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Small Community Wastewater Issues Explained to the Public

MOUNDS: A SEPTIC SYSTEM ALTERNATIVE

Ancient Americans began building mounds starting around 700 B.C.E. While they apparently were constructed throughout eastern North America, the highest concentrations seem to have been in what are now the Midwestern states of Ohio, Illinois, Iowa, and Wisconsin. Archaeologists tell us that these mounds were used to bury the dead.

If, somehow, these mound builders were to magically return—nearly 3,000 years later—they might be pleased to see that mounds are still being constructed in their old stomping grounds. The reason for the new mounds, however, is slightly different: they contain an above-ground wastewater treatment method known as a "mound septic system."

Why a mound system?

Mounds were developed to overcome three natural conditions: (1) slow or fast permeable soils, (2) shallow soil cover over creviced or porous bedrock, or (3) a high water table. A site that has any one of these three conditions (or a combination of them) is not suited for a conventional septic system. Because acceptable soil conditions are not always found below the surface, the mound allows the conditions to be created above the surface.

The mound system was developed in North Dakota in the 1940s by the U.S. Department of Health, Education, and Welfare. Originally called the "NODAK disposal system," after its state of origin, the design featured an above-ground gravel mound with distribution pipes running its length and width.

Conditions That Indicate a Mound System

Mound septic systems are designed to address certain site restrictions. Typically, a mound is used when there are:

1. Slow or fast permeable soils,
2. Shallow soil cover over creviced or porous bedrock, or
3. A high water table.

NODAK systems were typically constructed as a circular mound, covered with topsoil and seeded with grass. The systems were designed to overcome failure of conventional septic systems—mainly due to slow permeable soils—and to perform adequately in the state's varying site conditions and harsh climate.

The most common type of mound

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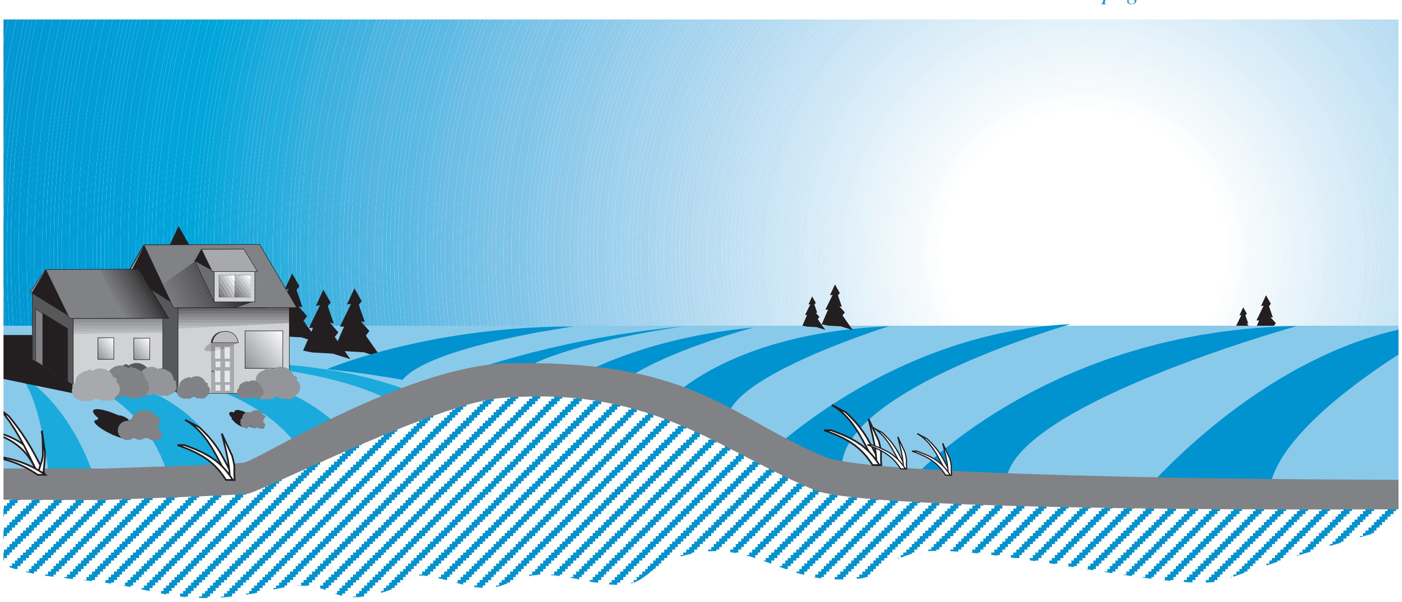

Advantages and Disadvantages of Mound Systems

As with any endeavor, mound septic systems have advantages and disadvantages. While the disadvantages may seem great, remember that an above-ground system may be the only viable option in some areas.

Advantages

- The mound system enables use of land that would otherwise be unsuitable for in-ground or at-grade onsite systems.
- The natural soil used in a mound system is usually the top layer, which is typically the most permeable.
- A mound system does not have a direct discharge to a ditch, stream, or other body of water.
- If care is taken, construction damage can be minimized since little excavation is required in the mound area.
- Mounds can be used in most climates.

Disadvantages

- Construction costs are typically much higher than those of conventional systems.
- Since there is usually limited permeable topsoil available at mound system sites, extreme care must be taken not to damage this layer with construction equipment.
- The location of the mound may affect drainage patterns and limit land use options.
- The mound may have to be partially rebuilt if seepage or leakage occurs.
- All mound systems require pumps or siphons.
- Mounds may not be aesthetically pleasing in some cases.

Source: Environmental Technology Initiative Fact Sheet

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design used today was modified from the NODAK design by extension personnel at the University of Wisconsin-Madison in the 1970s. Their design consisted of gravel trenches set into a mound of sand. The distribution pipes were placed in the gravel trenches and the wastewater was pressure-dosed to insure uniform distribution. A soil cover provided climatic protection and allowed certain types of vegetation to be planted on the mound, thus preventing erosion or other threats to it.

The Wisconsin Mound, as it came to be known, was incorporated into that state's code as an alternative septic system in the 1980s. Today, a number of states have adopted this mound design—or some variation thereof—and it can be found from Washington to Virginia.

How does the system work?

There are three main components to a mound system: (1) a septic tank or pretreatment unit, (2) a dosing or pump chamber, and (3) the elevated mound. (See page 3 for an illustration of a typical mound system.)

The Septic Tank

The septic tank (or pretreatment unit) is a large, buried container, typically constructed of concrete, fiberglass, or polyethylene. Wastewater from the home flows into the tank. Heavy solids—called sludge—settle to the bottom where bacterial action partially decomposes them. Most of the lighter solids—called scum—rise to the top.

The wastewater then leaves the septic tank and flows, by gravity, to the pump chamber. The wastewater leaving the septic tank is a liquid known as effluent.

The Dosing Chamber

Also made of concrete, fiberglass, or polyethylene, the dosing chamber is a container that collects the septic tank effluent. The chamber—also called a pump chamber—contains a pump, pump control floats, and a high-water alarm float.

When the effluent rises to the "on" float, the pump delivers a set amount of effluent to the mound. (See schematic below.) Once a sufficient amount of effluent has been discharged, the level returns to the

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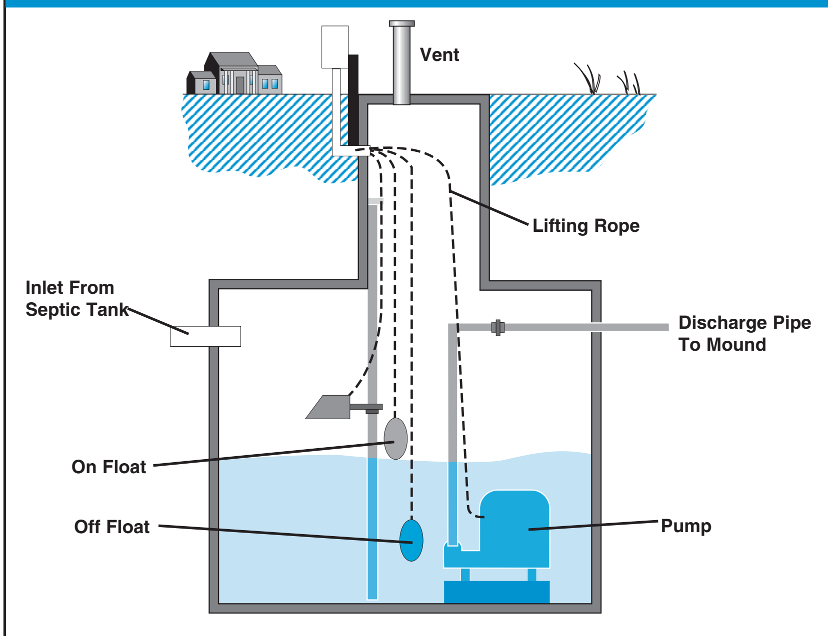
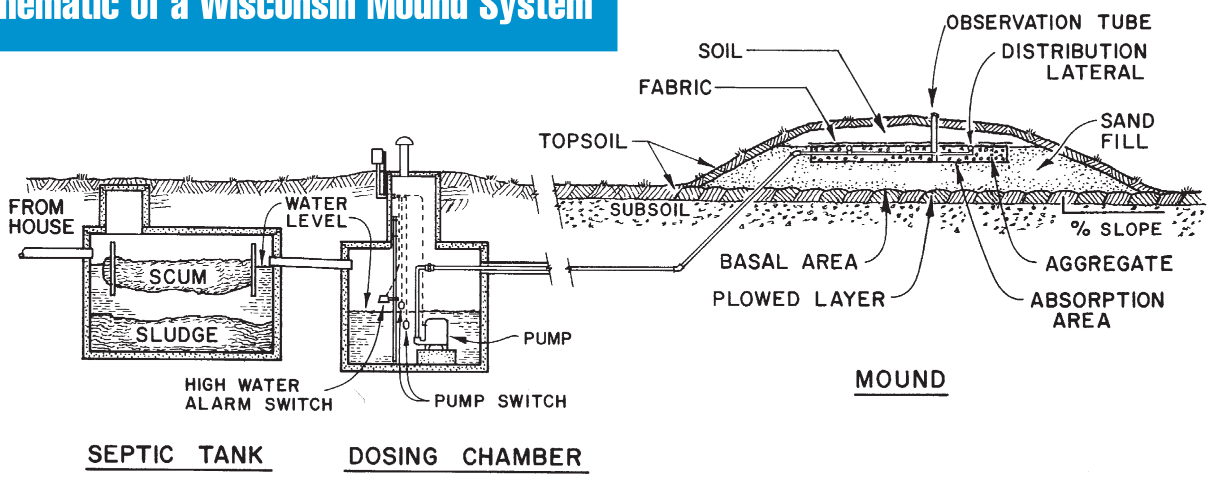
Schematic of a Dosing Chamber



Schematic of a Wisconsin Mound System



Source: Converse and Tyler, copyright © 1987 by the American Society of Agricultural Engineers, reprinted with permission

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"off" float and the pump stops. The control floats are adjustable so that a specific amount of effluent can be sent to the mound.

Most dosing chambers are now equipped with an "alarm" float to warn of pump or system problems. The float is set so that an alarm goes off if the effluent rises above the "on" float. Experts recommend that the alarm consist of a buzzer and an easily visible light, and that it be wired to a circuit separate from that of the pump.

Experts also recommend that the pump discharge pipe have a union or other quick disconnect coupler so that the pump can be easily removed. A piece of nylon rope should be secured to the pump for taking it out of the chamber.

The Mound

The mound is a drainfield that is raised above the natural soil surface. The mound is composed of a sand fill that has a gravel-filled bed and a network of small diameter pipes known as the distribution system.

From the pump chamber, effluent is pumped through the pipes in controlled, low pressure doses so that uniform distribution is achieved throughout the bed. The effluent comes out of the pipes through small holes and trickles downward through the gravel bed and into the sand. Treatment occurs as the effluent moves through the sand and returns to the natural soil.

Design Criteria

The first step in designing a mound is to have a certified soil tester complete an analysis of soil characteristics of the site. This test is required in several states and is a good idea everywhere.

Once the flow rate is established, the size and configuration of the mound is determined by the manner of effluent movement and the rate at which it moves away from the mound. These factors are calculated based on many years of experience with different soil and site types. All mound construction must leave the topsoil in place as much as possible and use coarse sand fill based on distribution specifics. (See table on page 4.)

In most states, a new mound is required to also have a designated replacement area. This area is similar in size to the existing mound and must be maintained should the existing system need an addition or repairs.

Soil Depth, Percolation, and Loading

Before the effluent reaches the limiting condition (e.g., bedrock, high water table, slowly permeable soil layer), there must be a suitable depth of soil. Although the depth varies from place to place, most effluent is sufficiently treated after passing through one to four feet of soil.

In some areas, percolation tests are used to estimate soil permeability because they are related to the loading rate (i.e., how much effluent can be handled). Loading rates should be based on soil texture, structure, and consistency, with the percolation test used to confirm soil analyses. Loading rates should also be in accordance with state and local regulations.

High Water

The high water table is determined by direct observation, soil boring, interpretation of soil mottling, and other criteria. The underlying bedrock is then classified as crevice, non-crevice, semi-permeable, or non-crevice impermeable. This classification indicates the depth of the sand media used in the mound.

Siting and Design

While the most common image of a mound is an oval-shaped "bump" on a relatively flat piece of land, these systems can be constructed in different shapes and on different terrain. For example,

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Ten Maintenance Procedures To Keep Your Mound In Good Shape

Because it is more complex and more costly than conventional systems, regular maintenance is even more important for mound systems. You can avoid expensive repairs—not to mention headaches—if you follow recommended maintenance procedures.

1. If the system is not currently equipped with observation tubes, install them. Observation tubes allow inspection of the tank without unearthing and removing the access port.
2. Routine pumpings of the septic tank and dosing chamber should be done at least once every three to five years, depending on the size of the septic tank. Tanks should be routinely inspected on a yearly basis to determine the rate of sludge accumulation.
3. Regularly inspect both the septic and dosing tanks using the observation tubes. Any progressive increase in the depth of the water in the tanks could indicate a problem.
4. Equip the dosing chamber with a high-water alarm to alert the homeowner to potential serious or sudden problems with the system.
5. Maintain grass or other vegetative cover over the mound to maximize water uptake and prevent erosion.
6. Avoid traffic and construction on the mound or on its slope. This could compact the soil, thus reducing the absorptive capacity of the soil.
7. Grease, oil, solvents, and toxic chemicals should never be poured or flushed down the drain, as these materials may damage the system.
8. Take steps to reduce household water use. Avoid putting any solids, such as food, plastics, and paper, in the wastewater system.
9. Discharge of water from house gutters should be directed away from the absorption mound.
10. Keep a diagram showing the location of the septic tank, dosing tank, and absorption field in relation to the house.

Source: Virginia Cooperative Extension Service.

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mounds may be built on sites with slopes up to 25 percent.

There are, however, several places where it isn't a good idea to construct a mound system. A U.S. Environmental Protection Agency fact sheet titled "Mound Systems" has this to say about their siting and design:

Mounds should not be installed in flood plains, drainage ways or depressions unless flood protection is provided. Another siting consideration is maintaining the horizontal separation distances from water supply wells, surface waters, springs, escarpments, cuts, the boundary of property, and the building foundation. Sites with trees and large boulders also make it difficult in preparing the site. Trees should be cut to ground surface with tilling around the stumps. The size of the mound should be increased to provide sufficient soil to accept the effluent when trees and boulders occupy a significant amount of the surface area.

The actual design of a mound system consists of estimating the sand fill loading rate, soil (basal) loading rate, and the linear loading rate. Once these values are established, the mound can be sized for the lot. (See Resources on the back page for information about how to order this fact sheet.)

How's the performance?

After more than 50 years of monitoring mound system performance, the simple answer is that mounds perform very well. In Wisconsin, for example, the success rate of these systems is greater than 95 percent. As with any onsite system, proper design, installation, and operation greatly enhance the system's ability to function correctly.

The selection of sand fill material is critical to the performance of the mound. A suitable sand is one that can be loaded at a reasonable rate and adequately treat the effluent. The sand should contain 20 percent or less material greater than 2.0 millimeters (mm) and 5 percent or less finer than 0.053 mm. It should also have a size distribution that meets certain sieve analysis specifications, ASTMC-33 specifications, or meets limits for effective diameter and coefficient of uniformity.

Proper design is also critical to mound performance. For residential mounds, the daily wastewater volume is usually determined by the number of bedrooms in the house.

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Recommended Soil and Site Criteria for the Wisconsin Mound System

Parameter	*Value*
Depth to high water table (permanent or seasonal)	10 in.
Depth to crevice bedrock	2 ft.
Depth to non-crevice bedrock	1 ft.
Permeability of top 10 in.	Moderately low
Site slope	25%
Filled site	Yes[a]
Over old system	Yes[b]
Flood plains	No

[a] Suitable according to soil criteria (texture, structure, consistence).
[b] The area and backfill must be treated as fill because it is a disturbed site.

Source: Converse and Tyler, used with permission

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Typical design flow requirements for individual homes are up to 150 gallons per day (gpd) per bedroom. Mounds for businesses—especially those with higher strength wastes—have different criteria, including pretreatment and lower loading rates.

Mound failures are most often due to overloading the system's original capacity. The result of overloading is clogging and seepage problems.

Photo by Josette Schwarz

While a new septic system is often a cause for celebration, experts recommend against allowing a mariachi band to perform on your mound.

A well-documented case in the Midwest provides a valuable lesson in how to avoid a failure. In the 1970s, a Wisconsin firm expanded from a staff of 65 to more than 160 employees. This expansion resulted in a hydraulic overload of the system.

Originally designed to handle a flow of 750 gpd, the additional employees resulted in flows of up to 2,600 gpd. To solve the problem, the company expanded the mound system and instituted a water conservation program.

After two failures, one might guess that the firm had learned their lesson. Apparently they didn't because another hydraulic overload occurred after the firm had grown to 215 employees and an average daily flow of 3,000 gpd. By now, there was no more space available to expand the mound system itself, so the firm redesigned the dosing chamber to avoid large peak flows, allowing the mound system to receive optimum dosing without overload.

If significant growth occurs—as in the case of the Wisconsin firm or when, for example, a family adds a hot tub to their home—the mound system must be considered. A little foresight can save big money down the road.

How To Properly Maintain Your Mound System

If the mound system has been properly designed and if a few simple maintenance procedures are followed, it will last for many years. (See sidebar on page 4.) As with any septic system, poor maintenance can result in system failure.

The septic tank and dosing chamber should be checked for sludge and scum buildup and pumped, as needed, to avoid carryover of solids into the mound. Screens or filters can be used to prevent large solids from escaping the septic tank.

The dosing chamber, pump, and floats should be checked annually and replaced or repaired as needed. It is imperative that the septic tank and dosing chamber be water-tight. Electrical parts and conduits should be checked for corrosion. Flushing of the laterals is also recommended each year.

Follow all of the manufacturer's operation and maintenance instructions. All equipment must be tested and calibrated according to manufacturer specifications. (See the list of resources on the back page for a "Homeowner Record Keeping Folder" that allows for easy tracking of system operation and maintenance.

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INTERNET INFO

Mound System Information on the Internet

A wealth of good information about mound septic systems can be found on the World Wide Web. Search using the terms "mound septic system" or "septic system, mound" to see a listing of hundreds of sites. Several university extension service sites also provide extensive information about mound septic systems. Here are five:

University of Minnesota
http://locutus.mes.umn.edu/

University of Wisconsin
http://www1.uwex.edu/

North Dakota State University
http://www.ext.nodak.edu/

Virginia Polytechnic Institute and State University
http://www.ext.vt.edu/

Ohio State University
http://www.ag.ohio-state.edu/

The U.S. Environmental Protection Agency offers a seven-page article—available only on the Internet—that discusses mound system applicability, advantages and disadvantages, design criteria, performance, operation and maintenance requirements, and costs. To download the document, go to: *http://www.epa.gov/OWM/mtb/mound.pdf.*

CONTACTS

Extension Service Offices

Land Grant universities have U.S. Department of Agriculture's (USDA) Extension Service offices on campus and in other locations that provide a variety of services and assistance to individuals and small communities. For the phone number of the extension office in your area, check the government pages of your local phone directory, call the NSFC at the number listed above, or call the USDA directly at (202) 720-3377.

State and Local Health Departments

Homeowners and residents of small communities who want more information about mound septic systems—including local regulations, permit requirements, and guidelines—should contact their state or local health department. These agencies are usually listed in the government section or blue pages of the local phone directory.

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What if the alarm goes on?

If the effluent level in the pump chamber reaches the alarm float, the alarm light and buzzer will activate. Sometimes the alarm will go on due to a faulty pump, problems with the floats, or a tripped circuit breaker. Before calling a repair service, the Washington State Department of Health suggests that you check to see if the problem could be:

1. A circuit breaker has been tripped or a fuse blown. The pump should have a separate circuit with its own breaker or fuse. If the pump is on a circuit with other equipment, that equipment can trip the breaker.
2. A pump or float switch power cord has come unplugged. If electrical connections are of the plug-in type, be sure that the switch and pump plugs are making good contact in their outlets.
3. The control floats are tangled. The floats or other parts in the dosing chamber such as the electrical power cord, the lifting rope, or the pump screen, can become tangled. Make sure the floats operate freely in the chamber.
4. Debris is on the floats and support cable, causing the pump to switch off. Lift the floats out of the chamber and clean them thoroughly.

Photo by Jim vonMeier, Septic Protector

A budding septic system inspector? Fifteen-month-old Austin Richard Ahner looks down the observation tube of a septic system in Zimmerman, Minnesota.

Make sure to turn off the power supply at the circuit breaker and unplug all power cords before handling the pump or floats. Do not enter the dosing chamber: gases inside are poisonous and the lack of oxygen can be fatal. Turn the alarm off by pushing the reset light on the alarm panel.

By using water conservatively (e.g., postpone baths, showers, and clothes washing), the reserve storage in the dosing chamber should allow enough time to correct the problem.

What's the final word?

A prime concern for anyone needing a septic system is the price tag. Obviously, the cost of a mound system will differ depending on site characteristics and home size. Several sources peg the average cost at $9,000 for a system serving a three-bedroom home. The largest part of this cost is the mound construction itself. Annual operation and maintenance costs will typically be less than $100. Experts recommend using locally available, good quality materials to ensure performance and hold costs down.

As for our mound-building ancestors, who knows? Maybe those aren't burial places, maybe septic technology is a lot older than we think.

Landscaping Mound Septic Systems

So, all the conditions at your site point to the need for a mound septic system. One of the first questions many people ask is "What am I going to do with a large mound in my backyard?" Granted, having a hill that is typically three or four feet high and can be as long as 90 feet offers a unique challenge to the landscaper. There are, however, several things you can do to help protect the mound and make it visually appealing at the same time.

The right vegetation cover helps keep the mound intact, as well as making it more attractive. But, the wrong cover can do irreparable damage to the mound. Do not plant trees, shrubs, or any plant with an extensive root system on the mound. The roots will interfere with and possibly destroy the distribution system. The mound can be framed with trees or shrubs, but they should be at least 20 feet away. It is also ill-advised to plant vegetables or herbs on the mound.

The best things to plant on the mound are low-maintenance grasses—a mixture of creeping red, hard, and sheep's fescues works well—or perennial flowers, such as daylilies and peonies. (See the sidebar at right for some ideas about what can be planted successfully on a mound.) Because the mound will tend to be dry on top, plant grasses and other ground cover that are resistant to water stress there. Cool-season grasses and other plants may be planted on the sides of the mound. Be sure to wear gloves when landscaping the mound.

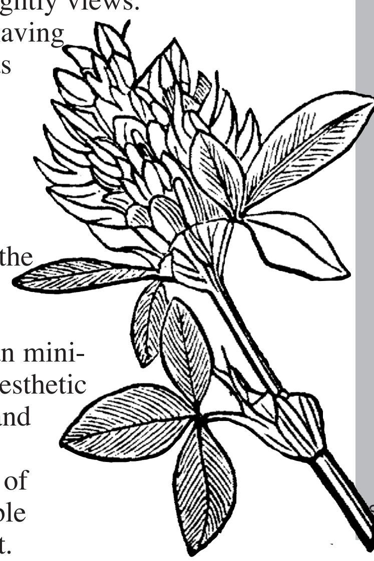
Use minimal tilling when planting and establish a cover as quickly as possible to limit erosion. The topsoil on the mound should be at least six inches, but no more than 30 inches deep. Keep traffic on the mound to a minimum; if you plant a lawn grass, plan to mow it only two or three times a year. If you have pets or young children, you may need to erect a fence around the area. Do not irrigate or water the mound once you have vegetation on it.

Photo by Josette Schwarz

Josette Schwarz, a master gardener from Forest Lake, Minnesota, shows that a mound septic system can be attractively landscaped. Note the grass on the mound itself, with a stone wall and a decorative edging of perennials around the sides and "toe" of the mound.

The actual shape of the mound may be changed to suit individual landscaping and site needs. Constructing a contoured mound works well for hillsides. One built at a right angle can be used in the corner of a property. A rectangular mound is most often used when there is plenty of room and uniform slope. Landscaped areas around the mound can serve as a privacy barrier, a windbreak, or as a screen to block unsightly views.

While having a mound as part of the home's landscape isn't always desirable, the right landscaping can minimize the aesthetic intrusion and maximize protection of this valuable investment.



Prairie clover (*Dalea*)

Suggested Plants for Use on Septic Mounds

Here are 15 plants that grow well on a mound septic system and require little maintenance. Check with your local extension office to see which plants will grow in your climatic region.

- Prairie smoke (*Geum triflorum*)
- Prairie onion (*Allium stellatum*)
- Pussytoes (*Antennaria neglecta*)
- Butterflyweed (*Asclepias tuberosa*)
- Prairie clover (*Dalea*)
- Pale purple coneflower (*Echinacea angustifolia*)
- Rattlesnake master (*Eryngium yuccifolium*)
- Rough blazing star (*Liatris aspera*)
- Wild bergamot (*Mondarda fistulosa*)
- Oxeye daisy (*Helianthus helianthoides*)
- Heath Aster (*Aster ericoides*)
- Bigleaf Aster (*Aster macrophyllus*)
- Pennsylvania sedge (*Carex Pennsylvanica*)
- Wild geranium (*Geranium maculatum*)
- Violets (*Viola*)

Source: University of Minnesota Extension Service