

Orengo® Effluent Sewer Systems: Operational Costs – On-Lot Components

Executive Summary

Communities that want to build or improve their wastewater infrastructure soon discover that more than one type of sewer system is available. When researching, bidding, and selecting a sewer system, community leaders and their consulting engineers often focus on up-front capital costs. Decision-makers will make a more financially sustainable decision if they evaluate all the costs of any given technology — up-front costs but also ongoing O&M costs (operation and maintenance) and future R&R costs (equipment repair and replacement). That's because these "life cycle" costs differ greatly by technology.

Community decision-makers need this complete cost picture for two reasons: 1) to make a fair cost comparison, before a technology is selected and buried underground, and 2) to establish a rate structure for citizens that will fully fund all system costs, after the system is operational.

Orengo's engineers have spent more than three decades researching, designing, manufacturing, and supporting the installation and maintenance of Orengo® Effluent Sewer Systems (also known as STEP systems or pressure sewers). Approximately 600 communities throughout North America and around the world have selected Orengo Effluent Sewers for their wastewater needs. Not only are effluent sewer capital costs frequently lower than those for gravity sewers, O&M and R&R costs are lower as well. This position was first taken by the US Environmental Protection Agency in 1997.¹ And it was reiterated by the EPA, in a March 2009 article surveying multiple effluent sewer systems in Alabama, Tennessee, and Georgia. According to the EPA's Robert Freeman and Joyce Hudson, effluent sewer systems in Mobile, Alabama (for example) "...have provided savings of 25% to 50% over centralized collection and treatment."²

In fact, based on the documented performance of thousands of households, the operational costs for an Orengo® Effluent Sewer total about \$7.05/month/equivalent dwelling unit (EDU).³

This Technology Fact Sheet explains the basis for that figure.

O&M and R&R costs for Orengo Effluent Sewers fall into four main categories. These categories and costs are summarized in Table 1:

Table 1. Orengo® Effluent Sewers: Uniform Equivalent Monthly O&M and R&R Costs (4% Interest)

I.	Preventative Maintenance (PM)	\$1.60/month/EDU
II.	Reactive Maintenance (RM)	\$0.60/month/EDU
III.	Equipment Repair & Replacement (R&R)	\$2.81/month/EDU
IV.	Tank Pumping	\$2.04/month/EDU
TOTAL		\$7.05/Month/EDU

Each of these cost categories is described in greater detail in this Fact Sheet, beginning with a general overview of effluent sewer O&M requirements.

¹ *Response to Congress on Use of Decentralized Wastewater Treatment Systems*, USEPA, April 1997, pp. 13-14.

² Freeman, Robert, and Hudson, Joyce, "Small, Green, and Useful," *Water Environment & Technology*, March, 2009, p. 68.

³ These costs are consistent with those reported by Kevin White, Ph.D., P.E., in his article titled "Decentralized Wastewater Cluster Management: Operation and Maintenance Experience and Costs," published in *WEFTEC 2005 Proceedings* by the Water Environment Federation.

Orenco Effluent Sewer Systems: On-Lot Operational Costs (cont.)

Overview: Effluent Sewer O&M Requirements

Operation and maintenance of effluent sewers is relatively simple and, for most small communities, only requires a part-time operator and inexpensive equipment and tools.

Operation and maintenance of the mainlines for an effluent sewer system is, by and large, insignificant. Occasionally, the operator services or exercises the mainline valves, including air release valves. If the system includes odor control filters, these are periodically replaced. While it's possible to pig or flush the mains in an Orenco effluent sewer, it's rarely necessary. Also, breaks or leaks from collection mains are rare and very inexpensive to repair.

Most of the operator's time will be allocated to maintaining the on-lot part of the system: e.g., periodic checking and cleaning of the STEP (Septic Tank Effluent Pumping) components inside each property's on-lot tank. These include filters or screens, as well as servicing the pump, floats, and controls. Due to the number of components and products in the on-lot part of effluent sewers, the quality of the equipment purchased by system managers and operators has a profound impact on the overall life cycle cost of the system.

It is imperative to purchase and install reliable, durable equipment. Failure to do so will negatively affect operation and maintenance requirements and therefore greatly increase O&M and R&R costs.

According to Mike Saunders, who served nearly 10 years as a Utility Engineer and Technical Services Manager for Charlotte County, Florida, a single technician with a small maintenance vehicle can maintain 2,000 STEP connections in an effluent sewer system, as long as the system has been installed correctly with high-quality products. Saunders was responsible for coordinating and planning a system that included 360 miles of gravity sewer lines, 200 miles of force mains, 250 miles of effluent sewer lines, more than 6,000 STEP connections, and 300 lift stations.

To keep costs low, not only is it important to purchase and install high-quality equipment, it is also important to standardize on an equipment package so that operators can stock and carry a limited number of items that are designed to work together.

Following is additional information on the four main categories of O&M and R&R costs for effluent sewer systems. Unless otherwise noted, the economic calculations in the following sections assume a 4% effective annual interest rate.

I. Preventative Maintenance (PM) = \$1.60/Month/EDU

Preventive maintenance (PM) protocols vary widely between systems, which is one reason why system operators and their utilities report widely different O&M costs.

Typically, a PM program includes periodic servicing of the following on-lot components:

- Interceptor Tank — Measuring the sludge/scum in the tank
- Pump and effluent filter or screen — Cleaning the pump and its surrounding effluent filter or screen
- Control panel and float switches — Verifying the operation of the control panel and float switches

Some utilities have elected to operate their effluent sewers with little or no PM. In a 2009 article titled "O&M Considerations for STEP Systems,"⁴ Saunders notes that this approach can yield low PM costs in the early years but "major repairs and replacement activities will escalate as the system suffers from neglect." This increases reactive maintenance (RM) requirements and total operational costs.

Conversely, some utilities have elected to operate effluent sewers with highly aggressive — even excessive — PM schedules. This, says Saunders, can also "result in higher overall O&M costs when PM activities unnecessarily target components that have a significant level of reliability with less frequent PM." Saunders concludes, "The most cost-efficient STEP management approaches balance PM and RM to achieve the lowest overall cost for O&M."

Specifically, that means scheduling PM activities every 3-5 years. Conservatively estimating a service visit every three years at about 1.5 hours per service visit and a labor rate of \$40/hour, that comes to \$60/visit over 36 months or a uniform equivalent monthly PM cost of about \$1.60/month/EDU.

⁴ Saunders, Mike, "O&M Considerations for STEP Systems," *Water Environment and Technology*, March, 2009, p. 24.

Orenco Effluent Sewer Systems: On-Lot Operational Costs (cont.)

II. Reactive Maintenance (RM) = \$0.60/Month/EDU

In the initial year of operation, Reactive Maintenance (RM) requirements tend to be related to installation issues. After the first year, as noted in the previous section, Reactive Maintenance is affected by Preventive Maintenance schedules. However, to arrive at a “typical” RM cost, Orenco has gathered RM data from 11 Orenco Effluent Sewer Systems, totaling more than 3,100 connections, and compiled it into Table 2, below.

Table 2. Residential Service Call-Out Requirement per 100 Connections.

State	Community	EDUs	Screened	Hrs/Month/100 EDUs
CA	Mt. Lake Estate	8	yes	1.0
CA	Villa Verona	337	yes	2.5
MT	Missoula	350	yes	1.5
OR	Elkton	135	yes	0.7
OR	Glide	1,054	30%	1.5
OR	Lake Side	51	yes	0.3
OR	La Pine	215	yes	1.8
OR	Tangent	180	yes	2.5
WA	Boston Harbor	166	yes	1.6
WA	Conconnully	75	yes	0.5
WA	Diamond Lake	525	yes	1.2
Average Annual Hrs/Month/100 EDUs				1.4

As you can see, these systems average 1.4 hours/month of RM per 100 EDUs. Even conservatively estimating 1.5 hours/month/100 EDUs, that comes to \$60/month/100 EDUs or an RM cost of \$0.60/month/EDU – assuming a typical business-hour labor rate of \$40/hr. (We can apply a non-overtime labor rate because tanks have sufficient reserve capacity to allow operators to handle after-hours calls during the next business day.)

III. Equipment Repair & Replacement (R&R) = \$2.81/Month/EDU

Equipment Repair & Replacement (R&R) costs for effluent sewers consist primarily of R&R costs for pumps, floats, and various other miscellaneous components, with pumps contributing most of the cost. These costs are low when the proper pump is used. A high-quality multi-stage effluent pump should have run-dry capability, a UL listing, a continuous operation rating, and a 3-5 year warranty. Additionally, the pump should be corrosion-resistant and rebuildable, either by replacement of individual components or by replacement of either the liquid-end or the motor-end. Used in conjunction with an effluent filter or screen, such a high-quality pump will provide, on average, more than 20 years of service.

Note that, of the four cost factors in operating effluent sewers, R&R costs are the largest. And these costs are directly related to equipment quality.

Poor quality equipment almost always requires frequent and costly R&R schedules and thus significantly contributes to overall operational costs.

To arrive at a typical monthly R&R cost, Orenco empirically derived costs from a number of Orenco Effluent Sewer systems and compiled it into Table 3, below. As you can see, R&R averages only \$2.81/month/EDU, partly because Orenco’s pumps are small (10 GPM, ½ HP, 115 VAC) and relatively inexpensive.

In reality, however, costs may be even lower, since pump R&R assumes complete replacement of the pump every 20 years at approximately \$600 per event (materials plus labor). Orenco Effluent Pumps are repairable, however, and repair costs are often half as much as replacement costs. At the Orenco Effluent Sewer System in Yelm, Washington, which includes 1,700 pumps, only 28 had been replaced since 1994.⁵

Table 3. Orenco Effluent Sewers: Uniform Equivalent Monthly Repair and Replacement Costs for On-Lot Components (45% Interest)

Component	Frequency	Cost/Event (Materials + Labor)	Amortized at 4% Interest
Pump Replacement	20 years	\$600	\$1.62/month
Float Replacement	10 years	\$100	\$0.68/month
Misc. Component R&R	10 years	\$75	\$0.51/month
Total:			~\$2.81/month/EDU

⁵ Yelm, Washington Case Study, “Low Life Cycle Costs Keep Rates Low,” Orenco Systems®, Inc., October 2009 (NCS-7).

Orengo Effluent Sewer Systems: On-Lot Operational Costs (cont.)

IV. Tank Pumping = \$2.04/Month/EDU Uniform Equivalent Monthly Cost

Not unlike PM and RM protocols, tank pumping costs and mandated frequencies vary widely. Based on an 8-year audit of watertight tanks in Glide, Oregon, during the 1980's and a 5-year audit in Montesano, Washington, during the 1990's, Orengo established reliable pump-out intervals for households with various sizes of tanks and number of occupants, as shown in Figure 1⁶.

Assuming a 1,000 gallon tank and 2, 3, or 4 people per residence, Orengo projects a pump-out interval of ~21 years, ~11 years, and ~7 years, respectively. Conservatively estimating a pump-out frequency of 10 years with a per event fee of \$300 at an annual interest rate of 4%, the cost comes to \$2.04/month/EDU.

These figures are for watertight tanks – which are required in an Orengo Effluent Sewer system – calculated at a 95% confidence level.

Average pump-out intervals can be even longer. In the Orengo Effluent Sewer system in Glide, Oregon, for example, the average pump-out frequency was 55, 28, and 17 years, respectively.⁷

A Comment About Low Power Costs and Low Treatment Costs

The four O&M/R&R cost categories described above are the costs assumed by the utility and therefore must be calculated into user rates. Please note that there are no power costs. Power costs for Orengo Effluent Sewer systems are minimal. It costs little more than \$1.50 per month to run each household's on-lot pump⁸ — and that negligible cost is part of each household's monthly electric bill, so doesn't need to be factored into utility rates. Typically, energy-consuming lift stations are not required with effluent sewers, as they are with gravity sewers.

Orengo Effluent Sewer systems also provide primary treatment, reducing solids by about 80%. Therefore, they are often followed by downsized and less costly secondary treatment facilities, such as a media filter, constructed wetland, or lagoon.⁹ Additionally, infiltration and inflow rates are nearly eliminated with effluent sewers, further reducing treatment facility costs.

Low power and treatment costs are one reason why Orengo Effluent Sewers are not just an affordable technology; they are an environmentally sustainable one.

In Conclusion

Clearly, when evaluating and selecting a sewer system, community engineers and decision-makers should ask for and then evaluate all costs — up-front capital costs, ongoing O&M costs, and recurring R&R costs — to make a financially supportable decision. Get real life data to validate all manufacturers' claims. And, if possible, visit, tour, and acquire data from sewer systems that have been operational for several years, preferably longer than ten. Contact manufacturers or your regulatory authorities to find a system close to you.

For more information on Orengo Effluent Sewers, call Orengo Systems®, Inc., 800-348-9843.

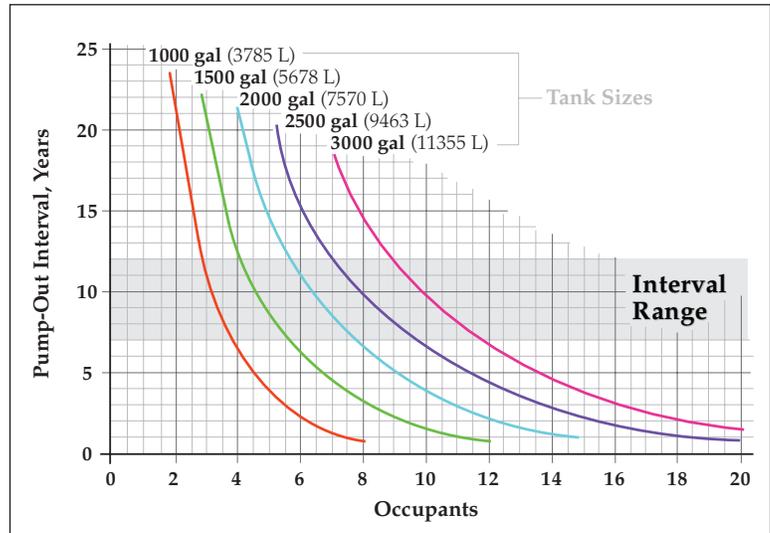


Figure 1. Pump-Out Intervals at 95% Level of Confidence

⁶ Bounds, T.R., PE, "Septic Tank Septage Pumping Intervals," 1995, pp. 7-13 (NTP-TNK-TRB-1).

⁷ Ibid., p.10.

⁸ Run Time = 20 min/day, VAC = 115, A = 12.7, National Average Power Cost = \$0.10/kWh

⁹ See descriptions of secondary treatment facilities for Mobile, Alabama, and Lake City, Michigan, in "Affordable Wastewater Solutions that Fit Your Community," Orengo Systems®, Inc., April 2009 (ACS-SMALLCOMM-1).