Project Administration Department

324 East Pine Street
Tarpon Springs FL 34689
(727) 942-5638

Memorandum

Date: May 21, 2024

To: Mark LeCouris, City Manager

From: Bob Robertson, P.E. Project Administration Department Director

Subject: Bayshore Drive Septic to Sewer – Response to 5/13/24 Comments and Concerns from Mrs. Evans

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The following information is provided in response to an email inquiry from Mrs. Janet Evans, received by you and the Board of Commissioners on May 13, 2024. The questions in her original email are provided below in their entirety and original formatting. Responses from the City to each question (or group of questions) are provided in a green font for clarity. Some items will require additional research and/or follow-up as indicated herein.

This response along with previous responses to homeowner inquiries has been posted on the City's project website at https://www.ctsfl.us/bayshore-drive-septic-to-sewer-project/ for public access.

From: Janet Adams <janet.flhomes@gmail.com>
Sent: Monday, May 13, 2024 1:29 PM
To: Mike Eisner <meisner@ctsfl.us>; John Koulianos <jkoulianos@ctsfl.us>; Panagiotis Koulias <pkoulias@ctsfl.us>; Frank DiDonato <fdidonato@ctsfl.us>; Board Of Commissioners <boc@ctsfl.us>; Mark LeCouris <mlecouris@ctsfl.us>; Costa Vatikiotis <cvatikiotis@ctsfl.us>
Subject: ALERT: Town wants to pay residential cost of sewer transition | Highlands News-Sun | midfloridanewspapers.co

ALERT: Town wants to pay residential cost of sewer transition | Highlands News-Sun | midfloridanewspapers.com

Good afternoon,

The letter we all received, did not address the cost and maintenance of the LPSS system. You have all chosen a system for us that we have to pay for. You have a fiduciary duty to not waste our money especially when you are forcing it out of our pockets for an inferior choice. During this "discovery process" you ALL REFUSED TO DIVULGE THE AMOUNT THE CITY HAS FOR GRANT/FUNDS. I believe there is ample funds that could be directed to the Bayshore Dr Sewer Project so NO OUT OF POCKET resident money is needed.

City Response:

The commitment of City grant funds through the American Rescue Plan Act (ARPA) was approved publicly by the Board of Commissioners (BOC) at the Feb 22, 2022 BOC Meeting. Three residents of Bayshore Blvd. spoke at the meeting, all of whom spoke in favor of committing the funds to the project. The video of that discussion is available at this link: https://tinyurl.com/4mtzuzdn. As mentioned in the City Manager's memo to residents on 5/10/24, the City is preparing a grant application to help offset homeowners' costs for the grinder pump unit installation. That grant application is being prepared now and will be submitted before the application deadline next month (June 2024).

Regarding connection costs, we have researched typical costs and are providing the summary table below to highlight the difference between costs that customers may see to connect to a gravity sewer system versus a low-pressure sewer system. These are estimates that are provided for comparison purposes only and are not meant to represent exact pricing and/or price quotes. Individual customer costs may vary based on the condition of their existing system, the distance from their system to the City sewer point of connection, the type and features of the grinder pump selected, and other factors.

Additionally, in response to a previous inquiry, a list of plumbing contractors that are capable of providing equipment and installation of these types of systems will be distributed to homeowners as the project construction approaches completion. The intention of the list will be to provide homeowners with a resource of capable contractors and would not be intended to serve as a City recommendation or a City preferred list of contractors. Plumbers or contractors that wish to be placed on the list can contact the City at projectadmin@ctsfl.us or call 727-942-5368.

Estimated Costs, Summary, and Comparison Table[1]

	Gravity Sewer System	Low Pressure Sewer System
Sewer Impact Fees[2]	$1,616	$1,616
Sewer Connection Fee[2]	$350	$350
Sewer Connection Deposit[2]	$40	$40
Sewer Pipe between the home and City Sewer[3]	$3,000[4] or more	$3,000[4]
Septic Tank Abandonment / Decomissioning[5]	$1,500[5]	$1,500[5]
Grinder Pump Unit	N/A	$5,000[6]
Total	**$6,506 or more**	**$11,506**

Notes:

1. *The values provided in this table are estimates based on quotes and cost research by City staff. These are provided for comparison purposes and intended to highlight the difference in costs to homeowners for gravity sewer system connection versus low-pressure sewer system connection. Actual costs may vary based on home configurations, the model of pump selected, or many other factors.*

2. *To be paid to the City by the homeowner. Financing options are available through the City for the impact fee and connection fee.*

3. *To be paid to an independent contractor or plumber. Homeowners have the option to self-perform these installations. Both options require a plumbing permit through the City Building Department.*

4. *Estimated cost of materials and labor. Average estimate provided by plumbing contractors to City staff for typical residential installations. Some contractors may offer financing options. Gravity sewer connection is a larger diameter pipe and generally at greater depth to achieve gravity flow, both can lead to higher costs.*

5. *Estimated cost to be paid to an independent contractor or plumber. Some contractors may offer financing options. Typically, septic tanks are drained, disabled and backfilled, and drain fields can be abandoned in place if desired or completely removed. Septic tank abandonment is to be coordinated through the Florida Department of Health (www.pinellashealth.com). An information packet for septic tank removal is posed on the City project website at this location: https://www.ctsfl.us/wp-content/uploads/2024/05/Septic-Tank-Abandonment-Packet.pdf.*

6. *This estimate is based on recent City staff research on installation costs and includes the estimated cost of materials and labor to purchase and install a new grinder pump unit, including electrical costs (if needed, some homes may already have sufficient external power available) to be paid to a plumber or contractor chosen by the homeowner. Some contractors may offer financing options.*

   Please note that the City is in the process of applying for a grant to help offset this cost (grinder pump unit, electrical and installation cost), currently proposed as a rebate program for qualified homeowners. Additional information will be provided to homeowners regarding this program at a later *date. The concept is to provide funding so that out-of-pocket costs to homeowners are essentially equivalent for a gravity sewer connection or an LPSS system connection.*

It should be noted that the City's Engineer of Record indicated that the cost of the grinder pump station and the connecting pipeline work could be as high as $15,000 in its 2022 Alternatives Analysis Report. However, City staff's recent research and quotes from contractors indicates that number to be an overly conservative high estimate.

*** There are many residents with new technology 3 tank septic systems, made to accommodate usage near waterfront areas. There are also residents with septic systems that are LAND LOCKED and a hook-up will surpass 20 - 30+ feet/ What are the chances for leakage in that scenario?**

City Response:

The City's ability to potentially waive the mandatory connection for these types of advanced treatment septic systems is being reviewed and discussed with the Florida Department of Health. The DOH is aware of only one such installation on Bayshore Drive.

As the EPA's *Wastewater Technology Fact Sheet* (attached) explains, "Since pressure sewers are, by design, watertight, the pipe connections ensure minimal leakage of sewage."

*** While the contractor that was on Bayshore Dr trying to answer our question, while the city rep was hiding in his office, He mentioned his company doesn't use this system so he was learning just like were were They prefer a better sound municipal application for towns & cities.**

City Response:

As explained at the public meeting on Monday, May 6th in response to this specific question, the contractor has extensive experience installing force mains just like the one that is being installed for this project. Their line of work and scope of work does not include installation of the individual grinder pumps as they do not do individual residential plumbing jobs. There are many plumbing companies that provide these customized services to homeowners.

*** The contractor also pointed out that this system does not handle a "PITCH/SLOPE OVER 4%". *That could interfere with other near by pumps due to speed into the pipeline. Did your "team" didn't know that? If yes, why wasn't that addressed? If no, why don't they know? I am just touching the surface here *(pun intended)*. This is being rushed without costs & ramifications being identified and shared with the citizens.**

City Response:

There may have been some confusion regarding this subject. "Pitch/slope" limitations primarily apply to gravity systems, not to pump systems. The City's engineer of record states the following: *Minimum and maximum slopes are recommended for the proper transport of wastewater in gravity sewer systems. Because the low-pressure sewer system (LPSS) uses pumps instead of gravity to transport the wastewater, these slopes are not applicable to the design and layout of the new system.*

*** What about a "LAND LOCKED" CONFIRGURATION? That's where septic exists a house on a rear or back side, with water or neighbor's home blocking the direct path. Hook up could be a 20 - 40+ foot line. Is this the first time you have heard about this? Was this discussed? If yes, why wasn't it addressed with the citizens? If No, why not? What else don't YOU/WE know????**

City Response:

A pressurized pumping system should have no issues with pump discharge situations like this (see previous response). Residents with such specific concerns can contact the City and we or the City's engineering consultant will help advise on options if needed.

*** As is turns out, we can install a gravity system. THE ENGINEER REPORT SUPPORTS THIS.**

City Response:

As the City Manager's 5/10/24 memo mentions, the 2022 Alternatives Analysis discussed gravity sewer as a significantly more costly option (roughly four times the cost of gravity sewer), and only physically feasible for the North Bayshore area, not the South Bayshore Area. The report also states that the cost to install gravity sewer in just the North Bayshore section alone would be $1,930,000 (in 2022 dollars), and that number did not include the cost of potential land acquisition for a wastewater pumping station (lift station). By comparison, the total cost to install the Low Pressure Sewer System (LPSS) in both the North Bayshore and the South Bayshore sections is $1.0M (the North Bayshore construction of the LPSS is approximately $510,000).

For additional comparison information, included in this response is an article from the Florida Water Resources Journal titled *Low Pressure: A Viable Collection System Alternative* that explores and elaborates on the different collection system technologies.

* **ALL during the course of Monday's meeting. NO ONE COULD ANSWER ANY OF OUR QUESTIONS! We heard answers like: "*<u>I am not in charge</u>*", "*<u>I am really not sure</u>*" , *(my personal favorite)* *<u>"They hired an engineering assessment team to assess & stamp the project".</u>* Will did you use the same "assessment team" to on the Sea Breeze project that was a complete disaster? Why are some parts of Tarpon**

using the gravity system when we all know the whole topography of Tarpon Springs has hills and valleys? Aren't all Tarpon Springs residents equal citizens? Do local builders have more rights that the residents? It sure doesn't seem that way. Where were the proper legal notifications as mandated by Tarpon Law? I have the ordinance in my hand, and it was NOT met!

City Response:

Staff answered many questions at the Monday, May 6th public meeting for over an hour, providing as much information as we could both verbally and with written information (hard copies) available for attendees to take with them after them meeting. If you have additional questions or felt that your questions were not answered, please continue to submit them in writing as you have done in your email here and we will work to address them with you and share the responses with your neighbors on the project web site. Documents provided at that meeting are also available on the City's project web page at https://www.ctsfl.us/bayshore-drive-septic-to-sewer-project/ (or by Google searching for "Tarpon Springs Bayshore Sewer").

Section 1 of Tarpon Springs Ordinance 20-22 (attached) requires owners of onsite sewage treatment and disposal systems (i.e. septic systems) to connect to the City sewer system within 365 days after written notification by the City to the property owner. The City does not issue this written notification to septic system owners until the sewer project is constructed and approved/cleared by the Florida Department of Environmental Projection, so the 365-day clock has not started yet with regards to mandatory connections. Furthermore, as stated in the City Manager's 5/10/24 memo to homeowners, we are working with the City Attorney to focus on giving residents the maximum amount of time possible to connect to the City sewer system within the requirements of the City Ordinance and State Statute. Additional information will be provided on this matter.

One of the residents of Bayshore Drive works at Hillsborough County. These Hillsborough officials told her that *the system will fail, not later, but sooner*. They also warned her that Tarpon is probably putting maintenance off on the private residents, so that any failures would be fixed privately, thus *NO EPA REPORTS WILL BE FILED AND PUT ON RECORD.* *Clever, don't your think?* They also alluded to their waterfront areas like Davis Island as an example. It is big, hilly, surrounded by water, and yet Hillsborough County said: *(see 1-3 below)*

Hillsborough County Assessments:

#1: Hillsborough County is able to put in a gravity system in waterfront areas despite the hilly topography

#2: Gravity is Less likely to have major failures vs the temperamental LDS grinder/pump sewer system.

#3: They would never put such a financial burden on their citizens, especially so close to water.

City Response:

We understand the concern regarding maintenance requirements, and we acknowledge that one resident who spoke up at the 5/6/24 public meeting has had a negative experience with his system. However, we have also spoken with residents who have used these systems for many years that report minimal issues. It should be noted that while septic systems do tend to have a long useful life, they do eventually need to be replaced, and at a significantly high cost to homeowners.

With regards to the comments about Hillsborough County's system, we have been able to reach out to the County and discussed some of these items previously with them. We will follow up on these comments later when more information comes available.

We have a commercial EPA type advisor that visits the commercial shipping facilities along the east coast that has kindly weighed in on our sewer project. Professionally he disagrees with City of Tarpon Springs selection as potentially or as he worded it "sooner than later will fail. He also echoed Hillsborough thoughts that from a leak/spillage scenario, the City of Tarpon maybe trying to negate the responsibility of knowing, responding & formally reporting any spills as they are on private property. That should be the most chilling & troublesome point for ALL TARPON CITIZENS !!!

City Response: Please provide the name and contact information of the commercial EPA type advisor that you mentioned, and we would be happy to contact him to hear and discuss his concerns directly.

Respectfully,
Janet Adams

727-432-1338

Respectfully,
Janet Adams

727-432-1338

JANET ADAMS *GRI, CNE, SRS, ABR, RSPS, BPOR*
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Low Pressure: A Viable Collection System Alternative

I.S.M. Alexandra Terral and Brian Houston

Low-pressure sewer systems can be an unconventional option for some regions in Florida and other places where conventional systems such as gravity and vacuum do not present as many benefits. A preliminary geotechnical evaluation or soil investigation of the project limits is recommended to finalize its feasibility.

Florida counties such as Charlotte County have found the low-pressure system to be an advantageous alternative that today has become one of their typical operations. This article will discuss the challenges encountered during design, bidding, and construction of several low-pressure sewer systems within the county.

The creation of a hydraulic mini-model aided the evaluation and optimization of the pipeline diameters and layout, considering several low-pressure pump capacities. Later research applied to the results of the hydraulic model yielded a reduction in cumbersome, standardized air-release valve units used for this type of system and modification of some of the typical low-pressure components, such as service connections and clean-outs. These modifications translated into simpler construction with a great potential to lower bid costs and reduce maintenance requirements.

Permitting this system requires close coordination with regulatory agencies to avoid miscommunication due to its uncommon use, allowances, and restrictions. Success of low-pressure systems requires careful planning because of the intricacies of operation and maintenance, including crews, spare parts, and equipment.

Rotonda Sands and Rotonda Meadows are two communities located in Charlotte County, near Florida's west coast. Rotonda Sands is located on the west side of the highway and Rotonda Meadows is located on the east side of the highway, approximately three miles south of the Rotonda Sands boundary. These communities include more than 5,000 equivalent residential units (ERUs), and they are yet to be fully developed.

Currently there are nearly 10 percent existing ERUs, and some of the houses are owned by seasonal residents. Supported by the homeowners association, Charlotte County Utilities initiated the process of public approval to design and construct a sewer system to provide current and future residents this service while eliminating septic systems.

With flat terrain and high groundwater, a low-pressure effluent system was selected as the collection system of choice. In comparison with the most widely used collection systems like gravity and vacuum systems, low-pressure sewers provide a viable collection system alternative for areas like Sands and Meadows, where the common systems will be considered the second choice.

I.S.M. Alexandra Terral, P.E., is a senior engineer with the Orlando office of the consulting engineering firm AECOM Water, formerly Boyle Engineering at the time this article was written. Brian Houston, P.E., is a senior project manager in the Tampa office of the consulting engineering firm R.W. Beck. At the time this article was written, he was a principal engineer with Boyle Engineering in Orlando. The article was presented as a technical paper at the 2008 Florida Water Resources Conference in May.

Collection System Alternatives

Gravity

Gravity sewers use natural topography to collect the flow into a lift station. As minimum criterion, scouring velocities must be maintained, so the mean flow velocity should be at least two feet per second during full pipe flow.

Since gravity is providing the force to convey the wastewater, the greater the slope, the smaller the required pipe. In areas where there is limited natural slope, deeper manholes are required in order to keep the slope; as a result, excavation cost can be relatively high.

Gravity sewers have no mechanical parts and usually have low operation and maintenance costs, although in some cases the gravity system may require several lift stations to convey the flow to a main lift station; therefore, the cost of O&M to the utility will be higher.

Vacuum

Vacuum sewer systems rely on gravity to move wastewater from homes to a vacuum valve pit package. They then use a pressure differential, instead of gravity, to move wastewater to a vacuum station and on to the treatment plant. Differential air pressure is used as the motive force to transport sewage. The main lines are under a vacuum of 16 inches to 20 inches Hg (-0.5 to –0.7 bar), created by vacuum pumps located at the vacuum station (Figure 1).

The vacuum system requires a vacuum/gravity interface valve at each entry-point valve pit. Vacuum collection piping typically consists of four-inch to 10-inch diameter installed with minimum cover and a vacuum station. Vacuum stations are usually concrete block buildings on concrete foundations with minimum plan dimensions of approximately 25 feet by 30 feet.

Vacuum sewers are recommended where there are at least 75 connections, rolling hills with small elevation changes, a high ground-

Continued on page 34

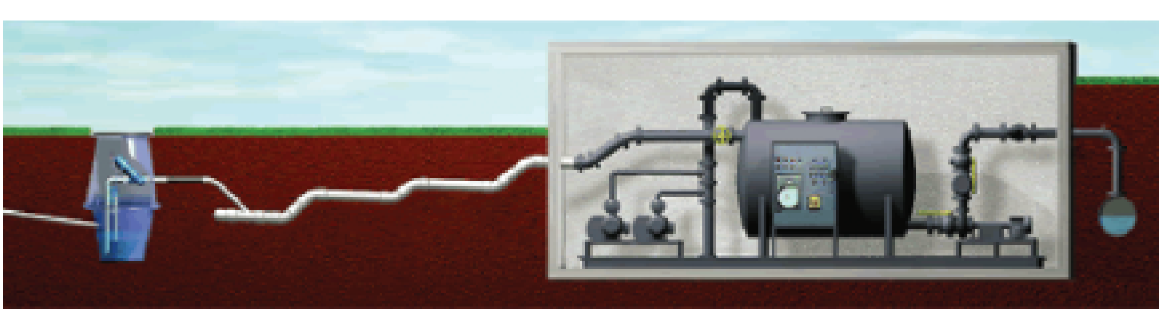


Figure 1: Vacuum Sewer System

Courtesy of AirVaC

Continued from page 33
water table, restricted construction conditions, unstable soils, flat terrain, rock, a sensitive ecosystem, or areas where no reliable power is provided to the community. Vacuum stations will have an emergency generator to keep the collection of the flow, regardless of the status of the power sources.

Low Pressure

Low-pressure sewer systems are collection systems that use individual residential pumps to push the flow to a master lift station, where a force main conveys the flow to another lift station or directly to the treatment plant. The main characteristic of a low-pressure system is that the capacity of the residential pumps selected determines the location of the lift station(s).

Other essential components of all low-pressure systems are isolation valves and air-release valves. Similarities of all low-pressure systems are:

- Inflow and infiltration (I/I) reduction.
- Smaller diameter (even smaller than vacuum sewers). Low-pressure sewer can be as small as 1.5-inch to six-inch diameter lines.
- Can be used for both flat and steeply sloping terrain. It doesn't depend on the natural topography of the area to convey wastewater and simplifies the sewer alignment.
- Can be installed in high groundwater areas, reducing the cost of dewatering during construction.
- Can be directionally drilled to avoid environmentally sensitive areas, reducing disturbances to the community.

There are two different types of low-pressure systems: grinder pump and effluent pump types.

Grinder pump systems – With this type of pump, tanks at the residence collect the sewer flows and a grinder pump mixes flow with the solids to be pushed through the pipes to the lift station. Like the effluent pump systems, each residential assembly requires periodic maintenance. Some of the advantages and disadvantage of this type of pump are:

- The tanks do not require periodic solids removal.
- Sewage is not as corrosive because of the air introduced, which may assist with odor reduction.
- Grinder pump repairs usually cost more than effluent pump repairs because the grinder assembly wears faster with sand.
- Velocities need to be between three and five feet per second in order to avoid solids settling and grease buildup, according to the *Myers Design Manual for Pressure Sewers, Based on Grinder & Effluent Pumps.*

Effluent pumps systems – For effluent type systems, the solids settle in the bottom of the tank. Then, the gray/effluent will flow through a weir into a chamber, where an effluent pump will, by level sensors, initiate the push of flow toward the lift station. Some of the advantages and disadvantages of this type of pumps are:

- The tanks require periodic solids removal.
- It is recommended that all the system components be non-metallic.
- Routine maintenance is necessary; however, pump repairs are not frequent.
- Velocities can be a minimum of one foot per second.
- Grease and solids are expected to remain in the tank and not travel through the collection system, reducing the need for flushing maintenance.

In summary, the major decisive factors for low-pressure effluent collection systems are:

- ***A very mild to flat terrain.***
- ***Lower cost of construction***. The low-pressure sewer system allows for shallower pipe installation.
- ***Less above-ground infrastructure***. Unlike the case of the vacuum system that requires a vacuum station and structures above ground, the low-pressure system requires a standard lift station without any significant above-ground structures.
- ***Lower cost of frequent repairs***. It is expected that for grinder pumps, the impellers will require more expensive and more frequent repairs because of the presence of sand in the flows.
- ***Less maintenance cost***. Vacuum systems require a full-time, well-trained operator, while low-pressure systems require only periodic maintenance.

The need to reduce cost, especially during the current money crunch, has driven utilities like Charlotte County Utilities to select low-pressure effluent sewer systems for most of their collection systems.

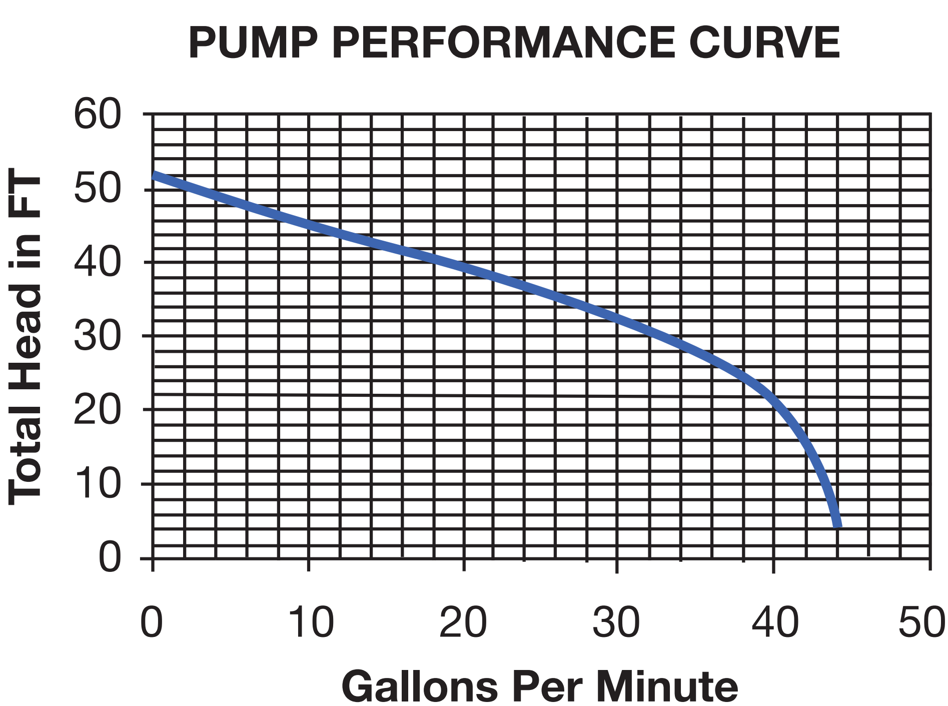


Figure 2: Performance Curve for a ½-Horsepower Effluent Pump

Design Peculiarities

The design of a low-pressure effluent sewer system has many similarities to other types of collection systems—especially during the initial stages:

- Collection of information: existing utilities (as-builts), topographic and geotechnical investigations.
- Land use and equivalent residential unit counts per lot.
- Calculation of the flows (average and peak) per equivalent residential unit.
- Selection of diameters, velocities, and headlosses based on design criteria specific to the low-pressure system (minimum velocities) and materials to be used (friction factors, etc.).
- Layout and alignment.
- Location of isolation valves and potential air entrapment.
- Lift station location.
- Lift station pump selection.
- Design plans and specifications.

For low-pressure effluent sewer systems,

Continued on page 36

								Target:	43.0		
								Max:	42.4	6 fps	1 fps
From	**To**	**Add'l Lots**	**Cum Lots**	**Peak Q (gpm)**	**Linesize**	**Peak Vel**	**Seg Len**	**Seg hL**	**Total hL**	Linesize Range	
Sa1	Sa2	35	35	43	3	1.9	260	1.6	42.4	3	4
Sa2	Sa3	19	54	60	3	2.7	260	3.1	40.8	3	4
Sa3	Sa4	20	74	78	4	2.0	260	1.2	37.6	3	4
Sa4	Sa5	19	93	94	4	2.4	260	1.7	36.4	3	6
Sa5	Sa6	19	112	109	4	2.8	280	2.5	34.7	3	6
Sa6	Sa7	1	113	110	4	2.8	788	7.0	32.2	3	6
Sa7	Sa8	22	135	126	4	3.2	260	3.0	25.1	3	6
Sa8	Sa9	7	142	132	6	1.5	260	0.5	22.1	3	6
Sa9	Sa10	15	157	143	6	1.6	260	0.5	21.7	4	6
Sa10	Sb7	15	172	154	6	1.7	260	0.6	21.1	4	6

Figure 3: Hydraulic Evaluation and Results of the LP System for Rotonda Sands

Continued from page 34

as with any other collection system, the selection/optimization of diameters is an iterative process; however, since there are no commercial models available for the low-pressure system, we created a model to help us design the system and minimize the effort of iteration. As a result of the evaluations, several lift stations were eliminated, saving thousands of dollars in construction and maintenance costs.

For the model, the following design criteria were used:

- Friction factor C=130 (pumping station design: Robert L. Sanks)
- Hazen Williams formula
- AADF 190 gallons per day per ERU
- Peaking factors
  - For the LP lines: Q peak = 3.5Qavg^0.807
  - For the force main: Q peak =18 $\sqrt{P}$/4 + $\sqrt{P}$. Where P is population in thousands.

Two peaking factors were used because the expected peaks and time of concentration for the low-pressure sewer system is different than for the force main. Low-pressure sewer lines will see peak flow depending on the number of pumps running at the same time, while the force main will see peaks depending on the lift station pump's operation.

- Maximum headloss per run has to be less than 43 feet to reach the lift station because the effluent pump was pre-selected to be a ½-horsepower pump (Figure 2) and typically their operational set up sets the rate of flow at approximately 10 gallons per minute.

Before the model is set up, using base map, a preliminary layout is needed to determine the drainage or collection basins, number of nodes, length of the segments, and anticipated location of the master lift station. The collection basins are defined typically by the topography, and since the topography is essentially flat, the limits of the basins were determined, in great part, by the streets. Looping was avoided in the layout to eliminate the possibility of dead zones, or zones where flows do not typically reach and cleanse the pipe; consequently, at the end of each street, a clean-out was placed to provide easier maintenance.

A closer look at the model shows the setup (portion of Figure 3) where each segment is identified by the **From** node to the **To** node.

- The **Add'l Lot** (additional lots) column is to input the number of lots added at the **To** node.
- The **CumLots** (cumulative lots) column is calculated automatically by adding all the cumulative lots (in the above rows with the same node number in the **To** column as the **From** node of the segment in questions) and the **Add'l Lot** cell. As shown in the example illustrated, for segment **Sa10** to **Sa7**, the cumulative lots are a sum of the **CumLots** of segment **Sa9** to **Sa10** (157 lots) and 15 lots, resulting in a total of 172 lots.
- The **Peak Q** (peak flow) cell calculates the peak flow of the cumulative flows (based on the design criteria mentioned above.
- **Linesize** calculates, by default, the closest practical diameter with the capacity for the flow and velocity no greater than six feet per second.
- The **SegLen** (segment length) is an input that can be obtained from the base map and the preliminary layout.
- The **Seg hL** (segment headloss) is calculated based on the velocity and flow in the pipe (assuming a full pipe).
- The **Total hL** (total headloss) is calculated similarly to the **CumLots**. The model reads the **Total hL** from the segment above with the same node number in the **To** column as the segment's **From** node.
- If the **Total hL** exceeds the 43 feet of headloss in any segment, a revision will be made to the upstream diameters. Diameter size will be increased, having the best cost/benefit in mind, to reduce the headloss starting with the segments where the velocity is equal or higher than six feet per second.

Final Layout

With the results of the model, the layout can be finalized (Rotonda Sands shown in Figure 3) using the base map and the calculated pipe diameters. All diameters were verified to make sure the downstream diameters are equal or larger. Diameters for both the Rotonda Sands and Rotonda Meadows range from two to three inches in diameter in the collector streets and from three to 10 inches in diameter in the mains. The diameters for the force mains to transport the flows from the master lift station to the treatment plant are both 12 inches.

Air Entrapment

Air entrapment in pressure lines can lead to an increase in the system head loss, higher energy costs, and/or the inability of pumps to move flow at all (air lock). One of the "rules of thumb" states that air release valves (ARVs) need to be installed at high points and at 2,500 linear foot intervals along lengths of flat main. Another recommends an air release valve every 14 diameters. Applying either of these typical criteria in these projects, with 43 miles of pipe, may have resulted in an unnecessarily large number of ARVs—more than 91.

Research by Wallingford Hydraulic Research Institute studied the movement of air within pressure lines. Findings indicated that air bubbles can be moved reliably along flat sections of pressure mains and even pass downward through sloping sections of mains, given sufficient velocity. Smaller mains require less velocity in order to move air along; therefore, for smaller diameter pipes, the downward slope can be steeper than for larger diameters.

Table 1 provides a portion of the results of the calculations, as it applies to the Sands and Meadows projects. Since the hydraulic

Continued on page 38

Figure 4: Rotonda Sands Final Layout

Pipe Diameter (inches)	Downward Slope (%)	Vc (fps)
3	10	1.1
3	20	1.6
3	40	2.2
3	100	3.0
4	10	1.2
4	20	1.8
4	40	2.5
4	100	3.4
8	10	1.7
8	20	2.5
8	40	3.5
8	100	4.8
12	10	2.1
12	20	3.1
12	40	4.3
12	100	5.9

Table 1: Velocities and Slopes by Diameter Necessary to Avoid Air Entrapment

Continued from page 36

analysis for the project resulted in mains' velocities of an average greater than 1.6 feet per second, most mains could have downward slopes of up to 20 percent without experiencing air entrapment. This concept was very useful to cross under existing utilities, resulting in a significantly lower number of ARVs.

Initial system conditions—low flows—were considered where the peak velocities can be near zero; thus, the downward sloping mains will have to be minimized. In fact, design will include an objective of maintaining upward sloping mains to the extent possible and within reason because of potential cost impacts of deep lines. Until the subdivisions become substantially populated, periodic flushing will be required to prevent air locks.

Isolation Valve Locations

Isolation Plug Valves will be located at the intersection of each dead-end street and every 1,000 linear feet of main, as required in *Design and Specification Guidelines for Low Pressure Sewer Systems*, 1981. All plug valves will vary in size and materials; however, for this project all valves were listed in the Charlotte County Utilities Acceptable Materials List. The clean-out at the end of each street also has an isolation valve. The rest of the isolation valves were located strategically to isolate basins to a maximum of 22 residents in case of system problems.

Permitting & Funding

Rules 62-604 and 62-555 of the Florida Administrative Code (FAC) were followed for designing the collection system. The construction permit for the project was prepared and obtained after applying to the Florida Department of Environmental Protection (FDEP), utilizing the form for the Notification/Application for Constructing A Domestic Wastewater Collection/Transmission System (Form 62-604.300(8)(a)). Additional information such as hydraulic calculations were presented with the application to help the reviewer understand this uncommon collection system.

Since there were no wetlands involved in the project, the application to the Southwest Florida Water Management District was prepared as a Notice General. This application was later approved by the FDEP, the new reviewer agency (based on the latest agencies agreement).

The project was funded with a State Revolving Fund load base on the eligibility stated within rule 62-552 FAC. In order to fulfill the funding requirements, the funding agencies also reviewed the preliminary and

Continued on page 40

Continued from page 38

final project design. Other requirements included public hearings and approval, along with notification of the project status until completion.

Bidding

Since most contractors are not familiar with this type of collection system's construction, it is important that the bidding document states clear information to avoid mistakes during construction and problems during operation.

Since the system was designed with a specific residential effluent pump, the documents stated that no substitutions were allowed. Several standard details, such as the clean-out and the service connection details, were simplified to reduce confusion and reduce potential cost of the "unknown factor." In the general notes of the plans, it was stated that the contractors must maintain a flat or positive slope from the cleanouts to the master lift station(s) to help the air travel upward.

Decisions on construction methods were made by considering several factors. One of them was coordination with Charlotte County's public works department and its schedule for re-pavement to minimize the capital cost to the county. Another factor was that most of the lots are not developed; therefore, open trench methods were acceptable. Furthermore, in order to obtain better bid prices, the decision of what methods of construction to use were limited only where necessary, but left for the contractors to decide, allowing them flexibility based on their capabilities.

Maintenance & Operations

Periodic maintenance is essential for a reliable low-pressure system. According to research and the county's experience, a two-person crew can manage annual preventive and emergency maintenance for about 1,000 pump stations. Typical duties during maintenance are:

- Inspecting the control panel.
- Testing the alarm light.
- Checking resistance on power leads and checking ground wire.
- Washing down the holding tank and pump.
- Checking floats for grease build-up.
- Pulling the pump.
- Checking the stainless steel cutter blade for wear.
- Flushing the lines periodically.
- Removing solids from each tank every 10 years, according to the Peabody Barnes Manual.

It was also recommended that the utility keep spare pumps, as a minimum, totaling between 3 and 5 percent of the total number of pumps in service. The percentage will increase after 10 year of service life, to between 5 and 10 percent. Some pumps are known to have a total shelf life of 20 years.

In summary, the low-pressure effluent collection system was selected for these two projects because of its advantages over gravity and vacuum sewer systems in areas with high groundwater and flat terrain, such as these projects. This selection made it possible to minimize cost and provide reliable service to the communities.

Although the design of the projects required consideration of the peculiarities of the low-pressure sewer, value engineering in these projects saved thousands of dollars by eliminating unnecessary lift stations. The design also considered the operation and maintenance for phased growth and the need to reduce costs, even after the community is completely built out.

United States
Environmental Protection
Agency

Wastewater Technology Fact Sheet

Sewers, Pressure

DESCRIPTION

Conventional Wastewater Collection System

Conventional wastewater collection systems transport sewage from homes or other sources by gravity flow through buried piping systems to a central treatment facility. These systems are usually reliable and consume no power. However, the slope requirements to maintain adequate flow by gravity may require deep excavations in hilly or flat terrain, as well as the addition of sewage pump stations, which can significantly increase the cost of conventional collection systems. Manholes and other sewer appurtenances also add substantial costs to conventional collection systems.

Alternative

Alternative wastewater collection systems can be cost effective for homes in areas where traditional collection systems are too expensive to install and operate. Pressure sewers are used in sparsely populated or suburban areas in which conventional collection systems would be expensive. These systems generally use smaller diameter pipes with a slight slope or follow the surface contour of the land, reducing excavation and construction costs.

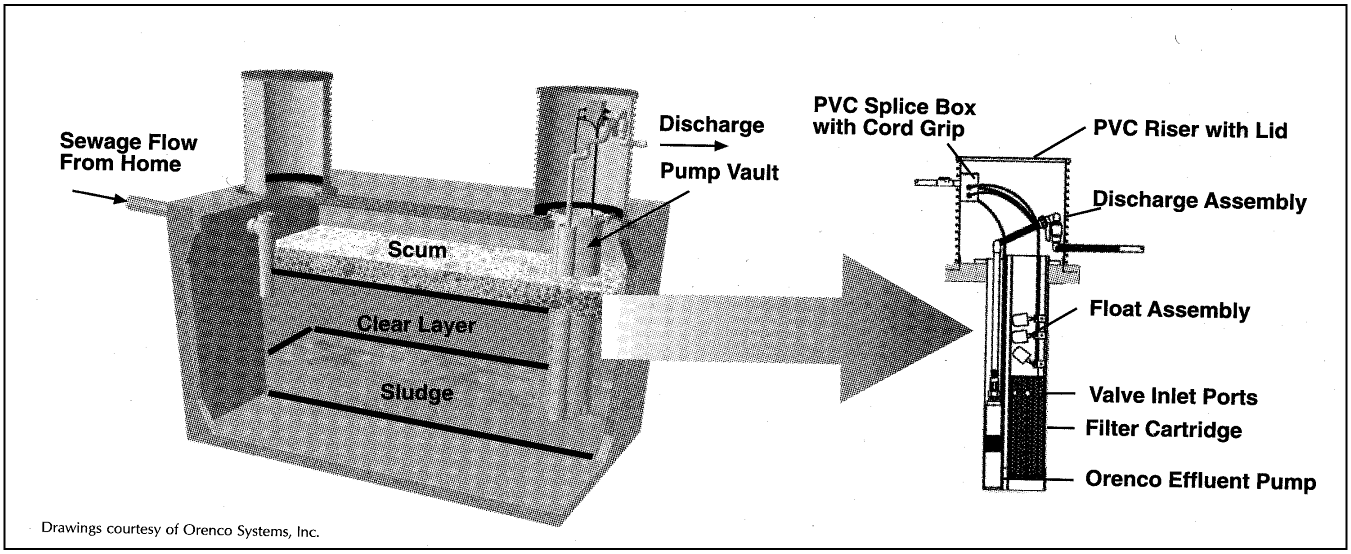
Pressure sewers differ from conventional gravity collection systems because they break down large solids in the pumping station before they are transported through the collection system. Their watertight design and the absence of manholes eliminates extraneous flows into the system. Thus, alternative sewer systems may be preferred in areas that have high groundwater that could seep into the sewer, increasing the amount of wastewater to be treated. They also protect groundwater sources by keeping wastewater in the sewer. The disadvantages of alternative sewage systems include increased energy demands, higher maintenance requirements, and greater on-lot costs. In areas with varying terrain and population density, it may prove beneficial to install a combination of sewer types.

This fact sheet discusses a sewer system that uses pressure to deliver sewage to a treatment system. Systems that use vacuum to deliver sewage to a treatment system are discussed in the *Vacuum Sewers* Fact Sheet, while gravity flow sewers are discussed in the *Small Diameter Sewers* Fact Sheet.

Pressure Sewers

Pressure sewers are particularly adaptable for rural or semi-rural communities where public contact with effluent from failing drain fields presents a substantial health concern. Since the mains for pressure sewers are, by design, watertight, the pipe connections ensure minimal leakage of sewage. This can be an important consideration in areas subject to groundwater contamination. Two major types of pressure sewer systems are the **septic tank effluent pump (STEP)** system and the **grinder pump (GP)**. Neither requires any modification to plumbing inside the house.

In STEP systems, wastewater flows into a conventional septic tank to capture solids. The liquid effluent flows to a holding tank containing a pump and control devices. The effluent is then pumped and transferred for treatment. Retrofitting existing septic tanks in areas served by septic tank/drain field systems would seem to present an opportunity for cost savings, but a large number (often a majority) must be replaced or expanded over the life of the system because of insufficient capacity, deterioration of concrete tanks, or leaks. In a GP system, sewage flows to a vault where a grinder pump grinds the solids and discharges the sewage into a pressurized pipe system. GP systems do not require a septic tank but may require more horsepower than STEP systems because of the grinding action. A GP system can result in significant capital cost



Source: C. Falvey, 2001.

FIGURE 1 TYPICAL SEPTIC TANK EFFLUENT PUMP

savings for new areas that have no septic tanks or in older areas where many tanks must be replaced or repaired. Figure 1 shows a typical septic tank effluent pump, while Figure 2 shows a typical grinder pump used in residential wastewater treatment.

The choice between GP and STEP systems depends on three main factors, as described below:

Cost: On-lot facilities, including pumps and tanks, will account for more than 75 percent of total costs, and may run as high as 90 percent. Thus, there is a strong motivation to use a system with the least expensive on-lot facilities. STEP systems may lower on-lot costs because they allow some gravity service connections due to the continued use of a septic tank. In addition, a grinder pump must be more rugged than a STEP pump to handle the added task of grinding, and, consequently, it is more expensive. If many septic tanks must be replaced, costs will be significantly higher for a STEP system than a GP system.

Downstream Treatment: GP systems produce a higher TSS that may not be acceptable at a downstream treatment facility.

Low Flow Conditions: STEP systems will better tolerate low flow conditions that occur in areas with highly fluctuating seasonal occupancy and those with slow build out from a small initial population to the ultimate design population. Thus, STEP systems may be better choices in these areas than GP systems.

APPLICABILITY

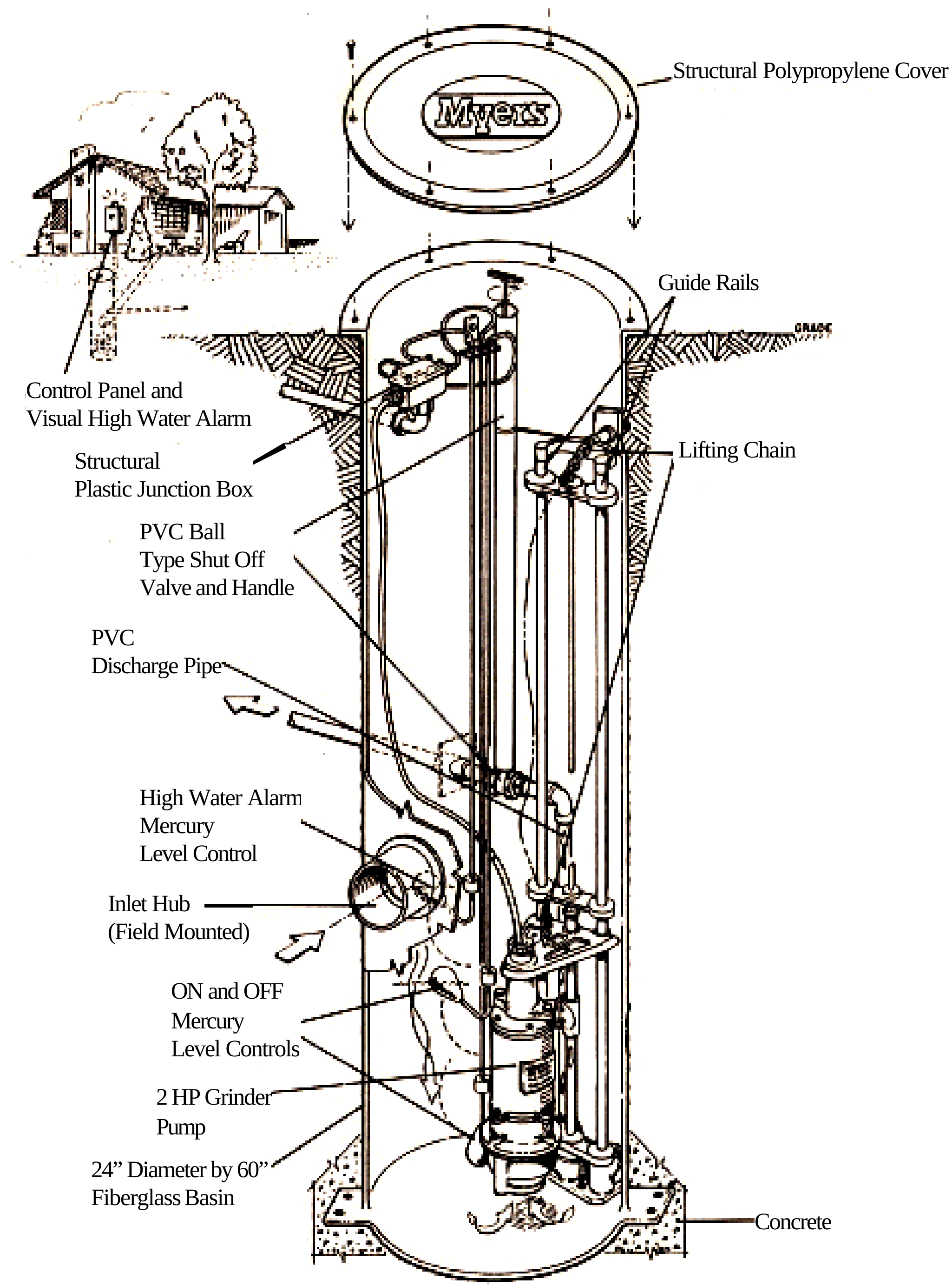
Pressure sewer systems are most cost effective where housing density is low, where the terrain has undulations with relatively high relief, and where the system outfall must be at the same or a higher elevation than most or all of the service area. They can also be effective where flat terrain is combined with high ground water or bedrock, making deep cuts and/or multiple lift stations excessively expensive. They can be cost effective even in densely populated areas where difficult construction or right of way conditions exist, or where the terrain will not accommodate gravity sewers.

Since pressure systems do not have the large excess capacity typical of conventional gravity sewers, they must be designed with a balanced approach, keeping future growth and internal hydraulic performance in mind.

ADVANTAGES AND DISADVANTAGES

Advantages

Pressure sewer systems that connect several residences to a “cluster” pump station can be less expensive than



Source: F.E. Meyers Company, 2000.

FIGURE 2 TYPICAL GRINDER PUMP

conventional gravity systems. On-property facilities represent a major portion of the capital cost of the entire system and are shared in a cluster arrangement. This can be an economic advantage since on-property components are not required until a house is constructed and are borne by the homeowner. Low front-end investment makes the present-value cost of the entire system lower than that of conventional gravity sewerage, especially in new development areas where homes are built over many years.

Because wastewater is pumped under pressure, gravity flow is not necessary and the strict alignment and slope restrictions for conventional gravity sewers can be relaxed. Network layout does not depend on ground contours: pipes can be laid in any location and extensions can be made in the street right-of-way at a relatively small cost without damage to existing structures.

Other advantages of pressure sewers include:

Material and trenching costs are significantly lower because pipe size and depth requirements are reduced.

Low-cost clean outs and valve assemblies are used rather than manholes and may be spaced further apart than manholes in a conventional system.

Infiltration is reduced, resulting in reductions in pipe size.

The user pays for the electricity to operate the pump unit. The resulting increase in electric bills is small and may replace municipality or community bills for central pumping eliminated by the pressure system.

Final treatment may be substantially reduced in hydraulic and organic loading in STEP systems. Hydraulic loadings are also reduced for GP systems.

Because sewage is transported under pressure, more flexibility is allowed in siting final treatment facilities and may help reduce the length of outfall lines or treatment plant construction costs.

Disadvantages

Requires much institutional involvement because the pressure system has many mechanical components throughout the service area.

The operation and maintenance (O&M) cost for a pressure system is often higher than a conventional gravity system due to the high number of pumps in use. However, lift stations in a conventional gravity sewer can reverse this situation.

Annual preventive maintenance calls are usually scheduled for GP components of pressure sewers. STEP systems also require pump-out of septic tanks at two to three year intervals.

Public education is necessary so the user knows how to deal with emergencies and how to avoid blockages or other maintenance problems.

The number of pumps that can share the same downstream force main is limited.

Power outages can result in overflows if standby generators are not available.

Life cycle replacement costs are expected to be higher because pressure sewers have a lower life expectancy than conventional systems.

Odors and corrosion are potential problems because the wastewater in the collection sewers is usually septic. Proper ventilation and odor control must be provided in the design and non-corrosive components should be used. Air release valves are often vented to soil beds to minimize odor problems and special discharge and treatment designs are required to avoid terminal discharge problems.

DESIGN CRITERIA

Many different design flows can be used in pressure systems. When positive displacement GP units are used, the design flow is obtained by multiplying the pump discharge by the maximum number of pumps expected to be operating simultaneously. When centrifugal pumps are used, the equation used is $Q = 20 + 0.5D$, where Q is the flow in gpm and D is the number of homes served. The operation of the system under various assumed conditions should be simulated by computer to check design adequacy. No allowances for infiltration and inflow are required. No minimum velocity is generally used in design, but GP systems must attain three to five feet per second at least once per day. A Hazen-Williams coefficient, (C) = 130 to 140, is suggested for hydraulic analysis. Pressure mains generally use 50 mm (2 inch) or larger PVC pipe (SDR 21) and rubber-ring joints or solvent welding to assemble the pipe joints. High-density polyethylene (HDPE) pipe with fused joints is widely used in Canada. Electrical requirements, especially for GP systems, may necessitate rewiring and electrical service upgrading in the service area. Pipes are generally buried to at least the winter frost penetration depth; in far northern sites insulated and heat-traced pipes are generally buried at a minimal depth. GP and STEP pumps are sized to accommodate the hydraulic grade requirements of the system. Discharge points must use drop inlets to minimize odors and corrosion. Air release valves are placed at high points in the sewer and often are vented to soil beds. Both STEP and GP systems can be assumed to be anaerobic and potentially odorous if subjected to turbulence (stripping of gases such as H_2S).

PERFORMANCE

STEP

When properly installed, septic tanks typically remove about 50 percent of BOD, 75 percent of suspended solids, virtually all grit, and about 90 percent of grease, reducing the likelihood of clogging. Also, wastewater reaching the treatment plant will be weaker than raw sewage. Typical average values of BOD and TSS are 110 mg/L and 50 mg/L, respectively. On the other hand, septic tank effluent has virtually zero dissolved oxygen.

Primary sedimentation is not required to treat septic tank effluent. The effluent responds well to aerobic treatment, but odor control at the headworks of the treatment plant should receive extra attention.

The small community of High Island, Texas, was concerned that septic tank failures were damaging a local area frequented by migratory birds. Funds and materials were secured from the EPA, several state agencies, and the Audubon Society to replace the undersized septic tanks with larger ones equipped with STEP units and low pressure sewerage ultimately discharging to a constructed wetland. This system is expected to achieve an effluent quality of less than 20 mg/L each of BOD and TSS, less than 8 mg/L ammonia, and greater than 4 mg/L dissolved oxygen (Jensen 1999).

In 1996, the village of Browns, Illinois, replaced a failing septic tank system with a STEP system discharging to low pressure sewers and ultimately to a recirculating gravel filter. Cost was a major concern to the residents of the village, who were used to average monthly sewer bills of $20. Conditions in the village were poor for conventional sewer systems, making them prohibitively expensive. An alternative low pressure-STEP system averaged only $19.38 per month per resident, and eliminated the public health hazard caused by the failed septic tanks (ICAA, 2000).

GP Treatment

The wastewater reaching the treatment plant will typically be stronger than that from conventional systems because infiltration is not possible. Typical design average concentrations of both BOD and TSS are 350 mg/L (WPCF, 1986).

GP/low pressure sewer systems have replaced failing septic tanks in Lake Worth, Texas (Head, et. al., 2000); Beach Drive in Kitsap County, Washington (Mayhew and Fitzwater, 1999); and Cuyler, New York (Earle, 1998). Each of these communities chose alternative systems over conventional systems based on lower costs and better suitability to local soil conditions.

OPERATION AND MAINTENANCE

Routine operation and maintenance requirements for both STEP and GP systems are minimal. Small systems that serve 300 or fewer homes do not usually require a full-time staff. Service can be performed by personnel from the municipal public works or highway department. Most system maintenance activities involve responding to homeowner service calls usually for electrical control problems or pump blockages. STEP systems also require pumping every two to three years.

TABLE 1 RELATIVE CHARACTERISTICS OF ALTERNATIVE SEWERS

Sewer Type	Slope Requirement	Construction Cost in Rocky, High Groundwater Sites	Operation and Maintenance Requirements	Ideal Power Requirements
Conventional	Downhill	High	Moderate	None*
Pressure				
STEP	None	Low	Moderate-high	Low
GP	None	Low	Moderate-high	Moderate

* Power may be required for lift stations
Source: Small Flows Clearinghouse, 1992.

The inherent septic nature of wastewater in pressure sewers requires that system personnel take appropriate safety precautions when performing maintenance to minimize exposure to toxic gases, such as hydrogen sulfide, which may be present in the sewer lines, pump vaults, or septic tanks. Odor problems may develop in pressure sewer systems because of improper house venting. The addition of strong oxidizing agents, such as chlorine or hydrogen peroxide, may be necessary to control odor where venting is not the cause of the problem.

Generally, it is in the best interest of the municipality and the homeowners to have the municipality or sewer utility be responsible for maintaining all system components. General easement agreements are needed to permit access to on-site components, such as septic tanks, STEP units, or GP units on private property.

COSTS

Pressure sewers are generally more cost-effective than conventional gravity sewers in rural areas because capital costs for pressure sewers are generally lower than for gravity sewers. While capital cost savings of 90 percent have been achieved, no universal statement of savings is possible because each site and system is unique. Table 1 presents a generic comparison of common characteristics of sanitary sewer systems that should be considered in the initial decision-making process on whether to use pressure sewer systems or conventional gravity sewer systems.

Table 2 presents data from recent evaluations of the costs of pressure sewer mains and appurtenances (essentially the same for GP and STEP), including items specific to each type of pressure sewer. Purchasing pumping stations in volume may reduce costs by up to 50 percent. The linear cost of mains can vary by a factor of two to three, depending on the type of trenching equipment and local costs of high-quality backfill and pipe. The local geology and utility systems will impact the installation cost of either system.

The homeowner is responsible for energy costs, which will vary from $1.00 to $2.50/month for GP systems, depending on the horsepower of the unit. STEP units generally cost less than $1.00/month.

Preventive maintenance should be performed annually for each unit, with monthly maintenance of other mechanical components. STEP systems require periodic pumping of septic tanks. Total O&M costs average $100-200 per year per unit, and include costs for troubleshooting, inspection of new installations, and responding to problems.

Mean time between service calls (MTBSC) data vary greatly, but values of 4 to 10 years for both GP and STEP units are reasonable estimates for quality installations.

TABLE 2 AVERAGE INSTALLED UNIT COSTS FOR PRESSURE SEWER MAINS & APPURTENANCES

Item	Unit Cost ($)
2 inch mains	9.40/LF
3 inch mains	10.00/LF
4 inch mains	11.30/LF
6 inch mains	15.80/LF
8 inch mains	17.60/LF
Extra for mains in asphalt concrete pavement	6.30/LF
2 inch isolation valves	315/each
3 inch isolation valves	345/each
4 inch isolation valves	440/each
6 inch isolation valves	500/each
8 inch isolation valves	720/each
Individual Grinder pump	1,505/each
Single (simplex) package pump system	5,140/each
package installation	625 - 1,880/each
Automatic air release stations	1,255/each

Source: U.S. EPA, 1991.

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Other Related Fact Sheets

Other EPA Fact Sheets can be found at the following web address:

http://www.epa.gov/owm/mtb/mtbfact.htm

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