

Drinking Water Source Water Protection Best Practices

Minnesota Water Sustainability Framework January 2011

What is source water protection?

Source water protection is, in simple terms, the practice of using land management and conservation to protect drinking water supplies, including public drinking water sources and private wells. Most public water supplies are treated to some degree, but the cost of treatment can be reduced and public health risks minimized by protecting the water at its source, both surface (lakes, streams, and rivers) and ground water.

Treating degraded water quality is difficult and expensive, whereas prevention measures, including the conservation of forests and other natural areas, can minimize the need for filtration and treatment and produce long-term cost savings. According to the U.S. Environmental Protection Agency (EPA), the costs of treating contaminated groundwater supplies was, on average, 30 to 40 times more (and up to 200 times greater) than preventing their contamination. The Trust for Public Land and the American Water Works Association found in a 2002 survey of 27 water suppliers that the more forest cover in a watershed, the lower the costs of treatment.

According to the EPA, the leading cause of source water degradation is nonpoint source pollution. Although agriculture is currently the greatest nonpoint source threat to drinking water quality, urban runoff is the fastest growing threat nationwide. New development, particularly development that replaces forests, wetlands, and riparian buffers, exacerbates agricultural nonpoint impacts by removing the natural vegetation and soils that filter pollutants. As a result, there is increased storm water runoff, accelerated soil erosion, and movement of nutrients and contaminants into unprotected waterways. Development on naturally vegetated lands threatens water quality and increases the impacts of agricultural pollution.

Contaminants potentially present in source water prior to treatment include:

- Microbial contaminants, which can come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife
- Inorganic contaminants, such as salts and metals, which can occur naturally or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming
- Pesticides and herbicides, which can come from sources such as agriculture, stormwater runoff, and residential uses
- Organic contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production and can come from gas stations, urban stormwater runoff and septic systems.
- Radioactive contaminants, either naturally occurring or from oil and gas production and mining.

The Safe Drinking Water Act (SDWA) is the main federal law that ensures drinking water quality. Under SDWA, EPA sets drinking water quality standards and oversees jurisdictions, including states, local communities, and water suppliers, who implement the standards. SDWA, originally passed by Congress in 1974 and amended in 1986 and 1996, does not regulate private wells serving less than 25 individuals.

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Under the SDWA, EPA is authorized to set national health-based standards for drinking water to protect against naturally occurring and man-made contaminants. EPA, states, and water systems cooperate to meet these standards. The 1986 amendment to the SDWA established the Wellhead Protection Program (WHP).

While the original SDWA focused primarily on drinking water treatment, the 1996 amendments enhanced the existing law by incorporating source water protection, operator training, funding for water system improvements, and public information into the Act, with the goal of protecting drinking water quality from source to tap. The 1996 amendment, with its new emphasis on source water protection, required each state to examine existing and potential threats to the quality of all public water supplies and to develop a Source Water Assessment Program (SWAP). While drinking water standards are enforced and SWP plans are required to be in place, SWP is not required as a means to meet those standards, only recommended. For this and other reasons, source water protection is driven to a large degree from “the bottom up” by cooperative involvement of non-governmental organizations, communities, state, and federal entities. The Source Water Protection Act represents a national commitment to a flexible, state-driven prevention approach. A related act established in 1972, the Clean Water Act, also provides guidelines and resources that contribute to source water protection. The Clean Water Act (CWA) has two fundamental national goals: eliminate the discharge of pollutants into the nation’s waters, and achieve water quality levels that are fishable and swimmable.

Source Water Protection Requirements

Guidance from the EPA to the states outlines the required elements of an EPA-approvable state Source Water Assessment Program submittal and EPA’s recommendations for what may be included in a state Source Water Protection Program. The 1996 amendments contain prevention provisions based on two key elements, including a clear state lead, with flexibility and resources to achieve results, and a strong ethic of public information and involvement within the states’ decision-making processes.

The Source Water Protection Program requires that every community take six steps:

- Risk identification
 1. Delineate the drinking water source protection area, using a variety of accepted methods (e.g., calculated fixed radius; computer modeling).
 2. Inventory known and potential sources of contamination within the SWP area, including the level of concern assigned to each potential risk by ranking, rating, or prioritizing management measures to reduce or eliminate them.
- Risk ranking and screening
 3. Determine susceptibility of the water supply system to these contaminants by relating the nature and severity of the threat to the likelihood of source waters being contaminated. Mitigating factors taken into account when determining susceptibility include potency or toxicity of the contaminant, volume of discharge or release, distance from wells or intakes, and the likelihood of entry of the contaminant into the source waters.
- Risk management
 4. Notify and involve the public regarding threats identified in the contaminant source inventory, including potential impacts to the public water system, to ensure that the public has the information necessary to modify their own actions to prevent contamination and participate in community approaches to protecting drinking water.
 5. Implement management measures tailored to prevent, reduce, or eliminate threats identified through the source water assessment (steps 1-3).

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- Contingency planning
 6. Develop contingency planning strategies to deal with water supply contamination or service interruption emergencies that coordinate all available organizations and efforts to restore service.

Together, these form the basis of comprehensive drinking water source protection.

Financing and Resources For Source Water Assessment and Protection Programs

The Safe Drinking Water Act provides for a number of resources to help local communities protect their drinking water, including financial resources. There are two major avenues of funding for the drinking water source water assessment and protection programs, including the Drinking Water State Revolving Fund (DWSRF) and the Clean Water Act State Revolving Fund (CWASRF).

The 1996 Amendments to the Safe Drinking Water Act authorized the DWSRF to assist public water suppliers to finance the cost of infrastructure needed to achieve or maintain compliance with SDWA requirements and to protect public health. In addition, the DWSRF supports required Source Water Assessments, administration and technical assistance (states may set aside up to 10 percent of their allotment for the DWSRF to administer or provide technical assistance), and source water protection activities (states may set aside up to 15 percent of the state's capitalization grant for land acquisition/easements, voluntary protection and petition activities, source water assessments, and well head protection).

Subchapter VI of the CWASRF provides a partnership between EPA and the states, providing states with the flexibility to fund projects that will address their highest priority water quality needs, including certain source water protection activities, and cost savings can be realized through combining SWP and CWA efforts. CWASRF loans can be used for watershed protection, funds allocated under Section 106 of the Act may be set aside for state ground water programs, and Section 319 funds, aimed at non-point source pollution prevention, may also be used for source water protection.

Additional resources and programs provided by the Safe Drinking Water Act include:

- Wellhead Protection — States must establish a program to protect the land areas around water supply wells from contaminants that may enter the ground water and adversely affect human health.
- Source Water Petition Program — To assist states in the local development of a voluntary, incentive-based partnership between water supplies and community members. States can use DWSRF funds for loans to water supplies to implement local programs.
- Water conservation planning guidelines — EPA issued guidelines under Section 1455 for water conservation plans for public water systems. States may require systems to submit water conservation plans as a condition of receiving a DWSRF loan.
- Sole source aquifer protection — Entities may petition EPA for protection of an aquifer that is the sole or principal source of drinking water for 50 percent or greater of the local population served.
- State Underground Injection Control (UIC) programs — EPA reviews applications prior to adoption by states or tribes, which then promulgate rules to ensure non-endangerment of drinking water sources. The UIC program is a crucial component of the source water assessment and protection program, because it identifies, permits, and regulates the design, siting, operation, and maintenance of injection wells that are designed to dispose of waste underground. It is the major federal and state program to control some 800,000 wells with the potential to contaminate drinking water sources if not properly managed. The Safe Drinking Water Act requires EPA to provide safeguards so that injection wells or other similar systems do not endanger current and

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future underground sources of drinking water. Through the UIC program, EPA has developed minimum federal standards to regulate wells that range from deep, technically-sophisticated and highly-monitored wells, to shallow on-site drainage systems such as septic systems, cesspools, and storm water drainage wells. Wells that discharge a variety of hazardous and nonhazardous fluids above, into, or below aquifers are also covered. EPA's main concern relative to the source water assessment and protection program is the large inventory of Class V UIC wells — typically shallow on-site drainage systems such as septic systems; cesspools; storm water and agricultural drainage wells; aquifer recharge, storage, and recovery wells; industrial waste disposal wells; large capacity cesspools and septic systems, and motor vehicle waste disposal wells. Their simple construction provides little or no treatment of injected fluids.

- Oil and gas programs — EPA can approve existing state oil and gas programs if the state can show that the program is effective in preventing endangerment of drinking water supplies.
- Land conservation, treatment and filtration, and distribution system integrity are all parts of a multiple-barrier approach to providing clean drinking water; each is essential to long-term protection of water supplies.

A number of additional resources are available under the Clean Water Act, which also contribute to the support of source water protection, as described below.

- Federal assistance is available to states for ongoing water pollution control programs, including ground water programs.
- States must update their water quality standards every three years.
- Point source effluent limits, or Total Maximum Daily Loads (TMDLs) — States establish a ranking of waters for which point source effluent limits are not stringent enough to implement a water quality standard, taking into account the severity of pollution and the designated uses.
- Establishment and publication of TMDLs for suitable pollutants that take into account seasonal variation and a margin of safety.
- States submit their lists of impaired and threatened water and established TMDLs to EPA for approval and must report to EPA through the National Water Quality Inventory Report on the quality of their waters.
- States must 1) conduct statewide assessments of their waters identify waters impaired or threatened by NPSs; 2) develop NPS management programs to address impaired or threatened waters.
- Discharge of dredged or fill material into waters of the U.S. is regulated.
- Point source discharges to surface waters are regulated under the National Pollutant Discharge Elimination System Program.

In addition to federal resources, several tools are available to assist local communities with source water protection. These include:

- Education to improve consumer awareness and citizen advocacy
- Voluntary Best Management Practices (BMPs) to help citizens understand simple ways that they can contribute to source water protection.
- Sanitary Setbacks prescribed by local health codes for placement of individual private waste disposal systems (septic tanks) and community waste-treatment systems
- Zoning as a tool to prevent siting of potential contaminant threats or activities adjacent to public drinking water supply source waters

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A number of additional tools and databases have been developed by various for-profit, not-for-profit, and governmental entities to support decision making on the implementation of best practices. Examples include:

- The International Stormwater (BMP) Database website was developed to provide scientifically sound information to improve the design, selection and performance of BMPs and includes a database of over 400 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other publications.
- The Source Water Protection Cost/Benefit Tool is designed to help evaluate costs and benefits of different source water protection options. Cost/benefit calculations help prioritize, justify, and ultimately implement source water protection initiatives.
- American Water Works Association (AWWA) Standard G300, Source Water Protection and Operational Guide. This provides the definitive standard for a drinking water utility to protect its water supply sources by defining the minimum requirements for the development, implementation, and effectiveness assessment of source water protection programs for water utilities. The operational guide provides practical instructions for users of AWWA Standard G300, Source Water protection, suggests various approaches for source water protection programs, and includes worksheets and case studies of successful programs.

Best Management Practices (BMPs) Available for SWPAs

Septic Systems: Improper siting, maintenance, and use may contaminate both surface and ground water by percolation or runoff. Bacteria, protozoa, and viruses present in sanitary wastewater can cause gastrointestinal illness, cholera, hepatitis A and typhoid if consumed. **BMPs:** Establish proper siting criteria; specify appropriate design and construction criteria; establish operation and maintenance protocols; analyze assimilative capacity of soils and receiving water to determine appropriate density of septic system units; consider connecting to a public water system.

Lawn and Garden Fertilizer: Field leaching or runoff into surface and ground water. Nitrogen leaching into drinking water supplies at levels above Maximum Contaminant Levels may cause “blue baby syndrome” in infants under 6 months — life-threatening without immediate medical attention. Phosphorus may affect taste and odor of drinking water and may require treatment. **BMPs:** Eliminate excess uses; ensure proper application; select appropriate fertilizer; avoid application near wells used for drinking water, agricultural drainage wells; surface waters; plant native plants and grasses requiring less fertilizer and water.

Pet Waste: Watershed runoff or direct contact can introduce wastes into drinking water supplies. *Cryptosporidium*, *Giardia lamblia*, *Salmonella*, and *E. coli* pose the greatest threats. **BMPs:** Pick up after pets.

Pesticide Application (Large Scale): Runoff to surface waters due to rainfall or irrigation return flow threatens surface water sources. Soil injection threatens ground water sources. Possible health impacts from exposure to large amounts of pesticides in drinking water over a long period of time include: cancer, liver and kidney damage, reproductive difficulties, and nervous system effects. **BMPs:** Pesticide alternatives through Integrated Pest Management; mix, load, and apply pesticides consistent with label directions; reduce techniques such as soil incorporation, pre- and post-plant emergence applications, spot treatments; split applications; proper storage and disposal; avoid application around wells used for drinking water, agricultural drainage wells, and surface water.

Turfgrass/Agricultural Fertilizer Application: Field leaching or runoff into surface and ground water. Nitrogen leaching may cause “blue baby syndrome.” Phosphorus may affect taste and odor of drinking

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water and may require treatment. BMPs: Use application rates and fertilizer types consistent with actual plant needs; time applications with periods of maximum crop uptake; impede runoff by using tillage buffer strips, or filter strips; store and dispose of fertilizers properly; avoid application near wells used for drinking water.

Livestock and Poultry Waste: High nitrogen and pathogens can enter both ground and surface water sources used for drinking water via runoff or percolation. BMPs: Prevent animal waste contact with water; ensure proper land application of manure; avoid application near drinking water wells and surface waters; use pasture management techniques such as fencing and planting legumes; avoid siting animal waste lagoons near drinking water wells or flood plains; use low-permeability lagoon liners; aerobically compost horse manure; divert wildlife from sensitive areas by fencing, mowing, landscaping, tree pruning, and drainage devices.

Sanitary and Combined Sewer Overflows (SSOs/CSOs): SSOs discharge untreated sewage through broken pipes, equipment failures and overloads. CSOs discharge untreated sewage and storm water when system capacity is exceeded. Chief threats are gastroenteritis, cholera, dysentery and infectious hepatitis. BMPs: Non-structural prevention methods such as visual inspections, monitoring and maintenance programs, employee training and public education; structural prevention methods such as upgrading of collection systems, wet-weather storage facilities, and new sewer collection systems.

Storm Water Runoff: Rain or snow runoff carrying sediments and contaminants into surface or ground waters. Possible contaminants include gasoline, oil, automotive fluids, sediment, pesticides, nutrients, animal wastes, and hazardous wastes. Nationally, 77 of 127 priority pollutants have been detected in urban runoff. BMPs: Erosion and sedimentation control measures; land use controls; grassed swales; buffer strips; filter strips; storm water capture and detainment ponds, and constructed wetlands; maintain native vegetation in source water protection area.

Vehicle Washing: Contaminants include used oil, degreasers, antifreeze and synthetic oils. Potential health effects include kidney damage; circulatory problems, increased cancer risk; delays in physical or mental development. BMPs: Alternative cleansing agents such as phosphate-free, biodegradable detergents; discourage use of solvent and emulsifier-based agents; install water-recycling systems; train employees on spill control and response to problems; control and manage spills.

Small Quantity Chemical Use: Chemicals of concern may reach ground and surface waters through improper disposal practices via discharge to sewers, septic systems, dry wells, or through improper handling, hauling and disposal. Includes chemicals used in cleaning, degreasing, polishing, paint preparation, rust removal, photo processing, medical practices. BMPs: Avoid excess use; follow label directions on proper use, storage and disposal; train employees on spill control and response protocols; refer to manufacturer's Material Safety Data Sheets for specific hazard descriptions.

Underground and Above Ground Storage Tanks: Underground — Releases of petroleum fuel substances through corrosion of parts, improper installation, failure of piping systems, sloppy fuel deliveries, and improper operation and maintenance. Above ground — Release of petroleum fuel substances mainly through leaks or spills may enter drinking water supplies via soil accumulation or runoff in storm water to surface waters. BMPs: Ensure compliance with federal requirements; consider local registration programs for exempt tanks; consider local land-use controls such as zoning, use restrictions, permits and setbacks.

Minnesota's Source Water Protection Program

There are three primary parts to Minnesota's Source Water Protection Program:

- Wellhead Protection
- Source Water Assessments
- Protection of Surface Water Intakes

Wellhead Protection — A capture zone for the well (called the wellhead protection area) is designated and a plan is developed and implemented for managing potential contamination sources within the wellhead protection area. The Minnesota Department of Health (MDH) assigns staff in the Source Water Protection Unit to assist public water suppliers with preparing and implementing wellhead protection plans. MDH administers the state wellhead protection rule that sets standards for wellhead protection planning. Wellhead protection plans (approximately 1200 in Minnesota) will be required by 2020.

Source Water Assessments — MDH has completed assessments for the over 7,000 public water systems in the state, ranging from small businesses on their own well to large city water systems using several different water sources. Assessments are easily available to the public on the MDH Source Water Assessment web page and can be found either by name of the facility or by county.

Protection of Surface Water Intakes — Protection for surface water intakes is not required, but many of Minnesota's 24 community water supply systems that use surface water have expressed interest in developing protection plans. The MDH has convened a work group to help determine how these plans should be prepared and who should approve them.

Current Status

Source water assessments are being used by some States for prioritization of protection efforts and program resources to improve their drinking water protection programs, and by assistance organizations for education and outreach to support development and implementation of protection measures. However, at the local level, assessment use is limited. While seen as a good starting point, some limitations of the assessments themselves and other barriers hinder their potential for success in leading to local-level initiation and implementation of source water protection measures.

While States continue to make progress on completing source water assessments and many are developing and implementing source water protection strategies, several obstacles have been identified by EPA that hinder States' efforts to protect source water. The program remains vulnerable and requires a more secure and consistent funding source for long term success. States and local entities will have to continue to rely on intra- and inter-agency coordination, program integration, partnerships, and collaborative efforts to leverage human and financial resources, technical assistance, and outreach to utilities and communities.

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