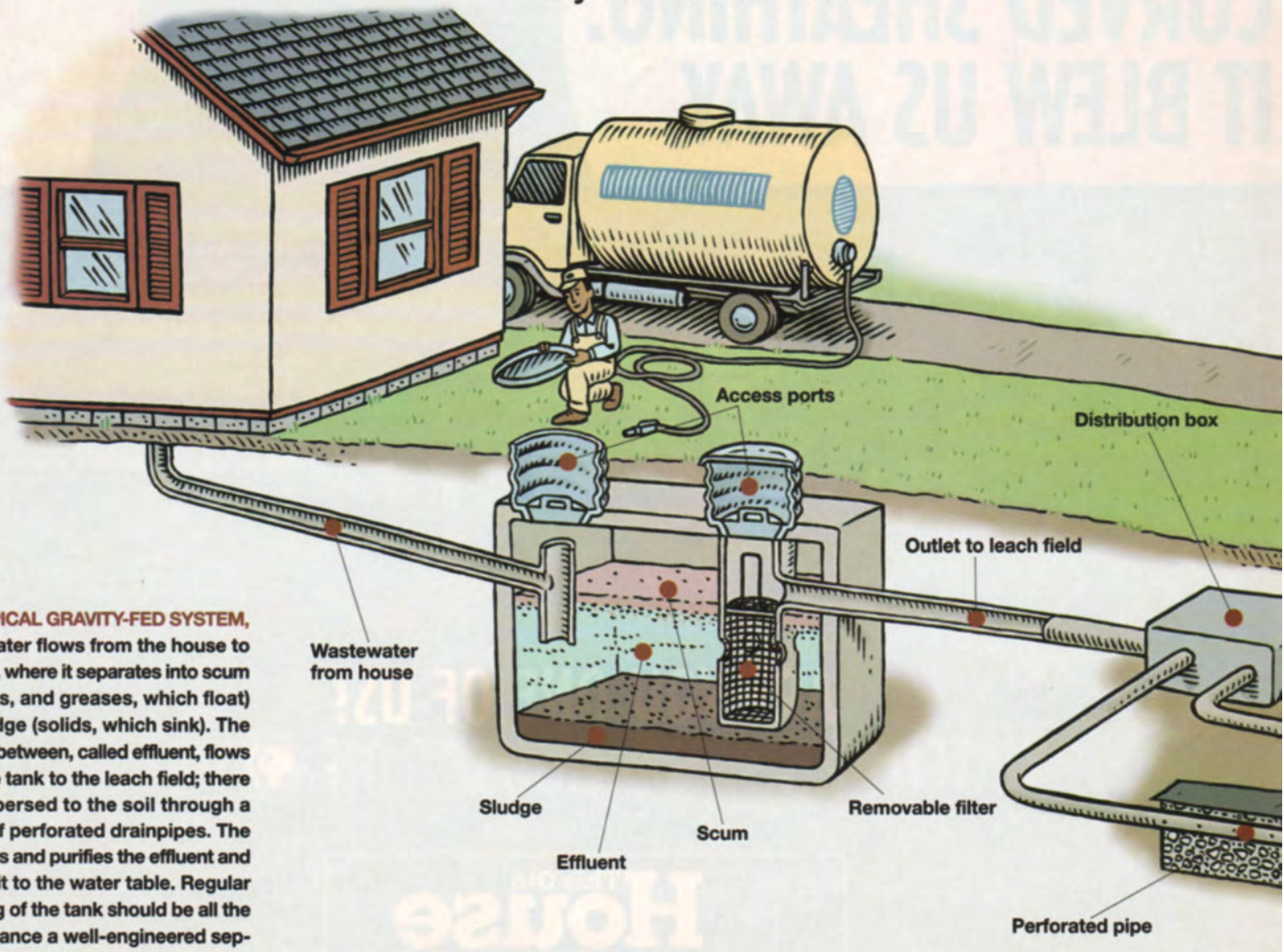
What you need to know about household waste systems

septic HAPPENS

By Max Alexander



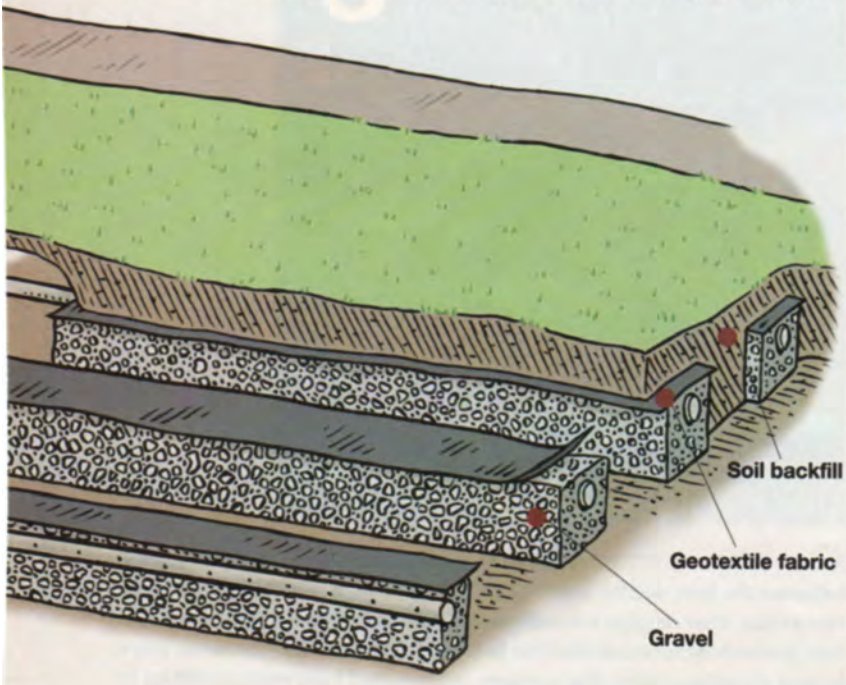
IN A TYPICAL GRAVITY-FED SYSTEM, wastewater flows from the house to the tank, where it separates into scum (oils, fats, and greases, which float) and sludge (solids, which sink). The liquid in between, called effluent, flows from the tank to the leach field; there it is dispersed to the soil through a series of perforated drainpipes. The soil filters and purifies the effluent and returns it to the water table. Regular pumping of the tank should be all the maintenance a well-engineered septic system ever needs.

Like most septic-system owners, I didn't pay much attention to what was going on under my croquet field—until the day last spring when black gunk started oozing up from the lawn. Since there are no crude-oil deposits in this corner of Maine, I assumed the worst and immediately called a septic-maintenance company. Sure enough, the decades-old system that came along with my 1850 farmhouse had failed and had to be replaced. But first, I needed a ground-up—or, more precisely, ground-down—education in the ways of waste management.

A conventional septic system has two basic components, both underground: the tank and the leach field. Raw waste is delivered to the tank through a pipe connected to the house's drain system. Inside the tank (which is typically made of concrete but can also be fiberglass or plastic), the solids sink to the bottom, while oils, fats, and greases float to the top. In between the base layer of solid sludge and the top layer of greasy scum is watery effluent, the stuff that flows out to the leach field, where it is dispersed into the soil through a series of perforated drainage pipes. The soil purifies the effluent by filtration and natural biological activity, and returns it to groundwater.

A septic tank is set in place at a new house in Schwenksville, Pennsylvania. The 1,500-gallon tank serves a four-bedroom house and will need pumping every two to three years.

PHOTO: PASCAL BLANCON. ILLUSTRATION: GREGORY NEMEC



It's a brilliant system—even elegant, if that word can be applied to sewage—in which nature and gravity do all the work.

As I discovered the hard way, leach fields don't last forever. Over time they can become saturated with waste matter, preventing adequate dispersion of liquids. When that happens, waste backs up onto the lawn or, worse still, into the house's drains. A chief cause of saturation is failure to remove grease and solids from the tank every few years—a readily available service that typically costs less than $200. In fact, experts say, tank-pumping is the only maintenance chore most septic systems need. (Additives that supposedly promote good bacteria are unnecessary and possibly harmful.) If left to accumulate in the tank, sludge and scum eventually migrate out to the leach field along with the effluent, wrecking the whole operation.

But not all septic backups are necessarily cause for panic. The trouble could be something relatively minor, like a broken tightline—the pipe between the tank and leach field—or a pipe clogged with tree roots. And not every leach-field problem requires total replacement. Sometimes partial failures can be fixed by snaking out the perforated pipes, adding drainage ditches to aid rainwater runoff, or aerating compacted soil to provide a friendlier environment for cleansing microorganisms. But if a professional can't diagnose the problem and correct it with a few simple solutions, it may be time for a new system.

SEPTIC-SYSTEM DESIGN

The basic concept behind a septic system is simple, but it takes careful planning to design a setup that will safely meet a household's needs for years to come. Most states require that new or replacement systems be designed by licensed professionals; they may be independent engineers or contractors also certified to install the equipment.

The first step is figuring out the best place to site the components. To avoid contamination of water sources, leach fields must be set back from wells (usually a minimum of 100 feet). No part of a septic system can be beneath a building—if you're planning any additions to your home, be sure to discuss them with the designer—and neither the tank nor the leach field should be under a driveway or parking area. (Pipes rated for vehicular loads can run under driveways.) Leach fields should also be clear of trees, to avoid future damage from roots. In ideal circumstances, the field will be below the level of the tank for a gravity feed, but more com-

monly the effluent is pumped out to the field in metered doses. "That assures that the effluent is distributed over the entire absorption area, instead of just trickling into one corner or at one end," says Dave Knoble, a soil scientist with Piedmont Environmental Group, in Lederach, Pennsylvania.

SOIL TESTING

Once you've settled on a site, the next step is to analyze the soil conditions. How well the effluent drains, or percolates, through the soil affects the size of the leach field. Another key soil consideration is what's known as the limiting factor. In many parts of the country, the limiting factor is seasonal high water—the level of natural groundwater at its highest, typically in the spring. Because septic effluent cannot drain directly into the water table, the level of seasonal high water represents the limit of a system's depth. (In dry areas, the limiting factor could be bedrock.) Most states now set a minimum distance above the limiting factor that leach fields can be installed. That's a problem if your limiting factor is within 2 feet or so of the surface: After allowing for the minimum distance requirement, you may only have a few inches in which to lay the leach field—not enough for the necessary gravel bed, pipes, and topsoil backfill. It's a common occurrence, and the usual solution is to build the leach field up above ground level, under a grassy mound. (Mound systems are also used where a "perc test" or other soil analysis shows that the soil doesn't percolate well enough to allow for an exclusively below-ground installation.)

The final step is calculating the capacity of the system. Typically, designers look at the number of bedrooms, which is a more reliable indicator of potential occupancy than, say, the number of bathrooms. The bigger the house, the bigger the tank and the larger the leach field. Throw in a garbage disposal, which adds more organic solids to the tank, and the requirements increase even more. When the design is finished, you might be shocked by the massive scale of the system—especially if it includes a mound the size of a swimming pool in your backyard.

In addition to being twice the cost of a standard system, those septic mounds can be a landscape nightmare on small suburban lots. To construct one, the site must be built up with sand to the minimum depth required by code, then covered with a layer of gravel to make a bed for the pipes. By the time the whole mound is covered with topsoil, the height can reach 6 feet or more. Fortunately, engineers have come up with a variety of innovative ways to make mound systems a choice of last resort. All basically involve treating effluent before it reaches the leach field, to reduce or even eliminate pathogens. The resulting liquid is clean enough to be spread on thin soil or even bare rock.

Reducing mounds is just one benefit: Pretreatment also makes it possible to build homes in places where conventional systems would never fly. *This Old House* host Steve Thomas, for example, is hoping to install such a system—a two-tank German model that uses special bacteria and a series of microfiltration membranes to do the cleaning—at his vacation home in Maine. The treatment tanks can be installed aboveground, a boon because there is hardly any topsoil on Steve's rocky

DIARY OF A SEPTIC SYSTEM INSTALLATION

Once black ooze appeared in my backyard, it didn't take long for an expert to determine that my system needed replacing. The first step was to decide where to put the components. And so, on a warm day in June, site evaluator David Studer arrived at my house, carrying his most important tool: a 16-inch spade. "The soil is where it all happens," he said, plunging the shovel into the spot where we hoped to put the new leach field. "That's where the good bugs eat the bad bugs." The good bugs are aerobic, meaning they require oxygen. The bad bugs are generally anaerobic, thriving in places without much air (like your gut) and causing disease. Soil purifies effluent by exposing the anaerobic microbes to a hostile environment, where they are consumed by aerobic microbes (and larger creatures like worms), killed by exposure to air, or trapped (the process of filtration).

Once he determined that the soil drained well, Studer's next step was to calculate the size of the system. For five bedrooms, I needed a 1,250-gallon tank and a field of about 1,500 square feet. Studer suggested a proprietary plastic pipe to cut the size of the leach field in half, to a manageable 20 by 40 feet. The pipe, roughly 12 inches in diameter, is corrugated to increase surface area; with more perforations contacting the soil, less length is required.

I paid Studer his $200 fee, plus another $100 to the state for a permit, and sent the plan to four local septic contractors. Knowing that any installer would have to follow Studer's specs and submit to inspection, I took the low bid of $5,547. Here's what happened next.

A GRAVITY-FED SYSTEM requires that the site have the necessary pitch between the tank and the leach field—in this case, a ⅛-inch drop for every foot of run. After digging a trench for the pipe that connects the tank to the field, the contractor excavated the field itself. Because the high-water mark is only 18 inches below the surface, the finished field will be built up to the code-required minimum depth of 2 feet, under a grassy mound.

A FEW WEEKS LATER, the excavation contractor got to work. In a matter of minutes, he dug a room-size hole for the new septic tank. INSET: As the first step in any septic system design, the soil at the proposed site must be evaluated. Here, a soil scientist analyzes a test pit. By observing the various layers and matching the dirt to a color-coded key, he is able to determine the type of soil, how well it drains, and the location of the seasonal high-water mark, which establishes the limit of a leach field's depth.

A CRANE OPERATOR lowered in the 3-ton concrete septic tank. After it was set in place and leveled, it was connected to the house with a line of solid sewer pipe. The tank holds 1,250 gallons, enough to support this five-bedroom Maine farmhouse.

WORKERS LAID OUT and leveled the eight rows of perforated drainpipe. Effluent flows to the leach field through a distribution box that sends the liquid evenly to all pipes, so that none is overloaded. The pipes are wrapped in a geotextile fabric, which keeps out fine sand and aids in the filtration of wastewater.

THE NEXT DAY, the contractor backfilled clean sand over the pipes and replaced the topsoil. As a finishing touch, the leach field was seeded with grass and mulched with a layer of hay. With proper care, the system should last 40 to 50 years.

island. To add a conventional tank and leach field, he would have to haul in hundreds of cubic yards of sand and gravel and build a giant septic mound on the rugged land. "On an island, all that fill has to come by barge," he says. "It would be a gigantic construction project."

NEW TECHNOLOGIES, MORE-EFFICIENT SYSTEMS

While high-tech systems like Steve's are common in Europe, they are only beginning to catch on here. Suburban sprawl beyond municipal sewage lines, the trend of larger houses on smaller lots, and increasingly stringent state environmental regulations (there are no federal guidelines for private sewage disposal) have all combined to drive demand for more treatment in less space. American manufacturers have responded with a host of improvements, from more-efficient distribution pipes to aeration systems that hasten decomposition in the tank to microwave bacteria-zappers that kill pathogens before they reach the leach field. Many of these treatment systems function like miniature municipal sewage plants, typically circulating effluent through a filtering agent inside the tank. Like real sewage plants, they come complete with computerized controls and an automatic dial-up to a service technician if any part of the system fails.

The downside is that such bells-and-whistles systems require more vigilance and are more expensive, adding perhaps $10,000 to the cost of a septic installation (a conventional system can run from $5,000 to $20,000 or even higher, depending on type, size, site considerations, and regional costs). Richard Otis, the vice president of applied technologies at Ayres Associates, a Wisconsin engineering consulting firm, says homeowners should consider all the options before investing in a sophisticated waste system. "There are many passive systems that do a better job by simply relying on the soil," he says.

The right type of system, installed and maintained properly, should not fail for decades—if at all. Even so, modern setups are expensive enough that at least one company now insures them.

Septic mounds are required when soil conditions don't allow for a conventional below-ground system. By the time the sand, gravel, and topsoil are added, heights can reach 6 feet.

If you live in one of the five states where it currently writes policies (New York, Pennsylvania, New Jersey, Connecticut, and Maryland), a company called Pro-Sept will insure your new or old system for up to $25,000. A three-year policy costs from $235 to $450, depending on the system's age. The policy requires an initial inspection and regular pumping of the tank—something you should do anyway. "It is really important that people get their tanks pumped out frequently," says *This Old House* master carpenter Norm Abram, who has a gravity-based septic system at his home in Massachusetts. "I try to do mine every two years. It's short money for what you end up getting." After spending $5,500 on a brand-new tank and leach field, I couldn't agree more. ■

CARE AND FEEDING

A little extra attention can prolong the life and health of any septic system. Here are a few guidelines.

- **AVOID ADDITIVES:** "All the microorganisims that you need are right there in human waste," says Jay Hardcastle, site evaluator for Maine's Bureau of Health. Additives that purport to promote bacteria are unnecessary; some can even contaminate the groundwater or clog your leach field.

- **COMMON HOUSEHOLD PRODUCTS CAN BE HARD ON SYSTEMS.** Vegetable oil, for instance, tends to stay suspended in effluent and end up in the leach field, where it can eventually clog the soil. (Animal fat, in contrast, solidifies and floats in the tank.) Today's hand-dishwashing soaps are especially good at "cutting" grease, which is simply the process of suspending the grease molecules in water; eventually that grease recongeals out at the leach field.

- **NEVER FLUSH TRASH** (such as cigarette butts, tampons, or cat litter) that can disrupt digestion in the tank or clog pipes, or chemicals (such as paints, varnishes, and thinners) that could contaminate surface water and groundwater.

- **OTHER SEPTIC-SYSTEM ENEMIES INCLUDE** bleach and antibacterial soaps (they kill good bacteria); hair conditioner (it's made mostly of coconut oil or a man-made equivalent, which can wind up in the leach field); powdered laundry soap (the ingredients include fine particles that can clog leach fields); and fabric softeners (which have a base of gummy cornstarch). "We've become a nation of clean freaks," says Hardcastle, with a sigh.

  Fortunately, you don't have to go back to cooking with lard or washing your clothes over a metal tub. Modern septic systems can be sized to take modern lifestyles into account. "All these things are okay in moderation," Hardcastle says.

WHERE TO FIND IT – SEE DIRECTORY – PAGE 141