Drainfield Rehabilitation

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The septic system, once thought of as a temporary solution for the treatment of domestic wastewater, is still the best choice for homes or residences and small communities where it would be cost-prohibitive to access public sewer systems. In the U.S., these onsite systems collect, treat, and release about four billion gallons of wastewater per day from an estimated 26 million homes.

Current interest in the impact of these systems on groundwater and surface water quality has increased interest in optimizing the systems' performance. It is now accepted that these onsite systems are not just temporary installations that will eventually be replaced by centralized sewers, but are a permanent part of the wastewater infrastructure.

Septic systems are typically simple in design, which makes them generally less expensive to install and maintain. And by using natural processes to treat the wastewater onsite, usually in a homeowner's backyard, septic systems don't require the installation of miles of sewer lines, making them less expensive and less disruptive to the environment. In addition, there are many innovative designs for septic systems that allow them to be placed in areas with shallow soils or other site-related conditions previously considered to be unsuitable for onsite treatment and dispersal.

Although the septic tank settles out most of the heavier solids and breaks down almost half of the suspended solids from household wastewater, the effluent still has a high amount of biodegradable organic materials, along with a high bacterial content that may include pathogens. Therefore, septic tank effluent is not suitable for direct discharge into surface waters or onto land surfaces. Further treatment is needed to remove these harmful pathogens. The most common way to do this and dispose of the partially treated wastewater is through subsurface soil absorption through the drainfield.

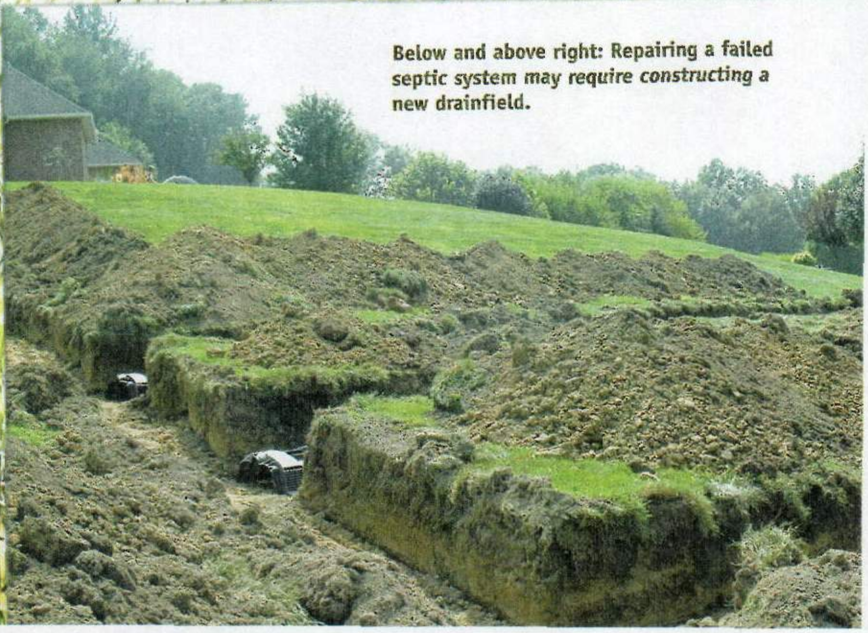
Septic systems were never intended for lifetime use without maintenance. Neglecting maintenance of system components only leads to failures. When properly designed, installed, and maintained, septic systems have a minimum life expectancy of 20 to 30 years.

The U.S. Environmental Protection Agency (EPA) *Onsite Wastewater Treatment Systems Manual* (2002) defines system failure as "a condition where performance requirements are not met." Typically, failures are declared when wastewater is observed on the surface of the ground or is backing up into the household plumbing.

When a septic system fails, it can pollute nearby water resources and endanger public health. Children are most susceptible to these health problems because they very often come into contact with the contaminated areas. There's really not all that much that is going to go wrong with the septic tank itself as long as it is watertight and pumped on a regular basis. However, what usually fails is the soil absorption system.

The soil absorption system, or drainfield, is an arrangement of perforated pipes or chambers buried underground that channel the pretreated wastewater—the liquid discharge (effluent) from the septic tank—out over a large area of the soil. The effluent then moves slowly down through the soil to become naturally purified before returning to the aquifer. The drainfield acts as a natural filter for effluent by absorbing the organic materials, reducing or removing bacteria and viruses, and removing some nutrients.

The most obvious sign of drainfield failure is surfacing effluent. If the soils can no longer accept the effluent being delivered, the effluent will either



Below and above right: Repairing a failed septic system may require constructing a new drainfield.

DESIGN BY JULIE BLACK

rise to the ground surface, or "blow out" at the end of the last trench. Either of these two events should alert the homeowner that there is a problem.

The reason the soil can no longer accept the pre-treated effluent is most often because of the biomat. As the effluent or pre-treated wastewater enters the drainfield, bacteria in the soil begin to thrive on the new food source. As these bacteria grow, they form a thick, slimy colony called the biomat that restricts the flow of effluent to the surrounding soil. (**See sidebar on page 21**.)

Causes for failure are many and varied—ranging from improper siting, design, or construction, to the simple overuse of water-generating appliances. It is vital that the exact cause for the failure is determined before attempting any remediation to the system. The suggested process for correcting system failure is to gather information about the system, determine the cause of failure, and design the corrective action.

Causes of Failure

Drainfield failure can be caused by many things, including excessive rainfall, tree roots interfering with the drainlines, or vehicles driving over the system and cracking pipes. But the two most common causes are hydraulic and organic overloading. Hydraulic overloading occurs when too much water is sent to an underdesigned system. Organic overloading is the result of too much organic matter in the effluent.

The initial design of a system is based on soil and site characteristics, including depth to groundwater or bedrock. Part of the design includes the system's capacity, which takes into account the number of people living in the home.

Capacity is usually based on the number of bedrooms in the home, but this may not be an accurate way to determine flow generation. Extra people or the addition of a hot tub, for instance, can quickly create more wastewater than the system and drainfield can handle.

The addition of appliances, such as garbage disposals and dishwashers, can greatly change the quality of the wastewater sent to the system. These appliances send increased amount of solids to the system, possibly causing organic overloading. Use these appliances in moderation, keeping in mind that a garbage disposal is not a waste receptacle.

Many local and state regulatory authorities require onsite systems to be sized larger to handle the additional load from such appliances as garbage disposals. Check with your local health department or permitting authority to see if this is the case in your area. Telephone numbers of such agencies are normally listed in the government or blue pages of the local telephone directory.

Septic system failure can also result from:

- Overloading with water. Homeowners should avoid putting too much water into the system at one time. It is better to stagger laundry loads throughout the week rather than having a "wash day" where you might do all the laundry within a 24- to 48-hour period. Divert your hot tub away from your onsite system when draining it.
- Discarding decay-resistant materials into the system, such as grease, sanitary napkins, and other solids.
- Allowing tree roots to clog or destroy the absorption system.
- Compacting soil over the drainfield. Avoid driving or parking vehicles over the drainfield.
- Age of the system. Septic systems are designed for an operational life of 20 to 30 years. If you have an aging system, it may be time to inspect and replace it.

The Correction Procedure

When an onsite system fails, it is important to gather specific information about the system in order to diagnose the problem and determine the appropriate corrective action.

Initial Data Gathering

- Visual observation of the failure should be made to confirm the problem. All system components should be inspected, and any mechanical components (such as float switches and flow diverters) should be tested by a qualified/certified system inspector.
- A complete history of operation and maintenance of the system should be reviewed. Frequently, a study of the past three to five years of operation and maintenance will reveal a possible problem. The correction may be as simple as pumping the tank or cleaning a tank filter.
- Obtain a copy of the original permit and any updates. This permit will contain a layout of the system from a site survey or drawings of the original design.
- Determine approximate loading rates from the original design and permit.

Alternating drainfields provide relief for a failing system. *Here, a second drainfield is installed.*

- Soil test results should be reviewed. If soil test results are not included in the permit, soil samples should be taken to determine the soil profile and to locate any soil boundaries that may be present. The age of system should also be determined.
- Obtain a complete report of the symptoms of failure. For example, surfacing effluent above the drainfield suggests that the soil may be overloaded, either with too much total water or that the water has inappropriate amounts of organic matter that has clogged the soil pores. Additionally, if the failure is seasonal, wet weather conditions are likely to be the cause.
- Determine the amount of wastewater entering the system. Using data from the dwelling's water meters, actual flow (even if estimated) is then compared to the design loadings. This will yield a good approximation of how much wastewater is entering the wastewater system. Leaking plumbing fixtures will skew this number, causing more water to enter the system. Thus, all leaking fixtures must be repaired.

Determining the Cause

From the information gathered through the above steps, ideas about the potential causes of failure should come to light. It might be necessary to do some additional steps to test the idea before any corrective actions are taken. Wastewater metering or testing, equipment testing and monitoring, or additional soil testing might help more clearly define the cause of the system failure.

Repair permits may be required before any corrective action begins. Contact your local health department or permitting agency to find out what is required to obtain such a permit.

Remediation Techniques

There are various repair or remediation techniques that may be considered, depending on the investigation into the causes of failure as described above, economic considerations, and the flexibility of the local permitting entities. State and local statutes vary as to what technologies are permitted. Homeowners must work closely with their local health departments or permitting authorities to make the best choice for their individual situation.

Short-Term Solutions

If the neighborhood is soon to receive public sewerage, it might be practical to use a short-term technique such as water conservation. But conservation and other management techniques are only part of most solutions. Drainfield failure must be considered a serious health hazard and as such, should be taken care of with long-term goals in mind.

Sometimes the overloaded drainfield can recover if a strict policy of water conservation is observed by the homeowner. After pumping the septic tank, this would involve replacing water-guzzling appliances with more efficient ones, repairing leaking fixtures, and staggering showers and clothes washing times to reduce the output of effluent.

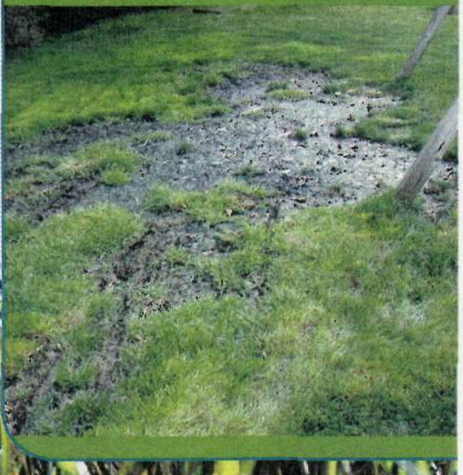
If the soil around the piping is allowed to dry out, it may be able to function properly once again. This method obviously requires a good deal of homeowner commitment. It usually takes a 30 percent reduction in water use to allow the drainfield to recover.

In cases of physical damage, system restoration may only require the leveling of the distribution box or repairing crushed or broken pipe. If tree roots are interfering with the operation of the soil absorption field, they can be removed. Broken or deteriorated baffles in the septic tank can allow solids to go to the drainfield; these should be replaced or repaired.

There are now some new technologies that may provide temporary relief to drainfield failure. The first is "jetting," a procedure that utilizes special pumps to inject high-pressure water into the drainlines to break up silt deposits and other solids, coupled with powerful vacuum lines that suck the broken-up solids out of the lines before they can settle again.

If the problem stems from poor or compacted soil, hope may come

Effluent from a failed drainfield has surfaced in this backyard.



Biomat Formation

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As the effluent is discharged into the soil absorption system, bacterial growth develops beneath the distribution lines where they meet the gravel or soil.This layer is known as the clogging mat, clogging zone, biocrust, and biomat. This biomat (biological mat) is a black, jelly-like layer that forms along the bottom and sidewalls of the drainfield trench. This clogging zone reduces infiltration of the wastewater into the soils.

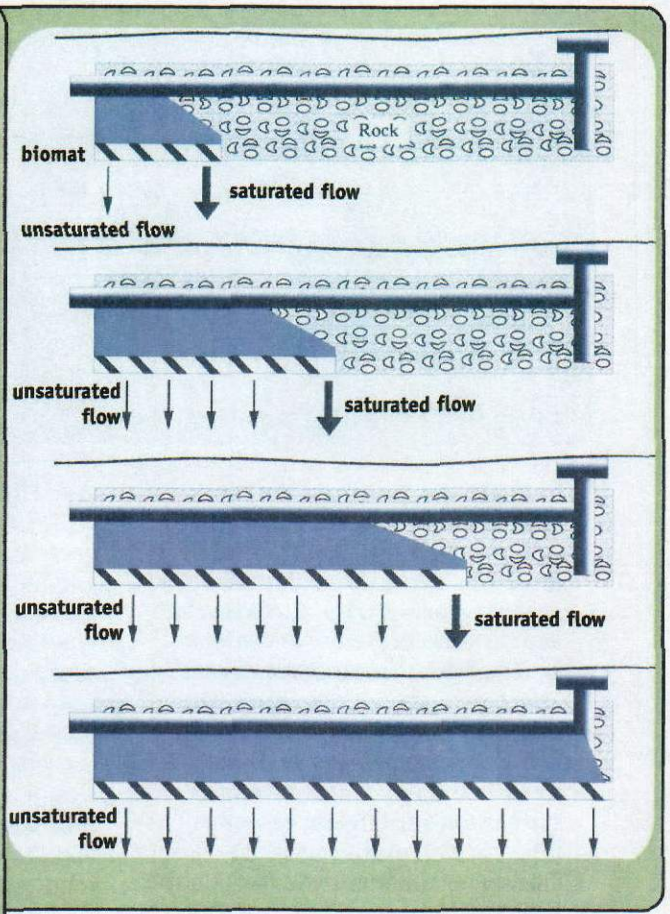
The biomat is composed of anaerobic microorganisms (and their byproducts) that anchor themselves to soil and rock particles. Their food is the organic matter in the septic tank effluent. Less than one centimeter to several centimeters thick, the biomat acts as the actual site for effluent treatment.

The biomat forms first along the trench bottom near the perforations where the effluent is discharged, and then up along trench walls. It is less permeable than fresh soil, so incoming effluent will move across the biomat and trickle along the trench bottom to an area where there is little or no biomat growth. (See growth pattern diagram at right.)

Biomats tend to restrict the flow of effluent through the drainfield, but are crucial because they filter out viruses and pathogens. As the biomat develops, the soil infiltration rate decreases. Once the hydraulic loading rate exceeds the soil infiltration rate, ponding starts. At some point, wastewater will either back up into the home or break out onto the soil surface.

Biomat formation cannot, and should not, be prevented, but septic tank filters, proper organic loading, and proper maintenance of the septic tank can slow the rate at which it forms. Septic tank filters prevent excess suspended solids from flowing into the drainfield and can be retrofitted to existing systems.

Other maintenance that should be performed on the septic system includes having the system inspected and the tank pumped at regular intervals. Pumping the tank allows it to better settle out solids, also reducing the organic load to the drainfield.



in the form of another new-technology solution known as "soil fracturing." Highly specialized equipment uses a pneumatic hammer to drive narrow probes down into the soil of the drainfield, typically to a depth of between three and six feet.

Air is then forced into the soil at a controlled rate, which fractures the hard soil and creates tiny open channels through it. Next, polystyrene pellets are injected into the newly aerated soil, which keeps the passages open so the soil will not simply compact again. This technology has met with mixed results and is only approved by certain states. It is very important to check with your local health officials to find out what similar process (if any) is approved for your situation.

Some of these more extreme procedures may provide some temporary relief for a failing system that is soon to be replaced or connected to a municipal system. In many states, the process falls between the regulatory cracks whether or not it is a repair and requires a repair permit.

Long-Term Solutions

In some cases, corrective measures are not enough; a new soil absorption system must be constructed. New soil absorption systems can be placed either in an isolated area so the old system is not disturbed in the process or in between the existing trenches if there is adequate room. These additional lines are considered part of an alternating drainfield system.

A diversion valve is installed so that in the future it will be possible

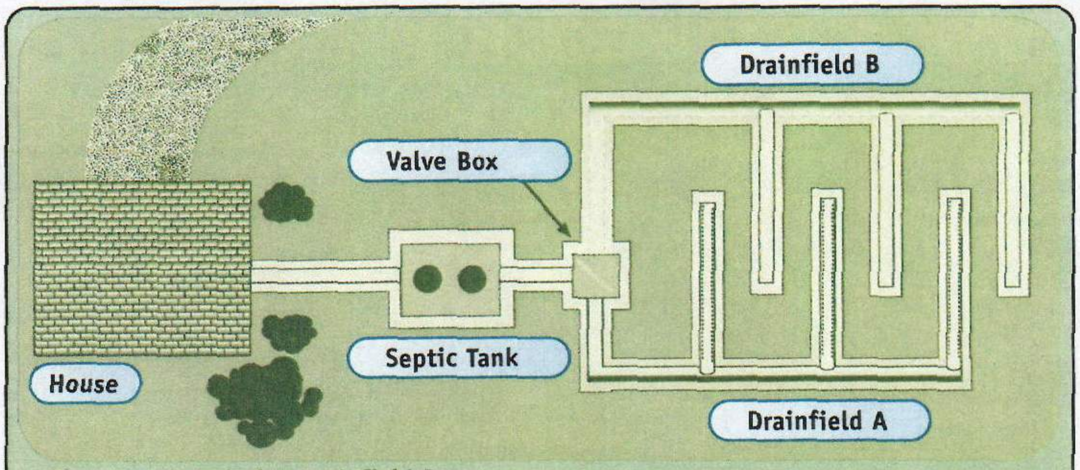


Figure 1 - Interlacing Drainfield System

to direct the flow from the septic tank to either of the soil absorption systems. After the new drainfield is in place, the flow is diverted from the old field, which will slowly rejuvenate itself and be available for use in the future.

The rejuvenation process takes about two years and involves naturally occurring organisms that decompose the clogging mat that has formed and return the absorptive system to near original capacity. (The old drainfield can recover faster if a septic tank pumper can open the field and remove as much of the ponded wastewater as possible.)

After a replacement system has been installed, a homeowner should switch back to the old drainfield after two years, and then switch back and forth between the two systems annually. This will result in a continuous use and rejuvenation cycle for both drainfields and should prevent future failures. An observation tube in each drainfield may be used to monitor the condition of the drainfields and can help the homeowner determine the frequency of alternating between the two fields.

If an adequate area for a new system does not exist, and the old system is a trench system with at least six feet of undisturbed soil between the trenches, it is possible to install new replacement trenches interlaced between the old ones. However, the plumbing for the new and old system must be entirely separate so that when one is in operation, the other has the opportunity to completely dry out.

(**See Figure 1 above**.)

Another option to reduce the organic load on the drainfield is by adding an advanced treatment system such as an aerobic treatment unit or a sand filter. Sand filters and aerobic treatment units (ATUs) are systems that use natural processes to treat wastewater and are frequently used to renovate organically clogged, failing septic tank-soil absorption units. Typically, sand filters are used as the second step in wastewater treatment after the septic tank where solids in raw wastewater have been separated out. Constructed of a bed of sand about two or three feet deep and often contained in a liner, sand filters receive the partially treated effluent in intermittent doses. The effluent slowly trickles through the media and is collected in an underdrain and flows to further treatment and/or disposal.

Sand filters are very effective at reduction of organic matter and are capable of handling heavy hydraulic loads. These two qualities make them particularly useful in cases of drainfields that have been overloaded either hydraulically or organically.

Aerobic treatment units are similar to septic tanks in that they use natural processes to treat wastewater, but unlike septic treatment, the ATU process requires oxygen. ATUs use a mechanism to inject and circulate air inside the treatment tank. Bacteria that thrive in oxygen-rich environments work to break down and digest the wastewater inside the aerobic treatment unit.

Aerobically treated effluent is defined as effluent exiting a properly operating ATU or sand filter. This additional step reduces the amount of total suspended solids (suspended solids value of less than 10 to 15 mg/L, compared to typical septic tank effluent with suspended solids in the range of 100 to 250mg/L).

In situations where the soil absorption units have failed due to an excessive biomat formation, aerobic effluent reduces the symptoms. (Several states allow systems that are failing due to clogging biomat to be renovated using aerobically treated effluent, provided the site meets separation requirements between the aggregate/ soil interfaces and limiting conditions of high water table or bedrock.)

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Items referenced above with # codes are available from the NESC at (800) 624-8301.