Phosphorus Best Management Practices

Protecting Water Quality

Septic Drain Field Design and Maintenance

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Definition:

Septic drain fields are subsurface systems that recycle human wastewaters. Properly designed systems transmit and store the household effluent below the surface and allow soils and soil microorganisms to clean the wastewater before returning it to the hydrologic cycle.

Purpose:

The entire septic system serves as an onsite, household-sewage-treatment system. The drainfield keeps human waste below ground, away from human contact, which reduces the risk of nutrient and disease-causing pathogens from reaching water bodies.

How Does This Practice Work?

A septic system is composed of three parts: a septic tank, drainfield and soil (Fig. 1).

The liquid and solid household waste flows into a septic tank, which is typically belowground. The septic tank primarily functions as a separation chamber and an anaerobic digester. Solid material more dense than water sinks to the bottom, and less dense material, such as fats and oils, float to the top. The liquid in the middle of the tank is termed grey water and exits the tank to flow to the septic drainfield.

Typically, the drainfield consists of three to four trenches that are 18 to 24 inches deep with a perforated pipe in 12 to 18 inches of gravel covered by 6 inches of soil. A properly designed drainfield should distribute wastewater over a large enough area to allow it to infiltrate into the soil and be treated. A distribution box is often used to accomplish equal distribution.

The soil acts as a natural filter and contains organisms that help treat the wastewater. The nutrients, such as phosphorus (P), in the wastewater are adsorbed or chemically bonded to the soil particles, which limits mobility. The pathogens in the wastewater are typically destroyed by the natural populations of soil microorganisms.

The septic drainfield must be properly sized to the soil conditions at each location. Each soil should get a thorough examination by a professional prior to installation. There must be a uniform soil color (indicating well-drained conditions) in the area where the drainfield is located. Infiltration is inferred from the texture or may be determined crudely by a percolation test. A perched seasonal water table is determined by observing the color and uniformity of colors in the soil and knowledge of the depth to the regional aquifer. A grey-colored soil or a soil that has grey mottles (spots) indicates standing water during the rainy season.

Where This Practice Applies and Its Limitions:

Drainfields will function properly in a wide range of soils in all climatic regions within the U.S. Septic systems are required in areas where municipal wastewater treatment systems are not available.

There are limitations to these systems. Drainfields will not function hydraulically in soils with high clay or a perched seasonal water table. The high-clay soils will not allow the wastewater to infiltrate fast enough

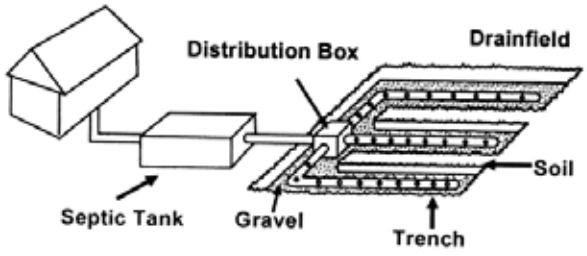

Figure 1. Layout and components of a typical septic system.

Gray soils indicate seasonal saturation with water. This soil would be unacceptable for a septic drainfield

to remain below the soil surface. On the contrary, soils with extremely high sand content or shallow depth to bedrock do not renovate the wastewater before reaching the aquifer. The soils with a perched seasonal water table near the surface will fill with natural rainwater at some times during the year and will not have the capacity to accept additional wastewater. This will cause the wastewater to surface, where it will run off into streams or may come into direct contact with humans.

In some cases, alternative designs that involve pretreatment of wastewater prior to reaching a drainfield may be acceptable if the soil does not provide proper renovation.

Effectiveness:

With a properly designed septic system, the wastewater will remain below the soil surface, where it will come in contact with sufficient microorganisms and soil complexing agents to be properly renovated and returned to the hydrologic cycle. However, P removal by adsorption/precipitation is highly dependent on the media capacity. The total P concentration in wastewater averages 1-2 g/person/day; however, the data analysis of wastewater through soils is limited and ranges from 0 percent to 100 percent removal.

Cost of Establishing and Putting the Practice in Place:

The laws vary from state to state. However, the same general guidelines apply. Prior to constructing a septic system and drainfield, a permit from the state department of health or department of environmental quality is commonly required. Apart from the septic system material, such as a septic tank, pipe and gravel, a licensed professional must evaluate the soil and provide a design. Then, a licensed septic system installer must be used.

With a conventional (septic tank, drainfield, trench) system, the average cost of materials and installation is $3200. When soils are limiting, alternative systems must be used. The most expensive system is a recirculating sand filter, which costs around $6300.

Operation and Maintenance:

Proper drainfield function requires wastewater with a minimum amount of solid material; therefore, the septic tank should be cleaned out every seven to 10 years. If the septic tank overfills and solid materials begin exiting the tank with the wastewater, the solids will cause a decrease in the soil's permeability, and the drainfield will fail by surfacing.

Limiting the flow of water from the household may also be helpful. To lessen water flow, low-flush toilets and other water-conserving measures are commonly used. In alternative systems, yearly maintenance contracts are commonly required by the state prior to approval.

Avoid driving or parking over the septic drainfield. Heavy vehicles may crush the pipes within the drainfield. Also restrain from flushing non-degradable objects or hazardous chemicals down the toilet. These items my clog your system or disrupt the microbiological treatment of the waste.

Trees or shrubs over the drainfield may cause problems in some septic systems. These plants have extensive root systems, which seek out the nutrient-rich water, and thus may clog the system. Also, do not build structures over the field or cover the field with hard surfaces such as asphalt.

There is no evidence that septic tank additives improve the performance of septic systems. Additives are costly and may even be harmful to the system.

References:

Angoli, T. 2001. *Summary of the Status of Onsite Wastewater Treatment Systems in the United States During 1998*. In Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems. ASAE, St. Josephs, MI.

Siegrist, R.L. 2001. *Advancing the Science and Engineering of Onsite Wastewater Systems*. In Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems. ASAE, St. Josephs, MI.

USEPA. 2002. *Onsite Wastewater Treatment Systems Manual*. STP EPA/625/R-0‰8. Washington, DC.

For Further Information:

The National Small Flows Clearinghouse has free or low-cost information on septic system designs, functions and maintenance. They may be contacted at:
National Environmental Services Center
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064
1-800-624-8301
http://www.nesc.wvu.edu/nsfc/

The local Department of Health or Department of Environmental Quality must be contacted for a permit prior to septic system installation. These state agencies maintain a list of licensed providers, as well as information on proper drainfield function.