

Private Wastewater Treatment Regulations:  
Existing Conditions, Incentives, and  
Some Policy Suggestions

by

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Melville L. McMillan, and Ronald E. Shaffer



## PREFACE

The problem of how to handle the wastewater from rural, unsewered residences has become increasingly important in recent years. Growing population densities in rural areas, increasing water use due to modern appliances, and growing concern for the environmental effects of man's activities are among the primary contributing factors. The conventional septic tank-absorption field and the enforcement of regulations governing its installation and maintenance are often inadequate. As a result of the failure of these systems, poorly treated household effluent often appears on the land or in surface and ground water.

The Small Scale Waste Management Project at the University of Wisconsin-Madison is responding to this problem. One area of study involves the development of improved methods of treating household waste, methods which will allow effective treatment in areas of the state where soil or ground water conditions prevent the proper functioning of existing techniques of effluent disposal. A second area is the study of improved regulations to govern the installation and operation of wastewater treatment facilities for households in rural, unsewered areas. While in the long-run these regulations must recognize new technological possibilities, the first efforts are directed toward improving the present system. It is toward this goal that this paper is aimed. We would like to thank the many people -- particularly Richard Otis, David Stewart, and Eric Strauss -- without whose assistance this work could not have been carried out.

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## INTRODUCTION

In order to develop an improved regulatory system for household wastewater disposal, it is necessary to understand how the present one works. Thus, the objective of the first chapter is to discuss the current regulations governing the installation and use of septic tank systems in Wisconsin. Details of how a septic tank-soil absorption field operates have been covered in other publications<sup>1</sup> and will not be repeated here except as relevant to the topic at hand. It is useful to review the steps taken by someone wishing to build a new house in a rural area, starting with his initial search for suitable land, and ending with the completed house and sanitary system. Since most of the enforcement of regulations governing household waste disposal systems occurs at the county level, some assumptions will have to be made concerning the nature of the county in which the homeowner plans to build. The hypothetical county will have what might be called an average level of enforcement - and we will assume initially that nowhere in the process does the homeowner meet with any difficulties, environmental or administrative.

In the second chapter, a range of possible environmental difficulties will be introduced, as well as a range of possible responses on the part of the prospective homeowner, those hired by him, and county and state regulatory agencies. Some of the responses will represent standard administrative procedures, some will be unquestionably illegal, and many will be in between. The objective is not to imply that some of these

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<sup>1</sup>"On-Site Wastewater Disposal for Homes in Unsewered Area." Otis, Bouma. Small Scale Waste Management Project Bulletin R 2533.

responses are typical, but being realistic, to illustrate the problems which can and sometimes do develop because people respond to the incentives embodied in the current regulatory system.

The third chapter will outline a range of possible modifications to the current system based on the incentives brought to light in Chapter 2. The focus will be on the ways in which regulations can be modified to encourage people to act in the best interests of the community as a whole.

Finally, a discussion will be presented of the costs which might be expected to accompany enactment of a more readily enforceable system of regulations governing household waste management facilities.

## CHAPTER 1

### SMALL SCALE SANITARY SYSTEM CONSTRUCTION: AN INTRODUCTION TO THE PROCESS

The steps in the process of septic system development may be categorized as pre-construction, construction, and maintenance.

#### Pre-Construction

While selecting a location on which to build a home, many people would be aware of the effect that local zoning regulations could have on their plans and would find out about these regulations before purchasing land. In many areas, however, the regulations governing the installation of household waste treatment facilities are less widely known and the average person may or may not verify the suitability of his prospective homesite for the installation of sanitary facilities before purchase. It is possible for someone's construction plans to be thwarted after he has purchased the property, if he is not aware of the soil absorption standards against which his land would later be measured. This point will be discussed further in the next chapter.

#### Construction

Following purchase of the land comes what may be described generally as the construction phase. After plans are drawn and contractors lined up, the first administrative step is generally to apply for county sanitary and building permits and the state septic tank permit.

Application for the county sanitary permit follows a "percolation test" of the proposed drainage field site, and an inspection of its slope, proximity to bedrock and ground water, and susceptibility to flooding. The test involves first boring a number of holes at the location of the proposed drainage field. The material removed from the holes shows the subsurface soil structure, texture, and color, and indicates the presence of any impermeable layers which might later interfere with the functioning of an absorption field.

The next step is to fill the test holes with water, allowing the surrounding soil to become saturated. After this initial period of stabilizing the soil moisture, measurement of the rate of drop of the water level gives the tester a further basis for judging the capacity of the soil for absorbing and dispersing effluent.

The results of the percolation test and the on-site examination are reported on the permit application form. It is also necessary to specify on the form a number of characteristics of the house to be constructed on the site. This allows the county sanitarian or state officials to estimate the volume of waste likely to be generated by its occupants, thereby permitting a more accurate sizing of the sanitary system. The county permit may be free or may cost up to \$25, and is necessary before a sanitary system can be legally installed. This fee, when charged, is designed to cover some of the bookkeeping costs at the county level, and the costs of any official inspections of the sanitary system while it is under construction.

The state permit, and its accompanying \$1 fee, is primarily for bookkeeping purposes -- the filing requirement allows the state to keep track of the number and location of new systems. The state permit is necessary

before a septic tank can be purchased, and is generally obtained after compliance with county requirements.

Ideally, inspections are made of the sanitary system at certain stages of the construction process to oversee the work of the plumbing contractors employed to install the system. Similar to the periodic visits by a building inspector during the home construction process, these inspections by the county sanitarian or his staff are designed to enforce compliance with sanitary regulations for those parts of the system which will later be buried and hidden from view. The frequency and timing of these inspections varies by county. Most frequently, one inspection is performed shortly before the absorption field is covered with fill.

#### Maintenance

Upon compliance with the sanitary regulations and various other building code requirements, the house can be used for habitation. While in theory it is necessary that the sanitary system function properly for as long as it is in use, public regulations have in practice been satisfied upon passing the pre-coverup inspection; while current regulations require that the homeowner carry out the occasional septic tank pumping which is necessary for proper long-run functioning of the system, few, if any, counties have a program to enforce or administer this pumping requirement. As a general rule, the next time that the performance of the septic system comes to the attention of the authorities is after failure is noted by the owner or by neighbors.

## CHAPTER 2

### ECONOMIC AND SOCIAL INCENTIVES INFLUENCING SYSTEM APPROVAL AND CONSTRUCTION

This chapter will again follow through the process outlined in the previous chapter, but at each step the many possible obstacles to the house builder will be introduced and the possible reactions by all concerned will be explored. It will again be assumed that the components of the process unrelated to the construction of sanitary facilities goes smoothly -- zoning approval (although shoreland zoning does relate to sanitation) and building permit approval.

#### The Soil Test and On-Site Inspection

The regulations governing the licensing of soil testers in Wisconsin have recently been modified. Previously, the soil test could be performed by a: 1) registered sanitarian; 2) master plumber; 3) surveyor; 4) architect; or 5) professional engineer. This licensing procedure gave the state some control over the professional livelihoods of professional groups engaged in soil testing, and was meant to ensure that high standards were observed in the performance of these tests.

A number of difficulties interfered with these expectations, however. First, many professionals authorized to perform the tests may have a field of specialization which is quite removed from the skills necessary to competently evaluate the suitability of soil for wastewater absorption. Professional integrity would prevent most from engaging in a practice outside the realm of their training and experience, but the law did not

demand it. On the other hand, professionals such as soil scientists may be quite well qualified to conduct the soil tests and make on-site evaluations, but were prevented from doing so because of the licensing criteria.

The recent passage of Chapter 287, the Laws of 1973, alleviates this problem. Soil testers are now required to pass an examination geared specifically to the requirements of the soil test, thus restricting the profession to qualified people while at the same time opening it up to individuals not possessing one of the five licenses previously considered sufficient.

The prospective homebuilder should not have difficulty in obtaining an accurate assessment of the suitability of his property as a waste disposal medium. But a problem still to be investigated is his incentive to influence the process.

Since he has purchased the land for residential purposes, the landowner will be quite interested in obtaining a favorable result on his permit application. His home plans, and a large percentage of the market value of his property, depends on the outcome. He will have an incentive to induce the person doing the test to choose conditions and manipulate techniques so as to lean the results in his favor. Failing that, he has the option -- perfectly legal -- of having the test redone by another qualified individual, who may as a simple matter of chance return a more favorable verdict. The homeowner may also be tempted to search for an individual who is more easily persuaded to alter his testing techniques, or his report.

Another area of difficulty is with the percolation test itself. If the results are to be a valid indication of the ability of soil to absorb

and purify septic tank effluent, the soil around a test boring must be in a saturated state at the time the percolation rates are measured. This requires that someone -- generally the soil tester -- keep the boring filled with water for several hours before the test is done (such a task would be extremely difficult in sandy soils, and they are, therefore, exempted). While there are automatic mechanisms designed specifically to do this task, they may not be available. This preliminary step is therefore frequently impractical -- with the result that otherwise properly performed percolation tests, especially those done during dry conditions, do not give valid results. Beyond this technical problem is the general drudgery involved in such a test. Particularly in cases where the tester's experience allows him to guess the soil suitability with some confidence, he may be encouraged to abbreviate the formal test procedure to avoid the drudgery.

There is a third reason why the test may not be done properly -- or at least the results of the test not reported accurately on the permit application. The person doing the test may in many cases be the plumber whom the home builder has contracted to install the septic system. This person would have a financial interest in the success of the permit application, for if the permit is not granted, he loses his contract. Undoubtedly, very few plumbers are ever tempted to report inaccurate data, but the point is that the current system of regulations encourages this behavior.

It is difficult for the county sanitarian to identify unreliable reports and to check this accurately. Given the constraints of time and resources the sanitarian must depend upon the integrity of local testers in most cases. His familiarity with the local conditions, however, may lead him to suspect the validity of certain tests. If time allows, he may then require and supervise a supplementary test to check the results and, if negative, refuse the permit.



As already noted, failure to acquire a permit once the property is acquired and plans made imposes a hardship upon the individual who may appeal to local officials. Although the sanitarian or zoning administrator is responsible for the administration of the state plumbing code and county ordinances pertaining to septic tank systems, he is hired by the county board of supervisors and is answerable to them. County board members are responsive to the wishes of their constituents, and act to carry out the desires of residents of their district. It is possible that county sanitarians could come under pressure from elected representatives, his superiors, who are seeking to carry out the desires of their constituents. Local residents may be more concerned with the employment and additions to the tax base that will result from new residential development than they are with the less obvious benefits which would come from enforcing sanitary regulations to the letter, particularly in sparsely populated areas. And to the extent that the board members are themselves inclined because of their positions in the community to view economic expansion as desirable, these tendencies could be reinforced.

It is, therefore, easy to see how a sanitarian or zoning administrator may feel some pressure from his neighbors and his superiors to be less than strict in his interpretation of site standards, and he may be particularly influenced by the appeals of the lot owner. These appeals will have particular force and persistence if the lot owner has already begun construction of his house, since the owner could suffer large economic losses if the permit is not approved. While county regulations increasingly require the issuance of a sanitary permit before a building permit is granted, this is not always effective.

Having outlined the incentives likely to be at work during the percolation test and site inspection process, we will assume success of the part of the home builder and proceed to the step in which the home builder obtains the necessary permits. It is unlikely that an application which is approved by the county will later be denied by the state. With the exception of subdivision approvals, which are reviewed in detail at the state level, decisions made by the county are generally reviewed by state personnel only where particular problems have been brought to their attention, where fill-type systems have been proposed, or on a spot-check basis.

The applicant who remains unsuccessful has one remaining alternative -- installation of a holding tank. The cost of regularly pumping a holding tank is quite high<sup>2</sup>, and is generally desirable only if there is no other alternative -- for instance if the house is already constructed but approval cannot be obtained for an absorption field. Other alternative systems, such as mechanical treatment devices<sup>3</sup> or the mound system<sup>4</sup> are still being researched and are not approved for private installation at present.

#### System Design

This step is not separate from the previously discussed permit application process, since at least the general system design must be indicated

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<sup>2</sup>"The Cost of Holding Tanks for Domestic Wastewater." Barrows, Bouwes. (December 1973). Small Scale Waste Management Project Technical Paper TN 6.

<sup>3</sup>"Characteristics of Commercially Available Aerobic Household Wastewater Treatment Units." Otis. Small Scale Waste Management Project Progress Report, July 1972, Appendix D.

<sup>4</sup>"Experimental Mound Systems." Bouma *et. al.* Small Scale Waste Management Project Progress Report, July 1972, Appendix A; and, "A Mound System for Disposal of Septic Tank Effluent in Shallow Soils over Creviced Bedrock." Bouma, Converse, Magdoff. Presented at International Conference on Land for Waste Management, Ottawa, Canada. (October 1-3, 1973).

on the application. But it is distinct from the yes-no decision as to the suitability of the site, and as such will be treated separately. There are three primary areas of variability in design among conventional septic tank-absorption field systems: (1) tank size; (2) absorption field size; (3) absorption field type: bed, trench, or seepage pit. These will be discussed in turn.

Tank Size: The size of tank required is related to the volume of wastewater likely to be generated by occupants of the household. Volume is related to the number of occupants (with number of bedrooms in the house used as a proxy), and the presence of water consuming or waste generating appliances, such as clothes washers, dishwashers, and garbage grinders. The house owner has a short-term incentive to understate these indicators in order to allow him to purchase a smaller tank than would otherwise be required. But he has a long-term incentive to design accurately, possibly even to overdesign the system, since this will tend to minimize the costs of maintaining the system, and minimize the risk of its premature failure; adequate capacity permits less frequent pumping and allows a longer detention time for wastewater in the tank, which reduces the possibility of clogging the absorption field. How the homeowner responds to these incentives is likely to be governed by his short-term financial situation and awareness of the importance of this aspect of the design of his system.

Field Size: Sizing of the drainage field is similar to sizing of the tank, with the primary variables being the amount of water that must be infiltrated, and the type of soil present around the building site. Again, the longer life and more efficient operation which can be expected give the homeowner a long-term incentive to install a field of adequate size. As in the case of septic tank sizing, however, the homeowner may wish to economize in the short-run, and press for the smallest possible field.

Field Type: The type of absorption field installed and the method of its construction is often determined by the contractor. Current regulations permit either a bed or trench absorption field, or a seepage pit. Its relative ease of construction often induces the contractor to install the bed type absorption field. And since the bed is likely to be cheaper, quicker to install, and take up less space on the lot, the owner may well be persuaded to favor it also. However, research and observation of existing systems indicate that the trench system is far superior.<sup>5</sup> The characteristics which make the bed more convenient for the contractor -- smaller size, and the ability to move equipment into the excavation -- also tend, because of soil compaction during construction and a smaller interface between the gravel field and the soil, to make it a less efficient performer. The homeowner has a long-term incentive to install the more desirable system from the public point of view -- the trench system. But the contractor has an incentive to install the bed system because it is cheaper and easier, and the homeowner may also want to reduce short-run construction costs, particularly if he is unaware of the problems with the bed system. Thus, unless the homeowner is well-informed, the generally inferior bed system may be installed.

#### Installation

The technical details of system construction are spelled out in the Uniform Plumbing Code, and while the regulations may be somewhat conservative with reference to their recognition of new technology,

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<sup>5</sup>"Notes on Soil Absorption Field Construction for Septic Tank System."  
Otis, Bouma. Small Scale Waste Project Technical Paper TN 4. 1973.

the methods are relatively proven. As a result, it may be assumed that the homeowner would wish his system to be installed "by the book." But the contractor would again find it easier and cheaper to take short cuts in some areas. There is no real purpose in enumerating these areas in this discussion -- it is enough to observe that the present regulatory system provides an economic incentive for the plumbing contractor to act contrary to the interests of the public and the homeowner.

The pre-coverup inspection was mentioned in the previous chapter, and compared to regular visits by the building inspector. But the two are not strictly comparable since during the pre-coverup inspection one cannot observe such things as the ground conditions at the time the absorption field trenches were dug (which can later affect soil permeability at the gravel-soil interface<sup>6</sup>) and any piping details already covered by gravel. Building inspections, by way of contrast, are timed to permit the inspector unobstructed view of details at various stages of construction. For the present it will only be suggested that a simple inspection at such a late date is not adequate, since unsatisfactory construction has been found to be a primary cause of system failure.<sup>7</sup> Possible modifications to the inspection process will be discussed in the following chapter.

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<sup>6</sup>"On-Site Wastewater Disposal for Homes in Unsewered Areas." Otis and Bouma. Small Scale Waste Management Project Bulletin R 2533.

<sup>7</sup>"On-Site Investigation of Some Small Scale Waste Disposal Systems in Dane County." Carlson and Bouma. Unpublished Seminar Presentation.

### Maintenance

Proper maintenance is necessary to the continued functioning of a septic tank-absorption field system. Inadequate operation of a particular system will generally only be detected by the homeowner or by neighbors, and their concern is relied upon to correct or report system failures. Failures are usually made apparent by the appearance of inadequately treated effluent in basement drain pipes or at the ground surface above the absorption field. Less visible, but more dangerous, is the contamination of nearby wells which may also result.

Maintaining the system primarily involves pumping accumulated grease and sludge from the tank every two to four years. Maintenance is completely the responsibility of the homeowner at present. Since such service is an important part of protecting his investment in the sanitary system, he should need no additional incentive to have the relatively inexpensive work performed. But in fact, this maintenance is frequently neglected because of inadequate knowledge on the part of the homeowner. It may be that an effort to inform the rural homeowner of the benefits to both himself and his neighbors of proper maintenance would be adequate, but if experience indicates that it is not, then the public welfare might require that periodic maintenance be enforced. The justification would lie with the general public having an interest in avoiding the presence of poorly functioning systems; a malfunctioning system may present a health hazard, degrade the quality of the local ground and surface water and affect the value of neighboring property, even though in some cases it may not be particularly annoying to the homeowner at fault. Mechanisms by which adequate preventative maintenance might be enforced will be discussed in the following chapter.

### Summary

The critical points in the regulatory process occur when the incentives which operate on the individual may tend to encourage actions which are not in the broader public interest. These critical problems are:

1. Soil Test and Inspection
  - (a) The test may not be performed properly.
  - (b) The tester may be the plumbing contractor -- with an interest in a favorable test result.
  - (c) Informal appeals are encouraged by the possibility of political pressure on sanitarians.
2. System Design
  - (a) The field may not be the most desirable type.
  - (b) Tank and/or absorption field size may be inadequate.
3. Installation - inspection may not reveal adequate detail.
4. Maintenance
  - (a) Reliance on homeowner to report and repair failure.
  - (b) Inadequate information on pumping requirements.
  - (c) No standard procedure for detecting sanitary system failure.

The importance of having an educated homeowner is apparent throughout this discussion. Many of the problems listed may arise because this individual is unable to critically evaluate the alternatives open at each step in the process, and therefore responds to a narrow and possibly short-run idea of what is in his own self-interest.

## CHAPTER 3

### MODIFICATION OF THE PRESENT INSTITUTIONAL SYSTEM: SOME POSSIBILITIES

In this chapter a discussion will be presented of the ways in which present regulations might be modified to deal with the incentives which operate on the people involved in the construction, inspection, and ownership of septic tank systems. The discussion will focus on the administrative system rather than the physical system because the products of new technology can hopefully be incorporated into the procedures for regulating existing systems.

This chapter is divided into four sections. These steps will follow in the now-familiar order of events applicable to each new home-site--with the exception that we will place heavy emphasis on how the prospective home builder can protect himself from the potential shortcomings of a site before it is purchased. This is the concern of the first section.

#### Public Availability of Information

The availability of generalized information on soil types and depth to bedrock should be publicized so as to reach prospective lot purchasers or home builders. Individuals would be encouraged to visit Soil Conservation Service or Zoning Administrator offices and find out, to the extent possible without a field inspection, the probable feasibility of various kinds of waste disposal systems on that site.

The objective would be to allow someone seeking a homesite to approach the decision-making process in a more intelligent manner--to



help him better gauge the usefulness of a piece of land for his purposes before purchase, without the expense of a formal soil test.

Two further mechanisms might be utilized to protect the perhaps unwary land purchaser:

1. A statement by the present owner on the offer form or property description describing the characteristics of the land as known to him. This should include:
  - (a) Information from soil maps.
  - (b) Results of past soil tests known to the owner. The requirement should be worded so as to require the owner to furnish information known to him or easily accessible, but not an excessive amount of research or the commissioning of new tests.
2. (a) A statement on the offer of purchase which would make the sale of undeveloped land valid, subject to the land being found suitable for household waste disposal. The prospective buyer would be allowed a reasonable period of time, 30 days perhaps, to have necessary tests conducted.
  - (b) For properties with existing waste disposal systems, sale could be made conditional on its proper functioning.

The effect of these procedures would hopefully be to decrease the pressure on soil testers and county officials to approve inadequate septic systems, since fewer people would purchase unsuitable land for residential purposes.

### The Soil Test-Site Inspection

Certified Independent Testers: Chapter 287, the Laws of 1973, will help to insure that soil tests are performed by technically qualified individuals.

The examination required before becoming a certified soil tester, and the information necessary to pass it, is available to all. This removes the barriers which now prevent qualified individuals who do not fall into one of the five license categories from engaging in soil tests. There can be no argument with the justice and equity of this approach, but it must be recognized that if the new law results in an increased number of testers, the presently overworked county sanitary staffs will have an even more difficult time checking on the performance of soil testers than they do now; personal knowledge of the competence and honesty of each tester will be even more difficult to maintain. Again, few are likely to be dishonest -- but decreasing the chances of catching those few is not likely to decrease their number.

The law may appear to weaken the sanctions against offenders. To this time, the only punishment which could be levied against someone found guilty of malfeasance was the removal of his professional license -- frequently the source of his entire livelihood. This punishment, which might be viewed as excessive, was not frequently invoked. Under Chapter 287, removal of a soil tester's license will not affect his master plumber or other licenses. This, coupled with the often part-time nature of the job and relatively small investment in equipment and training required reduces the financial penalty involved in the loss of a soil tester license. This lesser punishment may elicit greater effective enforcement, and thus provide a greater deterrent. Only experience with these regulations will provide an answer.

Another solution which has been experimented with is the certification of a limited number of people by the county to do the testing. In this way the performance of both testers and contractors can be more closely monitored. Also, the testers were not allowed to be in the business of installing systems. This eliminates the incentive to approve a site with the expectation of receiving a contract to install the sanitary system, something not done by Chapter 287.

Government-Employed Testers: Anywhere there is county control of the hiring or certification, as in the above case, there is room for political pressure on the soil testers. An alternative would be to utilize a uniform statewide exam as called for under Chapter 287, but with state-employed testers assigned to each county.

The primary advantage of such a system is that it would remove many of the economic and political pressures on the testers to go against their technical judgement. This is not to say that the incentives operating on a county-employed person would not be operating at the state level. But a state employee would have a much larger peer group from which to draw support if his position was challenged for political reasons. Membership of the testers in a state employees union or association would help insure that individuals could not be removed without legitimate reason. Another possible arrangement would be to require the establishment of a county civil service system for soil testers. In this case they would still be hired by the county, but there would be more of a guarantee that they could be fired only with good cause and after due process.

In addition to the group of local testers, there could also be a centrally based "at large" group of inspectors who would be charged with:

1. Spot-checking tests done by local inspectors.
2. Advising local inspectors when asked.
3. Adjudicating appeals (described below).

County assignments of central inspectors could be rotated or randomly assigned at frequent intervals, making it difficult to bring local power to bear on the person. Or, central inspectors could operate on a multi-county basis, removing them from local political pressures, yet alleviating the need to constantly transfer the individuals from one place to another.

Financing of county or at-large testers could be at the state level, with fees charged the property owner covering some of the costs of inspection. If the fees completely support the testing and enforcement program, there would be no subsidy from urban residents to owners of open-country sanitary systems. On the other hand, such a subsidy might be justified, since urban residents benefit from better open-country waste disposal, and open-country residents already subsidize urban sewage facilities through taxes paid to support water and sewer grant programs.

Since there is always the possibility of human error or bias in conducting a soil test, a mechanism should be created whereby disputes could be settled. This would take the local tester "off the hook" to some degree in that he need not feel obliged to defend his professional competence to disgruntled would-be home builders. The latter would simply be required to post an extra fee to cover the cost of testing by one of the central testers. If the previous tests were found to be in error enough to change a rejection to an acceptance, the extra fee would be refunded. On the other side of the coin, people dissatisfied with the granting of a permit would have open the same protest procedure. In this case particularly, it would be necessary to insure that the

dispute was settled speedily to avoid the use of the protest as a delaying or harassing tactic.

Problems with the protest procedure would be that local testers would have an incentive to minimize the number of appeals lost in order to enhance their status as a competent tester. This would hopefully increase their use of central testers for informal advice, but might, in fact, make them wary of refusing installations anywhere near the borderline. This would be one important argument for making central testers non-rotating and instead have them responsible for several counties all the time. A good rapport between local and central testers would make the local testers more willing to trust the judgement and seek the advice of the central testers.

#### System Design

There are several alternative ways of inducing homeowners to adopt the trench rather than the bed type of absorption field. The most obvious would be to simply declare the trench system to be the only legal type of drainage field.

A second method, currently being considered as part of a proposed revision of these regulations, would rely on changing the relative attractiveness of the two types by changing their area requirements; to this point, the square footage requirement of each have been the same, making the simpler and more compact bed the more attractive of the two. Increasing the square footage requirements of the bed to compensate for its lower efficiency will tend to reduce the cost advantage it once held, and induce--rather than prescribe--the desired increase in drainage field effectiveness.

Additionally, it would seem appropriate to introduce a public information program to inform homeowners of the advantages of the trench system -- such as the avoidance of compaction by earth-moving equipment during construction -- which even the now enlarged bed systems are unlikely to overcome.

#### Supervision of Design and Construction

In addition to the problems involved in obtaining accurate soil tests, there are also problems with the pre-coverup inspection as a means of insuring proper system performance. An obvious alternative to the present system would be to expand the number of inspections to cover several critical points during the installation of the systems. The first such inspection would be most appropriate during the time the trenches for the absorption field are being dug. Soil moisture conditions, trench depth, and slope could be easily verified.

A second inspection could take place after the bottom layer of gravel and the pipes had been placed in the trenches. The suitability of the pipe and its installation could be observed. The contractor would be required to have sufficient gravel at the site to complete the installation of the system. After this second inspection it would be assumed that he would complete the installation in a satisfactory manner.

Maintaining this type of installation inspection at the county level seems desirable. The pressures on the inspector to approve sub-standard systems would be substantially less than during the soil test-site inspection phase. County inspectors would have an easier time than multi-county inspectors in coordinating their inspections with the activities of local contractors. And last, but not least, it would be

politically easier and perhaps more efficient to utilize existing positions and personnel. In many cases, however, the county sanitarian's office would need an expanded staff; not only would the number of necessary inspections be doubled, but, in fact, at the present time many county offices are not able to carry out the pre-coverup inspection on all new systems. The financial implications of an expanded inspection office will be discussed in the last chapter.

An alternative is to structure the incentive system so as to make the business of installing septic tanks and absorption fields self-policing. One suggestion is to require performance bonds of those in the business of installing waste disposal systems. The procedure would be similar to that often required of those engaged in the construction of public roads, buildings, and other structures. The company would, in effect, guarantee--through the purchase of insurance or on the basis of the assets of the company--that systems installed by them would continue to perform properly for a specified length of time after the system is put into service. This would remove the necessity for installation inspection since it would now be in the interest of the installers to do their job well. While a promising approach, there seem to be several important areas where problems could arise.

The first is that one must determine how long a good system should last. One possibility would be to require that any system perform above a certain level for a minimum number of years, and allow the contractor to design to those specifications. A problem would develop in that contractors would have an incentive to overdesign systems, since presumably he pays for his bonding on the basis of past failures, whereas the homeowner would pay the entire cost of overdesign. Competition would

certainly develop among contractors, but possibly not to the long-run good. If the lifespan was set at a moderately high figure such as five years, contractors expecting to terminate their enterprise might use such a termination date as their design life. They could, as a result, underbid their competitors, who presumably have longer range goals. The bonding company would be left with the liability, with possibly no recourse against a contractor no longer concerned with his professional reputation. The turnover rate among construction companies is probably high enough to make this a justifiable fear.

A second problem is that required bonding might inhibit the entrance of new competitors, who would not have a history upon which rates could be based. Any insurance they could obtain might be at rates high enough to make entry into the construction business unprofitable. Competition would be restricted to larger established firms, whose primary construction interests may lie elsewhere, and who would probably be less responsive to the individual householder.

Further, since poor absorption field location frequently contributes to system failure, installers would probably not be willing to rely on a soil test carried out by another party. Installers would have a strong incentive to provide both testing and installation services in order to maintain adequate control over the systems which they are required to guarantee. This might further tend to restrict participation in the business to larger enterprises.

#### Maintenance

This is closely tied in with the concept of installation bonding since a bond of even minimal duration would demand some assurance that the system would be maintained. The alternatives would seem to be:



1. Homeowner maintenance, as at present.
2. Installer maintenance.
3. County-franchised maintenance.
4. County maintenance.

The first alternative is not working as well as some people would like, and would certainly be unacceptable to installers if they are expected to be responsible for system performance. An alternative would be enforced homeowner maintenance with the owner required to submit a statement, or a copy of the receipt from a licensed pumping company, stating that the septic tank had been pumped as scheduled. While improved maintenance should decrease the rate of failure, detecting those failures that exist would present the same problems as at present. Requiring the pumping companies to report failing systems would seem unenforceable since companies would be loath to get a reputation for being strict in this regard, and there doesn't seem to be any really objective criteria for what is failure.

Installers could be responsible for maintaining the systems. Installers could inspect and maintain the system themselves, authorize others in their company to pump the tanks, or hire those who are presently engaged in septic tank maintenance. One problem with this alternative is that the consumer would pay for the overmaintenance that the installer would have an incentive to provide. Since a maintenance contract would probably be tied into an installation contract, the problems discussed there would all apply. Another problem would be that small, independent septic tank pumpers could be adversely affected, since installers must be master plumbers, and thus master plumbers would be granted, in effect, a monopoly in septic tank pumping.

County-franchised maintenance and county maintenance would be very similar to each other. In the former, the county would subcontract to private individuals to work according to county direction, while in the latter, the

county would own the trucks and employ the personnel. County-franchised maintenance would involve contracting with local pumpers to service septic tank systems. The county would incur very little initial capital costs. Local pumpers may be receptive, since required maintenance would mean more frequent septic tank pumping, and more business for pumpers. A county-owned and operated maintenance system would have the economic and political disadvantage of requiring a system of personnel and equipment which would duplicate existing private enterprise, with no reasonable expectation that the publicly provided service would operate more efficiently.

Under either a county-contracted or a county-owned maintenance program, the degree of maintenance expected of the septic tank system would be spelled out in the specifications required of contractors. The county would then take the responsibility for insuring that the maintenance is performed on a regular basis. This might, however, have the effect of inhibiting new technology having different maintenance requirements.

County-controlled maintenance would have the distinct advantage over previous schemes in allowing regular observation of system performance. Since pumpers, whether privately or publicly employed, would not be retained by the homeowner, there would be no incentive to maintain a customer by not reporting failure. Centralized recordkeeping would be possible, and the incidence of failed systems continuing in use over a long period of time greatly reduced.

#### Alternative Mechanisms for Controlling Small Scale Waste Systems

To this point the discussions have reviewed small scale waste treatment facilities as they are currently installed, operated and regulated. Several recommendations suggesting improvement in the existing system have been made. Typically, these modifications require that a more active role be played by public authorities in supervising

private activities involved in the testing, inspection and maintenance of septic systems. Although better regulating these activities offers one means of improving the performance of small scale disposal systems, more radical departures from current practice may also provide viable solutions and deserve mention. The alternatives noted here represent two extreme positions - purely private responsibility for the provision and performance of the system, and public responsibility.

First, consider the case where the owner of the waste treatment facility is solely responsible for providing and maintaining a system meeting the established standards. In this case the public does not involve itself in the supervision of a percolation test, any examination during installation, or review of maintenance. The suitability of the site, the design and quality of the system and its maintenance are the responsibility of the owner. The public only concerns itself with the results. It would periodically inspect installations to determine the adequacy of its functioning. If the system operates well there is no problem, but if it fails the public can require its correction or, if necessary, its replacement. Faced with this ultimate test, the homeowner is induced to assure the proper selection of site, design, construction and maintenance of a system which will adequately protect water quality.

While this procedure may be "low cost" in terms of public involvement, and could conceivably reduce the number of failing systems, several problems may arise. One, of course, is the question of determining when a system has failed. While sight and smell alone may offer adequate tests in some instances, more sophisticated procedures would certainly be required in many cases. A reliable and operational criteria must necessarily be established. Secondly, if it is determined that a system

has failed, correction of the problem may impose a hardship on certain individuals. How are such cases to be handled? But then, how are they dealt with now? This question, though, may become more pertinent as it is likely to arise more frequently under the proposed system than presently. The evolution of existing regulations was no doubt in part to protect homeowners from unexpected and avoidable failures. Perhaps the public would be required to assist if not subsidize proper installations.

This suggests the second alternative, public responsibility for small scale treatment units. In urban areas public ownership of sewers and sewage treatment units are the norm. Yet in rural or unsewered areas the opposite occurs and individuals are privately responsible for their own units. Dissatisfaction with the performance of the latter system may, however, warrant public services. One advantage of this method is that the public authority would determine the type of treatment unit suitable for each location. Prospective home builders would be advised to obtain the authorities' recommendation regarding any site prior to making a commitment to buy property since the type or scale of installation required could very well determine the property's value. Once that is settled, the public authority would build or have built the appropriate system and maintain it as necessary. The cost of the system would be assessed on an annual basis to the individual homeowner based on the expected life of the system. If the unit fails, the public authority would be responsible for replacing it without additional charge to the homeowners. In essence the homeowner buys a sewer system and service plus insurance that it will work. On the other hand, the public authority is assured the small scale treatment units are appropriate for the sites, are maintained properly and function properly since the homeowner will be quick to report any deficiency which must be corrected

at no cost to himself in order to maintain the quality service he has been assured. The major difficulty with such a system is the high initial capital outlay before the system becomes self-financing. In spite of this, programs establishing such individually situated but publicly owned and managed sewerage systems are being tried in California.<sup>8</sup> Other local government units there are also undertaking septic tank inspection and maintenance. Some Wisconsin town sanitary districts are currently engaged in inspecting and pumping septic tank systems.<sup>9</sup> The extension to a publicly owned and operated on-site system is feasible under Wisconsin law governing town sanitary districts. The Small Scale Waste Management Project currently has a grant to demonstrate such a system.

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<sup>8</sup>Refer to Winneberger, J. T., and W. H. Anderman, Jr. "Public Management of Septic-Tank Systems in a Practical Method of Maintenance," Journal of Environmental Health, Vol. 35 (September/October 1972), pp. 145-46.

<sup>9</sup>Klessig, Lowell and Douglas Yanggen. Town Sanitary Districts in Wisconsin: The Legal Powers, Characteristics and Activities. Inland Lake Renewal and Shoreland Management Demonstration Project Report, November 1973, p. 10.

## CHAPTER 4

### POSSIBLE FINANCIAL IMPLICATIONS OF A REVISED SYSTEM OF REGULATIONS

This section will briefly consider the financial implications of the enforcement of more stringent sanitary regulations. Because each county organizes its environmental and public health agencies in a unique way, it is impossible to estimate precisely how each county would be affected by the revised regulatory structure discussed in the previous chapter. Instead, a generalized picture of probable personnel and equipment requirements will be attempted.

#### The Soil Test-Site Inspection

Characteristics of Present Testing Operations: There are three important factors which must be considered when estimating the personnel and equipment requirements for a state or county-sponsored soil testing program of the type proposed in the previous chapter. The first is the seasonal nature of the construction industry, which generates a corresponding seasonality in the need for soil tests; it is common for 80-95% of soil tests to fall within seven summer and fall months. This complicates the estimation of personnel and equipment requirement since one must decide the extent to which the service should be designed to meet the peak demand of the summer months, at the expense of a large amount of overcapacity during other parts of the year. Although the seasonality of soil testing appears to some extent inevitable, steps to reduce this will be discussed later.

The remaining important characteristics of soil testing are the time consuming nature of the test, combined with the significant distances which often separate test sites. It has been estimated that a test on light soils with a percolation rate of one inch in less than three minutes, requires approximately four man hours to perform, while on heavier soils it requires an average of ten to twelve hours.<sup>10</sup> Much of this time, particularly on the heavier soils, is spent waiting the necessary length of time between water level measurements. In these heavier soils slower percolation rates often make it possible to run two tests simultaneously, if they are close enough to each other (two to three miles) to permit the tester to travel between sites, alternating in his measurements.

The implications of these factors are that :

1. Personnel and equipment requirements might be reduced below levels currently required if the seasonal nature of soil testing could be reduced.
2. Productivity can be improved by having test sites in close proximity done simultaneously.
3. There is at least the potential for increasing efficiency further through the substitution of automatic equipment to accomplish some of the routine tasks presently done by hand.

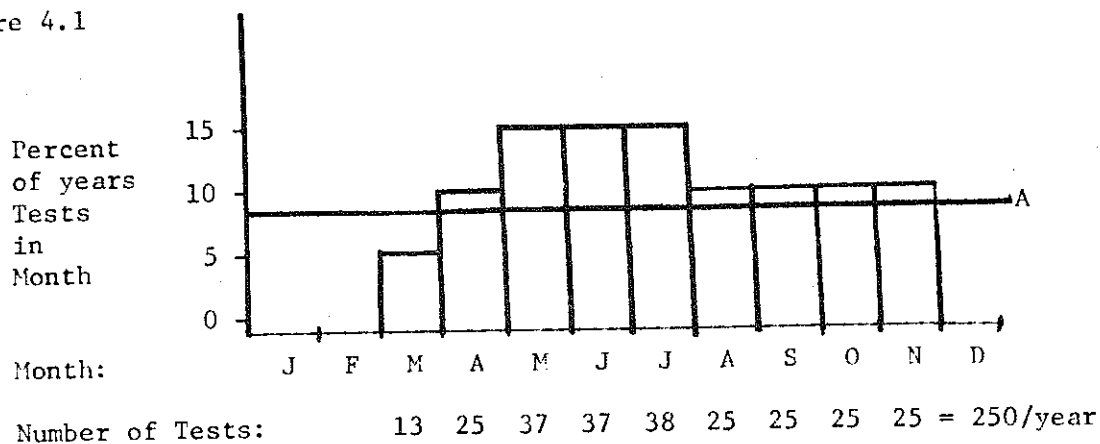
Costs will now be estimated under several different sets of assumptions for a hypothetical county testing program. Under operation conditions prevailing at present, it will be assumed that one man and one auger-equipped truck can complete one test per day. A county with, for

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<sup>10</sup> Annual Report, LaCrosse County Health Commission, 1972.

example, 250 tests per year would probably find them distributed by month as in Figure 4.1.

Figure 4.1



Assuming 22 working days per month, one man would be essentially fully employed for eight months, and 60% employed for a ninth; line A illustrates this. But only 189 of the 250 tests would get done. If a second man were hired, he would not be fully employed in any month--but all the tests would get done.

The following hypothetical but reasonable annual cost figures will be used for purposes of illustration:

Yearly Cost for One "Testing Unit"

Salary: Soil Tester	9,000
Truck expense @ \$0.16/mile, 8,000 miles/year	1,280
Auger unit, amortized at 7% over 10 years	500
Maintenance on auger unit, and incidental expenses	100
<b>TOTAL</b>	<b>\$10,880</b>

This total cost translates into an average cost per test of \$87.04 when two of these testing units are employed for the hypothetical county.<sup>11</sup>

<sup>11</sup>  $(10,880 \times 2) \div 250 = \$87.04.$



If each man were employed in other tasks when not performing tests, thereby allowing the assignment of a proportion of salaries to these tasks, total cost would fall to \$49.13.<sup>12</sup> But this reduction in labor costs assumes a perfect mobility of employee's time and effort to other tasks, something not likely to be true in practice. An alternative method of calculation would retain the two testers, but shift each in or out of the soil testing operation on a monthly basis -- a more realistic assumption. Under these conditions, cost per test would become \$66.04 -- although this is, of course, quite sensitive to the size of the county.<sup>13</sup> The entire cost of idle equipment would still be borne by the testing program but this effect would be relatively minor.

This example shows the influence of both seasonality and the present labor-intensive test procedures on soil testing costs, and is designed to provide an indication of the magnitude of the expenditures being discussed.

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<sup>12</sup>This can be calculated by multiplying the monthly salary cost for the two testers (\$1500) by the proportion of their 44 working days required for soil testing in each month. For example, the 13 tests assumed for March would account for  $(13/44 \times \$1500) = \$443.18$  of the salary costs for that month. Following this procedure for each month, and adding in the truck expenses, results in a total expenditure of \$12,282.71. Dividing this total cost among 250 tests results in an average cost of \$49.13.

<sup>13</sup>Referring to Figure 4.1, it may be noted that no testers are required during three months out of the year, one tester during the month of May, and two testers for the remaining eight months. These 17 "tester-months" would generate salary costs of \$12,750. Adding this to the \$3760 in maintenance and overhead costs for two vehicles produces a total cost of \$16,510. Dividing this among 250 tests produces an average cost of \$66.04.

Note that in all of these cases the hypothetical county produces too many tests during the summer months to be handled by one tester, but too few to keep two testers fully occupied. The average cost figures, of course, reflect this. The value of these examples is not intended to lie in the accuracy of the numbers generated but in the relative shifts which take place as the assumptions underlying the program's operation are changed.

Possible Technical Innovation: Of the alternative technical approaches to operating a program, the first possibility would involve the development of a test usable during all months of the year. In this example, full-time employment would be provided for one set of equipment, lowering the average cost (making no allowance for the cost of new technology) to \$43.52. It might not, however, be sufficient to possess the capability to carry out the tests in all seasons; it might be necessary to provide an incentive for home builders to spread their activities throughout the year. Long waiting lines for summer soil tests might be an adequate incentive, but a differential rate system, charging more in the summer, might also be desirable. The technical problems associated with such a test may, for practical purposes, turn out to be insurmountable. The possible manpower and equipment economies do, however, suggest that such possibilities should be explored.

A second technical innovation which would decrease testing costs would be the development of equipment which would cut down the need for continuous manned monitoring of soil test sites. Once holes are dug and observations made of soil conditions at various depths, automatic equipment could be installed which would complete the rest of the process. The simplest such device could contain a float operated valve which would release water from an adjacent tank in such a way that the water level in the test hole is maintained at a specified level. Such a device could be left unattended for any desired length of time, the drop in water level in the tank providing a measure of the percolation rate. Where more exacting measurements are required, a timer-controlled punch or printer could be used to make tank measurements at any desired interval, while left unattended.

The use of such equipment would greatly reduce the time that personnel would need to spend at each site making routine measurements. In addition, tests could be set up to run overnight in those soils where the percolation rate would not require a prohibitive amount of water to maintain water levels for that length of time. At least a doubling of the workload which could be handled by each soil tester would seem to be possible. While the cost of purchasing and maintaining new equipment of this sort can only be roughly estimated, the increase in efficiency resulting from its use would certainly justify its adoption in areas of the state where heavy soils predominate.

Increasing efficiency in this manner would allow one tester and one set of equipment to perform all of the tests without attempting to redistribute them seasonally; thus, his time would still be available for alternative employment during the winter months. Assuming a doubling in productivity, and assigning the tester's salary to other tasks during three winter months, average cost per test would fall to \$34.52. A reasonable estimate of the cost of new technology is about \$2,000. Even if this were to be amortized over only five years, it would still add less than \$2.00 to the basic cost of \$34.52 just calculated. There might be, in addition, increased maintenance costs for the more intensively used truck and auger rig. But again, this calculation highlights the important reduction in testing costs which would accompany an increase in the productivity of the labor component.

A third method for reducing testing costs would utilize pricing policy to eliminate some of the time that soil testers spend traveling between sites, and the related vehicle maintenance expenses. A reduced

rate could be instituted for those landowners who would accept a test done at the convenience of the tester--rather than the "yesterday if not sooner" attitude which often seems to accompany the process of home construction. Such a pricing incentive might evoke enough foresight in some home builders to permit the scheduling of soil tests in a more efficient way. And even if the monetary difference turns out to be insignificant to most people involved in a project as expensive as home construction, there would still be an equity argument that those unwilling to wait for the convenience of the tester should bear at least some of the efficiency costs of their actions.

In summary, each county or region of the state would need to predict the cost of a testing program based on conditions prevailing locally, and any advances in equipment or organization which it could incorporate. The illustrations have attempted to show the nature of the costs involved, and the relative returns that might be expected from different approaches to organizing a county-based soil testing program.

#### Inspection of Systems Under Construction

The estimation of manpower requirements and costs for a program of inspection similar to the one suggested in the previous chapter is difficult. Since each of the two inspections put forward as desirable would not in themselves take long to accomplish, the importance of travel time and expense between sites takes on even greater significance than it does for the soil testing program. For this reason, it would be desirable to coordinate these inspections with other health department activities, such as soil tests and well inspections--the way it is generally done

now. Since each county has some experience with the conventional pre-coverup inspection, the best estimate of the costs which would accompany a more comprehensive monitoring of septic systems construction would come from the hypothetical extension by each county of its current efforts; if, for example, county personnel currently are able to perform pre-coverup inspections of one-half of new installations, then there exists some basis for estimating the cost of providing each new system with two inspections -- but the answer will be somewhat unique to each county organization.

#### System Maintenance

Septic tank pumping is the only predictable maintenance for the conventional septic tank-soil absorption field. The cost of this service -- presumably borne by the homeowner -- will depend upon such factors as:

- 1) the size of the septic tank; 2) the distance from the pumper's base of operations to the home, and to the disposal site; and 3) the accessibility of the septic tank to a pumping truck. One would not expect the first two factors to be influenced by the desirability of minimizing pumping costs; the larger tank, while more expensive to pump, would need pumping less frequently, and would extend the life of the relatively expensive drainage field, while the cost of hauling the waste would certainly not be significant enough in itself to influence home location. The third factor, accessibility, could be important; septic tanks which are buried and their location forgotten, or which are covered over by some improvement to the grounds, can be both expensive and disruptive to unearth for pumping. While current regulations require that an access cover be located within six inches of the ground surface, this does not provide a positive indication

of the tank's location. A requirement that the precise location of septic tank access ports be recorded would do much to minimize maintenance costs for all concerned, and minimize the incentives that homeowners frequently have for avoiding this necessary task.

Public control of pumping activities should, if anything, serve to reduce costs. Because travel time and expense make up a large part of these costs, significant benefits could be derived by centralizing the scheduling of haulers; much of the "crossing of paths" which must currently exist could be eliminated by the assignment of territories convenient to the base of operations of the pumper, and having pick-up sites in close proximity of each other. A significant aspect of this is that the assignment of territories to existing haulers would eliminate the possibility for competition, both among those currently in the business and possible new competitors. But if they are to undertake the role of observing septic system operation while carrying out their maintenance activities, then there is a need to separate their performance from their compensation; the freedom of the homeowner to select a pumping service must necessarily be restricted. And since the public will be paying the bill (although the funds might come from taxes levied solely on rural homeowners) it would seem fair that the public have a role in reducing that bill by increasing the efficiency of the operation.

#### Summary

The cost of stiffened regulatory and inspection procedures would not be great. The nature of the soil test, and therefore presumably its cost, would be the same whether carried out by private individuals

or a public agency. Indeed, the cost might be reduced by possible scheduling efficiencies.

The inspection of systems under construction is the area where an increase in cost would be most noticeable. To some extent this is because present staffing of county health departments frequently does not permit them to achieve even the requirement of present legislation; a significant proportion of any increase in costs calculated could, in many cases, be considered "catching up."

Finally, septic tank pumping is preventive maintenance. The short-run costs - probably about \$30.00 to \$40.00 every three years for the average household - becomes even less significant when the long-run benefits to the life of the drainage field are considered.

## CONCLUSION

This paper is not presented as a finished and coherent plan for the reorganization of the institutions and regulations governing rural household waste treatment facilities. Rather, the objectives have been to: 1) point out a number of reasons why regulations as they now stand give people incentives to act in ways not in the public interest; 2) present possible solutions; and 3) give the advantages and disadvantages of those solutions. The final interpretation and judgement of the alternatives is left to the reader. This paper deals with an area where too little is presently known, and where changes in both the needs of society and society's technological means of fulfilling those needs are occurring so rapidly that there is no "right" answer.