

C A S E S T U D Y

An Affordable Wastewater Collection Solution for Municipalities and Communities

VERO BEACH, FLORIDA

Problem Along the Indian River Lagoon adjacent to Vero Beach, Florida, both residents and government officials were becoming increasingly concerned about excessive nutrient loads and pollution. About 1,500 homes in Vero Beach had septic systems, many of which were antiquated and failing. Experts believed that the failing onsite systems were a major contributor to the environmental degradation of the lagoon, loss of sea grass habitat, and the unexplained deaths of manatees and dolphins.

Solution The City of Vero Beach installed an Orenco Effluent Sewer consisting of directionally drilled, small-diameter mainlines and individual Orenco STEP (Septic Tank Effluent Pump) packages. Primary-treated effluent from each residential or multi-family property is ultimately conveyed to the city's existing centralized wastewater treatment plant.

Seeking an Affordable Technology

Vero Beach (population 15,220 in 2010) is a small but densely populated city adjacent to the Indian River Lagoon on Florida's east coast. Many of the city's approximately 1,500 on-site septic tanks and drainfields were failing, and the excess nitrogen, phosphorus, and bacteria were considered a primary contributor to the pollution of the watershed.

Due to financial constraints, sewerage small cities like Vero Beach has long been an extreme challenge. For decades, engineers have encountered difficulties identifying affordable and viable wastewater solutions



Concerned about nutrient runoff to the adjacent lagoon, the City of Vero Beach installed an Orenco Effluent Sewer, a much less-expensive and less-intrusive option than extending the city's gravity sewer.

Municipal and Community Market

Project Overview

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Design Parameters

- Approx. 1,500 homes at full build-out

Installation Date

- First on-lot STEP packages were installed in April 2015

Total Project Cost*

- Approx. \$11,000,000 at full build-out (includes engineering, legal, administrative, and construction costs)

Cost of Installing Mainlines and Service Laterals

- Mainlines: approx. \$885,000
- Service laterals: approx. \$750,000

Funding Sources

- St. Johns River Water Management District: \$292,050 grant for mainlines; \$247,500 grant for service laterals
- Remaining amount paid by homeowners, less any credits:
 - ~ STEP Up and Save Credit: \$2,290 offered by the city to property owners who sign up within twelve months of sewer availability notification
 - ~ Wastewater Utility Extension Credit: \$1,100 offered by the city to property owners who pay in full for their STEP package at the time they submit their sewer application

*Ongoing installation costs have been used to estimate total cost at project's end.

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for these communities. Even during the construction grant era following the passage of the Clean Water Act in 1972 (when grants dwarfed loans), state and federal agencies struggled to identify and implement cost-effective solutions for small communities.

For many years, Vero Beach and various independent consultants searched for an affordable technology to eliminate the impact caused by residents' failing septic systems. Immediately following the damage caused by hurricanes in 2004, approximately 60 homes with failing systems voluntarily connected to the city's existing gravity sewer system. The construction impact was extensive and required digging up narrow residential streets for installation of the gravity sewer collection lines and ancillary equipment. The expansion was expensive but was funded through an assessment process that ranged from \$6,200 to \$19,400 per connection, depending on the area served.

In 2007, the city was offered a \$1.5 million grant from the State of Florida to expand the sewer system to more homes on the barrier island. The grant required 60% support from affected homeowners but ultimately failed, with only 14% voting in favor of the proposal. Even with the grant subsidies, opponents cited concerns about the overall affordability of the proposed gravity sewer extension. Social impact was also an issue, as many residents feared the sewer installation would damage their large live oak trees.

A Solution with Low Capital Costs

Based on his experience with low-pressure effluent sewer systems used in the nearby City of Palm Bay, Robert J. Bolton, P.E., Director of Water and Sewer for Vero Beach, began thoroughly investigating alternative sewer systems. After months of comprehensive research and evaluation, Bolton concluded that an Orenco Effluent Sewer system, also known as a STEP (Septic Tank Effluent Pump) system, was the most cost-effective solution for the city. He estimated the cost of an Orenco Effluent Sewer to be approximately \$11 million. In comparison, an expansion of the city's gravity sewer system was expected to cost about \$22.5 million.

The dramatically lower cost of an Orenco Effluent Sewer is largely attributed to its use of small-diameter mainlines laid at a constant depth to follow the con-



Further extending gravity sewer was too expensive and disruptive due to the small lots and mature trees common throughout Vero Beach.

tour of the land. Such mainlines are less time-consuming to install and minimize the construction impact of the system. Comparatively, a gravity sewer system typically involves tearing up roads to install 8-inch (200-mm) diameter sewer mains in conjunction with manholes and service laterals to property lines. Bolton estimated a six- to nine-month construction period to extend the gravity sewer, versus just weeks for an effluent sewer system.

Bolton also calculated each option's "availability cost," which he defined as the cost of making sewer available to all residents by installing just the mainlines and components (excluding the on-lot portion of the system). By his estimates, the availability cost of an effluent sewer would be about \$885,000, or less than \$600 per lot. In contrast, he estimated the availability cost of further expanding the city's gravity sewer system to be approximately \$18,000,000, or \$12,000 per lot.

Encouraged by the prospect of lower capital costs, minimal construction disruption, and the ability to reassure residents that their live oak trees would be unaffected, Vero Beach chose to install an Orenco Effluent Sewer.

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For constructing the mainlines and service laterals, the St. Johns River Water Management District, a branch of the State of Florida Department of Environmental Protection, issued two grants totaling approximately \$540,000. In a news release issued by the district, Vero Beach's Vice Mayor at the time, Jay Kramer, said, "The STEP System really saved us; we can now be environmentally active while keeping the costs down for the community."¹

Incentives for Residents

Because of the Orenco Effluent Sewer's much lower availability cost, residents of Vero Beach aren't required to connect to the low-pressure sewer mains. Conversely, gravity sewers almost always require mandatory connections, due to the municipality's need for cash flow to retire the debt associated with the much higher cost of conveyance infrastructure.

To encourage residents to connect, the city developed a "STEP Up and Save" incentive program. The first incentive is the "STEP Up and Save Credit" of \$2,290, which offsets the wastewater impact fee that is normally charged to new sewer customers. This credit is available to property owners who sign up within twelve months of notification. The second incentive is the \$1,100 "Wastewater Utility Extension Credit," available to homeowners who pay in full for their STEP package at the time of application. Residents do have the option of receiving the STEP Up and Save Credit while financing the equipment cost for ten years at no interest; however, they do not receive the Wastewater Utility Extension Credit with this option.

The first 2-inch (50-mm) collection lines and on-lot STEP packages were installed in the spring of 2015. A total of 1,500 residences are expected to opt in before the project is complete. The majority of homes will have a new, watertight 1,000-gallon (3,800-L) tank and STEP package installed at an estimated cost of \$7,000 (installation plus materials) per connection. However, if a home was recently constructed and the city deems the existing septic tank to be watertight and structurally sound, the tank will be retained and the cost of construction will be reduced to about \$5,600. In this case, the on-lot component design includes a simple, 100-gallon (380-L) pump chamber installed immediately following the existing tank (see photo at right). Once connected to the Orenco Effluent Sewer system, primary-treated effluent from each



The total cost of installing an Orenco Effluent Sewer in Vero Beach was estimated to be half the cost of expanding the city's gravity sewer.



The city owns and operates the entire effluent sewer infrastructure, including the on-lot tank and pump package at each home.

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Connecting an estimated 1,500 residences to the city's new Orenco Effluent Sewer should dramatically improve water quality in the lagoon.

home's on-lot STEP package is pumped to the city's central wastewater treatment facility.

George McCullers is with Reliable Septic, the company that has installed most of the STEP packages. As quoted by VeroNews.com, McCullers says, "Dollar for dollar, this is the best system out there, and that is coming from the guy who puts them in the ground." McCullers says it takes about two days to do the job, including a cleanup that makes the surrounding landscaping appear undisturbed.²

Every five years, the city requires a licensed septic tank technician to inspect the septic tank and drain-field on properties that are not connected to the system. The technician then submits a report to the city. If any critical part of the on-site septic system is determined to be deficient, the homeowner is required to connect to the city's effluent sewer system.

Operation and Maintenance Advantages

During his initial research, Bolton determined that an effluent sewer system could save the city millions in up-front capital costs. However, he needed to ensure that the components were sustainable and would not result in excessive maintenance costs. While contacting other cities that had installed Orenco Effluent Sewer systems, he found that they were able to maintain their systems with minimal staffing and negligible maintenance issues. "At this point, I determined that Orenco products led the industry," says Bolton.

While consideration of capital costs is important, most sewage collection systems require greater fiscal resources for lifetime operation, maintenance, and repair than will be spent on the initial capital investment. Unfortunately, despite the major savings on capital costs associated with Orenco Effluent Sewers, it is still a common misconception that they are more expensive than gravity sewers over the full life cycle of the system.³ This mistaken belief stems from a lack of information about long-term effluent sewer operation and maintenance (O&M) costs, as well as a tendency to underestimate the O&M costs of gravity sewer, including biosolids management, daily staffing needs, and electricity.

The City of Vero Beach maintains 123 miles (198 km) of gravity sewer lines, 48 miles (77 km) of force mains associated with the gravity sewer, 118 electrical panels, 236 lift station pumps, and 2,660 manholes. Based on a 75-year term, Bolton's projected O&M costs for extending conventional gravity sewer to the city's unsewered areas was \$12.42/month per EDU. Estimated O&M costs for the Orenco Effluent Sewer were comparable at \$13.18/month per EDU, dispelling the myth that an effluent sewer is much more expensive to operate and maintain than a gravity sewer.

The city owns and operates the entire effluent sewer infrastructure, including the on-lot tank and pump package at each home. Monthly costs for residents include a basic fee of \$19.89/month per EDU, plus a usage charge of \$3.59 per 1000 gallons (3,800 L).

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However, the usage fee only applies to the first 10,000 gallons (38,000 L), so the maximum monthly charge is \$55.79. The city has taken the approach that the health of the Indian River Lagoon is a quality-of-life issue, and that the cost of converting septic systems to STEP packages should be shared by all residents.

“The Orenco product line is awesome,” says Bolton, “Everything has been high quality. Before we decided to go with an effluent sewer, I did my research and spoke with other cities that had used this technology. The feedback was very positive. The support I’ve received from Orenco every time I’ve had a question has also been fabulous.”

Minimal Construction Impact

According to Bolton, the installation time required for an effluent sewer system is less than a quarter of that required for a conventional gravity sewer. Directional boring (generally not possible for gravity sewer installations) was used in Vero Beach to minimize the impact of construction on both the public and the environment. This less-intrusive construction method reduces a number of unfavorable by-products of the construction process, including adverse environmental impacts, permitting concerns, problems with handling and disposing of excavated soils and groundwater,



Orenco Effluent Sewers' affordability stems primarily from their use of small-diameter mainlines, which can be installed with minimal disturbance to neighborhoods.



Each home connected to the system has an Orenco STEP package, including a 1,000-gal (3.8-m³) watertight tank and an energy-efficient, low-horsepower pump that conveys effluent to the treatment plant.

the number and cost of utility conflicts and resulting relocations, and the high costs of surface restoration.⁴

Even though records of existing utilities are more accurate today than ever before, communities are still littered with unmarked and hidden electrical, gas, and telephone utilities. Gravity sewers, due to their larger construction zone and amount of excavated material, have a greater propensity for encountering existing utilities. The slope requirements of gravity sewers also make it challenging and costly to avoid existing utilities. The costs associated with existing utility conflicts include additional design costs, repair costs for inadvertently damaged utilities, and loss of production time while making the repairs. Conversely, effluent sewer mains can be easily re-routed to avoid existing utilities.

When constructing a gravity sewer in an existing, active street, prolonged and inconvenient traffic delays are likely to occur. This is not the case with effluent sewer, for which mainlines can typically be installed along the side of the road with light-duty equipment. Due to gravity sewer's larger construction footprint, road and landscape restoration costs are also more expensive when compared to those associated with effluent sewer. With regards to gravity sewer, “Depending upon soil conditions, either a portion of the roadway or the entire roadway may be removed during the trenching operation. In some cases, where only a portion of the roadway is removed for sanitary [gravity] sewer installation, the

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remainder of the roadway is effectively destroyed due to the heavy construction traffic that must use it to complete the project.”⁵

In Vero Beach, the minimal construction impact of the new Orenco Effluent Sewer was appreciated, especially considering that a significant percentage of the city’s residential lots are located on narrow streets and contain large homes surrounded by mature and established live oak trees. In fact, a substantial number of homes that are expected to connect to the system are located on lots of 0.3 acres (.12 ha) or less. Table 1 shows lot size data for the Bethel Creek area, which is representative of the city.



Trenchless construction is a less-intrusive method for installing new pipes while reducing negative environmental impacts and disruption to residents.

Cleaning Up the Lagoon

At full build-out, with an estimated 1,500 residences connected to the city’s new effluent sewer, water quality in the Indian River Lagoon is expected to improve considerably. In its news release, the water management district reported that “the STEP project will divert septic system effluent ... preventing up to 40,500 pounds [18,370 kg] of nutrients per year from entering the groundwater.” In addition, the replacement of failed septic systems will result in fewer pollutants ending up in the lagoon. Local officials are confident this will be a boon to the dolphins, manatees, and other wild creatures that make their home in these vital waters.

¹ St. Johns River Water Management District, “District partners with Vero Beach to improve lagoon water quality” (news release, Palatka, Florida, February 13, 2015).

² Steven Thomas, “Innovative Sewer System Will Help Lagoon,” VeroNews.com, December 10, 2015, http://www.veronews.com/32963_features/innovative-sewer-system-will-help-lagoon/article_c7696ae8-9e9b-11e5-91abc169dc09af1.html.

³ Bill Cagle, Terry Cargil, and Roger Dickinson, “20-Year Life Cycle Analysis of an Effluent Sewer (STEP) System” (paper presented at the Water Environment Federation Technical Exhibition and Conference, Chicago, Illinois, October 8, 2013), 17-18.

⁴ Paul Bizier, ed., Gravity Sanitary Sewer Design and Construction (Reston, Virginia: American Society of Civil Engineers, 2007), 395-396.

⁵ Bizier, Gravity Sanitary Sewer Design and Construction, 369.

Data used by Orenco to derive the representations and conclusions contained within this case study were current as of November, 2015.

Municipal and Community Market

User Charges

- Base monthly rate: \$19.89/Equivalent Dwelling Unit (EDU) per month
- Usage charge: \$3.59/1000 gallons (3,800 L) up to 10,000 gallons (38,000 L)

Collection System

- Approx. 1,500 connections
- Approx. 93,000 linear ft (28,346 linear m) of 2-in. (50-mm) diameter collection lines at full build-out
- 1,000-gallon (3,800-L) tanks
- Orenco S1-Series control panels with elapsed time meters, cycle counters, and manual transfer switches

Treatment

- Existing centralized treatment plant owned by the city

Engineer

- Robert J. Bolton, P.E., Director of Water and Sewer, City of Vero Beach

Operation and Maintenance

- City of Vero Beach

Table 1. Vero Beach Parcel Statistics (Bethel Creek Area)

Lot Size (acres)	# of Homes
0.00 - 0.15	4
0.16 - 0.2	3
0.2 - 0.3	82
0.3 - 0.4	38
0.4 - 0.5	18
> 0.5	12

For more information about Orenco Effluent Sewers and AdvanTex® Treatment Systems, contact Orenco Systems®, Inc., at 800-348-9843.

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