Small, Green, and Useful

Encouraging green development with decentralized wastewater approaches

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The southeastern United States — along with the rest of the country — will see dramatic population increases during the next 20 years. A projected increase of 16 million people in Florida, North Carolina, and Georgia would equate to more than a 1.5-billion-gal/d (5.7-million-m^3/d) demand for water and the resulting wastewater production.

Decentralized wastewater treatment systems have the potential to provide a critical infrastructure element of wastewater treatment in a cost-effective and beneficial manner, as well as enable green development and more efficient land use, helping meet this population demand.

In *Response to Congress on Use of Decentralized Wastewater Treatment Systems* (EPA-832-R-97-001b), the U.S. Environmental Protection Agency (EPA) asserts that despite high failure rates of decentralized and onsite systems in the 1990s, "adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less populated areas."

Experience with decentralized systems in several southeastern states has demonstrated their benefits and provided models of sound management to ensure successful operation at an affordable cost.

System Description

Decentralized systems offer smaller, simpler treatment systems sized for specific areas, communities, or developments. Larger areas also can be served with this approach, but the system usually will consist of several smaller complete systems.

Decentralized systems in the U.S. Southeast typically fall into two groups: individual onsite treatment units and cluster systems serving multiple users. The individual onsite systems include traditional septic tank and drain field systems updated with improved designs and applications, as well as more advanced individual household treatment units that achieve much higher levels of treatment, in some cases high-level nutrient removal.

Cluster systems, on the other hand, typically are used where extending a centralized system is impossible or too costly. Cluster systems typically serve 50 or more residences and are characterized by lower costs and less complex collection and treatment, usually followed by subsurface dispersal of treated effluent or treated effluent reuse.

One of the most common cluster system designs includes a septic tank at each house, a filter and pump well in this tank, small-diameter (2- to 3-in. [50- to 75-mm]) polyethylene collection line, recirculating fixed-film treatment system, and subsurface drip irrigation system. This type of system, often called a "septic tank effluent pumped" (STEP) system, is shown in Figure 1 (below) and the photo on p. 67.

The septic tank, filter, and pump at each house remove settleable solids, and the effluent flows through the collection line to the recirculating fixed-film treatment system. This system uses simple technology with low operation and maintenance costs to produce an effluent that is often higher quality than effluent that has undergone traditional secondary treatment.

The treatment system effluent typically is dispersed through small, subsurface drip lines. Because the drip lines are buried only 6 to 10 in. (150 to 250 mm) deep, they provide additional separation distance to groundwater and allow

Figure 1. Typical Cluster (STEP) Wastewater Collection System Layout

STEP = septic tank effluent pumped.

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The Windy Oaks decentralized treatment system near Mobile, Ala., is so innocuous the adjacent residents did not realize the equipment was for wastewater treatment. Each green pod is an individual fixed-film (textile) bioreactor; a large recirculation tank with pump equipment is buried next to the pods. Effluent is dispersed via a subsurface drip field in the grassed area beyond the treatment system.

cover vegetation to take up a significant amount of nitrogen and phosphorus. Alternately, effluent can be disinfected via ultraviolet radiation and reused, depending on state reuse standards.

Since decentralized systems focus on smaller areas, the location where the wastewater is treated and reused (or dispersed in subsurface irrigation) can be closer to its original source, offering savings in the most expensive element of a traditional centralized approach: the collection and transmission system.

For example, in the type of STEP system described above, settling solids in the individual septic tanks enables the use of the smaller-diameter collection line, which is much quicker and easier to install than the traditional 6- to 8-in. diameter (150- to 200-mm diameter) collection piping. The larger pipe and more invasive installation lead to much higher costs per foot of line and much greater disturbance to the route (see Figure 2, p. 70).

Cases in Point

Three Southeast communities have found that cluster systems can yield significant rewards. While the media in the recirculating fixed-film treatment system vary, the basic operation is the same.

- Each cluster system is fully owned and operated by a utility to ensure proper maintenance and treatment.
- Each utility owns and manages several cluster systems.
- All of the systems use the STEP configuration.

Mobile Area Water and Sewer System. The Mobile (Ala.) Area Water and Sewer System (MAWSS) serves 400,000 residents. In addition to two large wastewater treatment plants with a combined capacity of approximately 42 mgd (159,000 m^3/d), 1200 mi (1900 km) of gravity sewers, 200 lift stations, and 120 mi (190 km) of force mains, MAWSS owns and operates five cluster wastewater treatment systems. MAWSS is one of the few large centralized collection and treatment utilities that have seen the benefit of moving into the cluster wastewater area.

MAWSS's cluster treatment systems treat a total capacity of more than 150,000 gal/d (570 m^3/d), serving more than 700 homes and two schools. The largest of these systems is approximately 60,000 gal/d (225 m^3/d). The recirculating fixed-film treatment system uses sand and gravel media followed by a subsurface drip system that uses the effluent to irrigate a sod farm.

Each system has telemetry monitoring at each house connected via telephone line to the MAWSS control center, so any problems will be detected immediately.

The users' only involvement in these systems is to pay the "sewer" bill to MAWSS, just as if they were connected to the centralized system. MAWSS bills the same sewer charges for the cluster system users' operation and maintenance cost as for the users of the centralized system. This is a financial

benefit to MAWSS, since the cluster systems are less costly to operate.

South Alabama Utilities. Also in the Mobile region, South Alabama Utilities (SAU) is a water and gas utility that entered the decentralized wastewater treatment system business in the late 1990s. The utility serves western Mobile County, where most of the residential growth has occurred during the last 10 years. SAU has more than 10 cluster systems with the capacity to serve approximately 2500 homes, two schools, two apartment complexes, and a truck-stop facility.

When developers came to the area, SAU offered the option of STEP-style cluster wastewater systems instead of individual septic tanks. The cluster system requires much less land and frees homeowners from maintenance worries.

SAU also owns and operates the entire system from the point the wastewater leaves the house through the subsurface dispersal system. The subdivision developer funds the initial construction, including the collection lines, recirculating fixed-film treatment facilities (usually textile media), and dispersal system — all built to SAU specifications. The individual house portion of the system — septic tank, filter, and pump — is built with the house and included in its cost.

For the $35 to $45 average bill, the homes served by SAU's cluster systems receive outstanding treatment with no odor or noise problems, as well as support a fund for future equipment replacement costs.

The Alabama Department of Environmental Management requires monitoring nitrate in groundwater at the perimeter of the subsurface dispersal area for all the decentralized systems in the state. The department has found that these systems show excellent compliance with the groundwater monitoring requirement of 7.5 mg/L limit, which is more stringent than the EPA limit of 10.0 mg/L.

These STEP systems in the Mobile area represent a significant performance improvement over traditional septic tank and drain field developments of the past, and have provided savings of 25% to 50% over centralized collection and treatment.

Rutherford County Consolidated Utility District. The Rutherford County (Tenn.) Consolidated Utility District (CUD) owns and operates 25 STEP cluster systems. CUD also owns and operates all equipment from the tank on. If any equipment malfunctions, CUD will repair or replace it. However, if a stoppage occurs in the inlet pipe entering the tank, the homeowner is responsible for clearing it.

A 2-year study of 10 such systems in Rutherford County shows impressive treatment capabilities. The CUD system results are significantly better than most major centralized treatment plants; this high-level performance, coupled with the cost savings associated with these systems, explains the increase in their use (see table, p. 71).

Figure 2. Conventional Versus Decentralized Collection Line Installation

Two-Year Performance Study of 10 Systems in Rutherford County, Tenn.		
Parameter	**Average**	**Maximum**
Biochemical oxygen demand	Less than 5 mg/L	Less than 5 mg/L
Ammonia	Less than 0.1 mg/L	2.2 mg/L
Fecal coliform	Less than 2	3300
Data collected after treatment, before subsurface drip dispersal. Source: Tennessee Department of Environment and Conservation		

Sprawl Control

Cities and counties know that extending a centralized wastewater collection system to serve a remote development will almost ensure that all the land along the collection line will fill in with development. Also, transporting wastewater long distances to treatment hinders reuse possibilities.

Decentralized systems offer the potential to preserve green space or the rural character of a region while ensuring adequate wastewater treatment to protect the environment from larger populations. Unfortunately, the current experience with decentralized systems has not lived up to this potential. Some systems have merely allowed development in places that could not be served with traditional approaches, with little evidence of benefits, other than to the developers.

However, recent trends indicate these systems are being seriously considered in some regions as part of sustainable development. For instance, in Coweta County, Ga., one of the urban fringe counties south of Atlanta, officials recognized that the rapid growth threatened the rural character of their county. The county began planning for future growth in a way that maintained and encouraged the livable community atmosphere valued by the residents.

The county plan envisions a series of village centers in existing communities, with other land predominantly preserved. The county recognized that centralized collection and treatment would have an important role in urbanized areas and that attempting to connect village centers to a central system would encourage infill development along the sewer line routes. As a result, the plan promotes the use of STEP-type cluster systems.

The county has contracted with a local public utility to construct, operate, and maintain decentralized wastewater systems in the county. The utility provider has a similar agreement with a neighboring county and handles a total flow of about 600,000 gal/d (2300 m^3/d) with cluster systems.

Another example of a sustainable development concept is the Serenbe Community in southwest Fulton County, Ga., about 35 mi (56 km) from Atlanta. The area is a 600-home planned development that is the first in a 40,000-ac (16,000-ha) portion of Fulton County zoned as conservation development, which requires 60% of the land to remain undisturbed.

The Serenbe project will consist of three villages connected by a winding road and numerous hiking trail and footpaths. Each home will face a village street and back up to preserved green space. Approximately 70% of the development's acreage will remain undisturbed.

The Serenbe villages are served with a STEP-type wastewater system. Treatment is provided by the combination constructed wetland and recirculating fixed-film treatment facility that includes ultraviolet disinfection and a reuse system for subsurface landscape irrigation.

Evolving Success?

To paraphrase EPA's *Response to Congress,* the key to successful decentralized wastewater treatment is adequate management. Many of the best systems also are wholly owned by the entity responsible for operation and maintenance; in this model, the homeowners are only responsible for paying their bills, as they would be if connected to a centralized system.

The decentralized wastewater treatment and reuse concept has the potential to provide efficiencies and benefits not present with traditional centralized wastewater collection and treatment, as some notable communities have demonstrated.

If the benefits of decentralized wastewater treatment related to land-use planning are to be realized, they will have to be made part of a sustainability paradigm and not used only as a way to serve remote communities or develop land with poor soils. Whether this occurs will be determined by how well growth-planning ideas are blended with wastewater treatment concepts, which will require more interaction between city and county planners and wastewater utilities.

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