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Septic Systems for Homeowners

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SEPTIC SYSTEMS FOR HOMEOWNERS

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Purpose of the Septic System

Septic systems are an effective, long-standing method for collecting, treating, and disposing of wastewaters from rural and surburban homes that do not have access to municipal sewage treatment plants. They collect and treat wastewaters produced in the bathroom, kitchen, and laundry of a home before discharging them into the soil. These systems are used by homeowners in every county in Kentucky.

Soil Suitability for Septic Systems

The most ideal soil areas for septic systems are those that are gently sloping, thick, and permeable with water tables located deep in the profile. Soil color should be a uniform reddish-brown, reddish, yellow-brown, or yellowish and should not have gray spots within three feet of the surface. The gray colors often indicate drainage problems. The soil texture should be neither too sandy nor too clayey, and should have good structure as evident by the presence of good aggregation. Avoid areas that have rock within three feet of the surface, sticky clays, or layers (such as fragipans) that support shallow water tables and restrict downward water movement.

State law requires that county health departments visit each homeowner site to assess the soil characteristics. A water percolation test is no longer used to determine septic system suitability. They will determine suitability of a proposed site based on the soil characteristics and recommend the components needed to provide adequate treatment of homeowner wastewater.

Site Suitability and Size of System

Unlike municipal treatment systems which discharge into streams, septic systems depend on several components and soil to treat the wastewater. A septic system should be located on soils that will adequately absorb and treat the effluent. When a septic system drainfield is installed in soil that cannot adequately handle the effluent, wastewater will seep onto the soil surface. This results in unpleasant odors, potential health problems, and potential surface water contamination. When the soil will not adequately treat effluent, there may be contamination of the underlying groundwater. Greatly reduced soil absorption has resulted in toilet and sink backup in the home. Additional guidelines for siting septic systems relative to risk of groundwater contamination can be obtained from a KY-A-Syst publication, Household Wastewater Treatment (IP-44).

More than 300 soil types in Kentucky are reported by the NRCS (formerly SCS) in county soil maps. However, these maps do not indicate soil type for areas less than four acres. Therefore, prospective homeowners need a soils evaluation by the local health department officials before purchasing land or locating a home. The homeowner should obtain a complete list of all components needed for a prospective site. This is particularly important when additional components are needed beyond a conventional system due to less than ideal soils, steep slopes, or presence of a significant wooded area. This list is used to contact prospective installers for obtaining cost estimates.

Usually the system will fit within the back or side yard of a typical home site. When such components as constructed wetlands, pump chambers, modified mounds, or leaching chambers are required, they should be planned for in the area required. However, the soils makeup of some sites due to grading and leveling by the developer leaves no alternative but to locate a system in the front yard. This should be known by the homeowner before purchasing a site or beginning home construction.

Drainfield size increases with the number of bedrooms in the house and when soil is higher in clay content (more slowly permeable), more shallow to bedrock, or has an underlying shallow water table (fragipan or clay pan). Adequate land area must be available to isolate the entire system from any nearby wells (300 feet), springs, streams, or other water bodies. There should be enough land area to install a replacement drainfield in case it is needed in the future.

Components of a Septic System

Many kinds of septic systems are used in Kentucky. The minimum components and size needed for each homeowner's system is largely determined by the local health department. The health department bases component choices on the capacity of the available soil around the home to absorb and purify the wastewater that passes through primary treatment. Components that may be included are: septic tank, constructed wetland, drainfield, pump chamber, modified mound,

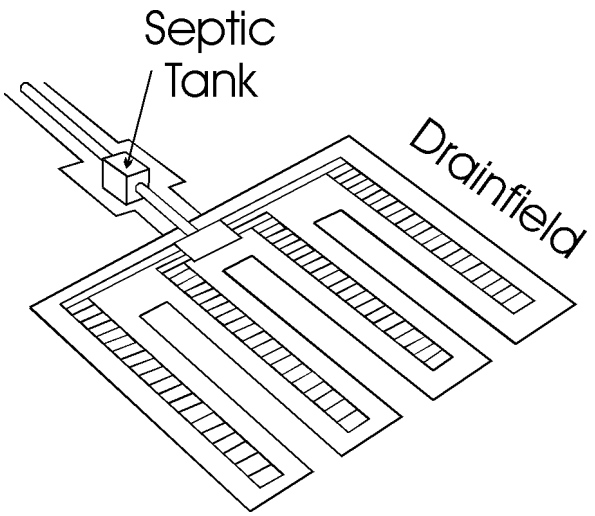

Figure 1. Conventional system

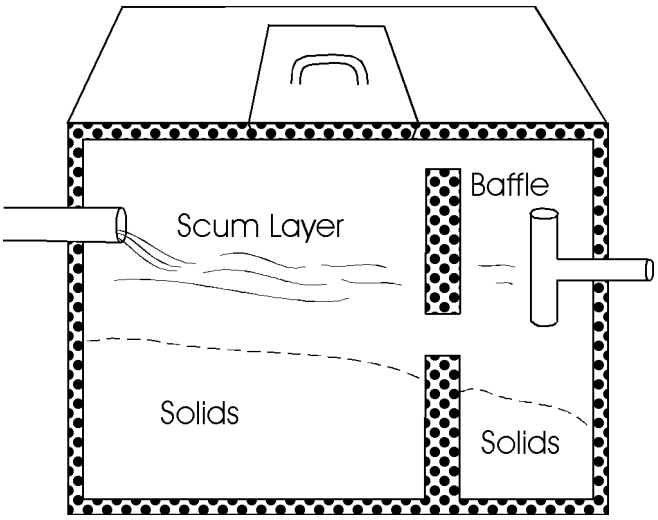

Figure 2. Septic Tank

leaching chamber, pressure manifold, open collection pond, or open ditch drainfield. What is referred to as the more conventional system (Figure 1) consists of a septic tank and a drainfield. Other components will be designed into the system when the soil around the home site is not suited for adequate treatment by a conventional system.

A. Septic Tank — (Figure 2) a watertight concrete box buried just outside the home which collects wastewater from the home. It is typically designed with a 1,000-gallon capacity although the size is determined by the local health department which bases capacity on the number of bedrooms in the home. The septic tank is the primary treatment component of a septic system: it retains solids, reduces organic wastes and pathogens, and releases effluent to the next component.

B. Drainfield — consists of a distribution box and usually two to six trenches excavated into the soil. In most systems, the trenches are 2 feet wide, 3 to 4 feet deep, and 8 to 10 feet apart. Each trench has a 4-inch perforated distribution pipe placed near the bottom with a 1-foot layer of washed gravel or crushed rock placed over the pipe and covered with soil to the top of the trench. The drainfield delivers wastewater to the soil for final treatment and purification in which pathogens and pollutants are removed before they reach the groundwater.

C. Constructed Wetlands — consist of a shallow trench (6 to 12 feet wide by 30 to 80 feet long) that has 12 to 14 inches of washed gravel or crushed rock containing aquatic plants (Figure 3). Wastewater flows through voids in the rock with the water surface 1 to 2 inches below the rock surface (subsurface flow). As wastewater flows through this component, suspended solids and some elements settle to the bottom, other nutrient elements are absorbed by the plants, and much of the nitrogen is converted to nitrate and then converted to nitrogen gas. Microbes in the water use oxygen from the air or plant roots to convert the nitrogen, destroy the pathogens, and decompose organic pollutants to carbon dioxide gas which is released to the atmosphere. This component is used when soil depth or soil water movement is a restricting factor with a more conventional system, and where additional treatment beyond the septic tank is needed to reduce pollutants going to the drainfield. When site features prevent gravity flow from the septic tank, a pump chamber must be added to deliver wastewater to this component.

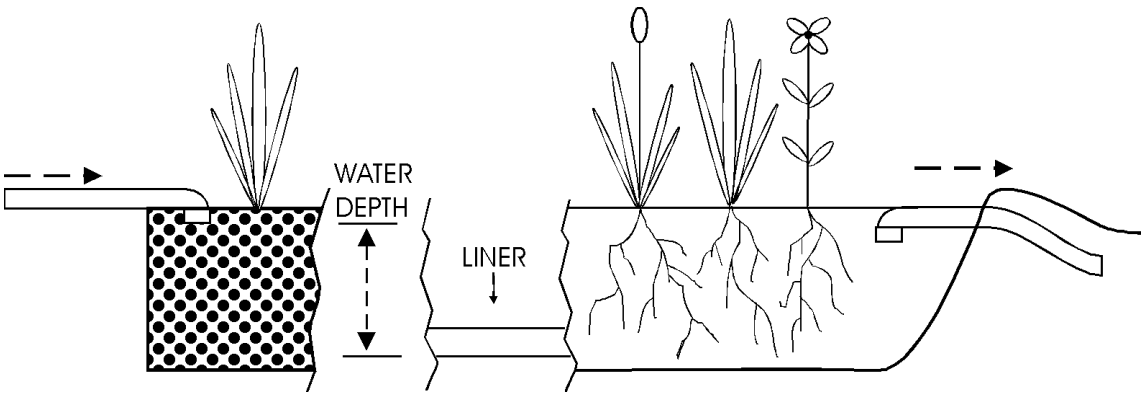

Figure 3. Constructed wetland

D. Pump Chamber — consists of a second septic tank with a large top opening equipped with an electric powered pump which periodically delivers wastewater to other components (constructed wetland, modified mound, or pressure manifold) to maintain more consistent treatment. This component receives wastewater by gravity from the septic tank. Controls consist of both a timer and a float for low liquid cutoff. This component increases system cost due to special electrical needs, the pump, and its controls. It is most commonly used with the constructed wetlands or modified mound treatment components.

E. Modified Mound — an above-grade soil treatment and absorption component which relies either on a mound of sand and/or the underlying soil to treat and purify septic wastewater. This may be used where soil depth poses a severe limitation to conventional systems. It requires an experienced soil evaluator, designer, and installer to successfully implement its use. The sand mound is a long, narrow bed in which the soil surface is disturbed, 12 to 24 inches of sand are placed over the disturbed soil, then a perforated pipe surrounded with rock is laid over the sand, and covered by another 1 foot of sand and 8 inches of topsoil. The perforated pipe receives wastewater from a pump chamber. This component performs very well on natural soil sites with limitations and should not be used on filled sites due to the soil textural variability.

A variation of this component (leaching chamber) is to disturb the soil, place two or three perforated plastic pipes on the disturbed soil, cover each pipe with a plastic half-circle leaching chamber (1-foot-high by 24-inch-wide domes), and then cover the chambers with topsoil at least 1 foot above the chamber center and 2 feet beyond the edge of the domes. All topsoil should be removed from the entire area, not just below each leaching chamber and mixed with the topsoil to be placed over all domes to create a mound.

F. Pressure Manifold — consists of a solid plastic pipe at least 6 inches in diameter contained within a small concrete box that has solid, 3-inch plastic pipes connected between it and the perforated drain lines. It replaces the distribution box and receives periodic doses of effluent from the pump tank. These must be installed level and are used where many drainfield lines are present in systems serving a high volume water user. Dosing the drainfield periodically and uniformly improves performance and increases longevity. These are commonly used as part of a low-pressure pipe system.

G. Open Collection Pond — a small pond that collects wastewater from the septic tank for evaporation and storage prior to irrigation on a dedicated land area. It may be used when the water table is close to the soil surface or the soil has a severe wetness problem. Adequate fencing is needed, odor can be a problem, and the vegetation on the land area needs to be removed regularly.

H. Open Ditch Drainfield — it has two to four perforated field lines installed in trenches 2 feet wide and 2 to 3 feet deep filled with crushed rock without a topsoil cover on steep sloping land. The drain lines are installed at-grade perpendicular to the land slope with a grass covered spacing of 10 to 12 feet between lines. Septic tank effluent flows by gravity through a distribution box with valve controls and will rise in the trench and flow over the grass strip for final treatment and absorption. The control valves are needed to control access to each line separately for longer site life.

Function of the Septic Tank

As wastewater enters the tank, solids settle to the bottom forming a sludge layer, and the greases, fats, and oils float to the top forming a scum layer. Baffles prevent solids from leaving until some decomposition and waste reduction has occurred. Microbes in this oxygen-devoid system decompose organic components of the liquid and sludge and reduce pathogens. As effluent leaves the tank, the solids are reduced both in concentration and particle size.

Importance of the Drainfield

The major function is to provide the most significant portion of treatment by delivering wastewater for final treatment. The wastewater flows (or is pumped) through some type of control box from a septic tank or other component into the drain pipes. The liquid trickles through the rock, sand, or soil where pathogens are filtered out and destroyed by the "microbial mat" surrounding the pipes. This "microbial mat" converts organic materials into carbon dioxide gas and the ammonium nitrogen into nitrate nitrogen (nitrification) and consumes pathogens. A major concern in siting is to evaluate the soil's capacity to adequately perform this final treatment.

When additional treatment components are used, the "microbial mat" around the drain lines is less dense due to additional removal of pollutants from the septic tank effluent. This promotes greater lateral movement of the wastewater. When soils with some limitations are encountered, combining a septic tank and constructed wetland reduces the probability of drainfield failure.

Summary

The septic system is an efficient and convenient method for treating and disposing of homeowner wastewater. Several components may be used in designing an adequate system. The soil's capacity to absorb and treat the wastewater after primary treatment is an important part of site suitability and system function. The size of any system is dependent on the number of bedrooms in the house and soil characteristics. Local health department officials must visit the prospective site to evaluate the soils and determine the components, location, and size of the system needed.

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