Assessing and Protecting Water Quality in the Home and Community

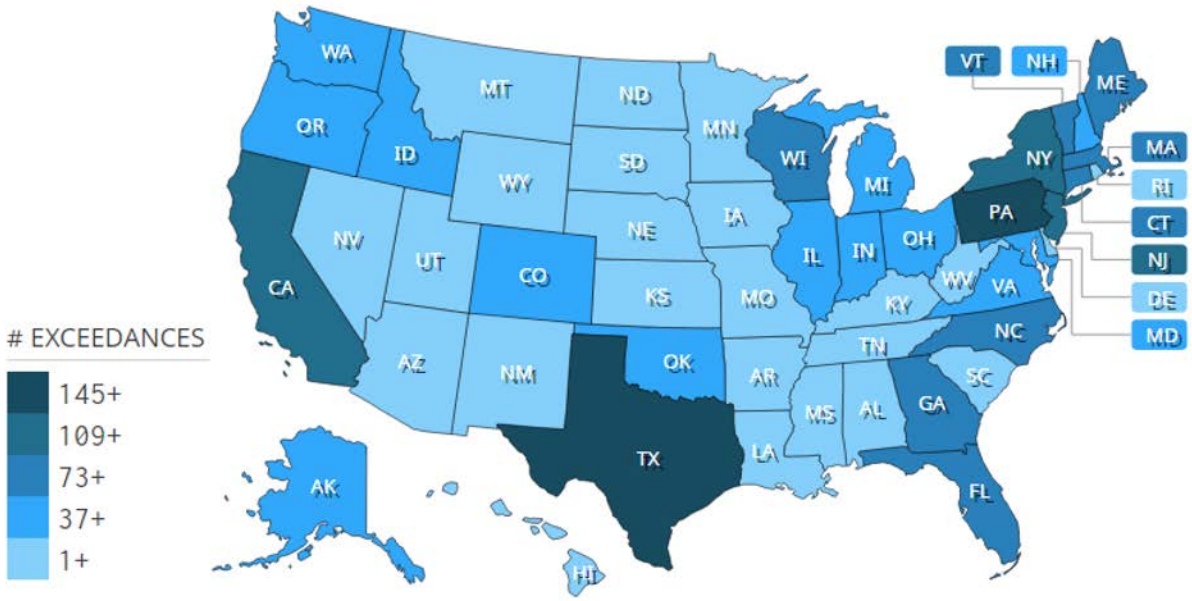

Figure 1. Number of lead exceedances by state 2012–15, with increasing exceedances corresponding to darker blue. Image from USA TODAY (Kelly & Nichols, 2016) based on data from EPA's Safe Drinking Water Information System database.

We may take for granted the clean water that pours from our household faucets, but clean water isn't always a reality for people, even in some U.S. communities. *USA Today* (Young & Nichols, 2016) and *The New York Times* (Wines & Schwartz, 2016) report that excessive lead levels have occurred in over 2,000 water systems since 2012 (**Figure 1**). In Mississippi, elevated lead levels were detected in the Jackson area in July 2015.

The two major sources of contamination of home water supplies are aging water infrastructure (delivery pipes) and pollution of source drinking water. Poor water quality can negatively affect human and ecological health (Center for Disease Control and Prevention, 2014; U.S. Fish and Wildlife Service, 2015). Numerous natural and human-induced factors can affect water quality. Natural factors include geology, climate, vegetation, wildlife, and wildfires, and human-induced factors include point source pollution, non-point source pollution, and structural changes such as stream modifications.

Policies that Protect Water Resources

Appropriate water quality standards are determined based on the intended use of that water; drinking water standards are different from standards for water used to support aquatic life, for recreational use, or for irrigation. For example, water that contains suspended sediment particles may not be suitable for human consumption, but it would be perfectly fine for watering the lawn. Abundant water supplies may be of no use for agriculture production if the water is salty. Early detection of poor water quality and proactively guarding water resources are important actions to take to ensure that clean water is maintained in our homes and communities.

Currently, there are two major acts and a range of rules and regulations in place to help keep our waters safe. The Clean Water Act (CWA) of 1972 "establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and regulating quality standards for surface waters" (U.S. EPA, 2017a). The Safe Drinking

Water Act of 1974 was established to protect the quality of drinking water in the United States. It "focuses on all the water actually or potentially designated for drinking use, whether from above (surface water) or underground (groundwater) sources" (U.S. EPA, 2017b).

The state of Mississippi is required under the CWA to establish, review, and update the state's water quality standards. The current standards were adopted by the Mississippi Commission on Environmental Quality in 2016 (MDEQ, 2016). The CWA also gives authority to the state to designate uses for its surface waters. Degradation of designated waters is allowable under very limited circumstances, and anti-degradation policies protect water quality throughout the state.

Mississippi has established general conditions, which are minimum conditions applicable to all waters, and specific water quality criteria for different water use categories. These categories include: public water supply, shellfish harvesting, recreation, fish and wildlife, and ephemeral (temporary) waters. In the following sections, we will provide basic ways of identifying poor water quality and protecting clean water in your home and community.

Identifying Poor Water Quality at Home

Most Mississippians receive their water from one of two sources—public water works or private water wells. Many public water works use groundwater, in a similar way that private wells work. Private water wells are used often in Mississippi. In fact, 29 percent of people in our state's most populated areas rely on a private well for their drinking water (Barrett, 2015). A few public water works rely on nearby surface waters, such as the Ross Barnett Reservoir near Jackson, to supply drinking water to their customers.

Whether your water comes from a public or private source, there are some basic indicators that your water is safe for consumption (**Table 1**). You should also note that, if your water comes from a public source, it will be treated and tested following federal and state regulations. Public water systems must notify the public of any violations of water quality standards, so it is not common to have a problem with water delivered from a public supply.

Appearance

Perhaps the most obvious indicator of poor water quality is how it looks. If water from the faucet appears cloudy or foamy, has particles floating in it, or has a reddish-brown or yellow color, it is best to assume the water is not safe for drinking until further tests are conducted. Commonly, reddish-brown or yellowish water is associated with iron and tannins from iron pipes or dissolved organic matter (tree leaves that have decomposed into microscopic particles) entering your home water system. Sometimes sediment can get into your water from a broken water line, in which case a boil water notice will be in place.

Sometimes poor water quality becomes apparent on bathroom fixtures or clothes. Staining or deposits that are red or brown, yellow, black, and green or blue can indicate numerous problems, from hard water (dissolved carbonate) to dissolved metals or algae. Most of the minerals found in drinking water are at safe, sometimes beneficial, levels for human health. However, frequent, high concentrations of these minerals can have harmful effects. For example, "low levels of [lead] exposure have been linked to damage to the central and peripheral nervous system, learning disabilities, shorter stature, impaired hearing, and impaired formation and function of blood cells [in children]" (U.S. EPA, 2016).

Odor and Taste

If your water smells or tastes bad or unusual, you should use caution before drinking or cooking with it. Sometimes odors come from sink drains and not necessarily the water. Pour water from the faucet into a glass and move away from the sink to determine if the water is the source of the smell.

Common odor problems are from water treatment, bacterial growth, or organic matter decay. Often these smells or tastes aren't a problem, such as a bleach taste from a chlorination shock to prevent bacterial contamination of the water system. Actually, typical levels of chlorine in drinking water from public water works range from 0.2 to 5.0 ppm (Saha et al., 2012), while the optimal range for a chlorine residual is specific to the public water system, typically falling between 0.1 to 1.0 ppm. The U.S. EPA maximum contaminant level goal for chlorine is 4 ppm (2017c). Exposure to air for a few minutes will help dissipate the chlorine and the odor.

Fuel-like odors are a more serious problem and can result from leaking fuel tanks, discharge from industry or landfills, or oil and hydrocarbons from road and parking lot run-off. These types of odors or tastes should be reported to the county health department, as there is increased risk of health problems from inhaling or consuming fuel/gas.

Table 1. Water quality concerns, common signs, causes, and recommended tests.			
Concerns	**Common Signs**	**Causes**	**Recommended Tests**
Appearance	Reddish-brown or yellowish	Dissolved organic matter or iron	Iron and tannin
	Frothy or foamy	Detergents	Detergents or total anionic surfactants
	Cloudy	Suspended sediments	Turbidity and total suspended solids
	Slimy, brown precipitate	Dissolved iron with iron bacteria	pH, iron, and bacteria
	Black flakes or particles	Dissolved manganese	pH and manganese
Stains on bathroom fixtures or clothing	Red or brown	Dissolved iron	pH and iron
	Yellow	Dissolved iron, hydrogen sulfide, hard water	pH, hardness, iron, and hydrogen sulfide
	Black	Dissolved manganese, hydrogen sulfides	pH, manganese, and hydrogen sulfide
	Green or blue	Corrosive water, dissolved copper	pH, hardness, alkalinity, saturation index, and copper
Abnormal odor or taste	Bitter	Dissolved nitrate or sulfate	Nitrate and sulfate
	Rotten egg	Hydrogen sulfide	Hydrogen sulfide
	Soapy	Detergents, surfactants	Detergents and total anionic surfactants
	Metallic	Dissolved metals like iron, manganese, zinc, copper, lead	pH, iron, manganese, zinc, copper, and lead
	Salty	Excessive soluble salts	Total dissolved solids, chloride, sodium, and electrical conductivity
	Septic, musty, earthy	Decaying organic matter in the drain; pollution of well water from surface drainage; bacteria in the drain and/or well	Bacteria and pH
	Gasoline, kerosene, oil	Contamination by petroleum hydrocarbons, oil, and grease	Petroleum hydrocarbons, oil, and grease
	Fruity	Fuel spill, leaking underground fuel storage tank, road runoff, ponding near well	Volatile organic compounds
Other	Corrosion of plumbing materials	Corrosive water	pH, hardness, alkalinity, saturation index, lead, copper, iron, manganese, sulfate, chloride, and electrical conductivity
	White deposits on bathroom fixtures and pots; soap scum	Hard water	pH, hardness, alkalinity, sulfate, and electrical conductivity (or total dissolved solids)
	Tarnished silverware	Hydrogen sulfide gas	pH and hydrogen sulfide
	Gastrointestinal illness (e.g., stomachache, nausea, diarrhea)	Bacterial contamination, presence of excess nitrate, sulfate, and manganese	Bacteria, nitrate, sulfate, manganese, and detergents
	Discoloration and/or mottling of children's teeth	Excessive fluoride	Fluoride
Adapted from *Testing for Water Quality*, Cooperative Extension, University of Georgia, circular 858-2 and *Water Quality Series: Drinking Water Testing*, Oklahoma Cooperative Extension Service, AgCE-878.			

Resources and Support

You may not always be able to recognize poor water quality from appearance, odor, or taste. Some contaminants are not noticeable but can still affect human health. For this reason, everyone should contact the managing board of their local public water system for information regarding their water quality. You can find contact information or reports by searching the keywords "EPA Consumer Confidence Reports" and using the "Find your local CCR" tool on the EPA's website.

If you are one of the many Mississippians who use a private well, you should test for nitrates and bacteria at least once a year. Contact the testing laboratory you plan to use, and ask about sampling, handling, and shipping procedures (if necessary) to ensure that your test results are accurate. It is a good idea to have your water tested in multiple seasons throughout the year.

Your physician may also request a water quality test if the health of family members, pets, or livestock changes. For more information about private well testing, please see Mississippi State University Extension Publication 1872 *Protecting Your Private Well* (http://extension.msstate.edu/publications/publications/protecting-your-private-well).

Protecting Water Quality at Home

You can protect your water at home by monitoring its condition using the basic methods outlined above. Have bacteriological and basic water chemistry tests conducted annually for private wells, or view the annual reports from the local public water system (**Table 2**). You should also monitor for sources of contamination on your property (e.g., chemical or fertilizer spills), especially if you have a private well. It is good to check for burst pipes (stemming from aging infrastructure), which can lead to loss of water pressure, water damage to buildings and appliances, and sewage or chemical leaks.

If you do notice potential contamination on your property, contact the Mississippi Department of Environmental Quality. Their spill response teams can help minimize the impacts to water, the environment, and human health. If you notice degrading or damaged infrastructure, have it replaced as soon as possible, then follow through with water quality testing to ensure safe drinking water. Personnel at the Mississippi State Department of Health can help you with water quality problems in your home or public buildings. See **Table 3** for select EPA standards governing drinking water quality.

Protecting Water Quality in Your Community

Recognizing poor water quality in lakes, rivers, streams, and ponds is important for our recreational uses of these water bodies, for the wildlife that depend on them, and for aquatic plants and animals that live in them. Protecting water quality in these aquatic systems is just as important as protecting water quality at home. Mississippi's recreational opportunities, including hunting, fishing, hiking, camping, birding, and boating, are very important to the state's economy (Baker, 2016).

The basic principles of monitoring water quality in your community and in your home are similar. However, the appearance and odor of outdoor water resources is more variable because of temperature fluctuations, rain, and biological factors. Appearance and odor of community water resources become a concern when they are abnormal for extended periods of time. Sustained chemical or sewage-like odors are indicators that community water resources should be tested for contaminants. Unmanaged water quality problems can lead to health issues for wildlife and people.

What You Can Do

Citizens can help protect water quality by monitoring the appearance and odor of community water sources. One of the best and simplest ways to be more involved is to become aware of water bodies near you; online mapping services can be helpful in identifying these.

Get to know local ordinances and state laws that protect your local surface waters from harmful pollution. Become a part of the public water quality discussion. Contact the managing board of your local public water system or the mayor's office to learn about measures to protect local water sources. Be sure to attend public meetings regarding water concerns, issues, proposals, protections, and ordinances.

You might also want to start, support, or join a local Adopt-A-Stream program, Waterkeeper Alliance group, Water Watch group, or EarthEcho Water Challenge program. Through these groups, you can conduct basic water chemical and bacteriological monitoring efforts and contribute to scientific databases. In addition, you can become a member of nonprofit organizations geared toward protecting environmental and/or drinking water, such as American Rivers, Ducks Unlimited, 1 Mississippi, Mississippi Wildlife Federation, or the Nature Conservancy of Mississippi (see **Table 4**).

If we all take an active role in protecting our water resources today, we can help preserve these resources for future generations.

Table 2. Generally recommended water tests for private wells.		
Testing Objective	**Type of Test**	**Testing Frequency**
Minimum Testing Recommendations		
Well maintenance	Bacteria	Annual
	Nitrates (total nitrate and nitrate + nitrite)	Annual
	Turbidity and color	Annual
	Comprehensive water chemistry: basic water chemistry (see below) plus alkalinity, soluble salts (or total dissolved solids), nitrate, chloride, fluoride, and sulfate	Initially and then every 3 years
	Basic water chemistry: pH, hardness, aluminum calcium, chromium, copper, iron, magnesium, manganese, and zinc	Annually after initial comprehensive water chemistry
Additional Testing Recommendations		
Verification of potential contamination	Lead and copper	At least once and then yearly follow-up for: 1) houses with plumbing that predates the 1987 plumbing codes with copper piping with lead solders 2) very old houses in which there are lead pipes 3) houses with brass and/or chrome fixtures (brass contains 3–8% lead; chrome fixtures contain lead)
	Arsenic	At least once and then a yearly follow-up
	Uranium	At least once and then a yearly follow-up
	Volatile and semi-volatile organic compounds, pesticides, petroleum hydrocarbons, and other organics	Not required on a regular interval; recommended only when contamination is suspected.
Adapted from *Testing for Water Quality*, Cooperative Extension, University of Georgia, circular 858-2 and *Water Quality Series: Drinking Water Testing*, Oklahoma Cooperative Extension Service, AgCE-878.		

Table 3. U.S. Environmental Protection Agency drinking water standards for select contaminants.	
Contaminant	**Maximum Concentration Limit**
Primary contaminants	
Arsenic	10 ppb
Lead	15 ppb
Total coliform	0 MPN/100 mL
E. coli	0 MPN/100 mL
Secondary contaminants	
Aluminum	0.2 ppm
Iron	0.3 ppm
Manganese	0.05 ppm
Sulfate	250 ppm
Adapted from *Testing for Water Quality*, Cooperative Extension, University of Georgia, circular 858-2 and *Water Quality Series: Drinking Water Testing*, Oklahoma Cooperative Extension Service, AgCE-878.	

Table 4. Selected list of governmental and nongovernmental organizations with water quality monitoring and protection endeavors.

Agency	Office or Program	Contact Website
Mississippi Department of Environmental Quality	Water Quality Assessments	https://www.deq.state.ms.us/MDEQ.nsf/page/FS_SurfaceWaterQualityAssessments?OpenDocument
Mississippi Department of Environmental Quality	Water Quality Standards	http://www.deq.state.ms.us/mdeq.nsf/page/WQSB_Water_Quality_Standards?OpenDocument
Mississippi State Department of Health	Bureau of Public Water Supply	http://msdh.ms.gov/msdhsite/_static/30,0,76.html
American Rivers	Southeast Region	https://www.americanrivers.org/region/southeast/
Ducks Unlimited	Mississippi Chapter	http://www.ducks.org/conservation/how-du-conserves-wetlands-and-waterfowl
The Nature Conservancy	Mississippi Division	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/mississippi/
Mississippi Wildlife Federation	Adopt-A-Stream Mississippi	http://mswildlife.org/AAS/
1 Mississippi	River Citizen Program	http://1mississippi.org/
Waterkeeper Alliance	no Mississippi chapters	http://waterkeeper.org/
Global Water Watch	no Mississippi chapters	http://www.globalwaterwatch.org/
EarthEcho International	Water Challenge Program	http://www.worldwatermonitoringday.org/about

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