

C A S E S T U D Y

An Affordable Wastewater Collection and Treatment Solution for Municipalities and Communities

CHRISTIANSBURG, OHIO

Problem

The smell of sewage was becoming harder to ignore in Christiansburg, Ohio, especially following a rainstorm. The village was plagued with failing onsite septic systems, and nearby West Fork Honey Creek had tested high for bacteria. With the Ohio EPA becoming concerned, village leaders began to explore wastewater management options.

Solution

Because Christiansburg is a community of roughly 500 residents with a median household income of just \$34,282 (2013),¹ village leaders needed an affordable solution. For collection, they chose an Orenco® Effluent Sewer System, which includes individual 1,000-gallon (3.8-m³) tanks for residences and 1,500- (5.7-m³) or 2,000-gallon (7.6-m³) tanks for businesses. All tanks contain an Orenco septic tank effluent pump (STEP) package. The collection system conveys primary-treated effluent through small-diameter mainlines, without manholes or lift stations, to a two-stage AdvanTex® AX-Max™ treatment facility. Disinfected effluent from the AdvanTex system is then discharged to West Fork Honey Creek under the authority of an NPDES permit with strict ammonia limits.

Evaluating Alternatives and Options



To solve its ongoing wastewater problems, the village council of Christiansburg, Ohio, chose the one option that would allow it to affordably manage its own wastewater system: an Orenco Effluent Sewer followed by AdvanTex® treatment.

Residents of Christiansburg, Ohio, already knew they had a problem with their onsite wastewater systems. System failures and odors were common, particularly during or shortly after significant rainfall. In 2012, the Ohio EPA detected high levels of bacteria in the stream that runs along the west side of the village, prompting community leaders to seek cost-effective wastewater management solutions. The big question was which wastewater option would be best for their small village ... and how to pay for it.

Municipal and Community Market

Project Overview

CHRISTIANSBURG, OHIO



Design Parameters

- 250 EDUs (residential and commercial)
- 65,000 gpd (246 m³/day) design average daily flow
- 85,000 gpd (322 m³/day) maximum daily flow

Permit Limits (NPDES)

- < 10 mg/L cBOD₅
- < 12 mg/L TSS
- < 1 mg/L NH₃-N summer (< 3 mg/L winter)
- < 161 CFU/100 ml E. coli
- 6.5 to 9 pH

Average Effluent Quality*

- 3.6 mg/L cBOD₅
- 1.7 mg/L TSS
- < 0.1 mg/L NH₃-N

Start-Up Date

- November, 2014

Total Project Cost

- \$5,100,000 (includes engineering, legal, administrative, and construction costs)

Total Constructed Cost

- \$4,089,400 or \$16,358/EDU (includes collection and treatment costs)

Funding Sources

- Ohio EPA, Ohio Water Development Authority (OWDA), Ohio Public Works Commission (OPWC), Community Development Block Grant (CDBG) program
- Approximately 60% grants, 40% loans

Regulatory Authority

- Ohio EPA

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Before the EPA took regulatory action, community leaders hired an engineer to evaluate their options and estimate costs. With the population of Christiansburg at little more than 500 people — and the village’s median household income well below the national average — the village council knew it was imperative that up-front capital outlays, as well as operation and maintenance (O&M) costs, be kept affordable. The engineer evaluated multiple options ranging from centralized collection and treatment to pumping raw wastewater or effluent to the neighboring town of St. Paris for treatment.

Many residents of Christiansburg advocated for complete control of their wastewater infrastructure due to a desire to maintain affordable monthly rates. In 2012, St. Paris’ proposed fee for processing the wastewater from Christiansburg was assessed at \$92,400 per year, with no cap on future fee escalation. If Christiansburg



The Christiansburg wastewater facility consists of twelve AdvanTex AX-Max™ treatment units. The treatment system is configured as a two-stage process, designed to meet low ammonia limits in both the summer and winter.

chose this option, the village would also have to finance the up-front capital costs to install a wastewater collection system, including miles of force mains to convey the wastewater to St. Paris, as well as provide revenue to cover the cost of ownership. This would result in higher projected sewer fees, plus possible rate increases enacted by St. Paris. In the end, the village of Christiansburg voted to install its own treatment facility.

Chuck Lyons, a member of the village council for 16 years, recalls his determination that the village end up with an efficient, workable sewage system. “Keeping costs down for the residents was a high priority,”

he says. After reviewing the cost comparisons in the engineer’s report, council members realized that an Orenco Effluent Sewer followed by AdvanTex treatment was the most economical option. In addition, it offered the ease of operation that would allow the village to affordably manage its own system.

Constructing a new wastewater treatment facility required that Christiansburg obtain an NPDES permit through the Ohio EPA. With the goal of reducing nutrient content in state waterways, the EPA mandated that all discharges to West Fork Honey Creek had to meet a strict ammonia limit of <1 mg/L (summer). The AdvanTex system the council chose would be ideal to ensure that the village could meet this limit. In addition, the AdvanTex treatment system offered low biosolids management requirements, low energy consumption, and low maintenance requirements, as well as the ability to successfully treat highly variable flows.

The Chosen Solution: “A Success Without a Doubt”

Construction began in January, 2014. Every septic tank in the entire village was decommissioned and new interceptor tanks, which included Orenco Pro-STEP™ Pump Packages, were installed at each residence and business. In an effluent sewer system, also known as a STEP system, the onsite primary tankage provides passive anaerobic digestion that reduces the organic and solids load to the wastewater treatment facility. Primary-treated effluent from the tank’s “clear zone” is pumped with individual ½-hp (0.37-kW), 115 VAC effluent pumps through small-diameter (2-4 inch or 50-100 mm) force mains to the treatment facility.



The AX-Max is a fully plumbed and compact treatment unit, making it relatively easy to install. The entire system — including treatment media, recirculation tankage, pumps, and active ventilation — is built inside an insulated fiberglass tank.

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The AX-Max system uses fractional-horsepower, high-head effluent pumps that are inexpensive and operate intermittently throughout the day, thus minimizing electrical consumption and life-cycle costs.

The Christiansburg treatment facility consists of twelve AdvanTex AX-Max units, configured in two stages to meet the stringent ammonia limits required by the NPDES permit. The first stage includes nine AX-Max units, while the remaining three units essentially provide additional treatment for enhanced biological nitrification.

AdvanTex treatment systems use a fixed-film/attached-growth treatment process and are an excellent solution for small communities and small-flow applications. In an AdvanTex system, wastewater is uniformly distributed onto the textile media in an unsaturated condition. The system uses fractional-horsepower fans to draw air through the media and provide sufficient oxygen for aerobic digestion. Low-horsepower, high-head turbine pumps operate intermittently with sophisticated controls that automatically adjust recirculation ratios and pump run-times based on daily flows. The energy required for aerating and distributing the wastewater onto the media is considerably less than for activated-sludge facilities commonly used by larger cities.

Randy VanTilburg, P.E., designed the Christiansburg project. “This was my first time working with Orenco,” says VanTilburg, “and it’s been a success without a doubt. I am actively seeking new projects we can work together on in the future.”

Saving on Both Capital and O&M Costs

With a constructed cost of just \$16,358 per equivalent dwelling unit (EDU), the Orenco Effluent Sewer and AdvanTex Treatment System at Christiansburg are highly affordable compared to other wastewater technologies. Conventional technologies, including gravity sewers, have a diseconomy of scale, especially when lift stations are required. Lift stations, manholes, and other appurtenances essential for gravity sewers are expensive when applied to small communities, such as Christiansburg, which lack critical density. Effluent sewers have proven to be a cost-effective solution largely because they use small-diameter, shallowly buried PVC or HDPE mainlines along variable grades to convey wastewater to a treatment facility, rather than using large-diameter, deeply excavated conveyance mains laid at a constant slope.

Another important feature of effluent sewer systems is the settling of solids in the interceptor tanks, which facilitates the use of inexpensive, durable pumps. These pumps are lightweight (~30 lbs or 14 kg) and typically last longer than 20 years. The cost-effectiveness of these pumps, combined with infrequent tank pumpouts, translates to low solids management and equipment repair and replacement (R&R) costs for effluent sewer systems — so low that they are insignificant when compared to the costs of managing, repairing, and replacing expensive grinder pumps. All of these factors contribute to the life-cycle cost of effluent sewers being widely reported as less than half the life-cycle cost of grinder collection systems.²

An additional financial benefit of effluent sewers is that they provide years of anaerobic digestion. Textbook process evaluations indicate that typically 80% of biosolids in onsite interceptor tanks are digested on an annual basis.³ This lower organic and solids load from the STEP system provides a substantial reduction in power costs at the treatment facility. In addition to saving on O&M expenses, the reduced organic load of a STEP system decreases the size and capital cost of the facility.

Operational costs were also kept in check by using the AdvanTex Treatment System, especially compared with O&M costs at a conventional activated-sludge plant. Small community treatment systems like the one in Christiansburg generally require infrequent, part-time O&M with limited adjustment and occasional,

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rather than continuous, laboratory control. However, when conventional activated-sludge technologies are applied to small communities, aeration controls are normally set to over-aerate. As a result of such operational inefficiencies, energy consumption in small plants is typically 30-40% or more of the plant's overall O&M budget, compared with 15-30% of the O&M budget at a large facility.⁴ The AdvanTex system helps the Christiansburg facility minimize its energy use.

Monte J. Edwards II, M.S., is a 22-year veteran of the environmental engineering field and a principal partner with Analytical Associates. His environmental services company was contracted by the village of Christiansburg to operate and maintain its new treatment facility. Says Edwards, "We maintain another plant for a community of a similar size that chose a different wastewater technology [a package activated-sludge facility], and that plant uses ten times as much electricity per day as the Christiansburg plant does."

In addition to low power consumption, AdvanTex systems are known for low labor requirements. Edwards and the Analytical Associates team currently spend just 4-6 hours per week maintaining the Christiansburg facility, and he doesn't expect that will change much for the first few years of operation. "We'll probably see a slight increase of an hour or two per week once we start sludge monitoring the septic tanks, but that won't happen until the first 3-4 years have gone by," he says.

At small wastewater treatment plants, energy consumption is elevated compared to that of larger plants because small plants typically lack economies of scale and the ability to provide round-the-clock O&M — a common problem with villages like Christiansburg. Generally, these small communities do not have the necessary funding or the access to experienced operators to allow them to be able to run a complex, activated-sludge treatment facility optimally at low flows. Thus, AdvanTex treatment technologies provide a welcome alternative.

Other villages in Ohio are already taking note of Christiansburg's new sewer system and wastewater facility. They've sent representatives to tour the community and ask questions, researching the possibility of building their own wastewater facility. According to Edwards, "These smaller communities would not be able to afford a sewer system without having Orenco Effluent Sewers and AdvanTex treatment as an option."

¹ City-Data. "Christiansburg, Ohio." Accessed September 9, 2015. <http://www.city-data.com/city/Christiansburg-Ohio.html>.

² Water Environment Research Foundation. "Fact Sheet C2: Pressure Sewer Systems" and "Fact Sheet C3: Effluent Sewer Systems." Accessed September 17, 2015. http://www.werf.org/1/c/DecentralizedCost/Decentralized_Cost.aspx.

³ Metcalf & Eddy, Inc. *Wastewater Engineering: Collection, Treatment, and Disposal*. New York: McGraw-Hill, 1972.

⁴ Water Environment Federation. *Energy Conservation in Water and Wastewater Facilities*. New York: McGraw-Hill, 2010.

Data used by Orenco to derive the representations and conclusions contained within this Case Study were current as of September, 2015.

Municipal and Community Market**User Charges**

- Monthly residential rate: \$60/EDU (includes cost of debt retirement plus operation and maintenance)

Collection System

- 250 STEP tanks:
 - ~ 1,000-gallon (3.8-m³) tanks for homes
 - ~ 1,500- or 2,000-gallon (5.7- or 7.6-m³) tanks for businesses
- 1.25-inch (32-mm) diameter service laterals
- 2,800 LF (853 meters) of 4-inch (100-mm) diameter mainlines
- 1,075 LF (328 meters) of 3-inch (75-mm) diameter mainlines
- 17,250 LF (5,258 meters) of 2-inch (50-mm) diameter mainlines

Secondary Treatment

- 1st Stage – (9) AdvanTex® 42-foot (12.8-meter) AX-Max units
- 2nd Stage – (3) AdvanTex 42-foot (12.8-meter) AX-Max units
- Automatic alkalinity feed system
- Magnetic flow meter
- UV disinfection

Discharge

- Surface discharge (NPDES) to West Fork Honey Creek

Monitoring, Control, and Instrumentation

- Orenco TCOM™ telemetry controls
- Temperature, pH, ORP, and dissolved oxygen instrumentation

Engineering Project Manager

- Brice Schmitmeyer, P.E., Access Engineering Solutions

Designer

- Randy VanTilburg, P.E., Mannik Smith Group

Operation and Maintenance

- Monte Edwards II, M.S., Analytical Associates

**Samples collected and analyzed by a third party between 06-01-2015 and 08-31-2015.*

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

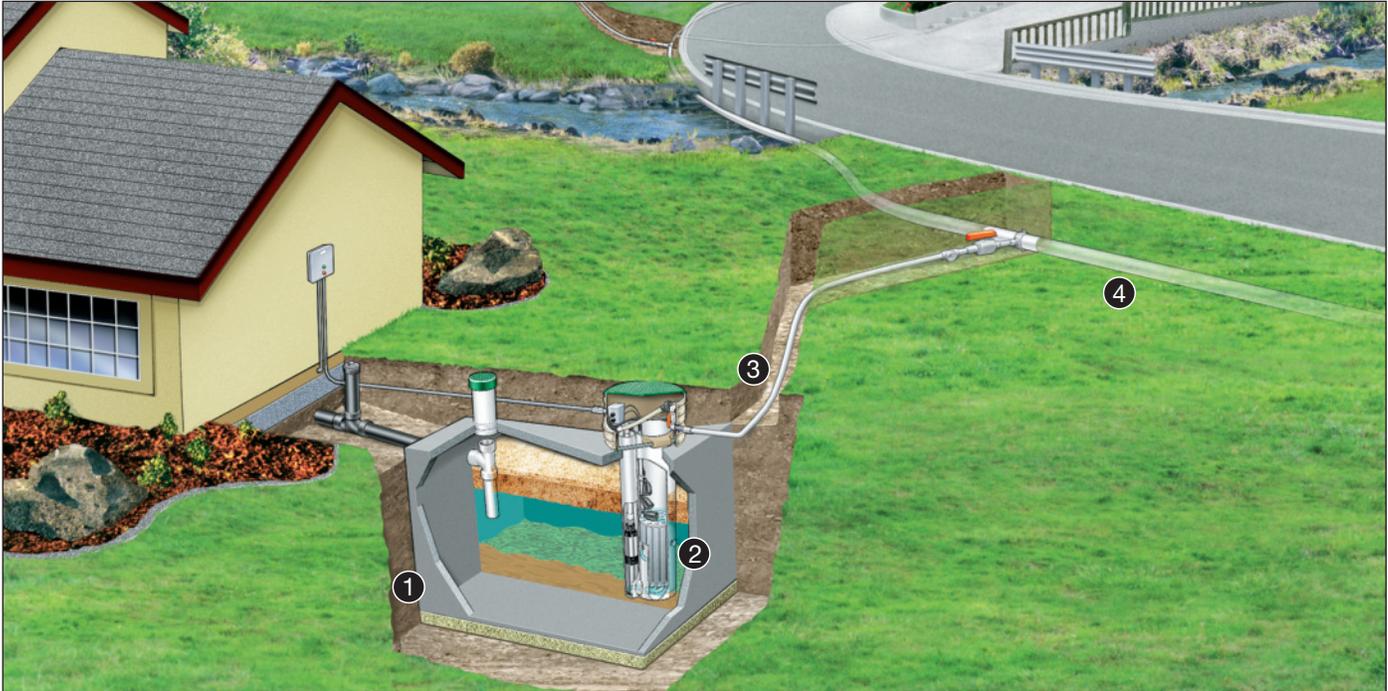

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Christiansburg, OH Wastewater Collection and Treatment



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Orenco® Effluent Sewer Collection



- 1 Watertight tanks provide primary treatment, so only liquids are conveyed to the treatment facility. With proper use, tanks can go 8-12 years between pump-outs.
- 2 Orenco's Biotube® Pump Vault filters out solids, and our lightweight, non-corroding pumps can last more than 25 years.
- 3 One-inch (25-mm) diameter service lines can be easily installed with a trencher or directionally bored.
- 4 Small-diameter main lines follow the contour of the ground, saving excavation costs. No expensive manholes or lift stations are required.

AdvanTex® AX-Max™ Wastewater Treatment

- 1 **Engineered Textile Media:**
 - Large surface area
 - High void space
 - High loading rates
 - Non-submerged media
- 2 **Effluent Distribution:**
 - Proprietary spin nozzles
 - Efficient distribution
 - Micro-dosed at regular intervals
 - Optimized treatment
- 3 **Low-Horsepower Pumps:**
 - High-quality
 - Simple operation
 - Low energy usage
 - Low equipment R&R costs
- 4 **Insulated, Pre-Manufactured AX-Max Unit:**
 - Containerized, fully plumbed
 - Portable, versatile, compact
 - Above- or in-ground installation
 - Easy to set

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