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Residential Onsite Wastewater Treatment: Mound Systems

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Information on using mound systems for onsite wastewater treatment, including how an onsite mound system treats water, why homeowners or business owners may want to consider having one installed, advantages and disadvantages, current regulatory framework, and maintenance considerations.

Several areas in Nebraska are not appropriate for on-site wastewater treatment using conventional septic tank/drainfield systems. Mound systems are one of a number of alternative systems that have been developed to overcome site conditions that limit the use of a conventional drainfield, including soils with slow or fast permeability, shallow soils over bedrock, or a high water table. A mound system creates suitable conditions for initial wastewater treatment above the natural soil surface. After preliminary treatment in a septic tank, effluent flows to a dosing chamber. Then it is pumped to the mound for further treatment and also uses the existing soil beneath the mound, where final treatment occurs and the water re-enters the environment.

How does treatment occur?

There are three main components to a mound system: a septic tank (or aerated tank in some cases), a dosing or pump chamber, and the mound (*Figure 1*). Wastewater flows from the home to the septic tank where heavier materials settle to the bottom as sludge. Bacteria partially decompose this material. Lighter materials float to the top of the tank, forming a scum layer. The middle layer of wastewater, called septic tank effluent, flows to the pump tank, sometimes called the dosing tank.

The pump tank, made of concrete, fiberglass or plastic, collects the septic tank effluent. It contains a pump, floats for pump control, and a high-water alarm float. When the

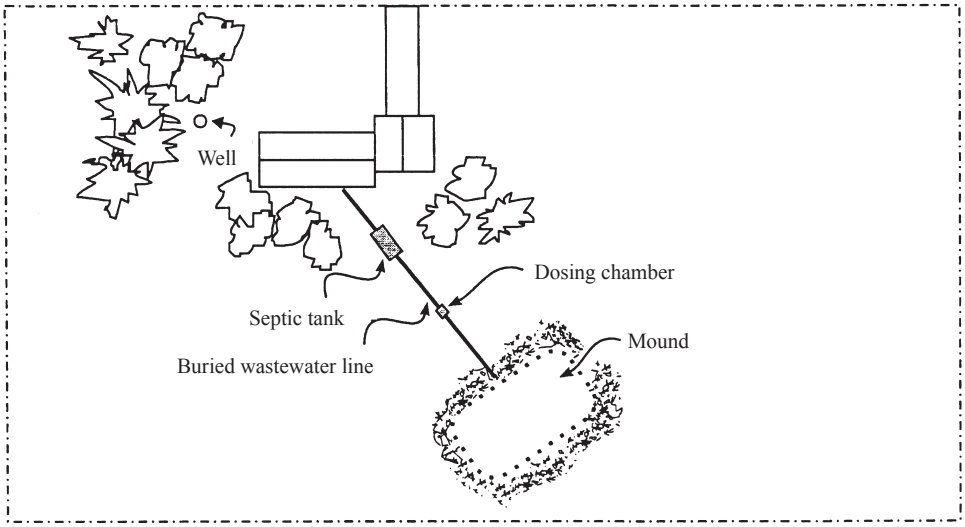

Figure 1. Mound system on a residential site.

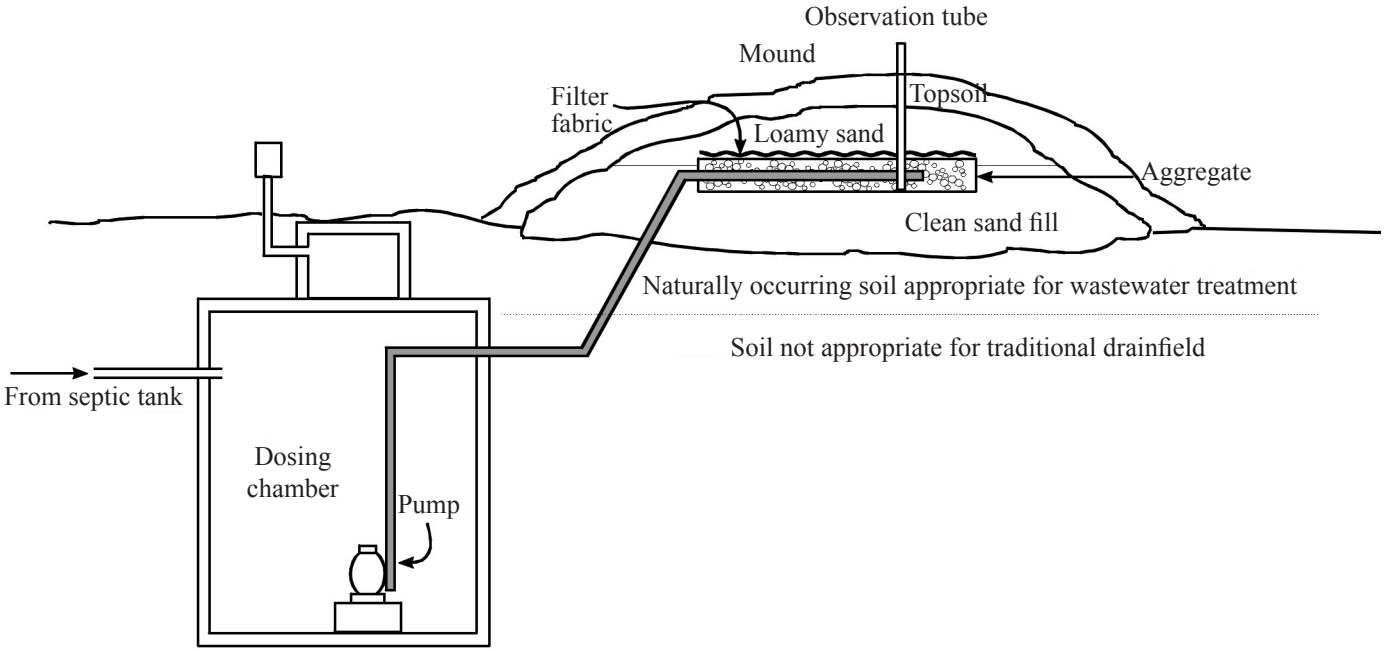

Figure 2. Side view of dosing chamber and mound.

effluent rises to the "on" float position, the pump delivers effluent to the mound. Once a sufficient amount of effluent has been discharged, the effluent level falls to the "off" float position and the pump stops. The control floats are adjustable so that a specific amount of effluent is pumped to the mound in each dose.

Pump tanks must have an alarm float to warn of pump or other system problems. The float is set so that an alarm is triggered if the effluent rises above the "on" float level. Nebraska regulations require audible and visible alarms, such as a buzzer and flashing light. The alarm should be wired to a circuit separate from that of the pump. The pump discharge pipe should have a quick disconnect coupler so that the pump and controls can be easily removed for inspection, repair, or replacement.

The mound *(Figure 2)* is a drainfield raised above the natural soil surface. It consists of a sand fill that contains a gravel-filled bed and network of small diameter pipes, called the distribution system. Effluent is pumped from the pump tank through the mound's distribution system in controlled, low-pressure doses. These doses distribute effluent evenly throughout the mound. Effluent flows out of the distribution system pipes through small holes and trickles through the gravel bed into a sand layer. Some treatment occurs in the sand layer; large particles are filtered from the wastewater, and some pathogens are destroyed. However, because wastewater travels through sand rapidly, more treatment is needed. There must be a layer of suitable naturally occurring soil beneath the mound that is thick enough to complete the treatment process. The soil filters out smaller particles, removing some chemicals and nutrients, and acts as a site for pathogens to be inactivated. There must be a cap of topsoil over the sand mound to shed rain, protect against frost and allow vegetative cover to grow.

What are advantages and disadvantages of a mound system?

One advantage of a mound system is that it often can be used on land that is not suitable for a traditional septic tank/drainfield system. Thus, if a parcel of land is desirable from a development perspective, and a traditional onsite system will not work, then a mound system may be a viable alternative. Also, the mound system uses the top layer of naturally occurring soil, which is typically the most permeable. Since minimal excavation is required, construction damage to the site is minimized. Mounds can be used in most climates, and, with creative landscaping, can be attractive.

There are disadvantages to a mound system. Design and construction costs are typically higher than those of conventional septic tank/drainfield systems. Mounds require a more highly skilled installer than needed for a standard septic tank/drainfield system. Since there usually is limited permeable topsoil available at mound system sites, installers must be careful not to damage this layer. Mound placement may affect site drainage patterns and limit land use options. In addition, mounds are not suitable for steeply sloping sites. Mounds are difficult and may be expensive to repair. Quality of construction materials (clean sand and gravel) is extremely important to the success or failure of the system. A mound system requires a pump instead of gravity to move wastewater through the system. If there is no power, the pump, and therefore the system, will not work and treatment will not occur. Lastly, mounds can be overloaded by high water use, resulting in repairs or in extreme cases, replacement.

State Authorized by Rule and Construction Permitting

Nebraska Department of Environmental Quality (NDEQ) Title 124: "Rules and Regulations For The Design, Operation, and Maintenance Of Onsite Wastewater Treatment Systems" provides two processes for mound design in Nebraska: "authorization by rule" or "general provision."

On Aug. 11, 2012, NDEQ implemented specific "authorization by rule" regulations about the design and construction of mound systems in a revision of Title 124. Under authorization by rule, only domestic flows under 1,000 gallons per day are allowed. The design must meet the prescribed requirements set in Title 124 with components selected by either an NDEQ certified master installer with a mound endorsement, a registered environmental health specialist, or a Nebraska licensed professional engineer. Mound endorsements are issued by the NDEQ to certified master installers who have passed an examination specifically about mound design and construction. A new Chapter in Title 124 spells out specific requirements for mound site preparation, system size and design, and materials selection and installation. Mound systems that are designed and constructed by qualified individuals as listed above and that are in complete accordance with the requirements specified in Title 124 for a mound system are "authorized by rule." "Authorized by rule" also means a construction permit from NDEQ is not required for these mound designs since many design considerations are prescribed in Title 124. However, NDEQ engineers have the option to review authorized by rule designs on a case-by-case basis. As with all installations, system registration is required within 45 days, and in this case, mound specific registration materials must be submitted to the NDEQ upon completion of the construction project.

In some cases, site conditions prevent an "authorized by rule" mound design that meets all Title 124 regulations. These systems fall under the Title 124 "general provisions" category and require a construction permit. Only Nebraska licensed professional engineers may design mound systems under the general provisions of Title 124. Documents consisting of a construction permit application, soils information as well as plans and specifications describing all aspects of the system must all be prepared by the professional engineer and submitted to NDEQ. Engineers at NDEQ will review the information and recommend issuance of a construction permit to the director if the proposed system merits approval. An NDEQ construction permit is required prior to any construction of a mound system designed under the general provisions of Title 124. A permitted system must be registered by the installer within 45 days of construction completion with NDEQ using the "Title 124 Permit System" registration form and a "Notification of Construction Completion" must be submitted by the engineer. If the registration and notification information is found acceptable, an operating permit will be issued to the owner and is required prior to any use of the system.

Mound Design and Sizing

An engineer or endorsed master installer must consider a number of factors when determining the size of a mound, including the number of bedrooms in the home or business (assuming the business has a wastewater profile similar to residential wastewater) which dictates the wastewater flow rate to be used, the soil percolation rate of the top 12 inches of soil where the mound will be placed, the allowable loading rate of the soil (how many gallons of effluent per square foot the soil can absorb), and the slope, among others. For example, a mound system for a three-bedroom home, with a flow rate of 450 gallons per day (using tables based on number of bedrooms), a soil percolation rate of 20 minutes per inch, and a 2 percent slope would need a mound with a "footprint" approximately 45 feet wide and 70 feet long. This includes the area beneath the sloping sides. The mound could be smaller if the percolation rate was faster, the allowable loading rate was greater, there were fewer bedrooms or other factors were more favorable to effluent treatment.

Landscaping

The mound can be shaped in a variety of ways to suit individual landscaping and lot size needs. Properly landscaped areas around the mound can serve as a privacy barrier, a windbreak for homes, and to screen unsightly views. Building a contoured mound works well for slightly sloping hillsides, while one built in the shape of a right angle can be placed on a corner. A rectangular mound is acceptable for uniform slope locations.

Vegetation will help to make the mound look attractive, as well as keep it intact. Do not plant or allow large trees, shrubs or plants with extensive root systems to grow within 20 feet of the mound because of the possibility of damage caused by roots. Low maintenance grasses or perennial flowers may be planted on the mound, with those that are resistant to water stress planted at the top, where the soil will tend to be dry.

Maintenance

Septic Tank

Some maintenance of the septic tank, consisting of inspections and pumping, is required to prevent solids from entering the mound. Several factors determine tank-pumping frequency, including the number of people living in the home, wastewater generation rates and the amount of solids in wastewater, including whether a garbage disposal is used. Many experts recommend pumping a tank every two to three years. Depending on the factors listed above, a tank may need to be pumped more or less frequently. A safe approach is to have the tank inspected by a professional annually until pumping is required. Once the pumping interval is established, use that until there is a change in water use patterns. Additional people living in the home, children becoming teenagers, the installation of a garbage disposal, or the addition of a large-capacity whirlpool or

soaking tub could all increase water usage. Conversely, fewer people living in the home could decrease water use. For more information on septic tank maintenance, see NebGuide *Residential Onsite Wastewater Treatment: Septic System and Drainfield Maintenance* (G1424).

Septic Tank Effluent Filter

Due to the higher cost of a mound system, you will want to protect your investment and reduce the risk of failure by having an effluent filter installed at the outlet baffle of the septic tank. This filter is required by NDEQ regulations, and captures larger particles that might otherwise flow to and clog the mound system. The effluent filter should be cleaned when the tank is pumped, typically every few years.

Dosing Chamber

As with the septic tank, the pumping chamber should be checked by a qualified professional for sludge and scum buildup and pumped as needed. A qualified professional should check the pump and floats annually for signs of wear and replace as necessary. Follow the manufacturer's recommendations for pump maintenance. Have electrical parts and conduits checked for corrosion and to make sure the alarm is in working condition.

Mound

Maintain grass or vegetative cover to prevent erosion and also use some of the wastewater. If the mound has a lawn grass cover, mow it only two or three times a year. To reduce the chance of compaction, never mow grass on the mound if the soil is wet. Don't allow vehicular, animal or human traffic on the mound, as these also may compact soils. Consider fencing the mound area to keep pets or young children off the mound.

Summary

A mound system is an alternative to the traditional drainfield when the lot has slowly permeable soils, sandy or gravelly soils, or a high water table. A professional engineer, endorsed master installer, or registered environmental health specialist must design the mound system. The system includes a septic tank, pumping chamber and mound, all of which must be sized according to potential wastewater generation from the home. This is determined by the number of bedrooms and whether the home has a large capacity whirlpool or soaking tub or other amenities such as garbage grinders that increase wastewater generation rates or quality. Mound systems designed and constructed by qualified individuals in accordance with the requirements specified in Title 124 for a mound system are "authorized by rule" and do not require a permit from NDEQ. When a mound is designed using general provisions of Title 124 (i.e., not under the "authorization by rule" endorsement provision) a construction permit from NDEQ is required. A properly designed, installed and maintained mound system will protect human health and the environment.

Acknowledgments

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