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Decentralized Sewer Systems Can Provide Solutions

Historically, wastewater treatment concepts have fallen into two generically distinct categories. These include large centralized wastewater treatment systems typical of densely populated urban areas, and individual on-site septic systems typical of rural areas.

However, with today's expansion of population into suburban and rural suburban areas, the centralized treatment system and individual on-site septic system should be considered end members for viable sanitary wastewater concepts to address the needs of our expanding population growth. Filling the gap between these two end member concepts are decentralized or cluster (D/C) sewers.

A D/C sewer system can be thought of as numerous disseminated mini-centralized sewer systems that are distributed throughout areas of moderate population, which cannot be cost effectively serviced by a centralized treatment system. Additionally, suburban areas with moderate population densities cannot be served by individual onsite systems because of soil conditions or lack of viable land.

The above concepts are illustrated on Figure 1 and described in detail in USEPA publication "Voluntary National Guidelines for Management

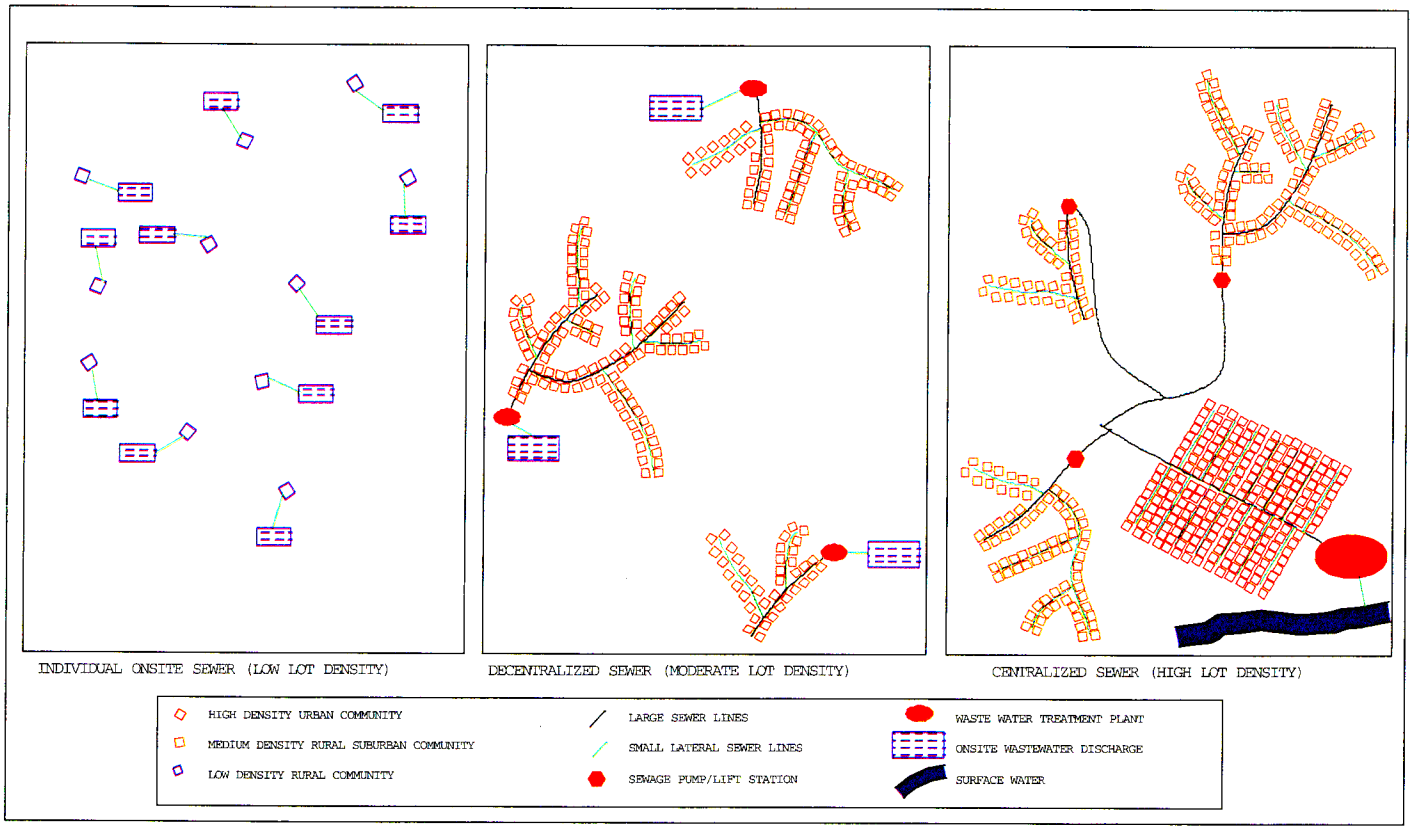

FIGURE 1 - GRAPHIC REPRESENTATION OF SANITARY SEWER CONCEPTS

TABLE 1 – THREE SANITARY CONCEPTS

Sanitary Option	Applicability	Advantages	Disadvantages
Individual Onsite	Low density areas with large lots and "good" soils (i.e., rural areas)	• Very little maintenance required • Operation costs are low ($150-200/year) • Temporary malfunction of an individual system results in very little harm to the environment • Little to no collection system to maintain	• Homeowners rarely perform required maintenance • Capital costs are high ($10,000-$20,000/lot) • Systems can be damaged inadvertently by homeowners • Homeowner is responsible for proper operation and maintenance • Systems are difficult for state agencies to regulate
Decentralized/ Cluster Sewers	Medium density areas (i.e., suburban areas)	• Municipality is responsible for operation and maintenance • State-of-the-art technology can be used in the collection, treatment and discharge components of the system • Temporary malfunction of system results in minimal harm to the environment	• Municipalities are reluctant to operate because technology is unconventional • Permitting systems can be difficult because no regulatory structure exists in most states
Centralized/ Regional Sewers	High density areas (i.e., urban areas)	• Municipality is responsible for operation and maintenance • Capital costs and operation costs are high but can be adsorbed by a large customer rate base • Systems are easier to regulate by state agencies	• Collection and treatment systems are large, complex and require constant maintenance • Serving remote locations is expensive • Temporary malfunction can result in significant environmental harm • Existing infrastructure is difficult to repair or replace

of Onsite and Cluster (Decentralized) Wastewater Treatment Systems," (March 2003, EPA 832-B-03-001).

What Exactly makes up a decentralized system?

Table 1 (page 30) presents an overview and generalized tabulation of the three basic sanitary wastewater treatment concepts, their applicability and some of the advantages and disadvantages of each.

D/C sewer systems utilize either upsized components of onsite systems and/or downsized components of centralized systems.

.Information on various technologies, including specific collection, treatment and discharge technologies, can be found on the Web or from individual equipment manufacturers.

As shown in Table 1, D/C systems can use innovative collection systems (i.e., vacuum sewers, small diameter pressure sewers) that do not require transporting sewage long distances by using large diameter pipe and lift stations to regional treatment plants.

Since the treatment facility is located closer to where the waste is generated, and the pipes carry smaller flows, a D/C system can downsize the collection system.

Treatment technologies for D/C systems can be as simple as using a septic tank with a recirculating media filter up to a small aeration plant (i.e., 50,000 GPD) with tertiary treatment

and an onsite discharge using drip irrigation.

The type of treatment system depends upon the strength (i.e., residential, commercial, or industrial) and amount of sewage generated. Discharge for a D/C system can use either an onsite discharge, or a combination of onsite and conditional surface water discharge (discharge only during ideal conditions of high stream base flow).

Using onsite or a conditional surface water discharge is impracticable for a large regional treatment plant because the onsite discharge would require enormous quantities of land, which in urban areas can be significantly more expensive than in rural areas. Additionally, the plant's daily flow can be subject to large fluctuations primarily due to stormwater and groundwater infiltration during rain events.

Operation and Maintenance

The first aspect of a successful D/C system is proper design and installation of the system. However, the second and equally important aspect of a successful D/C system is proper operation and maintenance. Table 2 (page 32) shows a general operation and maintenance overview for the three types of sanitary concepts.

Traditionally, municipalities have believed that large regionally centralized sanitary systems are the most cost effective systems to build, operate, and maintain. In high-density urban areas these types of systems may, in fact, be the most cost effective.

However, in less dense suburban areas, the capital cost and operation and maintenance of centralized systems can place a permanent financial strain on the municipality. D/C systems can be sustainably operated and maintained by a municipality provided that:

1) the system is designed and installed correctly (preferably in accordance with logical specifications understood and approved by the municipality);
2) the personnel responsible for the operation and maintenance are adequately trained.

Case Study

Miami County in Ohio, just north of Dayton, is a rural suburban county that receives commuter traffic from Dayton and contains several small to medium businesses in the cities of Piqua Tipp City and Troy. Interstate 75 runs north and south through the middle of the county and represents a viable development artery for the county.

Currently, the county has some centralized sewers serving the cities, but, the majority of the county is not sewered. While the county is encouraging the development of business and industry in order to create jobs, it lacks the financial resources to construct, operate, and maintain a large regional sanitary infrastructure to service those industries.

Miami County's situation mirrors many other municipalities located in close proximity to large cities.

The southern part of the county nearest to Dayton can obtain some access to central sewers, but only through annexation to adjoining cities, which is not politically popular. Therefore, to avoid the use of individual onsite systems, which because of poor soils have traditionally had a high failure rate, the Miami County Sanitary Engineering Office (MCSEO) is proposing utilizing D/C sanitary sewers to service some areas of the county that are currently experiencing and/or expecting growth.

Working with developers, consultants, and the Ohio EPA, the county will compile guidelines1 for design and construction of D/C systems. The cost to design and install the systems will be paid for by the project developer.

After start up of the D/C system, the county will assume ownership of the system and be responsible for operations and maintenance. Depending upon the type of system, the county's responsibilities could vary from replacing grinder pumps to adjusting spray irrigation heads to routing monitoring. These types of responsibilities have traditionally been performed by private companies, property owners, or homeowners (with varying degrees of constancy and success).

In order to pay for the long-term operation and maintenance of the system, customers using the D/C system would be billed in accordance with their water usage. MCSEO is also proposing utilizing D/C systems to address previously developed pockets of the county that have failing onsite systems.

By utilizing newer innovative collection systems (i.e., Septic Tank Effluent Pump "STEP" systems), existing homes and businesses can be

TABLE 2 – OPERATION AND MAINTENANCE OF SANITARY SYSTEMS

Sanitary Option	Operation	Maintenance
Individual Onsite	• Very little operation expense for system owner • Requires owner to not "abuse" the system (i.e., disposing of household chemicals, grease, etc.)	• Requires system owner to perform some maintenance (i.e., pump septic tank) • Verify no infiltration into system such as foundation drains, leaky pipes or tanks, etc. • Very difficult for a municipality to maintain since a community may have numerous individual systems that are operated by the system owner
Decentralized/ Cluster Sewers	• More expensive to operate than onsite system because collection, treatment and discharge system may contain more electromechanical parts • Entire system should be operated by a municipality • Requires occasional monitoring of discharge (frequency depends upon location)	• Easier for a municipality to maintain since a community may only have one to four systems that are operated by the municipality • Easier to verify and/or mitigate infiltration because of smaller size and state-of-the-art components • Repair or replacement of components is less expensive and disruptive due to smaller size and easier access
Centralized/ Regional Sewers	• Most expensive to operate because of large complex collection system • Requires constant monitoring of the discharge	• Repair or replacement of system components is very expensive because of large size and difficult access • Difficult to verify no infiltration into the system from a large network of collection lines • Repairs and maintenance are disruptive to the community • Due to lack of resources and money considerations, maintaining existing centralized sewer systems and expanding existing sewers to accommodate growth cannot be done cost effectively

sewered without the major construction disruption that often accompanies the installation of large diameter gravity sewers.

Sewering existing homes and businesses will be accomplished by carefully surveying what type of systems are currently in use at each location, and using that information to design one or several cluster systems.

For example, depending upon the results of the initial survey, five homes and two businesses may share two septic tanks and one discharge system, while 30 homes may be clustered into one treatment and discharge system. The guidelines Miami County is currently implementing represent the future of sanitary infrastructure development for rural suburban municipalities that want to encourage development. **LDT**

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[1] The USEPA has recently published several guidance documents pertaining to D/C systems on their Web site.