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Project Summary

Oregon Onsite Experimental Systems Program

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This study was initiated to develop useful design and performance data on onsite wastewater treatment and disposal systems that would permit the use of nonsewered technological solutions to residents of rural and suburban areas of the State of Oregon and the rest of the United States.

To exclude the possibility of system failure because of neglect or abuse, all systems were installed at the homeowner's expense. The systems were choosen to suit the specific climate, soil conditions, and topography of the site from a variety of previously developed and locally conceived systems modified to suit the application. Among the technologies evaluated were three types of sand filters, two types of evapotranspiration systems, mounds, biological (composting) toilets, graywater systems, steep-slope systems, pressure distribution, tile-dewatering systems, and various combinations there of.

The study resulted in several significant findings. The sand filters consistently (a) removed significant amounts of nitrogen, (b) removed organics and suspended solids to extremely low levels, and (c) forestalled development of clogging mats in subsequent disposal trenches. Successful hand-dug systems were installed on slopes of up to 45% where soils were deep (>150 cm). A successful demonstration was given of the ability of pressure distribution to prevent groundwater contamination where the unsaturated soil depth exceeds 77 cm. Pure evapotranspiration systems in Oregon were shown to be impractical. And finally, the substandard performance of some commercial graywater treatment systems was demonstrated and compared with that of conventional septic tanks and subsurface disposal fields proportioned to graywater flow only.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Because of various site constraints, many Oregon property owners and developers were not able to develop land and build homes in the 1970's because they could not obtain permits for onsite subsurface sewage systems. This situation aggravated the housing shortage, stimulated higher prices on existing housing, and increased pressure to develop prime agricultural land. These trends conflicted with the stated land use planning goals of Oregon to provide for the housing needs of the citizens of the State and to preserve and maintain agricultural lands. This conflict prompted the Oregon Department of Environmental Quality (DEQ) to develop alternatives to the standard septic tank and drainfield. In addition, suitable alternatives were needed to repair failing systems that were causing public health and groundwater problems.

In 1975, the DEQ initiated a program to relate onsite sewage system performance to soil, landscape, groundwater depth, and other potentially important site characteristics. A second facet of this program was to install and test a variety of experimental onsite systems designed to overcome site constraints to conventional soil absorption systems. By 1977, the program was supported jointly by the Oregon Legislature and the U.S. Environmental Protection Agency (EPA). The intent of the program was to develop alternatives to the standard septic tank and drainfield through controlled experimentation. The DEQ identified problem soil areas, either with a history of failing systems or high denial rates, selected suitable sites according to defined criteria, designed alternatives to overcome site limitations, supervised construction, monitored system performance, evaluated data, and drafted rules to adopt alternatives that would function satisfactorily. The land owners installed systems according to plans and specifications and allowed the DEQ access to monitor them. In addition, the owners had to be willing to risk investing money on experimental systems that might fail.

As a result of this program, certain technologies that proved successful were adopted as alternative systems for use where certain site constraints existed that had heretofore prohibited development of otherwise suitable lands. These alternatives have raised the site evaluation approval rate from 72 percent in 1978 to more than 95 percent during the first half of 1981, thus easing the demand for prime agricultural land.

Results and Discussion

The most significant success has been related to the sand filter systems. The three basic designs evaluated were recirculating, intermittent, and intermittent-recirculating (I-R) filters. All three reduced influent septic tank effluent biochemical oxygen demand (BOD_5) by >95%, suspended solids (SS) by >93%, and total nitrogen (TN) by >34%. Since the septic tank effluent averaged 217 mg/L BOD_5, 146 mg/L SS, and 57.5 mg/L TN, final concentrations were <4 mg/L, <10 mg/L, and <35 mg/L, respectively. Also, these effluents appeared to reduce the normal clogging usually encountered in the disposal trenches with septic tank and aerobic unit effluents. The intermittent filters required no maintenance, and the recirculating designs and I-R systems required periodic removal of fallen debris and weeds. Also, the I-R systems were subject to freezing and spray-nozzle clogging.

Though the results of these filter studies were slightly better in terms of removal efficiencies (particularly in relation to nitrogen), the hydraulic loading rates were lower and the media size were smaller than other recent studies, thus providing performance consistency through variable adjustment.

Other onsite technologies studied included graywater systems. The data generated were similar to those from other North American studies and showed the similarity of composition to combined household wastewaters and the need for identical public health precautions in disposal. Evapotranspiration-absorption (ETA) systems worked well in areas where precipitation did not exceed 63.5 cm/year, construction was adequate, sufficient sizing was employed, and soils were adequately drained. Most disposal was estimated to have resulted from soil absorption. Pressure distribution systems were most useful in coarse- to medium-textured soils, where groundwater contamination problems often associated with gravity-dosed systems were avoided. Hand-dug systems on steep slopes of up to 45% performed well where the soil was well-drained and the unsaturated zone was a minimum of 150 cm deep. Most States have limited the site slope to about 25% because of the limitations of excavating equipment. Drainage was successful in reducing groundwater levels in a disposal area of medium-textured soils with otherwise intolerable water tables. Several systems installed with this tile drainage arrangement (1.2- to 1.8-m deep) separated from pressure-distribution disposal trenches by at least 3 m performed well and gave no indication of deleterious effects on the groundwater or drain water on sites with sufficient relief to allow gravity drainage of the perimeter drains.

Several other alternative onsite designs were also installed and evaluated. Some were never adopted as alternatives by the State for various reasons. For example, evapotranspiration systems were dropped because of their cost even in arid regions of the State. Also, mounds were dropped because of their cost and lack of applicable sites in Oregon. Some systems enjoyed a certain level of success, but they have not yet been adopted for reasons varying from insufficient data to inadequate performance versus design parameter evaluation.

Conclusions

Several alternative technologies are arrayed against site constraints in Table 1, showing the technologies applicable to a particular site condition. For example, the table indicates that shallow groundwater at a site should alert a designer to choose among capping fills, intermittent sand filters, tile dewatering, pressure distribution, evapotranspiration systems, or mounds. Another way of using the table is to determine the applicability of a given alternative technology. For example, pressurized distribution has been determined to be useful for very permeable, deep soils with slopes of up to 30%. The table does not include all of the site variables (such as climate) or all of the technologies studied during this project. But for reference it does include two previously proven technologies—conventional onsite and capping fill designs.

The main conclusion of the study is that the conventional septic tank/soil absorption system is the most cost-effective and trouble-free solution for onsite wastewater disposal where suitable site conditions exist, but that several alternatives can be used to overcome one or more site constraints.

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Table 1. *Oregon Onsite Subsurface Systems Versus Site Constraints*

	Site Constraints											
	Soil Permeability			Solid Bedrock or Soil Pans		Depth to Saprolite or Fractured Bedrock		Groundwater		Slope		
System	Rapid	Moderate	Slow	Shallow	Deep	Shallow	Deep	Shallow	Deep	0-12%	12-30%	30-45%
Standard sub-surface system		X*			X		X		X	X	X	
Camping fills	X	X		X	X	X	X	X	X	X		
Evapotranspiration absorption			X		X		X		X	X	(15%)	
Pressurized distribution	X	X			X		X		X	X	X	
Intermittent sand filter systems	X	X	X	X	X	X	X	X	X	X		
Steep Slope system		X			X		X		X			X
Tile dewatering system	X	X			X		X	X		(3%)		
Split waste system		X			X		X		X	X	X	
Evapotranspiration bed	X	X	X	X	X	X	X	X	X	X		
Mounds	X	X		X		X		X		X		

** X Means that system can function effectively with that constraint.*

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The complete report, entitled "Oregon Onsite Experimental Systems Program," (Order No. PB 85-107 126 Cost: $22.00, subject to change) will be available only from:
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