Stormwater Best Management Practice

Preventing Stormwater Contamination from Septic System Failure

Minimum Measure: Illicit Discharge Detection and Elimination
Subcategory: Decentralized Wastewater

Description

Septic systems, which are a type of decentralized or on-site wastewater system, treat household wastes in areas without access to public sewers or where a sanitary sewer system is not feasible. A typical septic system consists of an underground septic tank and a drainfield. The septic tank collects wastewater from the home and allows solids to settle out as sludge. The wastewater is then directed to the drainfield where it is filtered through the soil and eventually reaches groundwater. Bacteria in the tank help break down the sludge, however, EPA recommends that the sludge be periodically pumped out of the tank for off-site treatment or disposal. An estimated one in five homes relies on on-site septic systems to treat its wastewater—in all, around 4 billion gallons of wastewater per day for the United States (U.S. EPA, 2014). Without proper design and maintenance, a septic system can fail, possibly harming public health and the environment. It can be helpful for Municipal Separate Storm Sewer System (MS4) program managers to understand how septic systems work and how to detect and work with owners to correct failing septic systems, which can release pollutants into the MS4 and directly impact stormwater quality. Stormwater that is high in bacteria, nutrients or optical brighteners discharging from an MS4 may be the first indication of a failing septic or wastewater system in the area.

Even when functioning properly, septic systems can discharge wastewater with pollutant concentrations exceeding established water quality standards. This problem grows when the system lacks proper design or maintenance. More than half of the existing on-site systems are more than 30 years old, and at least 20 percent of systems are malfunctioning to some degree (U.S. EPA, 2003). Such systems contribute significant amounts of pollutants, especially nitrogen and microbiological pathogens, which can then enter the MS4 and discharge into waterways.

Several factors can cause on-site systems to fail, including unsuitable soil conditions, improper design and installation, and inadequate maintenance practices. In most cases, the property owner is not aware of a system failure until sewage backs up into the home or breaks out above ground. Identifying and eliminating failing septic systems helps control untreated wastewater discharges that contaminate groundwater, stormwater and ultimately surface water supplies.

A septic system failure can lead to contamination of surface waters.

Applicability

Conventional septic systems are in use throughout the United States. They are the most common wastewater treatment method for areas without public sewer systems and wastewater treatment plants.

Siting and Design Considerations

Generally, state and local regulations dictate design and installation requirements. To prevent septic system failure, systems should have proper design, siting and size. Below are basic principles of septic system design to provide a base-level understanding of important considerations in designing and siting a septic system:

- **Lot size.** Conventional septic systems need large lots to allow for uniform effluent distribution across the drainfield. Design engineers should enlarge septic drainfields where soil permeability is low,

steep slopes are present or they expect increases in daily sewage flow.

- **Soil type.** Soil type influences the effluent's ability to percolate through the soil for treatment.
- **Separation distance from the water table.** The location of septic systems should ensure an adequate horizontal separation from surface waters and vertical separation from groundwater. Distances (setbacks) between septic system components and artificial or natural water supplies vary according to local site factors, such as soil percolation rate, grain size and depth to water table. States or local municipalities determine the vertical and horizontal setback requirements for soil absorption fields near building foundations, property boundaries, water supply wells and other surface waters. An individual site assessment before installation is the best way to determine siting distances necessary for efficient on-site wastewater disposal.
- **System size.** To avoid hydraulic overloading, it is necessary to properly size a system. Overloading can cause system backups or force waste through the septic tank before it receives adequate treatment (Perkins, 1989). Overloading can also create anaerobic conditions in the drainfield, reducing the system's ability to treat pathogens, and it might not give solids time to settle out before being pushed through the system.

Many alternatives to conventional septic systems offer improvements in efficiency, treatment capability and footprint. The use of mound or recirculating sand filters can benefit sites with limiting factors such as inadequate lot size, limited separation distances and the presence of problem pollutants like nitrogen. De-nitrification systems or aquaculture systems are useful to control pollutants like nitrogen and phosphorus. Alternating bed systems, mound systems, pressure distribution (low-pressure pipe) systems, sand filter systems or constructed wetlands are useful as retrofits for conventional systems with inadequate siting or size. These different types of systems can handle site-specific problems and decrease the likelihood of septic failure. EPA's decentralized wastewater systems technology fact sheets provide information about many of these alternative systems. In most cases, individual states approve alternative treatment systems. An EPA Web page lists such approvals, organized by state.

Maintenance Considerations

Periodic maintenance of on-site systems ensures their proper functioning. A septic system management program consisting of scheduled pumpouts and regular maintenance is the best way to reduce the possibility of failure. EPA recommends inspecting septic systems every 3 to 5 years. A typical inspection will include (U.S. EPA, 2017):

- Reviewing pumpout and maintenance records.
- Reviewing the age of the system.
- Checking the levels of sludge and scum in the tank.
- Checking for signs of leakage, such as low water levels in the tank.
- Checking for signs of backup, such as staining in the tank above the outlet pipe.
- Checking the integrity of the tank, inlet and outlet pipes.
- Checking the drainfield for signs of system failure like standing water.
- Checking the distribution box to ensure that lines are receiving equal flows.
- Reviewing compliance with local regulations regarding function and location.

Since property owners may not employ routine maintenance practices, agencies may need to establish programs to track pumpout and maintenance requirements. EPA's voluntary guidelines for decentralized on-site wastewater management include five voluntary management models for programs managing on-site and decentralized wastewater systems. The guidance consists of steps of increasing oversight to help communities and programs that regulate septic systems build effective septic system management programs. The programs below are examples of municipalities that have taken on the responsibility of managing septic systems and have included maintenance-tracking in their plans (U.S. EPA, 2012).

Jamestown, Rhode Island

- In 2001, Jamestown adopted an ordinance to better monitor and manage individual wastewater systems. The program consists of routine inspections, maintenance reminders, an online database, siting and installation rules, and designation of a high groundwater table district.
- The ordinance requires routine inspections of all systems every 3 to 5 years.
- The ordinance gives the town the authority to pump septic systems at the owner's expense.
- Property owners pay an annual $30 fee to fund the ordinance.

Monroe County, Florida

- In 1999, Florida adopted new wastewater treatment standards to protect the environmentally sensitive ecosystems of Monroe County (the Florida Keys).
- All wastewater systems in Monroe County must now use advanced treatment technologies with designs to achieve an effluent limit of 10 milligrams per liter or less for nitrogen.
- Septic system owners must renew an operating permit annually at a cost of $100.

Pena Blanca, New Mexico

- Deciding whether to repair or replace 133 of the 185 existing treatment systems or spend $3.1 million on a centralized sewer system, the community of Pena Blanca formed the Pena Blanca Water and Sanitation District in 1990 and developed a wastewater management program with an emphasis on system maintenance. The program features an operating permit and maintenance contract requirements, mandatory tank pumping every 2 years, and maintenance of system records.
- The Water and Sanitation District retains the authority to pump septic tanks every 2 years, with property owners retaining the option to hire an outside pump service.
- The Water and Sanitation District charges a monthly fee that ranges from $9 to $20.

Auburn Lake Trails, California

- In 1985 in response to local soils and topography that had poor suitability for conventional septic tank designs, the community of Auburn Lake Trails authorized the Georgetown Divide Public Utility District to design and manage conventional and advanced individual and clustered wastewater treatment systems. The program consists of operating permit requirements, routine inspection and maintenance requirements, and groundwater and surface water monitoring.
- The district has broad authority to investigate, design, monitor, operate, maintain and repair treatment systems.
- The district charges monthly user fees ranging from $15 to $23.

MS4 programs with septic systems should consider addressing failing septic systems by utilizing field screening to pinpoint areas warranting more detailed on-site inspection surveys by the appropriate regulating authority (see common field tests to the right).

EPA has created a Web site that describes steps for a property owner to take after a system has failed. When a septic system has failed and requires replacement, consider connecting to the local sanitary sewer system. This may not be possible in all parts of the country—but where it is feasible, it may be cheaper than installing a new septic system and provides the highest level of protection to the local environment and public health.

Limitations

Economics affect the ability for a person or a community to repair or replace a failing septic system. Septic owners may not have adequate funding to install new systems. In some cases, rebates or subsidies are available to property owners to replace aging septic systems, install advanced on-site wastewater treatment systems or connect to centralized systems. These

programs vary regionally; consult local or state wastewater authorities for more information.

Reliance on individual on-site inspections to detect failed systems is another major limitation. Individual on-site inspections are labor-intensive and require access to private property to pinpoint the locations of failing systems. Property owners might be reluctant to provide this access, and an ordinance mandating inspection authority may be necessary. Some communities have dealt with access issues through ordinances requiring inspection at time of property transfer to pinpoint systems requiring repairs. An example of this type of ordinance is available on the Center for Watershed Protection Web site in the illicit discharge category.

Perhaps the biggest limitation to correcting failing septic systems is the lack of techniques for detecting individual failed systems. While visual inspections and dye testing can locate a malfunctioning system, they require access to private property and demand staff time. Dealing with failing septic systems requires a stronger emphasis on developing screening techniques that local governments can use to detect and correct improperly operating systems. Water quality sampling at MS4 outfalls for wastewater indicators (e.g., bacteria, nutrients, optical brighteners) can be a good indicator of failing septic systems in a particular area.

Common Field Tests

Below are common field tests that county health departments or other authorized personnel can conduct:

- **Visual and olfactory screening.** Odors, surface pooling and isolated patches of green grass sprouting out of season are common indicators of a failing septic system.
- **Bacterial or chemical indicators.** High concentrations of bacterial or chemical indicators in nearby drainage systems or waterways can be effective, rapid means of identifying failing septic systems. Fecal indicator bacteria can identify severe septic failures (Ahmed et al., 2005), while compounds commonly in domestic wastewater, such as caffeine and sucralose, can pinpoint individual sources of contamination (Lange et al., 2012; Lim et al., 2017; Schaider et al., 2017).
- **The brightener test.** This test uses ultraviolet light to screen for the fluorescence of the optical brighteners in detergents and toilet papers.
- **Color infrared aerial photography.** This test uses variations in vegetative growth or stress patterns over septic system field lines to identify potentially malfunctioning systems.

Following analysis of any of the above tests, a detailed on-site visual and physical inspection can confirm if the system has failed and determine the extent of the repairs necessary.

Cost Considerations

The costs of detecting and correcting septic system failures are subject to several factors, including the type of screening, availability of trained personnel, cost of materials and the level of follow-up necessary to fix system problems. For routine inspections of single homes by a qualified professional, costs generally range from $250 to $500 per inspection (U.S. EPA, 2017). Community-wide screening or field sampling campaigns are more expensive and depend on the type of screening and scale of implementation. One technique to reduce costs is to conduct MS4 outfall screening for wastewater indicators, which can be relatively cheap, and allows for the targeting of sub-watersheds and more resource-intensive individual septic system inspections.

Once a community identifies a failing septic system, it should secure procedures and funding to replace it. The cost of replacing a septic system varies widely across the country, but it is typically at least several thousand dollars, depending on site conditions and geographic location. More advanced treatment systems are generally more expensive. Various methods have financed septic system replacement, including money from state revolving funds or from local utilities through user fees. EPA's Web page on funding for septic systems contains more information on funding sources.

When considering the cost of septic system remediation or replacement, one should compare the long-term costs and benefits of in-kind replacement to the costs and benefits of connecting to local sanitary sewer networks. Some states and municipalities provide incentives to remove septic tanks and connect to the local sanitary sewer system, even without demonstrated septic system failure.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.