



Decentralized Onsite Wastewater Technologies

Sustainable Green Infrastructure Protects Source Water Quality and Public Health

About 25 percent of the wastewater that is generated daily in the United States and Canada is treated by decentralized wastewater systems that use onsite technologies.* Further, the U.S. Environmental Protection Agency (EPA) reports that properly designed, installed, operated and maintained onsite systems are capable of providing treatment comparable to the most sophisticated centralized wastewater treatment plant. Despite the large amount of sewage that is handled by onsite systems and their excellent treatment capabilities, decentralized technologies have not truly been considered part of the permanent wastewater infrastructure. The State Onsite Regulators Alliance (SORA) believes that decentralized systems using onsite technologies must be considered a permanent part of our wastewater infrastructure, if source water and public health are to be adequately protected. Decentralized systems must be installed, operated, managed, and funded as an integral part of our permanent infrastructure if they are to sustainably protect our environment and public health in a sustainable manner.

In the 1997 *Response to Congress on Use of Decentralized Wastewater Treatment Systems*, EPA stated, “adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals.” In addition to being sustainable, onsite systems may be one of the oldest “green” technologies from three perspectives.

1. Onsite technologies effectively recycle water resources back to the environment for reuse. Most onsite systems use soil absorption for treatment and dispersal of wastewater. Water purified by the soil absorption portion of an onsite system can either replenish the groundwater supply or move as base flow recharge to adjoining surface waters.
2. Often, far less energy is expended to treat sewage with an onsite system than a centralized treatment facility. Many basic systems require no energy to operate because they have gravity-flow collection and rely on soil absorption for treatment of sewage. Further, because the treatment system is near the source of wastewater, collection

* The Consortium of Institutes for Decentralized Wastewater defines a decentralized wastewater treatment system as, “a wastewater treatment system for collection, treatment, and dispersal/reuse of wastewater from individual homes, clusters of home, isolated communities, industries, or institutional facilities, at or near the point of waste generation.” The definition of an onsite wastewater treatment system is, “a wastewater treatment system relying on natural processes and/or mechanical components to collect and treat sewage from one or more dwellings, buildings, or structures and disperse the resulting effluent on property owned by the individual or entity.”

systems associated with onsite systems are smaller than centralized systems, and require less energy to move the sewage around the system.

3. Decentralized systems, under the right circumstances, can be more cost effective than a centralized system, using available community resources more efficiently.

While SORA recognizes that decentralized systems are not the answer to every wastewater treatment problem, the onsite industry has developed a remarkably diverse array of options. If suitable soil is not available to completely treat the sewage, pretreatment of wastewater may be an option, provided a site has sufficient hydraulic capacity to disperse the treated effluent. Onsite pretreatment is accomplished most frequently by providing an anaerobic process followed by an aerobic environment in which disease organisms cannot survive and sewage strength rapidly decreases to acceptable levels.

Common Pretreatment Technologies

Pretreatment systems commonly used in conjunction with decentralized systems include: fixed media filters, trickling filters, aerobic treatment units, and membrane bioreactors.

Fixed media filters contain unsaturated media to which aerobic organisms can attach. An aerobic environment is maintained in these filters by the “passive” movement of air into the media. As sewage filters through the unsaturated media, treatment is accomplished by the aerobic organisms attached to the media. Many different types of materials can be used for the fixed media: sand, fabric, peat, polystyrene pellets, and other proprietary media. The treated effluent from the filter is sometimes recycled back to an anaerobic environment like the septic tank to achieve nitrogen reduction through denitrifying bacteria, if the groundwater or nearby surface waters are nitrogen sensitive.

Trickling filters generally have larger media than a fixed media filter. The larger media allow for more rapid transfer of air into the filter by passive means than the finer media found in most fixed media filters. Because of the improved transfer of air, higher strength waste (e.g. from a restaurant) can be treated. The disadvantage is that trickling filters contain less surface area per unit volume for attached growth of aerobic organisms. This means that greater depth of filter or recirculation of the waste back through the filter may be necessary to achieve adequate treatment of the waste. Alternatively, forced aeration may be combined with the coarser media to create what is termed an aerobic packed bed bioreactor.



Aerobic treatment units develop an aerobic treatment environment by “actively” forcing air into the sewage with a pump. Disinfection of the effluent may be required. These units are approved under National Sanitation Foundation Standard 40 and are used in a number of states.

Membrane bioreactors are beginning to be used in conjunction with decentralized systems. The remarkable characteristic of this system is that the filter is able to remove contaminants of concern by filtration, while still maintaining sufficient permeability to pass the treated water through the filter. The system has the potential for producing treated water that could be reused onsite.

This list of available onsite technologies is not intended to be exhaustive; it is intended to demonstrate that most all of the treatment options available to the designer of a central sewage system are available to the designer of a decentralized system.

Sustainable performance of any wastewater treatment system requires proper operation and management of the system. Decentralized systems are no different than other wastewater treatment systems in this regard. Even a septic tank system that serves an individual residence must have the contents of the tank pumped from time to time, to prevent the soil absorption system from being clogged by solids. Responsibility for the operation of such systems is most often assumed by the owner, although some environmentally sensitive areas have chosen to manage them through a sanitary district or rural cooperative in order to protect the resource which attracts people to the area. Systems that treat a large amount of wastewater have daily operational needs. A trained and certified individual is required to operate such systems. A complex pretreatment system may also require that the system be operated by a certified operator. Complex systems designed to meet the needs of even an individual home will need an operator to maintain pretreatment system components and monitor system performance. The level of operation required to achieve sustainable performance of a decentralized system depends on system size and complexity.

The SORA fully endorses the need for appropriate management of decentralized wastewater systems. Proper management is required to achieve sustainable operation of a decentralized system. The SORA further recognizes that management requirements must be sensitive to the political concerns of the community that the wastewater system serves. No single management framework will suit the needs of all communities.



EPA has developed a set of guidelines to assist communities with the appropriate choice of management for a broad range of decentralized systems. Management requirements for a complex decentralized system that serves a large community are similar to a municipal system and may require the formation of a private or public utility to meet the needs of such systems. SORA recognizes that the community served by a decentralized system must be involved in the selection of management structure that is deemed appropriate for any particular system.

Finally, the choice of wastewater treatment system must be cost effective if sustainability is to be achieved. A decentralized system may be more cost effective than a centralized system under the right circumstances. Careful assessment is required to determine the best option for a given set of site conditions. Both capital and operational costs must be considered in the assessment.

The SORA encourages community leaders and system designers to evaluate the potential for decentralized systems to meet their wastewater treatment needs. Further, the SORA believes funding sources for wastewater treatment systems need to be open to considering decentralized systems as a sustainable alternative to traditional central sewage systems.

For More Information

Many resources are available to assist the community leader and system designer in determining which alternative is best suited to their needs.

The National Environmental Services Center (NESC) provides a number of free materials at: www.nesc.wvu.edu. In particular, NESC offers the following resources:

“Decentralized Wastewater Treatment Systems.” 2000. *Pipeline*, Volume 11, No. 4. Available online at: www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_FA00.pdf

“Funding Sources are Available for Wastewater Projects.” 1999. *Pipeline*, Volume 10, No. 4. Available online at: www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_FA99.pdf

The U.S. Environmental Protection Agency offers the following three publications:

The Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems. 2005. (EPA/832/B-05/005). Available online at: www.epa.gov/owm/septic/pubs/onsite_handbook.pdf



It's Your Choice: A Guidebook for Local Officials on Small Community Wastewater Management Options. 1987. (EPA/430/9-87/006). Available online at: www.epa.gov/owm/septic/pubs/septic_its_your_choice.pdf

The Onsite Wastewater Treatment Systems Manual. 2002. (EPA/625/R-00/008). Available online at: www.epa.gov/nrmrl/pubs/625r00008/html/625R00008.htm

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