian carbonates, shale and sandstone with minor coal overlain by glacial deposits (loess, till, etc.). Water infiltration through the subsurface is limited by these sequences of geologic strata. No sinkholes or caves have been documented in the basin. Groundwater quality is poor and no high yield potable bedrock aquifers are available. Wells that terminate in the glacial till above bedrock are low yielding. Only two springs have been documented in the basin. Water movement in the basin is predominantly through the surface stream network and stream base flow is very low during dry periods.

Land Use

Land use in the watershed is approximately 50 percent grassland, 25 percent cropland, 15 percent forest, 5 percent developed, 4 percent wetland and 1 percent water. Historically, the landscape of the Lower Grand basin was a diverse mix of prairie, savanna and forest plant communities with numerous small oxbows and bottomland lakes and sloughs. The northern part of the watershed is characterized by rolling hills and dominance of pasture, while the southern area has less steep terrain and is dominated more by row crop agriculture. Recently, changes in grain prices has led to the conversion of some pastureland to row crop agriculture.



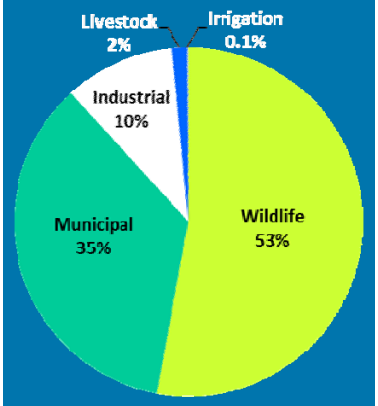
Our Missouri WATERS

Lower Grand River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

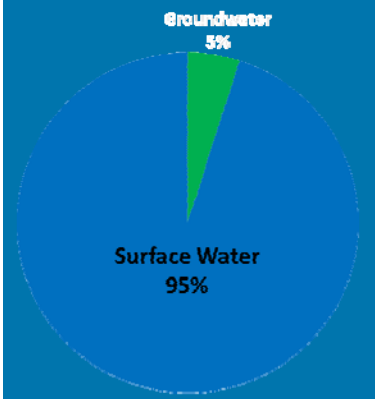
Climate and Water Availability

Estimated Water Use by Sector for Lower Grand



Drinking water supply sources in the watershed include Elmwood Lake, Milan City Lake, Marceline City Lake (New Reservoir), Brookfield Lake, Locust Creek, West Yellow Creek and several alluvial wells.

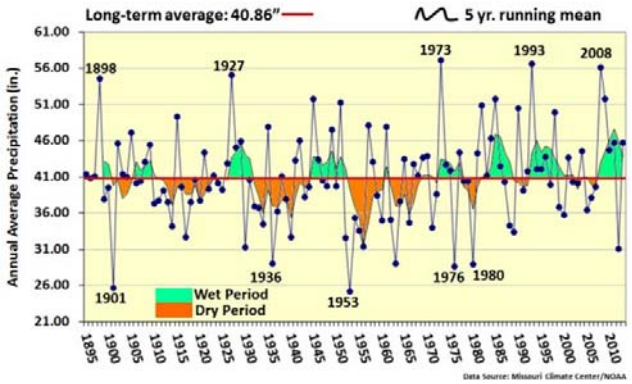
Estimated Water Use by Source for Lower Grand River Watershed



Precipitation

The adjacent figure shows annual average statewide precipitation in Missouri from 1895 to 2013. A five-year trend line reveals several wet periods have dominated since the early 1980s, and 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.

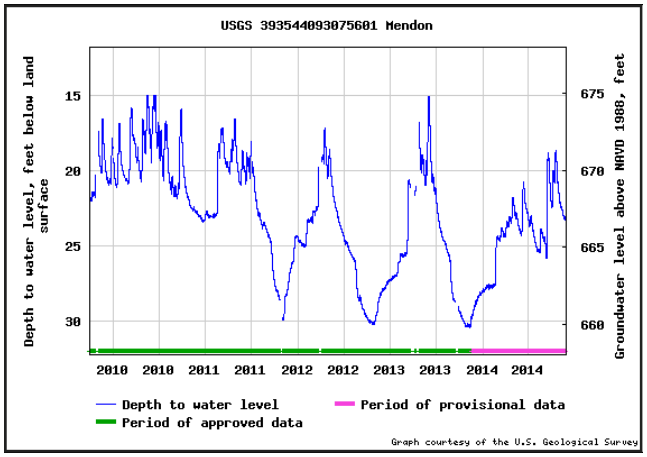
Missouri Annual Average Precipitation (1895-2013)



Groundwater and Stream Levels

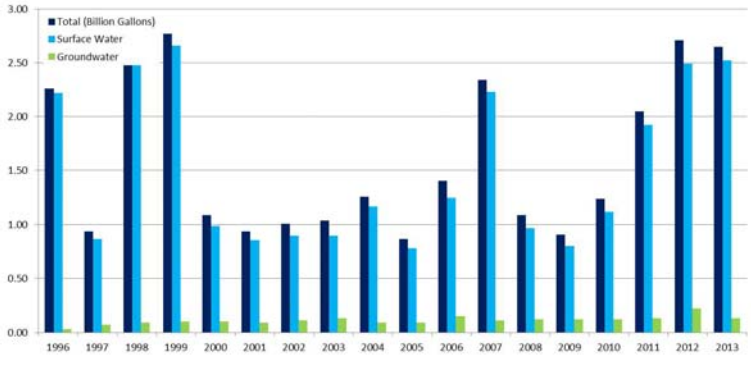
There are three groundwater monitoring wells within the watershed as part of the Missouri Observation Well Network. These observation wells are located at Pershing State Park, Fountain Grove Conservation Area, and Mendon. Annual average groundwater levels appear to be fairly stable at these wells, but groundwater levels fluctuate several feet throughout the year, with groundwater lows typically occurring in winter and highest groundwater levels occurring in late spring. There are currently eight stream gauges in the watershed that measure average stream flow that varies from 0.1 to 3,354 million gallons per day.

USGS Mendon, MO Groundwater Monitoring Point



Water Use Trends

Historical Water Use - Lower Missouri –Moreau Watershed



Sixteen 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 2.7 billion gallons, of which 95 percent is surface water and 5 percent is groundwater. Major water use categories for this watershed are predominately wildlife (53 percent), municipal (35 percent) and industrial (10 percent). There are 34 public drinking water systems in the watershed and 17 of these systems rely solely on surface water, two systems buy from both surface and groundwater sources, and 15 systems use only groundwater. There are an estimated 89 private domestic wells in the watershed that provide an estimated 26,700 gallons of water annually for domestic uses.

Our Missouri WATERS

Lower Grand 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:

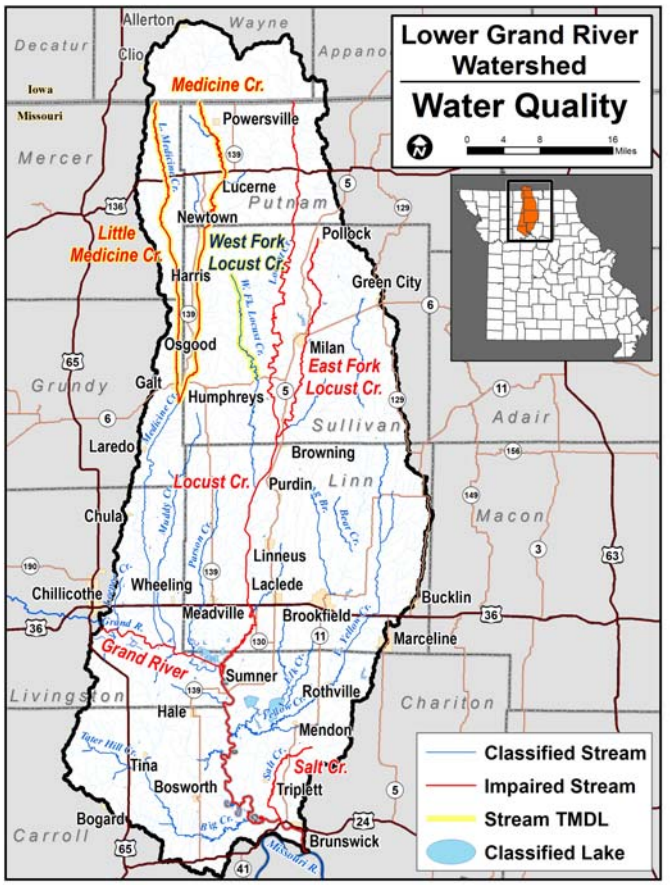
- Source Water Protection Plans for drinking water sources
- Section 319 funding for watershed planning and projects
- Funding to plan for source water protection
- Soil and Water Conservation funding
- State Revolving Fund grants and loans for community drinking water and wastewater improvements

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 streams within the watershed are listed on the state's 2014 list of impaired waterways and are presented on the adjacent map: East Fork Locust Creek (Bacteria & Low Dissolved Oxygen), Grand River (Bacteria), Hickory Branch (Low Dissolved Oxygen) Little Medicine Creek (Bacteria & Unknown), Locust Creek (Bacteria), Medicine Creek (Bacteria), and Salt Creek (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 Grand 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.

Watershed Protection

Total Maximum Daily Loads (TMDL)

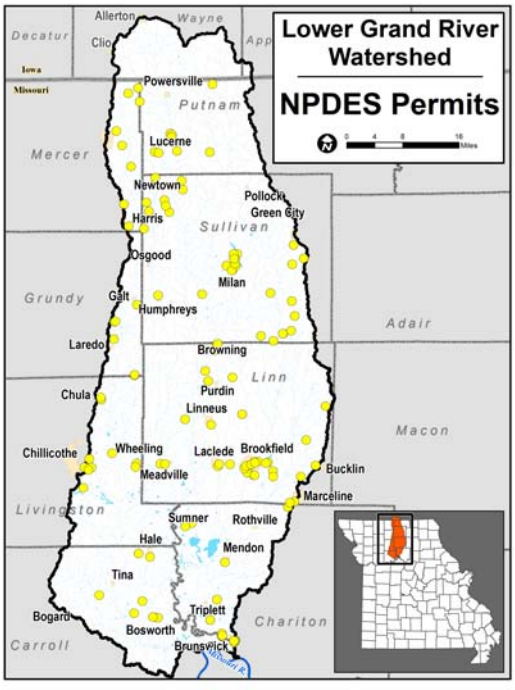
A TMDL is a mathematical calculation of the maximum amount of a pollutant that a water body can absorb and still meet water quality standards. A TMDL study identifies the potential or suspected pollutant sources in the watershed and allocates the allowable pollutant load among these sources. It also includes an implementation plan to identify how the load will be reduced to a level that will protect water quality. In this watershed, two sediment TMDLs were written to address aquatic life impairments in Medicine Creek (formerly East Fork Medicine Creek) and Little Medicine Creek. These TMDLs establish allocations of total suspended solids to both point and nonpoint sources, which should be implemented to protect and restore the designated aquatic life uses within the watersheds. A third TMDL, written for West Fork Locust Creek, addresses an unknown pollutant by setting pollutant allocations for nutrients and suspended solids. These pollutant targets should be implemented to protect and restore the aquatic life designated use in West Fork Locust Creek. Pollutant reduction recommendations in TMDLs are plans, for which actions still need to be taken so that water bodies meet the water quality standards for their designated beneficial uses.

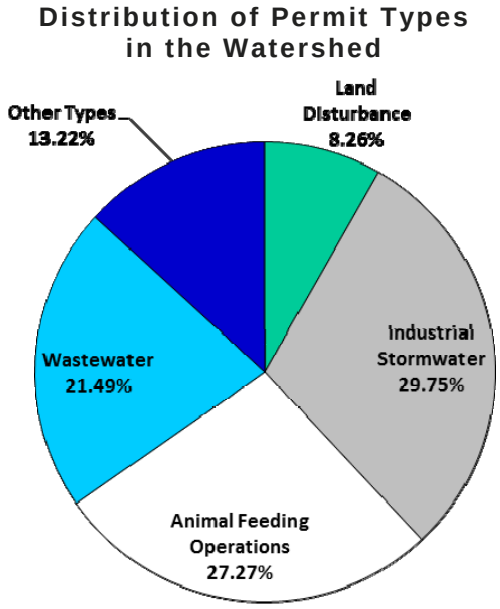
For more information regarding these TMDLs, visit the following links.
West Fork Locust Creek TMDL: http://dnr.mo.gov/env/wpp/tmdl/0613-w-fk-locust-ck-record.htm
Medicine Creek TMDL: http://dnr.mo.gov/env/wpp/tmdl/0619-e-fk-medicine-ck-record.htm
Little Medicine Creek TMDL: http://dnr.mo.gov/env/wpp/tmdl/0623-l-medicine-ck-record.htm

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 Grand River Watershed.





Our Missouri WATERS

Lower Grand River Watershed

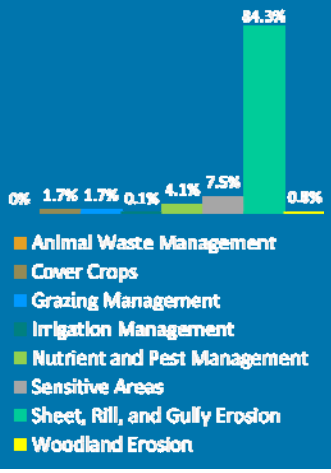
The State of Our Missouri Waters—Current Conditions and Trends

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.

2014 Implemented Conservation Practices



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. Stream Team volunteer monitors have provided the department with valuable water quality data from 23 sites throughout the watershed.

Soil and Water Conservation and Nonpoint Source Grants (319 Grants)

Over the last 10 years, the department has provided several watershed project grants to local groups to improve water quality through stream channel stabilization, water quality monitoring, education/outreach efforts and incentivized water conservation practices. These grant projects have included: installation of rock grade control structures in Higgins Ditch and the avulsion between Higgins Ditch and Locust Creek, a study of endocrine modulators and excess nutrients in Little Medicine Creek and West Locust Creek, student watershed festivals in Trenton and Princeton, an abandoned well education and assistance project in Grundy County, and stream team monitoring and educational activities by the Chillicothe Middle School.

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: Bosworth, Marceline, Meadville, Carroll PWSD #1, and Missouri American-Brunswick.

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. Missouri American Water-Brunswick has participated in the department's well plugging grant program and received a grant for the purpose of safely closing two inactive wells.

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 to 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. District funding requests for FY15 show that sheet, rill and gully practices are most prevalent.

Our Missouri WATERS

Lower Grand River Watershed

The State of Our Missouri Waters

For More Information

Missouri Department
of Natural Resources
Northeast Region
Watershed Coordinator
Mary Culler
1709 Prospect Drive
Macon, MO 63552-2602
660-385-8000

Or visit the Web at
dnr.mo.gov/omw

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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Missouri Stream Team Watershed Coalition Website, (http://mstwc.org/)

Multi-Resolution Land Characteristics Consortium, 2011 and 2001 National Land Cover Database, (http://www.mrlc.gov)

Missouri Climate Center, (http://climate.missouri.edu/modata.php)

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

Guinan, Pat, State Climatologist, MU Extension, Missouri Climate Center, (http://climate.missouri.edu/modata.php)

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