

C A S E S T U D Y

A Sustainable Wastewater Collection and Treatment Solution for New Developments

SUNSET BAY, TENNESSEE

Problem

The developers of a slow build-out, 750-home subdivision of full- and part-time residents in rugged terrain bordering a Tennessee lake had a challenging wastewater problem. They needed a modular, build-as-you-go wastewater solution that could consistently meet the stringent (20 mg/L) nitrate requirements set by the Tennessee Department of Environment and Conservation, in spite of highly variable flows. Connecting to an existing municipal treatment plant was not an option, since the nearest plant was 20 miles (32 km) away. Standard septic systems could not be relied on to meet the stringent nitrate requirements, and many of the lots were not large enough (or were too close to the reservoir) to use an onsite advanced treatment system.

Solution

The developers — together with Environmental Systems Corporation (engineers) and Orenco Systems® (wastewater equipment designers and manufacturers) — conceived of an innovative effluent sewer system for this high-end subdivision. The effluent sewer system includes a tank at each lot to collect household wastewater, as well as an advanced treatment unit (an AdvanTex® AX20 or AX20-RT Treatment System) that produces TN of <20 mg/L. The treatment unit then pumps this highly treated effluent through small-diameter collection lines to a drip field dispersal system that serves the entire subdivision. The system has a design capacity of 165,000 gpd (625 m³/d), is maintained by a local utility (Hallsdale-Powell), and is outperforming all permit requirements.

Innovative Effluent Sewer Reduces Nitrate Despite Low Flows



Located in an environmentally-sensitive area, the planned community of Sunset Bay needed a highly effective on-site wastewater solution.

The developers of Sunset Bay — a high-end residential community on Norris Lake in Union County, Tennessee — needed an innovative wastewater solution.

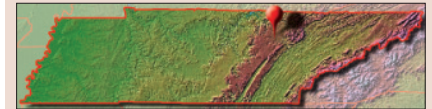
The development was in an environmentally sensitive locale, along the lake and

adjacent to the Chuck Swan Forest & Wildlife Management Area. Consequently, the Tennessee Department of Environment and Conservation (TDEC) applied stringent state discharge limits on the project, including a maximum of 20 mg/L nitrate (NO₃-N). Since many of the residents are part-timers, any wastewater treatment solution had to be able to handle periods of low flow without compromising the quality of the effluent.

New Development Market

Project Overview

SUNSET BAY, TENNESSEE



Design Parameters

- 750 residences at build-out
- Clubhouse with tennis court and swimming pool, boat launch, parking area
- Design flow: 165,000 gpd (625 m³/d)

Permit Limits

- 45 mg/L BOD₅ (maximum)
- 20 mg/L Nitrate (NO₃-N) (maximum)

Installation Date

- March 2003: 1st residential installation
- March 2010: 110 total installations

Project Cost

- AdvanTex® system plus local 1,500 gal (5.7 m³) tank: \$7,845 ±
- Onsite installation: \$2,600 ±
- Pressure sewer mains and drip dispersal: \$520 per user ±

Collection System

- Approximately 4.5 miles (7.25 km) of 3-, 6-, and 8-in. (76-, 150-, and 200-mm) PVC small-diameter pressure sewer lines

Primary Treatment

- 1500 gal (5.7 m³), 2-compartment Barger concrete tank

Secondary Treatment

- Individual AdvanTex AX20 or AX20-RT Treatment Systems

Dispersal

- Subsurface discharge
- Equalization tankage: two 25,000-gal tanks (95 m³/d)
- Drip dispersal field: 41,400 ft (12,619 m)
- Dispersal site: 4.8 acres (1.9 ha)

Engineer

- Environmental Systems Corporation

Utility and Equipment Supplier

- Hallsdale-Powell Utility District

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The nearest municipal wastewater system was in Maynardville, 20 miles (32 km) away, so on-lot advanced treatment was clearly the best option. But the terrain was complex, including waterfront lots and lots on steep hillsides, many of which had no room for drainfields.

Moreover, the development was large. Some 750 homes were planned for the 1000-acre (~400 ha) property, so the system had to be able to handle wastewater flows up to 165,000 gpd (~625 m³/d).

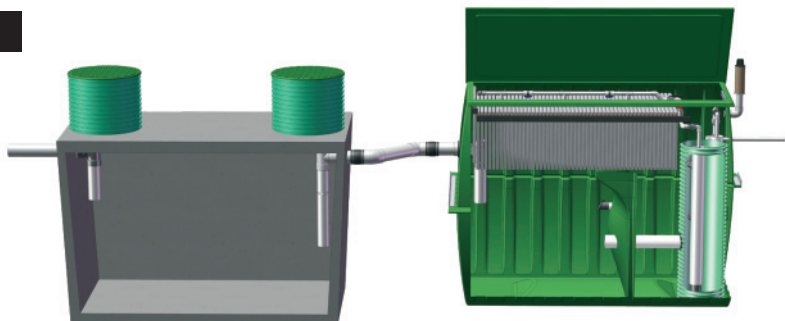
In late 2001, the developer — TN Emmons, LLC — started working with one of Orenco’s distributors — Specialized Operations Services — to come up with a cost-effective solution that would meet TDEC’s requirements. They brought Orenco®, TDEC, Union County, and Hallsdale-Powell Utility into the discussions.

Ultimately, Orenco proposed and TDEC approved a decentralized effluent sewer that used individual on-lot advanced treatment systems followed by low-pressure sewer lines to convey the highly-treated effluent to equalization tanks, before final dispersal into a 41,400 linear-foot (12,619 m) drip field serving the entire community. By mid-2002, details of the project’s layout were being finalized, and the developers were able to install the sewer lines and community drip field while doing their other site work.

By mid-2003, the first on-lot advanced treatment system was installed: Orenco’s AdvanTex AX20, which regularly produces less than 10/10 BOD₅/TSS, with total nitrogen reduction as high as 82% in third party testing and field trials.¹ By 2010, 100 more were in the ground.

Since 2010, the AdvanTex AX20-RT, Orenco’s second generation AdvanTex system, has been installed (see illustration). The AX-RT combines recirculation, treatment, and discharge functions within a single, pre-plumbed unit, which reduces installation time by 40%.

The Sunset Bay wastewater system is owned and operated by the Hallsdale-Powell Utility District (HPUD). Property owners pay a minimum monthly fee of \$9 to maintain the effluent sewer lines and community drip field. When they’re ready to build, they purchase their AdvanTex system from Hallsdale-



The pre-plumbed AdvanTex® AX20-RT Treatment System (rt.) follows an on-lot tank with effluent filter (lt.)

Powell, and the purchase price can be included in their mortgage. Then they arrange for its installation by a pre-qualified contractor and contact HPUD for an inspection and start-up.

As Table 1 shows, these on-lot units are performing well, averaging 4.7 mg/L BOD₅, 3.0 mg/L TSS, and 9.0 mg/L NO₃ (nitrate). This is far better than TDEC’s maximum permit requirements of 45 mg/L BOD₅ and 20 mg/L nitrate. And they achieve this nitrogen reduction with no supplemental additions of carbon or alkalinity.

Table 1. Typical Effluent Quality*

From Individual On-Lot Treatment Systems

BOD ₅	TSS	Turb	TKN*	NH ₃ -N	NO ₃ -N	pH	Alk
4.7 mg/L	3.0 mg/L	4.5 NTU	3.6 mg/L	9.9 mg/L	9.0 mg/L	7.0	131 mg/L

* Samples collected between 07-01-05 and 12-13-11 and analyzed by a third party.



¹ “AdvanTex Performance Summary #1 (April 2009) and #2 (May 2009),” Orenco Systems®, Inc.

An Innovative Decentralized Wastewater System with Numerous Benefits²

Sunset Bay's wastewater system offers unique benefits for developers, property owners, their utility, and the environment.

Benefits for Developers

- **ELIMINATION OF MOST TREATMENT COSTS** — All Orenco Effluent Sewers offer reduced up-front costs for developers. In a typical STEP/STEG system, homeowners pay for their own primary treatment (on-lot) and developers can pay for additional secondary treatment capacity gradually, as their project builds out. Sunset Bay's hybrid system goes a step further. Homeowners pay for both primary *and* secondary treatment costs, on-lot. Developer's infrastructure costs are therefore reduced to the upfront costs for 1) the small diameter, low-pressure sewer lines throughout the development that only convey clean effluent, 2) the dispersal area, which can potentially be downsized because of the high-quality effluent, and 3) any subsequent nutrient removal processes, if necessary. This is an especially valuable benefit to developers when their projects experience a slow build-out and/or when stringent treatment levels are required.
- **SHORTER INSTALLATION TIME** — Because there is no customized central treatment system, the time required for design and for design review/approval of this unique hybrid system is significantly shorter.

Permitting authorities only need to review the drainfield, since the permits for the on-lot primary and secondary treatment systems are approved as a standardized package. Without a central treatment system, total installation time is considerably shortened also.

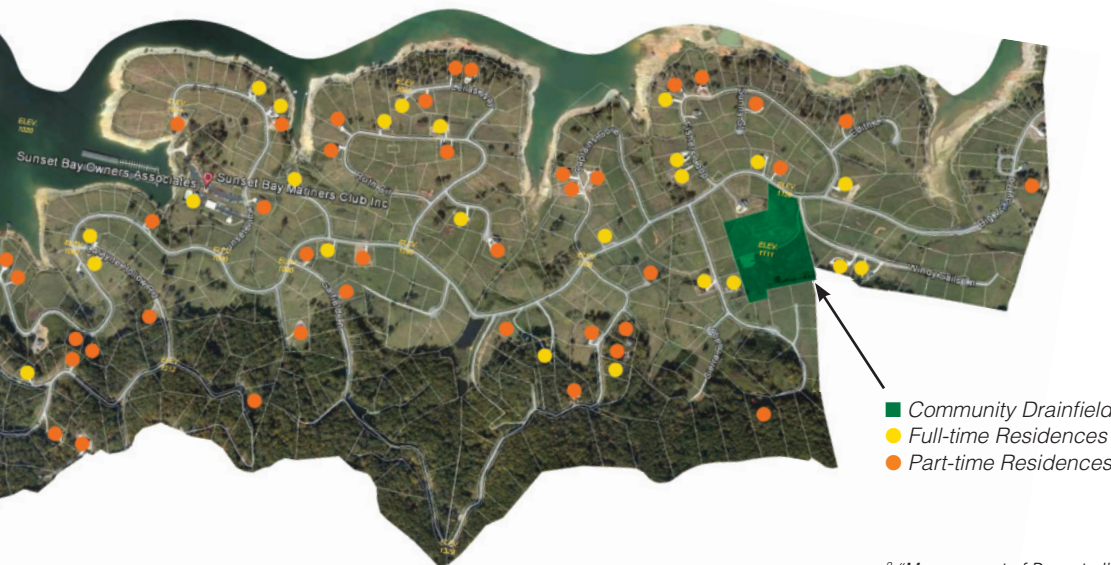
Benefits for Homeowners and Their Utilities

- **REDUCED POWER CONSUMPTION AND FAIR ALLOCATION OF POWER COSTS** — All Orenco Effluent Sewers allow for low-cost, energy efficient treatment systems, since 60% of the treatment happens in the primary STEP tank, at each property owner's lot. At Sunset Bay, 100% of the secondary treatment happens on-lot, using a small-scale treatment system that is so energy efficient it qualifies for LEED credits.

So Sunset Bay's low power costs for wastewater treatment are paid directly by individual property owners, without any additional administrative or billing fees. And these power costs are proportional to usage. If a property is only being used part-time, or if the owners go on frequent trips, they pay

even less for power (especially since each property includes a control panel that automatically adjusts the treatment system to an economical, low-energy mode during periods of low or no use).

Consequently, everyone pays less for power, including the utility managing the system.



² "Management of Decentralized and Onsite Wastewater Systems," T.R. Bounds, American Society of Agricultural and Biological Engineers, 2001.

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- **POTENTIAL FOR WATER RE-USE** — AdvanTex Treatment Systems produce high-quality effluent that is 10 times better than greywater.* Where regulations allow, utilities can re-use the AdvanTex effluent for subsurface irrigation, groundwater recharge, or other beneficial uses. It is also possible for property owners to re-use the AdvanTex effluent on their own lots, if regulations allow them to divert the flow from their service lines. This would have the added benefit of periodically reducing discharges to the central dispersal field, creating a “seasonal resting event” that extends the life of the dispersal system.

Benefits for the Environment

- **INCREASED NITROGEN-REDUCTION** — All Orenco Effluent Sewers followed by AdvanTex treatment are capable of producing effluent that is equal or superior to that of conventional municipal sewers, including nitrogen reduction, with considerably lower O&M costs and efforts. And they do it without the environmental damage from leakage and sewage overflows that have become all-too-routine with conventional municipal sewers. However, as noted, Sunset Bay’s unique decentralized design offers even greater potential for removing organic and nutrient constituents.

BOTTOM LINE: An Orenco Effluent Sewer coupled with an AdvanTex Treatment System at each lot offers significant benefits to developers, property owners, and utilities.

*NSF® International Standard 40 Evaluation Report, April 2002. (Evaluation performed by NovaTec Consultants, Inc.)

New Development Market**Summary of Benefits****Effluent Sewer with Advanced Treatment On-Lot**

- Low infrastructure costs, easier to finance
- Modular build-out, treatment costs deferred
- Shorter timeframe for design, approval, installation
- Utility managed system
- Power costs paid by property owners, based on actual usage
- Lower power and billing costs for utilities
- Ease of phasing in advanced treatment capacity
- Outstanding wastewater treatment, including reduction of total nitrogen
- Small local contracting companies can bid and install homeowner’s treatment system, as well as mainlines and dispersal systems
- All sewage pre-treated before conveyance, protecting environmentally sensitive terrain and reducing collection system O&M needs
- Dramatically reduced risks of sewage overflows or problem discharges requiring utility remediation
- Improved troubleshooting characteristics
- Power and water conservation

For more information about effluent sewers, Orenco Sewers™ and AdvanTex® Treatment Systems, contact Orenco Systems®, Inc.



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Data used by Orenco to derive the representations and conclusions contained within this Case Study were current as of June, 2013.