ALTERNATIVE WASTEWATER SYSTEMS IN ILLINOIS

Written and Published by the Illinois Community Action Association[i]

INTRODUCTION

Access to clean water and adequate wastewater systems are an important part of any community's infrastructure. A communitiy's wastewater system plays an important role in the health and quality of life of its citizens as well as the ability of the community to grow and prosper.

Unfortunately, many small communities in Illinois are served by private septic systems that are failing, resulting in serious health problems for the community. These small rural communities are often populated by residents living on low to moderate incomes, who cannot afford the cost of a conventional sewer system. As funding sources become more scarce due to government budget cuts and a shift from grants to revolving loan funds, financing conventional sewer systems is beyond the reach of most small rural communities.

In 1992, the Illinois Rural Community Assistance Program and Illinois Rural Development (formerly Farmer's Home Administration) asked the Governor's Rural Affairs Council to address the wastewater problems of small rural Illinois communities. In a cooperative effort to help these small communities reduce costs, speed up planning and construction and overcome regulatory barriers, the Council created the Small Community Wastewater Needs Committee composed of representatives from the Illinois Community Action Association's Rural Community Assistance Program, Rural Development, Illinois Environmental Protection Agency, Illinois Department of Public Health, Illinois Rural Water Association, Illinois Department of Commerce and Community Affairs and the Consulting Engineers Council. The Committee adopted the following five-point Action Plan:

1. Target, coordinate and maximize the use of federal and state wastewater treatment funds for small communities.
2. Reduce the administrative and regulatory burden on small communities as they seek alternatives to conventional wastewater systems.
3. Encourage and support the development and application of proven, low-cost alternative wastewater technologies for small rural Illinois communities.
4. Design and implement an alternative wastewater demonstration project for small communities that is representative of the geographic, topographic and wastewater problems in Illinois.
5. Develop and implement an outreach technical assistance and educational program on proven alternative wastewater technologies for small community officials, consulting engineers, regulatory officials and community residents.

Four Illinois communities agreed to participate in the demonstration program. They represented various geographic and soil conditions and problems common to many small rural communities throughout the state. They had already considered conventional sewer systems and found them too expensive. The four communities selected were Browns, Creston, Eddyville and New Minden.

The Village of Browns, 200 population, is located in Edwards County in Southern Illinois. It has high groundwater, flat terrain and poor soil conditions. The existing private septic tanks and drain fields have created standing sewage in drainage ditches and yards. Eddyville, also located in Southern Illinois in Pope County, population 118, has hilly rocky terrain and poor soil conditions. Its private septic system has also created standing sewage in drainage ditches and leakage into nearby Wild and Scenic Waterways.

The Village of New Minden, located in Washington County in South Central Illinois, has a population of 219. It also has private septic systems with poor soil conditions, high ground water, flat terrain and lot size limitations which have resulted in the discharge of raw sewage into drainage ditches and yards.

The Village of Creston, population 535, is located in Ogle County in Northern Illinois. It is in a fast growing area near Chicago set among rolling hills, poor soil conditions and failing private septic systems.

These four communities have experienced the problems of failing private septic systems. Poor soil conditions, high ground water, relatively flat terrain and sub-surface rock outcroppings are unsuitable conditions for the efficient use of traditional private septic systems. When this occurs in a community, a typical solution is to build a conventional gravity sewer and treatment plant. This can solve the problem, but often at great expense and disruption to the community.

What does a small rural community do if it can't afford a conventional gravity sewer system? The Council's Small Community Wastewater Needs Committee addressed this problem by exploring the use of proven alternative wastewater systems.

With the help of the Illinois Rural Community Assistance Program, each community was visited by a group of experts in alternative wastewater systems to evaluate each situation and suggest an appropriate solution. Since Creston was located in a fast growing area, the community decided to install a pipeline and transport their sewage to a neighboring community for conventional treatment. Browns decided to install a Septic Tank Effluent Pump system, commonly known as a STEP system, for collection and pre-treatment in combination with a recirculating filter for final treatment. New Minden and Eddyville elected to install a Septic Tank Effluent Flow system, commonly known as a STEF system which combines gravity flow with the STEP system with final treatment in a recirculating filter and lagoon respectively.

Following the site visits to each community, two engineering workshops were held to demonstrate alternative wastewater technologies. Planning and engineering design grants were awarded by the Community Development Assistance Program (CDAP), administered by the Department of Commerce and Community Affairs, to assist the communities in designing their alternative systems. Each community later received grants and loans from Rural Development and CDAP to build their systems.

CONVENTIONAL VS. ALTERNATIVE SYSTEMS

A typical wastewater system for a community involves a collection system, a series of pipes to transport the raw sewage to a treatment plant, and a treatment system to treat the raw sewage so it can be disposed of without harming the environment. The major challenge in constructing any wastewater system is the cost of the collection system which can represent as much as 80% of the total cost of the project. This includes the main sewer lines which transport the sewage from the household or business to the treatment plant. The potential cost savings of alternative systems is in the collection system. Most alternative systems use small diameter flexible pipe buried at a shallow depth using septic tanks to pre-treat the raw sewage as opposed to large diameter inflexible pipe buried in deep ditches to transport raw sewage by gravity.

Conventional Collection Systems

Conventional collection systems are typically installed in urban areas or areas of high population density. These systems are standard across the U.S. since the practice of installing municipal sewage collection systems began in the mid 19th century. They require large diameter piping which is constructed on a design grade with manholes routinely spaced throughout. They are designed to carry fluids and solids by gravity and have to be cleaned by mechanical cleaning equipment. Large pump stations are required to lift the sewage to higher elevations to maintain gravity flow.

The minimum allowable pipe size for a conventional collection system is eight inches in diameter. These sewer lines are usually constructed at depths ranging from 5 to 25 feet and are placed in public or private easements. Due to the excessive depth of construction, a great deal of surface area must be disturbed. As a result, the construction of a conventional collection system can be slow, messy and very expensive.

Alternative Collection System

The technology for alternative collection systems has been available since the 19th century, however, its use has not been widely implemented until recent years. In the past few decades, the cost of conventional gravity collections systems in rural communities was found to be excessive in relation to the cost of the treatment system. This has resulted in a search for lower cost collection systems.There are three main categories of alternative collection systems with several variations within each category. They are pressure sewers, small diameter gravity sewers and vacuum sewers. Many collection systems consist of combinations of different alternative collection systems as well as combinations of alternative and conventional collection systems.

Pressure Sewers

Pressure sewers are the most popular and most common of the alternative collection systems. They typically have small diameter (2 to 4 inches) PVC pipe, installed in shallow trenches just below the frost line in the same manner as a water line. In fact, a pressure sewer collection system resembles a water distribution system. The collection system has valves to isolate certain areas and cleanouts installed at the ends of each branch of the system. In order to move the sewage or septage, the pressure sewer system requires pumps at each household or at centralized locations.

There are two distinct types of pressure sewer systems, solids handling and solids removal. The solids handling system has grinder pumps at each household. The grinder pumps grind the raw sewage into a slurry before it is pumped into the collection system. The solids removal system has a septic tank at each household which provides pre-treatment of the sewage, the same as a traditional on-site septic system with drainfield. The septic tank usually includes a screened vault to prevent solids from being discharged into the distribution line. The flow into the vault is through holes about mid-height in the tank, which allows the solids to settle and the scum to rise so the effluent comes from a relatively “clear zone.”

Figure 1 shows a septic tank with a pump inside the tank and Figure 2 shows one without a pump. The one with the pump inside the tank is called a **Septic Tank Effluent Pump (STEP)** unit which was used in the Village of Browns demonstration project. The one without the pump is called a **Septic Tank Effluent Filter (STEF)** unit. This was used in the Villages of Eddyville and New Minden. The STEP unit pump is usually a fractional horsepower and receives its power from the individual residence, as in the case of Browns or directly from the power utility. The effluent from the STEF unit must flow by gravity to another larger tank where it is pumped into the pressure sewer. These larger tanks are called cluster pump stations and usually have pumps of one to five horsepower. They receive power from the utility. See Figure 3.

Small Diameter Gravity Sewers

Small Diameter Gravity Sewers (SDGS) are constructed in much the same manner as pressure sewers, except they rely on gravity to move the septage from the septic tank to final treatment through small diameter pipes which follow the natural topography. See Figure 4. These sewers are somewhat limited in their application because the collection lines must run downhill. However, if the topography is appropriate, SDGS can eliminate the need for pumps. SDGS rely on septic tanks for solids removal and a STEF tank must be installed at each household. It is not uncommon to combine pressure and SDGS systems in certain topographic systems as was used in the Villages of New Minden and Eddyville.

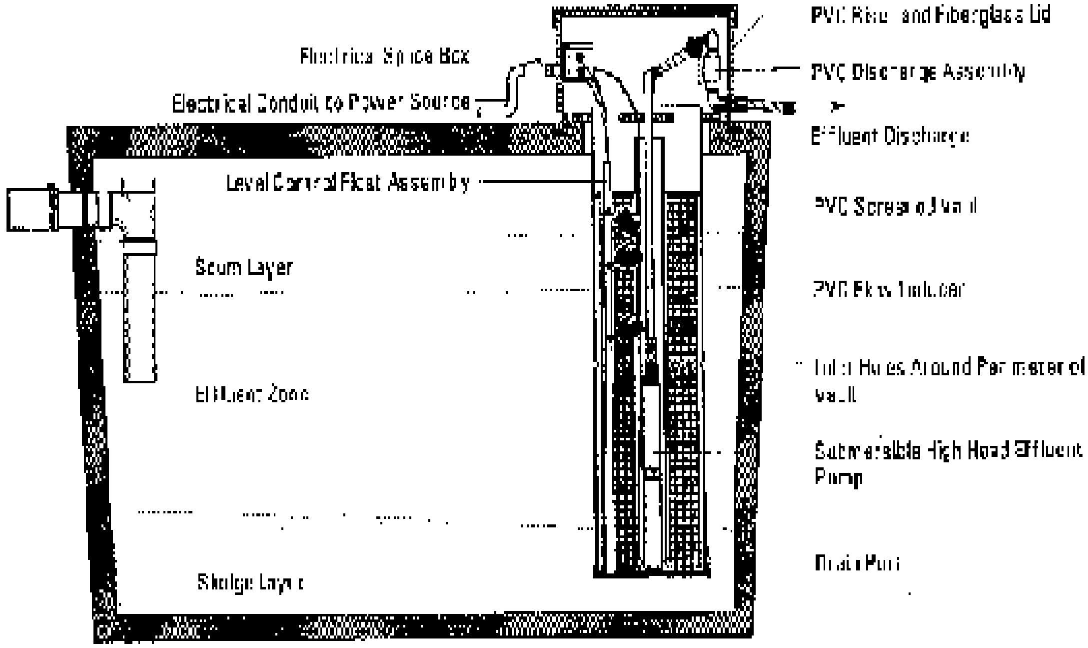


Figure 1 Septic Tank Effluent Pump

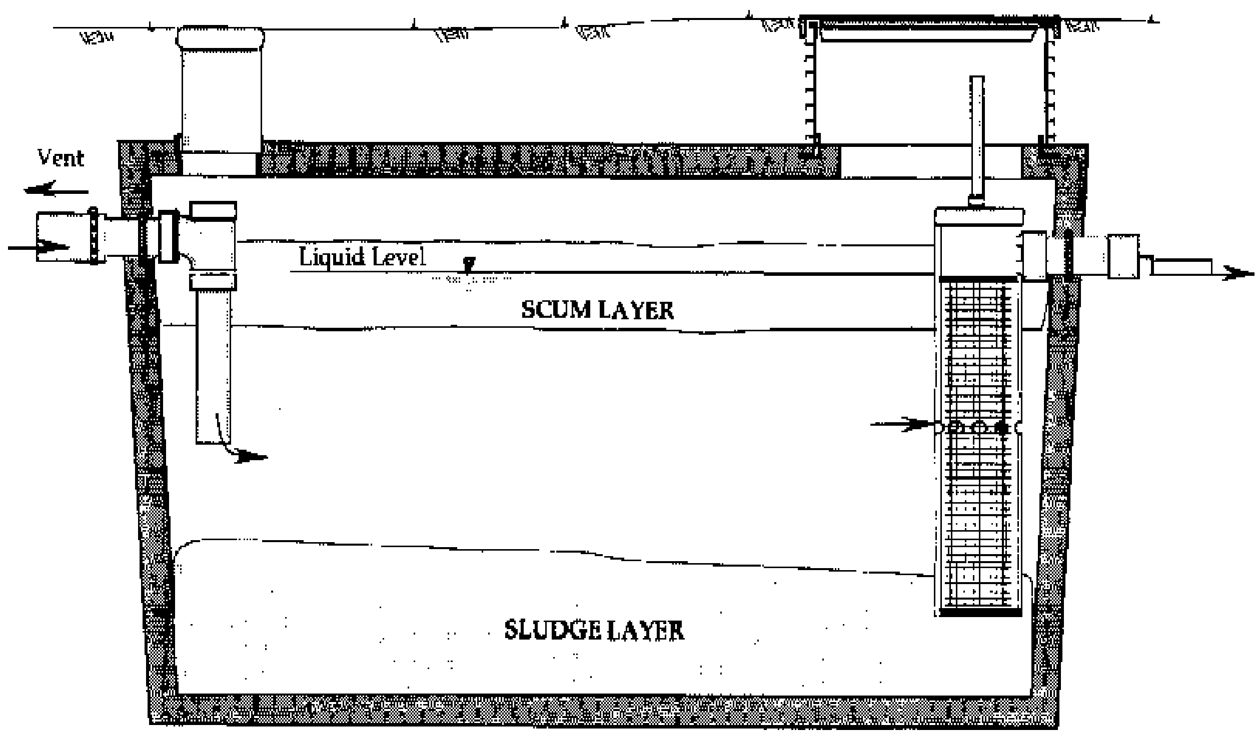


Figure 2 - Typical Septic Tank with Effluent Filter

Vacuum Sewers

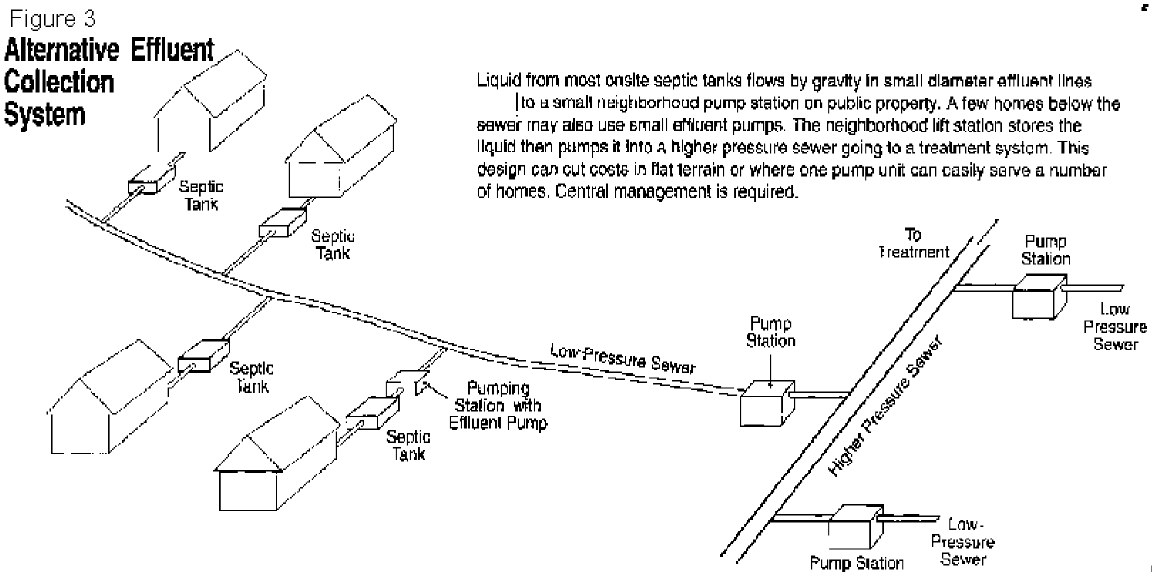
This type of technology has found limited use in the U.S. Vacuum sewers consist of small diameter collection lines which are placed on grade and can go uphill by using a stair step effect. A centralized vacuum station is required to create the vacuum on the collection system analogous to a vacuum cleaner. Some of the vacuum systems require special plumbing in the household while others use conventional household plumbing. Vacuum sewers are not usually combined with other types of collection systems.

Treatment Systems Associated with Alternative Systems

The sewage treatment technology used with alternative collection systems depends primarily on whether or not solids are removed before entering the collection system. For pressure and SDGS collection systems which use STEP or STEF units, raw sewage from the household is treated in the spetic tank before entering the collection system. This is often called pre-treatment. Therefore, a final treatment system is only required to perform secondary sewage treatment. This treatment is typically handled by a lagoon or recirculating gravel filter. The recirculating gravel filter is generally preferred because of the minimal land required and the aesthetics compared to a lagoon.

Vacuum and grinder pump collection systems typically use treatment systems found in conventional sewer systems. The solids still remain in the effluent and must be removed at the treatment facility. The additional costs associated with conventional treatment reduces the cost efficiency of these alternative collection systems when compared with a conventional sewer system.

Figure 3



Comparison Between Conventional and Alternative Sewer Systems

There are many factors to consider when deciding what system to build for your community. There are advantages and disadvantages to each type of collection system and these are site specific. Each site is different and one system does not fit all situations.

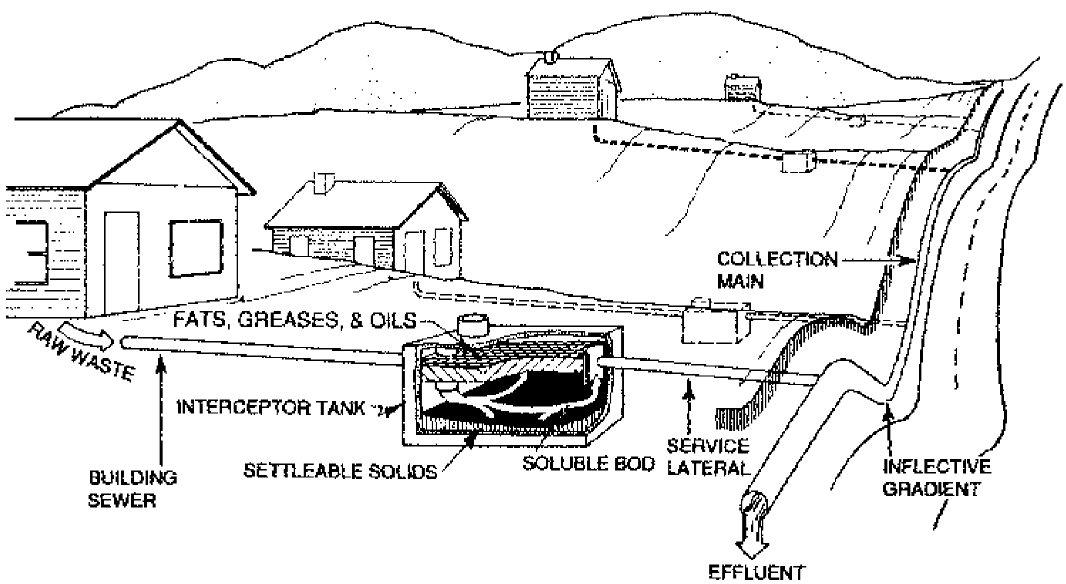
In general, alternative collection systems should be considered for smaller rural communities with low population density and site specific environmental conditions.. The cost effectiveness of alternative collection systems decreases as population density increases. This is due to the capital cost associated with each household connection and limited available space.

Environmental conditions of the area are also a major factor. Shallow bedrock, high groundwater conditions, extremely flat or very hilly terrain and limited room for construction make alternative collection systems more cost effective than conventional systems.

During the 1970's, under the federal Innovative & Alternative wastewater grant program, Illinois installed several small diameter alternative systems using septic tanks for pre-treatment. Many of these systems experienced difficulty due to leaking septic tanks, poor installation and inadequate pump and screen systems.

Today's alternative systems use water tight septic tanks which are tested on sight for leakage; the elimination of water drainage into the household sewer system such as basement and downspout drains which can cause septic failure; better designed pumps and filter screens; and special attention to proper installation of septic tanks to prevent infiltration of water into the system.

Figure 4 **Components of a small diameter gravity sewer (SDGS) system.**



THE VILLAGE OF BROWNS

The Village of Browns is a small community located along the eastern boundary of Edwards County, Illinois, located in Southeastern Illinois. The village has a population of approximately 200 persons which amounts to 99 household sewer connections. The only industry in the village is a grain elevator which was considered as a household connection.

The village had no existing municipal sewage collection and treatment system. The residents used septic tanks and seepage fields for sewage treatment. This type of treatment had completely failed. Combined with extremely flat topography, poor drainage, high groundwater and poor soil conditions, raw sewage was often standing in drainage ditches and yards. These conditions made the use of conventional septic tanks and seepage fields non-functional. The idea of a conventional municipal sewage system was also considered impractical due to the high cost of construction to overcome the topography and poor soil conditions. These conditions compounded the village's problems, because the majority of the residents were low-moderate income. The residents were only willing to support a typical monthly sewer bill of $20. With poor design conditions, the estimated cost of a conventional sewage system would place the monthly bill well beyond the limits of the average resident.

Given the above situation, the village was willing to consider an alternative wastewater system and was selected as the first demonstration community. The village received technical assistance from the Illinois Rural Community Assistance Program to explore the feasibility of an alternative wastewater system and later received grants from the Illinois Department of Commerce and Community Affairs for planning and engineering design. Construction grants and loans were provided by the Community Department Assistance Program and Rural Development. Lamac Engineering Company was selected as the engineering firm and John Acree was the project engineer. Based on a planning study, a septic tank effluent pump (STEP) system was selected as the most cost effective for the village.

During the design process, many questions arose concerning the estimated capital costs of the alternative system compared to a conventional system, as well as the comparison of the estimated operation and maintenance costs associated with each system. At the request of Rural Development, it was decided to design both a conventional and alternative system, and competitively bid both systems in order to perform a true capital cost comparison between the two systems. The following narrative describes each system and compares the costs associated with each.

Alternate A - Conventional

This was a conventional sewer system consisting of large diameter piping placed on grade with manholes and lift stations. This system was designed in accordance with the "10 State Standards", which is the design standard used for water and sewer construction in the mid-west.

This proposed system consisted of 13,000 lineal feet of 8 inch diameter collection mains constructed on grade. The depth of the collection mains ranged from 5 to 25 feet in depth with a typical depth of approximately 12 feet. Forty manholes each 4 feet in diameter were required at various depths. Three lift stations were required where the collection mains were buried too deep. The lift stations conveyed the sewage through 2,000 lineal feet of 4 inch diameter force mains. Connection to the sewer main was achieved by 3,500 lineal feet of 4 inch diameter household service connections. There were also several miscellaneous railroad and highway borings, as well as an excessive amount of street repair from constructing the system.

The final treatment system was the same for each alternative and consisted of a recirculating gravel filter. The village was opposed to a lagoon system. For the conventional system, primary treatment still had to be performed prior to the gravel filter. A community septic tank field with a capacity of 70,000 gallons was to be constructed ahead of the gravel filter to perform primary treatment of the raw sewage.

Alternate B - Alternative Alternate B was an alternative collection system consisting of small diameter mains and STEP units at each household. This system is classified as a pressure sewer system with solids removal. There are several published books and manuals which were followed to design this system. However, there are no design standards for this system which are recognized in Illinois.

This system consisted of 15,000 lineal feet of 2 inch diameter pressure collection mains. The collection mains followed the existing topography at a depth of 3 to 4 feet. Twenty clean-outs were placed throughout the distribution system. Forty 2 inch gate valves were installed to isolate areas of the collection system for maintenance.

Each household had a STEP unit installed on private property for a total of 99 units. A one inch diameter pressure service line connected the STEP unit to the pressure main. There were several miscellaneous railroad and highway borings and no street repair was required. The collection mains and services were pushed under the village streets.

The STEP units consisted of 1,000 gallon concrete septic tanks. The tanks were specially constructed to allow the insertion of a pump vault assembly which consisted of a screened vault with a fractional horsepower pump mounted inside the tank. Power for the pump was provided by the household. The raw sewage enters the STEP unit through a 4 inch service line from the household and the partially treated effluent from the septic tank is pumped into the pressure main to go to final treatment. Each STEP unit was hydrostatically tested after being installed to ensure it was watertight.

The final treatment consisted of a recirculating gravel filter. This filter was designed to recirculate the sewage at a ratio of 5 to 1. The design of filter somewhat follows the design standards of the Illinois Department of Public Health, which regulates private sewage disposal. Therefore, the filter itself is not considered new in Illinois, but its use as a municipal treatment facility is unique. The final treated effluent is then pumped to a nearby receiving stream. Disinfection of the effluent is not required.

Cost Comparisons

Bids for the conventional and alternative sewage systems for the Village of Browns were opened in early 1996. They were received from several contractors for each system. The low bid for the conventional system (Alternate A) was $978,933, which amounts to a cost per user of $9,888. The low bid for the alternative system (Alternate B) was $823,527, which amounts to a cost per user of $8,318. The capital cost savings in the alternative system over the conventional was $155,406, or $1,570 savings per user. The capital cost savings for the alternative system was nearly 16% over the conventional system.

The capital cost of the alternative system fell within the established budget for the project. The average monthly sewer rate per user to cover the capital costs, operation and maintenance costs and to establish a loan reserve was $19.38. This was within the $20 constraint established by the village.

An extensive operation and maintenance cost evaluation was performed of the two systems. The operation and maintenance costs for the conventional system was actually higher over time compared to the alternative system. However, for comparison purposes the operation and maintenance costs for both systems were assumed to be equal.

THE VILLAGE OF EDDYVILLE

The Village of Eddyville is a small community located in Pope County in Southeastern Illinois, surrounded by the Shawnee National Forest. It has a population of 118, with 81 sewer connections. The village had no existing municipal sewage collection and treatment system and relied on individual septic tanks and seepage fields for sewage treatment. Due to the hilly terrain, extensive rock outcroppings and poor soil conditions, the existing on-site septic systems had failed resulting in standing sewage in drainage ditches and pollution of the nearby Wild and Scenic Waterways. The village had considered a conventional sewer system, but initial cost estimates were prohibitive.

Given the above situation, the village was willing to consider an alternative wastewater system and was selected as a demonstration community. As with Browns, the village received technical assistance from the Illinois Rural Community Assistance Program to explore the feasibility of an alternative wastewater system and later received grants from the Illinois Department of Commerce and Community Affairs for planning and engineering design. Construction grants and loans were provided by the Community Department Assistance Program and Rural Development. Walker Baker & Associates, Inc. was selected as the engineering firm and Bill Walker and Kenny McDanial were the project engineers. Based on a planning study, a septic tank effluent flow (STEF) system followed by a two stage aerated lagoon was selected as the most cost effective for the village.

The centralized collection and treatment system is based on the Orenco Systems, Inc. design concept and consists of 78 gravity flow and 3 effluent pumped septic tanks, 10,350 feet of 3" gravity flow pipes, 12 pump stations containing duplex ½ horsepower turbine effluent pumps and 11,550 feet of pressure mains followed by a two cell aerated lagoon. The pump stations are sized for up to 12 homes. Each user is provided a Village owned 1,000 gallon septic tank equipped with an internal screen. The septage flows by gravity to a collection line to one of the pump stations. If gravity flow is not feasible, an individual pump is placed in the septic tank and the effluent is pumped into the pressure main. The total estimated construction cost for the project was $765,000. Including engineering, legal, administration, land and equipment the total project cost was estimated at $1,050,000. By comparison, a conventional gravity system was estimated to cost an additional $500,000 due to the shallow bedrock and steep terrain. See Table 1 for cost comparison.

Each user was provided a village owned septic tank equipped with an internal screen to screen out solids. The septage from the tank flows by gravity to a collection line, which may serve up to twelve houses. If gravity flow cannot be achieved, an individual pump is placed in the septic tank and the effluent is pumped in to the pressure main. The three inch gravity collection lines have slopes varying from 0.4 to 4% with end cleanouts and no manholes. At the end of each collection line is a pump station that pumps the septage into a final pressure main grid. The pump stations are sized for up to twelve homes.

Pre- treatment starts with the individual septic tanks, where the solids are separated and digested by the anaerobic process of the septic tank. The screen inside the septic tank acts as a barrier to solids and only the “gray water” is discharged in the collection lines. This “gray water” flows to the pump stations and is pumped through the pressure mains to the aerated lagoon where final treatment takes place.

VILLAGE OF NEW MINDEN

The Village of New Minden is located in South Central Illinois, in Washington County, and has a population of 200. It was served by individual private septic systems which are dischargedraw sewage into drainage ditches and yards due to poor soil conditions, high ground water, flat terrain and small residential lots. The village also considered a conventional sewer system, but rejected it because it was too expensive.

New Minden was the third community in the demonstration project to select an alternative wastewater system. As with Browns and Eddyville, the village received technical assistance from the Illinois Rural Community Assistance Program and planning and engineering design grants from the Department of Commerce and Community Affairs. Construction grants and loans were provided by the Community Department Assistance Program and Rural Development. Walker Baker & Associates, Inc. was selected as the engineering firm.

The system consists of 119 gravity flow and 11 effluent pumped septic tanks, 9900 feet of two and three inch gravity flow pipe, 20 pump stations containing duplex ½ horsepower turbine effluent pumps and 17,000 feet of pressure mains followed by a two cell recirculating granular filter. The septage flows by gravity to a collection line, which may serve up to twelve houses. If gravity flow cannot be achieved an individual pump is placed in the septic tank and the effluent is pumped into the force main. The average size septic tank with internal screen is 1,000 gallons. Power for the pumps is provided by the community.

The total estimated construction cost for the project was $1,090,000. Including engineering, legal, administration, land and equipment the total project cost was estimated at $1,550,000. By comparison, a conventional gravity system was estimated to cost an additional $1,000,000 due to flat terrain and high ground water. The system is identical to Eddyville, except for the final treatment process using a recirculating filter. See Table 1 for cost comparison.

Table 1
Construction Cost Comparisons
Between Alternative and Conventional Wastewater Systems

	Cost / User			Total Cost	
Community	Alternative	Conventional	Savings/User	Alternative	Conventional
Browns	$8,318	$9,888	$1,570	$823,527	$978,934
Eddyville	$9,444	$15,617	$6,173	$765,000	$1,265,000
New Minden	$8,384	$16,077	$7,693	$1,090,000	$2,090,000

SUMMARY

In the last thirty years, alternative wastewater technologies have become viable options for many small communities in the U.S. However, their use is generally dependent on site specific conditions, such as high ground water, poor soil conditions, relatively flat terrain, low population density and subsurface and surface rock outcroppings. For small rural communities in Illinois with low to moderate income populations and site conditions mentioned above, the construction of a conventional centralized sewer system is too expensive. In most cases, their individual private septic systems are inadequate, discharging untreated sewage into drainage ditches, yards and nearby streams and private wells. Therefore, alternative wastewater systems designed to fit the environmental conditions of the community can be cost effective solutions.

There are several advantages to alternative wastewater systems, such as the use of flexible small-diameter plastic pipe. It is much lighter than conventional sewer pipe and easier to install for the community and homeowner. This is possible because the wastewater transported through the pipe has been pre-treated by the septic tank, reducing the solids, grease and oils in the septage.

Another advantage of alternative over conventional systems is the watertight design which eliminates the infiltration of other water or the leakage of raw sewage into the water table. Watertight design is essential for alternative systems to work properly, since the infiltration and inflow of storm water from basement drains and down spouts can reduce the operating efficiency of the system. This occurred in the late 1970’s, when many poorly designed alternative systems had non-watertight septic tanks with basement and storm drains emptying directly into the septic tank. This had a great deal to do with giving alternative systems a bad name in Illinois, resulting in the opposition to alternative systems by the regulatory and engineering community. However, with careful attention to design and the introduction of new equipment technologies, these flaws have been overcome.

Those alternative systems that do not rely entirely on gravity, such as the STEP system in Browns and the STEF system in Eddyville and New Minden, offer another advantage. They require less excavation and disruption of the community roads and driveways, since the lines can be buried at shallow depths below the frost line and follow the natural contours of the land. According to a recent article in Small Flows, "(s)uch features make alternative sewer technologies appropriate for areas with hilly terrain or extremely flat terrain, shallow bedrock, and high water tables and areas where the costs and environmental impact of excavating for traditional gravity sewers would be excessive. Trenchless installations and other new techniques can further reduce the costs and impact of construction."[ii]

Although alternative wastewater systems offer significantly lower costs in the construction of the collection system than conventional sewer systems, it is still not clear if the operation and maintenance costs are less. More study is required. But where systems are carefully designed by experienced engineers, the systems have worked quite well at lower costs.[iii] 3 Since there are more components in the alternative system, such as pumps, screens and mechanical parts which can fail over time as well as power outages which can disrupt service, it is important to establish an on-going operation and maintenance program. This requires a commitment on the part of the community and should be part of the planning process when designing the system. In some areas, small rural communities are developing regional operation and management programs using the circuit rider concept. This helps reduce costs by clustering communities under one service program. Autonomy of the community can be maintained by contracting with a regional organization to provide the service.

For further information on alternative wastewater systems for small communities contact the Illinois Rural Community Assistance Program staff at the Illinois Community Action Association, 3435 Liberty Drive, Springfield, Illinois 62704. Telephone 217/789-0125. Fax 217/789-0139. Web site (http://www.icaanet.org).

ALTERNATIVE WASTEWATER SYSTEMS REFERENCE MATERIAL AND CONTACTS

Community and Business Program Director, Rural Development, Illini Plaza, Suite 103, 1817 South Neil, Champaign, Illinois 61820. Tel: 217/398-5412 Ext.243. Fax: 217/398-5337. Web site (http://www.rurdev.usda.gov).

Division of Water Pollution Control, Illinois Environmental Protection Agency, P.O. Box 19276, Springfield, Illinois 62794-9276. Tel: 217/782-0610, Web site (http//www.epa.state.il.us/).

James S. Gidley and Donald D. Gray, CONVENTIONAL AND ALTERNATIVE SANITARY SEWERS: CONCEPTS, EXPERIENCE AND COSTS, conference paper cited in Jesperson article, p. 1, and can be ordered from the National Small Flows Clearinghouse, item #l2087.

Kathy Jesperson, "Alternative Sewers: Technologies Provide Cost-effective Option for Many Small Systems'" SMALL FLOWS, Fall, 1997, (National Small Flows Clearinghouse: Morgantown, WV), 4 pp.

Lamac Engineering Company, P.O. Box 160, Mt. Carmel, Illinois 62863. Tel: 618/262-8651. Fax: 618/263-3327. John Acree was the project engineer for the Village of Browns project.

Illinois Rural Community Assistance Program, Illinois Community Action Association, 3435 Liberty Drive, Springfield, Illinois 62704. Tel: 217/789-0125. Fax: 217/789-0139. Web site (http://www.icaanet.org).

National Small Flows Clearinghouse, West Virginia University, PIPELINE, quarterly newsletter on wastewater issues for small communities written for a general audience, Tel: 800/624-8301, web site (http://www.nsfc.wvu.edu).

National Small Flows Clearinghouse, West Virginia University, SMALL FLOWS, quarterly newsletter covering all wastewater issues for small communities. To order contact the National Small Flows Clearinghouse, Tel: 800/624-8301, web site (http://www.nsfc.wvu.edu).

National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064, Tel: 800/624-8301. Web site (http://www.nsfc.wvu.edu). This is an excellent source for information on alternative wastewater systems.

U.S. Environmental Protection Agency, ALTERNATIVE WASTEWATER COLLECTION SYSTEMS MANUAL, EPA/625/1-91/024, October, 1991, 207 pp.

U.S. Environmental Protection Agency, FEDERAL FUNDING SOURCES FOR SMALL COMMUNITY WASTEWATER SYSTEMS, EPA 832-F-97-004, November, 1997, 28 pp.

U.S. Environmental Protection Agency, SMALL WASTEWATER SYSTEMS: ALTERNATIVE SYSTEMS FOR SMALL COMMUNITIES AND RURAL AREAS, 830/F-92/001, May, 1992, brochure.
U.S. Environmental Protection Agency, SUMMARY REPORT: SMALL

COMMUNITY WATER AND WASTEWATER TREATMENT, EPA/625/R-92/010, September, 1992,92 pp.

U.S. Environmental Protection Agency, WASTEWATER TREATMENT/DISPOSAL FORSMALL COMMUNITIES, EPA/625/R-92/005, September, 1992, 110 pp.

Walker Baker & Associates, Ltd., 102 North Gum Street, Harrisburg, Illinois 62946. Tel: 618/252-7944. Fax: 618/252-8472. Bill Walker and Kenny McDanial were the project engineers for the Eddyville and New Minden projects.

Alternative Wastewater Systems
Endnotes

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[i] This pamphlet was funded in part by the Illinois Rural Community Assistance Program and the Governor's Rural Affairs Council. It accompanies a video tape of the same name produced by CAA Media Services under a contract with the Illinois Community Action Association funded by a Rural Development Technical Assistance and Training Grant.

[ii] Kathy Jesperson, "Alternative Sewers: Technologies Provide Cost-effective Option for Many Small Systems'" SMALL FLOWS, Fall, 1997, (National Small Flows Clearinghouse: Morgantown, WV), p. 4.

[iii] Ibid., reference to Glide, Oregon, which has had a STEP system for over 20 years, with lower maintenance and construction costs than a similar sized conventional system.