ONLOT SEWAGE SYSTEMS

Homeowners Can Choose from TRIED and TRUE Technologies or ALTERNATIVE Options for Wastewater

BY **BRENDA WILT** / ASSISTANT EDITOR

The options for onlot sewage disposal systems keep increasing by the minute, it seems. From the old standbys of septic tanks and seepage beds to newfangled drip irrigation systems, the choices can be overwhelming. Read on for an overview of some of the most commonly used conventional and alternative onlot systems in Pennsylvania.

Ages ago, especially in rural Pennsylvania, household wastewater disposal was as simple as throwing wash water out the back door and digging a hole in the ground and covering it with a privy to take care of human, well, necessities.

Those days are long gone.

Potential contamination of the commonwealth's waterways, not to mention threats to human health, led to Act 537, the Sewage Facilities Act, in 1966. The law was enacted to address existing sewage disposal problems and prevent future ones by requiring planning for all types of sewage facilities and permitting of onlot sewage disposal systems.

The act also specifies uniform standards for designing onlot systems, which a quarter of all commonwealth residents depend on to treat their sewage, according to the state Department of Environmental Protection (DEP).

However, when it comes to onlot systems in this geologically diverse state, a one-size-fits-all approach does not work. While Chapter 73 of the Pennsylvania Code provides standards for conventional onlot sewage treatment facilities, new technologies are also receiving state approval.

"Alternative systems are often being used to repair malfunctioning conventional systems," John Diehl, chief of DEP's Act 537 Section, says. "They are especially useful in areas where conditions are more marginal and the soil is shallow."

To help township officials make sense of all the systems available, the *News* takes a look at conventional onlot disposal systems and the most commonly used alternative systems in Pennsylvania. Descriptions of the various systems are based on information from Penn State Extension.

Treating wastewater in tanks

Conventional onlot disposal systems generally consist of a treatment tank and a soil absorption area. The treatment tank removes solids from the wastewater, which is then moved to the absorption area to filter down through the soil. The systems differ in the type of absorption area and how the wastewater gets to it, which depend on the soil and site conditions.

Most onlot treatment is through **septic tanks,** which are watertight compartments made of concrete, fiberglass, or plastic. In Pennsylvania, new systems must have a two-chamber tank or two tanks connected in a series. A home with up to three bedrooms requires a tank that holds at least 900 gallons. For each additional bedroom, the tank must be larger.

Wastewater from toilets, showers, tubs, sinks, washing machines, dishwashers, water softeners, and garbage disposals is detained in the first chamber or tank for a day or two. Solids settle to the bottom as sludge, and lighter particles, such as oils, grease, fats, and paper, float to the surface as a scum layer. The partially treated water flows from the first chamber or tank to the second chamber, where the processes continue.

Next, the wastewater, now called effluent, leaves the tank and moves to the absorption area through gravity or a pump system. Baffles at both the inlet and outlet of the tank prevent the scum layer and suspended particles from flowing with the wastewater to the absorption area.

Tried and true systems remain popular

In most conventional onlot systems, the soil absorption area is a below-ground system, either a **seepage bed** or a **network of trenches.** Both types consist of perforated pipes on top of a

Most onlot sewage disposal systems in Pennsylvania have a septic tank that receives wastewater from toilets, showers, bathtubs, sinks, dishwashers, and washing machines. *(Photo courtesy of DEP.)*

"Alternative systems are typically used in areas where the **limiting zone is too close to the surface."**

layer of crushed stone. In a seepage bed, the entire absorption area is excavated and lined with stone, while a trench system, as the name implies, is a series of trenches that are lined with stone.

The rectangular geometry of seepage beds is more compact than a network of trenches. Consequently, they usually cost less to build. Seepage beds may be used on sites with slopes up to 8 percent, while trench systems are most often used in areas with steeper slopes.

If the onlot system depends on gravity to move the effluent from the tank to the absorption field, there must be at least 48 inches of suitable soil under the absorption area. The soil must have a percolation rate, or the rate at which it absorbs water, between 6 and 60 minutes per inch.

The lower limit of the suitable soil is called the limiting zone, which is any layer that prevents proper absorption and treatment of wastewater. Examples include bedrock, a layer of impervious soil, a seasonal or year-round high water table, or a fractured rock layer.

On sites where the absorption area is uphill from the treatment tank, the effluent must be distributed under pressure. In pressure distribution, or pressure dosing, systems, the effluent flows into a pump or dose tank that contains a float-switch-controlled pump. When the tank fills to a set level, the effluent is pumped out of the tank into the distribution pipes in the absorption field.

These types of absorption fields may be used in soil with less-than-ideal permeability if a **subsurface sand filter** is added. This is a layer of sand over the entire excavated area below the crushed stone and pipe. The sand must be at least 12 inches deep. These systems always require pressure-dosed distribution of the effluent.

Treating wastewater in shallow soils

Some sites do not have enough soil above the limiting layer for traditional seepage beds or trench systems to work. In these cases, a few other conventional systems may be used.

Aerobic treatment units, or ATUs, can take the place of traditional septic tanks in areas with shallow soils and allow for a smaller soil absorption field. ATUs are multichamber tanks or a series of tanks that pretreat the wastewater before it goes to the absorption field.

The first chamber or tank acts like a septic tank, allowing solids to settle to the bottom. The effluent then flows to an aeration chamber or tank, where air is pumped into the water to digest, or stabilize, the biological waste. By periodically stopping the aeration process, much of the nitrogen in the wastewater can be released as a gas.

Finally, the aerated effluent moves to the clarifier, where more solids settle to the bottom. The treated water is then pumped out of the tank to the absorption field.

On sites without 48 inches of suitable soil between the bottom of a traditional absorption area and the limiting zone, homeowners may choose to install an above-ground system, such as an **elevated sand mound,** for the absorption field. This is a mound of sandy fill material placed on top of the natural soil. These systems are limited to sites with a maximum of 15 percent slopes and percolation rates between 3 and 180 minutes per inch.

Because the onlot system's distribution pipes are placed atop the sand mound, they are usually higher than the outlet of the septic tank. The effluent must be pumped from the tank to

the sand mound using a dose tank as described above.

Most systems transfer effluent several times a day, depending on the volume of wastewater from the home. The periodic applications of effluent to the sand mound allow the mound to "rest" between dosings. This draws air into the mound, which aerobically treats the wastewater.

Spraying wastewater away

One other conventional treatment system is designed for sites with restrictive soil conditions: the **individual residential spray irrigation system,** or IRSIS. There is a tradeoff for being able to dispose of wastewater on marginal soils, though. For IRSIS to be used, at least 10,000 square feet of land is needed for the system. The maximum slope allowed for the spray field is 4 percent on nonfood-producing agricultural areas, 12 percent on open grassy areas, and 25 percent on closed-canopy forested areas.

IRSIS consists of six components: a treatment tank, a dose tank, a secondary filtration unit, such as a sand filter, a chlorine contact unit, a storage tank, and a spray field.

Wastewater leaves the home and flows to the treatment tank, usually a septic tank, where the usual settling of solids and flotation of lighter particles takes place. The effluent flows to a secondary filtration unit, where the water is treated aerobically and the remaining solids settle to the bottom. If the filtration unit is uphill from the treatment tank, a dose tank must pump the effluent to the unit.

DEP permits two types of conventional filtration units: the **free-access sand filter** and the **buried sand filter.** The first is a tank with splash plates that distribute the effluent over the surface of a 39-inch layer of sand. The effluent seeps down through the sand, then 12 inches of pea gravel, and finally into a three-quarter-inch layer of clean gravel.

The buried sand filter is a lined, confined volume of sand that is sandwiched between layers of aggregate. The effluent is piped into the top layer of stone, filters down through the sand, and collects in the bottom layer of stone before being piped to the next tank.

Conventional onlot sewage system components may include, clockwise from top left, a two-series septic tank, a trench absorption field, or a filtration unit and dose tank. ***(Photos courtesy of DEP.)***

The **peat biofilter** has been approved as an alternative filtration unit to the sand filters. It is essentially a large tub filled with peat, which is a soil-like material composed of partially decomposed plant matter. The effluent percolates down through the peat and collects at the bottom for discharging to the next stage.

After pretreatment in the filtration unit, the effluent flows to the chlorination unit, where chlorine is added to the wastewater to kill harmful bacteria. From there, the chlorinated water goes into a large tank that stores it until it can be pumped to the spray field.

The spray system uses irrigation sprinklers to spray the treated effluent over the soil surface and native vegetation. The size of the spray field depends on the depth to the bedrock and water table, the slope, and the number of bedrooms in the home.

While IRSIS can be a good alternative in areas that will not support traditional septic tank and absorption field systems, it is an expensive one. There are many components, and most require periodic maintenance. In rainy weather, the homeowner must decide whether to apply the treated wastewater to the land. In short, these systems can-

"The shallower the soil, **the cleaner the effluent** needs to be."

not be installed and ignored for several years until the septic tank needs to be pumped, as is the case with traditional systems.

Finding alternative solutions

In addition to these conventional onlot sewage disposal systems, new technology offers more treatment options for homeowners. DEP has authorized the use of so-called alternate systems that have been proven to work but are not specified in the Chapter 73 regulations.

Chapter 73 does allow for alternative onlot systems to:

- solve an existing pollution or public health problem;
- overcome specific site suitability deficiencies or substitute for conventional systems on suitable lots;
- overcome specific engineering problems related to the site or its proposed use; or
- use under varying site conditions an experimental design that DEP has deemed successful.

"Alternative systems are typically used in areas where the limiting zone is too close to the surface," DEP's John Diehl says. "You can have as little as 10 inches of soil and can divert piping around trees, rocks, and other obstacles as long as the piping is level."

Diehl says that the alternative systems often include advanced treatment or secondary treatment units due to their use in marginal soils.

"The shallower the soil, the cleaner the effluent needs to be," he says.

These systems tend to be more expensive than traditional onlot facilities, Diehl says, and often require installation by the manufacturer, rather than a septic service company.

One alternative system that is similar to IRSIS is the **drip irrigation onlot disposal system.** This alternative technology is designed for sites where the limiting zone is within 20 to 26 inches of the soil surface or deeper.

In this system, wastewater flows from the home to a septic tank, where solids settle to the bottom and lighter particles float on the water surface. From here, the effluent moves to a hydraulic unit pump tank. The water passes through a disk filter to remove any remaining particles that may clog the irrigation emitters, and a hydraulic unit pumps the filtered effluent to the drip irrigation system, alternating between two zones. ➤

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Some onlot disposal systems require effluent to pass through a filtration unit before it is dispersed to the absorption field. One option is a peat biofilter, which uses partially decomposed plant material to remove contaminants from the wastewater. ***(Photo courtesy of DEP.)***

Each drip irrigation zone consists of a supply pipe that carries the wastewater to the drip irrigation lateral, as well as a return pipe that collects and returns undischarged effluent to the hydraulic unit so it can be transferred back to the septic tank. Connecting the supply pipe and return pipe are small-diameter drip irrigation laterals that contain emitters that meter the effluent slowly into the soil.

The drip tubing must be installed so that there is always at least 18 inches between it and the limiting zone. It may be placed as deep as 12 inches but is usually installed about 6 inches deep.

This system can be a more aesthetically pleasing alternative to an elevated sand mound because the irrigation system is below the surface. However, it requires a large dose tank after the septic tank, as well as a hydraulic unit. The system also requires regular maintenance.

A **drip irrigation micromound system** may be used on sites where the soil depth to the limiting zone is less than 20 inches. Its operation is basically the same as the drip irrigation system except the laterals are installed in a sand mound. This system is lower and less obtrusive than the conventional elevated sand mound, however, as the micromound has a maximum height of about 26 inches.

DEP has also approved **at-grade and shallow at-grade onlot disposal systems** as alternative options. The at-grade system is appropriate for sites with restrictive soil conditions and limiting zones that are less than 48 inches below the surface.

Like many of the other systems described, the at-grade and shallow-grade systems treat wastewater with a septic tank or aerobic treatment tank, a filtration or advanced treatment unit, and a dose tank to pump the effluent to the absorption field.

On sites where the limiting zone is more than 20 inches below the surface, an at-grade system is used, in which two distribution pipes are installed in a bed of aggregate on the soil surface and covered with topsoil. If the limiting zone is less than 20 inches below the surface, a shallow at-grade system is used, in which a single distribution pipe is installed in a trench-type absorption area. It works much like the at-grade system, but only one pipe is used and the resulting elevated area is smaller.

These systems have a lower profile than the elevated sand mound and are an attractive alternative for sites that have a limiting zone that is closer to the surface. The downside is that they usually require a filtration or advanced treatment unit after the septic tank and need regular maintenance.

DEP has also approved other onlot disposal systems for use by homeowners. A complete list may be found at **www.dep.state.pa.us,** keyword "Act 537." Choose the link for "Act 537 Sewage Facilities Program" and then click on "Onlot Disposal System" in the right column. Finally, click on "Onlot Alternate Technology Listings" in the middle of the page.

One thing to remember is that whether conventional or alternative onlot systems are used, the designs must be reviewed and permitted by municipal sewage enforcement officers. Consequently, SEOs must be familiar with the technology.

"Some of the systems are relatively simple, with no moving parts," DEP's John Diehl says. "Others are fairly complicated, so they require training, which is typically offered by the manufacturer."

If a homeowner wants to use a system that the SEO isn't knowledgeable about, the regional DEP office can walk the SEO through the proposal so that the design can be permitted. *(See Page 21 for a list of regional offices.)*

As DEP continues its push to keep Pennsylvania's waterways clean and pollution-free, it will continue to evaluate alternative technologies, Diehl says, to ensure that homeowners can rely on functioning systems no matter what the characteristics of their property. ✦