

LAND MANAGEMENT PRACTICES FOR WATER QUALITY IN MISSOURI

Nonpoint Source Pollutants and Rainfall

During rainfall events, water running across fields, pastures, and impervious surfaces (such as parking lots and streets) will quickly pick up and move sediment and pollutants. Such contaminants are considered nonpoint source pollutants (NSP) and are a primary factor in degradation of groundwater and surface water (lakes, streams, and ponds). NSP contaminants can include phosphates and nitrates from fields and lawn fertilizers, pathogens and nutrients from animal waste, engine oil and antifreeze from parking lots, and other materials carried with sediments from eroding areas.

The goal of many water quality education and protection programs is to reduce NSPs from reaching groundwater and surface water by implementing “best management practices” (BMPs) for appropriate land management. A number of BMPs are described in this bulletin. Fortunately, both technical and financial sources of assistance are often available from federal, state, and local government sources to help implement BMPs for water quality. Several of these programs are described under the section on “financial and technical assistance” at the end of the bulletin.

Application of Pesticides and Nutrients

In agricultural production areas, careful management of nutrient and pesticide applications is needed to minimize contamination of surface and ground water sources. Timing of applications is important, as is the method of application and formulation of the product used. For example, surface applying a granular fertilizer on sloping ground right before a heavy rainfall can lead to much of the fertilizer being carried off with the rain runoff, which can contribute to build up of phosphates and nitrates in water. Using slow release fertilizers and incorporating fertilizers when feasible can help minimize runoff. The form of nitrogen can affect the movement of nitrates into groundwater. Nitrogen is considered a

very mobile nutrient and leaches readily through the soil profile compared to phosphorous and potassium. Application of animal manure is beneficial to the soil but proper timing and method of application is important to reduce the chance of runoff. Liquid manures should preferably be injected into the soil as opposed to sprayed on the surface. When applying solid manures, incorporation into the soil through tillage or composting the manure before application can reduce runoff problems. Applying manure to frozen ground that cannot absorb the material is a practice that should be avoided on sloping ground.



A simple vegetative buffer of native plants along a lake.

Vegetative buffers

Missouri’s rolling terrain has a significant impact on runoff; the more severe the slope, the faster the runoff unless obstacles impede the flow of water. Ideally, vegetation is in place to slow the water, trapping debris, sediment and pollutants, and preventing lakes and streams from being polluted. When natural vegetation has been removed for farming or development, there is a need to provide some control of runoff. Near commercial developments, black plastic silt fences are often used as a temporary measure to prevent runoff. A longer-term solution in most areas is to replant vegetation with a plan in mind to limit excessive runoff from sloping ground. A simple approach is

to use grass filter strips, not with lawn grass but taller stiff-stemmed grasses such as switchgrass, big bluestem, or eastern gammagrass.

A more complete form of protection for streams and other water bodies is to plant riparian buffers. A variety of plant species and types can be used in a riparian buffer, but the goal is to trap and filter runoff as well as stabilizing the shoreline of a stream or lake. A combination of grasses, shrubs, and trees is typically recommended for a riparian buffer, depending on the location and mix of native plants that will work best in a given area. Near a crop field or developed ground, usually a strip of grasses or other herbaceous plants is used, with some combination of woody plants closer to the stream or lake. The strong root system of the woody plants can better stabilize an erosive shoreline compared to grasses or other herbaceous plants. In some cases, aquatic plants may also be used along a shoreline to provide additional filtering and help provide aquatic habitat.



Small demonstration wetland at the Morton Arboretum (IL).

Wetlands

Wetlands play an important role in not only providing habitat for many plant and animal species but also filtering runoff. While natural wetlands have decreased in number and size, there has been a push to add constructed wetlands in many parts of Missouri. The Missouri Department of Conservation has staff that help design constructed wetlands for rural properties,

and in some cases government assistance is available for part of the costs of adding a wetland. Wetlands can tie up nutrients and break down pesticides before they reach other surface water or ground water supplies. Wetlands are also important layover spots for migrating waterfowl.

No-till and Reduced Till Farming

It is well-established that crop residue (leaves and stalks/stems) maintained on the soil surface can reduce both wind and water erosion. There are a variety of tillage techniques that involve leaving residue on the soil surface. Perhaps the most common of these in the Midwest is the use of the chisel plow as an alternative to the older practice of moldboard plowing. Whereas a moldboard plow completely inverts the top soil layer, burying most residue and leaving the soil surface bare and highly erodible, a chisel plow has more of a stirring action with sweeps pulled through the soil, mixing the residue into the soil but leaving some on the surface to reduce erosion. Some farmers seek to go even further with minimum tillage, such as using strip till devices that only disturb the soil in the row space where the next crop will be seeded. Other farmers will leave a crop field undisturbed after fall harvest, waiting until spring to do a light tillage operation such as field cultivating or using a vertical tillage tool to prepare for seeding.

Where the field surface is left undisturbed year round, the farming is called “no-till.” The residue of the previous crop is left entirely on the surface. This provides immediate benefits for reducing soil erosion and reducing the amount of energy used to grow the crop due to less tractor operations. Over time, no-till farming also provides other benefits. Earthworm and root channels form in the undisturbed soil, allowing rain to more easily move deeply into the soil. The overall soil structure improves, which after a few years can begin to improve root growth. Weed emergence may be reduced since many weed seeds need to be exposed to light from tillage disturbance before germinating. The soil usually retains more

moisture in a no-till situation, but at the same time harvest can occur in wetter conditions on a no-till field than a conventional field due to better soil structure.

No-till farming does have some challenges, including the risk of soil compaction from heavy equipment. The most common reason that farmers in northern states do not use no-till is that they feel their soils warm up too slowly in the spring and make the soil dry out more slowly, delaying crop planting. Still, no-till farming is an increasingly popular option on Missouri farms.

Grazing

In a state like Missouri, with millions of animal units and extensive pastures, the management of grazing animals can have a significant impact on local water quality. Many farmers and ranchers have taken steps to reduce impact of livestock on water quality, including by fencing grazing animals out of streams that cross pasture areas. For confined animal feeding operations, control of runoff through earth berms, sediment basins, and other techniques has reduced the incidence of inadvertent surface water contamination. Appropriate timing and method of applying animal manures to fields and pastures can also help reduce the chance of animal waste and nutrients entering our water supply. A variety of government assistance programs can provide financial assistance in implementing water quality protection measures for livestock operations, including the NRCS Environmental Quality Incentives Program (see the financial assistance section at the end of this bulletin).

A particularly valuable approach many livestock producers have implemented in Missouri is use of management intensive grazing, also called rotational grazing. In this approach to grazing, cattle or other livestock are placed at a higher than traditional stocking rate on a temporarily fenced paddock, often as little as an acre in size. The idea is for the livestock to graze that small area intensely before being moved onto an adjacent

area. Many research studies have proven that this approach not only leads to more efficient pasture use, but also less erosion and less runoff, particularly compared to keeping animals in dry lots or given unfettered access to streams or ponds. University of Missouri Extension offers a variety of educational programs to teach producers and landowners about this approach.

Urban/Suburban

A number of water quality control measures are being implemented in urban and suburban areas, many of them having to do with storm water management and control of runoff from parking lots and building sites. Two newer management techniques to help with water quality in densely populated areas are rain gardens and permeable parking. Rain gardens are a simple approach where the ground is shaped to collect rainwater runoff, typically from an impervious surface such as a parking lot or near buildings. A shallow depression is shaped or a small earth berm is constructed on a slope to collect the rainwater.



Rain gardens can provide diverse and attractive habitat while helping with water quality. (photo by C. Bohnert)

Although retention ponds have often been used to help with storm water runoff, rain gardens differ by typically being smaller, designed to minimize standing water, and planted with wetland-type plants that can tolerate wet conditions and help filter the runoff. Both the rain garden plants and the soil serve a filter function in helping remove pollutants from runoff before they can enter

groundwater or surface water bodies. Rain gardens can also help beautify the landscape and provide a bit of diverse habitat for songbirds, frogs, butterflies, and other creatures.

Another approach to reducing runoff is through use of permeable materials for parking surfaces instead of the typical impervious concrete or asphalt. Old-fashioned gravel parking lots are a type of permeable parking. Newer approaches to permeable parking surfaces are to use permeable asphalt, permeable concrete, or permeable pavers. These surface materials are designed to allow rainwater to percolate directly through the parking surface rather than running off.

Equally important to the design of such lots is the unseen part of the lot, the area below the surface. Where the existing soil is poorly drained, a deep gravel base, as much as 18-24 inches, is placed underneath the parking surface to allow temporary storage of rainwater underneath the parking lot. Ideally, the rainwater then slowly drains into the soil, but in some cases drainage tiles are added to carry excess rainwater away to a secondary filtering area such as a rain garden.

Permeable asphalt and permeable concrete parking surfaces are similar to regular parking lots in appearance, except that the finer particles of the paving mix are removed, giving the parking surface a slightly coarser appearance. Permeable asphalt and concrete are believed to have similar lifespan and cost to conventional paving mixes, but the overall cost of the lot is normally higher due to extra engineering design and extra gravel beneath the lot. Another alternative uses specially designed pavers that have been designed to allow rainwater to flow over the edge of the individual paving blocks into the gravel bed underneath. Pavers are typically made of concrete in a range of colors and patterns, allowing for attractive parking surfaces. Although they have a significantly higher upfront cost for installation, permeable paver parking lots have a longer lifespan, require less maintenance, and have potentially lower long-term cost than conventional parking lots.



Example of permeable paver parking at the Jefferson Farm.

Homeowners can also be part of the solution for protecting water quality. Lawn fertilizers in particular are a major nonpoint source of water contamination. Some BMPs for homeowners or residents include:

- recycle grass clippings and reduce lawn fertilizers
- use lawn fertilizers with little or no phosphorous (P)
- apply lawn sprays/pesticides by label instructions
- recycle engine oils and repair leaking engines
- recycle old paints and solvents instead of dumping
- have septic systems inspected for proper operation
- make sure well-heads are properly protected

Financial and Technical Assistance

There are a variety of federal and state assistance programs related to water quality, and in some cases there can also be county or municipal programs available. In general, there are more resources available for rural landowners than for those in municipal areas, but the latter may have access to programs to support rain gardens, storm water management, or riparian plantings.

The Missouri Department of Natural Resources (DNR) has a comprehensive division dealing with water protection and a significant amount of information available on their website. One of the principal programs to assist with water quality protection is the “319 nonpoint source implementation program.”

This program, funded by the Environmental Protection Agency but managed in Missouri by DNR, provides both mini-grants and major grants to organizations and municipalities to address water quality issues. They can also provide financial assistance to groups or coalitions to develop watershed development plans. From the MO DNR website, a summary of the 319 program states: “The overall goal of the grant program is to provide citizens with the knowledge and ability to improve their common land-use practices and to protect water quality. Selection for 319 funding emphasizes projects that restore the quality of waters on the state's 303(d) list of impaired waters due to NPS pollution. However, other high quality NPS projects are encouraged.” For more information, call 800-361-4827 or see <http://www.dnr.mo.gov/env/wpp/nps/index.html>

The largest financial programs available for rural landowners are federal, including programs offered through the USDA Natural Resources Conservation Service (NRCS). There are several relevant NRCS financial assistance programs available that include water quality components (most of the programs have broad conservation goals, of which water quality is one aspect).

One of the most significant NRCS programs that can help landowners with water quality and other conservation practices is the Environmental Quality Incentives Program (EQIP). Typically over \$20 million per year is available in Missouri through NRCS to do multi-year contracts for adding conservation practices to a farm. This support comes in the form of cost-share payments, where the agency pays either a certain percentage of the cost of implementing the practice, or a per acre or per practice flat rate. For example, a landowner can get assistance for stream crossings, nutrient management plans, planting of native plants or cover crops, various riparian protection steps, and many other conservation practices.

Some NRCS programs provide conservation benefits, including water quality protection, through per acre multi-year contract payments, such as the Conservation Reserve Program (CRP), the Wetlands Reserve Program (WRP), or the Grasslands Reserve Program (GRP). Within the multi-billion dollar CRP program, there are opportunities such as the Conservation Reserve Enhancement Program (CREP) and specific initiatives, including CP2 for native grasses, CP21 for filter strips, CP22 for riparian buffers, and CP23 for wetland restoration.

Detailed information about these programs is available through the Missouri NRCS website at <http://www.mo.nrcs.usda.gov> Landowners can also directly contact their local NRCS office (click on “find a service center” from the NRCS website home page or check your phone directory).

Another good source of technical assistance is through the Missouri Department of Conservation (MDC). MDC has “private lands conservationist” staff located throughout the state who can provide guidance on developing detailed conservation plans for private property. For more information, call (573) 522-4115 or see <http://mdc.mo.gov/land-care/landowners/farmers/assistance-programs/private-land-programs>

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