

Choosing an Alternative Septic System for a Homesite with a High Water Table

WATER RESOURCES CENTER AND BIOSYSTEMS AND AGRICULTURAL ENGINEERING

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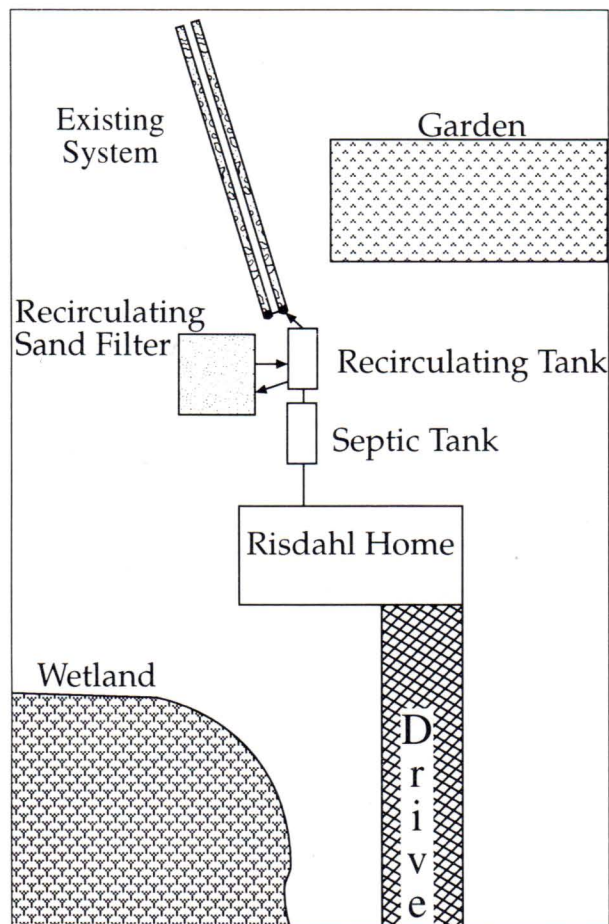
Problem Overview

Homeowners in Lino Lakes wanted to remodel their house by adding bedrooms and a bath, and increase the square footage of their living space. During inspection for a building permit, they were informed that the existing on-site wastewater treatment system was not in compliance with the current standards. With only 18 inches of unsaturated soil to the water table beneath their backyard, wastewater from their home was not adequately treated by their existing system. The untreated sewage had the potential to affect groundwater and nearby wetlands (figure 1) and could pose a serious risk to human health. The system needed to be replaced before they could get a permit for their remodeling project.

Because of the high water table, just adding to the existing standard drainfield trenches wasn't an option. The homeowners could have constructed a mound system, but chose to install an alternative system. The City of Lino Lakes supported exploring alternative options for on-site treatment. If you are considering an alternative system, be sure to contact your local government unit (LGU) early in the process to get approval.

This household uses water supplied by the municipality, so the location of a well was not a criterion when the system or location was chosen. Minnesota require-

Figure 1. Map of the site in Lino Lakes



Project Specifications

Location—Lino Lakes.

Problem—failing system didn't meet code.

Reason to upgrade—to remodel house.

Site limitations—high water table.

Type of system—recirculating sand filter (RSF).

Installation cost—\$5,400 including RSF, septic tank, refit of current tank.

Installation time—two days.

Unit size—10 ft x 10 ft RSF.

Capacity—600 gallons per day.

Effectiveness—excellent.

Monitoring—one hour/month to verify proper operation.

Annual maintenance—tank pumping and cleaning.

Effluent quality goals

- ◆ less than 20 mg/L BOD
- ◆ less than 20 mg/L TSS
- ◆ less than 10,000 coliform bacteria/100mL

ments establish minimum distances, or setbacks, between septic systems and wells, buildings, shoreland, and property lines. Setback requirements should be considered before selecting a system or location.

Why Did the Homeowners Choose an RSF System?

Because there was not enough separation distance between the bottom of the existing drainfield trenches and the water table to treat their household sewage, the homeowners needed a system that treated pathogens (disease-causing organisms) *before* the wastewater entered the drainfield trenches. Moreover, experimental studies have shown that a recirculating sand filter (RSF) is very effective at removing pathogens from wastewater.

The homeowners in Lino Lakes chose an RSF because it provides excellent wastewater treatment and was a cost-effective solution to their problems.

Certainly it's going to increase the value of the property and it sounds like it's a very simple system—so there shouldn't be a lot of upkeep.

Jack Risdahl, homeowner

In addition, the RSF required only a small area of the lot, so the installation did not disturb much of their lawn, and the finished system left room for their garden and other backyard activities.

System Design

An RSF was placed between the existing septic tank and trenches (figure 1). Wastewater moves from the house into a septic tank where solids settle out and some organic matter is decomposed (figure 2). Liquid effluent moves to the recirculation tank, and from there to the sand filter. The effluent is pumped repeatedly through the sand filter and then flows out via gravity

overflow to the drainfield. The system is designed to recirculate effluent through the filter at least five times before it is discharged into the trenches for final treatment.

When wastewater enters the system from the house, an equal amount is delivered into the trenches. A gravity-overflow system ensures that the recirculating tank does not drain completely, which would reduce treatment efficiency and possibly allow the system to freeze during the winter.

To ensure the system is working properly, samples are collected from the recirculation tank. Sampling frequencies are determined by the LGU or permitting agency. Usually, homeowners contract with a professional to collect and analyze these samples. During the first six months samples are collected weekly. Samples are collected monthly for the next six months and, thereafter, samples are collected annually to ensure the system is working properly.

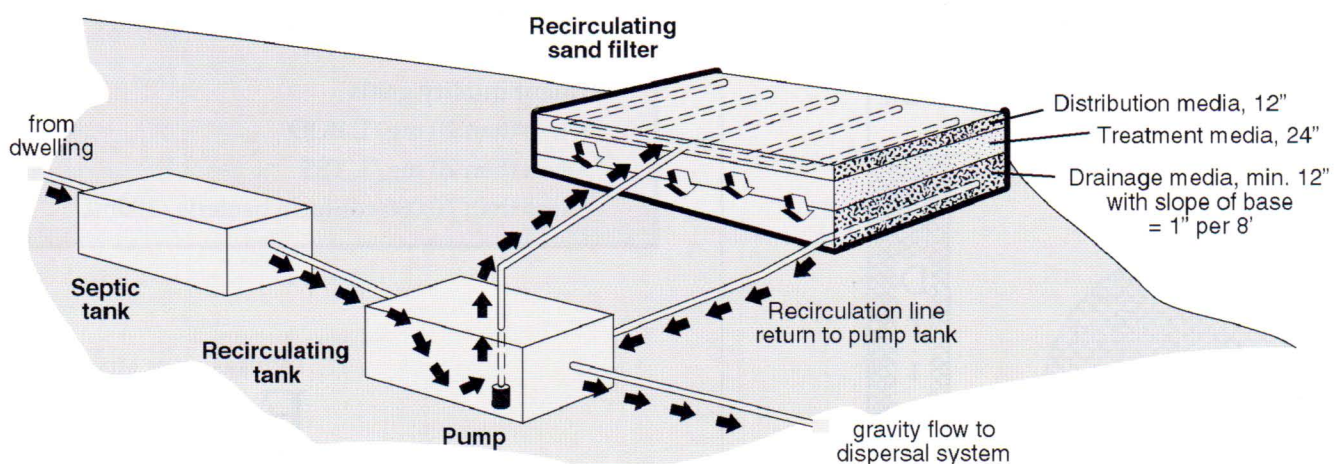
RSFs require regular observation and maintenance to make sure the timer control is working correctly. If the timer control fails, the system will *not* treat wastewater, although there may be no obvious signs that untreated sewage is reaching the drainfield. Monthly monitoring is required at start-up, but monitoring frequency decreases as system performance is documented.

If you are considering an alternative system, it is extremely important to estimate typical flow rates from your household and make sure that the system is properly sized, designed, installed, inspected, and maintained.

Installation and Costs

Installing an RSF in Lino Lakes minimally disturbed the homeowners' yard and family life. Installation took about two days and the system was operational immediately. It took several weeks for grass to regrow. The final cost of this system was \$5,400, which included the new tank and RSF.

Figure 2. Septic system design using a recirculating sand filter



Treatment Effectiveness

Biochemical oxygen demand (BOD) is the most widely used parameter to evaluate wastewater. It is a measurement of the dissolved oxygen used by microorganisms in the oxidation of organic matter in sewage. Total suspended solids (TSS) is a measure of the organic and inorganic solids that remain in wastewater after separation occurs in the septic tank. There are many pathogenic organisms present in wastewater that are difficult to isolate and identify. The human intestinal tract contains many types of coliform bacteria that are passed with feces. If coliform organisms (which are easy to test for) are present in wastewater, this is a warning that pathogenic organisms may also be present.

The Lino Lakes system was installed as part of an experimental project to assess treatment efficacy, so the system is being monitored regularly during the first few years of service. Treatment goals for the newly installed RSF are to achieve 20 mg/L BOD, 20 mg/L of

TSS, and fewer than 10,000 most probable number (MPN) of coliform bacteria per 100 mL in the wastewater.

The system has performed well but has not reached the desired treatment goals. Currently, BOD is 15 mg/L, TSS is 23 mg/L, and there are 17,000 MPN coliform bacteria/100 mL of wastewater. However, a high level of treatment is being achieved in the RSF because 75–93 percent of the contaminants are being removed. In addition, 39 percent of the total nitrogen and 36 percent of the total phosphorus are also being removed. The recirculation rate was increased in an attempt to improve treatment. If needed, an effluent filter may be placed on the septic tank to limit the amount of solids leaving the tank.

To date, the Lino Lakes upgrade has been a success because the RSF and trenches have operated properly. Estimated treatment costs for various types of septic systems are given in table 1.

Table 1. Cost in dollars of treating sewage over 25 years for a typical homeowner using various treatment options*

	Design and installation	Annual cost of operation, maintenance, and repair	Total cost
Septic tank with trench	3,000–6,000	30–200	6,300
Septic tank with mound	4,000–12,000	80–500	12,800
Septic tank—with alternative treatment system and sub-surface discharge			
♦constructed wetland	5,000–15,000	50–550	13,500
♦sand, peat, or recirculating filter	5,000–15,000	500–1,000	22,000
Drip dispersal	7,000–10,000	600–1,700	31,500
Aerobic tank (package plant)	4,000–7,500	600–1,700	28,750
Holding tank (strict water use)	2,000 + new fixtures	800–1,500+	25,000
Holding tank (normal water use)	2000–3000	2,000–5,000+	70,000
Municipal	4,000–10,000+	200–400	13,000

*Values were determined using median cost of design, installation, operation, maintenance, and repair over 25 years and do not take into account the changing value of money over time.

On-Going Maintenance

Unlike a more traditional septic tank and drainfield system, an RSF cannot be completely ignored between annual maintenance appointments. Initially, the RSF requires weekly inspections, which can be reduced to monthly inspections after a few weeks. In addition, an RSF requires regular attention to ensure the timer control is working and, just like a traditional system, the septic tank needs regular cleaning. The *Septic System Owner's Guide* (see at right to order) will help you calculate how often your tank needs cleaning, based on how much water you use.

The pump (costing \$400-500) will probably need to be replaced in the next 20–30 years. RSFs are so effective at treating waste that the life of the drainfield may be extended.

Homeowners, however, will have to pay for regular monitoring of the effluent. Because RSFs are designed to treat wastewater *before* it enters the trenches and groundwater, it is imperative that the system is working correctly. Check with your LGU to find out whether it requires a contract agreement for monitoring.

County Contact

For more information about requirements and guidance concerning alternative systems in your county, contact your county planning and zoning department. In the seven-county Twin Cities metropolitan area, you may call the Metropolitan Council at 651-602-1005 for assistance in identifying the correct local office. In greater Minnesota, check with your county Extension office.

Additional Resources

Septic Systems Revealed: A Guide to Operation, Care, and Maintenance. Item number: VH-6768-WRC. \$15.00.

This video describes the basics of septic systems, including system features, safety, use, operation, maintenance, and troubleshooting. It also serves as a stand-alone resource, or may be purchased in a package along with written material titled "*Septic System Owner's Guide*," item number EP-6769.

Septic System Owner's Guide. Item number PC-6583-WRC. \$4.00.

A fully illustrated guide for owners of septic systems. Includes information on safety, system features, use and operation, maintenance, and troubleshooting.

Ordering Information

To order Extension educational materials, call 1-800-876-8636 or contact your county Extension office.

To find more information about Extension publications (including quantity discounts), point your browser to www.extension.umn.edu.

Septic System Package Available

A video was developed to accompany this and other septic system publications, or is included if you ordered package EP-7572. The video documents the construction of three alternative systems (including the one described here) and the reasons for selecting each type. It also includes interviews with homeowners and experts.

Special thanks to Metropolitan Council Environmental Services for funding the design, construction, and monitoring of this—and two other—alternative systems in the Twin Cities area.

FO-7571-B
EP-7572
2000

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