United States
Environmental Protection
Agency

Office of Municipal
Pollution Control (WH-595)
Municipal Facilities Division
Washington, DC 20460

September 1987

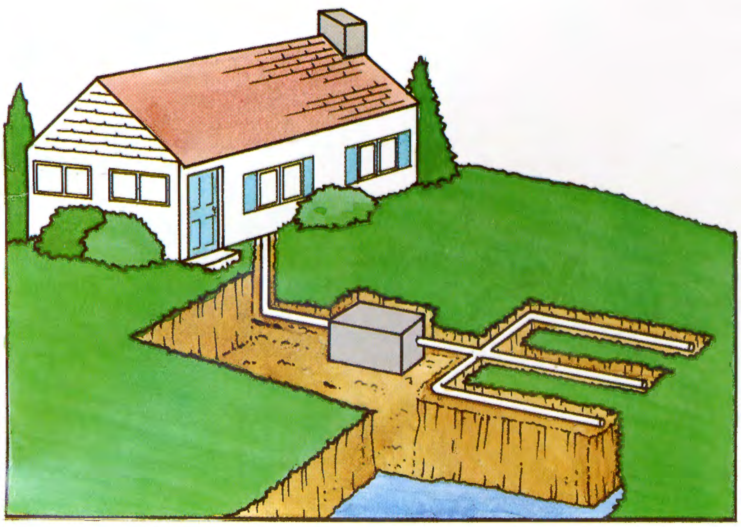
Office of Water

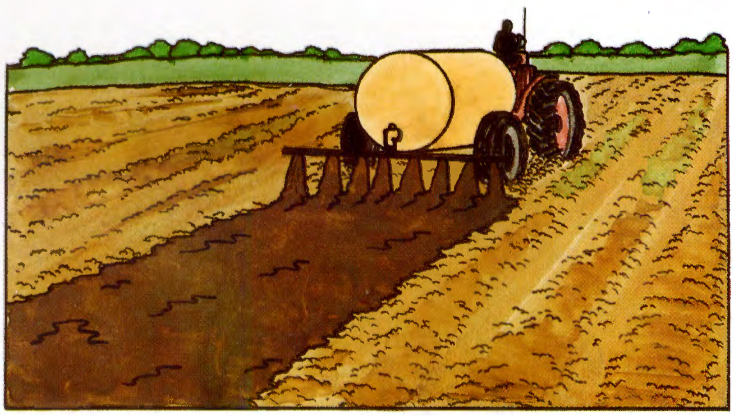
EPA 430/9-87-006

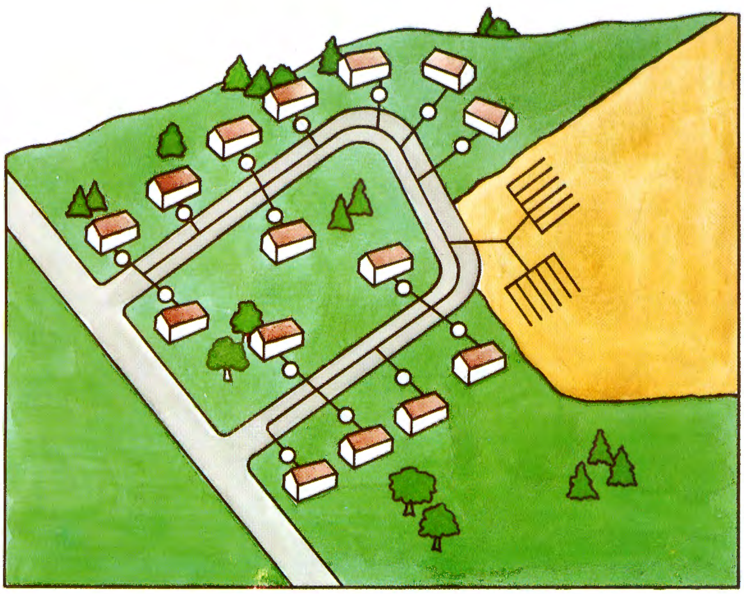
EPA

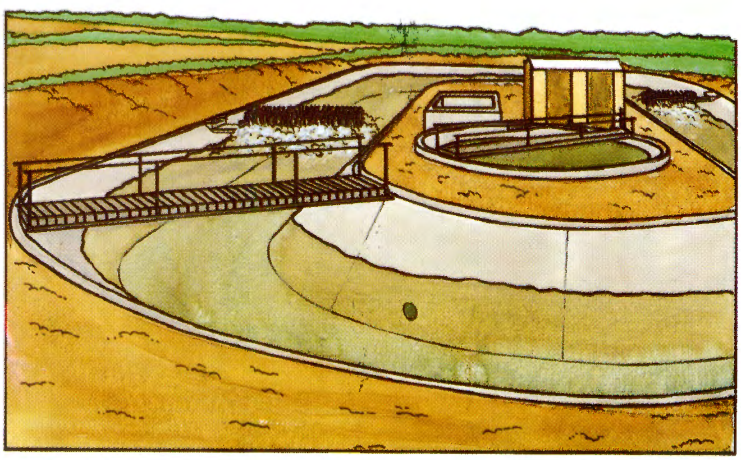
It's Your Choice

A Guidebook for Local Officials on Small Community Wastewater Management Options









Office of Water EPA 430/9-87-006

It's Your Choice

A Guidebook for Local Officials on Small Community Wastewater Management Options

September 1987

This document was published by:
U.S. Environmental Protection Agency
Office of Municipal Pollution Control,
Municipal Facilities Division

Acknowledgements

Principal Author

Peter E. Shanaghan, U.S. EPA Office of Municipal Pollution Control

Contributing Authors

John E. Flowers, U.S. EPA Office of Municipal Pollution Control

Alfred E. Krause, U.S. EPA, Region V

Don C. Niehus, U.S. EPA Office of Municipal Pollution Control

Kenneth C. Wiswall, P.E., Lombardo and Associates, Annapolis, MD

Chapter Three was largely adapted from "A Guide to Selecting Engineers for Rural Water and Wastewater Projects" by James C. Spencer, Rural Housing Improvement, Inc., Winchendon, MA.

The principal author and editors wish to acknowledge Irene Sacks, Progressive Learning Resources, Gillette, NJ for her assistance with the preparation of this document.

Editors

Sheree Romanoff and Virginia Hathaway, JACA Corp., Ft. Washington, PA

Peer Reviewers

Lawrence Allen, Hamilton, MO

Patricia Crawford, Cushing, MN

Stephen Dix, National Small Flows Clearinghouse, West Virginia University

Walter Gills, Virginia State Water Control Board

Thomas R. Halbach, Extension Service, U.S. Department of Agriculture

Robert Hale, Trimble, MO

Jackson Hall, Southeast Rural Community Assistance Project, Roanoke, VA

David G. Hanna, New Mexico Environmental Improvement Agency

Chip Heckathorn, Michigan Department of Natural Resources

Dr. Michael Hoover, North Carolina State University

Ancil Jones, U.S. EPA, Region VI

Vicki R. Keenan, American Consulting Engineers Council

James F. Kreissl, U.S. EPA Water Engineering Research Laboratory

Kathy Martin, Trimble, MO

Allan Mollenkopf, Grasslake, MI

Christine Noah–Nichols, U.S. EPA, Region X

Don Owen, California State Water Resources Control Board

Dr. Robert Rubin, North Carolina State University

Peter Thurston, Lane County, OR

Jane West, Trimble, MO

Robert Bastian, Robert J. Blanco, James Bourne, Haig Farmer, Charles E. Gross, Alan Hais, Robert Hardaker, John H. Samson, and Cleora Scott — U.S. EPA Office of Municipal Pollution Control

Graphics

Jo–Ann Hockemeier, JACA Corp., Ft. Washington, PA

Publication Layout and Production

Jeffrey Freedman, Jo–Ann Hockemeier, and Sheree Romanoff — JACA Corp., Ft. Washington, PA

Photo Credits

Dr. Albert R. Jarrett — The Pennsylvania State University (page 19, column 1)

Dr. Michael Hoover — North Carolina State University (page 64)

Table Of Contents

Foreword

This is a booklet about choices. Choices **you** as a small community official, have in how your community solves its existing wastewater problems, or addresses its future wastewater treatment needs.

The U.S. Environmental Protection Agency (EPA) prepared this booklet specifically for local officials like yourself from communities of less than 10,000 people to help you become an educated consumer. Educated consumers generally make good choices because they learn about the available options and base their decisions on the facts.

In the past, EPA Construction Grants were available to cover 55 to 85 percent of most project costs. Federal and State grants together would typically cover the lion's share of a community's wastewater construction costs. So it's not surprising that some local officials weren't too concerned with how much their wastewater systems cost. These local officials were quite willing to leave decisions to the "experts." However, the Federal Water Quality Act of 1987 will phase out construction grants and will create state revolving loan funds from which communities may borrow some of the money needed for their project. So local officials like you who are faced with building or upgrading a wastewater system need to be actively involved in making the decisions so you will be sure you get a system that will do the job and is affordable.

This booklet will let you know what your options are and will direct you to sources of more detailed information. Topics included are:

- ❑ How to get started
- ❑ Who you can turn to for help
- ❑ How to choose the right consulting engineer for your situation
- ❑ The different ways there are to collect and treat wastewater, and where each is most appropriate
- ❑ How to work with your engineer to be sure your town gets a system that's right for you
- ❑ Alternatives for financing your project
- ❑ How to make your wastewater system self-sustaining by setting up appropriate user fees.

This booklet is part of an ongoing EPA effort to provide local officials, consulting engineers, and State regulatory agencies with information on all aspects of wastewater management.

In A Nutshell...
A Summary Of Key Points

IT'S YOUR CHOICE

A wastewater treatment system may be the biggest investment your town has ever made. Don't leave decisions to the "experts." Too much is at stake. You as a local leader must guide your town in the process of selecting the right wastewater system and the best way to pay for it.

Selection of a consulting engineer is one of the most important decisions you will make.

DEFINING THE PROBLEM

A citizens' advisory group can help you define the problem and find a solution.

You need to determine exactly what types of problems your town is having and how bad they are.

The National Small Flows Clearinghouse can help. Call them toll-free at 1-800-624-8301.

Identify other individuals or organizations that can help your community at little or no cost.

SELECTING YOUR CONSULTING ENGINEER

Consulting engineers are professionals who offer important skills available nowhere else. Your town should select an engineer with the same care you would use selecting a surgeon.

Look for an engineer with proven experience solving problems in communities like yours.

Do not choose your engineer on the basis of cost. It is well worth spending a little extra to get an engineer who will design a system which will provide lower cost service for years to come.

KNOWING YOUR OPTIONS

Most likely your town will need to use a combination of onsite systems, cluster systems, and centralized treatment.

Where lot sizes are 1/2 acre or more, think about installing or renovating onsite systems. Many different types are available which can overcome difficult site conditions.

Establish a management program to make sure that all onsite systems are properly maintained.

Sewers are very expensive. Don't install them unless absolutely necessary.

Conventional sewers may be appropriate where more than 100 houses will be connected to each mile of sewer.

Alternative sewers are less costly and should be considered where lot sizes range from 1/2 to two acres.

Where onsite systems won't work, consider cluster systems. In a cluster system, alternative sewers collect wastewater and transport it a short distance to a neighborhood treatment facility.

Centralized treatment is appropriate in areas of dense development.

FINDING THE RIGHT SOLUTION

Small communities need simple, low cost wastewater systems.

You and your advisory group need to be involved in:

- ☐ Determining wastewater problem areas
- ☐ Evaluating basic approaches to the problem
- ☐ Selecting specific technologies.

Find out the estimated total costs to the community of proposed solutions and what that means in terms of annual cost to each customer.

Hold at least one public meeting before you choose a wastewater system.

A value engineering study by another engineer during design of your project will pay for itself many times over by reducing costs.

Your town will also need to decide how your proposed wastewater system or systems will be managed — such things as who will operate and maintain the facilities, how the billing will be done, and who will prepare the budget.

PAYING THE BILL

Investigate all potential types and sources of funding the construction of your wastewater facilities.

You may need a financial consultant to give you advice on short– and long–term financing and to prepare a financial plan for your wastewater system.

You must charge fees to pay for your system's operation, maintenance, and equipment replacement costs plus debt service costs.

To make your wastewater facilities self–sustaining, establish a fund from excess user fees which will pay for new facilities when the old facilities reach the end of their useful life.

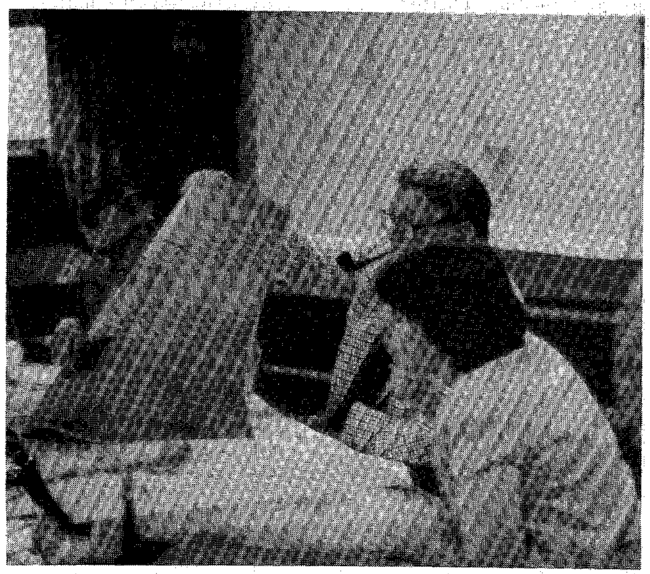
Chapter One

It's Your Choice

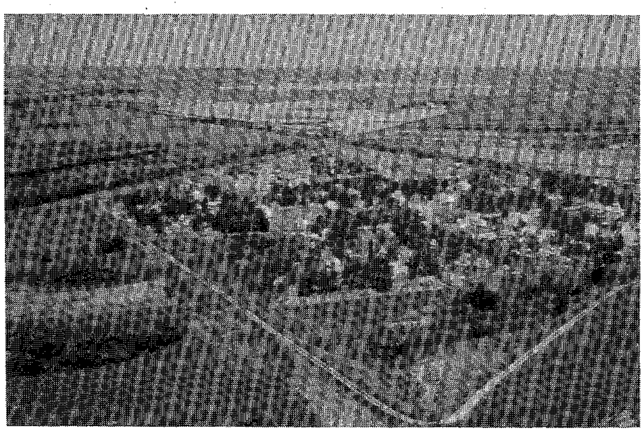
If you are reading this booklet, chances are your town already has a problem with wastewater. Perhaps your sewage treatment plant is not meeting the terms of its discharge permit and the State has ordered you to correct the problem or face legal action. Maybe you don't have a treatment plant but think you might need one because many of the septic systems in town are failing and the homeowners are tired of sewage in their yards. Perhaps local development has been severely restricted because soils in your area aren't suited to conventional septic systems.

Maybe you are lucky and don't have a serious problem yet. You may know of other local communities that have problems and you want to plan now to avoid trouble. Whatever the case, you as a local decision--maker realize that some decisions need to be made about how your town is going to deal with its present or future wastewater problems.

Where, you are wondering, do you begin?



You as a local leader must guide your town in the process of selecting the right wastewater system and the best way to pay for it.



Small communities like yours have special wastewater problems.

Consultants and government agencies can help you, but your community has to make its own decisions about wastewater management.

A public meeting.

Before you do anything it's important for you to understand that **your community must make its own decisions**. The decisions you make regarding wastewater management will have a great effect on the quality of life in your community for years to come. These decisions can't be made for you by consultants or government agencies. Rather, **you** as a local leader must guide your town in the process of selecting the right wastewater system and the best way to pay for it.

You must involve the public in the decision–making process from the beginning, since they will live with and pay for the system. Remember, selecting the right system is just the beginning. Once it's built, your community must not only pay for the system, but also operate and maintain it for years to come.

Selecting a consulting engineer is possibly the most important decision you'll make.

Of course you will need help in making your decisions. You will need to hire a consulting engineering firm to help you evaluate choices, design the system you finally select, and supervise the construction of the system. You will also need legal advice about contracts, buying land (if required), forming a special district or governmental agency (if necessary), and other matters. You will also need financial advice.

Selection of a consulting engineering firm is possibly the most important decision you will make. You will depend on your consultant to help you make good choices. Not all firms are equally well qualified to work with small communities. Chapter Three will provide some detailed suggestions on how to select the right consulting firm for your community.

The public must be involved in the decision–making process from the start.

You may also receive help from your State governmental agency, the U.S. Environmental Protection Agency, and from many other sources which will be discussed further in Chapter Two.

When all is said and done, however, it is you as a community leader who must decide what is best for your town. **It's your choice.**

Chapter Two

Defining the Problem

MAKING A START

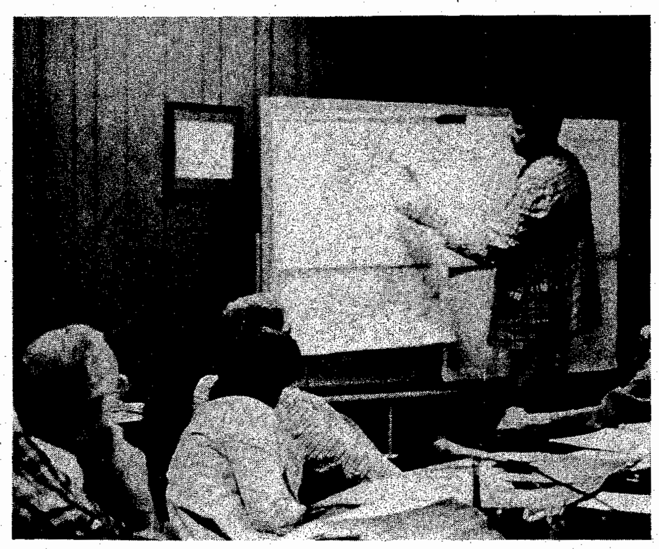
You as a local decision maker will have to lead your community through the process of solving its wastewater management problems. This is not a job that can simply be left to planning or engineering "experts." Too much is at stake. The decisions made regarding wastewater management will affect the quality of life for every resident, for years to come. So you, as an official accountable to the people, must lead the decision-making process. The first step in that process is defining what problem or problems need to be solved.

As we saw in Chapter One, it is very important to have the public involved from the beginning. One good way to start is to appoint an advisory group of concerned citizens. They can help you and the town's governing body to define the problem and solve it.

If you decide to form an advisory group, it should have clearly defined roles and objectives. Roles can range from simply reviewing and commenting on plans, to helping make preliminary planning decisions (such as whether to hire an engineering consultant), to long-term involvement in the project's management.

Choosing an advisory group is a good way to start.

The advisory group should consist of citizens representing the full range of your community's concerns and interests. Residents with training or experience in engineering, planning, management, or finance should be urged to join.



An advisory group can play an important role.

If your community is large enough to have a public works director or a staff person responsible for wastewater treatment, they too should work with the advisory group.

Once the group members have agreed to serve, they need to see a copy of this booklet or other instructive publications. These will help them to understand what they will be involved with and can serve as a starting point for their efforts.

Failing septic systems can be a serious problem.

WHAT ARE YOUR PROBLEMS?

As we mentioned earlier, your problems may range from failing septic systems to a treatment plant that is violating its permit.

Before you do anything else, you need to determine exactly what types of problems your town is having and how bad they are. In this section we will discuss different types of problems commonly experienced with small community wastewater systems. You will need to determine which of these problems is occurring in your community and how bad each problem really is.

You will need some help in making these determinations. On pages 10 and 11 we will tell you about some individuals and organizations which may be able to help you.

SEPTIC SYSTEM PROBLEMS

Plumbing backups are the most common evidence of a septic system problem. People probably first notice this problem when the plumbing fixtures at the lowest level of their house don't drain as fast as they should. This problem may be caused by stopped–up or collapsed pipes in the septic system or the inability of the soil beneath the drainfield to absorb all the wastewater being discharged from the house.

Surface ponding is a related problem and may be caused by the same factors as plumbing backups. Homeowners probably first notice it if the ground above their drainfield is regularly damp or if foul–smelling water pools or "ponds" on top of the ground. Surface ponding is a health hazard because of the possibility that people may come into contact with untreated wastewater. Additional hazards are created when rain washes ponded wastewater into local streams, making them unfit for drinking or swimming.

Groundwater contamination may be evident from problems homeowners have with their drinking water wells or from deterioration of the quality of nearby streams or lakes. Groundwater contamination may be caused by poorly operating or badly sited septic systems.

Replenishment of groundwater is a benefit of a properly functioning septic system. A septic system depends upon the soil beneath the drainfield to treat wastewater before it reaches the groundwater. The groundwater may become contaminated with disease–causing microorganisms or chemicals if the soil is not of the proper type or is not deep enough. Groundwater contamination may also result from too many septic systems in too small an area.

If groundwater, lakes, or streams are contaminated, you will probably need some expert assistance in determining if the contamination results from septic systems. There may be many other potential sources of contamination including pets, livestock, wildlife, agricultural or gardening chemicals, and lawn fertilizers.

You may be able to assemble some important preliminary information about the nature and extent of septic system problems in your town through a windshield survey and mailed questionnaires. A windshield survey is a brief visual survey of your area conducted from a car by someone familiar with the situation. The objective is to spot and document obvious problems like surface ponding. More information may be obtained through mailed questionnaires.

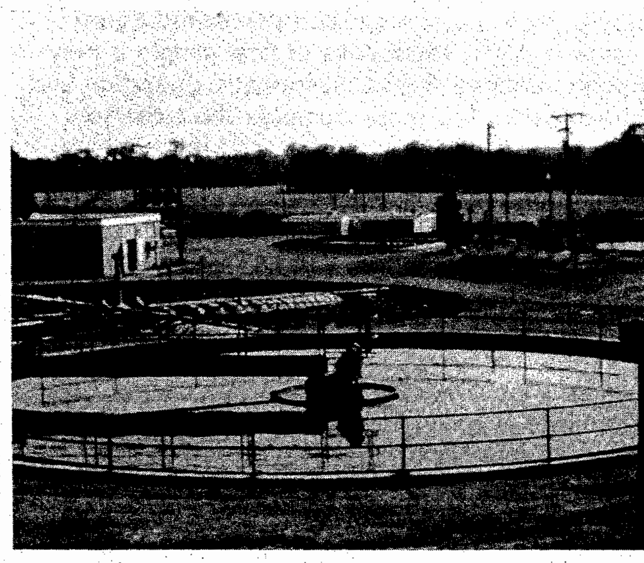
Unfortunately some residents may choose not to respond or may not want to tell the whole truth about their own situation. Try to ask clear, simple questions about problems that they or their "neighbors" may be having.

CENTRALIZED TREATMENT SYSTEM PROBLEMS

Permit limit violations at your treatment facility may be occurring. Generally treatment plants operate under a permit issued by the State or EPA. This permit specifies the level of treatment which must be achieved to protect the stream or lake into which the plant discharges.

Repeated permit violations are a sure sign that something is wrong.

Until about 20 years ago, small community treatment plants were generally required to remove only about 60 percent of the major pollutants in sanitary sewage. This is called primary treatment. In the early 1970s however, it became clear that our streams and lakes needed greater protection. Thus, Congress passed the Clean Water Act. Under the Clean Water Act, EPA and the States require most communities to remove 85 percent of the major pollutants. This is known as secondary treatment. Under certain circumstances, two common types of small community treatment systems, lagoons and trickling filters (which are discussed further in Chapter Four and on pages 55 and 61 in Appendix A) may be classified as equivalent to secondary treatment even if they don't remove a full 85 percent of major pollutants.



Every treatment plant regardless of how simple it may appear, requires regular operation and maintenance attention.

Depending upon the water quality of the stream to which your town discharges, your plant may be required to provide an even greater level of treatment, referred to as advanced treatment.

Your permit will require some routine monitoring of the treated discharge from the plant (the plant effluent) to be certain that the plant is meeting its permit limits. Repeated violations of permit limits are a sure sign that something is wrong.

Infiltration and inflow (known as I and I) is a major problem in many sanitary sewer systems. Treatment plant operators will notice I and I if the flow coming into the plant greatly increases during and after a heavy rainfall. These flow increases could be due to leaking manhole covers or gutter downspouts connected to the sanitary sewer. Such flow increases often greatly overload the plant's capacity and cause significant upsets.

Sanitary sewers are designed to collect only the wastewater from homes and businesses and transport it to a treatment plant. Storm sewers, on the other hand, are designed to transport only surface runoff and street wash directly to streams or lakes. In older cities, a single combined sewer leading to the treatment plant receives both sanitary and storm flows.

Improper treatment plant operation and maintenance may be causing problems. Every treatment plant, regardless of how simple it may appear, requires regular systematic operation and maintenance. The more complex the treatment plant, the greater its operation and maintenance needs.

Treatment plant operators need to be professionals with proper training. Your State will require the plant operator to be certified at a level necessary for the complexity of your plant.

You, as a local official, must be certain that your community is getting the maximum performance from your existing treatment facility. You must be sure that the plant operators are qualified and that they have access to necessary training. They must be given an adequate budget with which to run the plant. Every treatment facility will have some mechanical equipment. Equipment parts will wear out and will need replacement. Items such as motors, pumps, valves, and monitoring equipment must receive regular care. Before you think about expanding or upgrading your treatment plant or building a new one, you should be sure that your existing plant is performing up to its capability.

Treatment plant expansion may be necessary if more people are trying to use your treatment plant than it was designed to handle. Engineers, when designing treatment plants, estimate what the community's population will be in 20 years. The plant is generally made big enough to accommodate this expected population. However, your town's population may be growing much faster or much slower than anyone expected. So, if it's been a long time since your plant was built or if your population has been rapidly growing you may need to expand your plant. Treatment plant expansion involves increasing the capacity of the treatment processes you currently have.

A treatment plant upgrade may be necessary if your discharge has to meet more stringent discharge limits. An upgrade involves adding additional treatment processes which enable a higher quality discharge to be achieved.

WHO CAN HELP?

There are a number of organizations that can help you, at little or no cost, obtain necessary background information and evaluate your problems.

Identify individuals or organizations that can help your town at little or no cost.

Below are some suggestions about organizations to contact. When you contact them, be certain to ask about:

- ❑ Any publications they have available on small community wastewater management systems and financing.
- ❑ Recommendations they have about other organizations you can contact.
- ❑ Recommendations regarding engineering consultants in your area who specialize in small community wastewater management.

The State water pollution control agency may be your most important source of information, especially if you are building or upgrading a centralized treatment facility. This agency will most likely issue your discharge permit and may need to approve your plans before you do anything. They may be responsible for ensuring that you properly operate and maintain your facility. In addition, they typically administer treatment plant operator certification programs. Your State water pollution control agency may have a program to provide technical assistance to small communities, and they may also be able to tell you about grant or loan programs available to help pay for your project.

State and County health departments may have some responsibility for septic systems. Health departments may need to approve plans for systems and inspect the system's installation. Sanitarians typically employed by these agencies may know a great deal about the age, design, and current condition of septic systems and drinking water wells in your area. Some may have detailed knowledge about current problems, their causes, and possible remedies.

Other local agencies such as your County planning staff can help identify the areas of your community where needs are the greatest. They can also provide information concerning development trends and possible future needs. This information will help you develop a realistic plan for addressing these needs and will help you determine which of the community's needs to address now.

The National Small Flows Clearinghouse at West Virginia University will be able to help you get additional information. The Clearinghouse will be able to tell you about groups in your State that might be able to assist you. Case studies of small communities which have used some of the wastewater treatment systems described in this booklet are available from the Clearinghouse. It can also supply information about publications, slide presentations, movies, and video cassettes which may be useful to you. The Clearinghouse can be reached, toll-free, at 1-800-624-8301.

Your local Cooperative Extension Service office may be able to provide some technical assistance to your community or may be able to recommend other sources of help. Your county extension agent will know about the soils in your area. This information will be very helpful to you in deciding about certain types of treatment systems. Extension agents may also be able to provide information on small community wastewater technologies, facility financing, and financial management of treatment systems.

The EPA Small Flows Clearinghouse can help. Call them toll-free at 1-800-624-8301.

The Rural Community Assistance Program (RCAP) is a nonprofit network of groups whose purpose is to assist rural, low-income communities in solving water and wastewater problems. The RCAP network consists of six regional centers, each serving a specific area of the country. These centers are listed in Appendix B. The RCAP center serving your State may be able to assist your community in a number of ways including selection of a consulting engineer, engineering plan review, selection of a financing option, and system operation.

You as a local official will need to make judgements about your town's wastewater problems.

YOU BE THE JUDGE

Eventually you, the local official, will make judgments about your town's wastewater problems from all this preliminary information. Some things, such as a major breakdown at your treatment plant, obvious widespread failure of septic systems, and area-wide groundwater contamination, may require an immediate response, and probably the retention of a consulting engineer. Other problems, such as occasional backup of storm or sanitary sewer into basements, isolated septic system problems, or individual instances of well contamination, may not.

Your town really needs to take a long hard look at what the problems really are. Don't make the mistake of automatically thinking that because some homes appear to be having trouble with their septic systems your town needs to install or extend sewers. Or that because your treatment plant is out of compliance you need to build a new one. Some towns have unnecessarily built new facilities thinking their old plant was inadequate, when the problem was actually in the way they collected or analyzed samples of the treated wastewater. These actions may eventually be necessary, but start off by making certain that you've done everything possible to get the best performance out of your town's existing septic systems and treatment plant.

Contact the organizations we discussed earlier. They may be able to help you better understand the extent and seriousness of your problem. They may also be able to assist your town in solving some of its smaller problems without a lot of outside help.

It is very important that the response be proportional to the need. If your car were to have a flat tire, you would not necessarily need to build a railroad.

The State of New York has an active community "Self Help" program which encourages and assists communities in solving some of their problems on their own. The "Self Help Handbook" (see page 73 in Appendix C) may give you some good ideas about things you can do to solve some of your town's problems without spending a lot of money.

Your problems, of course, may be too severe for you to solve them on your own. If this is so, they you will probably need the services of a consulting engineer. Consulting engineers are professionals who offer important skills available nowhere else. In the next chapter we will discuss how to select the best consulting engineer for your town's particular circumstances.

Chapter Three

Selecting Your Consulting Engineer

This chapter is intended to serve as a guide for your community in selecting a professional engineering firm to help solve your various wastewater treatment problems.

Generally, selecting the right engineering firm for your town will involve five steps:

1. Identifying potential engineering firms
2. Issuing a request for proposals
3. Interviewing candidate engineering firms
4. Checking references
5. Selecting a firm and contracting for its services.

If you anticipate seeking funding through a State or Federal agency, contact that agency before you begin the selection process to insure that you satisfy the agency's requirements.

IDENTIFYING POTENTIAL ENGINEERING FIRMS

You should start by drawing up a list of at least five firms that might be able to meet your needs. Sources of names for your list include your own past experience or that of neighboring towns, lists maintained by your State water pollution control agency, and suggestions received from your local Cooperative Extension Service or Rural Community Assistance Program. Local professional engineering societies may be able to provide lists of members who specialize in wastewater work. The National Society of Professional Engineers and the American Academy of Environmental Engineers have lists of their members available (see page 73 in Appendix C).

An important point to remember is that different firms may have different areas of expertise. For example, a firm that is most experienced with centralized treatment plants may not be the best firm to consider if your town does not have sewers.

Identify engineering firms that might be interested in your project, and request proposals from them.

ISSUING A REQUEST FOR PROPOSALS

You now need to notify engineering firms that you are interested in their services. One good way to do this is by preparing a Request For Proposals (RFP). In your RFP, briefly describe your town's wastewater problem and request proposals from consultants on how they would solve it. Some of the organizations you contacted earlier may be able to help you prepare an RFP.

Depending on your community's size and the nature of your problem, the RFP may be a letter to the engineering firms on your list or it may be a longer, more formal document. You may wish to advertise your RFP. In any case, it should include at least the following:

- ❑ A brief description of the problem
- ❑ A statement telling what it is you want the consulting firm to do

- ☐ The deadline by which your town must receive the proposal
- ☐ The person in your town to contact for additional information
- ☐ Standards by which the proposals will be judged
- ☐ The place and time the proposal must be submitted.

INTERVIEWING CANDIDATE ENGINEERING FIRMS

When you receive the proposals, you should check to see if they meet your judging standards, and are within an acceptable cost range. From those that meet the standards, you should select three or four that look best. You should then interview each firm individually.

Be prepared to ask hard questions. Listen carefully to the answers you receive. Remember the engineer will be working for you!

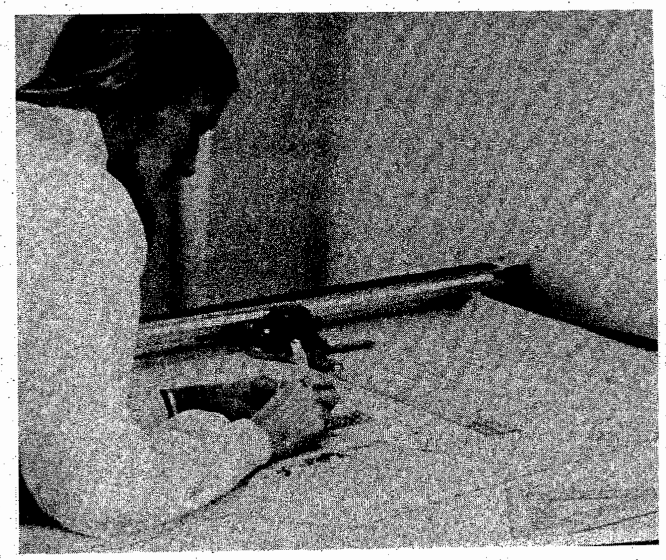
Interview the firms that made the best proposals. Ask hard questions.

The following eight tips may help you interview the engineering firms and evaluate their proposals.

Small Town Experience
Does the firm have experience with communities like yours? Which towns have they worked with in the recent past?

System Design Experience
Does the firm have experience in designing systems for small communities? Do they have experience with septic systems, or is their experience mostly with sewer systems and centralized treatment plants?

What types of systems has the firm actually recommended, designed, and installed? When were they installed? How are these systems working? What were the estimated costs? What are the present operation and maintenance needs and costs of these systems? What systems has the firm recommended for communities which are most like your own? Ask for the cost per dwelling served, the up-front assessments, and monthly charges for the last few projects of a size and technology comparable to yours.



You must be prepared to pay for good engineering work.

Experience with Financial Institutions and Funding Agencies
What experience has the firm had helping communities get financing from commercial sources (banks, bond sales)?

What experience has the firm had dealing with state grant or loan programs? Farmers Home Administration grant and loan programs? Housing and Urban Development Community Development Block Grant Program? What experience has the firm had in working with lending institutions or financial consultants?

Experience with State and County Agencies
What experience does the firm have in working with the State and County environmental agencies, the health department, etc.?

Willingness to Work with the Community
If your community came up with a range of acceptable user costs, would the engineer be willing to use these estimates as a guideline to design a wastewater system? How does the firm plan to handle public participation in this project?

Willingness to Work for the Community
Does the firm have any experience using technologies and maintenance programs that are different from what the State and County agencies have traditionally accepted? Does the firm have the willingness and capability to utilize innovative or alternative technology where appropriate? (Some engineers have dealt only with large centralized treatment systems and may not be familiar or experienced with other alternatives). Has the firm ever been active in trying to write or change State or local wastewater codes or regulations to make them more appropriate for small communities or rural areas?

Staff Capabilities and Workload
What projects is the firm now working on and what new ones may be coming soon? Which people on their staff will be devoted to your project? What time schedule does the firm propose for completing your work? Does the firm use subcontractors for certain work? If so, which firms and for what work?

Cost of Engineering Work
You must be prepared to pay for good engineering work.

Do not choose your engineer only on the basis of cost. It is well worth spending a little extra to get an engineer who will design a system which will provide service at lower cost to you for years to come.

Ask the engineer to briefly explain the firm's estimated fee. Make sure you understand exactly what services will be provided. Is there a distinction between basic services and additional services? What circumstances could significantly change the estimate?

CHECKING REFERENCES

Be sure to check references for the firms you thought were best.

Talk to representatives from communities the firm has recently worked for. Ask about the overall experience, problems or special situations that arose, delays, etc.

SELECTING A FIRM AND CONTRACTING FOR ITS SERVICES

The final selection of a firm involves evaluating all the information you have gathered.

Be sure to talk it over with your advisory group. Discuss the pros and cons of the good candidates. Finally, you must use your best judgment and select the firm which you believe will do the best job for your town. It's generally a good idea to maintain a written record which documents the basis for your choice.

Once you have selected a firm, you must negotiate and sign a contract for their services. The form of this contract and the payment may be governed by the method your town will use to finance this part of your project. Be sure to consider this aspect in your evaluation. When that is done you are ready to begin working with the engineer to evaluate and solve your town's wastewater problems.

Chapter Four

Ways to Collect and Treat Wastewater

A LITTLE HISTORY

In the 1960s and early 1970s, the popular approach to handling wastewater was to collect it in sewers and treat it at a central plant. This method was used because many onsite systems (septic systems) were failing. Also, it was believed that it was easier to manage one large system, which would be less costly to operate, than several smaller ones.

There were good reasons for these beliefs. Many septic tanks were poorly sited, designed, installed, and maintained. Large systems were believed to be less costly per user and to provide extra capacity in areas that were just developing.

Households in a very small town may pay three times more for sewers than households in a larger city.

Experience has shown, however, that this approach may be inappropriate in small communities. Rural populations are usually spread out, requiring longer sewers to serve each house. As a result, households in a very small town of 500 may pay three times more for sewers than households in a city of 100,000! This situation is worsened because the treatment plants in these small communities are not large enough to be cost–effective. The bottom line is that due to the size and layout of small communities, the cost per house of conventional sewers and treatment plants may be much greater than in larger cities.

In the past, sewers such as those being installed here were often used to collect wastewater in small communities for treatment at a centralized plant. Experience has shown that this approach is not always the best.

Unfortunately, many small communities that tried to solve their wastewater problems by installing conventional sewers and treatment facilities could not afford them or operate them. Even with large Federal and State grants to help pay for the system, some towns have experienced hookup costs per household of over $5,000. Annual fees per household to support the debt service and operation and maintenance of these facilities were greater than $500. In some cases, the upfront cost per household for conventional sewers and treatment facilities has been greater than the average value of the houses in the community.

In addition to their high cost, conventional systems are complicated and need skilled people to properly operate, maintain, and manage them. Small communities find it difficult to attract and pay for the necessary staff.

Small communities need simple, low cost wastewater systems.

These problems led the Environmental Protection Agency and others concerned with wastewater treatment to look at alternative wastewater systems for small communities and to encourage more appropriate solutions.

It is now widely recognized that small communities need simple, low cost wastewater systems. A variety of systems are appropriate for small communities. Appendix A contains summaries of many of these systems.

In this chapter we will look at the three varieties of systems which may be used in small communities: onsite systems, cluster systems, and centralized systems. In addition, we will look at the different types of collection systems which are available.

Your town will probably need to use a combination of these onsite, cluster, and centralized systems. Perhaps managed onsite systems can be used in outlying rural areas, cluster systems in small residential subdivisions, and centralized systems in more populated areas.

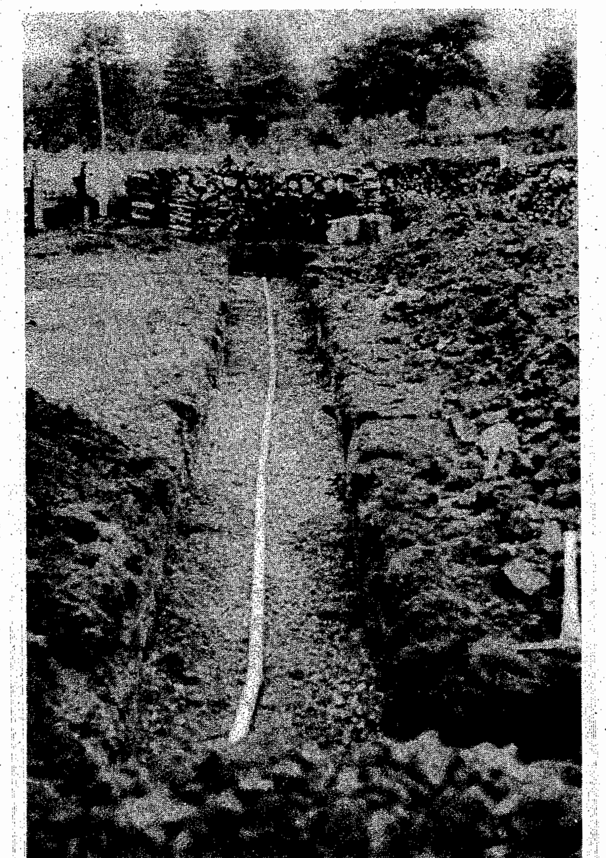
ONSITE SYSTEMS

Many homes, especially in outlying areas of your town are probably served by septic systems (typically consisting of a septic or aerobic tank and a drainfield). Some of these systems may not be performing properly. Wastewater may be bubbling up in people's yards or backing up into homes. Perhaps some residents' wells are contaminated. So there may be some folks in your town who are not too interested in hearing about septic systems right now.

Well, it doesn't have to be this way. On the right site, a well designed, installed, and cared for septic system can provide years of low cost trouble free service. But many systems installed in the past were poorly designed, constructed, and cared for. Homeowners have frequently been responsible for the maintenance of their systems. Some homeowners have not been aware of the necessary maintenance activities or have neglected to get the work done. No type of treatment system will work under those conditions! Also, many septic systems have been installed in areas where they could never work properly because the soil is too shallow or of the wrong type, the site is too small or steep, or other site conditions are wrong.

Generally, septic systems are best used on large, relatively level, well-drained lots with deep, moderately permeable soil.

You are probably wondering if there are any systems for sites which are not so perfect. Well take heart! There are many different types of onsite systems that can accommodate a wide range of site and soil conditions. For homes presently served by septic systems, these onsite systems should be seriously looked at. With proper management, they may be able to provide very simple, inexpensive treatment for many years. A summary of onsite alternatives is presented in Appendix A.



A conventional septic system being installed. Note the large, relatively level, well-drained lot with deep, moderately permeable soil. Other onsite systems can be used on more difficult sites.

There are many types of onsite systems for less than perfect sites and soils.

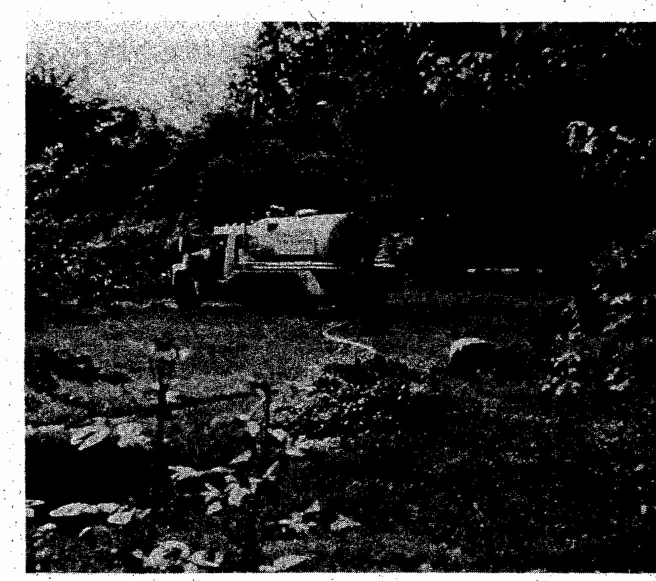
Simplicity of operation is a major advantage of onsite systems. All that onsite systems need is periodic inspection and servicing of simple pumps and pumping out of the septic tank every three to five years.

Some more sophisticated onsite systems such as sand filters and low pressure pipe systems may require a slightly more sophisticated maintenance approach. However, this maintenance effort is generally simpler than that needed for centralized treatment systems.

The material pumped out of septic tanks (septage) must be properly treated and disposed of according to State and County regulations.

Your town will need to establish some way to make certain that onsite systems are properly installed, repaired, and maintained. The options for a program of this type are discussed in Chapter Four.

As part of your management program you may wish to inform homeowners about how their onsite systems work and actions they can take to prolong the system's life. For example, conserving water and avoiding garbage grinders will help insure trouble-free operation.



Onsite system maintenance is essential to long-term operation. Here a septic tank is being pumped out. This should be done every three to five years.

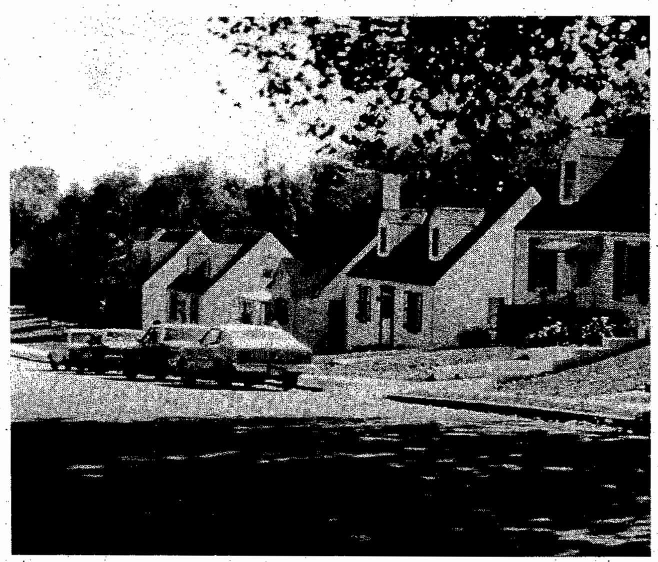
You will need to establish a program to make sure that all onsite systems are maintained properly.

COLLECTION SYSTEMS

Of course, there will be areas where onsite systems just will not work. In such areas, you will need to use some type of sewer system. A sewer system moves the wastewater from a number of homes to a treatment facility.

Conventional Sewers

Conventional gravity sewers are used in large cities and highly developed areas. They are costly to install but where people live close together and many households share the cost, such systems are advantageous. Generally, conventional sewers should only be used if 100 or more households will be connected to each mile of sewer. Another way to say this is that conventional sewers are appropriate where lot sizes are 1/2 acre or less.



Conventional gravity sewers may be appropriate where houses are close together such as in this photo. About 100 houses would be served by each mile of sewer.

Conventional sewers may be a poor choice for areas where people live farther apart. As the number of households sharing the cost of the sewer goes down, the amount each household pays goes up. That's why households in a small town may pay three times as much for conventional sewers as households in a city of 100,000. In fact, the cost of conventional sewers alone may account for 70 to 90 percent of the total cost of a conventional wastewater system that includes a treatment plant!

Alternative Sewers

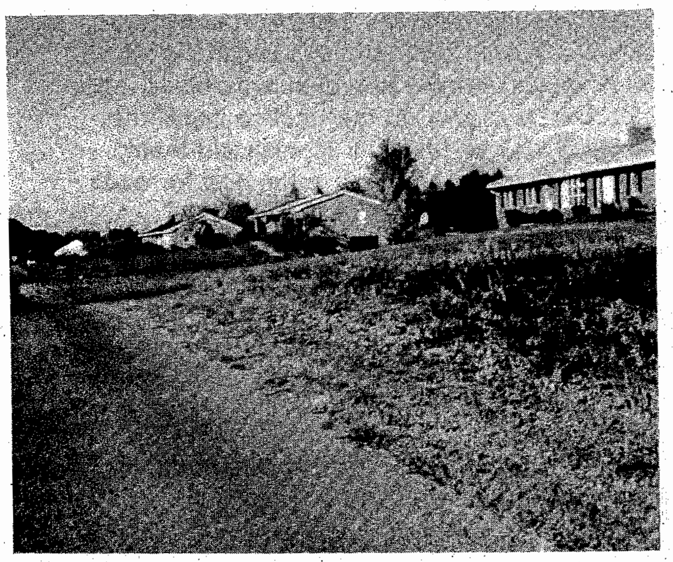
Fortunately there are alternative types of sewers available for small communities and less developed areas. Generally, alternative sewers are appropriate where 50 to 100 households will be connected to each mile of sewer (lot sizes are greater than 1/2 acre). Alternative sewers can flow directly to a treatment facility or they can flow into a conventional sewer system.

Conventional sewers alone may account for 70 to 90 percent of the total cost of a conventional wastewater system, including a treatment plant.

Where less than 50 households would be connected to each mile of sewer, you should be sure that some type of onsite system would not work. Consider alternative sewers if sewers are absolutely necessary in such areas.

Less costly alternative sewers are available for small communities.

Alternative sewers are smaller in size than conventional sewers and are installed at shallower depths. There are three main classes of alternative sewers — small diameter effluent sewers, grinder pump systems, vacuum sewers. Generally one or a combination of these will be more appropriate in a small community than conventional sewers.



Alternative sewers may be appropriate here. About 50 houses would be served by each mile of sewer.

Small Diameter Effluent Sewers
In this system, a septic tank is used at each home. Liquid flowing out of the septic tank (septic tank effluent) is collected in small diameter plastic pipe. Small diameter effluent sewers are installed at shallow depths and may generally follow the contour of the land. Since almost all solids are removed in the septic tank, sewer clogging is not generally a problem, even in low spots. Costs are less because expensive manholes are rarely needed, pipe installation is simpler, and the system can be built more quickly.

Some houses in very flat or low lying areas may need a small pump to help move their septic tank effluent in the effluent sewer. These systems are referred to as Septic Tank Effluent Pumping (STEP) systems.

Installation of small diameter effluent sewers is very simple and flexible! Only shallow narrow trenches are needed. These can be easily dug around trees and buildings to minimize disruption of the landscape.

Another advantage of small diameter effluent sewers is that a smaller and simpler treatment facility can be used, since the wastewater is partially treated in the septic tanks.

Operation and maintenance of small diameter effluent sewers involves making certain that septic tanks are inspected and pumped out and that STEP system pumps receive periodic preventive maintenance and service as needed. STEP system pumps require electrical power but will add only a very small amount to the average home electric bill.

Small diameter effluent sewers can be put in around trees and buildings.

Grinder Pump Systems
These are very similar to small diameter effluent sewers but instead of using a septic tank at each home to remove solids, a grinder pump (like a garbage disposal) is used to grind up the solids and pump them with the sewage.

Grinder pumps eliminate the need for septic tanks at individual homes. However, grinder pump systems may require more sewer line cleaning than small diameter effluent sewer systems. The grinder pumps themselves may require slightly more maintenance than STEP system pumps. Grinder pumps also require electrical power but, like STEP system pumps, add only a small amount to the average home electric bill.

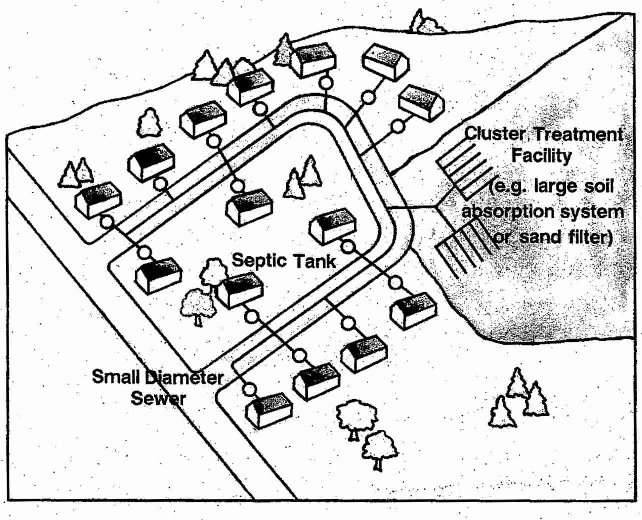
Vacuum Sewers
Vacuum sewers are an option for very flat areas where soils are shallow or where high groundwater exists. In a vacuum sewer system, no septic tanks or grinder pumps are used. Instead, wastewater from each home or group of homes travels by vacuum through a special valve into small diameter pipes and then to a central vacuum station. The wastewater is then pumped from the central vacuum station to an existing conventional sewer system or directly to a treatment facility.

Vacuum sewer systems use smaller pipe and permit flexible layout. They generally require more skilled maintenance than other alternative sewers. A vacuum sewer system requires only a single electrical power connection (for the central station) unlike STEP or grinder pump systems which require a separate electrical connection at each home. Under certain circumstances, vacuum sewers may be the best option.

A Final Word About Collection Systems
In heavily developed areas, such as your central business district, and in residential areas where the lot sizes are 1/2 acre or smaller and almost all lots are developed, conventional sewers may be cost effective. In less developed areas, where lot sizes are between 1/2 and two acres, alternative sewers may be the best system. As a result, the best approach for your town may be conventional sewers in the central business district and in densely developed residential areas, and alternative sewers in less densely developed residential areas. Your decision regarding which type of sewer system to use in a particular area will be based largely on the cost to install the sewers as well as the cost to maintain them. These costs will have to be estimated for each area by your engineer. Your town must realistically consider its growth expectations; planning too far ahead, particularly for sewers, will be very costly to current residents. Summaries of collection system alternatives are presented in Appendix A.

A combination of alternative and conventional sewers can be used.

CLUSTER SYSTEMS
Perhaps there is a certain neighborhood in your town where onsite systems can't be used. Then you need not only a low cost sewer system but a low cost, reliable, and easily operated treatment facility as well. This area may best be served by a cluster system. In a cluster system, alternative sewers collect wastewater and transport it a short distance to a small neighborhood treatment facility. Even where land is not suitable for an onsite system, it is often possible to find a usable site not too far away. Cluster systems generally serve two or more homes, but less than an entire community. They are well suited for subdivisions of a few dozen homes. Cluster treatment facilities are generally larger versions of onsite systems such as soil absorption systems or intermittent sand filters. They may be a good, low cost solution for subdivisions that are far from central facilities and where the houses are too close together to allow onsite systems on each lot.



In a cluster system, alternative sewers collect wastewater and transport it a short distance to a neighborhood treatment facility.

As with onsite systems, your town will need to make certain that the cluster systems are properly maintained. Options for doing this are discussed in Chapter Four.

CENTRALIZED TREATMENT

Some towns have areas of fairly dense development. These areas may be unsuitable for either onsite or cluster systems, or regulatory agencies may prohibit alternative systems in certain areas. In such areas, conventional or alternative sewers combined with centralized treatment may be the best solution.

There are many different types of centralized treatment facilities available. The right one for your town will depend on how strict standards for wastewater discharge are, and how much land you have available. The two general kinds of centralized treatment facilities are natural systems and mechanical systems.

Natural systems use soils, vegetation, or aquatic environments to treat the wastewater. Some types of natural systems, however, can't operate well during bad weather. Large holding ponds may be necessary to store wastewater during such periods. The amount of storage required varies throughout the country and is dependent upon local weather conditions and site characteristics. Natural systems generally require larger amounts of land than mechanical systems, but are simpler and usually much less costly to operate.

There are two classes of centralized treatment facilities — natural systems and mechanical systems.

Natural systems include applying wastewater to the land where it interacts with soil and vegetation. Land application can produce a very high quality effluent meeting strict treatment regulations. In some land application methods, treated wastewater evaporates, percolates to the groundwater table or is used by vegetation, thus eliminating any surface water discharge.

Various low cost, easily operated and maintained natural systems are available.

Other natural systems include lagoons and constructed wetlands. These systems vary in the amount of land they require and the degree of treatment they can give. Often several systems are used together; for example, lagoons will be used to treat wastewater before it is applied to land. Such an arrangement can take advantage of the best features of each system.

Pictured is a land treatment system where partially treated wastewater is sprayed on a golf course. Land application often transforms the wastewater into a valuable resource.

The important thing to remember is that various low cost, easily operated and maintained natural systems are available for wastewater treatment. You should seriously look at these systems both alone and in combination as possible solutions to your town's wastewater problems.

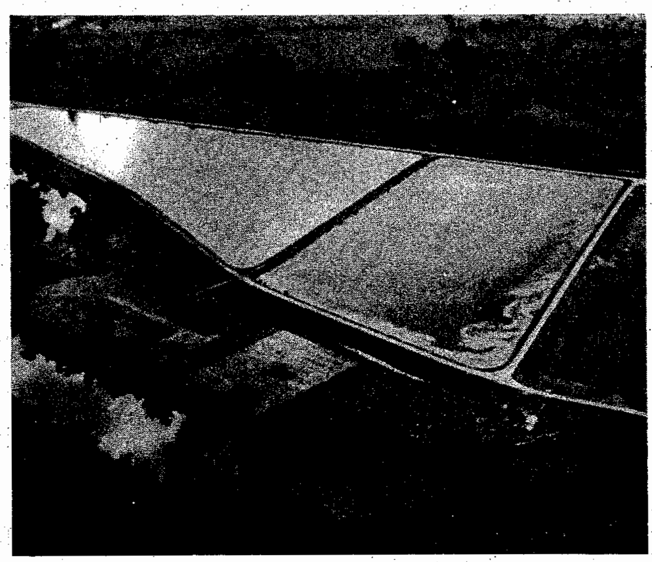
Mechanical systems consist of highly engineered treatment facilities which can treat relatively large quantities of wastewater in a small amount of space. Mechanical systems may be used where sufficient land is not available at a reasonable cost for a natural system.

Mechanical systems usually need greater operator attention and often use greater amounts of power than natural systems. However, the operator generally has much greater control over a mechanical system. Mechanical systems usually are not as sensitive to climatic conditions as natural systems.

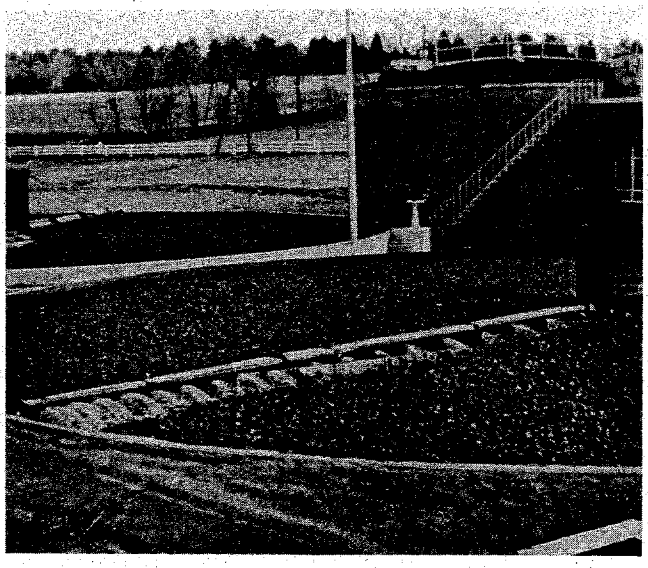
Trickling filters, oxidation ditches, and sequencing batch reactors are examples of mechanical systems that are usually appropriate for small communities. Trickling filters provide efficient, reliable service with a minimum of operator attention where discharge standards are not too high. Oxidation ditches may provide a slightly higher level of treatment. Sequencing batch reactors can produce a very high quality effluent but may need greater operator attention. Mechanical systems produce sludge which must be treated and disposed of. Therefore where mechanical systems are used, additional facilities for sludge treatment must be provided. These facilities require additional operator skill and attention.

Many mechanical systems with varying degrees of complexity are available.

Mechanical systems can also be used in combination with natural systems. For example, a land application system may be added to an existing trickling filter plant if additional treatment is required.



A lagoon system. If discharge standards aren't too strict, a direct stream discharge may be possible. Otherwise, some type of land treatment system may also be needed.



Where limited land is available, mechanical systems such as trickling filters can be used. Mechanical systems usually need greater operator attention and consume greater amounts of energy than natural systems.

Mechanical systems can treat large amounts of wastewater in a small amount of space.

Again, remember that many mechanical systems, with varying degrees of complexity are available. They may be used alone, in combination with each other, or with natural systems to solve your town's wastewater problems.

Chapter Five

Planning a Solution to Your Problems

The success of your wastewater project depends on proper planning. If you carefully consider your options at every step and fully involve the public, then you will probably achieve good results.

ANOTHER LOOK AT YOUR TOWN'S PROBLEM AREAS

As we discussed in Chapter Two, you need to clearly define what your problems are. Working with your consultant you must now identify in detail the existing and future wastewater management problems in your town and their locations.

Your goal is to identify problem areas where existing wastewater management facilities are inadequate or where you can expect problems in the future. You should consider the following items when deciding if an area has problems:

1. **The performance of existing wastewater management facilities in the area.** If there are onsite systems, how are they working? How are they maintained? If there is a treatment plant, does it meet its permit limits? Can operation and maintenance be improved thus avoiding costly construction? Can existing facilities be expanded or upgraded to meet the needs or is a new facility required? How adequate is the sewer system? Is it leaky during heavy rains? Are the existing facilities currently overloaded by residential or industrial wasteflows?
2. **The potential for growth and development in the area.** Is there any undeveloped land that might be developed in the future? Do you have a land use plan? What kind of development do you expect or want? Will a new facility spur development in areas that are not suitable? How can this be controlled? Based on projected land use, what will future wasteflows be, and how much will be industrial, commercial, and residential? If there is new development, will it be able to use the same wastewater management methods as existing development? Your town must realistically consider when and how growth may occur. If your town overestimates future growth, your wastewater system may not work very well and may be quite costly.

Identify problem areas where existing wastewater management facilities are inadequate or where you can expect problems in the future.

3. **The potential sites for wastewater and sludge disposal.** For new development where can onsite systems be used? If sites are not uniformly suitable for onsite systems, are there enough suitable areas for cluster systems? Are there potential sites for new centralized treatment plants? Where and how can sludge and septage be disposed of? Can sludge or septage be applied to farmland nearby?

WHAT WASTEWATER MANAGEMENT APPROACHES SHOULD BE CONSIDERED?

Once your engineer has evaluated existing facilities, identified problems, and looked at future service needs, he/she needs to look at various options to solve your problems. He/she should look at approaches to serve your area as a whole as well as smaller subareas which may have varying needs and characteristics. Remember a variety of solutions throughout your town may be the best choice. The job of your engineer is to look at all possible approaches, estimate the costs of construction, operation, and maintenance, and recommend the most cost-effective solution. The engineer also needs to consider your community's ability to pay.

As the engineer lays out options, he/she should summarize their costs and features for review by your townspeople. Work with your engineer, so that you can identify specific factors and approaches to be used when comparing the options. At this point, certain options can be eliminated while others may be identified. Be sure that you understand the costs and different aspects of the proposed alternatives. Be sure that your engineer considers the low cost technologies described in this booklet.

Some problem areas may best be served by managed onsite systems, while in others cluster or centralized systems may be best.

Once problem areas have been identified, your engineer needs to make a preliminary recommendation about which wastewater management option is best for each location. Some problem areas may best be served by managed onsite systems, while in others cluster or centralized systems may be best. Chances are your town has different problems in different areas, so different solutions may be needed in each area.

This preliminary recommendation is limited to identifying which of the three general approaches should be used in each of the problem areas.

Within each general approach there are numerous specific technology options. For example, if you decide to use onsite systems in an area, you then have many different types of onsite systems to choose from. These include the standard septic system, alternative drainfields, sand filters, constructed wetlands, etc. In large part the specific characteristics of a problem area, such as type of soil and lay of the land, determine which specific technology options can be considered.

Your consultant may need to collect additional information about actual physical conditions or other characteristics of specific problem areas in order to know which specific technology options to consider further.

WHAT SPECIFIC TECHNOLOGIES WILL BE USED?

Once you have agreed on a general approach, the engineer should sketch out technology options in more detail. This is often presented in a facilities plan, which includes detailed information about the characteristics of your community, evaluation of service needs, consideration of technology options, and description of recommended facilities. Three to five alternative wastewater management plans should be evaluated. The results should be summarized so that non-technical people can understand the alternatives and the reasons the proposed plan is recommended. It is especially important that the costs to the homeowner for the recommended plan and the alternatives be clearly compared. An EPA document, "Financial Capability Summary Foldout," will help with this. The next step is to hold a town meeting to receive public comments on the facilities plan. Based on the planning information and input from the public meeting, your funding agency may need to approve your plan.

You need to make the final decision on the specific collection or treatment options for each problem area. In addition, you must decide how sludge and/or septage (sludge from septic tanks) will be handled. When deciding between various specific options, you should consider the following:

- ❑ Construction and equipment costs of the system
- ❑ Operation and maintenance costs of the system
- ❑ User fees needed to pay for all of the community's costs to build and operate the system
- ❑ Ease of operation and maintenance
- ❑ Local environmental impacts of the facilities such as odor or generation of sludge
- ❑ Public acceptance of the project
- ❑ Performance reliability of the technology
- ❑ Ability to expand to meet future needs
- ❑ Regulatory requirements (i.e., discharge standards, etc.).

Your State regulatory agency will have to approve the plan you choose before you can move to the next step — design.

Before your engineering consultant gets too far into the design you should have an independent consultant perform a value engineering (VE) study. The ideal time for VE is when the design is approximately 30 percent complete.

A value engineering study will pay for itself by identifying ways to reduce the cost of your wastewater project.

A value engineering study gives you a second opinion on your proposed wastewater management system. The study should be performed by a qualified team from an engineering firm which is completely independent of the firm designing your system. They will take a detailed look at what you propose to do and how much it will cost. They will also make sure that nothing has been overlooked and that there are not better ways to solve your problems.

The value engineering study will generally pay for itself by identifying ways to reduce the cost of your wastewater project.

When completed, the detailed engineering design will include very specific cost estimates. It can be used later to obtain bids for construction of the system.

WHO WILL MANAGE THE FACILITIES?

During the planning process you must keep in mind that your community will need to supervise construction of the facility and its ongoing operation and maintenance. Your existing wastewater agency may not have sufficient staff or legal authority to carry out the necessary tasks. You may need to consider hiring new staff, conducting training, enacting new legislation, negotiating interagency agreements, or even establishing a special district.

Centralized facilities are generally operated by the town, county, or a special wastewater management district.

As we said earlier, the wastewater treatment methods may be different for different parts of your town. Thus your town may have onsite systems, cluster systems, and a centralized facility. You need to decide how each of these will be managed.

Generally the town or wastewater management district owns, operates, maintains, and manages centralized facilities. Users of the facility pay an annual fee for their wastewater service (user fees are discussed in Chapter Six).

If you are part of a regional system, responsibilities may be divided. Likewise, revenues will need to be shared.

Some towns are trying to reduce costs or operational responsibilities by turning to the private sector. For example, the town or district may own the facility, but hire a private firm to operate and maintain it. This is known as a contract operation. Private firms become even more involved in privatization, where the firm may be involved in facility design and construction (including the financing) and potentially in its operation and maintenance. There are many variations of these approaches. Be sure to discuss them carefully with your consultant so that you understand your responsibilities and the relative advantages and costs of the various options.

There are a number of options for management of onsite and cluster systems. They may be owned and managed by homeowners in compliance with regulations established by the town, sewer district, or health department. The homeowners are responsible either directly or through a homeowners' association, for the operation and maintenance of the system they use. Homeowners pay all costs for maintenance, septic tank pumping, and system repairs when necessary.

There are a number of options for management of onsite and cluster systems.

Another option is for the town or wastewater district to assume responsibility for routine operation and maintenance of systems which are owned by their users. To assure access to the property for system inspection and servicing, homeowners either sign a service agreement or provide an easement. The users pay a fee to the town or district for this service. Under this arrangement the cost of system repairs when necessary, would be the direct responsibility of the homeowner. At the homeowner's option, necessary repairs could be performed by the district or a private contractor.

In the final option, the town or district owns and operates the onsite and cluster systems, and collects user charges to pay for the service. All construction, operation, and maintenance tasks are performed by the public agency, or firms under contract to it.

Chapter Six

Paying the Bill

WHERE WILL THE MONEY COME FROM?

As with any other type of large project, a major concern is how to pay for your wastewater system. This concern actually has two parts: paying for construction of the project and paying for operation and maintenance of the system after it is built.

Consequently, a first question to be answered is: Where will you get the "upfront" money needed to pay for the design and actual construction of the collection and treatment facilities? These costs include not only the cost of the materials and actual construction, but also the project's administrative, legal, and engineering costs, as well as other costs such as land acquisition.

Normally you pay for part of the costs outright, and finance the rest.

There are several approaches to financing upfront costs. You may obtain a grant or loan for part of the costs. Normally you will pay for part of the costs outright, and finance the rest. You may get the money all from one source or more likely, from a combination of sources. Potential sources include:

- State revolving loans
- State bond banks
- State grants
- Federal loan or grant programs
- Local bond issues
- Bond or grant anticipation notes
- Loans from banks
- Cash on hand
- Property assessments
- Cost sharing with major users.

You may need advice from financial consultants about the best way to finance your project. Your engineer or some of the organizations such as the Small Flows Clearinghouse we listed in Chapter Two may be able to help you find and hire a financial consultant.

State Revolving Loans

These funds make loans to towns for purposes such as constructing wastewater treatment facilities. The loan repayments go directly back into the fund to be loaned to other communities.

Under the Federal Water Quality Act of 1987, EPA provides each State with startup money to establish a revolving loan fund, or with money to add to an existing loan fund for wastewater facilities. A few States already have such programs. Most, however, will be set up by 1989.

Each existing State revolving fund is a little different. Some State programs limit assistance to communities with poor or no credit ratings. Others base their assistance on such factors as affordability of the project, public health benefits, and potential for economic development. Programs also vary according to maximum loan amount, percentage of total project cost eligible for a loan, interest rate, and time for repayment. Some States simply fund projects on a first–come, first–served basis, relying on the community's ability to repay. Thus you need to check with your State to see if its revolving loan fund is yet in operation and if so, how it works.

State Bond Banks
Government bonds are backed either by the general taxing power of the issuing government (general obligation bonds) or by continuing sources of revenue such as sewer user charges (revenue bonds).

Most State bond programs act as go-betweens for municipalities and the national bond market. These programs help many small towns that can't issue bonds or, if they can, must pay high interest rates to attract investors. The State's usually high credit rating allows it to issue bonds at relatively low interest rates. Bond banks act in two ways: they may either guarantee local bond issues or they may actually buy local bond issues.

Not all States have bond banks, and those that do have a variety of arrangements. You will need to check with your State for additional information about eligibility, how to apply, and terms. EPA's "State Alternative Financing Programs Report" contains information about innovative financing programs and contacts in the States.

State Grants
Your State may provide grants for the construction of wastewater treatment facilities. These grants sometimes can be used along with funds from other sources, while in other cases they may be restricted to communities not receiving Federal assistance. Funds for the grant programs may come from the State's general fund or from State bond issues. A few States have more unusual funding sources. For example, Wyoming funds its revolving loan and grant program through royalties from the coal and mineral industries. The specific provisions of State grant programs vary from State to State.

Of course the major advantage of a grant is that you don't need to pay it back. However, grants may contain provisions that limit the way in which you can spend the money and may impose other requirements which increase construction costs.

Federal Loan or Grant Programs
The Farmers Home Administration (FHA) provides loans and grants to build, repair, improve, expand, or change wastewater disposal facilities in rural communities. The loans have a maximum term of 40 years, and are intended for communities that are financially sound but that can't get funds from other sources at reasonable rates.

Other Federal agencies such as the Economic Development Administration and the Department of Housing and Urban Development provide grants and/or loans to communities for various purposes which may include wastewater systems. Be sure to check with your county extension agent or regional planning agency about what's available.

The Environmental Protection Agency, under the Water Quality Act of 1987, will continue making new construction grants for wastewater facilities into the early 1990s. Grants generally pay for 55 percent of eligible project costs but may cover as much as 75 percent if innovative or alternative technologies (especially applicable in small communities) are used.

Your State maintains a list of wastewater projects which need to be built. This Project Priority List indicates the order in which projects qualify to receive construction grants. Your position on the list determines the likelihood of receiving a grant. Because of factors such as population and pollution impacts, small communities are generally low on project priority lists. Even if you receive a grant, it will cover only 55 to 75 percent of specific eligible project costs. Some things that are not eligible include excess capacity for future growth and conventional gravity collector sewers. Therefore, you will need to consider one or more of the other methods discussed in this chapter to finance the rest of the project.

Local Bond Issues
Like States, towns, counties, and special districts can issue either general obligation bonds or revenue bonds. Most jurisdictions have legal limits, however, on the amount of bonded debt they can have, particularly for general obligation

bonds. As a result, general obligation bonds are often used only for schools, libraries, municipal buildings, and police/fire stations. These bonds are secured by the taxing power of your town (usually property taxes). In many areas, voters must approve the issuance of general obligation bonds. Since there is a limit to the amount of general obligation debt a community can have, you should be very selective in using them.

EPA's "Financial Capability Guidebook" and "Financial Capability Summary Foldout" show how to evaluate your community's overall financial condition and ability to assume new debt.

Revenue bonds, on the other hand, are secured by user fees. By issuing revenue bonds for your wastewater project, you preserve your general obligation borrowing capacity for those projects that do not generate revenues. Revenue bonds are not usually subject to debt limits. However, interest rates are generally higher on revenue bonds than on general obligation bonds.

EPA's "Financial Capability Guidebook" shows how to evaluate your community's overall financial condition and its ability to assume new debt.

Issuing bonds is not a simple matter. Your town will need the help of an outside specialist such as a bond counsel or financial advisor. Consult the EPA publication, "Touching All The Bases — A Financial Management Handbook For Your Wastewater Treatment Project," for additional information.

Bond or Grant Anticipation Notes
These are forms of short term financing used to "hold you over" until a bond is issued or a grant is received.

Bond anticipation notes are based on your town's ability to sell bonds. They may be issued if you have satisfied all the legal requirements for issuing a bond.

Grant anticipation notes may be used if your town reasonably anticipates receiving a grant.

Loans from Banks
You may need to finance all or part of your project with a loan from the bank. Shop around! Compare interest rates and loan terms to be sure you get the best possible deal.

Cash on Hand
It is a good idea to establish a special fund (called a capital reserve) in which you save up for the day when your treatment system needs to be expanded, upgraded, or replaced. It may be required depending upon the method of financing you choose.

If you are lucky, your town has such a reserve now which can help pay for at least part of your project. If not, you should set one up. The money to be put in the capital reserve fund should be included as part of your user fees.

In some towns, a few industries will have a significant effect on the size or type of facilities needed. In some cases, the industries will build and operate their own waste facilities, or they may prefer to hook in to the municipal system. You may need to establish a pretreatment program to be certain that their wastes are compatible with your plant. You should determine the extra costs for treating this waste and establish cost-sharing agreements with the selected facilities. This could also include facilities such as a major college campus, armed service base, state park, prison, hospital, and so on.

You should establish a special fund to save up for the day when your treatment system needs to be expanded, upgraded, or replaced.

HOW MUCH SHOULD WE CHARGE USERS?

Your goal is to make your wastewater system self-supporting. The costs of running your wastewater system should be accounted for separately from other public services such as drinking water supply. You need to identify reliable sources of revenue that will match existing and projected expenses for operation, maintenance, replacement, and loan repayment costs (debt service).

Your main revenue source will probably be various user fees. However, you should not overlook other possible revenue sources. For example, in some cases, you may be able to sell your sludge, crops grown on land application systems, or other by-products.

Special assessments may be used to recover capital costs for wastewater facilities which benefit property owners within a carefully defined area; for example the costs of installing sewers in a neighborhood. You can give property owners the option of paying the entire assessment at once or paying it in installments at a specific interest rate. In areas of new development you may want the developer to fund assessments and pass the cost on to the new property owners.

Your goal is to make your wastewater system self-supporting.

User fees, however, will be your financial lifeblood. User fees must at least cover the operation and maintenance costs of the wastewater system. These costs include salaries, staff training, billing, general administration, chemicals, electricity, parts and equipment replacement, and so on. Users should pay according to the strength and amount of wastewater they discharge to your system. User fees can also recover all or part of the debt service costs for financing construction of the facilities. A little extra should also be charged to set up that capital reserve we mentioned earlier, which can help pay for future "big ticket" work on your wastewater systems such as major rehabilitation, expansion, or upgrading costs.

In areas served by onsite or cluster systems, the user fee will depend on the management system selected by your town. If homeowners are responsible for their own systems, the only fee they may need to pay to the town might be a permit fee to cover the cost of the town's regulation of their system, including periodic inspections. These users would pay the cost of septic tank pumping and other maintenance directly to the contractors they hire to do the work.

For example, the Marin County (California) Health Department charges homeowners $20 per year for a permit. Every other year the County inspects the homeowner's onsite system. If pumping or repair is necessary, the homeowner is told and is responsible for getting the work done. The permit won't be renewed until the homeowner submits proof that the work was done.

User fees should cover your facility's operation, maintenance, replacement, and debt service costs.

In recognition of the problems regulatory agencies face in requiring a homeowner to repair or replace a failing onsite system, the State of Wisconsin set up a special revolving loan fund. The fund provides loans to residents through County regulatory agencies, for individual system repair and replacement.

If your town assumes responsibility for all aspects of onsite system maintenance, however, a uniform, periodic fee may be charged to each user to cover the cost of the services provided. There are many options to consider for onsite and cluster systems. The EPA publication, "Management of Onsite and Small Community Wastewater Systems," provides additional information.

In areas served by centralized treatment there are not as many options. As we said earlier, the town or a wastewater management district owns and operates the sewers and treatment plant.

If your centralized system serves mainly residential users and small commercial establishments (such as retail stores and restaurants), you may be able to set one rate for individual homes and charge commercial establishments according to the number of homes it would take to produce an equal amount of wastewater. For example a small restaurant may generate the wastewater of about 10 homes, so it would be charged 10 times more than a residence. The nature of the wastewater (e.g., high grease content of restaurant wastes causing sewer blockages) may also be given consideration in user charge determinations.

If homes and businesses in your area use metered water supplies, it is possible to base the user charge on the amount of water used (which can be an estimate of the amount of wastewater produced). An approach like this provides a strong incentive for water conservation. (An even stronger incentive is to charge high volume water users more on a sliding scale.)

Your town may have industrial users or other users that produce wastewater that is much stronger than that produced by households. For those users, you can add a surcharge to the normal fee assessed for the volume of wastewater they generate. This is because stronger wastewater costs more to treat.

The EPA publication, "User Charge Guidance Manual for Publicly-Owned Treatment Works," presents additional information and examples of user charge calculations.

Chapter Seven

In Summary

This booklet has told you about the many options available to solve your existing and future wastewater problems. Information has been included on how to define your problem, how to get help from other sources and where to find it, how to choose a consulting engineer, making up a plan to deal with your situation, various approaches to wastewater management, and how to pay for your wastewater system. Of course you will want to add to the information provided here with other publications, as well as with conversations with your consultant and other wastewater authorities.

The success or failure of your efforts depends on several important things which should be kept in mind throughout the entire planning process. These are:

- ❑ Select the right consultants
- ❑ Involve the public
- ❑ Consider all the options
- ❑ Estimate the project cost
- ❑ Develop a plan for financing the project
- ❑ Determine how the system will be managed after its construction.

It cannot be stressed enough that you should hire consultants who are familiar with the wastewater problems of small communities, and who have worked with towns similar to yours. Remember, one of the best ways to make your system successful is to keep it small, simple, and affordable.

Public participation should be a key part of your efforts, since the people in your town must be told about the problems that exist, their possible solutions, costs of the selected method or methods, and financing for your wastewater system. You should ask for the help of any people in your community who have skills or knowledge that would help you in your planning efforts. You have greater chances of getting public approval of your plan if you keep your townspeople involved and informed.

Think about the options and answer the questions presented in this booklet, research them, and talk about them with your consultant. Check into combining various methods to come up with the combination that's right for **you.**

Don't be talked into large and complex solutions, when simple ones may work just as well at a much lower cost.

Carefully investigate all of the financing options available to come up with a method that's right for your town. Make certain that what you are proposing is feasible.

Estimate the total cost of the project, including operation and maintenance. If you can, speak with officials in other towns that have already installed the methods you have selected. Find out if there were any unexpected costs or problems associated with the system.

Finally, determine who will be responsible for the management of the wastewater system after it is constructed. Can your existing public works department handle it? Do you need a special authority or board?

Remember, it's up to **you** to determine what your wastewater problems are now and will be in the future, and their solution. Both technical and financial assistance are available, but the burden is on **you** and **your town** to select the best options for your particular situation.

Chapter Seven

In Summary

This booklet has told you about the many options available to solve your existing and future wastewater problems. Information has been included on how to define your problem, how to get help from other sources and where to find it, how to choose a consulting engineer, making up a plan to deal with your situation, various approaches to wastewater management, and how to pay for your wastewater system. Of course you will want to add to the information provided here with other publications, as well as with conversations with your consultant and other wastewater authorities.

The success or failure of your efforts depends on several important things which should be kept in mind throughout the entire planning process. These are:

- ☐ Select the right consultants
- ☐ Involve the public
- ☐ Consider all the options
- ☐ Estimate the project cost
- ☐ Develop a plan for financing the project
- ☐ Determine how the system will be managed after its construction.

It cannot be stressed enough that you should hire consultants who are familiar with the wastewater problems of small communities, and who have worked with towns similar to yours. Remember, one of the best ways to make your system successful is to keep it small, simple, and affordable.

Public participation should be a key part of your efforts, since the people in your town must be told about the problems that exist, their possible solutions, costs of the selected method or methods, and financing for your wastewater system. You should ask for the help of any people in your community who have skills or knowledge that would help you in your planning efforts. You have greater chances of getting public approval of your plan if you keep your townspeople involved and informed.

Think about the options and answer the questions presented in this booklet, research them, and talk about them with your consultant. Check into combining various methods to come up with the combination that's right for **you**.

Don't be talked into large and complex solutions, when simple ones may work just as well at a much lower cost.

Carefully investigate all of the financing options available to come up with a method that's right for your town. Make certain that what you are proposing is feasible.

Estimate the total cost of the project, including operation and maintenance. If you can, speak with officials in other towns that have already installed the methods you have selected. Find out if there were any unexpected costs or problems associated with the system.

Finally, determine who will be responsible for the management of the wastewater system after it is constructed. Can your existing public works department handle it? Do you need a special authority or board?

Remember, it's up to **you** to determine what your wastewater problems are now and will be in the future, and their solution. Both technical and financial assistance are available, but the burden is on **you** and **your town** to select the best options for your particular situation.

Appendix A

Choosing the Right Technology

INTRODUCTION

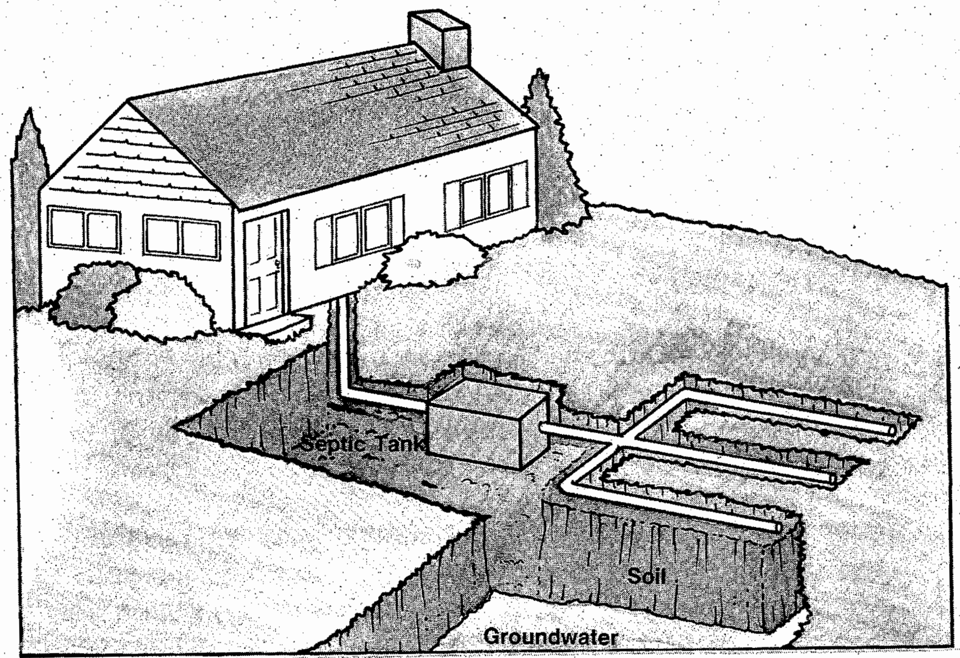
As we've seen, small communities have many choices in how they treat their wastewater: onsite systems, cluster systems, and centralized treatment systems. There are many variations of these three types of systems available.

This appendix will help you better understand your wastewater treatment options. The information provided here will help you work with your engineering consultant. You will depend upon your consultant for a detailed evaluation of the alternatives; however, the information contained here will make you an informed consumer. In addition, this information will help you to understand and ask important questions about the technologies your consultant is evaluating.

Remember, it's your choice. You must understand the alternatives if you are to make an informed decision.

SUMMARY — ONSITE SYSTEMS

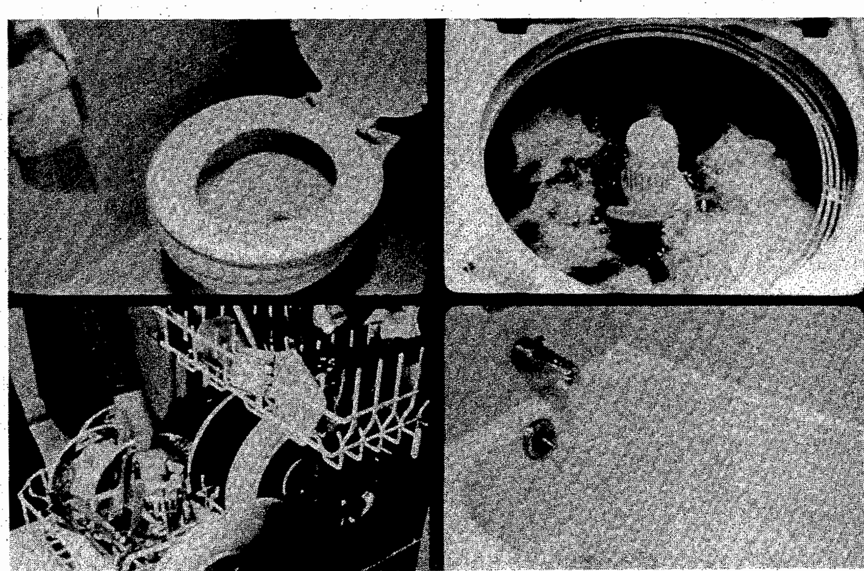
Standard Septic System



- Best where lot sizes are large.
- Minimum of 1/2 to one acre of level land having well-drained soil at least six feet deep.
- Uses septic tank (or aerobic tank) and a drainfield.
- Septic tank removes solids and grease.
- Drainfield absorbs and further treats wastewater from septic tank. Two drainfields may be installed and their use alternated periodically.
- A small pump can be used to more evenly distribute septic tank effluent to drainfield (dosing).
- Little maintenance needed (pump out tank every three to five years). Don't discharge excessive solids to septic tank. Avoid garbage grinders.
- Installation of low flow plumbing fixtures may correct or prevent system failure.
- Groundwater problems possible if too many systems are installed close together or if hazardous chemicals are used.

Drainfield Alternatives

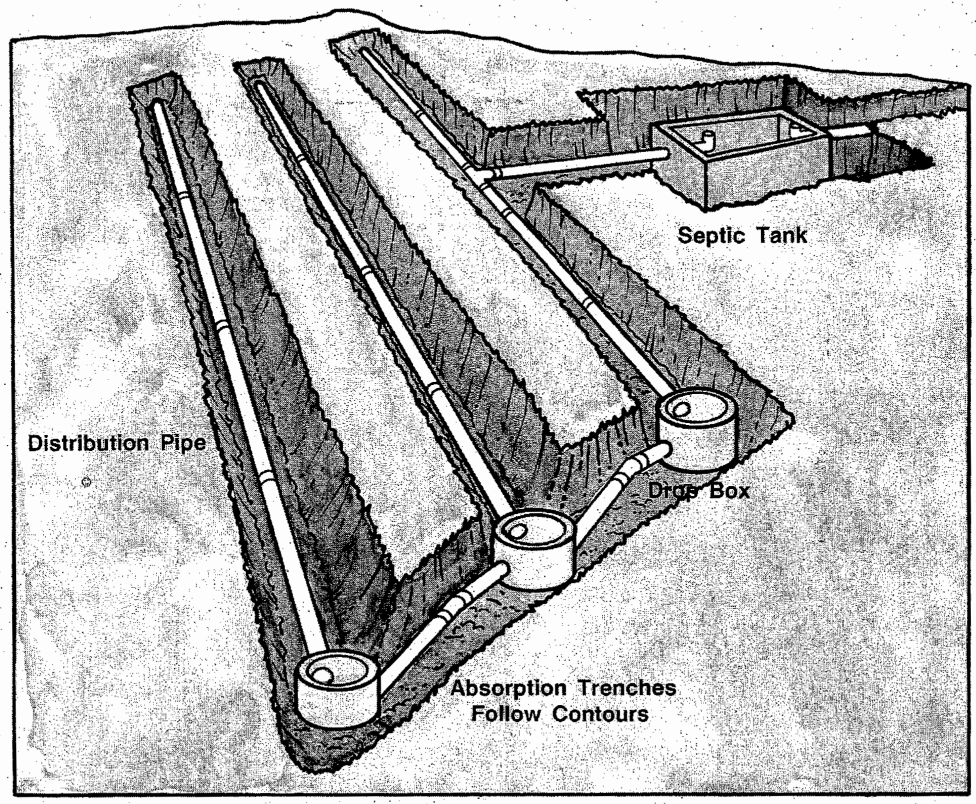
Flow Reduction



- ❑ Reduces the amount of water used in the house.
- ❑ May improve performance of any onsite system.
- ❑ Detection and repair of leaky faucets and toilets should be the first step, followed by installation of low flow showerheads, toilet dams, low flush toilets, and faucet aerators.
- ❑ Efficient toilets (1.5 gal or less), showerheads (1.5 gpm or less), and front–loading washers may cut the volume of wastewater generated by 40 to 70 percent. These items almost always pay for themselves in energy savings alone.
- ❑ With reduced flows toilet wastes (blackwater) may be handled separately from other wastes (graywater).
- ❑ Marginal septic systems may be suitable for treating graywater.

Drainfield Alternatives

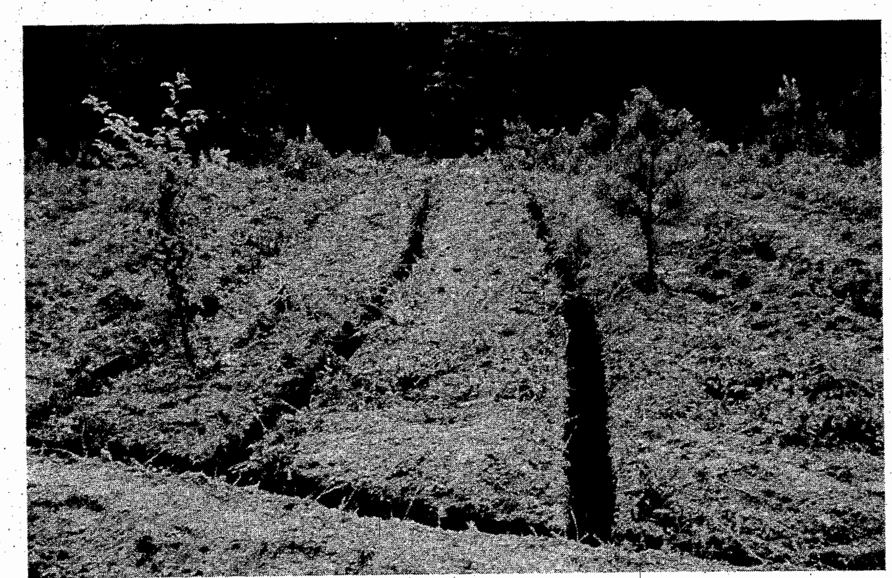
Serial Distribution



- Used on steeply sloping sites. Trenches are installed at different heights, running parallel to land contours.
- Drop boxes allow selective resting of individual trenches.

Drainfield Alternatives

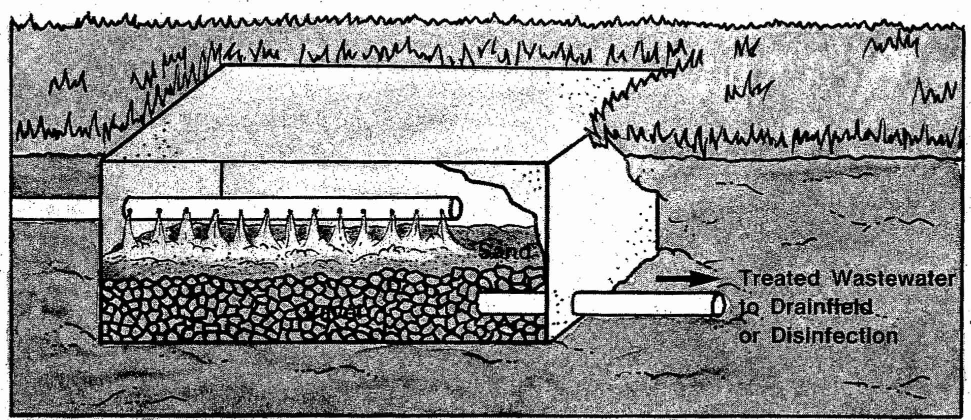
Shallow Trench



- ❑ Used when the soil layer is not deep enough, or the site is heavily wooded.
- ❑ Use thus far limited to warmer climates.
- ❑ Pipes are placed just below the soil surface in the permeable top soil.
- ❑ Low pressure pipe (LPP) version uses a small pump to insure even flow in all trenches.

Drainfield Alternatives

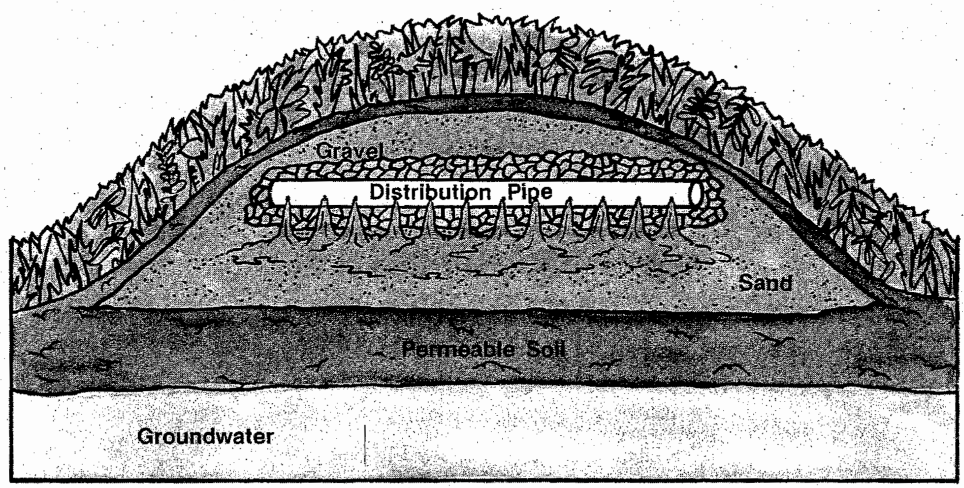
Sand Filters



- ❑ Used when soil is too shallow or too permeable.
- ❑ Bed of sand is built over a drainpipe that collects the wastewater after it has been filtered.
- ❑ Provides high degree of treatment.
- ❑ Treated wastewater goes to a drainfield or to a stream or lake (after disinfection).
- ❑ Two types — intermittent (wastewater travels through filter only once) and recirculating (wastewater goes through filter several times).
- ❑ Periodic maintenance required; may include occasional removal and replacement of top sand layer.

Drainfield Alternatives

Mound System

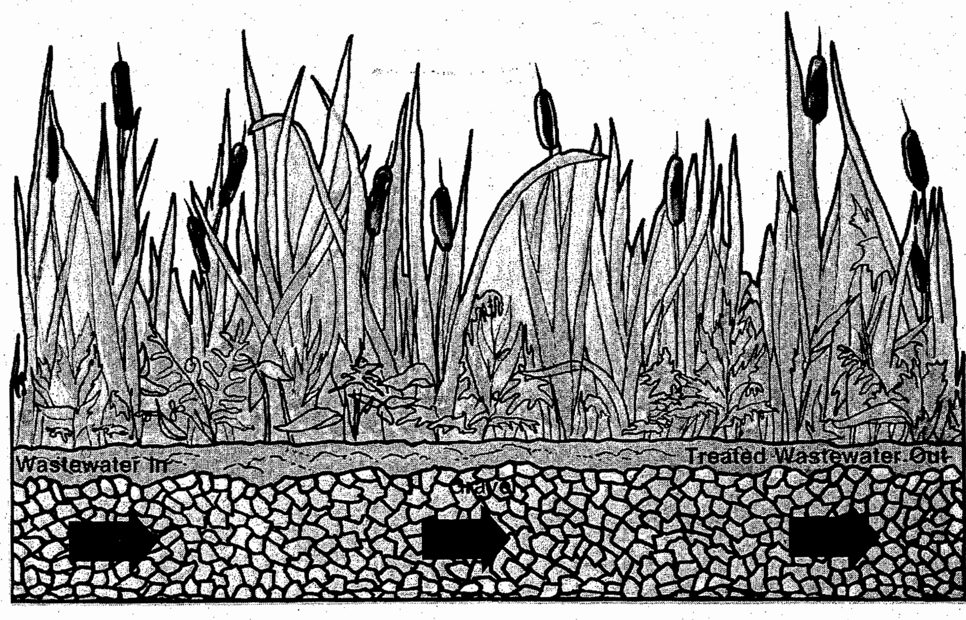


- ❑ Used when soil is too shallow for standard septic system.
- ❑ Septic tank effluent is pumped into drainfield built in mound.
- ❑ Sand fill and gravel are mounded on top of natural soil to filter the septic tank effluent before it reaches the natural soil.

SUMMARY — ONSITE SYSTEMS

Drainfield Alternatives

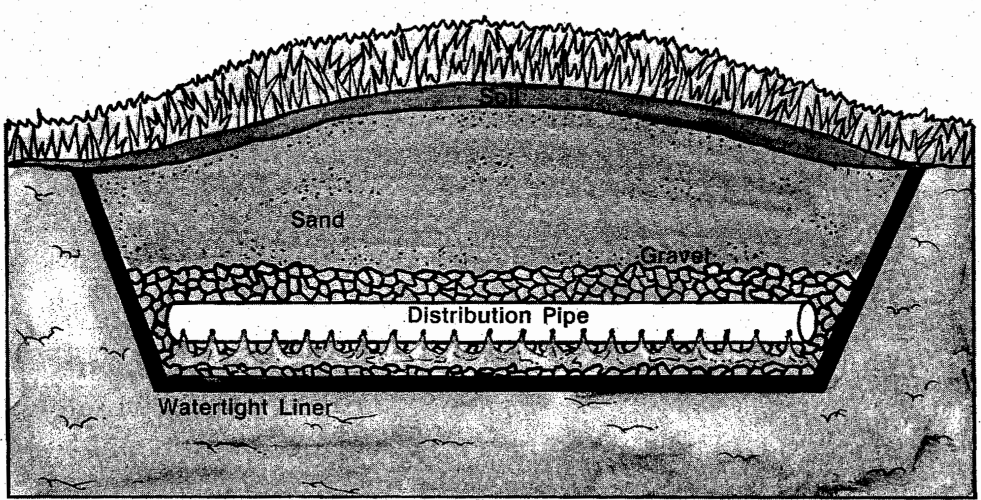
Constructed Wetlands



- ❑ Promising experimental system.
- ❑ Performance in different types of climates not yet proven.
- ❑ Used when soil is not deep enough for standard septic system or when the groundwater level is high.
- ❑ Marsh plants are grown in beds of soil or gravel through which wastewater flows.
- ❑ Low cost system needing minimal attention. Periodically check plants and sometimes harvest at end of growing season.

Drainfield Alternatives

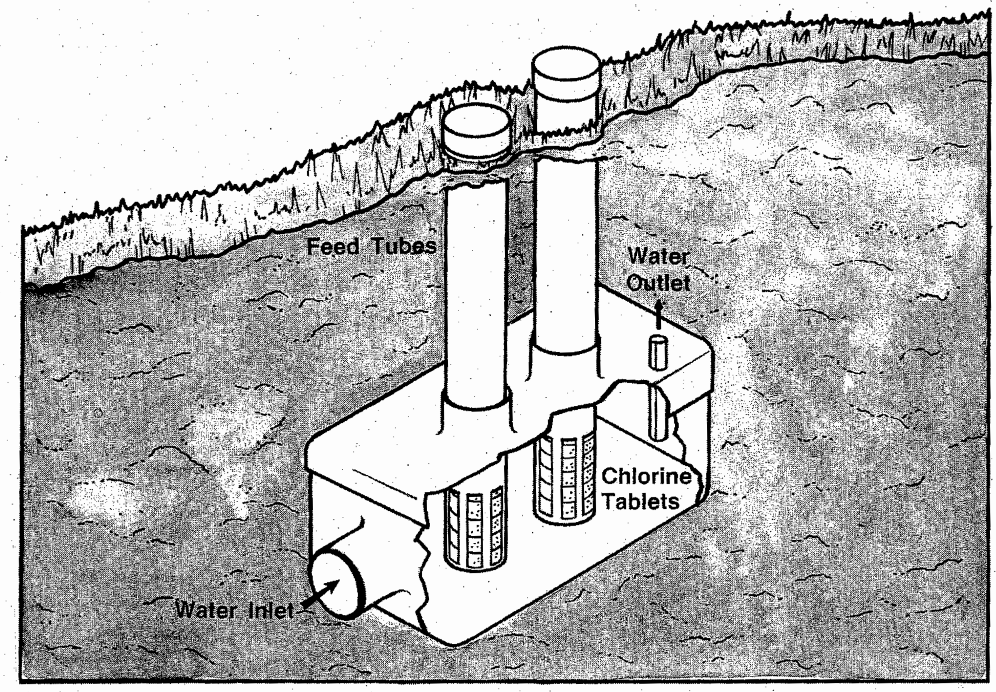
Evapotranspiration



- Used when there are concerns for groundwater quality.
- Plants living in a bed of sand reduce the amount of wastewater through evaporation and transpiration (use by the plants).
- Can only be used in dry climates.

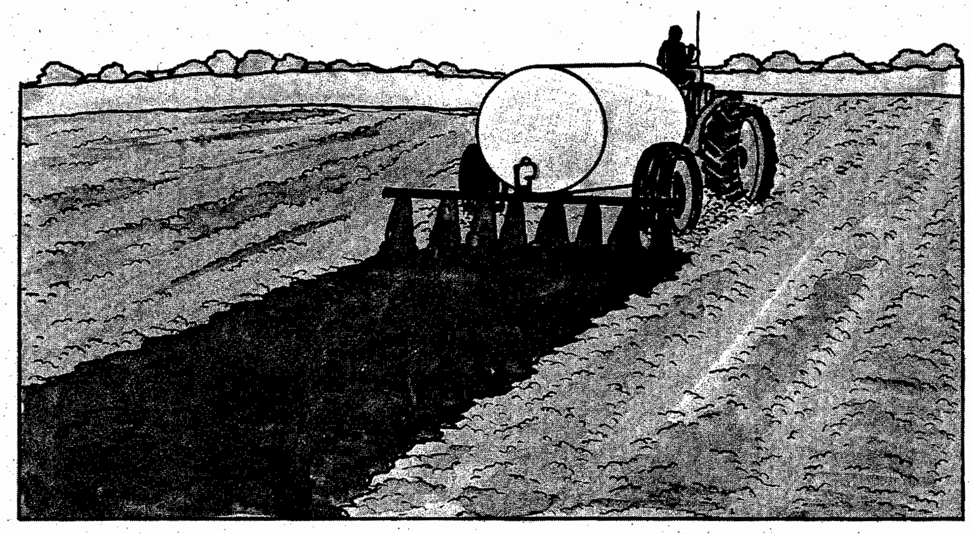
Drainfield Alternatives

Disinfection



- ☐ May be required if wastewater goes to a stream or lake.
- ☐ Chlorine and iodine tablet feed systems are typically used.
- ☐ Routine maintenance and water testing are needed.

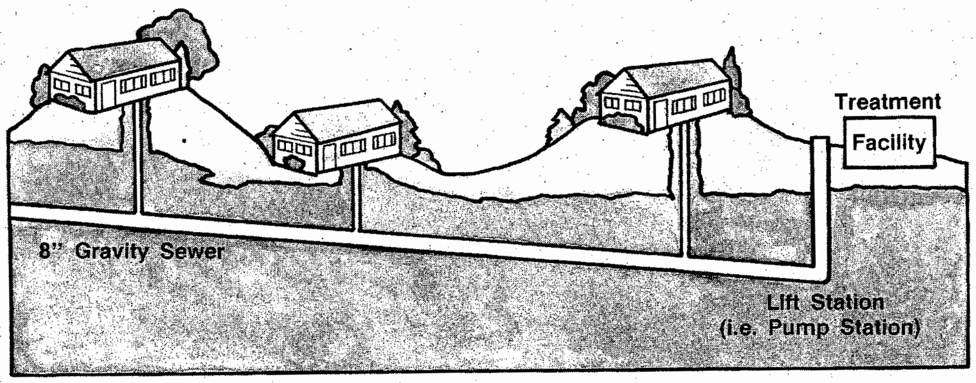
Septage Treatment



- ❑ Septage is the liquid and solid material that is pumped out of septic tanks.
- ❑ Three methods of disposal — direct land application of untreated septage, land application of treated septage, and treatment of septage at a sewage treatment plant.
- ❑ Direct land application of untreated septage is often limited by government regulation intended to control health risks, lack of available sites, and possible odor.
- ❑ Land application of septage treated by adding lime or other methods is common.
- ❑ Treatment in a sewage treatment plant is appropriate if it has enough capacity to handle the septage.

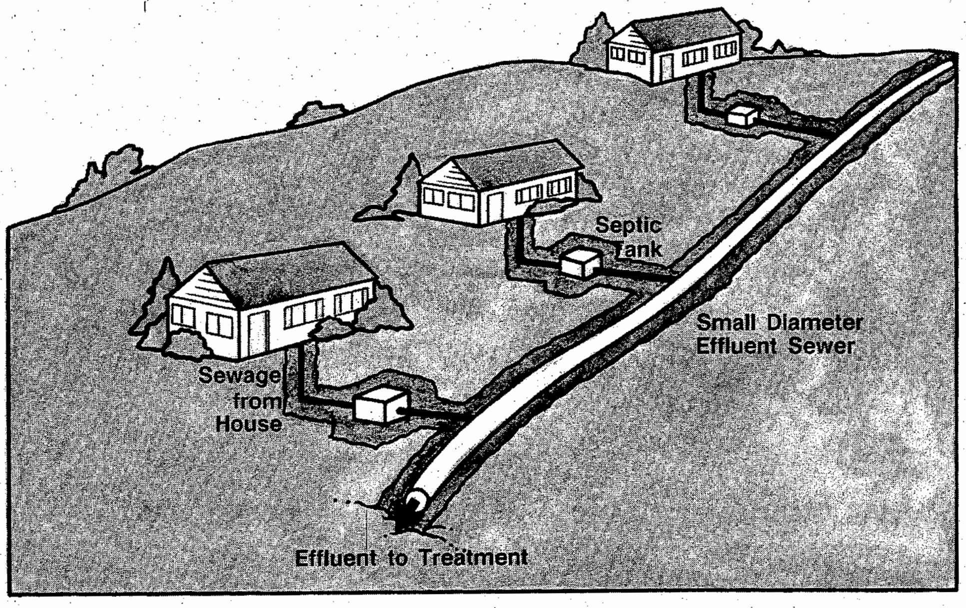
SUMMARY — COLLECTION SYSTEMS

Conventional Gravity Sewers



- ❏ Appropriate in densely developed areas (100 or more homes per mile of sewer; lot sizes 1/2 acre or less).
- ❏ Untreated wastewater travels mainly by gravity through a system of sewers and pumping stations.
- ❏ Difficult and expensive to install; must always slope downhill.
- ❏ Costly manholes are required for maintenance.
- ❏ Infiltration and inflow (leaky sewers) may be significant.
- ❏ Used alone or combined with other collection systems.

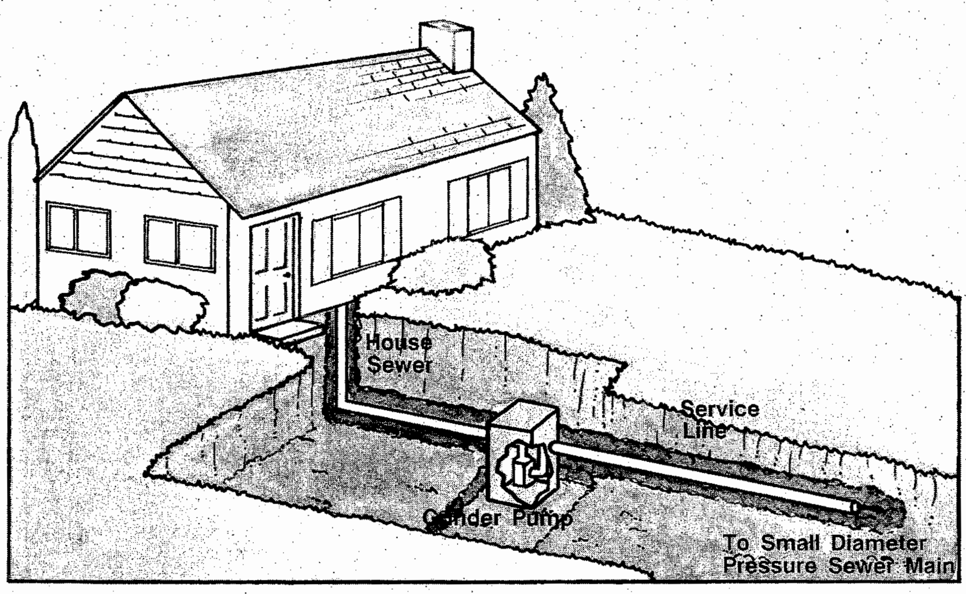
Small Diameter Effluent Sewers



- ❑ Appropriate in less densely developed areas (less than 50 to 100 homes per mile of sewer; lot size 1/2 to two acres).
- ❑ Septic tank effluent (water flowing out of septic tanks) travels through a small diameter plastic pipe. Some homes may require a pump (STEP system) to move the effluent.
- ❑ Installed at shallow depths and may follow land contours; can be "woven" around trees and buildings.
- ❑ Septic tanks remove the solids; sewer clogging is generally not a problem even in low spots.
- ❑ Less costly cleanouts may be used in place of manholes.
- ❑ Smaller and simpler treatment facility can be used.
- ❑ Septic tanks should be pumped out every three to five years.
- ❑ Less possibility of infiltration and inflow.
- ❑ Use alone or combined with other collection systems.

SUMMARY — COLLECTION SYSTEMS

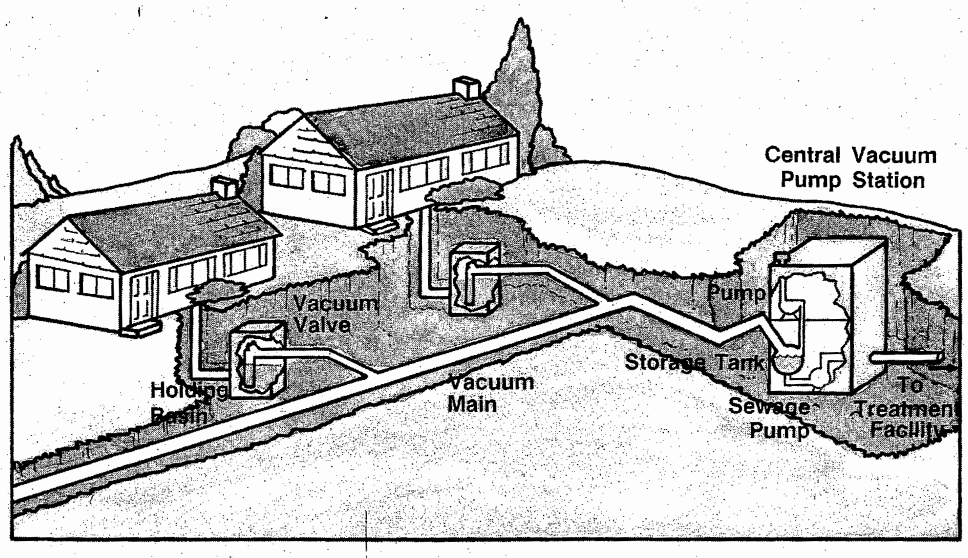
Grinder Pumps



- ❑ Appropriate in same areas as septic tank effluent sewers.
- ❑ Similar to septic tank effluent sewers, except that a grinder pump is used in place of a septic tank.
- ❑ Grinder pumps have built–in cutter mechanisms which grind solids so they don't clog sewers.
- ❑ Operation and maintenance requirements are slightly higher than for septic tank effluent sewers.
- ❑ Power costs $10 to $20 per year.
- ❑ Use alone or combined with other collection systems.

SUMMARY — COLLECTION SYSTEMS

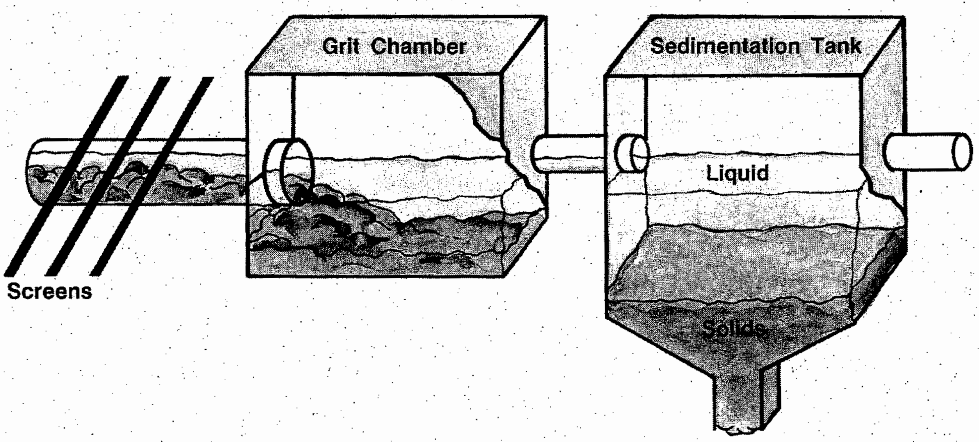
Vacuum Sewers



- ❑ An option in areas that are flat.
- ❑ Convey untreated wastewater by vacuum through a small plastic pipe to a central station. There it is pumped to treatment facility.
- ❑ Each home or group of homes is equipped with a vacuum valve rather than a septic tank or grinder pump.
- ❑ Require careful installation and skilled maintenance.
- ❑ Use alone or combined with other collection systems.

SUMMARY—TREATMENT SYSTEMS

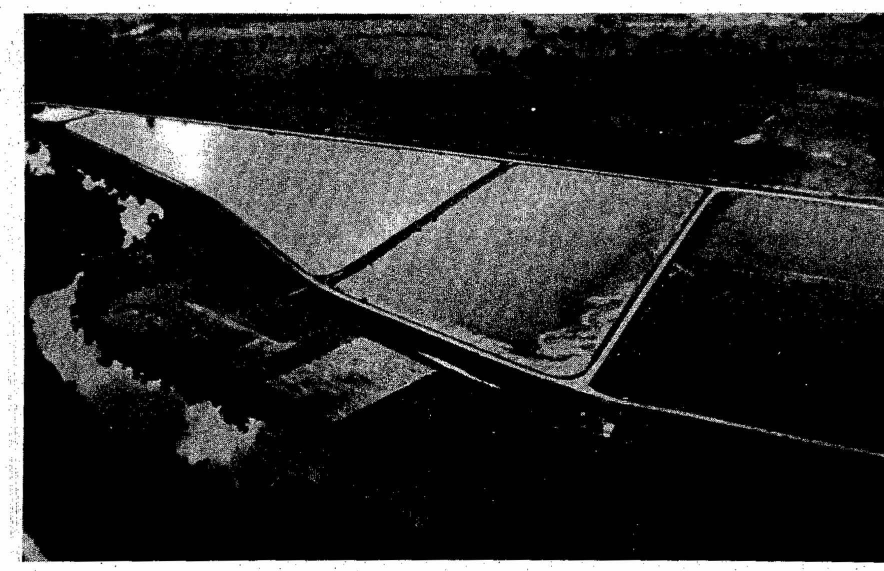
Preliminary And Primary Treatment



- ☐ Preliminary treatment removes large objects that could damage mechanical equipment (screening) and grit which causes excessive wear on pumps (grit removal).
- ☐ Screening is required at most facilities.
- ☐ Local conditions determine the need for grit removal.
- ☐ Primary treatment separates out settleable solids and scum from the wastewater.
- ☐ Primary treatment may not be needed with some systems.
- ☐ Where used, preliminary and primary treatment require daily operator attention.
- ☐ Grit, sludge, and scum will be generated by these processes, and must be treated and disposed of.

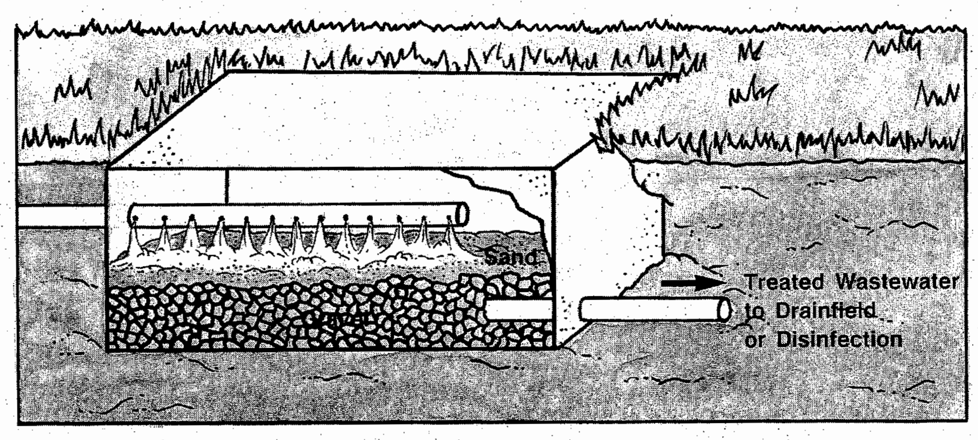
SUMMARY—TREATMENT SYSTEMS

Lagoons



- Low cost and simple treatment method requiring only a part–time maintenance staff.
- Suitable where there aren't strict discharge regulations.
- Primary treatment not generally required.
- May require watertight liners to protect groundwater.
- Some lagoons may qualify for equivalent secondary discharge standards.
- Stabilization ponds are shallow lagoons in which wastewater is treated entirely by natural processes.
- Stabilization ponds require a lot of land, about one acre for every 200 people served.
- Aerated lagoons are similar except that mechanical equipment is used to add additional air to the wastewater.
- Aerated lagoons require only 1/3 to 1/10 the land needed for stabilization ponds.
- Regardless of type, it's best to have several smaller lagoons in series rather than one big one.
- May avoid need for higher level of treatment by controlling lagoon discharge.
- Total containment lagoons never discharge. All wastewater evaporates. Used only in dry climates.
- Controlled release lagoons only discharge when streamflow is high.
- Sludge collects at the bottom of the lagoon and may have to be removed and properly disposed of every five to 10 years.

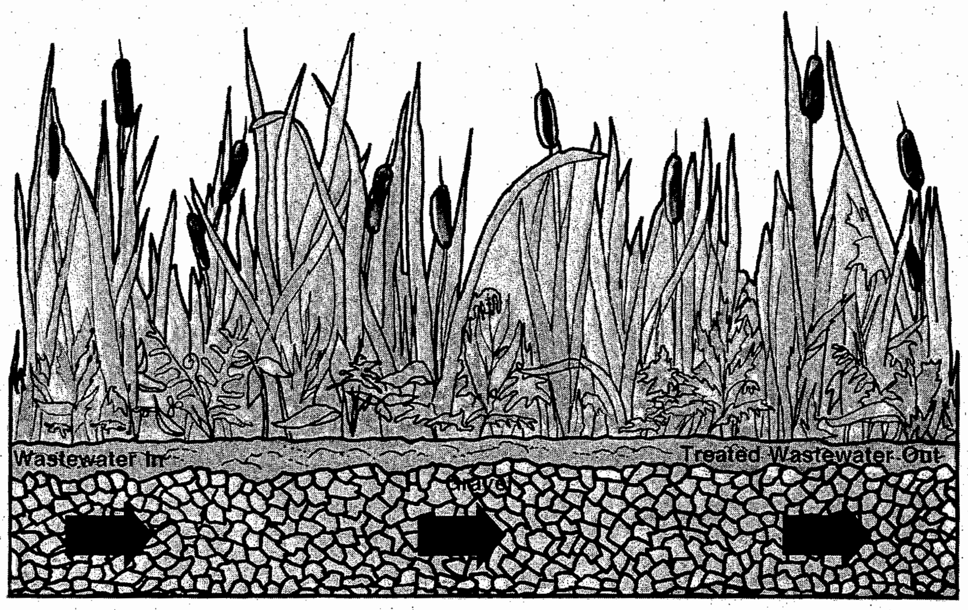
Sand Filters



- ❑ Ideally suited for populations less than 1,000.
- ❑ Consist of beds of sand built over drainpipes that collect the wastewater after it has been filtered.
- ❑ Provide high degree of treatment.
- ❑ Preceded usually by primary treatment or septic tanks.
- ❑ Two types—intermittent (wastewater travels through the filter once) and recirculating (wastewater goes through filter several times).
- ❑ Low cost system requiring minimal operator attention.
- ❑ Need to periodically remove or replace top layer of sand if clogging occurs.

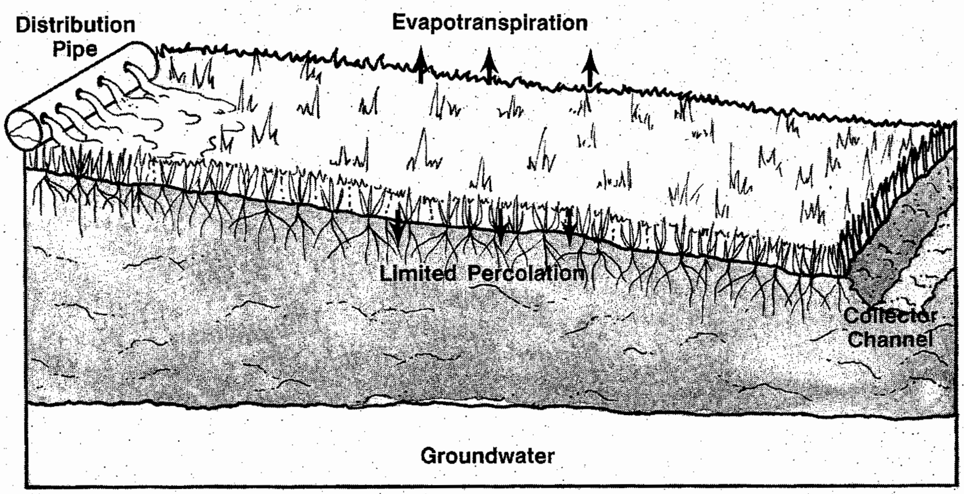
SUMMARY—TREATMENT SYSTEMS

Constructed Wetlands



- ❑ Promising new approach to wastewater treatment.
- ❑ Marsh plants (cattails, reeds, etc.) are grown in beds of soil or gravel through which wastewater flows.
- ❑ Usefull to further treat wastewater from a lagoon.
- ❑ Low cost system needing minimal operator attention. Periodically check plants and sometimes harvest at end of growing season.
- ❑ Relatively low land requirements compared to many land treatment systems.
- ❑ May be operated year-round in most climates.

Overland Flow



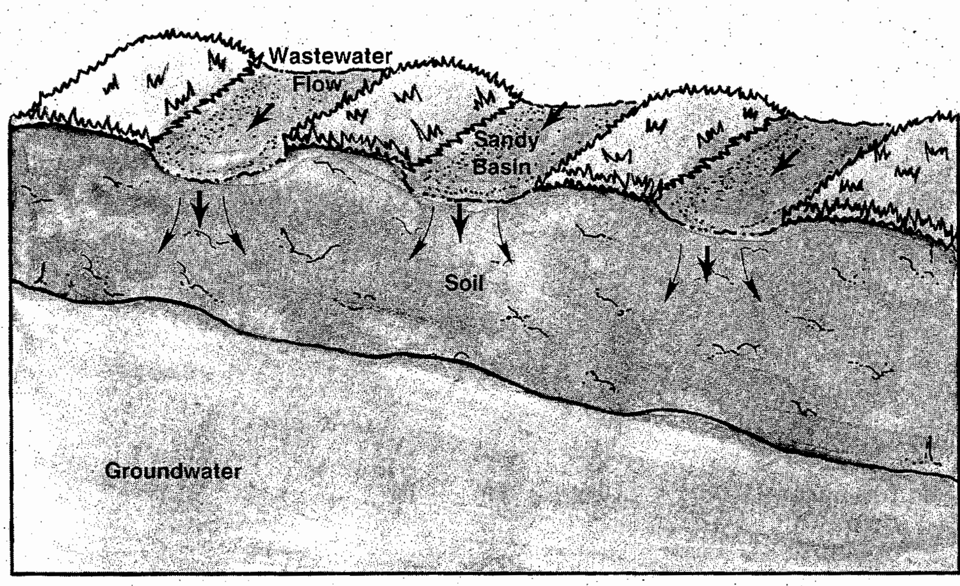
- Well suited for rural areas with large amounts of pasture or meadow land having tight soils.
- Wastewater is applied at the top of a gently sloping grass–covered hill and allowed to flow over the ground surface to the bottom of the hill where it is collected, disinfected, and discharged.
- Useful to further treat wastewater from a lagoon.
- In cold climates a storage lagoon capable of holding flows during nonoperational periods is needed.
- Requires minimal operator attention; periodically mow and remove the grass (may produce marketable hay).

SUMMARY—TREATMENT SYSTEMS

Spray Irrigation

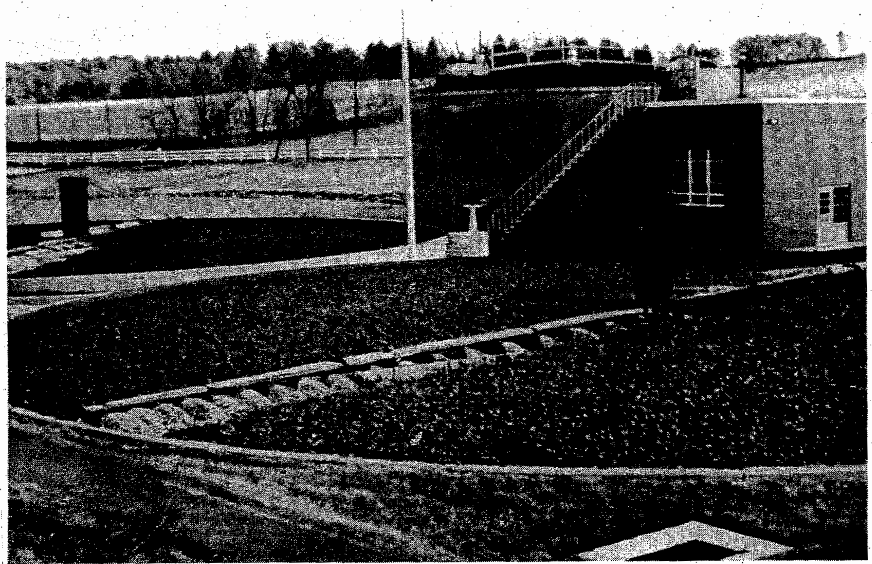
- ❑ Does not generally result in a surface discharge. Particularly appropriate where strict discharge regulations would require a costly facility.
- ❑ Sprinklers apply wastewater to cropland, woodland, golf courses, or other vegetated areas.
- ❑ Can be used with lagoon effluent.
- ❑ Relatively simple operation. Sprinkler system needs regular maintenance, and rate at which wastewater is applied must be adjusted to suit crop needs.

Rapid Infiltration



- ❑ May be appropriate in areas having the right type of deep, well-drained soil.
- ❑ Basins of sandy soils that are very permeable are flooded; wastewater is treated as it travels through the soil.
- ❑ Modest maintenance requirements.
- ❑ Generally follows primary treatment.

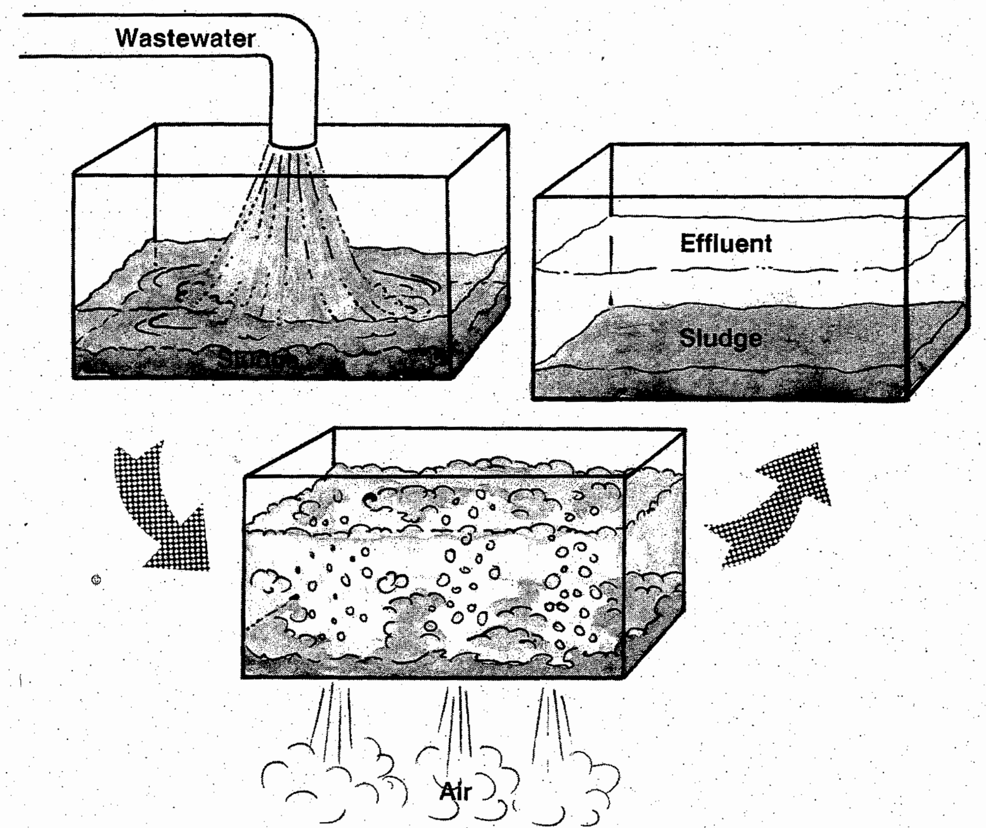
Trickling Filter



- Simple, reliable process appropriate in areas where large tracts of land are not available for a treatment system.
- Made of beds of rock or plastic material.
- Wastewater is distributed over the bed and trickles down through the rock or plastic. A layer of slime that forms on the bed treats the wastewater.
- Requires a separate final settling tank to remove the parts of the slime layer that come off of the bed when the wastewater passes through.
- Follows primary treatment.
- May qualify for equivalent secondary discharge standards.
- Additional treatment may be needed to meet strict discharge standards.
- Generates sludge which must be treated and disposed of.
- May need to be covered in cold climates.
- Regular operator attention needed.

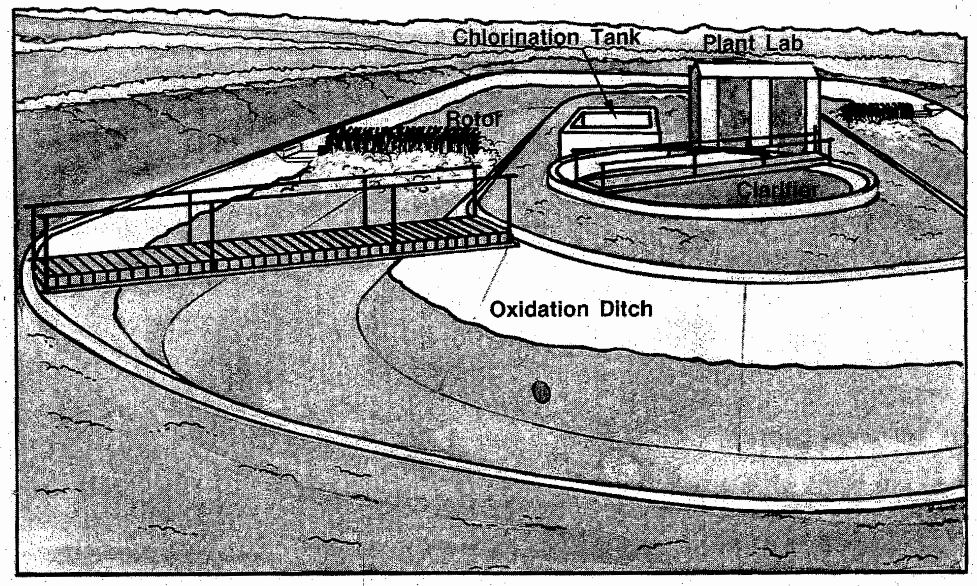
SUMMARY—TREATMENT SYSTEMS

Sequencing Batch Reactors



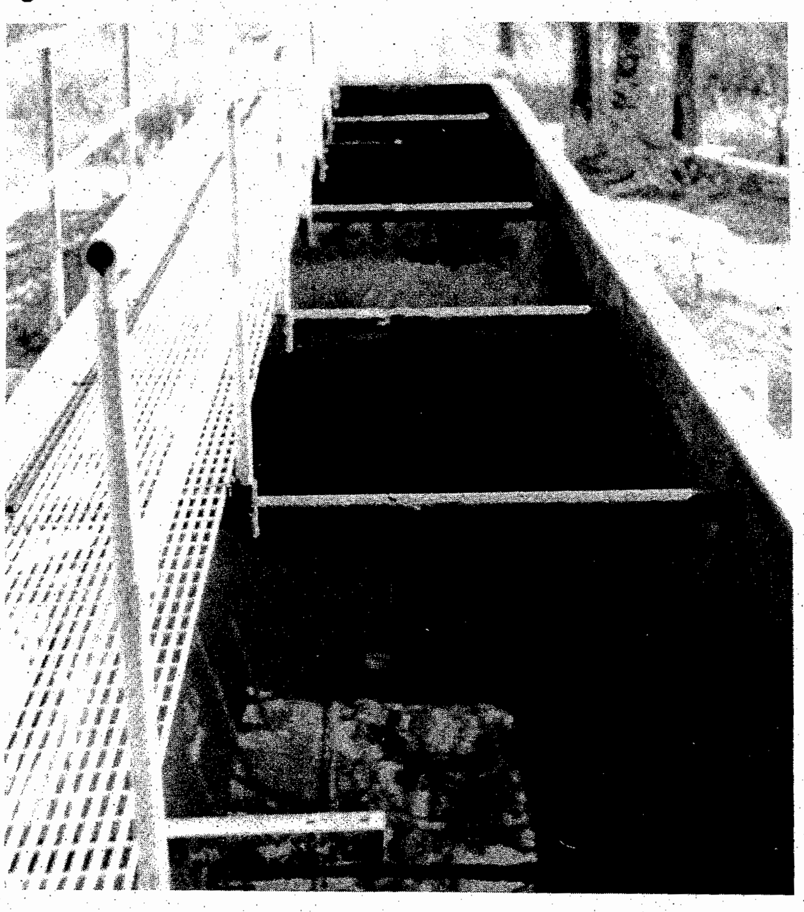
- Computer controlled system appropriate where strict discharge standards apply and where limited land is available.
- A tank is filled with a batch of wastewater and that batch is completely treated. Several tanks are provided so that while one batch is beng treated, the flow can be directed to another tank.
- Sludge is formed. Some of this sludge must be removed at the end of the cycle. Some is left in the tanks to help treat the next batch of wastewater.
- Aeration (adding air) and mixing are required; greater power requirements.
- Primary treatment is generally required.
- Generates sludge that must be treated and disposed of.
- Knowledgeable operator required.
- Extremely flexible system allowing a variety of treatment goals to be met.

Oxidation Ditch



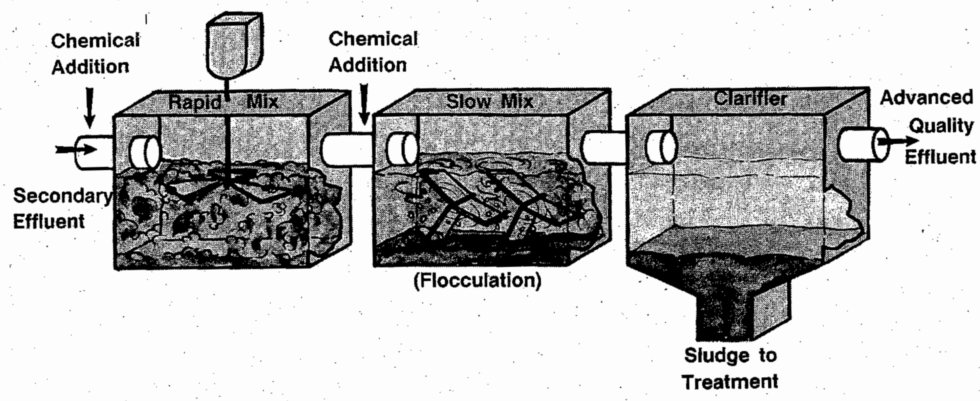
- ❑ Moderately complex system appropriate where strict discharge standards apply and where limited land is available.
- ❑ Wastewater flows through a looped channel where it is treated and sludge is formed.
- ❑ Mixing and aeration are required.
- ❑ Most designs need a separate clarifier to remove sludge.
- ❑ Generates sludge which must be treated and disposed of.
- ❑ Primary treatment usually not provided.
- ❑ Regular operator attention required.
- ❑ Most stable of mechanical treatment systems in all climates.

Package Plants



- Small, prefabricated mechanical treatment facilities.
- May be suitable for flows up to 50,000 gallons per day (approximately 200 homes).
- Generally require close attention of a qualified operator.
- Usually provide secondary treatment performance when properly operated.
- May be subject to operating problems in cold climates and to corrosion.

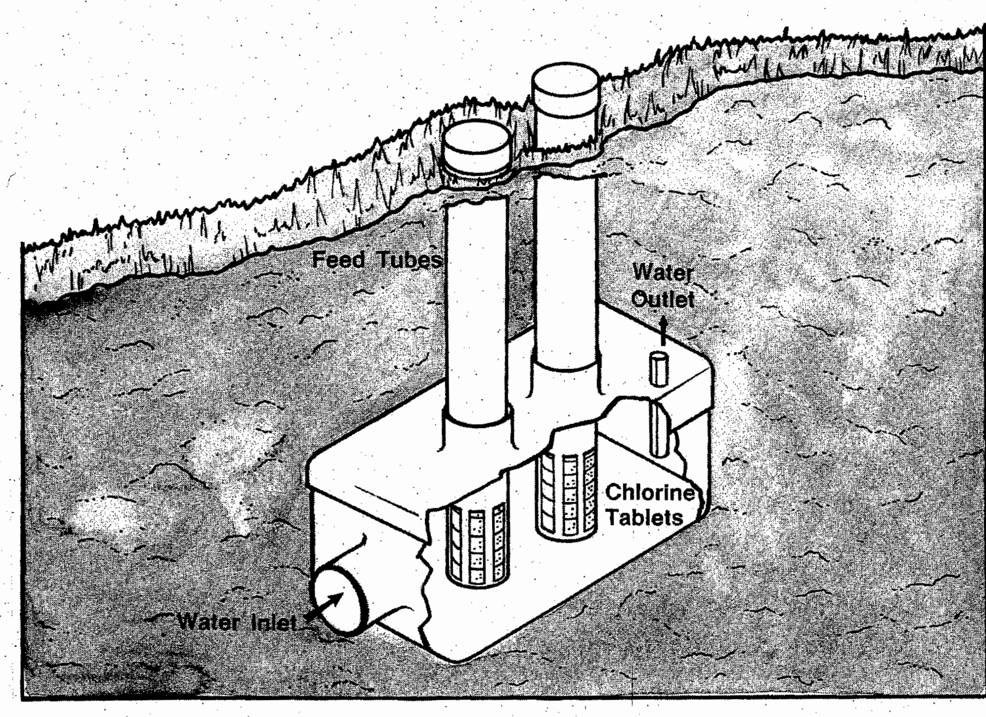
Advanced Treatment



- ❑ Used only where very strict discharge standards exist and land application is not possible.
- ❑ Usually consists of adding additional processes to a well operating treatment system.
- ❑ May involve addition of chemicals or a filtering process.
- ❑ Very expensive; requires substantial operator attention.
- ❑ Generates large amounts of sludge that may be difficult to process.

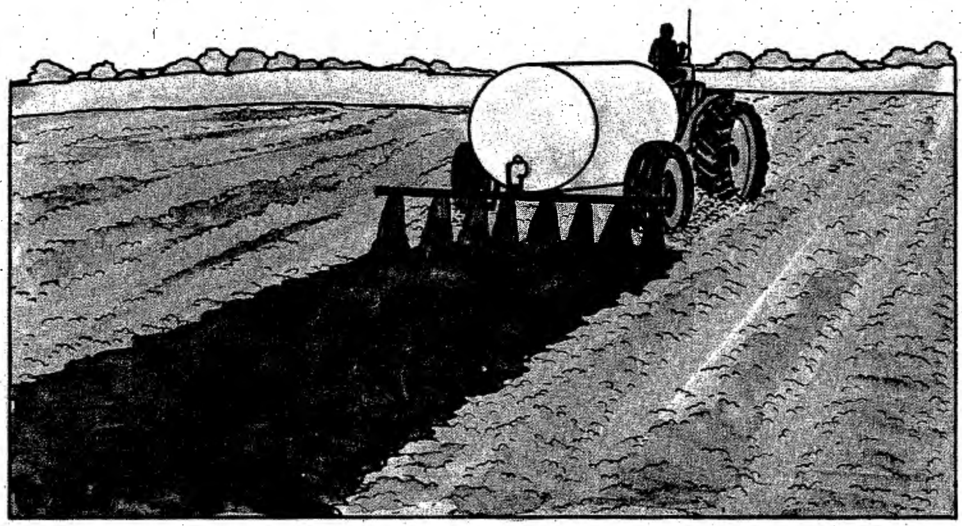
SUMMARY—TREATMENT SYSTEMS

Disinfection



- Generally last treatment step before a surface discharge.
- Goal is the destruction of disease–causing microbes in the wastewater.
- Chlorination is the most common method. However, removal of excess chlorine from wastewater before discharge may be necessary to prevent toxic effects in the receiving waters.
- Ozone is effective and leaves no toxic byproducts. However, it must be generated onsite and is more expensive.
- Ultraviolet light may also be used. Radiation from this type of light kills the microbes. No toxic byproducts result. Requires high quality wastewater feed to unit.
- Requires operator attention.

Sludge Treatment



- May represent 20 to 40 percent of the total operation and maintenance cost of a treatment facility.
- Generally consists of three steps — stabilization, dewatering, and disposal.
- Killing the disease–causing organisms (stabilization) is done by biological processes or by the addition of lime. Also controls odor.
- Removing excess water from the sludge (dewatering) is often accomplished on sand drying beds where water evaporates or drains away. The beds may be enclosed. This can be a land and labor intensive process.
- Vacuum assisted beds use porous plates instead of sand and a vacuum to draw off the water. These systems are more costly to build, but don't need as much land and require less labor.
- Land fill and land application are usually the most popular and least costly disposal options.

Appendix B

Rural Community Assistance Program Network

REGIONAL TECHNICAL SERVICES CENTERS

Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee, Texas

Community Resources Group
2705 Chapman Road
Springdale, AR 72764

Tel. (501) 756-2900

Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington

Rural Community Assistance Corp.
2125 19th Street, Suite 203
Sacramento, CA 95818

Tel. (916) 447-2854

Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont

Rural Housing Improvement, Inc.
Rural Community Assistance Program
218 Central Street, Box 370
Winchendon, MA 01475

Tel. (617) 297-1376

Iowa, Kansas, Kentucky, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wyoming

Midwest Assistance Project
P.O. Box 81
New Prague, MN 56071

Tel. (612) 758-4334

Illinois, Indiana, Michigan, Missouri, Ohio, West Virginia, Wisconsin

WSOS Community Action Commission, Inc.
109 S. Front Street, Box 568
Fremont, OH 43420

Tel. (419) 334-8911

Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia

Virginia Water Project
702 Shenandoah Avenue, NW
P.O. Box 2868
Roanoke, VA 24001

Tel. (703) 345-6781

Appendix C

What to Read Next...

You're probably interested in learning more about some of the things we've discussed in this booklet. A vast amount of information is available.

The National Small Flows Clearinghouse can provide you with an up-to-date list of publications you may be interested in receiving. Write to the Clearinghouse at the following address or call them toll-free:

National Small Flows Clearinghouse
West Virginia University
258 Stewart Street
Morgantown, WV 26506
1-800-624-8301

A few publications in which you may be especially interested are listed below. Contact the Clearinghouse for ordering information.

Financial Capability Guidebook (March, 1984), 80 pp.

Provides local officials with a method for analyzing their community's financial management capability to construct, operate, and maintain proposed wastewater treatment facilities.

Financial Capability Summary Foldout, 7 pp.

A summary of the Financial Capability Guidebook

Touching all the Bases – A Financial Management Handbook for Your Wastewater Project (EPA 430/9-86-001, September, 1986), 98 pp.

Explains how to manage your community's finances during planning and construction of a wastewater treatment system.

Cost Reduction and Self-Help Handbook (August, 1986), 75 pp.

Presents a detailed discussion of how to reduce the operating costs of municipal wastewater facilities.

Reducing the Cost of Operating Municipal Wastewater Facilities, 4 pp.
A summary of ways to reduce operating expenses of wastewater facilities.

User Charge Guidance Manual for Publicly–Owned Treatment Works (EPA 430/9–84–006, June, 1984.)
This document will assist you in understanding the various procedures needed to develop a user charge system and other cost recovery concepts.

Cost–Effective Operation and Maintenance (November, 1986), 14 pp.
Describes various cost–effective operation and maintenance procedures that have been implemented at various wastewater plants to reduce costs while maintaining or improving effluent quality.

Contract Operation and Maintenance (January, 1987), 14 pp.
Discusses the advantages and disadvantages of contracting with a private firm to operate and maintain a wastewater facility.

EPA Technology Foldouts.
A series of brochures providing additional information about some of the collection and treatment systems discussed in this booklet. These brochures are a good place to start if you want to learn more about specific technologies.

Clearinghouse Case Studies.
A series of case studies of small communities which have used some of the collection and treatment systems discussed in this booklet.

Clearinghouse/EPA Videotapes.
A series of videotapes produced for local officials covering various topics including Small Diameter Effluent Sewers, Upgrading Treatment Facilities, Sand Filters, and Planning Treatment Facilities. Videotapes are available in all formats and run for 10–25 mintues.

Clearinghouse Design Modules.
A series of detailed technical papers which discuss the engineering design aspects of many onsite systems and alternative sewers.

EPA Design Manuals.
A series of comprehensive engineering design manuals covering onsite and centralized treatment systems.

Planning Wastewater Management Facilities for Small Communities (EPA 600/8-80-030, August, 1980), 158 pp.

Presents information and techniques for recognizing and evaluating wastewater management problems frequently faced by small communities (10,000 people) and for planning the range of facilities which will solve those problems.

Management of Onsite and Small Community Wastewater Systems (EPA 600/8-82-009, July, 1982), 239 pp.

Provides information and guidance to persons interested in developing and evaluating programs to manage small wastewater systems. These management programs involve the application of various types of institutional arrangements which specify who will design, build, operate, maintain, and finance these small wastewater systems.

The Self-Help Handbook by Jane W. Schautz.

This manual gives specific guidelines and techniques for establishing self-help projects (projects where the community does some of the work itself to save money). Focus is on improving or creating water and wastewater systems in small rural communities. For ordering information, contact:

> Rensselaerville Institute, Rensselaerville, NY 12147
> (518) 797-3783.

These two publications below may help you identify engineering firms that might be interested in working on your project. These publications are not free. Before you buy them, check with your State Water Pollution Control Agency or local professional engineers society. They may be able to provide lists of engineers at no cost.

Directory - Professional Engineers in Private Practice.

Published by the National Society of Professional Engineers. Lists individual members of the Society and the firms they represent (alphabetically, geographically, and by specialty). Contact SPE Order Department, 1420 King Street, Alexandria, VA 22314.

Who's Who in Environmental Engineering.

Published by the American Academy of Environmental Engineers. Contains an alphabetical, geographical, and specialty listing of individual engineers who meet the Academy's Standards. Contact the American Academy of Environmental Engineers, 132 Holiday Court, Suite 206, Annapolis, MD 21401.

EPA