world water

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Decentralized treatment gains global acceptance

Community decentralized treatment systems provide critical protection to water resources in areas without access to affordable centralized sewer networks. Dennis Hallahan of Infiltrator Water Technologies explores recent regulatory developments and project applications that illustrate the global acceptance of the decentralized treatment solution.

The decentralized wastewater treatment model has finally gained recognition as a scientifically based and cost effective wastewater treatment solution. Today, advanced decentralized wastewater treatment technology and installation approaches are providing an expanding number of decentralized strategies to address evolving and increasingly challenging wastewater treatment needs. These approaches provide accessibility worldwide to treatment in areas that previously had few options.

Decentralized treatment systems provide land use options and restore local aquifers. If developers and builders had to rely solely on centralized sewering to dispose of wastewater from their projects, development in many areas would be unfeasible due to a lack of capacity to accommodate additional flows, the high unit cost of sewering, or a lack of funding to expand the centralized wastewater treatment facility. The decentralized approach supports smart, responsible growth. In more and more cases, the size and construction of the decentralized wastewater treatment system influences the way land can be used and developed.

The decentralized model collects, treats, and then discharges to the subsurface either at or very close to the point of origin, replacing the original water resource to the local aquifer at a much lower energy cost. Properly designed and installed decentralized wastewater treatment systems have the capacity to process large quantities of wastewater into the underlying soils, making this option one of the most passive and sustainable forms of aquifer recharge while providing both wastewater treatment and groundwater recharge in one step. Via this sustainable practice, the replenished aquifer can supply wells, recharge wetlands for wildlife, maintain base flow for streams, and counteract saltwater intrusion in coastal cities and towns.

Regulatory response

The value of preserving the world's water resources is recognized as one of the greatest challenges of our time. Increasingly restrictive codes with the goal of protecting vulnerable environments are causing municipalities to push engineers and developers to present wastewater treatment solutions that can perform long term and sustain development. Health codes that regulate onsite wastewater system design and installation are becoming more stringent with the growing awareness of environmental damage from nitrogen and phosphorus nutrients.

Regulators have embraced new products and engineered wastewater treatment solutions by adjusting codes to reflect the enhanced performance capabilities of new wastewater treatment products including the higher throughput rates of aggregate free products such as plastic leaching chambers and engineered geosynthetic aggregate. Advanced Treatment Units (ATUs) are also gaining attention because of the ability to treat nutrients. The scientific research findings and third-party performance testing data available is helping regulators worldwide to be proactive, benefiting those they serve by including advanced treatment systems within their array of wastewater solutions.

Beyond single family homes

Decentralized systems continue to serve small, single family homes in rural areas; however, large-scale municipal and commercial wastewater projects worldwide are using decentralized treatment technology to handle flow rates of more than 3.785 million liters per day (1 ML/d). Commercial developments and communities no longer must wait or pay exorbitant tap fees to tie-in to existing centralized services.

The expansion of acceptance and capability of decentralized wastewater treatment systems is critical to environmentally or economically vulnerable areas. Replacing or rehabilitating outdated onsite systems such as cesspools, installing wastewater treatment where none previously existed, and eliminating surface discharge and nitrogen pollution have been leading initiatives. Finding less capital-extensive solutions that can extend the life and expand the capacity of existing centralized systems is also a high priority in many communities that are open to smart, sustainable development but that have aging or undersized wastewater treatment plants.

Right: The IM tanks with the ECOPOD-N treatment system were installed behind the house by lifting into place with a mini-excavator. The use of low-profile chambers in the drainfield eliminated the need for imported capping fill. Installation and final grade resulted in negligible impact on the existing lawn.

Top right: This small community of Surgoinsville, Tennessee was far from any treatment plant so a wastewater district was created to access funding for the wastewater treatment project. The district manages the installed systems. The district received funding and charges nominal monthly fees to pay back the loans. The difficult Appalachian sites with steep slopes and limited backyard access to existing homes made tank installation challenging and the ease of handling of the plastic tanks provided the ideal solution. Photos by Infiltrator

New products expand applications

The new generation of onsite wastewater treatment products that enhance design options and system performance, ease installation, and reduce management dilemmas are the key to responsible and sustainable growth and environmental protection. Innovative, space-saving, and high performing flexible technologies can be easily adapted to site conditions, installed at a reduced size, and even contoured to match the available landscape.

Chambers

Recycled plastic leaching chamber systems account for an estimated one in every three onsite wastewater treatment systems constructed in the United States. Engineers and system designers have found that in addition to use in septic system leaching trenches and beds, chambers are effective for specialized system designs including sand filters, mound systems, evapotranspiration beds, community (cluster) systems. In large community or commercial systems, engineers often use a combination of technologically advanced filters, pumps, tank configurations, and chambers to provide a higher level of treatment. However, like sewers, these systems need a Responsible Management Entity (RME). The use of recycled plastic in manufacturing chambers reduces the volume of plastic entering landfills and waterways, which is appealing to communities and customers.

In the case of community wastewater treatment facilities that are reaching or are over capacity, adding an exfiltration bed using chambers can extend the life and community investment in the water resource recovery facility and have the added benefit of reducing phosphorus and eliminating outfall discharges to bodies of water. For example, the Forest Lakes Country Club, located just outside Halifax, Nova Scotia, Canada, installed an onsite distributed wastewater treatment and disposal system for this purpose.

The four-season resort community will ultimately include 2,700 single-family, town-house, and multi-unit residential units. It offers the only Nicklaus Design championship golf course in Atlantic Canada and a village center with commercial and retail operations. The low impact development strategy preserves the rural nature of the area while providing a wide range of housing units and recreational opportunities in the community.

Each neighborhood at Forest Lakes uses a decentralized wastewater collection, treatment, and disposal system. A key design consideration for these systems was the request that they work reliably, continuously, and year-round in the northern, maritime climate typical of Nova Scotia. The initial neighborhood system, serving 50 single family and semi-detached homes, has a peak flow design of 51,200 liters per day of residential sanitary wastewater. It includes a watertight Septic Tank Effluent Pump (STEP) pressurized effluent sewer collection system that delivers primary effluent via small-diameter mainlines to a secondary wastewater treatment plant, followed by a dispersal system dosing tank where it is pumped on a timed and intermittent basis using pressurized micro-dosing to a multi-celled, soil dispersal system that incorporates Infiltrator Quick4™ Plus Standard Chamber laterals in an area bed arrangement with two cells, each with five zones. A hydraulic distributing valve at the head of each cell automatically and sequentially directs the pumped flow to the appropriate zone.

Plastic tanks

The need for compact systems is serving as a catalyst for tank innovation including increased safeguards to ensure watertightness. On difficult sites, the ability to install a tank in a shallow, low profile configuration leverages the available space while avoiding rock or problematic soil conditions. Advances in the plastic tank manufac-turing process, including corrugations, ribbing, and interior structural bulkheads offer increased strength and durability over plastic tanks of the past. With significant breakthroughs in injection molding, larger plastic tanks (5,600 liters) can be manufactured that are lightweight and strong. These tanks are conveniently manufactured in halves to allow for ease of shipping, storing, and installation.

An example of a STEP system that uses plastic tanks is located in Surgoinsville, Tennessee, United States (US), a US$4.5 million project that serves 247 residences, two schools, and nine businesses. Installed on lots with existing homes, outbuildings, driveways, and landscaping, the project was designed with the additional capacity to serve approximately 700 properties. The low-pressure sewer system delivers wastewater to the City of Church Hill's wastewater plant. The system is comprised of approximately nine miles of low-pressure sanitary sewer collection lines, two pump stations, and individual STEP services at more than 200 residences that include Infiltrator IM-Tanks. Difficult Appalachian sites with steep slopes and limited backyard access to existing homes made tank installation challenging, and the ease of handling of the plastic tanks provided the ideal solution. Additionally, the tanks were delivered to the installer's onsite staging yard nested, and the staff assembled

In the Forest Lakes installation, the effluent is time-dosed on an intermittent basis using pressurized micro-dosing, to a multi-celled, soil dispersal system that incorporates Infiltrator Quick4 Plus Standard Chamber laterals in an area bed arrangement. Photo by Infiltrator

the tanks as needed to complete the project, saving time and space prior to installation.

Advanced Wastewater Treatment Units (ATUs)

The multiple reasons to use an Advanced Wastewater Treatment Unit (ATU) include poor soils, shallow vertical separation distances to limiting conditions, horizontal setback restrictions, tight lots, high strength wastewater, and nitrogen removal needs. One example of an ATU is a fixed film bioreactor (FFBR), a specially designed containment device that houses an engineered PVC media for residential installations, cluster designs, and small-to-medium commercial wastewater treatment applications. Often installed inside a plastic tank, FFBRs provide outstanding treatment in areas where traditional systems cannot be used. These systems excel where nitrogen removal is critical to the treatment plan, and they are extremely effective for high strength wastewater applications.

In Centralia, Washington, US, homeowners needed a new solution when faced with an aging conventional septic system and the desire to subdivide the property while retaining dedicated wastewater treatment service for their existing home. Due to changes in permitting requirements, any new system required the installation of a secondary treatment system to satisfy vertical separation. Several options were rejected due to size requirements, cost, and construction challenges. The final design features a FFBR system with pre-treatment and a chamber leachfield distribution system to provide seamless collection, treatment, and dispersal. Even better, all of the products used in the system design were sourced from the same company, adding to the ease of purchase and compatibility.

The effluent leaves a pretreatment tank and enters the Delta Treatment Systems' ECOPOD-N™ Fixed Film Wastewater Treatment System installed in an Infiltrator IM-1060 plastic reactor tank, where it is introduced to an oxygen-rich environment. In this environment, a colony of bacteria called the biomass develops and is capable of digesting (breaking down) biodegradable waste into carbon dioxide and water. This process continues as the biomass is supplied with incoming waste-water and oxygen. The effluent is then time-dosed to the 65-linear meter Infiltrator Quick4 Plus Low Profile chamber drainfield with pressure distribution.

Conclusion

Decentralized wastewater treatment can provide equal protection of public health while outshining centralized wastewater treatment in environmental protection. Where individual lots are not suitable for decentralized treatment on site, community decentralized systems can provide sustainable and responsible wastewater treatment. With aquifers becoming depleted at rapid rates and water tables dropping, minimizing the impacts to the water cycle is critical for sustainability.

Author's Note

Dennis F. Hallahan, PE is the technical director at Infiltrator Water Technologies, based in Old Saybrook, Connecticut, United States. The author has more than 30 years of experience with the design and construction of onsite wastewater treatment systems. Currently, Hallahan is responsible for technology transfer between Infiltrator and the regulatory and design communities, and consults on product research and testing for universities and private consultants. Hallahan received his MS in civil engineering from the University of Connecticut and his BS in civil engineering from the University of Vermont. He is a registered professional engineer in Connecticut and holds several patents for onsite wastewater products. For more information, contact the author by email at dhallahan@infiltratorwater.com.

Onsite STEP system handles seasonal peaks at US national park

The onsite effluent sewer system installed at Stinson Beach, part of the United States National Park Service system, keeps the facilities running smoothly during peak season when visitors rise to 5,000 per day. Michael A. Parker, PE of Orenco explains how the system works.

In 2017, the Golden Gate National Recreation Area in California, United States (US), was the second most visited place in the entire national park system, with almost 15 million visitors. Established in 1972, it's also one of the largest national parks located in an urban area, offering a wide variety of activities – from touring Alcatraz Island to hiking Montara Mountain to swimming at Stinson Beach.

While beachgoers might take the site's public restroom facilities for granted, the National Park Service (NPS) does not. When it was determined that the septic tanks and drainfields at Stinson Beach were coming to the end of their useful lives, they hired HECO Engineers of Idaho to recommend a cost-effective replacement that would not be overly noticeable to park visitors.

In addition to keeping costs down, the NPS needed an onsite wastewater collection and treatment system that would be relatively easy and inexpensive to maintain and troubleshoot because NPS staff would be responsible for its operation and maintenance.

To fulfill these requirements, the engineer recommended the installation of a septic tank effluent pump (STEP) system, also known as an effluent sewer system. In this type of system, raw sewage flows from the restroom facility to an underground tank. Only the filtered, liquid portion is discharged (by either pump or gravity) to shallow, small-diameter collection lines that follow the contour of the land.

An important feature of effluent sewer systems is the settling of solids in the onsite tanks. Solids remain in the tank and are removed every few years, depending on usage and tank volume. This onsite tankage provides primary treatment in the form of passive anaerobic digestion, which reduces the organic and solids load to the wastewater treatment facility.