Water Quality in Georgia

Septic Tank Design and Construction

Cooperative Extension Service • The University Georgia College of Agricultural and Environmental Sciences • Athens

The first known installation of a septic tank in the United States was in 1876, although Louis Mouras of Vesoul, France was given a patent in 1881 and credited with the invention. Baffles, which regulate the flow, were added in 1905 to make the septic tank more efficient. The first baffles were made of oak boards.

At the turn of the century, there were some very large community septic tanks. In 1903, four community tanks were constructed in Saratoga, New York, with a total capacity of one million gallons.

By 1920, septic tanks began to be a common feature. After World War II, septic tanks became important to housing developments in unsewered areas. A typical septic tank is shown in Figure 1.

Septic Systems and Groundwater

A few rules of thumb tell us when septic systems are most likely to function properly and minimize groundwater contamination:

Good soil facilitates treatment and disposal of septic system wastewater. Soil profiles made of sand, silt and clay work best. If there is too much clay in the soil, the waste may percolate poorly. If the soil contains too much sand and large particles, wastewater may pass through to the groundwater without being treated by soil microbes (see Figure 2).

Soil treatment occurs best when above the water table and the soil is relatively dry with oxygen present. Water at greater depths allows wastewater to remain in the unsaturated soil, where it can be treated most effectively before reaching groundwater.

Septic systems need space. Only part of the microorganisms and chemicals are removed from wastewater as it moves downward. Even properly operating systems can discharge some phosphates, nitrates and bacteria or viruses into the groundwater. To reduce loading of groundwater with effluent, install systems on lots with adequate space.

Proper design and use is important. Septic systems are designed to treat and dispose of a specific volume and type of wastewater in the conditions found at the site. The system must not be overloaded. Hazardous chemicals or large amounts of grease should not be disposed in septic systems. Kitchen grease should be placed in the garbage, not the septic tank. Water conservation extends the life of the system.

Routine maintenance is critical. Septic tanks must eventually be pumped. Sludge and scum accumulate and, if allowed to remain, will eventually cause the tank to overflow and clog the drainfield.

Good judgment in planning and design and diligent maintenance are the most important aspects of an effective septic system management program.

Septic Tank Function

Sewage or untreated household waste will quickly clog all but the most porous gravel formations. The septic tank conditions sewage to allow percolation of the liquid portion into the subsoil. The most important function of septic tanks is to protect the absorption ability of the subsoil. In doing this the septic tank does the following three things.

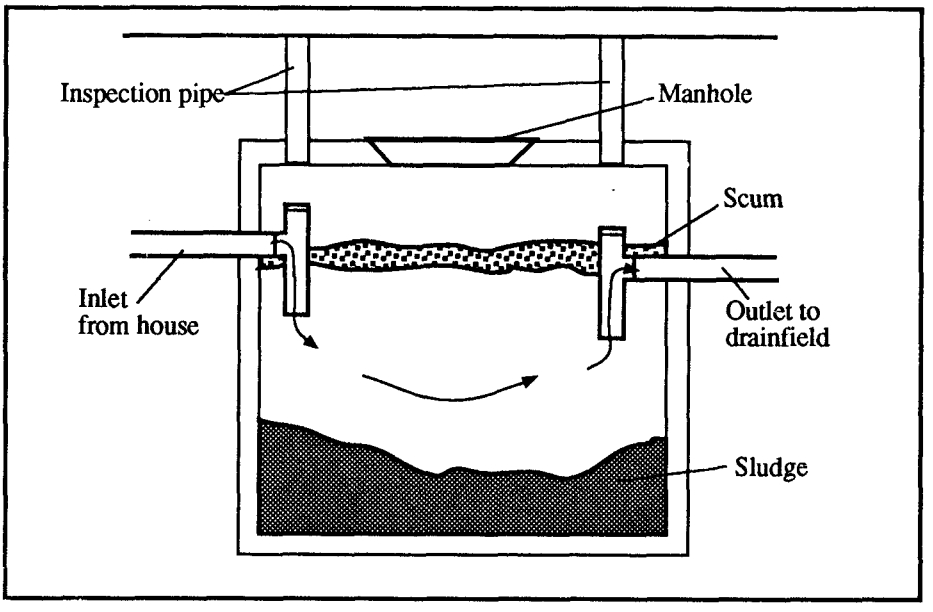

Figure 1. Cross section of a septic tank

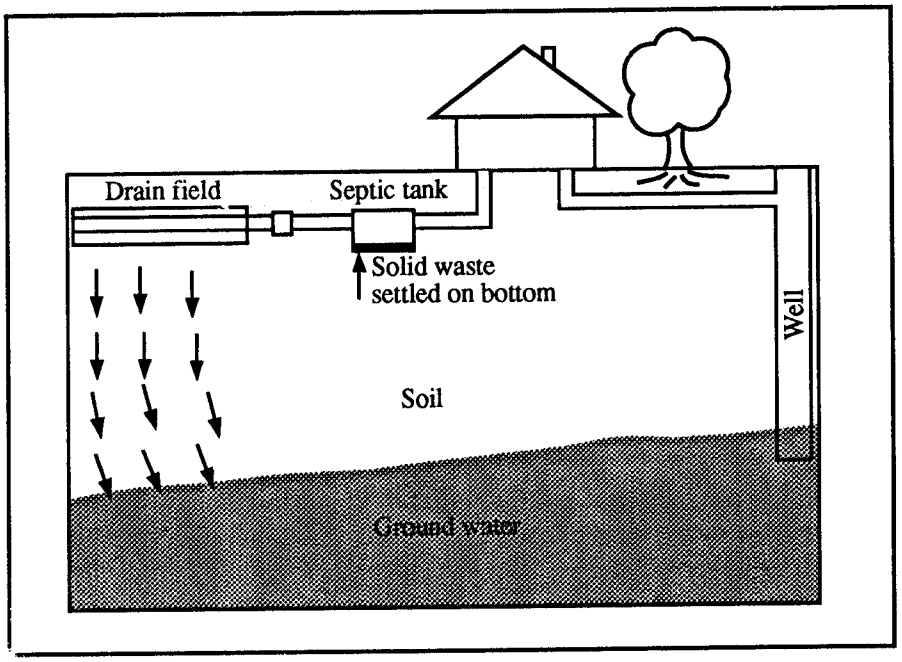

Figure 2. Septic systems can affect groundwater

Removes solids from liquid. As sewage enters the tank, the rate of flow is reduced and heavy solids settle, forming sludge. Grease and other light solids rise to the surface, forming a scum. The sludge and scum are retained and break down while the clarified effluent (liquid) is discharged to the drainfield for soil absorption.

Provides biological treatment. Natural processes break down the solids and liquids by bacterial action. The breakdown occurs in the absence of oxygen (anaerobic conditions). The anaerobic conditions are referred to as "septic", giving the tank its name.

Stores scum and sludge. The solids accumulate in the bottom of the tank to form sludge. The scum is a partially submerged mat of floating solids and grease. Scum and sludge are digested over time and compacted into a small volume. Areas with warm climates, such as the southern United States, allow more complete breakdown of solids and scum than in the cooler climates of the North. For this reason, tanks in warm climates do not usually need to be pumped or cleaned out nearly as often as those in cold climates. Regardless of climate, a non-volatile residue of material remains in the tank. Sufficient volume for the solids must be provided in the tank between pumpings or cleanings. If the solids fill the tank and enter the drainfield, the solids can clog the soil in the drainfield.

Grease from the kitchen is detrimental to septic tank functions. Effluent from grease traps must go through septic tanks before being discharged to drainfields to prevent soil plugging. The last approach is to put kitchen grease in old milk jugs and place in the garbage rather than into the drain. Small amounts of kitchen grease can go into the septic tank without damaging the system.

Effluent - Bacteria and Nutrients

The liquid faction that leaves the septic tank and enters the drainfield is called the effluent. The bacterial level of the effluent is quite high, contrary to popular belief. The effluent also contains nitrates (among other nutrients), which move downward. To reduce potential for groundwater contamination by the effluent, many areas restrict building lot sizes. Larger lots reduce loading rates and help protect groundwater. Some areas with porous or sandy soils are located in groundwater recharge areas. These areas may be unsuited for septic tanks or require building lot sizes 50 to 100 percent larger than lots not in the recharge areas. Pathogens break down with soil contact and pathogen levels are reduced as the effluent percolates through the soil. Bacteria eventually die and are removed by the filtering effect of the soil, further purifying the effluent.

The drainfield pipe is placed on the contour and perforated to allow the effluent to percolate into the soil. For this reason, the percolation of the soil is a critical factor when determining the amount of drainfield needed. A percolation test of the soil in the drainfield area is essential. If you are considering installing a septic tank, contact your local health department and building inspector for local requirements. The percolation test procedure is described here for your information.

Percolation Test

To conduct a percolation test, dig several straight-sided holes (with a hole digger or auger) at least 4 inches in diameter down to the drainfield level in the area to be used for the drainfield (see Figure 3). Roughen or scratch any slick clay or compacted soil in the bottom or sides of the holes by scraping lightly.

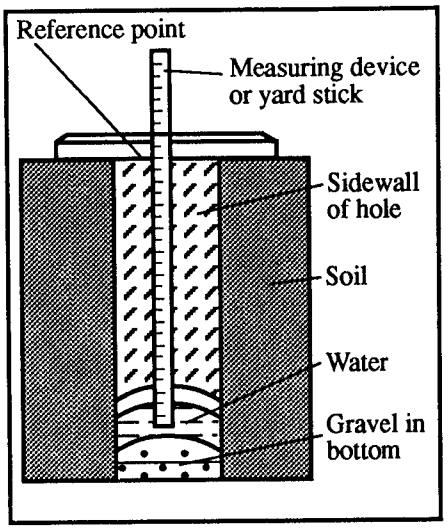

Figure 3. The percolation test

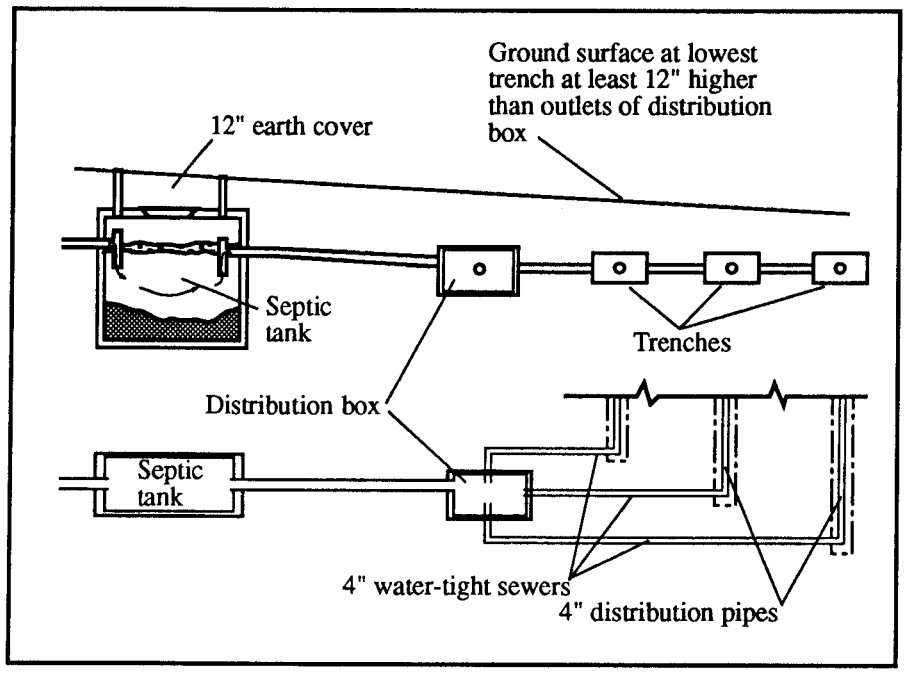

Figure 6. Sewage treatment system with distribution box

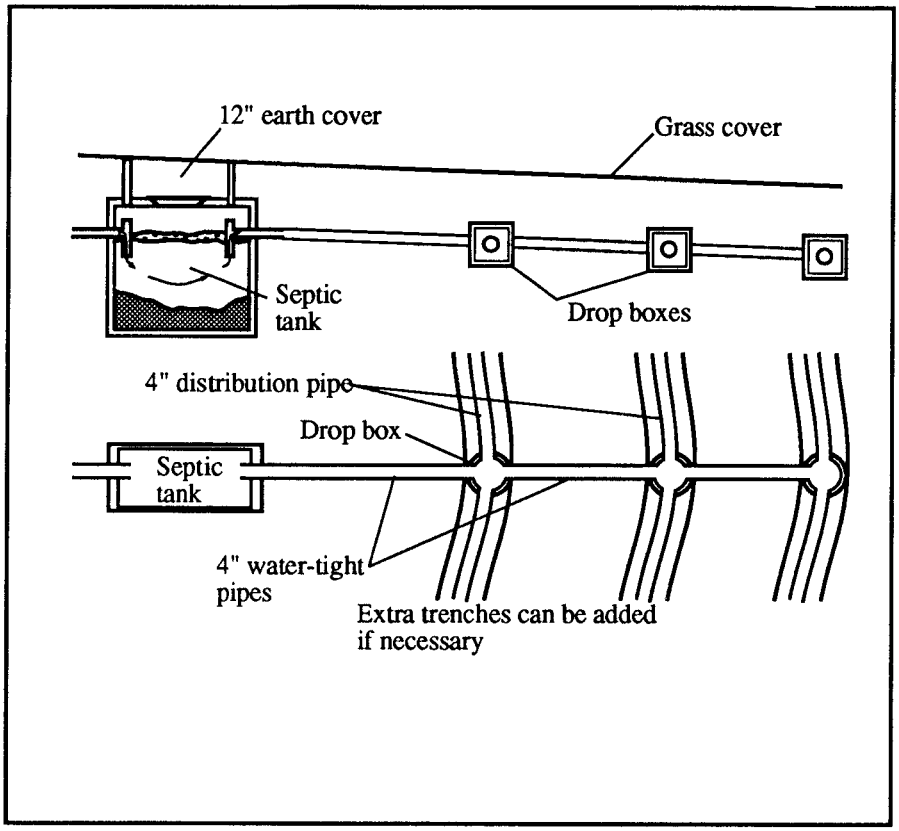

Figure 7. Sewage treatment system with drop boxes

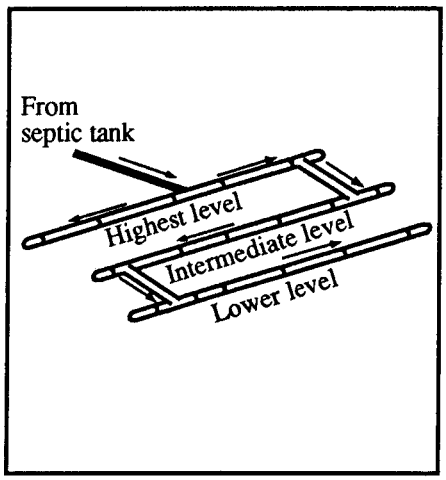

Figure 8. Serial distribution does not require a distribution box and can be used on sloping land. The individual drainfield lines are on the contour. The first trench receives effluent from the tank and when full overflows through the relief line to the next trench.

Conclusions

Properly designed and installed septic tanks can function for many years. Annual inspection to determine sludge depth is desirable to prevent tank solids from overflowing and sealing the soil in the drainfield. Minimize the amount of grease from the kitchen and garbage disposal solids going into septic tank. Water conservation reduces the loading and saturation of the drainfield.

Check with your local health department for specific requirements in your county before purchasing lots or beginning construction. Septic tanks serving a central system to serve commercial or industrial facilities, institutions, travel trailer and mobile home parks, subdivisions or multiple family dwellings of five or more family units require a design by a professional engineer.

To protect groundwater, many areas increase lot size requirements to reduce septic tank densities. Septic tank permits may be subject to additional restrictions in groundwater recharge areas.

Contact your local health department or county Extension office for additional information on septic tank maintenance.

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