Pollution Prevention Fact Sheet: Septic System Controls

Description

Septic system source control refers to the use of outreach programs to educate homeowners about the proper operation and maintenance of their septic systems to reduce the likelihood of failure. Septic systems are designed to treat wastewater by separating solids from liquids and then draining the liquid into the ground. Sewage flows into the tank where settling and bacterial decomposition of larger particles takes place, while treated liquid filters into the soil. When system failures occur, untreated wastewater and sewage can be introduced into groundwater or nearby streams and water bodies.

Pollution prevention practices are designed to restrict pollutant and nutrient loads from improperly functioning septic systems from entering local water sources. These loadings occur for a number of reasons, including improper siting, inadequate installation or system operation failures (See the Non-Stormwater Discharges Fact Sheet on Failing Septic Systems). As many as 75 percent of all system failures have been attributed to hydraulic overloading (Jarrett *et al*., 1985). Failures may also occur due to lapses in the regular inspection and maintenance that is required to ensure proper operation during the design life of the septic system. Homeowners may be unaware of the age of their system and whether preemptive planning is necessary before the system fails.

Applicability

Outreach regarding septic system controls is applicable mainly to large lot development in rural areas that are not served by sewer. When septic systems are used for wastewater treatment, there is a need for educational outreach and training to avoid system failure for owners of both new and existing systems. Septic system maintenance education is extremely important for coastal shoreline developments near shellfish beds and spawning areas, where septic effluent discharges can influence water quality and lead to bed closures and algal blooms. There is also a significant need for educational outreach regarding septic system maintenance near lake shoreline developments, where nitrogen inputs can lead to lake eutrophication.

Implementation

The most effective way to control on-site wastewater problems is through a comprehensive management program. An on-site wastewater management program can reduce water quality degradation and save local governments and homeowners time and money, as well as better track the performance of routine maintenance practices. This comprehensive plan is administered by one agency that has ultimate responsibility for all aspects of wastewater management, including on-site disposal systems (for more information see the Septic System Ordinance in the Illicit Discharges Ordinance Category).

Public outreach and training are vital elements to the control of septic system failure. Many of the problems associated with improper septic system functioning may be attributed to a lack of homeowner knowledge on operation and maintenance of the system. Educational materials for homeowners and training courses for installers and inspectors can reduce the incidence of failure. Education is most effective when used in concert with other source reduction practices such as phosphate bans and use of low-volume plumbing fixtures. Simple messages that can be conveyed to homeowners to reduce system failures and ensure proper functioning are listed in Table 1.

Table 1. Steps That Can Reduce Pollutant Loadings from Septic Systems

1. Do not wait until septic system shows sign of failure. Inspect the system annually and have it pumped-out at least once every three years. 2. Keep records of pumping and maintenance and a map of the location of your system and drainfield. 3. Practice water conservation indoors and divert roof drains and surface water away from the system. 4. Use caution in disposing materials down the drain. Household chemicals can kill the bacteria that make the system work and non-degradable materials (cigarette butts, etc.) can clog the system. 5. Keep heavy equipment and vehicles off your system and drainfield. 6. Don't cover your drainfield with impermeable surfaces that can block evaporation and the air needed for effluent treatment.

In addition to the general suggestions above, there are other management measures which can be implemented to help maintain a properly operating system. These include:

Chemical Additive Restrictions
Organic solvents are often advertised for use as septic system cleaners. There is little evidence that such cleaners perform any useful functions, and may instead exterminate the microbes necessary for waste treatment, resulting in increased discharge of pollutants. In addition, the chemicals themselves often contain constituents that are listed with US EPA as priority pollutants. Restrictions on the use of these additives can prevent improper system operation and groundwater contamination(US EPA, 1993).

Phosphorus Detergent Restrictions
Conventional septic systems are usually very effective at removing phosphorus. (See the Non-Stormwater Discharges Fact Sheet on Failing Septic Systems). However, certain soil conditions combined with close proximity to sensitive surface waters can result in phosphorus pollutant loading. If such conditions are sufficiently prevalent within areas of concern, restrictions or bans on the use of detergents containing phosphate can be implemented. Eliminating phosphates from detergent can reduce phosphorus loads to septic systems by 40 to 50 percent (US EPA, 1993). As of October 1993, 17 states had enacted phosphate detergent restrictions or bans (Osmond *et al*., 1995).

Elimination of Garbage Disposals for Households Served by Septic System
Garbage disposals contribute to the loading of suspended solids, nutrients, and BOD to septic systems, as well as increasing the buildup of solids in septic tanks. Garbage disposals can double the amount of solids added to a septic tank, creating the need for more frequent pumpouts.

Limitations

As with all pollution prevention measures, public unawareness about the suggested practices may be the biggest limitation to septic system source control. Many residents appear to be either unaware of or unwilling to implement the necessary steps to ensure the proper operation and maintenance of their septic systems. A recent survey of residents in the Chesapeake Bay region found that 50 percent of septic owners had not had their systems inspected within the last three years and that 46 percent had not had their system cleaned within the same time frame (Swann, 1999). Twelve percent of residents did not even know where their septic system was located. This indicates that residents are not receiving the necessary information on septic system care to prevent or reduce the incidence of failure. For more information, see *Understanding Watershed Behavior*, Article 126 in The Practice of Watershed Protection.

Effectiveness

Failing septic systems have been linked to water quality problems in streams, lakes, shellfish beds and coastal areas. Improvements in system operation and maintenance should be a strong element in watershed plans for those areas where septic systems are used for wastewater treatment (for more information see *Dealing with Septic System Impacts*, Article 123 in The Practice of Watershed Protection). Public education and outreach regarding septic operation and maintenance can be assumed to produce some positive effect on water quality, but studies on resident behaviors regarding septic pollution prevention practices are limited. Instead, effectiveness of septic source controls is most often measured in the number of informational packets mailed out or the number of attendees for training workshops. While this may help to define the demand for information, it gives no indication of whether the operation and maintenance practices presented are even implemented. To better determine whether pollution prevention outreach is being effective, residential surveys should be part of any program seeking to educate residents on septic systems and their influence on water quality.

Cost

The cost of septic system pollution prevention programs can vary greatly, depending on factors such as staff time, outreach components, and the extent of septic use within a region. Table 2 gives some examples of programs from various parts of the country and the expenditures for septic outreach.

Once a program is well established, the cost of creating educational materials and training programs decreases and funding can be redistributed to those outreach techniques that have proven to be the most successful. Programs should be sure to secure some funding for media outreach (especially television), as this often ranks as the most popular information source in surveys of resident preferences.

Table 2. Some Examples of Cost and Staff Time for Septic Outreach Programs

Program	**Expenditure**	**Staff time (Full time equivalent)**	**Components**
City of Olympia, Washington	$40,000	½	Flyers/brochures Training workshops System monitoring
Thurston County, Washington	$35,000	½	Flyer/brochures Discount coupons for septic pumping Training workshops
Minnesota Cooperative Extension	$18,000	¼	Publications/videos Flyers/brochures Training workshops/community visits Septic owners guide distributed with new permits Satellite conferences for policy makers Train the trainers program

View an Annotated Septic System Bibliography

Description

Septic systems provide a means of treating household waste for those areas that do not have access to public sewer or where sewering is not feasible. In the state of Maryland, over eighty percent of the land developed in the last decade has been outside the sewer and water "envelope" (MOP, 1991). Currently it is estimated that twenty-five percent of the population of the United States rely on onsite wastewater systems to treat and dispose of their household waste. Of that number, about ninety-five percent of the disposal systems are septic tank systems.

Managing septic systems requires regular maintenance, proper installation and siting, and the detection and correction of existing failing systems. A failing septic system is considered to be one that discharges effluent with pollutant concentrations exceeding established water quality standards. Failure rates for septic systems typically range between one and five percent each year (De Walle,1981) but can be much higher in some regions (Schueler, 2000) (for more information see "Microbes in Urban Watersheds: Concentrations, Sources and Pathways," Article 17 in *The Practice of Watershed Protection*). Failure of on-site disposal systems can be due to a number of causes including unsuitable soil conditions, improper design and installation, or inadequate maintenance practices. Improperly functioning septic systems are recognized as a significant contributor of pollutants (especially nitrogen) and microbiological pathogens and dispense more than one trillion gallons of waste each year to subsurface and surface waters (NSFC, 1995). Identifying and eliminating these failing septic systems will help control contamination of ground and surface water supplies from untreated wastewater discharges.

Applicability

Conventional septic systems are used throughout the United States and are the wastewater treatment method mostly commonly selected for those areas without public sewer systems and treatment plants. In areas without sewer systems, there are a number of factors that should be examined to determine if conventional septic systems are the right treatment choice. The first is the size of the lot where the system is installed. Conventional septic systems have a relatively large lot size requirement to allow for even effluent distribution across the drainfield. A second factor is the soil type within a region, which influences the ability of the soil to purify effluent and allow the effluent to percolate. Other conditions which can affect septic system applicability include: separation distance from the water table and bedrock, topography, flooding frequency, density of development, and distance to streams or shorelines.

Siting and Design Considerations

The best way to prevent septic system failure is to ensure that a new system is sited and sized properly and to employ appropriate treatment technology. Septic systems should be located to ensure a horizontal distance between surface waters and vertical separation to groundwater. Setback requirements are determined by each state or region regarding the vertical and horizontal distances that soil absorption field must be located from building foundations, property boundaries, water supply wells, and other surface waters. The distances between septic system components and man-made and natural water supplies will vary according to local site factors such as soil percolation rate, grain size, and depth to water table. The most effective siting distances for efficient on-site wastewater disposal are determined by doing individual site assessments prior to installation. For more information see "Dealing With Septic Systems Impacts," Article 123 in the *Practice of Watershed Protection*.

The proper sizing of a system is necessary to avoid hydraulic overloading. Overloading a system can cause the system to back up or can force waste through the septic tank before it receives adequate treatment (Perkins, 1989). Overloading can result in anaerobic conditions in the drainfield and might not give solids time to settle out before being pushed through the system.

In some cases, modifications to septic systems may be necessary in order to ensure proper treatment of wastewater discharges. The size of the septic drainfield must be enlarged in cases were soil permeability is low, steep slopes are present, or where increases in daily sewage flow is expected. Limiting factors such as inadequate lot size, limited separation distances, and the presence of problem pollutants such as nitrogen may require the use of alternative on-site disposal systems such as mound or recirculating sand filters. Selecting the right system to handle site specific problems often decreases the likelihood of septic failure. Systems can be designed to control pollutants such as nitrogen and phosphorus (Denitrification Systems or Aquaculture System) or as retrofits for conventional systems that were inadequately sited or sized (Alternating Bed System, Mound System, Pressure Distribution (Low Pressure Pipe) System, Sand Filter System, or Constructed Wetlands).

Proper siting and postconstruction inspection will work to prevent new systems from failing, but planning for existing systems is needed as well. A septic system management program of scheduled pumpouts and regular maintenance is the best way to reduce the possibility of failure for currently operating systems. A number of agencies have taken on the responsibility for managing septic systems and Table 1 provides some examples of programs and how they seek to control system failures.

Table 1. Examples of Septic System Management Programs (from USEPA 1993; CWP 1995)
Georgetown Divide Public Utilities (CA) Approximately 10% of agency's resources are allocated to septic system management Provides comprehensive site evaluation, septic system design, and makes inspections during construction Conducts scheduled post-construction inspections Homeowners pay $12.50 per month for services
Stinson Beach County Water District (CA) Monitors septic system operation to identify failures Detects contamination of groundwater, streams, and sensitive aquatic systems from septic systems Homeowners pay $12.90 per month, plus cost of construction or repair
Puget Sound Water Quality Authority (WA) Member jurisdictions have established revolving loan funds to provide low interest loans for repair of failing septic systems
Chesterfield County (VA) Private pumpers submit form to county, and county maintains database tracking pumpout Every five years county sends residents notification for pumpout requirement County contracts to have pumpout performed if owner does not comply and can fine or back charge to owner.

Field screening, which can pinpoint areas where more detailed on-site inspection surveys are warranted, should be used in these programs designed to address failing septic systems. There are several good references available discussing field screening techniques for identifying sources of contamination (Lalor and Pitt, 1999; Center for Watershed Protection, 1999). However, there is not much information available dealing with specific techniques for identifying existing individual septic systems that might be failing.

Two field screening techniques that have been used with success at identifying possible locations of failing septic systems are the brightener test and color infrared (CIR) aerial photography. The first involves the use of specific phosphorus-based elements found in many laundry products-often called brighteners- as an indicator of the presence of failing on-site wastewater systems. The second technique uses color infrared (CIR) aerial photography to characterize the performance of septic systems. This method has been found to be a quick and cost-effective method for assessing the potential impacts of failing systems and uses variations in vegetative growth or stress patterns over septic system fieldlines to identify those systems which may potentially be malfunctioning. Then a more detailed on-site visual and physical inspection will confirm whether the system has truly failed and the extent of the repairs needed. These inspections may be carried out by county health departments or other authorized personnel.

Once a septic system has been identified as failing, procedures must be in place to replace that system. The cost to replace a septic system typically ranges between $3,000 and $7,000 per unit (NSFC, 1999) but costs vary significantly depending on site conditions and geographic location. Various methods have been used to finance septic system replacement, including money from state revolving funds or from local utilities through user fees.

Limitations

Septic systems can have numerous impacts on the quality of ground and surface water supplies. Improperly located or failing systems can discharge inadequately treated sewage which may pond on the ground and runoff into surface waters, and inappropriate vertical distances from groundwater can result in contamination of water supply wells. The wastewater and sewage that may be discharged from failing on-site systems will contain bacteria and viruses that present problems for the health of both humans and aquatic organisms. In addition, excess nitrogen and phosphorus can cause algal blooms that reduce the level of available oxygen in the water and prevent sunlight from reaching desirable submerged aquatic vegetation.

There are also economic impacts associated with failing or overtaxed systems. Beach and shellfish bed closures affect tourism and the vitality of local businesses that rely on fishing and seafood.

The lack of proven field methods for identifying malfunctioning systems other than individual on-site inspection is another current limitation. These individual on-site inspection is very labor-intensive and requires access to private property to pinpoint the exact location of the failing system. Property owners may be reluctant to provide this access and an ordinance mandating inspection authority may be required. In addition, the replacement of failing systems may be limited due to economic situation of septic owners, who due to financial hardship may not have the funding to pay for replacement of their system.

Perhaps the biggest limitation to correcting the impacts of 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. A number of communities have dealt with access issues by using an ordinance requiring inspection at time of property transfer to pinpoint systems requiring repairs. A key point in dealing with failing septic systems is the need for a stronger emphasis on developing screening techniques for local governments to use to detect and correct improperly operating systems.

Maintenance Considerations

Periodic maintenance of on-site systems is necessary to ensure their proper functioning. Since many homeowners do not employ these routine maintenance practices, it may be necessary for agencies to establish programs to track pumpout and maintenance requirements. Table 1 gives some examples of programs that include maintenance tracking as part of their plan.

Effectiveness

The effectiveness of septic systems at removing pollutants from wastewater varies depending on the type of system used and the conditions at the site. The fact is even a properly operating septic system can release more than 10 pounds of nitrogen per year to the groundwater for each person using it (Matuszeski, 1997). Table 2 gives an overview of the average effectiveness for seven types of on-site systems for removing total suspended solids (TSS), biological oxygen demand (BOD), total nitrogen (TN), and total phosphorus (TP). As can be seen, even properly operating conventional septic systems have relatively low nutrient removal capability, and can be a cause of eutrophication in lakes and coastal areas. Communities may elect to require new septic systems to use more advanced treatment technologies to address concerns regarding pollutant loads from improperly functioning systems.

Table 2. Average Effectiveness of On-site Disposal Systems (total system reductions) (Source: USEPA, 1993)

Onsite Wastewater Disposal Practice	**TSS (%)**	**BOD (%)**	**TN (%)**	**TP (%)**	**Pathogens (Logos)**
Conventional System	72	45	28	57	3.5
Mound System	NA	NA	44	NA	NA
Anaerobic Upflow Filter	44	62	59	NA	NA
Intermittent Sand Filter	92	92	55	80	3.2
Recirculating Sand Filter	90	92	64	80	2.9
Water Separation System	60	42	83	30	3.0
Constructed Wetlands	80	81	90	NA	4.0

Cost

The costs associated with detecting and correcting septic system failures are subject to a number of factors including availability of trained personnel, cost of materials, and the level of follow-up required to fix the system problems. Mason County Washington Department of Health Services has conducted on-site sewage inspections for a number of years and has found that dye tests, while reasonably affordable, were too costly to conduct on a regular basis. The estimated cost for each dye test survey conducted was $290 dollars, and the cost for each visual inspection was $95 (Glasoe and Tompkins, 1996). Most of the causes of system failure were found to be relatively easy and inexpensive to repair, and the cost to oversee the repairs was estimated to be $285.

There are also significant cost differences between the various technologies available for on-site wastewater treatment. Table 3 gives both capital and maintenance costs for seven different on-site disposal systems. The installation cost for alternative systems may be higher due to variables like requirements for additional system equipment and the cost of permit approval for the system. Differences in maintenance costs may possibly be due to factors such as increased demand for replacement of treatment media and the lack of available personnel with training in maintenance of alternative systems.

Table 3. Cost of On-site Disposal Systems (Source: USEPA 1993)

Onsite Wastewater Disposal Practice	Capital Cost($/House)	Maintenance ($/Year)
Conventional System	4,500	70
Mound System	8,300	180
Anaerobic Upflow Filter	5,500	NA
Intermittent Sand Filter	5,400	275
Recirculating Sand Filter	3,900	145
Water Separation System	8,000	300
Constructed Wetlands	710	25