SANITARY SEWER COLLECTION SYSTEMS

The Ohio EPA requires that where sewage collection systems are available, or may be made available by feasible and reasonable extension of the system, such facilities shall be used and individual treatment facilities will not be allowed. All new sewer systems, extensions, and replacement sewers must be designed to exclude rainwater from roofs, streets, or other areas, and ground water from foundation drains. A major thrust of environmental policy at the present time is to provide for economic and efficient treatment of wastewater.

The following major factors must also be considered in the design of sanitary sewer systems:

1. groundwater infiltration
2. topography of the area
3. location of the waste treatment plant
4. depth of excavation
5. pumping requirements
6. rock excavation
7. soil conditions
8. discharge limits of the wastewater treatment plant
9. borings (streams, railroads, highways, etc.)
10. conflicts with other utilities

1. Conventional Gravity Sewer System

   In conventional gravity collection systems, the wastewater flows by gravity and, except where pumping stations are required to overcome elevation changes, the system is devoid of moving parts. The system eliminates septic tanks and leeching systems and replaces them with a private building sewer which connects the building to the main sewer. Operation and maintenance demands generally increase with age, but in well constructed systems, this is minimal. Due to larger pipe diameters, blockages are rare and generally easily removed when they do occur. With their simplicity of design and many years of application, conventional gravity sewer systems are a reliable and economical means of conveying wastewater.

A. Advantages

1) Design standards and procedures well established
2) Reliable operation
3) Handle grit and solids
4) At minimum velocity lower production of hydrogen sulfide
5) Higher excess capacity for future growth

B. Disadvantages

1) Slope requirements can require deeper excavation
2) Pumping and lift stations may be required to overcome slope requirements
3) Deeper manholes (confined space entry)
4) Higher inflow and infiltration
5) High bedrock could increase construction cost

Conventional gravity sewers are generally 8 to 12 inches in diameter and constructed of polyvinyl chloride (PVC) pipe with construction depths ranging from 7 to 20 feet. All sewers shall be designed and constructed to develop velocities not less than 2.0 feet per second when flowing full. Also, manholes shall be installed at the end of each line, at all changes in grade, alignment, intersections, and at distances not greater than 400 feet for sewer up to 15 inches in diameter.

Residential and non-residential flows along with allowable clean water infiltration quantities must be considered in the design of a wastewater collection system. Infiltration is clean ground water that seeps into a sanitary sewage collection system through pipe joints and other minor openings and mixes with sanitary flows creating larger volumes of wastewater to transport and treat. The allowable infiltration rate of 100 gpd/inch diameter limits is based on current sanitary sewer construction technology. However, this amount would be expected to increase over the years mainly due to sewer extensions and the age of the collection system. Conventional sanitary sewers shall also be designed on a peak flow basis with a peak factor of 3.33 times for municipalities. Subdivisions, campgrounds, and mobile homes are designed based on a peak factor of 5.0.

The minimum size of new conventional sanitary sewers shall generally be eight inches unless otherwise approved by the reviewing authority. Sanitary sewers shall be sufficiently deep to receive flow from the ground floor of the structure to prevent freezing. There are alternative sewer designs to the conventional gravity sewers. These are used in connection with grinder stations or septic systems to service difficult areas.

2. Low Pressure Sewer System

A low pressure sewer system consists primarily of numerous, small grinder type pumping units that serve one or more tributary properties. The pumping units are interconnected via a small diameter force main system which ultimately discharges to a gravity sewer or wastewater treatment system. The advantages of this type of system are that the force main need only be buried deep enough to prevent freezing, that trench width is narrower due to the smaller pipe thus reducing ground restoration costs, and that infiltration is not a concern as in gravity systems since pressure force main pipe is used. Possibly some of the best applications of this type of system are along low lying areas near lakes, in areas with steep and rolling topographic features, and in areas where shallow rock formations are encountered. Disadvantages of this type of system are that annual operation and maintenance costs are high due to the effects of the mechanical components and energy consumption, that the system is subject to the effects of power outages more so than gravity systems, that the connection of future high volume wastewater dischargers could be restricted, and that maintenance easements must be obtained from each property owner in order to gain access to the pumping unit for repair.

A. Advantages

1) Connect multiple residents to pumping unit
2) Slope and pipe alignment not as critical as gravity sewers
3) Infiltration reduced
4) Cleanouts and valve assemblies less expensive than manholes
5) Pipe size and depth requirements reduced

B. Disadvantages

1) Mechanical components require greater institutional involvement

2) O&M costs higher due to number of pumps
3) Annual preventative maintenance for pumps
4) Life cycle replacement costs are higher
5) Each grinder pump system requires electrical service
6) Power outages can result in limited use
7) Grinder pump systems produce higher TSS for treatment