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SMALL SCALE WASTE MANAGEMENT PROJECT

Planning Wastewater Facilities for Small Rural Communities

by

R.J. Otis

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UNIVERSITY OF WISCONSIN - MADISON
College of Agricultrual & Life Sciences
Biological Systems Engineering
Food Research Institute
Soil Science
Environmental Resources Center
College of Engineering
Civil & Environmental Engineering

Copies and a publication list are available at:
Small Scale Waste Management Project, 345 King Hall
University of Wisconsin - Madison, 53706, (608) 265 6595 and at
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PLANNING WASTEWATER FACILITIES FOR SMALL RURAL COMMUNITIES

INTRODUCTION

Wastewater facility planning in small unsewered communities present unique problems to the design engineer. The costs of construction, operation and maintenance of a conventional public facility consisting of gravity sewers and a central treatment plant are greater than most small communities can afford. Rural communities usually have a small commercial district surrounded by scattered housing. This results in higher costs per capita for construction of the wastewater collection system than in more densely developed communities. In addition, economies of scale are lost in construction, operation and maintenance of the treatment works due to the small number of users (Dames and Moore, 1978). In some communities, the costs of the treatment plant alone can be excessive because they are located on small streams with strict effluent standards requiring advanced wastewater treatment processes.

To relieve this financial burden on communities, state and federal financial aid programs provide grants for construction of public wastewater facilities. The grants help to offset the high per capita costs in small communities but, unfortunately, small communities have difficulty in obtaining them. The monies are usually allocated by using a priority system which favors the larger municipalities because a greater cost/benefit ratio is realized.

If state or federal aid is obtained, the local share of construction costs and the costs of operating and maintaining conventional sewerage and treatment often are still excessive. Even with a 75 percent grant, the local share of the construction costs have exceeded $4,000 per dwelling in the Midwest and at least in one case exceeded 2 1/2 times the value of the homes (Krause, et al., 1979).

The Farmer's Home Administration estimates that user charges (debt retirement plus operation and maintenance costs) in excess of 3/4 to 1 1/4 percent of the communities median annual family income will have a significant impact on family budgets. In many rural communities the median income is no more than $10,000. Therefore annual user charges should not exceed $100 to $125 if population displacement is to be prevented and economic growth encouraged. Yet in a review of 89 midwestern communities, actual user charges for a family of four exceeded $100 per year in 65 percent of the communities, $130 per year in 31 percent of the communities, $200 per year in 9 percent of the communities and $300 per year in 5 percent of the communities (Dearth, 1977). Not only are these charges often beyond the users' abilities to pay, but they are frequently difficult to justify by the environmental benefits which result.

The high costs of public wastewater facilities in rural communities are usually the result of applying technologies well adapted to large metropolitan areas. Until recently, most water pollution abatement efforts have been concentrated in large cities and metropolitan areas where a network of gravity collection sewers conveying the wastes to a central treatment plant where the treated wastes are discharged to a surface body of water is the only reasonable facility. However, not only are the costs of collecting the wastewater high from low density populations typically found in rural communities, but the costs of consistently treating the wastes to a level suitable for discharge into the surface water are also high. If the wastewater were not concentrated in one area and other elements of the environment with higher assimulation capacities to accept the wastes were used for disposal, significant savings in wastewater facilities might be realized.

Surface waters need not be the only receiving environment for treated wastewater. Wastewater also may be disposed of onto land or into the atmosphere by a variety of methods. If used properly, these environments can provide higher levels of treatment with much less operator attention and maintenance than treatment works discharging to surface waters but they do have their price. Since natural ecosystems are relied upon, larger land areas are needed than for mechanical treatment works. This price is too much to pay in urban areas where land is a highly sought commodity, but in small communities, land often can be obtained at a reasonable cost.

With the availability of ample land for treatment sites, the number of treatment and disposal options increase dramatically. Several treatment and disposal sites could be located within the community to keep costs of collection to a minimum by decentralizing the facility and treating and disposing of the wastes near where they are generated. This also could reduce treatment costs because the wastes would not be concentrated in one spot but dispersed over larger areas so that the receiving environments could be used more effectively.

The most extreme decentralized wastewater facility is one where each building is served by an individual onsite disposal system. Unfortunately, it is the failure of these systems to function properly which forces most communities into constructing conventional wastewater facilities in the first place. The cause of the failures can usually be traced to poor siting, design, construction and maintenance. Because these systems are located on private property, it has been the individual owners who have been solely responsible for them. The owner seldom has the training or inclination to maintain his system in good order, nor does he often have the incentive to seek someone who does. However, many of these failures can be corrected for a moderate cost and if properly maintained, could eliminate the need for central facilities. Since regular and timely maintenance is a key element to the success of this approach, public management of the systems paid for through user charges would be necessary. Some communities could completely solve their problem by forming a public onsite system management district to rehabilitate and maintain all the individual systems within their jurisdiction at a very reasonable cost.

In many cases, though, the site and soil conditions on each lot preclude the upgrading of the existing onsite systems. Alternatives to the conventional septic tank system could be installed, but they are usually more complex and costly. In such cases, it may be more cost effective to serve a group of homes on a common or "cluster" system. Cluster systems have the advantage of economy of scale as well as the possibility of locating the system on a nearby site with site conditions suitable for a less costly treatment system. Again, public management would be necessary as an integral part of the system.

A mix of individual and cluster systems is probably the more cost effective facility in most unsewered communities. It may be that one larger cluster system is necessary to serve most of the residents while individual systems are used only to serve outlying homes and establishments. Like conventional facilities, however, large cluster systems can require rather extensive collection networks. Since the costs of constructing the collection systems can be a major cost factor, alternatives to conventional sewers may be less costly.

The engineer has many options to reduce the costs of wastewater facilities in rural communities. The fact is, however, that these various alternatives have not been evaluated adequately in most facilities plans. The objectives of this project were to assess why alternative facilities have not been adequately considered and to develop alternative facilities plans for a few rural communities to determine the extent of savings that could be realized. From this, a planning methodology for small communities would be developed.

REVIEW OF COMPLETED FACILITY PLANS

Despite the fact that it is difficult for many small unsewered communities to afford conventional sewerage and treatment, onsite or other lower cost alternative facilities are rarely used. Unsewered communities continue to construct conventional facilities or construct no public facility at all. To determine why these communities are not selecting less costly facilities, facility plans prepared for unsewered communities in Michigan, Minnesota and Wisconsin were reviewed.

The plan reviewing agencies of each of the three states were contacted to obtain facility plans recently submitted for unsewered communities with populations less than 3500. Very few facility plans have been prepared for these communities. This is largely due to the fact that the regulatory agencies have not pressed the smaller communities into abating water pollution problems because the emphasis of abatement efforts has been on the larger municipalities. Of those plans obtained, however, all recommended central treatment by conventional means. Most proposed the use of conventional gravity sewers though pressure sewers were recommended in some cases. None of the plans carefully evaluated the use of onsite systems.

The reason onsite systems were not seriously considered seems to be due largely to the engineers' lack of knowledge of the systems. Onsite systems were eliminated from consideration early in the planning process purely on subjective grounds. Reasons given for their elimination were as follows:

1. Failing onsite systems: The failure of onsite systems was often the reason cited for the need of public sewerage. However, no plans provided detailed survey data to support this claim. If any survey was performed it was usually a windshield survey or based on homeowner complaints. In one plan, as few as 20 percent of the onsite systems were determined to be failing, which was considered sufficient to warrant public sewerage. No attempt was made to determine the cause of failure or whether rehabilitation was possible.

2. Growth: The use of onsite systems was also ruled out in some plans because of the belief that they would limit growth in the community. Changes in zoning to restrict growth in poor soil areas or cluster onsite systems on remote sites with good soils were never considered as a means of providing for reasonable growth.

3. Cost: Without detailing costs, onsite systems were considered too costly. This was based on the belief that subsurface soil absorption fields will fail within a short period of time requiring its replacement. No plan considered public management of onsite systems to insure regular maintenance necessary to prolong the life of the system.

4. Groundwater Contamination: The use of subsurface soil absorption fields for disposal of wastewater may contaminate groundwater supplies under some soil and geologic conditions. A few plans eliminated onsite systems for this reason. In no case was groundwater contamination by existing systems substantiated nor were onsite systems designed to overcome some of these site limitations considered.

5. Restrictive Onsite System Codes: In several cases, code requirements for onsite systems resulted in the elimination of onsite systems from consideration. While justified in some cases, in others variances from the code may have been granted to correct an existing problem without endangering public health, yet this option was not pursued. Also, the use of clustered systems on remote sites or alternative designs were not considered.

In summary it seems onsite systems are not considered to be a viable alternative because they have gained a bad reputation due to improper siting, design, construction and maintenance leading to premature failure. For this reason, alternative designs and cluster soil absorption fields have also been discarded. Yet public management of onsite systems could overcome these problems. Demonstration at public management districts as well as educational programs informing engineers and community leaders of the use, design and performance of onsite systems is needed.

DEVELOPMENT OF ALTERNATIVE FACILITY PLANS

In 1974, the Upper Great Lakes Regional Commission provided a grant to the Small Scale Waste Management Project to demonstrate a more cost-effective solution to water pollution abatement in small communities than the construction of conventional gravity sewers leading to a central treatment plant. The specific objective was to evaluate the use of onsite and cluster treatment and disposal techniques to reduce costs while maintaining reliability similar to conventional facilities.

The unincorporated community of Westboro, Wisconsin agreed to cooperate with the Project in this study. The facility plan prepared indicated that up to a 35 percent savings in user costs could be realized over a conventional facility if small diameter sewers collecting septic tank effluent from each home for treatment and disposal in a common subsurface soil absorption system were used. This plan was accepted by Westboro and constructed in 1977 with financial assistance from Farmers' Home Administration and the State of Wisconsin. The local share of the total costs were a $200 assessment for each connection and an $8 per month user charge. Not only are the costs well below those associated with conventional systems in Midwestern small communities but performance has also been very good (Otis, 1978).

Westboro demonstrates one alternative which is applicable to a number of small communities in the UGLRC area. However, there are many other communities with site and soil characteristics that may preclude the use of such an alternative. To demonstrate other low cost alternatives to conventional wastewater facilities, facility plans were developed for four additional communities with soil and site characteristics differing from those in Westboro.

Description of the Cooperating Communities

The communities that agreed to cooperate with the Project were Maplewood in Door County, Wisconsin, Town of Little Black, Taylor County, Wisconsin, Cornucopia and Herbster in Bayfield County, Wisconsin. Town sanitary districts were formed and consulting engineers hired by each community to perform the facility planning. Facility planning grants were applied for and received from the U.S. Environmental Protection Agency before the planning began. The Project is working directly with each district's engineers in developing the alternative plans.

Maplewood

The community of Maplewood is a small crossroads community of about 150 people. It was first settled in the 1850's as a service center for the surrounding farmers. There are no industrial or manufacturing establishments in Maplewood.

The area is flat with very shallow soils over creviced bedrock. Because of this, most of the septic tank systems in the community are not functioning properly. Some of the private wells have been declared bacteriologically unsafe because the soils are too shallow to adequately treat the septic tank effluent before it reaches the groundwater. This problem has caused a hardship in Maplewood and has limited growth despite the fact that Maplewood is within commuting distance of Sturgeon Bay where the ship building industry is rapidly growing.

Conventional sewerage was proposed for Maplewood but the costs were too high. In 1976, the estimated costs of construction were $7500 per connection. Since the residents could not afford it, nothing was done until the alternative facilities planning was undertaken.

Town of Little Black

The Town of Little Black is an agricultural area lying adjacent to the City of Medford where wood products, cheese packaging and frozen pizza making are the principal industries. Two population concentrations exist in the Town, the hamlet of Little Black consisting of 54 homes and commercial establishments and a small subdivision of 19 homes on the edge of Medford. The remaining population of the town resides primarily on scattered farmsteds.

Septic tank systems are presently used for wastewater disposal by all the residents within the town, but a majority of the systems are discharging septic tank effluent onto the ground surface. The soils are predominantly poorly drained silt loams which are not suited for the installation of conventional septic tank systems.

Because of the scattered housing, conventional sewerage offers no solution to their problem of failing onsite systems. Yet, some alternative is necessary. For this reason, a sanitary district encompassing the entire town was established and an effort made to find an alternative that would serve all of those properties in need of improved services.

Cornucopia and Herbster

Cornucopia and Herbster are two neighboring small communities along the south shore of Lake Superior. On the western fringe of the Apostle Islands National Lakeshore, these communities are set amongst wetlands, sand beaches and wilderness-like forests. They were settled in the early 1900's with fishing and logging their principal sources of income. Though both industries have declined, the communities retain the "charm" of the earlier years which has led to the growth of tourism attracting many summer residents. Non-residents own half or more of the lots in both communities. Hence, large seasonal fluctuations in population exist. Permanent populations are approximately 250 persons in each community.

The Wisconsin Department of Natural Resources had determined that over half of the septic tank systems in both towns were failing and needed correction. The clayey soils of the area, however, preclude the rehabilitation of most of the systems. Conventional sewerage had been proposed but opposed by the residents because of cost ($6000/connection in 1973) and the fear of uncontrolled growth due to the presence of sewers.

Status of Facilities Planning

After several public meetings with each of the community's residents and Project staff to discuss wastewater treatment and disposal alternatives which may be feasible, consulting engineers were selected by each community. The Project staff and engineers agreed to work together to develop the facilities plans.

To defray the costs of planning U.S. EPA facility planning grants were applied for and obtained. However, there was a long delay in receiving the grants which set the Project back. As a result, the plans have not been completed.

Preliminary costs of various alternatives indicate that in nearly every case, the use of onsite systems with public management are resulting in the most cost effective solution. Unfortunately, detailed descriptions and costs are not yet available for inclusion in this report. The results to date, however, show that in the small unsewered community setting, onsite systems should be evaluated in detail before they are eliminated as an alternative.

Procedure for Facilities Planning in Small Communities

A great variety of alternative technologies exist from which to select the most cost effective facility for a small community. A systematic comparison of each combination and permutation would result in the least costly plan but the savings made over a conventional facility might not offset the planning costs. A procedure is needed to arrive at the most appropriate plan without investigating all alternatives. The experience gained in the planning efforts for the four communities studied as part of this project lead to a procedure that might be employed in other communities.

Planning wastewater facilities that will meet water quality and public health goals at a cost small communities can afford requires a proportionately greater effort than is customary for larger communities. Each community can be quite different. No single solution will work for all. In larger communities it is a forgone conclusion that gravity collection sewers will be used with a central treatment plant. Alternative analysis is limited to the site of the treatment plant and the unit processes to be used. However, in small communities, individual onsite systems, clusters and alternative collection systems must be investigated to keep costs down. Maximum use must be made of the existing facilities and the natural resources of the community. This increases the need for detailed field work and public involvement. But it is not practical to evaluate every possible alternative. A systematic procedure should be followed which eliminates alternatives of little potential early in the planning so that field work concentrates only on the most viable. The five step procedure outlined in Figure 1 and discussed here is offered as a guide.

Preliminary Assessment

The objective during this phase is to define the scope of the problem, identify potential sources of needed information and provide a cost estimate for the planning. If grant funds are involved it would also include the application for a facilities planning grant. Since the work done during the preliminary assessment phase is prior to any grant application, it is entirely at the community's or engineer's expense. Therefore, the level of effort should be limited only to that necessary to provide an accurate planning cost estimate.

Needs Survey

The first step the engineer must take is to arrange a meeting with the community officials to discuss the needs and goals of the community and the directions the planning might take. If the community is small with much public interest, it might be valuable to make the meeting public. The engineer should use this meeting as an opportunity to learn the politics of the community and to establish a good working relationship with the client. This is important because if alternative facilities planning is to be effective much more public participation than occurs in conventional planning is required. If the engineer can gain the confidence of the residents early in the project, the planning will go much more smoothly.

One issue which should be discussed in this meeting is why the facility is needed. Usually the planning is initiated in response to orders from the Department of Natural Resources because failing onsite disposal systems are impairing the water quality of the area. However, the community may desire a wastewater facility for community improvement. The residents may recognize a

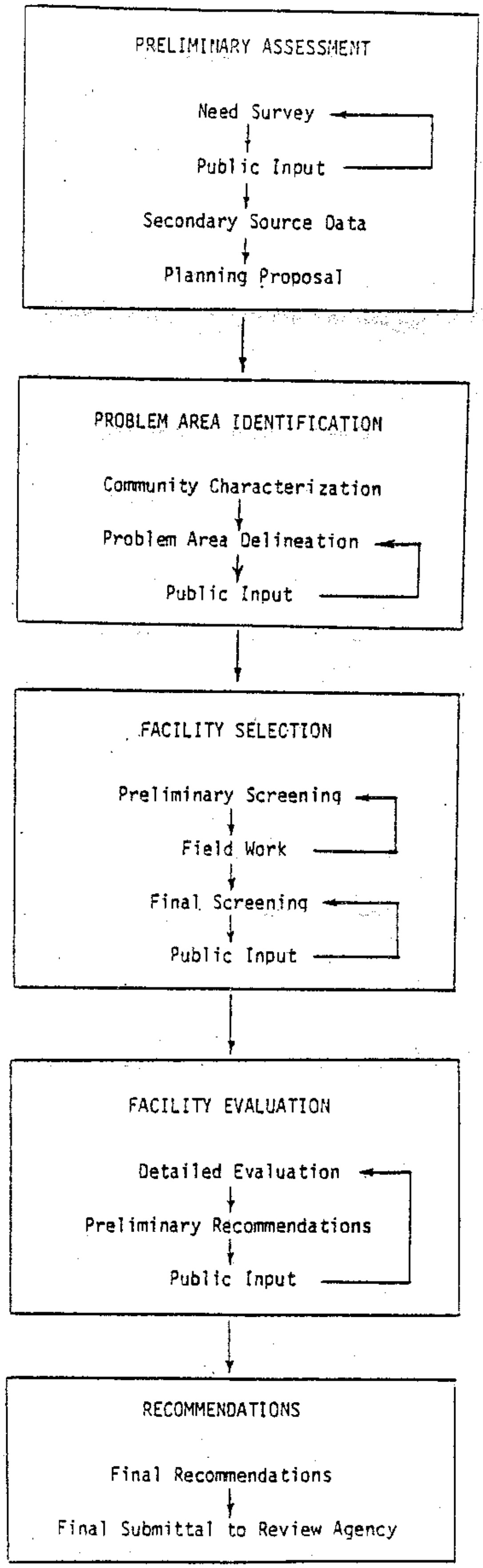

Figure 1. Wastewater Facilities Planning Procedure for Small Unsewered Communities

water quality or public health problem which needs correcting or they may wish to encourage development. If community improvement is the reason behind the desire for a facility, the community should be made aware that federal or state grant funds will not be available to them unless they can document that there is a water quality or public health problem which could be corrected by the construction of a wastewater facility. A sampling program may be necessary to provide documentation but often the county zoning administrator or sanitarian is familiar with the problem and can supply the necessary verification without sampling. If sampling is necessary the community should realize it will be at their expense.

The process of wastewater facilities planning and the direction it might take should also be discussed. In most cases, the residents assume that they have no choice but to construct a conventional facility of gravity sewers with a central treatment plant. Other options should be described to them such as individual systems under public management and scattered cluster systems. These types of facilities may reduce the costs substantially because they can be used to correct only the existing problems. Some residents may prefer a conventional facility because they feel it is the most reliable and only permanent solution. If they are growth minded. they also see conventional sewers as a means of encouraging development within the community. While this may be true for some, others may oppose conventional facilities because of the cost or because they prefer to discourage growth. They may feel they should not share in the cost of developing new areas for someone else's profit. These attitudes must come to the attention of the engineer so that the best facility can be planned for the community.

Secondary Source Data Collection

To develop a good alternative plan, it is necessary for the engineer to gain a good understanding of the soils, geology, topography and the existing wastewater disposal systems in the community. It can be costly for the engineer to collect this data. Fortunately, however, much of the needed information may be available from other sources. Therefore, before a cost estimate is made for the planning work, a check should be made of the availability of data which would reduce the field work.

The following sources of information should be checked:

- Census Data

  Regional planning agency
  National census

- Area-wide Water Resources Planning

  Department of Natural Resources
  Regional planning agency

- Water quality and effluent standards

  Department of Natural Resources

- Soils description

  Local farmers

Wisconsin Geologic and Natural History Survey

Detailed soil surveys may be published for the county including soil maps at a scale of 1:15,840

Soil and Water Conservation District Office/Soil Conservation Service

If a soil survey is not yet published for a county, check with SCS to learn if the mapping is in progress. Field work sheets may be available.

Wisconsin Geologic and Natural History Survey

USGS Quadrangle maps can be used to establish the regional water table elevation

- Geology

  Wisconsin Geology and Natural History Survey

- Topography

  Department of Transportation

  Aerial stereo photographs may be available for the area if a state or federal highway passes near the community

  Wisconsin Geologic and Natural History Survey

  USGS Quadrangle maps

- Land Use

  County Zoning Administrator

  Plat maps

  County Register of Deeds

  Plat maps

- Existing Onsite Disposal Systems

  County Sanitarian
  County Zoning Administrator

Cost Estimation for Planning Proposal

The engineer and community must realize that alternative facilities planning takes considerably more effort than planning for conventional facilities because of the need for detailed information about the community. Field work and public participation beyond that which is customary is usually required. However, if successful, the additional costs are insignificant in comparison to the savings made in construction of the facilities and their operation and maintenance.

Based on the limited information the engineer is able to collect during this preliminary assessment, it is difficult to estimate accurately the amount of effort which will be required to develop a good facilities plan. Sufficient information should have been gathered though to make a judgement as to what information is needed and how much is available in adequate detail from the secondary sources. What is not presently available will have to be collected by the engineer. The collection of data through field work and meetings may become a substantial portion of the total planning costs. It must be included to do an adequate job of planning.

Problem Area Identification

The objective of this phase of the planning is to identify those areas within the community where new or improved wastewater facilities are needed. It is in these areas where the planning efforts are concentrated. Areas where the existing onsite systems can be expected to perform adequately over the planning period with proper maintenance are not considered at this point. This determination requires that the potential of the existing onsite systems be evaluated.

Community Characterization

Since evaluation of existing septic tank systems is a difficult and time consuming task, it is desirable to eliminate from consideration those systems which are incompatible with the desired growth and development plan or have little hope of functioning adequately over the planning period. This requires that the engineer have a clear understanding of how the community wishes to develop and a good knowledge of the soil and site conditions which effect septic tank system performance.

Growth and Development

Information concerning the growth and development of the community is gathered from local planning agencies and the community officials. Questions which must be answered are:

- What is the current and projected population?
- What are the significant growth determinants and how are they expected to change? Will construction of a public wastewater facility result in an increased rate of growth? What is the employment outlook in the surrounding area?
- What is the pattern of development in terms of location, density and character? Is this pattern determined by soil and site suitability for septic tank systems? What changes would the community like to see in this pattern?
- What land remains undeveloped? Does it remain undeveloped because of the lack of wastewater facilities?

Once the information is gathered, it is useful to display it on a plat map. Existing and expected future development is shown.

Soil and Site Suitability for Soil Absorption Systems

Information regarding the soil types and their suitability for soil abosrption systems for all areas in and around the community must be obtained. A detailed soil survey may have been completed for the area which can be obtained from the Wisconsin Geologic and Natural History Survey. If it is not published, field sheets or other useful information may be available from the District Soil and Water Conservation Office, the County Zoning Administrator or County Sanitarian. Also, the County Zoning Administrator or Sanitarian may be a source of information concerning soil tests made in the area. Some cursory soil sampling by the engineer may be desirable. Whatever information is obtained is plotted on the same map used to show present and future development of the community. Topography and any significant geologic features which may restrict the use of soil absorption systems also should be noted.

Evaluation of Existing Onsite Systems

Before beginning a survey of existing septic tank systems, areas within the community where individual septic tank systems definitely are not a suitable alternative must be delineated. Areas may be unsuitable because of lot size, density, planned development, etc. Collection of the wastewater is required in these areas so evaluation of the existing systems is not necessary. Care should be used not to eliminate areas on the basis of the soil maps alone, however, unless other information such as soil borings or local knowledge is obtained to confirm the map's accuracy.

The developed lots are studied first. Are the soil and site conditions suitable for soil absorption of wastewater on each lot with the current development pattern? Would onsite systems still be suitable under the desired development pattern? In cases where insufficient information is available to make this determination, suitable conditions are assumed to exist at this point.

Next, a similar determination must be made for the undeveloped lots. Other considerations enter into this determination, however. Does the community wish to promote development on these lots? If not, no further consideration is necessary. If development is desired but the soil and site conditions are unsuitable for subsurface soil absorption, can the lots be replatted or rezoned such that each lot becomes suitable? If this cannot be done, is the community willing to invest in future development by providing a collection system to serve the unsuitable lots? If the community wishes to make this investment then onsite systems can be eliminated from further consideration in favor of cluster systems. However, it would be wise for the engineer to evaluate both alternatives because there may be a significant cost savings of which the community residents are unaware.

An evaluation of the existing systems is performed only in those areas where individual septic tank systems seem to be feasible. Incorporating these systems into the proposed public facility may reduce the costs of the facility substantially. Therefore, it is necessary to determine if the existing systems are sound and can be expected to perform adequately with regular maintenance over the planning period. If systems are found to be functioning poorly, the cause of the problem must be determined to ascertain whether rehabilitation or reconstruction is possible.

The first step in the evaluation is a quick survey to locate any areas where the majority of the systems seems to be failing. Residents and the county zoning administrator or sanitarian are helpful in this step. More than likely, it is less costly to provide a common system in such areas rather than rejuvenating or rebuilding the individual systems because of economies of scale. If so, these areas can also be excluded from detailed evaluation.

The septic tank systems in the remaining areas should be investigated in detail. The County Zoning Administrator or Sanitarian should be consulted for any sanitary permit applications that may be on file for systems recently reconstructed in the area. The applications provide soil test data and a sketch of the system installed. In addition, a door to door survey is performed to gain as much information as is possible. The survey should include an interview with the homeowner and a visual inspection of the system. The questionnaire in Appendix A can be used as a guide. It is recommended that this survey be performed by residents of the community rather than outsiders who may not be trusted. If residents are hired to perform this survey, however, they must be trained as to how a septic tank system functions and the causes of failure. The information collected should be sufficient to determine how the system can be rehabilitated if necessary (see Appendix B).

Designation of Problem Areas

With the information gathered at this point, those areas where new or improved facilities are needed are delineated on the plat map. A distinction should be made between those areas where off lot disposal is the only alternative and those areas where individual onsite systems may be feasible if the existing systems can be rehabilitated. It is beneficial to hold a public meeting at this point to invite comments on the delineated areas to confirm the designations and to make appropriate changes. These then become the areas in which the engineer will concentrate efforts in developing the facility plan.

Facility Selection

Once the areas in the community which are in need of improved or new wastewater facilities are identified, the next step is to select viable facility designs for detailed evaluation. Because of the large number of alternative technologies which are available, selection of the most appropriate facility can be a time consuming process unless a systematic procedure is followed. To be effective, this procedure must be able to eliminate the alternatives with the least potential based on the limited information gathered in the previous two steps. This reduces the additional field work to that necessary to select between only the most promising options.

A recommended procedure is presented in Figure 2. Each node in the diagram represents a point where a specific decision must be made to choose the best path to the next node (see Table 1). To develop this procedure, some simplifying assumptions were made.

- Where no restrictions exist, subsurface soil absorption of septic tank effluent is the least expensive alternative.
- Maximizing the use of existing septic tank systems minimizes the total costs.
- Cluster soil absorption fields are less costly than individual fields where new construction or reconstruction is necessary for a number of lots unless collection costs are excessive because of economies of scale.

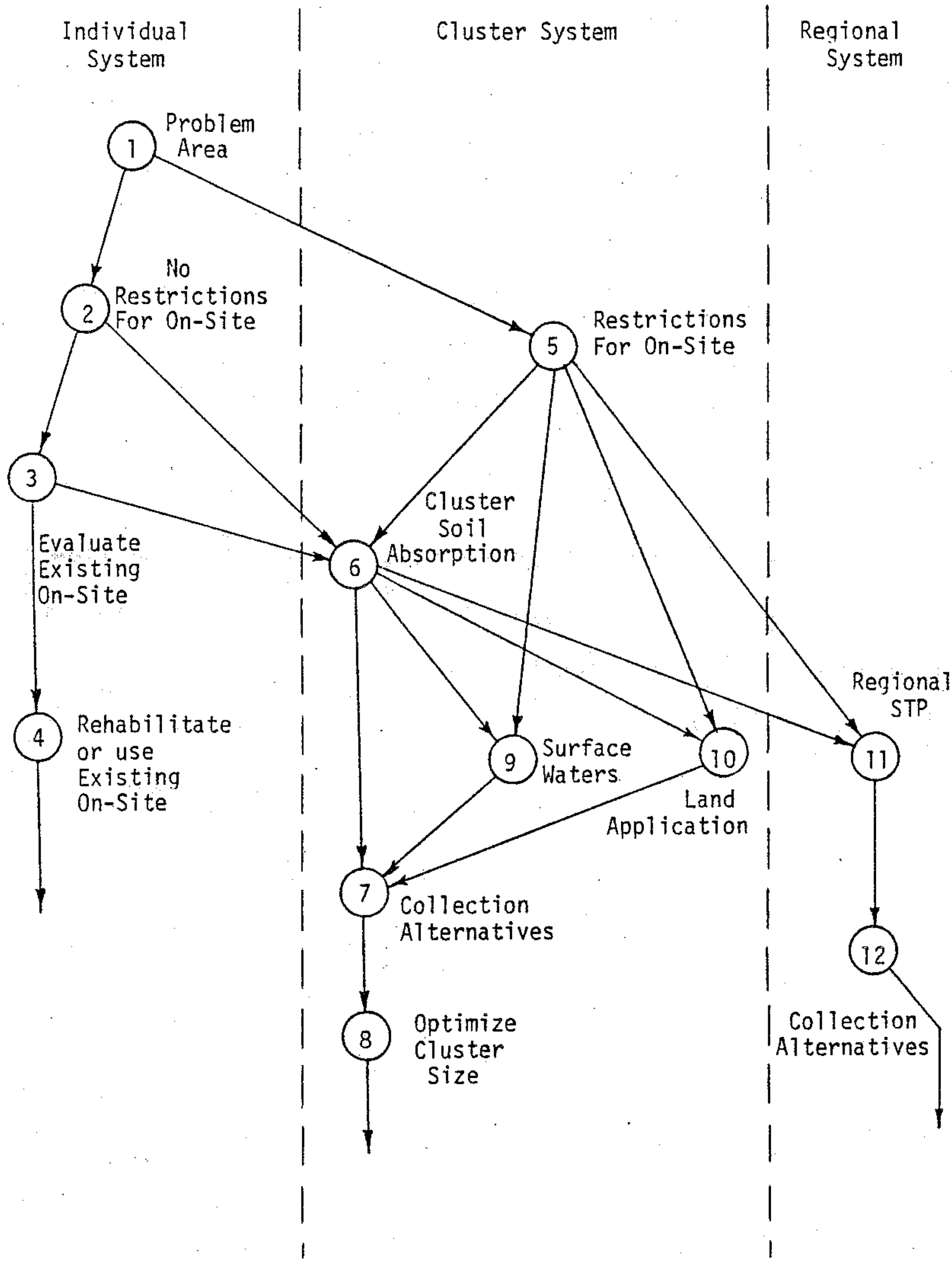

Figure 2. Facility Selection Procedure

NODE	DECISION	ACTION
1	Do the developed lots have soil and site characteristics suitable for onsite subsurface soil absorption?	Yes - Proceed to Node 2 No - Proceed to Node 5
2	Do the undeveloped lots have soil and site characteristics suitable for onsite subsurface disposal? (If not, can the area be replatted to make each lot suitable?)	Yes - Proceed to Node 3 No - Proceed to Node 6
3	Are the existing onsite systems functioning properly? (If not, can they be rehabilitated easily?)	Yes - Proceed to Node 4 No - Proceed to Node 6
4		Determine costs of rehabilitation
5	Is a suitable area available for a cluster soil absorption system within a reasonable distance?	Yes - Proceed to Node 6 No - Proceed to Nodes 9, 10, 11
6	Does it appear collection costs will not be excessive?	Yes - Proceed to Node 7 No - Proceed to Nodes 9, 10 11
7		Layout collection options and proceed to Node 8
8		Compare costs of various cluster sizes
9		Design low maintenance treatment works to meet water quality standards
10		Design low maintenance land application system to meet local design requirements
11		Investigate feasibility and local cost share of conveying wastes to a regional treatment plant
12		Layout collection options

Table 1. Facility Selection Decisions Corresponding to Figure 2.

This procedure is used to select the most cost effective facility for each designated problem area. This is done in an attempt to keep the costs of constructing collection sewers to a minimum. Once this is completed, problem areas can be grouped together on a larger common system in an attempt to reduce the total community costs. In this analysis, economies of scale are investigated to determine if the cost reductions in the treatment and disposal facility will offset the increased costs of collecting the wastes from more than one problem area. Costs of operation, maintenance and monitoring must be included in this analysis.

Preliminary Screening

In this step all disposal options within the community should be identified. Areas which appear to have soils suitable for subsurface or surface application should be noted and standards that a treated wastewater effluent must meet to discharge into the local streams or marshes are established. The former are obtained from soil maps or information from the residents of the area, while the latter must be obtained from the Department of Natural Resources.

At this point, the field work necessary to select an appropriate facility for each problem area can be planned. This should include the following:

- Building locations and foundation elevations
- Street elevations
- Septic tank locations
- Evaluation of selected areas for cluster soil absorption systems

This information is necessary to lay out the least costly collection system. It should be collected even if it appears the existing onsite systems can be utilized. It may be that if the systems require substantial rehabilitation, it will be less costly to construct a common disposal field.

Once the information is displayed on maps of the community, selection of wastewater facilities for each problem area begins. The areas that are considered first are those where rehabilitation of the existing systems may be possible. Rehabilitation techniques are outlined in Appendix B. If substantial rehabilitation is required for a number of buildings and a suitable area for a cluster soil absorption system exists within the area, then rehabilitation should be abandoned in favor of the cluster system. Where a suitable cluster area exists some distance away but it is not obvious that clustering would be more cost effective, both alternatives should be evaluated.

After this decision has been made for the areas where rehabilitation is considered, disposal options are considered for the other problem areas. Soil absorption is the first choice because of the low operation and maintenance costs. Other disposal methods are investigated when no suitable site for a cluster soil absorption field is found. These methods include surface water discharge, land application and transport to a regional treatment plant. In selecting these facilities, the emphasis is put on processes with low operation and maintenance costs.

Once the treatment and disposal facilities are selected for each problem area, collection alternatives are investigated. Though it may be less costly to combine one or more problem areas together on a common treatment and disposal facility, at this point the collection system for each cluster should be laid out separately. The end result should be the most cost effective facility for each problem area.

Final Selection

In this step, further savings are sought by combining clusters together for common treatment and disposal. If the cost of providing collection facilities between two clusters is less than either of the two treatment facilities, then combining the two clusters should be seriously considered. However, the consequences of constructing extended collection lines must be evaluated in terms of any additional connections that may affect the size of the treatment and disposal facilities. If the extensions pass through areas which the residents do not wish development, the engineer should present them with both alternatives.

When the initial facilities selection is complete, a public meeting is held to present the various courses of action which the community may take. All options considered, the impacts of each and their relative costs are fully explained by the engineer. The comments made at this meeting are used by the engineer to select the most desirable alternative facilities for detailed evaluation.

Facility Evaluation

In this phase of the planning, the engineer concentrates on estimating detailed costs for the various alternatives the community finds acceptable. These estimates include costs for construction, operation, maintenance and monitoring used to develop the total present worth of each alternative. In this form, the alternatives can be compared to determine the most cost effective plan. However, the most cost effective alternative may not be the least costly for the community residents. Federal and State funding programs only provide grants and loans for the construction of the facilities. Operation, maintenance and monitoring costs which are reoccurring and ever-increasing must be borne by the residents. Therefore, the costs for each alternative must be broken down to show the probable local share based on the various funding programs available and how this local share might be generated through assessment and user charges.

At this point, the final public meeting is held to present the engineer's recommendation. Since the costs to each resident is the primary concern, the engineer must know the probability of the community receiving various grants so the residents can make an informed decision whether to proceed. It may be that the engineer will be asked to re-evaluate some options.

Recommendations

Based on the comments receiving at the last public hearing, the final facilities plan is prepared for submittal to the reviewing agency. At this point the community should be fully aware of their options and the probable costs of the selected facility. There should be general agreement within the community to back the plan.

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APPENDIX A

REQUEST FOR INFORMATION ON WASTEWATER DISPOSAL SYSTEM

The following information is being requested for purposes of developing a wastewater facilities plan for your community. It is important that you answer the questions as accurately and completely as possible if the least costly wastewater facility is to be constructed. All information provided will be kept strictly confidential and none will be released for public review. Please return the completed questionnaire using the pre-addressed, stamped envelope.

Name ______________________________

Address ______________________________

1. Was your building constructed prior to October 18, 1972? ________ ,
   Prior to December 27, 1977? ________

2. How many people live in your household? ________

3. How many bedrooms in your house? ________

4. Does your house have a basement? ________ Basement drain? ________

5. Do you have a garbage grinder? ________ Clothes washer? ________

6. What is the approximate size of your lot?

   ________ less than 2500 sq. ft.
   ________ 2500-5000 sq. ft.
   ________ 5000-10,000 sq. ft.
   ________ 10,000-15,000 sq. ft.
   ________ 15,000-20,000 sq. ft.
   ________ 20,000-30,000 sq. ft.
   ________ 30,000-40,000 sq. ft.
   ________ over 40,000 sq. ft.

7. Is your house used on a year-round or seasonal basis?

   year-round ________ seasonal ________

8. What type of water supply do you have?

   municipal supply ________ private well ________

9. If you have a well, please provide the following information.

   Do you share the well with other homes? ________ How many? ________

   What type of well is it?

   drilled ________ driven ________ dug ________

   How deep is it? ________

   How deep is the well casing? ________

Is it a flowing well? ________ If not, what is the depth to water? ________

What is its distance from your septic tank? ________; absorption area? ________

Has it ever been tested? ________ What was the result? ______________

10. What type of wastewater disposal system do you have?

septic tank/soil absorption field ______; septic tank seepage pit ________;

cesspool ________; drain to surface water or drainage ditch ________;

holding tank ________; other (describer): ____________________________________

11. When was the system installed? ____________

12. What water sources are connected to your disposal system?

Toilet	________ Yes	________ No	________ Do not know
Kitchen	________	________	________
Laundry	________	________	________
Bathing	________	________	________
Water Softener	________	________	________
Roof Drain	________	________	________
Foundation Drain or Basement Sump	________	________	________

13. If any of the above wastes are not discharged into your disposal system, where are they discharged? ____

14. Have you had any problems with your wastewater disposal system?

Yes ________ No ________

If you answered "no", please skip to question 19.

15. If you answered "yes" to question "14," please check the type of problem that best describes your problem (check more than one if necessary).

Slow drainage in sink or other water using appliance ________

Drains or toilet occasionally back up ________

Odors outside ________

Liquid is visible on the ground surface ________

Other ____

16. How often do you have problems with your system?

5 to 10 times per year ________ 1 to 5 times per year ________
less than once a year ________

17. When do you generally have problems? (check more than once if appropriate)
spring ________ summer ________ fall ________ winter ________
after periods of frequent or heavy rainfall ________

18. If you still have a problem, how are you coping with it?

pumping ________ how often? weekly _______ monthly _______ quarterly _______
reducing water use ________ how? ____
repairing system ________ how? ____
other ________ describe ____

19. If you have ever repaired your system, please answer the following:

when was it last done? ____
what was done? ____

20. Have you repaired your system more than once?

yes ________ no ________ if yes, how many and when ________________________

____

21. If you have not recently had a problem, how often do you have your system pumped?

once a year ________ once every three years ________
once every two years ________ never ________
other ________

22. If you have a holding tank, how often is it pumped? ________
How much does it cost per pumped? ____________

23. Do any of your neighbors have problems with their wastewater disposal system?

yes ________ no ________
if yes, what type of problem is it?
odors ________ frequent pumping ________ liquid visible on
ground surface ________ other (describe): ______________________________

____

Appendix B

Rehabilitation of Septic Tank Soil Absorption Systems

Occasionally, soil absorption systems fail, necessitating their rehabilitation. The causes of failure can be complex, resulting from poor siting, poor design, poor construction, poor maintenance, hydraulic overloading, or a combination of these. To ascertain the most appropriate method of rehabilitation, the cause of failure must be determined. Figure B-1 suggests ways to determine the cause of failure and the corresponding ways of rehabilitating the system.

The failure frequency should be determined before isolating the cause. Failure may occur periodically or continuously. Periodic failure manifests itself with occasional seepage on the ground surface, sluggish drains, or plumbing backups. These usually coincide with periods of heavy rainfall or snowmelt. Continuous failure can have the same symptoms but on a continuous basis. However, some systems may be seriously contaminating the ground water with no surface manifestations of failure. These failures are detected by ground water sampling.

Periodic Failure

The cause of periodic failure is much easier to determine and rehabilitation can be more simple. Since the system functions between periods of failure, design and construction usually can be eliminated as the cause. In these instances, failure is the result of poor siting, poor maintenance, or hydraulic overloading. Excessive water use, plumbing leaks, or foundation drain discharges are common reasons for overloading. These can be corrected by the appropriate action as shown in Figure B-1.

The next step is to investigate the site of the absorption system. Occasional failure usually is due to poor drainage or seasonally high water table conditions. The surface grading and landscape position should be checked for poor surface drainage conditions. The local soil conditions should also be investigated by borings for seasonally high water tables. Checking the condition of neighboring soil absorption systems installed at similar elevations can be useful to differentiate between surface drainage and seasonally high water table as the problem. If most systems have problems during wet periods, then surface drainage is probably the cause. Corrective actions include improving surface drainage by regrading or filling low areas. High water table conditions may be corrected in some instances by installing subsurface drains. Maintenance of the treatment unit preceding the soil absorption field may also be a cause of occasional failure. The unit should be pumped and leaks repaired.

Continuous Failure

The causes of continuous failure are more difficult to determine. However, learning the age of the system when failure first occurred is very useful in isolating the cause. If failure occurred within the first year or two of operation, the cause is probably due to poor siting, design, or construction. If the system had many years of useful service before failure occurred, hydraulic overloading or poor maintenance is usually the cause.

The first step is to find out as much about the system as possible. A sketch of the system showing the size, configuration, and location should be made. A soil profile description should also be obtained. These items may be on file at the local regulatory agency but their accuracy should be confirmed by an onsite visit. If the system had provided several years of useful service, evidences of overloading should be investigated first. Wastewater volume and characteristics (solids, greases, fats, oil) should be determined. Overloading may be corrected by repairing plumbing, installing flow reduction fixtures, and eliminating any clear water discharges from foundation drains. If the volume reductions are insufficient for the size of the infiltrative surface then additional infiltrative areas must be constructed. Systems serving commercial buildings may fail because of the wastewater characteristics. High solids concentrations or large amounts of fats, oils, and greases, can cause failure. This is particularly true of restaurants, laundromats, and meat packing houses. These failures can be corrected by segregating the wastes to eliminate the troublesome wastes or by improving pretreatment.

Lack of proper maintenance of the treatment unit may have resulted in excessive clogging due to poor solids removed by the unit. This can be determined by checking the maintenance record and the condition of the unit. If this appears to be the problem, the unit should be pumped and repaired, or replaced if necessary. The infiltrative surface of the absorption field should also be checked. If siting, design, or maintenance do not appear to be the cause of failure, excessive clogging is probably the problem. In such cases, the infiltrative surface can sometimes be rejuvinated by oxidizing clogging mat. This can be done by allowing the system to drain and rest for several months. To permit resting, a new system must be constructed with means provided for switching back and forth, or the septic tank must be operated as a holding tank until the clogging mat has been oxidized. Another method, still in the experimental stage, is the use of the chemical oxidant, hydrogen peroxide. Because it is new, it is not known if it will work well in all soils. Extreme care should be exercised when applying the chemical because it is a strong oxidant and can eat through clothing and skin. Protective rubber clothing and eye glasses should always be worn when working with hydrogen peroxide.

If failure occurred soon after the system was put into operation, the cause is probably due to poor siting, design, or construction. It is useful to check the performance of neighboring systems installed in similar soils. If they have similar loading rates and are working well, the failing system should be checked for proper sizing. A small system can be enlarged by adding new infiltration areas. In some instances, the sizing may be adequate but the distribution of the wastewater is poor due to improper construction. Providing dosing may correct this problem. Damage to the soil during construction may also cause failure in which case the infiltrative area is insufficient. Reconstruction or an addition is necessary. Alternate systems should be considered if the site is poor. This would include holding tanks or investigating the feasibility of a cluster or community system.

FIGURE B-1

RECOMMENDED METHODS OF SOIL ABSORPTION FIELD REHABILITATION