ALABAMA COOPERATIVE Extension SYSTEM

ALABAMA A&M AND AUBURN UNIVERSITIES

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On-Site Sewage Treatment

Understanding Septic System Design And Construction

Years of experience have shown that properly designed, constructed, and maintained septic systems pose no undue stress on the environment. All three tasks—design, construction, and maintenance—are crucial if the system is to operate properly.

Typically, the homeowner does not become involved in the design details of a septic system. State and local regulations and design standards have been established to ensure properly designed systems. Similarly, if homeowners are careful in selecting a reputable construction contractor, they usually can be assured that the system will be installed properly.

But understanding septic system design and construction will enable homeowners to interact knowledgeably with local inspectors and contractors.

Conventional Septic System Design

Conventional septic systems have two key components: a septic tank and a soil absorption system. Each must function properly for the entire system to perform satisfactorily.

The Septic Tank. The septic tank is simply a container usually prefabricated from concrete according to standard designs. It receives wastewater from the home generated in the bathroom, kitchen, and laundry. The septic tank retains the wastewater for approximately 24 hours, allowing the solids to separate and settle out and allowing bacteria to partially decompose and liquify the solids.

There are three layers in the septic tank. (See Figure 1.)

• Sludge, consisting of heavy, partially decomposed solids that will not float.

• Liquid, containing dissolved materials such as detergents and small amounts of suspended solids.

• Scum, consisting of fats and oils and other light-weight solids that float on the surface of the wastewater.

Solids and scum in the tanks are digested or decomposed by anaerobic bacteria (bacteria active in the absence of oxygen). This decomposition liquifies up to 50 percent of the solids and scum. The liquid is carried out into the absorption field, and the undigestible solids remain in the tank as sludge.

Each time raw sewage enters the tank, an equal amount of fluid is forced out of the tank. Tees or baffles at the inlet and outlet of the tank slow the veloci-

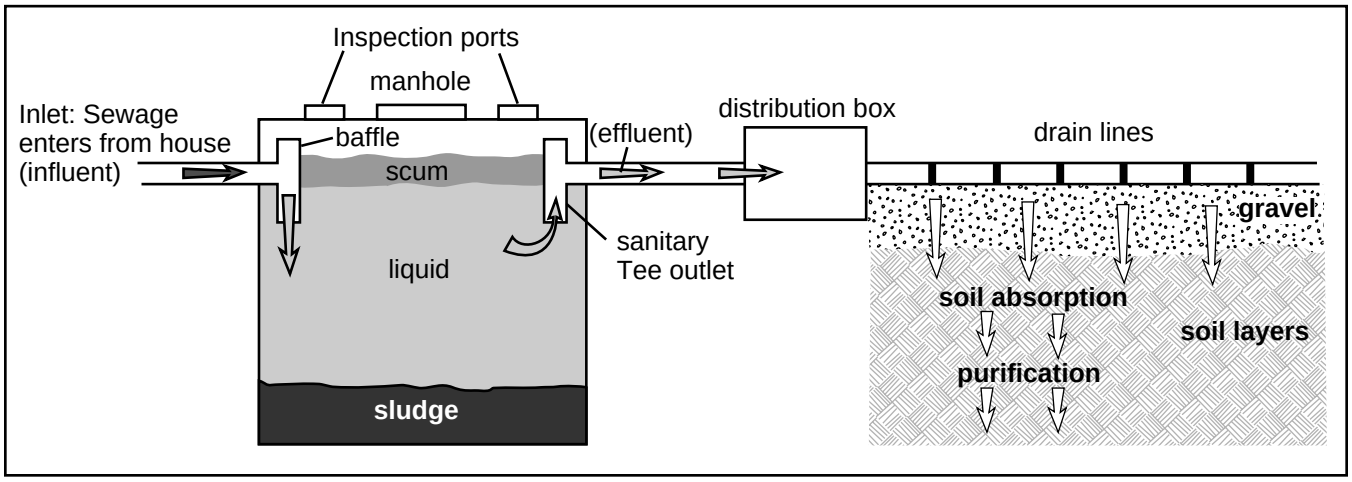

Figure 1. Conventional on-site wastewater treatment and disposal in the soil.

ty of incoming wastewater and prevent flow directly to the outlet of the tank. The tees also help prevent sludge from leaving the tank through outlet lines. The fluid leaving the tank is called effluent and can contain disease organisms. Small amounts of suspended and dissolved matter in the effluent not completely stabilized or digested also move out of the tank to the absorption field.

While typically designed to hold 1,000 gallons of liquid, the size of the septic tank varies, depending on the number of bedrooms in the home. Regulations require that septic tanks be a certain size based on the expected daily flow rate of wastewater. Proper sizing is important to allow adequate time for settling and flotation so that the soil absorption system is not clogged with sludge and scum.

The Soil Absorption System. The soil absorption system consists of a distribution box and up to 300 feet or more of tile or plastic drain lines buried in the soil. The soil absorption system receives wastewater from the septic tank. The partially treated liquid, called effluent, flows out of the septic tank to the distribution box, where it is evenly distributed throughout the absorption field. The effluent is allowed to trickle into the soil through perforated pipes placed at a certain depth throughout the absorption field.

As effluent moves through the soil, impurities and pathogens are removed. The soil provides filtering and treatment to remove pathogenic microorganisms, organics, and nutrients from the wastewater. Just as the septic tank requires a certain amount of time to allow solids to settle and light materials to float, so the soil requires a certain amount of time to remove harmful materials from the wastewater leaving the tank.

The size of an absorption area is based on the volume of wastewater generated in the home and the permeability of the soil. Usually, the absorption field can fit within the front yard or the backyard of a typical 1-acre homesite. The precise area requirements will depend upon the kinds of soils at the homesite, the size of the house (the number of bedrooms), and the topography of the lot. Adequate land area must be available to install a replacement system in case it is ever needed. This replacement area must meet the same soil and site requirements as the original system.

Conventional Septic System Location

Unlike a sewer system, which discharges treated wastewater into a body of water, the septic system depends on the soil around the home to treat and dispose of sewage effluent. For this reason, a septic system should be installed only in soils that will adequately absorb and purify the effluent. In addition, the septic system must be located a specified distance from wells, surface waters, and easements.

To insure that your septic system is located properly, keep the following tips in mind:

• The septic system should be installed where the soil tests were performed.

• The location of individual septic system components should meet certain setback requirements. If a septic system is located too close to wells, streams, or lakes, wastewater may not be properly filtered and may contaminate surface water supplies. Generally accepted safe distances are shown in Table 1.

• When the septic system is being installed, record the location of your septic tank, absorption field, and repair area. Measure and record distances from the septic tank, septic tank cleanout, and soil absorption system to aboveground features such as buildings, fence corners, or large trees. Then after the area has grassed over, you can still find the system.

A sample sheet for recording information is provided on the opposite page.

Table 1. Recommended Horizontal Separation Distances For On-Site Sewage Disposal System Components.[a]

Part Of System	Water Supply (well or suction line)	Water Supply (pressure line)	Lake Or Stream	Dwelling	Property Line
	feet				
Septic tank	50	30	50	10	10
Distribution box	50	30	50	20	10
Absorption field	100	30	50	20	10

[a]Distances may vary from state to state. Contact your local health department for specific guidelines.

Source: Lundstrom 1986, and Alabama Department of Public Health 1988 .

Septic System Installation Record

Date installed: _____

Building permit number: _____

Name and address of licensed installer:

_____

_____

_____

Size of septic tank: _____ gal

Amount of field lines: _____ ft

Depth of trenches or bed: _____ ft

Sketch the layout of your septic system. (Include the distances from the tank and the absorption field to buildings and wells):

Conventional Septic System Construction

While the construction of a septic system is a matter for professionals, homeowners can ensure proper construction by keeping the following tips in mind.

• Keep heavy equipment off the soil absorption system area both before and after construction. Soil compaction can result in premature failure of the system. During construction of the house, fence off the area designated for the soil absorption system as well as the required replacement area and the area directly downhill.

• Avoid installing the septic tank and soil absorption system when the soil is wet. Construction in wet soil can cause puddling and smearing and increase soil compaction. This can greatly reduce soil permeability and shorten the life of a system.

• Make sure the perforated pipes of the absorption system are level to provide even distribution of the septic tank effluent. If settling and frost action cause shifting, part of the soil absorption system may be overloaded.

• Divert rainwater from building roofs and paved areas away from the soil absorption system. This surface water will increase the amount of water the soil has to absorb and cause premature failure.

• Keep water from footing drains and water softener discharges out of the septic system. Water from footing drains can overload the capacity of the absorption field, reducing its ability to accept effluent. Water softener discharges contain high concentrations of sodium, which react with the soil to reduce permeability. Remember, the system was designed and sized to handle only the wastewater from plumbing fixtures and washing machines.

• Do not plant trees and bushes near the septic tank or absorption field because their roots can enter the system and cause extensive clogging problems. Do not cover the absorption field with a driveway, patio, or other paving that would prevent the release of water vapor.

• Allow accessibility for a pumper truck or backhoe to service your system. Septic tanks require routine pumping and periodic maintenance, so keep access to the area easy.

Alternative On-Site Sewage Treatment Systems

In locations where a conventional septic tank and soil absorption system is unsuitable (such as areas with high water tables or slowly permeable soils), you may be able to modify site conditions. For example, in areas with high water tables one option is to use underdrains or curtain drains to lower the water table. Another option is to raise the level of the soil surface with layers of fill soil.

When it is not practical to modify the site, consider an alternative system. The mound system and the aeration system are alternatives that may be used in areas with high water tables or slowly permeable soils.

With the mound system, the absorption field is built above the natural ground level. A distribution network supplies effluent to the mound, and the effluent is treated as it passes through the fill sand and natural soil.

The aeration system consists of a chamber that mechanically aerates (mixes air with) the effluent and decomposes the solids. Effluent is discharged to an absorption field or, after chlorination, to surface water or an evaporation pond.

Other alternatives include sand filters, lagoons, constructed wetlands, electro-osmosis systems, dropbox distribution systems, serial distribution systems, pressure-dosed distribution systems, and leaching chambers.

In general, alternative systems are more costly to install and operate than conventional septic tank and soil absorption systems and may require additional maintenance.

Conclusion

Improperly designed and constructed septic systems are doomed from the start. These systems usually fail in a few months because they are inadequately sized, installed in impermeable soils, or not properly constructed.

When on-site sewage disposal systems are installed on the proper site and are properly designed, constructed, and maintained, they provide a safe, cost-effective alternative to municipal and community sanitary sewage treatment.

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For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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