LANE COUNCIL OF GOVERNMENTS

208 PROJECT

INDIVIDUAL WASTE DISPOSAL MANAGEMENT PROGRAM

LANE COUNTY, OREGON

SEPTEMBER 1977

BC BROWN AND CALDWELL

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September 30, 1977

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Attention: Mr. Gary L. Darnielle
Project Director

INDIVIDUAL WASTE DISPOSAL MANAGEMENT PROGRAM

As provided under the terms of our professional services contract dated August 31, 1976, we submit herewith our final report on the development of an individual waste disposal management program for the 208 project area.

The report describes past and present conditions, practices, and septic tank system performance in Lane County and elsewhere; it develops and evaluates alternative management programs to improve system performance, and it describes the impact of the recommended management strategy in one portion of the study area.

We gratefully acknowledge the assistance and close cooperation we have received from you, your staff, and the Lane County Environmental Management Department throughout the study.

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CHAPTER 1

INTRODUCTION

The Lane Council of Governments (L-COG) is one of over 100 regional agencies designated in 1975 by the United States Environmental Protection Agency to carry out areawide waste treatment management planning under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500). L-COG has included among its planning concerns an Individual Waste Disposal Management Program due both to the public health implications of failing septic tank-drainfield systems in Lane County and to the inadequate comprehension, nationwide, of the best technical and administrative practices in management of these systems.

In August, 1976, L-COG engaged the firm of Brown and Caldwell to develop and evaluate management practices for septic tank systems and to recommend the most practical program to follow. This report is the result of that investigation; it contains a summary of the approach used in the study followed by findings and recommendations.

Background

The portion of the Willamette River Basin in Lane County contains a diversity of residential densities ranging from farm homes to the Eugene-Springfield metropolitan area. Outside of the Eugene-Springfield area (including the River Road-Santa Clara area), there are approximately 14,000 residential dwelling units housing approximately 45,000 people, which are not served by community sewerage systems. The number of such systems increases significantly each year as people are attracted to Lane County and choose to live outside the metropolitan area. While many of the homes served by individual sewage disposal systems are isolated one from another, the greater portion of them are clustered in unincorporated communities such as Jasper, Marcola, Elmira, and McKenzie Bridge.

Responsibility for public health through regulation of the installation, maintenance, and repair of all individual waste disposal systems lies with the Lane County Environmental Management Department. Lane County is one of 23 counties in Oregon which administers portions of the state regulations on subsurface sewage disposal under contract to the Oregon Department of Environmental Quality (DEQ). DEQ itself administers the regulations in the remaining 13 counties.

In an age when medical technology and public health practices have reduced the incidence of many diseases to nearly zero, it is easy to lose sight of two facts: (1) that individual sewage disposal systems can cause widespread disease and groundwater pollution when they are improperly designed, installed, or maintained, and (2) that septic tank systems are not intended to remove nitrate from sewage and can degrade groundwater quality, by raising nitrate levels, if too many systems are concentrated in one area. Public agencies are faced with additional difficulties arising from conflicting opinions, myths, and rumors regarding septic tank systems. It is unfortunate that relatively little effort has been made to determine best practice for septic tank systems, while concerted efforts have been made to improve community sewerage systems.

Scope and Objectives of the Study

The primary objective of this Individual Waste Disposal Program is the development of a management program which will achieve and maintain a level of environmental sanitation for nonsewered areas consistent with water quality goals. A satisfactory level of environmental sanitation is defined here as a quality of performance, in protecting public health, equal to that of a community sewerage system that is properly designed, constructed, and maintained.

The secondary objective of the study is the functional description of the administrative procedures and policies which should govern the installation, monitoring, maintenance, and repair of septic tank-drainfield systems to extend the useful life of these systems.

The scope of work involved in achieving the above objectives can be divided into six basic tasks, as described below:

1. Review past and present regulations regarding individual waste disposal systems in Lane County.

2. Review past performance of septic tank systems in Lane County.

3. Develop and evaluate alternative management strategies, including new regulations or modifications to existing regulations.

4. Recommend and assess the effects of alternative programs in areas selected by L-COG and Lane County.

5. Participate in public meetings.

6. Prepare and publish this report.

In addition to the six tasks above, three limitations on the scope of work were mutually agreed upon to achieve the greatest benefit from the study effort: (1) the study is limited to systems serving residential dwellings; (2) the study is to emphasize the most commonly used system for wastewater disposal, the septic tank-drainfield system; and (3) the study does not consider disposal methods for the pumped contents of septic tanks, called septage.

Study Area Description

The study area for the 208 planning program includes that portion of the Willamette River Basin in Lane County, extending from the Coast Range on the west to the summit of the Cascade Range on the east, excluding all federally owned lands. As shown in Fig. 1-1 the study area is divided into four subbasins defined by watershed boundaries: the Coastal Fork of the Willamette River, the Middle Fork of the Willamette River, the McKenzie River, and the Main Stem Willamette River. The Eugene-Springfield metropolitan area, also shown in Fig. 1-1, is excluded from the Individual Waste Disposal Management Study because wastewater treatment management for that area was the subject of analysis for a separate study and report within the 208 Planning Program.

Local physical characteristics pertinent to developing an individual waste disposal management program include: precipitation and evaporation; groundwater depths and seasonal variations; general soil suitability for installation and use of septic tank systems; and present development of communities and urbanizing areas. Each topic is discussed briefly below as an introduction to the study area. The latter three subjects are discussed again for specific areas in Chapter 3 or Chapter 5. Local political characteristics including policies on annexation, growth, and extension of utilities are not directly pertinent to a program intended to improve the operation of individual septic tank systems. Rather, they are usually associated with a situation when septic tank systems are failing to operate properly. For this reason, political characteristics are not described here, but are discussed indirectly in sections on advantages, disadvantages, benefits, and costs of alternative and recommended programs in Chapters 7 and 8.

Most precipitation in the Willamette Valley portion of Lane County falls as rain. Snow falls infrequently during the winter and melts rapidly. Over 90 percent of the total precipitation occurs between October and May, as shown for Cottage Grove in Table 1-1. With only minor differences, the same monthly distribution of precipitation occurs throughout the study area, including areas in the upper McKenzie River region. Table 1-2 shows the wide variation in annual precipitation throughout the study area, ranging from about 40 inches per year on the valley floor to nearly 80 inches per year near McKenzie Bridge, higher in the Cascade Range.[1] Reservoir evaporation rates measured in the valley average less than 30 inches per year.

In the winter, groundwater may rise nearly to the surface in some locations at lower elevations, but depth varies considerably throughout the study area. A study of groundwater in the Eugene-Springfield area (including Junction City, Elmira, Jasper, and Marcola) showed that in January, 1970 the water table was near ground level at several wells from Eugene northward to Junction City and Coburg.[2] Depths to the water table generally increase as ground elevations rise, but localized perched water tables can be found in many areas. Groundwater levels also approach the surface near rivers and creeks in the study area, but are not significantly influenced by surface water levels more than a few miles away.

An overview of the suitability of Lane County soils for septic tank systems has been presented by L-COG.[1] As noted in that publication, the combination of soil types, depths, and slopes, plus groundwater depths, presents at least moderate problems throughout the county, with severe problems in many areas. Areas with slight problems are generally small pockets within larger regions that have severe or moderate problems. It must be emphasized here, however, that the information presented in the L-COG Atlas is drawn from generalized information, and that the only true determination of suitability for a septic tank system is an on-site evaluation. As noted in the Atlas, the basic message of the septic tank suitability map is that " . . . septic tanks cannot be used indiscriminately and, therefore, that rural residential development must be planned for and encouraged in relation to the natural limitations imposed by soil conditions, as well as by other environmental factors."

Over the past 25 years residential development within the study area, as measured by subdivision platting activity, has been most intense during the 1960's and has occurred largely in the Main Stem Willamette sub-basin in terms of location within the study area. Of nearly 100 subdivisions platted between 1950 and 1973, slightly more than 80 were recorded from 1960 to 1969 and nearly 40 were located in the Main Stem Willamette sub-basin. In contrast to the heavy platting activity in the 1960's only about 10 subdivisions were platted between 1950 and 1959, and fewer than 10 between 1970 and 1973. Subdivisions in the Coast Fork Willamette, Middle Fork Willamette, and McKenzie sub-basins have been clustered principally along the major highways through those areas. L-COG projections of future rural residential and urbanizing areas in Lane County are generally represented in Fig. 1-2. Nearly 24,000 households in the 208 planning area, but outside the Metro Area, are expected to be using some form of individual wastewater disposal in the year 2000, nearly double the slightly more than 13,000 existing in 1970.[3] A more detailed projection of non-sewered households is presented in Chapter 3.

Sources of Information

Information contained in this report was taken from a variety of sources. Data on area characteristics, population, and numbers of households were obtained from L-COG and Lane County staff members and reports, and files of the County Land Use and Planning Division and Water Pollution Control Division. Septic tank system installation and pumping costs were obtained from information supplied by licensed installers and pumpers in the study area. Lane County Water Pollution Control Division staff also supplied information regarding past and present management practices and system performance found in Chapters 4 and 5. Description of system performance in areas outside Oregon was based upon information obtained by telephone calls, previous Brown and Caldwell reports, and two visits by Brown and Caldwell, L-COG, and Lane County personnel to Marin County. Technical reports and papers from throughout the United States were reviewed in describing best recommended practice, and frequent reference was made to both the Oregon Revised Statutes and the Oregon Administrative Rules throughout the conduct of the study.

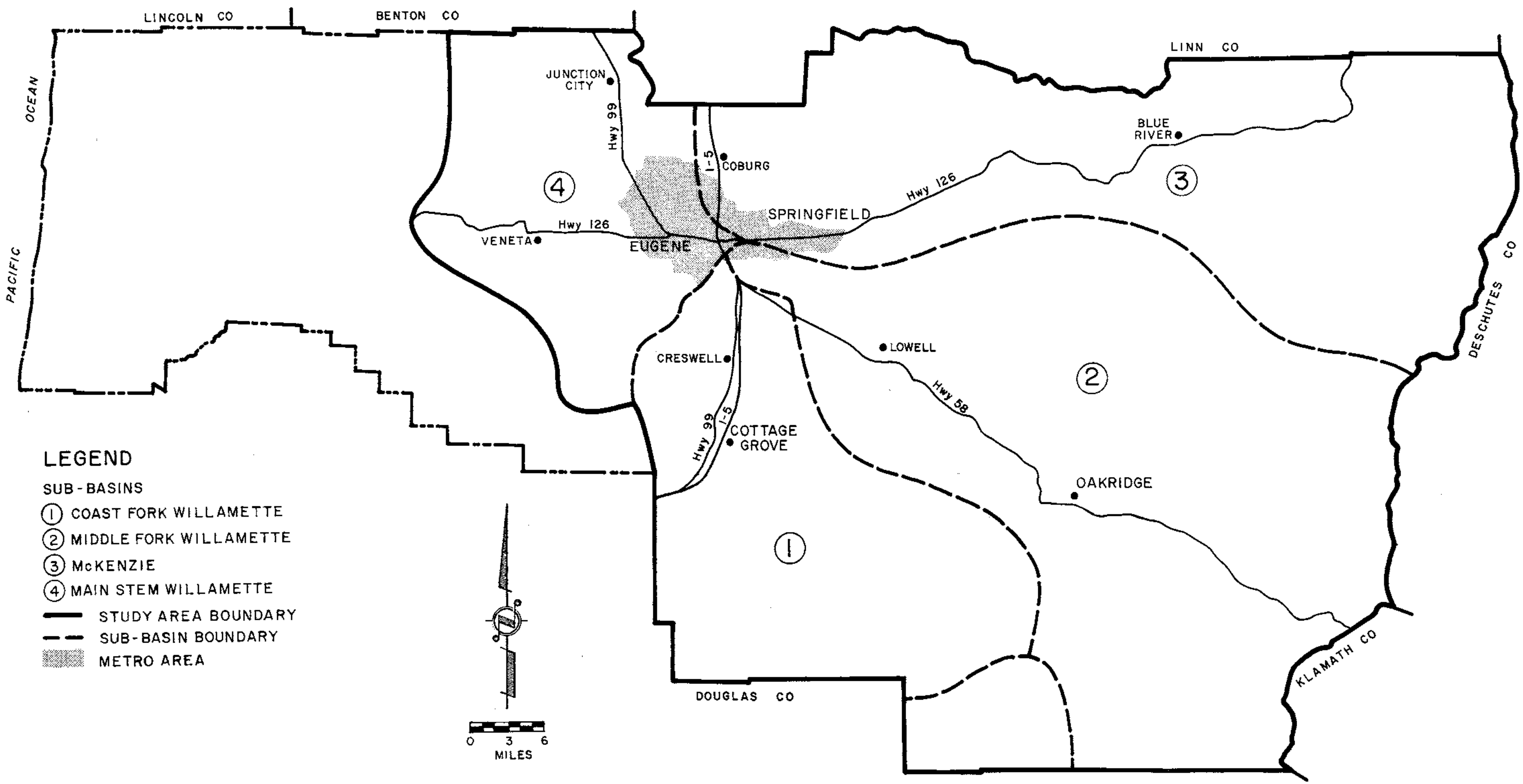


FIG. I-1 STUDY AREA LOCATION

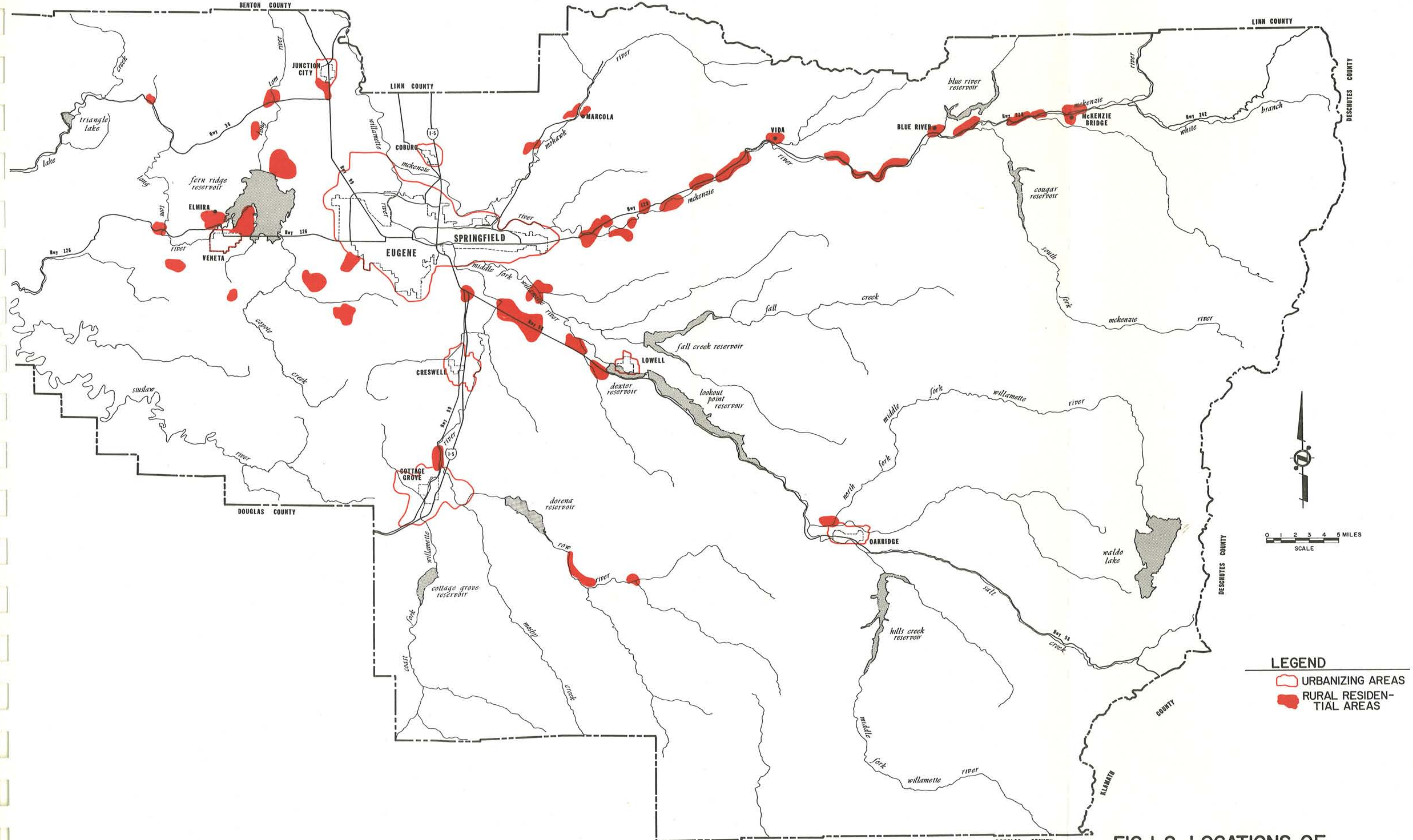


FIG. I-2. LOCATIONS OF FUTURE RESIDENTIAL DEVELOPMENT

TABLE 1-1. DISTRIBUTION OF AVERAGE MONTHLY PRECIPITATION IN COTTAGE GROVE

Month	Percent of total annual precipitation
January	15
February	12
March	12
April	7
May	6
June	4
July	1
August	1
September	3
October	9
November	14
December	16
Total Annual	100

Source: U.S. Weather Bureau

TABLE 1-2. ANNUAL PRECIPITATION AT LOCATIONS IN THE STUDY AREA

Location	Precipitation, inches
Veneta	50
Junction City	37
Cottage Grove	46
Oakridge	45
Leaburg	59
Blue River	70

Source: Reference No. 1

Acknowledgements

Successful completion of a study of this type is dependent on the advice and cooperation of a great many individuals. We are particularly indebted to Roy L. Burns, Director of Lane County's Water Pollution Control Division for his valuable advice and information; to Albert E. Wright, L-COG Project Director during our study; and Gary Darnielle, L-COG Project Officer, for their advice on policy matters and on legal and institutional aspects of the management program. We are also indebted to the L-COG 208 Technical Advisory Committee and its Subcommittee on Individual Waste Disposal for the hours spent reviewing our work for content and clarity. Finally, we would like to thank Suzanne Schweitzer of L-COG, and Craig Starr and Ted Dietz of the Lane County Water Pollution Control Division for their contributions in staff meetings and comments on draft copies of report chapters and maps.

CHAPTER 2

SUMMARY

Many of those who wish to refer to this report will have neither the time nor the inclination to study it in detail. For their benefit, this chapter presents in brief form the definitions, basic assumptions, and the findings and recommentations of the study. The reader is referred to the individual chapters of the report for more complete discussion of each topic.

USE OF INDIVIDUAL WASTE DISPOSAL SYSTEMS

The use of septic tank systems in that portion of Lane County within the study area is described in terms of physical characteristics of the system components, present and expected future numbers of systems serving single-family homes, current costs of constructing and pumping the systems, and the characteristics of septage - the contents of the septic tanks when pumped.

Types and Numbers of Systems in Use

The septic tank-drainfield system is by far the most widely used of all on-site sewage treatment and disposal systems both in Lane County and in Oregon in general. Other systems are approved for use only in homes without running water, and still others are considered experimental by DEQ and are therefore not approved for general use.

The septic tank-drainfield system includes both a tank and a subsurface trench disposal system under Oregon regulations. The septic tank is a watertight container which serves to separate solids from liquids, digest organic matter, and allow liquids to discharge into the soil outside the tank. A drainfield is composed of one or more disposal trenches containing coarse gravel and perforated distribution pipe. Multiple trenches are usually dug in parallel to minimize land area used, and they may be connected in loops or in sequence, or they may be left unconnected.

Past and present numbers of systems in the study area had to be estimated since no exact records exist which tabulate the total number of individual disposal systems in the county. Past and present non-sewered populations were obtained from L-COG for this purpose and were divided by an assumed average of 3.5 persons per household to determine the number of non-sewered households. The results of this calculation showed that the number of individual disposal systems in the study area has grown from about 10,000 in 1950 to slightly over

12,000 in 1970. If the Eugene-Springfield area is included in the totals, there were approximately 25,000 systems in the entire 208 basin in 1970 -- double the number in the area of investigation for this study.

Projections of the number of septic tank systems expected in the future were based on L-COG estimates of study area population and household size. The results of this determination showed that the number of non-sewered households in the study area is expected to increase to about 16,000 in 1980, 20,000 in 1990, and 24,000 by the year 2000. In other words, the number of non-sewered homes in the study area is expected to double between 1970 and the year 2000.

Current Costs and Septage Characteristics

During the study, the staff of the Lane County Environmental Management Department made a telephone survey of licensed septic tank pumpers and installers in order to determine current costs in the study area. Unit installation costs were then determined for the house sewer, septic tank, distribution box, and disposal trenches. Pumping costs included both direct pumping charges and a mileage charge for tanks outside the pumper's immediate service area. Theoretical installation costs for a three bedroom home using average unit costs varied from approximately \$800 to \$1600, depending on the size of tank used and type of soil on the site. Average pumping cost for a 1000 gallon tank are currently \$85 for direct cost, with an added \$0.25 to \$1.10 per mile if the pumper has to travel outside his normal service area.

The estimated volume of septage pumped in 1975 in the study area was 1.7 million gallons based on information supplied by licensed pumpers during the telephone interviews. In terms of strength, septage is a strong waste, since it is the concentrated material removed by the septic tank. Analysis of the septage delivered to the Eugene sewage treatment plant showed that local septage is typical of that found throughout the United States, that is, approximately 25 to 65 times more concentrated than typical domestic raw sewage entering a wastewater treatment plant. While disposal into municipal sewage treatment plants is the only disposal method approved generally by DEQ at the present time, the combination of high nutrient content and low heavy metal content of septage makes land application an attractive alternative disposal method where satisfactory application sites are available.

PAST AND PRESENT MANAGEMENT PRACTICES

The rules, regulations, and policies which comprise septic tank management practice are discussed in Chapter 4 under five headings - the five management elements used throughout this report. Additional information provided includes a general history of septic tank management in Lane County, and a description of related topics - sanitary surveys, information services, and recent costs of the county's individual waste disposal management program.

Management Elements

There are five phases in the life of a septic tank system which affect its life expectancy and reliability. In order of occurrence these phases are: (1) site evaluation; (2) design; (3) installation; (4) maintenance; and (5) repair.

Site evaluation involves analysis of the physical conditions on a specific lot to determine suitability for a septic tank-drainfield system according to DEQ design standards. The design phase includes determining compliance with DEQ standards which define suitable conditions, and determine necessary separation distances and drainfield and septic tank sizes. Installation includes excavation, placement, covering of the system components, and inspection of final construction. Maintenance as defined in this report includes those routine steps taken to improve operation - specifically periodic pumping of the tank. Repair procedures are any actions taken to correct a failure of the septic tank system.

Management Practices

Since January 1974 statewide responsibility for regulation of subsurface sewage disposal has been vested in the Oregon Department of Environmental Quality. DEQ is authorized to delegate portions of its administrative authority by contract to those counties willing and capable of carrying out the authorized duties. Lane County is one of 23 such counties. The current contract between Lane County and DEQ relating to septic tank systems permits the county to (1) process and approve construction permits; and (2) inspect completed construction, certify satisfactory completion, and aid in the handling of appeals.

Processing and approval or disapproval of construction permits requires activities in the first two management elements described earlier - site evaluation and design. Sites are evaluated by members of the County Water Pollution Control Division staff upon receipt of a construction permit application and fee. The evaluation includes type of soil, depth to groundwater, ground slope, type of water supply, and size of lot. A report is then prepared and given to the applicant indicating whether or not the site is suitable for a septic tank system. If not judged suitable, the applicant may take one of several possible actions to attempt to obtain approval for some type of individual waste disposal system on the lot. If the site is judged suitable the applicant is provided with a construction permit which includes a design sketch of system location on the lot, together with specifications regarding sizes and capacities of the tank and trench.

When construction of the system is complete, with the exception of final backfilling to cover the tank and trench system, the County Water Pollution Control Division is notified. An inspection is then made to determine if the system as constructed complies with all regulations.

Lane County has never had specific regulations for septic tank system maintenance, and no regulations are in effect today at either the state or county level. Information obtained from licensed pumpers in the study area indicates that tanks are pumped once every 12 years on the average. An additional fact obtained from the survey of the pumpers was that a majority of septic tank system owners have their tanks pumped only in response to a failure, not as part of a preventive maintenance program.

When a system owner applies for a repair permit, the County Water Pollution Control Division staff makes a site evaluation and issues a report to the owner, either providing a specific design for repair of the problem, or, in unique situations, requiring that the design be completed by a registered engineer. In each case, the specified modifications are intended to solve the problem or, if complete correction is not possible, to minimize hazards to public health. Once the repair is completed, county staff again makes a final inspection and either issues a certificate of satisfactory completion or instructions for additional corrections necessary before the certificate can be issued. From 1973 through 1976 the county has issued approximately 300 repair permits annually.

Information obtained from the County Environmental Management Department shows the following characteristics, countywide, for the individual waste disposal management program in 1970 and 1975:

Characteristic	1970	1975
Total systems	30,900	36,700
Site evaluations	500	1,200
Employees	7.0	8.7
Expenditures, dollars	74,000	133,900

A discussion with the Water Pollution Control Division Director revealed that the staff does not feel it has sufficient time to devote to all required activities. The program management element which suffers most is control of construction, in that there is often a lack of time to perform a final inspection as thoroughly as the staff would like, and little or no time to have a meeting with both the prospective owner and the installer before installation begins.

SYSTEM PERFORMANCE

The service life of a septic tank system is the measure of performance discussed in Chapter 5. In nearly all cases, failure by discharge of sewage onto the ground surface is the factor used to define service life, since this is the type of failure for which records are most readily available from agencies responsible for system management. Clogged pipelines, a second form of septic tank system failure, are normally corrected without public agency involvement or knowledge.

Lane County Study Area

A summary of the findings about septic tank systems performance in Lane County is as follows:

1. Using the most precise record of system age at failure, that is, repair permits and building permits, the median age of failing systems is less than 10 years.

2. If Assessment and Taxation Roll information is also used to estimate ages of systems which have failed and for which the owner has contacted the county, the median age at failure is raised to between 10 and 15 years.

3. Less than one homeowner in 10 can be expected to contact the county in order to obtain a repair permit for a failing system.

4. Only 50 percent of subsurface sewage disposal systems were found to be operating satisfactorily, and approximately 25 percent were found to be failing, on both a county-wide basis and in the study area, in a 1969-1970 environmental survey. The definition of failure in the survey, however, included direct discharges of dishwashers and clothes washers to the ground surface, as well as sewage surfacing from drainfields.

5. Insufficient information exists in county records from which to accurately define a survival curve for septic tank systems. This is not a criticism of the county's record system, which is above average. Administrative records rarely produce the detailed information necessary for accurate survival curves.

6. Of those failing systems known to the county, and for which the county has both definite construction and repair dates, about one-third failed within five years of installation, about half failed between six and ten years after installation, and a total of 81 percent failed within ten years of installation.

Areas Outside Oregon

Review of available literature on septic tank system performance in areas outside Oregon reveals the following significant points:

1. The number of published analyses of septic tank system performance is very small when compared to the number of people served by these utility systems.

2. In those analyses that are published, only a small fraction include field surveys or inspections to verify rates of survival or failure.

3. When repair permit records based on voluntary homeowner repair requests are used to calculate drainfield life without periodic field surveys, the average age before failure appears to be 25 to 30 years.

4. Where inspections or surveys have been combined with a review of office records, average length of service before failure has been less than 10 years.

BEST EXISTING MANAGEMENT PRACTICES

The description of "best recommended practice" is an exercise in the application of pragmatic technical judgements. A septic tank system once installed is unavailable for further evaluation except for observation of failure. We can therefore define by field observation that the drainfield system was too small, but there is no way that we can identify the ones that are too big. Since bigger, in terms of drainfield design, is almost always better, best recommended practice poses a problem of defining a nebulous set of criteria for a system that is just big enough. The goal must not be elimination of all failures, but reduction of the number and frequency of failures to a level which will produce a satisfactory level of environmental sanitation while assuring the homeowner that he may continuously occupy his dwelling.

Site Evaluation

The site evaluation, which determines the suitability of a given site for the installation of a septic tank system, is a key element in effective septic tank management. A properly designed system installed in the wrong location will still be subject to early failure. Of particular importance are the factors of soils, groundwater, and lot configuration. For a successful site evaluation program it is important that the evaluation be performed by a qualified technician with sufficient background and experience to draw sound technical conclusions from his field observations.

Design

The design of septic tank systems may be divided into two parts - the septic tank and the drainfield. Of the two components the drainfield is far more susceptible to problems leading to failure. The most important technical information available to date supports the following assumptions for drainfield design:

1. The life of a soil absorption system, properly installed, is directly proportional to the amount of infiltrative surface area, so long as soil percolative capacity is above a limiting value.

2. A gravity-fed absorption system in fine-grained soils with 450 square feet of infiltrative surface area per bedroom is defined as a control

system and will last for 15 years. Less infiltrative surface area will result in a proportionately shorter life. Infiltrative surface should be calculated on the basis of trench sidewall area only.

3. A control soil absorption system, supplemented after failure with a second identical system and an alternating valve, may thereafter be operated by alternately resting each half and will last for the life of the dwelling.

4. Systems smaller than a control system will have to be supplemented at shorter intervals until the total installed infiltrative surface equals that of two control systems. Thereafter, the systems may be rested alternately and will last for the life of the dwelling.

5. Coarse-grained soils which permit clogging in depth at the infiltrative surface will accept higher application rates. For coarse-grained soils a control system may be defined as 250 square feet of infiltrative surface area per bedroom. A coarse-grained soil would be one at least as porous as coarse sand.

6. Seasonal high groundwater should not rise higher than three feet below the bottom of the drainfield trench for a period longer than one to two weeks.

7. Drainfield trenches should be installed in series on slopes and looped on level ground. The use of distribution boxes should be discontinued since evidence to date indicates that they offer no advantage and, in fact, usually end up diverting most of the liquid to one part of the system.

8. Variations and gradations within these assumptions should be applied only by a skilled technician.

Assumptions 2, 5, and 6 above are all more restrictive than corresponding standards in current Oregon regulations for subsurface sewage disposal.

Installation

Control of septic tank-drainfield system installation should include both construction inspection and the preparation of record drawings. While septic tanks are normally free of construction defects, the drainfield is susceptible to serious damage from poor construction practice. At least one inspection, and preferably two, should be made during drainfield construction to control the worst abuses.

Other steps which also could be taken to improve installation practices include regularly scheduled regional training and review sessions for sanitarians involved in installation inspections, and a procedure for testing and certification of system installers who are now licensed solely on the basis of successful completion of an application, filing of an application fee, and posting of a bond.

Maintenance and Repair

While the design and installation practices described above can delay the date of failure for several years, they cannot by themselves guarantee the satisfactory performance of a septic tank system. To achieve truly satisfactory performance an effective surveillance and maintenance program must be established which includes the periodic inspection of each septic tank system and assures that tanks are pumped and defective systems repaired or replaced as necessary. Experience in Marin County, California, indicates that tanks should be inspected not less frequently than once every two years. Tanks should be pumped whenever the accumulated sludge depth reaches or exceeds one-quarter of the total liquid depth, or when the scum layer approaches the bottom of the tank scum baffle.

The best practice for repair of a drainfield actually takes place during the site evaluation and design phases, when a drainfield replacement area equivalent to 100 percent of the original drainfield is reserved so that a replacement field can be installed when the first field fails. The design should also insure that the replacement area is so situated that (1) the second field can be constructed without destroying the first, and (2) the two drainfields can be connected by a valve so they can be alternated as necessary thereafter.

Best Practices Outside Oregon

A review of current practices in public agencies around the country showed that there were only two areas where management practices are being applied which approach the best management practices for septic tank systems described above. One of those areas is Marin County, California, and the other is the Georgetown Divide Public Utility District, also in California. Other areas, including the State of Wisconsin, are in various stages of proposing changes in present management techniques, but the two programs described in Chapter 6 are the only ones known to be in operation for any significant length of time. Of the two California areas, however, only Marin County has performance records on a significant number of permanent homes.

In 1971, Marin County adopted an ordinance providing regulations for the design and maintenance of septic tank systems. The ordinance vested administrative control of the program with the County Health Officer, authorized the issuance of design and installation regulations, and established the legal basis for enforced inspection and repair of defective systems. Violations of the ordinance are punishable under the nuisance abatement provisions of the county code.

As adopted, the ordinance applies only to new septic tank systems constructed after the date of the ordinance. Design and site evaluation criteria were adopted which are equivalent to, or more stringent than, those described earlier in this section. Building occupancy permits are made subject to a two-year (biennial) inspection and determination that the septic tank system is operating satisfactorily and either does not require pumping, or has been pumped as required.

Marin County now has some 400 systems installed under the new ordinance over a period of five years, of which 142 have been inspected at least once. In that time, only three failures have been observed, two of which were the result of misapplications. This leaves only one documented failure in five years. While the time period is short for evaluation of the design and maintenance criteria used, these results are extremely encouraging.

FEASIBLE MANAGEMENT STRATEGIES

The two basic components of each management strategy in this evaluation are: (1) management functions and related technical practices, and (2) the powers and policies of the management agency. In the initial stages of developing management strategies, installation and maintenance were the management elements selected as requiring improvement to approach best practice. In addition, two institutional strategy components were developed: possible agencies capable of administering the program, and alternatives for the size and scope of the program.

The first portion of Chapter 7 describes two alternative practices for installation of new systems and repairs, five alternative strategies for maintaining septic tank systems, five statutory agencies capable of managing a septic tank system program, and five possible program sizes as measured by the number of systems to be included in the program. Considering all possible combinations of these alternative strategy components, there are a total of 250 alternative programs which could be described and evaluated. The obvious next step was to develop a set of evaluation criteria and screen the alternatives to a reasonable number for final evaluation.

Basis of Evaluation

Any proposed program, project, or strategy should be evaluated in terms of (a) the results which can be expected, (b) the likelihood of putting the program into operation in the first place, and (c) the costs which will be incurred in running the program. Four evaluation criteria are used in this report:

1. The management strategy or component must be effective in achieving desired objectives.

2. The strategy or component must be relatively easy to implement.

3. Manpower requirements for the strategy or component must be reasonable.

4. Costs of program or component management and costs to the homeowner must be reasonable.

Screening of Alternatives

As a result of the screening process carried out by L-COG staff, Lane County staff, and Brown and Caldwell, the number of program alternatives selected for final evaluation consisted of two alternatives for installation practices, three alternatives for maintenance, and two basic institutional alternatives combining program size and managing agencies.

Installation practice alternatives included both continuing present practices, and performing two construction inspections. The three maintenance alternatives were: (1) perform regular maintenance inspections and recommend action to the homeowner; (2) perform regular maintenance inspections and levy fines for no action, and (3) perform regular maintenance inspections and if the homeowner fails to take necessary action have the work completed and bill for the cost incurred.

The two basic institutional alternatives were: (1) limit the program to local areas only and include all systems, new and old, in a program administered by either Lane County, a county service district, or a sanitary authority; and (2) apply the program throughout the study area, but only include new systems, repaired systems, and volunteers in a program administered by either Lane County or a county service district.

Recommended Strategy

Based on an overall consideration of effectiveness, ease of implementation, staff requirements for a management program, and cost to the homeowner, the recommended strategy for the Lane County study area:

1. Would be managed by Lane County.

2. Would include all new systems and repaired systems, areawide, installed after the program starts, as well as voluntary entries and specified local areas defined to be appropriate for inclusion.

3. Would use best practice for installation of new systems and system repairs.

4. Would implement biennial inspections of all systems in the program, paid for by inspection fees, with necessary homeowner action enforced by fines.

EFFECTS OF RECOMMENDED MANAGEMENT PROGRAM

Chapter 8 of the report discusses expected benefits and costs of the program, its effect on land use, and specific effects expected in the Pleasant Hill area.

Program Benefits

Benefits of the recommended program fall into two categories: (1) improved system performance; and (2) improved environmental sanitation. In our opinion, implementation of the proposed technical practices should lengthen average drainfield service life from approximately 10 years at present to about 15 years. The expected 50 percent improvement in service life is one-half of what we believe could be achieved if best design practices were adopted by DEQ in addition to Lane County's adoption of installation and maintenance practices described herein.

Improved septic tank system service life on farms and large rural lots will obviously do less to minimize public health hazards than will improved system life in more densely populated areas. In recognition of this fact, present rules permit new systems in designated rural areas to be considered for approval even when they do not meet design regulations. While public health protection through improved septic tank system performance is not an overriding concern in these rural areas, environmental sanitation for individual farm families would be improved by the recommended program.

Rural residential areas with lot sizes of one to five acres can be expected to benefit more than agricultural areas from improvements in septic tank performance. In these more densely populated areas, failing septic tank systems represent a greater public health hazard because of the greater danger of disease transmission.

Maximum expected benefits from the recommended program will occur in urban fringe areas and growth centers, which are defined here as areas with lots smaller than one acre. Such areas contain the greatest possibility of an outbreak of a communicable disease caused by surfacing sewage from a septic tank system.

Program Costs

Three different types of cost are of interest in this study: (1) direct cost to the homeowner, (2) the indirect cost caused by the need to dispose of greater annual volumes of septage than would occur without the maintenance aspect of the program, and (3) increased county manpower requirements.

The cost to the individual homeowner for participating in the recommended management program is expected to be less than $20 per year more than present costs over the life of the system. In cases where use of best construction and maintenance practices prevents either the need for multiple drainfield replacements or early construction of a second drainfield, the cost of the recommended program will be less than $10 per year more than the cost of present practice.

A comparison of expected future volumes of pumped septage, with and without the recommended maintenance program, showed that annual septage volumes are expected to increase by approximately 100 percent, or 1.6 million gallons, in the study area by the year 2000 due to the recommended program. While these greater volumes can be handled relatively easily, detailed planning and action is required in the near future to determine desirable, appropriate, and economical disposal methods.

The recommended management program would also require Lane County to expend some 120 additional man-days, or nearly one man-year, in the first year of the program, and a total of about four additional man-years by 1984. It must be remembered, however, that these figures, like the septage volumes, do not include either the coastal area of the county or the Eugene-Springfield metropolitan area. If the entire county were included in the program, all manpower requirement projections would have to be multiplied by a factor of about three.

Effect on Land Use

The recommended program will have no effect on present land use. Land use planning and development based on the use of septic tank systems, however, can be carried out with more confidence that these systems will last for the life of the dwellings in each area.

Example Area - Pleasant Hill

The Pleasant Hill area was chosen by the Lane County Environmental Management Department as a representative specific area in which the impacts of the recommended program could be tested. The reasons for choosing Pleasant Hill were that (1) it is an area expected to grow significantly in the next 10 to 20 years; (2) it is presently served by septic tank systems; (3) it is located relatively close to the Eugene-Springfield metropolitan area and treatment plants, and (4) it is situated on soils which present severe restrictions to the use of septic tank drainfield systems.

The five subject areas for which effects of the recommended program are described are land use, homeowner costs, system performance, septage volume pumped, and management manpower requirements.

Land Use. There would be no change in land use caused by implementation of the recommended program, since approval of new septic tank systems would continue under the presently-used DEQ regulations regarding site characteristics.

Homeowner Costs. In addition to the costs associated with construction and maintenance of septic tank systems under current regulations, homeowners in the Pleasant Hill area under the recommended program would (a) pay about five percent higher construction costs, (b) pay a system inspection fee of about $20 every other year, and (c) pay for having septic tanks pumped every four years, on the average, rather than less frequently as at present.

System Performance. While the County Water Pollution Control Division staff describes present performance of systems in Pleasant Hill as reasonably good, implementation of the recommended program should extend the average life of systems in the program by three to five years, and should prevent many early failures due to poor construction practices. Under the predominantly severe site limitations in Pleasant Hill, the management program would produce a reduced incidence of surfacing sewage. The reduction in frequency of failures, in turn, would reduce public health hazard, maintain or increase property values, and minimize the possibility that community sewerage or annexation to a neighboring community would be required.

Septage Volumes. Assuming that the recommended program begins in 1980, approximately 40 percent more septage would be produced each five years than with a continuation of present pumping practices. By 1990, under the management program, 56,000 gallons would be pumped from 152 systems in the program plus 298 non-program systems. Correspondingly, 31,000 gallons would be pumped from the same 450 systems if there were no management program. The incremental volume due to the program in 1990, then, is 25,000 gallons, 80 percent greater than without the program.

Management Requirements. Management manpower requirements for administration of the recommended program in Pleasant Hill in the first year of the program (assumed to be 1980) and in 1990 were estimated to illustrated the effect of this one geographic area. Manpower requirements were based on an assumed number of 340 systems in the planning area in 1980, 450 systems in 1990, 11 to 13 new installations per year, one voluntary entry to the management program each year, and four repaired systems brought into the program each year. The impact of these figures on the management agency would be to require slightly more than four man-days in 1980 and 26 man-days in 1990.

CHAPTER 3

USE OF INDIVIDUAL WASTE DISPOSAL SYSTEMS

This chapter describes the physical characteristics of sewage treatment and disposal systems presently used for individual homes in Lane County. The magnitude of the present problem is described in a review of the number of septic tank systems used in the past and at present, and of the volume and quality of septic tank contents, or septage, past and present. The magnitude of future problems is portrayed by future projections of both numbers of septic tank systems and of the volumes of septage expected to be produced.

TYPES OF SYSTEMS IN USE

The system types currently in use are described in the following paragraphs in three sections: (1) treatment and disposal systems used with a supply of running water; (2) nonwater-carried waste disposal methods, and (3) alternative treatment and disposal methods not presently approved for general use in Oregon.

Systems for Structures with Running Water

At the time of writing this report, Division 7 of the Oregon Administrative Rules gave general approval to two conventional wastewater treatment methods, one conventional effluent disposal method, and three alternative wastewater treatment and disposal methods. In addition, one method of septage disposal is used throughout the study area and is also described below.

Septic Tanks. As defined in current administrative rules, a septic tank (Fig. 3-1) is "a watertight receptacle which receives the discharge of sewage from a sanitary drainage system and which is so designed and constructed as to separate solids from liquids, digest organic matter during a period of detention and allow the liquids to discharge into the soil outside of the tank through an absorption facility." One-compartment tanks, which are currently more common in Lane County than two-compartment tanks, are essentially identical to the two-compartment unit shown in Fig. 3-1 with two exceptions: (1) there is no compartment baffle, and (2) the outlet pipe extends downward into the clear space as the inlet pipe does in Fig. 3-1.

In a septic tank, primary treatment is achieved through gravity separation of liquid and solids. Septic tank effluent is therefore of a lower quality than that which can be achieved with higher degrees of treatment, but a high quality effluent is not required if final disposal is to a subsurface disposal field. The tank serves to remove scum, grease, and settleable solids from raw sewage to prevent these materials from clogging the disposal field. Septic tank performance in terms of percentage removals of influent biochemical oxygen demand (BOD) and total suspended solids (SS), is generally rated at 50 to 60 percent removal of BOD and 60 to 70 percent removal of SS.

Aerobic Sewage Treatment Systems. Aerobic, or mechanical oxidation, systems are treatment units which mechanically bring raw sewage in contact with air to permit aerobic decomposition of the sewage followed by effective removal of suspended solids. The most commonly available systems of this type involve extended aeration which retains the sewage long enough to convert most of the waste matter into carbon dioxide and water. Over a period of time, however, there is a buildup of sludge in the treatment tank, just as there is in a septic tank, which must be removed to permit continuing acceptable performance. A typical two-chamber extended aeration unit is shown in Fig. 3-2.

When properly operated and maintained, the extended aeration process is capable of removing approximately 90 percent of the dissolved organic material and suspended solids from raw wastewater and can reduce coliform bacterial populations by about a factor of 10. While a high quality effluent can be produced from one of these systems, extended aeration units require power for mixing and regular attendance for operation and maintenance. They are also more susceptible to upset due to shock loadings of concentrated wastes and harmful chemicals than are septic tanks. Effluent quality from extended aeration plants can therefore be highly variable unless special precautions are taken.

Disposal Areas and Distribution Systems. The disposal area receiving septic tank or aerobic system effluent, though simple in concept, is a physical, chemical, and biological complex. Performance of the disposal system is a function of the design of the system, the construction techniques employed, the strength and chemical characteristics of the wastes, the rate of hydraulic loading, the local geology and topography, the physical and chemical composition of the soil mantle, and the care given to periodic maintenance of the septic tank. In most installations experiencing problems or failures, it is the disposal field rather than the septic tank which is the cause of the difficulty.

The disposal trench and the seepage trench are the only distribution methods presently approved for final subsurface disposal of sewage in Oregon. Current regulations define a disposal trench as a ditch with vertical sides and substantially flat bottom overlain by a minimum of 12 inches of filter material containing a distribution line and a minimum of 6 inches of soil. See Fig. 3-3. A seepage trench differs in definition from a disposal trench basically in the depth of its vertical sides, which can be more than 36 inches.

A distribution system is composed of one or more disposal trenches containing perforated distribution pipe. Multiple trenches are usually dug in parallel to minimize land area used; they may be connected in loops or sequentially, or they may be left unconnected. See Fig. 3-4. Septic tank or aerobic tank effluent can be distributed into a loop system with either a distribution box or a pipe manifold, or by connecting all distribution trenches with a perpendicular trench as shown in Fig. 3-4. In Equal Distribution Systems, the ends of the trenches

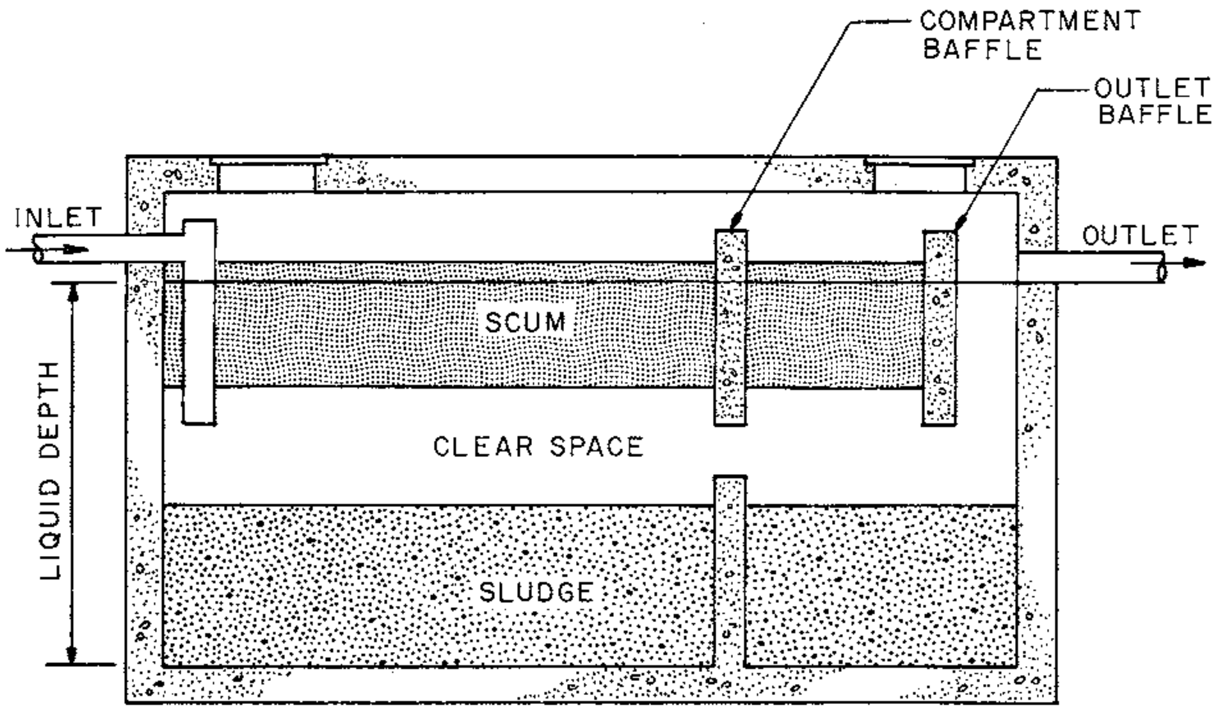
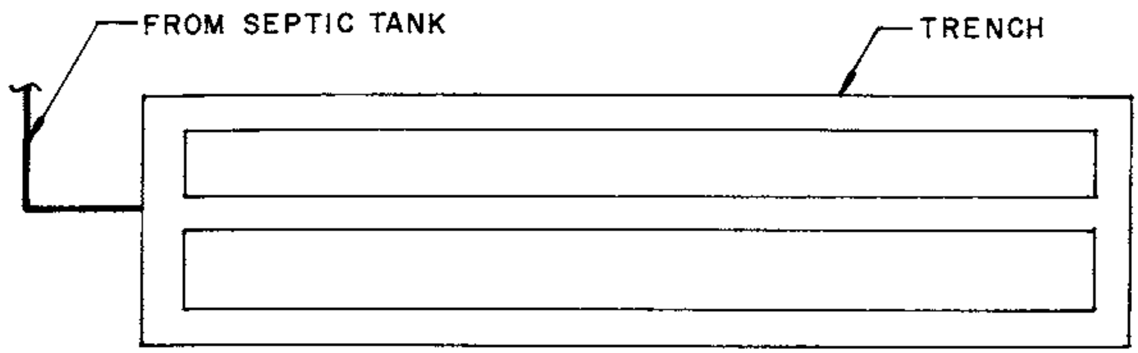
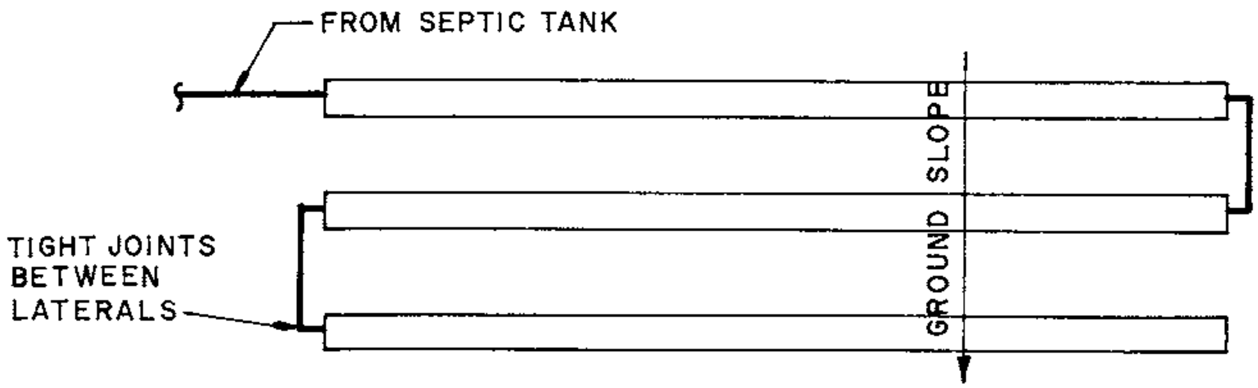


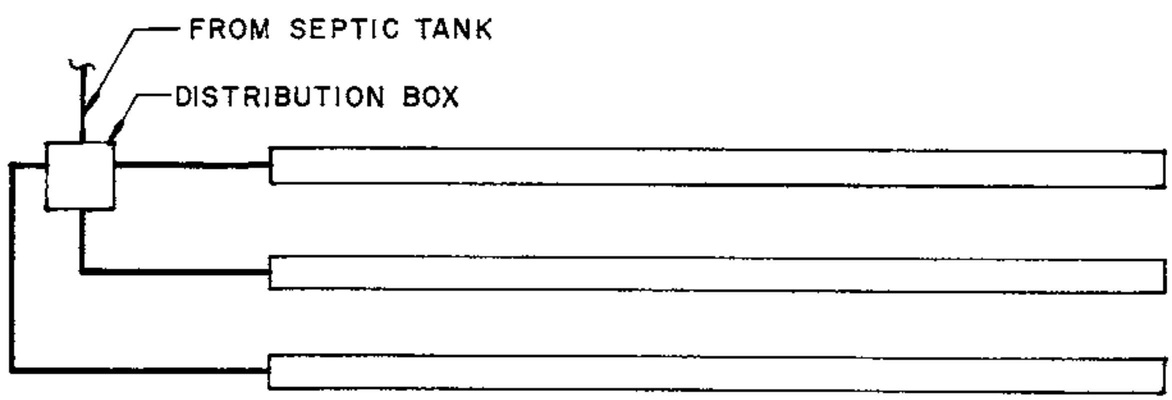
FIG. 3-1 TYPICAL TWO COMPARTMENT SEPTIC TANK



(a) LOOP SYSTEM WITHOUT MANIFOLD OR DISTRIBUTION BOX



(b) SERIAL DISTRIBUTION SYSTEM WITHOUT DROP BOX



(c) EQUAL DISTRIBUTION SYSTEM WITH DISTRIBUTION BOX

FIG. 3-4 TRENCH DISTRIBUTION SYSTEMS

farthest from the treated effluent inlet are left unconnected; treated effluent may be conducted into the trenches either with or without a distribution box. Sequentially connected trenches form what is known as a Serial Distribution System. This system is specified for areas with sloping ground and uses either drop boxes on the inlet end or tight joint connections at alternate ends of the trenches to convey treated wastewater from trench to trench.

Currently Approved Alternative Disposal Systems. Three alternative sewage disposal systems are currently approved by DEQ and included in the Oregon Administrative Rules. The three systems are: (1) sewage stabilization ponds, (2) land disposal by irrigation, and (3) holding tanks. Conditions placed upon the use of these systems prevent their use for urban or urbanizing residential areas. Sewage stabilization ponds are raw sewage evaporation lagoons which can be used only where mean annual evaporation exceeds rainfall; the lagoon must be located so that no existing or possible future residence will be within 300 feet of the pond. Land disposal by irrigation is permitted after sewage BOD and suspended solids have been reduced by treatment to 20mg/l and the waste has been chlorinated and stored before discharge. In addition, the land to be irrigated must not be accessible to the public. Holding tanks are permitted only on a temporary basis for residential dwellings faced with delays in installation of a subsurface or other alternative system, or when community sewers are expected to be available within five years. Holding tanks are permitted on a permanent basis only for small industrial or commercial buildings or occasional use facilities.

Septage Disposal Methods. The sole method of septage disposal approved by DEQ in current regulations is the emptying of tank truck contents into DEQ-approved disposal facilities. Approved sites in the study area at the present include all of the municipal sewage treatment plants. The plants are not required to accept septage, however. Disposal at other locations or onto the surface of the ground is prohibited except with specific authorization from DEQ.

Nonwater-carried Waste Disposal Methods

The use of nonwater-carried disposal facilities is presently acceptable with certain limiting conditions: (1) each installation must have a permit from DEQ; (2) no such facility is to be used for permanent dwellings having a water supply connection; (3) no water-carried sewage is to be placed in nonwater-carried waste disposal facilities, and (4) specific setback distances must be maintained between such facilities and groundwater supplies, surface public water, and property lines. Additional requirements are also set forth for maintenance of these facilities, for their construction, and for the construction of the structure housing them, with specific attention given to unsealed earth pit privies and self-contained toilets. Required maintenance for all nonwater-carried waste disposal facilities is that which will prevent the occurrence of a public health hazard or degradation of the quality of public waters.

Other Alternative Treatment and Disposal Methods

In recent years, several alternative sewage treatment and disposal methods have been developed which are applicable to individual homes, but are not currently approved for general use in Oregon. Responsibility for review and analysis of these experimental systems in Oregon is vested in the Department of Environmental Quality. Since 1974, DEQ has implemented a formal program for this review in two steps: (1) by contracting with Brown and Caldwell for an evaluation of alternative systems which was completed in 1975, and (2) by initiating a continuing program of installing and monitoring a limited number of experimental systems throughout the state[2]. The budget for that experimental program for the 1977 to 1979 biennium is $250,000.

Because review, analysis, and approval of these experimental systems is a DEQ responsibility, L-COG and Lane County agreed with the state to limit the scope of this study to septic tank systems, the most commonly used individual sewage disposal system. Therefore, alternative systems are not included in the management program discussed in this report.

NUMBERS OF SYSTEMS IN USE

The size of a management program for individual wastewater disposal systems in Lane County will depend upon the number of systems included. The following section presents information on the number of individual systems existing from 1950 to the present, and a projection of the expected number of systems in the future.

Past and Present

Since no exact records exist which tabulate the total number of individual disposal systems within the county, past and present system numbers were determined using estimated non-sewered populations in the study area and an assumption of 3.5 persons per household. Estimated population figures were obtained from L-COG for this purpose, and are shown in Table 3-1, together with estimates of the number of individual disposal systems. As indicated by Table 3-1, the number of systems in the study area has grown from about 10,000 in 1950 to slightly over 12,000 in 1970, serving corresponding populations of 34,000 in 1950 and 43,000 in 1970. Including the Eugene-Springfield area, there were approximately 25,000 systems in the entire 208 basin in 1970 - double the number in the area of investigation for this study.

A greater rate of growth in numbers of systems occurred between 1960 and 1970 (2,200 new systems) than occurred between 1950 and 1960 (400 new systems). While population increased more rapidly in the 1960's than the 1950's, there was not a five-fold difference in total population growth as Table 3-1 might indicate. One reason for the different rates of growth in the total study area population and in the non-sewered population is that Oakridge and Creswell,

TABLE 3-1. PAST NUMBERS OF INDIVIDUAL DISPOSAL SYSTEMS

Population and numbers of systems	Non-sewered in 208 basin	Metro-area non-sewered	Study area non-sewered
1950			
Population[a]	64,583	30,514	34,069
No. of systems[b]	18,452	8,718	9,734
1960			
Population[a]	74,655	39,237	35,418
No. of systems[b]	21,330	11,211	10,119
1970			
Population[a]	86,273	43,234	43,039
No. of systems[b]	24,649	12,352	12,297

[a]Information provided by L-COG.
[b]Assuming 3.5 persons per household.

which were served by individual systems in 1950, constructed municipal sewerage systems between 1950 and 1970; this decreased the number of people served by individual systems, while actual population in the area increased.

Future

The expected increase in numbers of households which may be served by septic tank systems can be based upon population projections recently made by L-COG for the rural portions of the study area. Population projections for the non-sewered areas made in February 1976 are shown in Table 3-2. Total study area population is projected to increase by 68 percent between 1970 and the year 2000, with the largest percentage gain in the Coast Fork Sub-basin (73 percent) and the smallest percentage gain in the Middle Fork Sub-basin (40 percent).

Based on projections of population per dwelling unit and total non-sewered population, L-COG has also derived projected numbers of households. Two projections were made: one assumed constant 1970 household sizes; the other assumed a continuing decrease in household size. The results of both projections are shown in Table 3-3 and Figure 3-5.

For purposes of planning in this 208 program it is assumed that population per dwelling unit will continue to decline. This assumption projects 3,300 more households than does the assumption of constant household size. Estimates of administrative manpower and cost based on this projection are not expected to be exceeded without major changes in land use planning policy in Lane County.

INSTALLATION AND PUMPING COSTS

Representative installation and pumping costs for septic tank systems within the study area were determined by a telephone survey of installers and pumpers conducted by the Lane County Environmental Management Department. The survey covered 24 of the 28 septic tank installers registered with DEQ and 9 of the 10 registered pumpers within the Willamette River basin portion of Lane County. Unit costs were obtained for major items associated with installation and pumping. These values are listed in Table 3-4. Installation costs include the house sewer, septic tank, distribution box, and disposal trenches. Costs associated with pumping include both direct pumping charges and a mileage charge for tanks outside of the pumper's immediate service area.

While there was considerable variation in all of the unit costs for installation as shown in Table 3-4, mean values were as follows:

House sewers	\$ 2.50 per foot
Septic tanks	\$ .31 per gallon (including installation)
Distribution boxes	\$27.00 per box
Disposal trenches	\$ 2.14 per foot of trench

The cost of the septic tank itself can be a significant fraction of total installations costs. Excluding installation, tank costs ranged from $225 for a 1,000 gallon tank to $425 for a 1,500 gallon tank.

The mileage charge for septic tank pumpers varied considerably, from a low of $0.25 to a high of $1.10 per mile, with a mean of $0.68 per mile and included charges for serivce to tanks in McKenzie Bridge and Oakridge by pumpers located in the Eugene-Springfield area. Direct pumping charges, on the other hand, were consistently either $0.08 or $0.09 per gallon pumped.

To illustrate the range of possible costs for actual systems, the above unit costs were applied to a septic tank system for a three-bedroom home under two sets of circumstances. In the first example the house is assumed to be located near the pumper and a disposal site, to have a 900 gallon septic tank, and to have a disposal field requirement of only 100 sq ft of sidewall area per bedroom, indicative of a sandy soil. These conditions result in an estimated installation cost of about $780, and a pumping cost of $77. (See Table 3-5.) Items in the installation cost include 60 ft of house sewer and a distribution box in addition to the septic tank and 150 ft of disposal trench. For the second example, the house is located 25 miles from the pumper and disposal site, is served by a 1200 gallon septic tank, and is situated in less suitable soil and groundwater conditions than the first example. The trench requirement in this example is 330 sq ft per bedroom. Under the latter set of assumptions the estimated installation cost is $1,609, and the pumping and mileage charges total $119. However, tanks do not need to be pumped every year. Findings in other areas indicate that tanks should be pumped on the order of once every four years - the same timing found locally by one of the larger pumpers in the county. Annual costs of pumping for the two homes are therefore about one-quarter of the charge per occurrence, as shown in Table 3-5.

SEPTAGE CHARACTERISTICS

Both the volume of septage and its strength affect the cost of disposal and the choice of disposal method. Each of these characteristics is discussed below.

Volume

A survey of nine of the ten registered septic tank pumpers in the study area provided some basic data regarding the volume of septage produced annually within the study area. This survey, conducted by county personnel, revealed that about 2,285 septic tanks were pumped during 1975, or about 8 percent of the total number of tanks within the 208 Program planning area. Assuming an average pumped volume of 750 gallons per tank, the total volume of septage pumped during 1975 was 1.7 million gallons. Using the unit pumping and mileage charges described above and assuming that half of the tanks incur 20-mile distance charges, the estimated cost to homeowners for pumping septage in 1975

TABLE 3-2. PROJECTED NON-SEWERED POPULATION

Sub-basin	Year			
	1970	1980	1990	2000
1	10,477	11,581	14,228	18,086
2	6,596	7,427	8,280	9,242
3	7,716	9,077	10,883	13,004
4	16,848	19,304	24,199	25,380
5[a]	1,405	1,671	1,988	2,364
Totals	43,042	49,060	59,578	68,076

Source: Lane Council of Governments
[a]Goshen-Seavey Loop Area

TABLE 3-3. PROJECTED NON-SEWERED HOUSEHOLDS

Sub-basin	1970[a]	1980		1990		2000	
		Constant ppdu	Declining ppdu	Constant ppdu	Declining ppdu	Constant ppdu	Declining ppdu
1	3,037	3,357	3,748	4,141	4,779	5,242	6,090
2	1,957	2,204	2,459	2,457	2,826	2,742	3,187
3	2,450	2,882	3,219	3,455	3,986	4,128	4,799
4	5,014	5,745	6,413	7,202	8,287	7,554	8,782
5[b]	407	484	541	576	655	685	796
Totals	12,865	14,672	16,380	17,831	20,533	20,351	23,654

Source: Lane Council of Governments

[a] Values based on average household sizes varying from 3.15 persons per dwelling unit (ppdu) in Sub-basin 3 to 3.45 ppdu in Sub-basin 1 as supplied by L-COG.

[b] Goshen-Seavey Loop Area

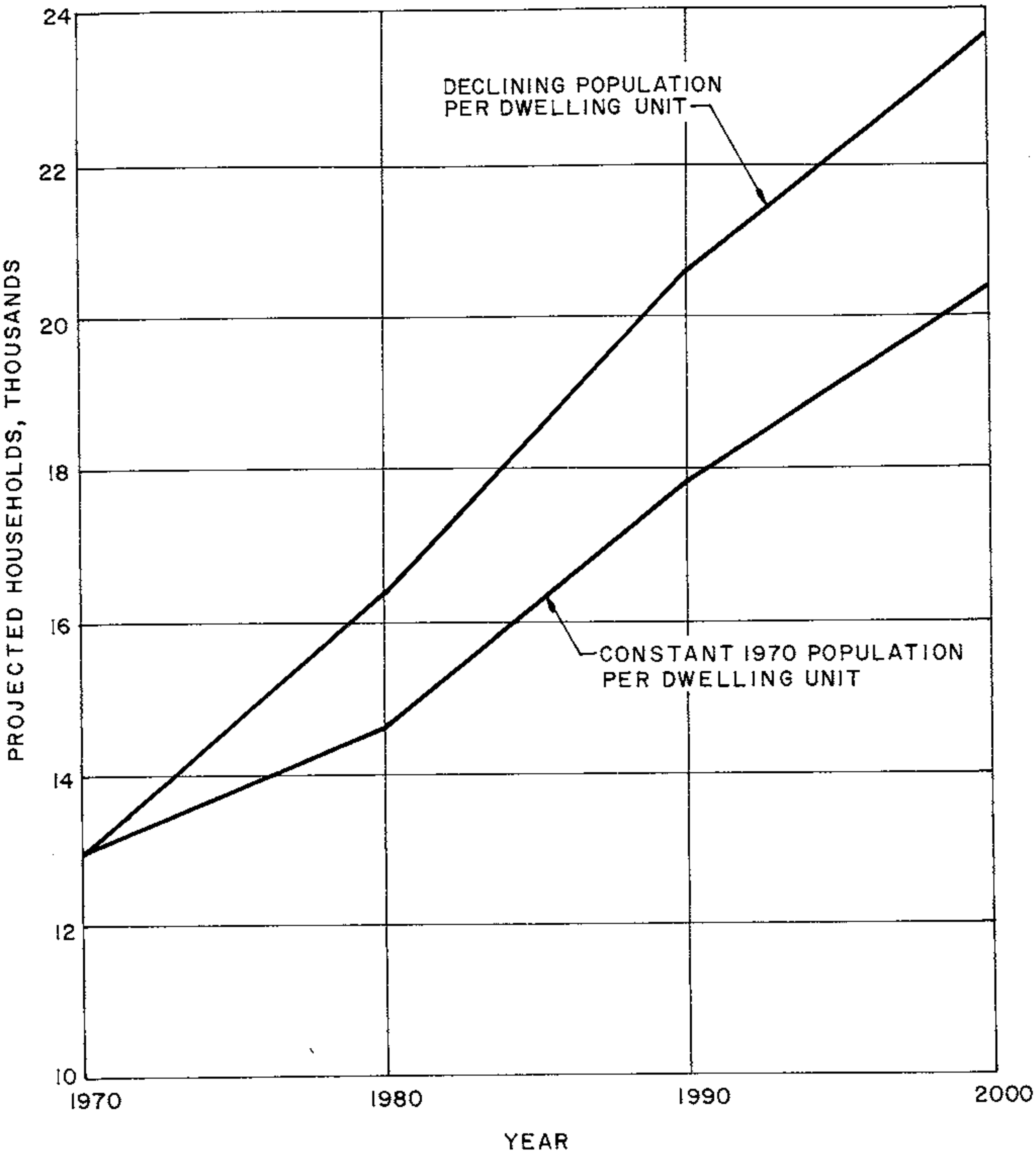


FIG. 3-5 PROJECTED NUMBERS OF NONSEWERED HOUSEHOLDS

TABLE 3-4. PRESENT INSTALLATION AND PUMPING COSTS

Item	Mean	Range
Installation Costs[a]		
Septic tank, $/gal	0.31	0.24- 0.45
Distribution box, $/box	27.00	15.00-50.00
Disposal trench, $/ft	2.14	1.70- 3.25
House sewer, $/ft	2.50	1.50- 4.50
Pumping Costs[a]		
Pumping, $/gal	0.085	0.08- 0.09
Mileage, $/mile	0.680	0.25- 1.10

[a]Costs obtained in December 1976.

TABLE 3-5. TYPICAL COSTS FOR THREE-BEDROOM HOUSE

Characteristics	Example 1	Example 2
Distance for travel charge, miles	0	25
Tank size, gallons	900	1200
Disposal trench requirements, sq ft of sidewall area/bedroom	100	330
Estimated installation cost,[a] dollars	778	1609
Estimated maintenance cost,[a] dollars		
Dollars per occurrence	77[b]	119[c]
Dollars per year[d]	19	30

[a]Based on costs prevailing during December 1976.
[b]Pumping cost only.
[c]Includes mileage charge.
[d]Based on septic tank being pumped every four years.

TABLE 3-6. SEPTAGE CHARACTERISTICS

Parameter	Septage		Typical domestic sewage
	Range	Mean	
BOD, mg/l	1,460-18,600	5,000	200
Suspended solids, mg/l	1,770-22,600	13,014	200
Total kjeldahl nitrogen, mg/l	66- 1,560	677	20
Total phosphorus, mg/l	24- 460	253	10

Source: Reference No. 3

was $160,000. ($145,000 in pumping costs and $15,000 in mileage charges.) Future volumes of septage are estimated in Chapter 8 .

Strength

The basic parameters of sewage strength are BOD and suspended solids. Heavy metal content and nutrient content are also of interest in final disposal. Septage is a strong waste, since it represents the concentrated solid material removed by the septic tank. The characteristics of septage have been quantified in several recent studies. Results from two Environmental Protection Agency (EPA) Demonstration Projects are shown in Table 3-6. Both the BOD and suspended solids values show a wide range, with means of 5000 and 13,000 mg/l respectively. For comparative purposes, the strength of typical domestic waste is also included in Table 3-6. As indicated, the septage is 25 to 65 times stronger than domestic waste, depending upon the parameter considered. Analysis of septage delivered to the Eugene Sewage Treatment Plant in December 1976 showed an average BOD of 3,100 mg/l and suspended solids of 3,500 mg/l. These values are within the range reported in Table 3-6.

The overall strength of the septage is not expected to increase significantly in the future. Some increase can be expected, however, in the rate at which septic tanks fill with scum and sludge as more rural homes install modern plumbing facilities such a garbage grinders, and automatic dishwashers and clothes washers. It has been estimated that these modern conveniences account for 35 to 75 percent of the total pounds of BOD and suspended solids discharged in domestic sewage.

The nutrient content of septic tank sludges is also shown in Table 3-6, as both total phosphorus and total kjeldahl nitrogen, which is the sum of the organic-nitrogen and ammonia-nitrogen contents of the sludge. Total kjeldahl nitrogen, or TKN, normally represents roughly 80 percent or more of the total nitrogen content, since only the nitrite and nitrate forms are not accounted for, and these are minor nitrogen forms in sludge. The heavy metal content of septage has never been found to be as high as that in municipal treatment plant sludge. Kreissl, for example, has shown that septage analyzed by the EPA has lower heavy metal concentrations, by factors of from two to 40, than municipal sludges. The combination of the nutrient and low heavy metal content of septage makes land application an attractive alternative where satisfactory application sites are available.

CHAPTER 4

PAST AND PRESENT MANAGEMENT PRACTICES

The performance of septic tank systems under both past and present management practices must be examined prior to developing and evaluating future strategies in order to evaluate past successes and failures. This chapter sets forth the history of those rules, regulations, and policies which comprise septic tank management practice. Chapter 5 will examine the performance of systems under these practices. Most practices are described below under the heading of one of five management elements.

Management Elements

There are five distinct phases in the life of a septic tank system; each phase affects the life expectancy and reliability of the system. The same type of analysis can be made of any manufactured device, whether it be an appliance, a utility system, or a motor vehicle. In order of occurrence these phases are: (1) site evaluation, (2) design, (3) installation, (4) maintenance, and (5) repair. Definitions of each element are presented below.

Site Evaluation. Site evaluation involves analysis of the physical conditions on a specific lot to determine suitability for a septic tank-drainfield system according to DEQ design standards. Site characteristics included in the analysis are soil profiles, groundwater depths, geology, and ground surface slope and stability.

Design. For purposes of this report, the design phase of a septic tank system includes the following activities:

1. Compliance with Department of Environmental Quality Standards defining suitable conditions for septic tank systems, and determining necessary separation distances, minimum trench sidewall areas, and septic tank volumes for various waste flows and soil types.

2. Specification of the septic tank's location on the lot, and choice of sizes and configuration of the tank and drainfield trenches.

Installation. Installation includes excavation, placement, covering of the system components, and inspection of final construction operation.

Maintenance. As used in this report, septic tank system maintenance includes those routine steps taken to improve operation, such as periodic pumping of the tank. Other maintenance steps including care of the vegetative cover over a drainfield are, of course, also desirable.

Repair. Repair procedures are any actions taken to correct a failure of the septic tank system. Correctable failures may take either one of two forms: (1) discharge of sewage onto the ground surface, or (2) line clogging which results in the backup of sewage into household fixtures. The first type of failure is a public health hazard and is the major area of concern in septic tank system operations. The second type of failure is a private nuisance to a system user only.

A third type of failure, which cannot be corrected by system maintenance or repair, is contamination of groundwater. Typically, this problem results not from misapplication of individual systems but from the construction of too many systems within a limited area. Groundwater contamination must therefore be dealt with primarily as a regional planning problem rather than as a problem of individual system maintenance and repair.

Management Practices

Discussion of management practices for septic tank systems is divided into several parts in the remainder of this chapter. The first is a brief history of state and local agencies which have been most deeply involved in the management process from 1950 to the present, as well as a description of some of the functions of those agencies. The next five sections describe the powers authority, and specific functions of these agencies with respect to the five management elements just defined: site evaluation, design, installation, maintenance, and repair. The remaining sections discuss the role of sanitary surveys, information services, and costs incurred in the past by Lane County for activities related to individual waste disposal systems. To some extent, each section is divided into a discussion of both past and present practices. The point of division between "past" and "present" is taken as January 1974, when the Environmental Quality Commission was first given authority by the state legislature to regulate the use of individual disposal systems in Oregon.

General History. From 1949 through 1973 the Oregon State Health Division was responsible for administering and enforcing statewide regulations concerning design and construction of individual systems. Beginning in January of 1974, the Department of Environmental Quality became the administering agency.

Throughout the period from 1950 to the present, Lane County has maintained its own program of permits, site inspections, and evaluations. Prior to 1974, all counties held the authority to implement such a program. Beginning in January 1974, DEQ delegated portions of its administrative authority by contract to those counties willing and capable of carrying out the authorized powers. Lane County is one of 23 such counties. There has been relatively little change in the scope of county responsibility from 1956 to the present. Perhaps the greatest change is that the county no longer has sole responsibility for variances or the issuance and enforcement of citations for violations.

There are currently four duties which DEQ may delegate by contract to local units of government under ORS 454.725: (1) issuing notices of violation and conducting hearings regarding such notices; (2) permit handling and approval; (3) inspection of completed construction, certification of satisfactory completion, and handling of appeals, and (4) issuing licenses to installers and pumpers. Of these four duties, DEQ had contracted with counties only for items (2) and (3) at the time this report was being written. Lane County entered into a contract with DEQ for administration of permit handling, inspection, and certification duties for conventional systems in January 1974. The contract was amended in February 1976, and in November 1976 authority was granted to process applications and issue permits for alternative systems.

Within Lane County, authority to approve designs, issue building permits, inspect construction, and issue certificates of completed construction was derived from the Lane County Building Code from 1957 through 1973. Beginning in January, 1974 when DEQ assumed statewide administration of the subsurface disposal program, however, the same authority has been derived from Lane County's contract with DEQ.

Site Evaluation. In accordance with both past and present regulations and procedures, the County Health Department has continuously performed certain site evaluation tasks since 1956. In particular, sites are evaluated as to type of soil, depth to groundwater, ground slope, type of water supply, and size of lot. Percolation tests may be performed, but the county has always considered soil profiling and description more reliable and valid than percolation tests. Building permits are denied if the proposed site does not meet state regulations for individual sewage disposal systems. Responsibility for the evaluation task was transferred from the Health Department to the Water Pollution Control Division (WPCD) of the County Environmental Management Department in November 1973.

Since January 1974, the County WPCD staff has carried out basically the same site evaluation duties that it did prior to 1974 except that a site evaluation is conducted when the county receives an application and fee either for a new subsurface disposal system or for modification or repair of an existing system. Soil and groundwater conditions are assessed at individual new sites by a sanitarian who inspects the soil profile, soil type, and indications of previous groundwater levels in a pit approximately 2 ft wide by 4 ft long by 4 to 6 ft deep, dug by the applicant, on the proposed disposal site. The applicant receives a copy of the site evaluation report indicating whether or not the site is suitable for a septic tank system. If the site is judged suitable, the applicant is provided with a site evaluation. Then if the site is suitable a construction permit is issued which provides a design sketch of system location and the specifications regarding sizes and capacities of the septic tank and trench.

A soil scientist has been on the staff of the Building and Sanitation Division and the WPCD since 1969, and has provided special consultation services to both the public and to other county agencies. Those services include re-investigation of sites declared unsuitable by the first site evaluation, general surveys for proposed subdivisions, and surveys conducted for county planning purposes.

As noted above in the section on general history, Lane County was authorized by DEQ in November 1976 to conduct site evaluations and issue permits for the three approved alternative disposal methods in addition to conventional subsurface disposal methods.

Design. General standards for the design and construction of septic tank systems in Oregon have been set at the state level for over 25 years by both the Oregon State Board of Health and the Environmental Quality Commission (EQC). Limiting conditions on site suitability, sizing, and separation requirements are shown in Tables 4-1 and 4-2 for the years 1962 through 1974 together with recommended values from U.S. Public Health Service (USPHS). These tables do not include all design standards and restrictions contained in the Oregon Administrative Rules (Chapter 340, Division 7), but are intended to show the most significant items in the standards. Taken together, the two tables form the basis of design for most conventional septic tank systems in the study area. Standards from 1950 to 1962 differed from the February 1962 standards in three respects: (1) per capita flow for design purposes (50 gallons per day prior to 1962); (2) the capacity of septic tanks considered adequate for two-bedroom to four-bedroom houses (500 to 750 gallon tanks permitted prior to 1962); and (3) in the required setback distance from drainfields to wells (100 ft, 1950 to 1953). The most recent revisions of the 1974 regulations were completed in November 1976 and include changes in the setback distances from components of the subsurface system to waterways and landforms. Specifically, the following new regulations were made:

- Depth to free water - 4 ft below trench, or 60 inches below around surface with a 12 inch trench depth and 12 inch capping fill.

- Setback distances - Setbacks between the septic tank and buildings and property lines were changed to USPHS recommended values. Regulations were extended by adding specific values for springs, intermittent streams, surface public waters, man-made cuts, and escarpments. Required distances from septic tanks and drainfields to the above waterways and landforms depend on whether the waterways and landforms are upslope or downslope from the disposal system component, and whether impervious or restrictive soil layers are present.

Two septic tank system requirements are of particular interest, one of which is included in Table 4-1. Both requirements pertain to the trench infiltrative surfaces - bottom and sidewalls - coming in contact with water from sources other than household sewage. The significance of such contact is twofold. First, when these surfaces become saturated with water, oxygen in the soil can become depleted by soil bacteria, producing an anaerobic condition. This condition leads directly and rapidly to biological clogging of the infiltrative surfaces, subsequent filling of disposal trenches, and ultimate failure of the entire system by surfacing of sewage. Second, the ability of soils to remove bacteria and chemicals from sewage is severely reduced under saturated conditions.

The first requirement is the minimum depth requirement for a temporarily perched water table of either 24 inches below the ground surface, or a depth which would cause the temporarily perched water table to come in contact with the effective sidewall of the disposal trench. The second requirement concerns ponded water on the surface of the ground above disposal systems and states that disposal trenches cannot be installed in an area where "an accumulation of surface water will occur for a period of two (2) weeks or longer". Both of these requirements are less restrictive than the best recommended technical practices for site evaluation of groundwater conditions described in Chapter 6, and could lead to early failure of a disposal system installed in areas which barely meet the requirements.

The most significant improvement in design requirements occurred in the rules adopted in May 1973, when area for a full-sized replacement drainfield became mandatory.

Authority for establishing design standards for subsurface sewage disposal systems of all types has resided solely with the Oregon DEQ since January 1974. During the years when the state health agency set minimum standards, counties in Oregon had the authority to set more restrictive standards than those of the state. Prior to 1974, however, Lane County was the only county in Oregon known to have been using a construction permit to implement and enforce design standards.

Since approximately 1957, Lane County has provided a design service for conventional subsurface systems through its permit procedure. Originally the County Health Department, and more recently the Water Pollution Control Division of the Environmental Management Department has provided a design sketch in accordance with state regulations pertaining to sizing and setback distances. Where a site evaluation indicates that a conventional system or alternative system cannot be used, a modified system may be approved under a variance procedure requiring specific DEQ approval. There are two variance procedures: one for rural land use categories and one for all other areas.

Installation. A final inspection prior to covering the system components has been required since the permit program began in 1950.

TABLE 4-1. HISTORY OF SEPTIC TANK SYSTEM REQUIREMENTS

	USPHS[a]	State of Oregon			
		February 1962	May 1973	October 1973	January 1974
Septic Tank					
Size, gallons					
Minimum	750	500	750	750	750
1bedroom	750	500	750	750	750
2 bedrooms	750	750	750	750	750
3 bedrooms	900	900	900	900	900
4 bedrooms	1,000	1,000	1,000	1,000	1,000
Gal./additional bedroom	250	250	250	250	250
Construction materials	concrete metal clay brick	concrete iron durable	concrete steel b	concrete steel b	concrete steel b
Distribution Boxes	no	yes	yes	yes	yes
Sewer Wells or Cesspools Permitted	yes	no[c]	no[c]	no[c]	no[c]
Drainfields					
Percolation test used	yes	no	d	d	no
Surface used for design	bottom	bottom	bottom	bottom	sidewall
Trench width required, in.	12-36	18-36	18-36	18-36	24
Gravel depth below tile, in.	6	6	6	6	6
Minimum absorption area, sq ft	140	150	300	300	200
Absorption area/bedroom, sq ft	70-325	70-250	70-250	100-330	100-330
Minimum trench spacing, ft	6	6	8	8	8
Replacement area required, %	none	none	100	100	100
Depth to perched water, in.	48[e]	24[e]	24[e]	24[e]	24
Depth to free water, in.	48[e]	24[e]	24[e]	24[e]	72
Depth to restrictive layer, in.	f	f	30	30	30
Depth to impermeable layer, in.	f	f	36	36	36
Maximum allowable slope, %	f	f	30	30	25

[a] 1967 revised version.
[b] Other materials as approved by the responsible state agency.
[c] Except where specifically approved by the State of Oregon.
[d] Not essential in requirements, but regulations give detailed description of test.
[e] Regulations do not distinguish between perched water table and free water table.
[f] None stated.
[g] Flatter slopes are required for locations with restrictive layers at depths less than 48 inches and impervious layers less than 72 inches.

TABLE 4-2. SEPTIC TANK SYSTEM SETBACK REQUIREMENTS

	USPHS recommendations, ft[a]	State requirements, feet			
		February 1962	May 1973	October 1973	January 1974
Septic tank to					
Buildings	5	10	10	10	10
Property lines	10	5	25/10[b]	25/10[b]	25/10[b]
Wells	50	50	50	50	50
Creeks or streams	50	25	100	100	50
Cuts or embankments	c	c	c	c	c
Water lines	10	10	10	10	10
Drainfields to					
Buildings	20	10	25/10[b]	10	10
Property lines	5	10	25/10[b]	25/10[b]	25/10[b]
Wells	100	50	50	100	100
Creeks or streams	50	25	100	100	100
Cuts or embankments	b	b	25	25	25
Water lines	25	10	10	10	10

[a]1967 revised version.
[b]Setback is 10 ft if property served by public water supply or if abutting public street, and 25 ft if served by on-site water supply.
[c]Not stated.

When construction is complete, with the exception of final backfilling to cover the tank and trench system, the applicant notifies the County Environmental Management Department. The WPCD then has seven days in which to make an inspection and determine whether the system, as constructed, complies with EQC rules. A routine inspection consists of visual inspection and measurements of the location and sizing of system components as specified on the construction permit, and a check of the slope and depth of trenches. When the system complies with EQC rules the applicant receives a Certificate of Satisfactory Completion. If the system does not initially comply, the applicant is so notified, and construction modifications and further inspections are required until satisfactory completion is certified.

The only major change in the present program occurred in 1962 when installer's records, including sketches of the as-built system, were first required for the county's record system.

Maintenance. Lane County has never had specific regulations for septic tank system maintenance, and none are in effect today at either the state or county level. DEQ is, however, empowered by ORS 454.615 to prescribe maintenance requirements. The general standard set forth in present regulations states that individual systems "... shall be maintained so as to not create a public health hazard or cause degradation of the quality of any public waters."

Information obtained from licensed pumpers in the 208 Program planning area was used to estimate present practices of individual homeowners. As noted in Chapter 3, approximately 2,300 tanks were pumped by the 10 licensed pumpers in the area in 1975, or approximately 8 percent of the systems in the 208 area. To express the same number in a different way, a single tank is pumped, on the average, slightly more than once every 12 years. Further analysis of the pumper questionnaire information showed that approximately 60 percent of the systems pumped during 1975 had either a clogged building sewer or sewage surfacing from the drainfield. It is apparent, therefore, that a majority of septic tank system owners are having their systems pumped only in response to a failure, not as part of a preventive maintenance program.

Repair. A construction permit is required for repair, and there are two ways in which Lane County becomes involved in the repair of an individual waste disposal system: (1) the system owner voluntarily applies for a repair permit, or (2) complaint is received about a neighboring system, which is subsequently inspected and found to be in violation of EQC regulations.

In those cases in which a system owner voluntarily applies for a repair permit, the County Water Pollution Control Division staff makes a site evaluation and issues a report to the owner, either providing a specific design for repair of the problem or, in unique situations, requiring that the design be completed by a registered engineer. The county is authorized to approve all designs including repairs which would normally be considered to fall within DEQ's Experimental System Program. In each case, the specified modifications are intended to solve the problem or, if complete correction is not possible, to minimize hazards to public health. At times the county does encounter the latter situation; that is, either soil, groundwater, topography, or lot size make complete correction of the problem impossible without providing community sewers or otherwise abandoning the subsurface system.

Once the repair is completed, county staff again makes a final inspection and either issues a certificate of satisfactory completion or instructions for additional corrections necessary before the certificate can be issued.

In those cases when a complaint is received by the county, the WPCD staff is authorized by contract with DEQ (ORS 454.635) to carry out inspection of the subject system. If a violation of an EQC rule is detected during the inspection, the owner is notified of the violation and the county is required to use its best efforts to persuade the violator to make corrections. Most owners comply by applying for a repair permit and making needed repairs. If he does not comply, the county must transmit all information concerning the case to DEQ for enforcement action.

Prior to January 1974, enforcement actions were carried out under the county's jurisdiction, either through the District Attorney's office or through the civil infractions process. In the years 1973 to 1976 the county has issued slightly more than 300 repair permits annually.

Sanitary Surveys. In addition to the county's activities under each of the five management elements as described above, general sanitary surveys of areas of interest are occasionally made for one of several reasons. Both in the past and at present, these surveys have been performed by the County Health Department. Reasons for conducting sanitary surveys include (a) frequent complaints coming from a general area, (b) the desire to determine individual disposal system performance characteristics in a given area, (c) a request by a local or state agency, or (d) a special study. If the results warrant it, a sanitary survey can be used to establish a health hazard area. The major consequences of an area being declared a health hazard may lead to denial of all new building permits, possible forced annexation to a nearby community with sewers, and placement at or near the top of DEQ's priority list for grant funds for sewerage.

Information Services. In recent years the County Water Pollution Control Division has endeavored to improve performance of septic tank systems through the use of newspaper atricles, public service radio messages, and pamphlets. While little information exists by which to judge the effects of informational pamphlets, at least one radio message and newspaper article in September 1976, urging pumping of septic tanks, appears to have been effective. According to septic tank pumpers in the 208 area, there was a significant increase in the number of requests for pumping, in response to the message.

Septic tank pumpers themselves also serve as information sources regarding the fundamentals of septic tank operation and maintenance. One of the larger pumpers in the study area has received mixed reactions to his attempts at homeowner instruction and his efforts to enroll homeowners in a program of having their tanks pumped every four years. Overall, however, the response to his efforts has been more positive than negative.

Individual Waste Disposal Management Program Costs. Staffing and budget records of both the County Building and Sanitation Division and the Water Pollution Control Division were obtained in order to demonstrate cost trends for past and present management practices. Detailed records are available from fiscal year (FY) 1968-69 to the present and are shown in Table 4-3 and Figure 4-1. While cost information is not available prior to 1968-69, information provided by the Director of the Building and Sanitation Division from 1953 to November 1973 shows that staffing of the individual waste disposal program increased as follows:

Fiscal Year	Personnel
1952-53 to 1955-56	3.5
1956-57 to 1965-66	4.75
1966-67 to 1968-69	5.5

The decrease in personnel and in support costs in the 1974-75 fiscal year was caused by a combination of a reorganization of county agencies and the implementation of the new DEQ regulations.

In order to determine total workload on the WPCD staff, and the ability of the staff to handle the load, data on county-wide numbers of total subsurface sewage disposal systems and numbers of sites evaluated were obtained from county records. As shown in Figure 4-2, the total number of individual systems in Lane County has risen from 30,900 in 1970 to abe 36,700 in 1975, while the number of sites evaluated each year has varied between 500 and nearly 1,500, with more than 1,000 sites being evaluated in each of the years since 1972. To determine workload per staff member, the values in Figure 4-2 were divided by the number of staff personnel shown in Table 4-3. The resulting ratios, shown in Figure 4-3, vary between 3,800 and 4,500 total systems, per employee, and between 35 and 160 site evaluations, per employee, with the higher ratios occurring in the later years, 1973 through 1975.

A discussion with the Water Pollution Control Division Director revealed that the staff does not feel it has sufficient time to devote to all required activities. In particular, implementation of DEQ rules adopted in 1974, and subsequent amendments, has added new complexity to work performed under previous rules, including aid provided to DEQ on issues of enforcement, variances, experimental systems, and alternative systems. The program management element which has suffered most is control of construction, in that there is often a lack of time to perform a final inspection as thoroughly as the staff would like, and little or no time to have a meeting with both the prospective owner and the installer before installation begins.

Sanitarians, secretaries, and clerical help have been part of the program since its beginning. The activities of professional staff members, including soil scientists and registered engineers have increased dramatically since 1974. Activities to which the staff and budget have been applied have changed very little over the years, as described in previous sections of this chapter. The following list of activities applies to all years subsequent to 1956-57, the first year site evaluations were conducted:

1. Evaluation of site for compliance with state regulations.
2. System design and specifications for construction permit.
3. Inspection and approval of subsurface system construction.
4. Assistance with and issuance of permit applications.
5. Investigation and enforcement of state regulations.
6. Provision of public information and development assistance.
7. Coordination with state and local agencies including other county agencies.
8. Program support.

Table 4-4 shows the current division of staff time among the eight activities, and, in particular, reveals that slightly more than half of WPCD personnel time is devoted to site evaluation and system design. Drawing an analogy to private industry, the first five items in Table 4-4 might be regarded as "production" activities and the last three as "overhead" activities. The ratio of 75 percent staff involvement in "production" activities is a favorable one and indicates that the Water Pollution Control Division is functioning efficiently as a technical group.

TABLE 4-3. INDIVIDUAL WASTE DISPOSAL PROGRAM EXPENDITURES

Year	No. of personnel	Personnel costs, $1,000	Support costs,[a] $1,000	Total cost, $1,000
1968-69	6.5	52.6	11.2	63.8
1969-70	7.0	59.7	14.3	74.0
1970-71	8.1	76.9	18.0	94.9
1971-72	8.8	91.0	20.1	111.1
1972-73	9.0	98.2	18.2	116.4
1973-74	9.5	112.7	22.8	135.5
1974-75	8.7[b]	118.0	15.9	133.9
1975-76	8.7	129.0	15.9	144.9
1976-77[c]	8.7	134.9	17.9	152.8

[a]Includes costs of equipment, staff training, travel, printing, and other miscellaneous items.

[b]Significant enforcement involvement and administrative support began to be provided by DEQ.

[c]Projected to end of FY 1976-77.

TABLE 4-4. DIVISION OF PERSONNEL TIME

Activity	Percent of total personnel time
1. Site evaluation	40
2. System design	15
3. Construction inspection	10
4. Permit applications	5
5. Site investigation	5
6. Public information	15
7. Coordination	5
8. Program support	5

Source: Director, Lane County Water Pollution Control Division

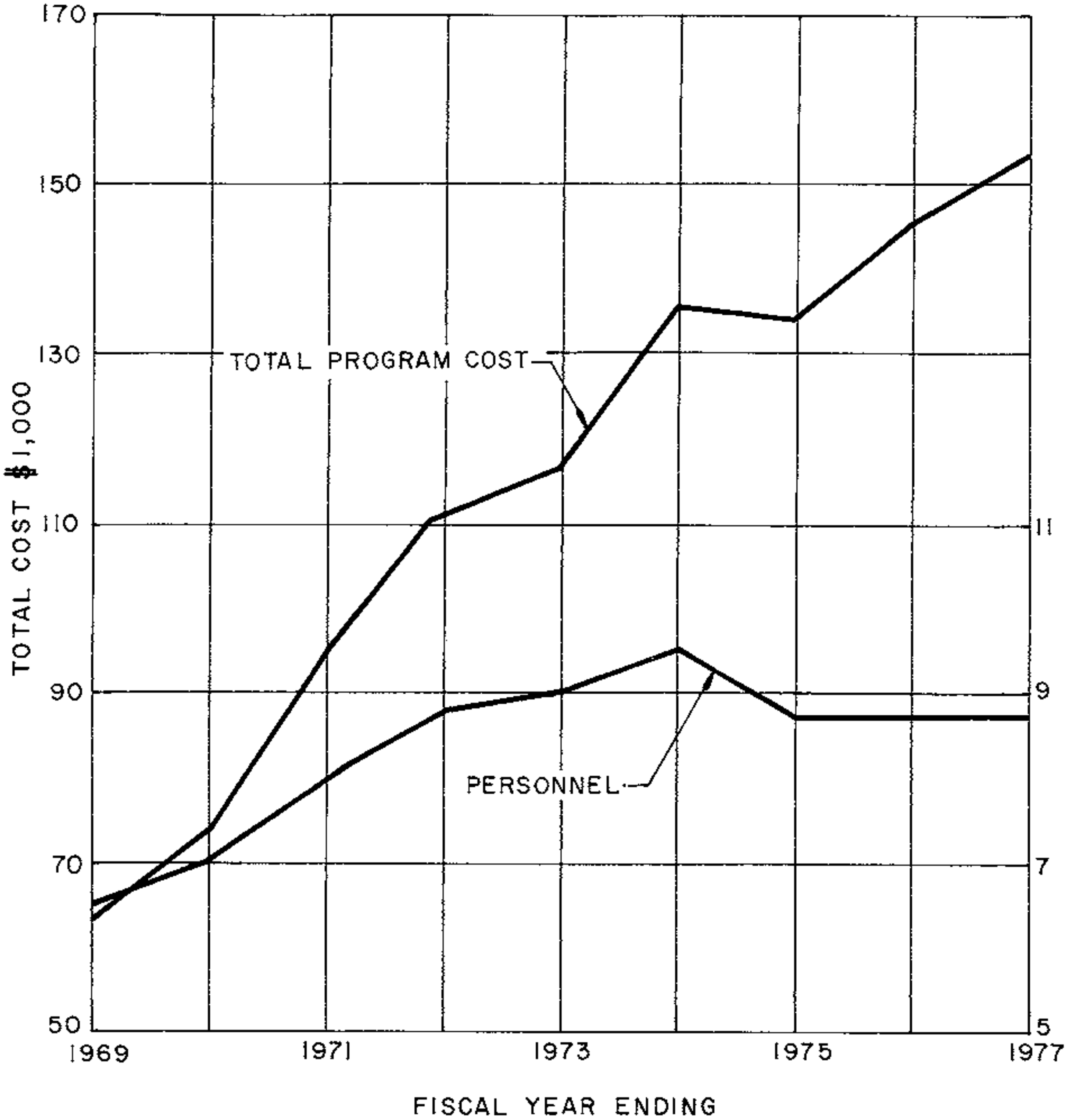


FIG. 4-1 INDIVIDUAL WASTE DISPOSAL PROGRAM COST AND STAFFING

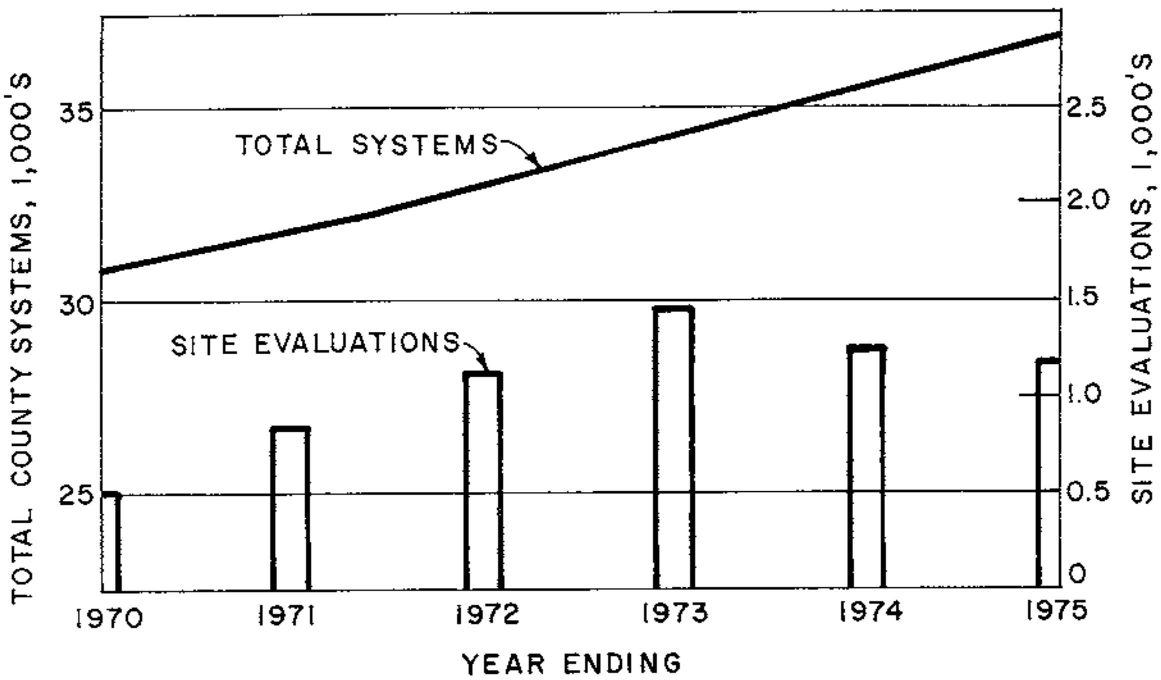


FIG. 4-2 COUNTY-WIDE NUMBERS OF SUBSURFACE SYSTEMS

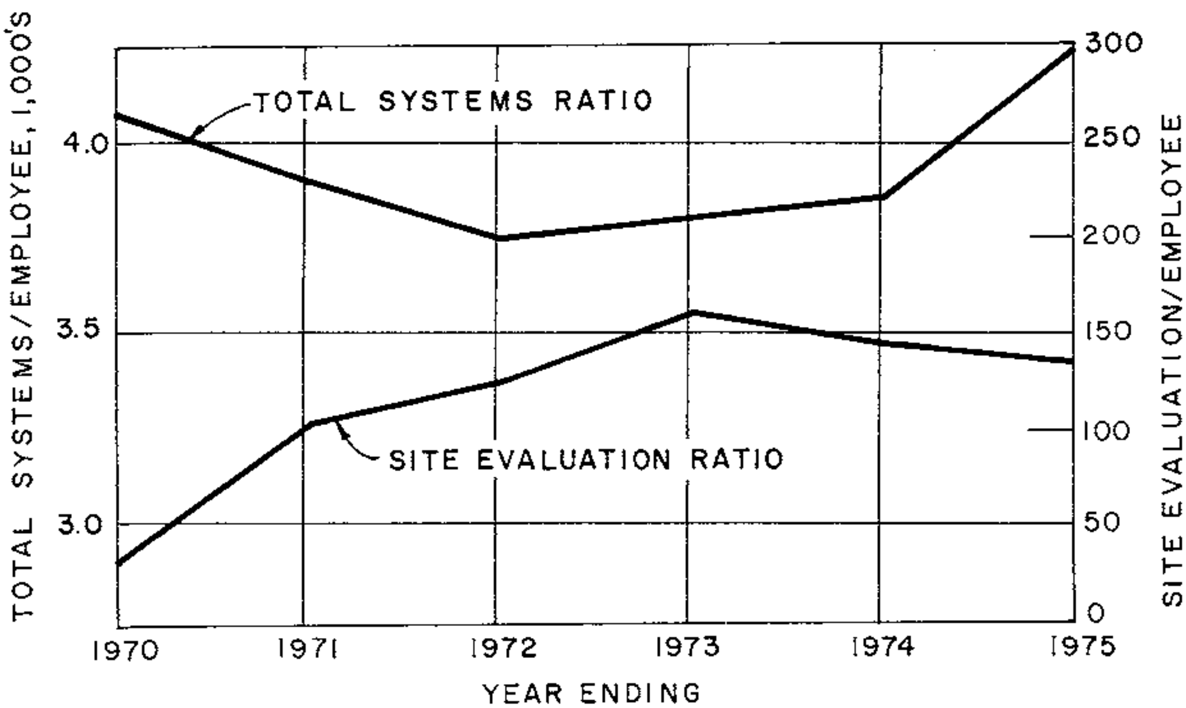


FIG. 4-3 COUNTY-WIDE SUBSURFACE SYSTEM STAFF WORKLOAD

CHAPTER 5

SYSTEM PERFORMANCE

Every household that is equipped with running water and modern plumbing is faced with the problem of water-borne waste disposal. In areas without community sewerage, this need has been met by installing individual sewage disposal systems. Ranging from simple cesspools to complex aerobic treatment units, these systems have performed the vital function of environmental sanitation, particularly in rural and sparsely-developed areas. In many areas, however, their misapplication has led to intolerable environmental degradation and public health hazards.

Presented below is a brief discussion of the general capabilities and limitations of subsurface systems, a review of septic tank performance within the Lane County study area, and comments regarding the performance record of such systems at specific sites outside the State of Oregon.

CAPABILITIES AND LIMITATIONS OF SUBSURFACE DISPOSAL SYSTEMS

When correctly designed, installed, and maintained, a septic tank-drainfield system can be an excellent wastewater treatment unit for the lifetime of the house it serves. Most soils remove organic material, phosphorus, and bacteria very effectively. Only nitrogen, in the nitrate form, moves freely through the soil system. If improperly designed, constructed, or maintained, however, the septic tank system may have only a short lifespan before failure occurs. Definite limitations on the use of septic tank systems have been described by McGauhey:[1] "In summary it may be said that at best the septic system increases the total dissolved mineral content of local groundwaters. At worst, it may introduce bacteria, viruses, and degradable organic matter as well. From an environmental viewpoint the best is not the best of all possible alternatives in an urban situation. Rationally it would seem undesirable to concentrate 2,000 to 15,000 septic systems on the roof of a single groundwater basin or along the margin of a recreational lake. Nor is it necessary today. On the other hand, the best is certainly adequate for the isolated dwelling, where service to man far exceeds any possible environmental effect."

The service life of a septic tank system is the measure of performance that will be discussed in the following sections of this chapter. In nearly all cases discussed, failure by discharge of sewage onto the ground surface is the factor used to define service life, since this is the type of failure for which records are most readily available from agencies responsible for system management. Clogged pipelines, a second form of septic tank system failure, are normally corrected without public agency involvement or knowledge.

LANE COUNTY STUDY AREA

There are two sources of information in Lane County's record system regarding the service life of septic tank systems prior to failure. The first source is the permit system described in Chapter 4; the second is the county-wide sanitary survey conducted in 1969. Service life of the systems is expressed in two different ways: by age distribution plots and by survival curves. Survival curves are the more detailed of the two methods, permitting the reader to see the change in the percentage of systems surviving over time. The data necessary to produce such curves accurately, however, consist of repeated field visits by public agency staff over a period of years. This kind of information is not commonly gathered by agencies managing septic tank systems, Lane County included. Distribution graphs of the ages of systems at failure are more common. These do not describe the performance of all systems with time, but they do show the overall age distribution of systems which have failed.

Repair Permit Information

The Lane County Building Permit files contain information both on the original construction of individual waste disposal systems and on their repair. The amount of detailed information in each file varies considerably, however, depending principally on the age of the system; much more emphasis has been placed on recording the details of individual waste disposal system construction and repair in the last 10 to 15 years than was the case in previous years. Consequently, file data for installations and repairs prior to about 1963 are often sketchy or incomplete, and often are totally missing.

Two sets of data from the Building Permit file were used in analyzing the service life of septic tank systems before failure. The first set of data covered all systems for which repair permits were approved from 1973 through mid-1976 and which had detailed information on their original date of installation. Out of a total of 846 systems receiving repair permits in the three and one-half year period, only 94,or approximately 11 percent, had original installation information. An analysis of the ages of those 94 systems at the time of repair shows that their median age was seven years at failure, that nearly 50 percent of the systems failed between the ages of six years and 10 years, and that 81 percent failed within 10 years of installation. See Figure 5-1.

While the above information uses the most accurate data available, it includes only 11 percent of the systems receiving repair permits from 1973 through mid-1976. In order to include additional information on individual systems installed over the last 25 years, a search of Lane County's Assessment and

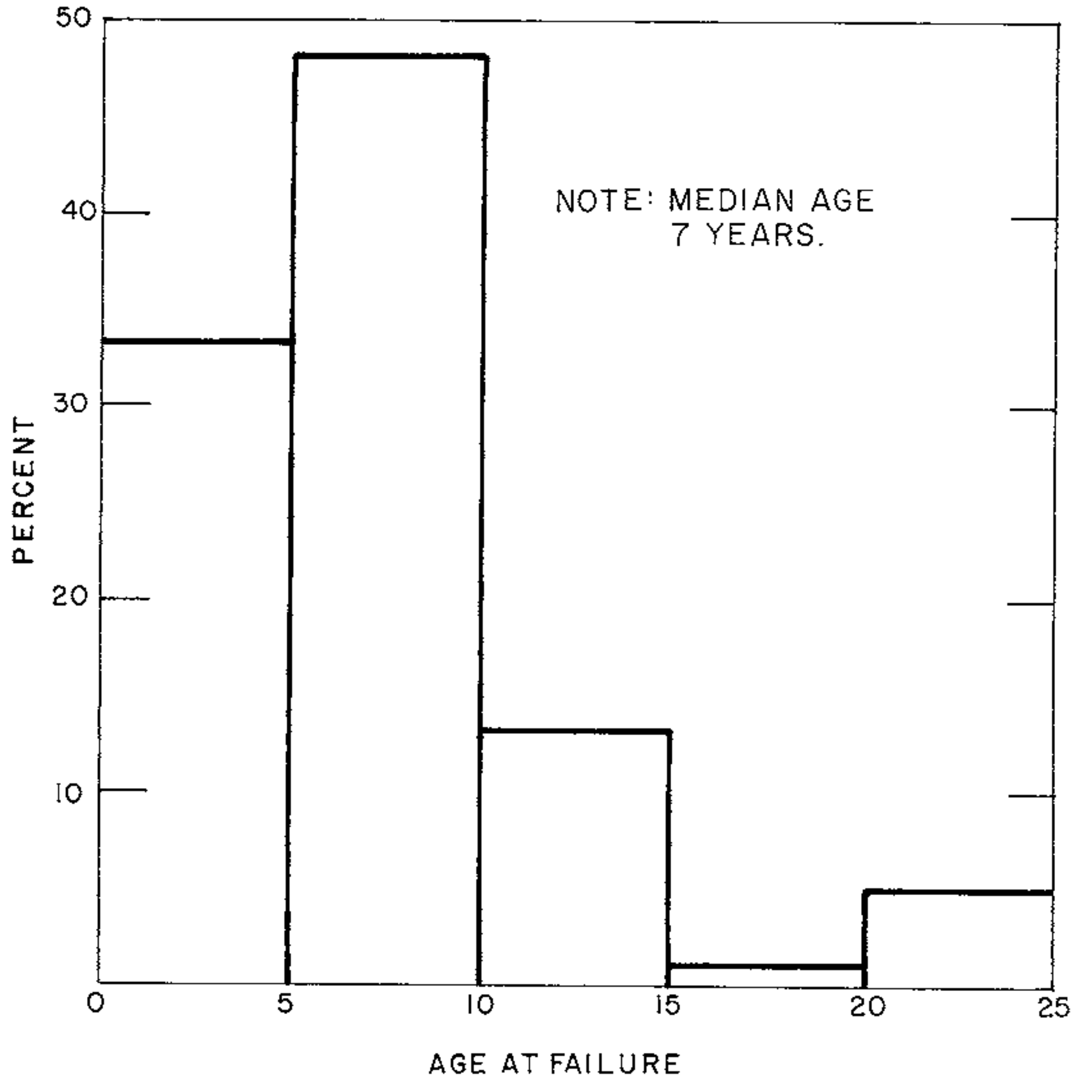


FIG. 5-1 AGE DISTRIBUTION OF SYSTEMS WITH REPAIR PERMITS ISSUED FROM 1973 TO 1976

Taxation Rolls was made. Each of the systems which failed in 1974, and which did not have an original installation date in the permit files, was assigned the year in which the dwelling was built as its year of installation. This assumption would be incorrect in those instances when the building permit was granted in one year and the waste disposal system was not installed or used until several years later. In these cases the sewage disposal system would be recorded as being older than it actually is. A 25-year period was used in this analysis on the assumption that most individual waste disposal systems installed in 1949 and 1950 were septic tank systems and not pit privies or cesspools, since septic tanks became the predominant waste disposal system throughout the country after World War II. Discussions with Lane County personnel confirmed that 1949 is a reasonable cutoff year; before 1949, septic tank systems were being installed in numbers equal to or less than the number of pit privies, cesspools, and other waste disposal methods.

Results of the data analysis of the permit files and the Assessment and Taxation rolls for systems with 1974 repair permits are shown in Figure 5-2. A total of 87 systems were included in this analysis, 31 of which had dates of original installation in the Building Permit files, and 56 of which were assumed to have been installed in the year in which the structure on that lot was built. The median age of these systems is 12 years; 24 percent of them failed between the ages of six and 10 years, and a total of 45 percent failed within 10 years of installation.

It is important to understand that not all drainfields that fail by discharging sewage to the ground surface are included in the data analysis shown in the previous two figures. If all systems requiring repair received county repair permits, the average of 240 repair permits per year between 1973 and 1976 in the 208 Program planning area would represent a rate of failure of 1.7 percent per year. Expressed in other terms, this would imply an average service life before failure of approximately 60 years - between five and 10 times the life shown in the data used in Figure 5-1 and 5-2. The discrepancy is explained by the fact that many homeowners attempt, successfully or unsuccessfully, to repair their own systems without contacting the County Water Pollution Control Division for a permit. In an attempt to quantify the number of actual failures, repair permit records for two years following the sanitary surveys in Blue River and Elmira were reviewed in order to determine how many homeowners with failing systems came to the county for a repair permit after being informed of system failure. In the Blue River area the ratio was one owner out of 12; in the Elmira area the ratio was one out of 18. While these ratios may not apply to the entire study area, they definitely indicate that the actual survival life of septic tank systems is closer to the seven to 12 years indicated by the repair permit record than to the 60-year life indicated by the number of repair permits applied for.

<u>Septic Tank Pumper Information</u>

A second, though less precise, indication that there are more failing systems than are accounted for by repair permits is available from an analysis of information obtained on questionnaires answered by septic tank pumpers in the study area. Out of the 2,285 systems estimated to have been pumped in 1975, the pumpers indicated that approximately 25 percent, or about 560 systems had failing drainfields - double the number of repair permits issued by Lane County in 1975. The questionnaire used for system installers in the study area unfortunately did not request information on percentage of calls for repair of failing systems - a number which would be added to the 560 failing systems encountered by the pumpers.

Sanitary Survey Information

In 1969 and 1970, an environmental survey was made of the unincorporated areas in Lane County and portions of incorporated areas not served by community sewerage systems. County investigators in that survey checked the condition of housing, water supply sources, and sewage disposal systems. Sewage disposal systems were rated as either satisfactory, unobservable, marginal, or failing. As defined for use in the survey, marginal systems were those which displayed signs of imminent failure by vegetative indicators (lush growth), saturated soils, or potential contamination of high water table, but could not be directly defined as failing either through bacterial testing or dye testing. Failing systems in the survey included drainfields with surfacing sewage, instances where dishwasher and clothes washer effluents were being discharged on the surface of the ground, and instances where septic tank lids were found to be either missing or removed from the tank so that the tank manhole was open. The discharge of dishwasher and clothes washer effluent onto the surface of the ground was recorded as a failure due to the fact that Oregon regulations define these effluents as sewage. The results of the survey were coded on data processing cards and stored in the county's computer system where they are accessible for county use. Listings of the survey results were reviewed for two purposes: (1) to demonstrate the performance of individual sewage disposal systems throughout the study area at the time the survey was taken, and (2) to define survival curves for septic tank systems in two areas of the county with widely differing soil characteristics. The results of each of those analyses is described below.

County-Wide and Study Area Results. Results of individual residential sewage disposal system surveys throughout Lane County are shown in Table 5-1. The survey showed that, while 52 percent of the systems appeared to be performing satisfactorily, 24 percent were failing, and a total of 37 percent were either marginal or failing.[2]

Subsurface system performance for individual sub-areas within the study area, shown in Table 5-2, is very similar in overall performance to the county-wide totals, in that approximately 50 percent of the systems were found to be performing satisfactorily, 25 percent were failing, and a total of 39 percent were either marginal or failing. In individual sub-areas, the percentage of systems performing satisfactorily ranged from a low of 34 percent in the Dexter area to a

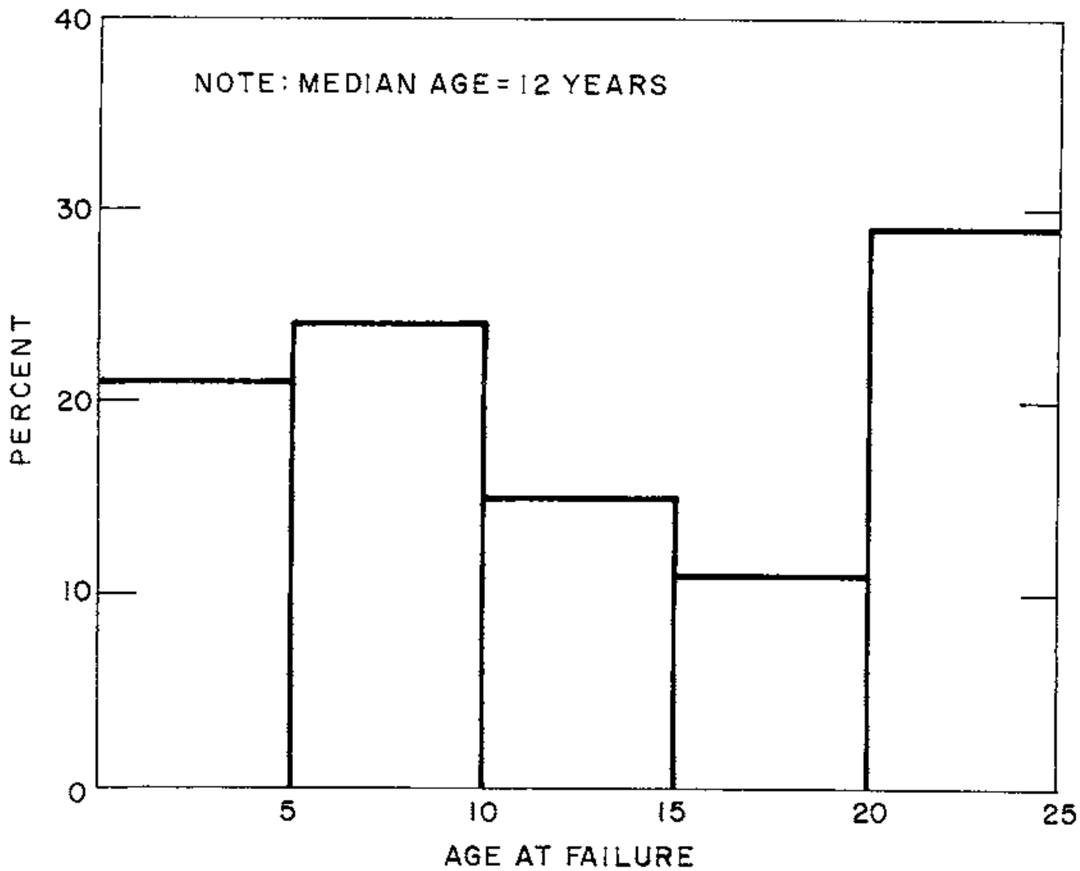


FIG. 5-2 AGE DISTRIBUTION OF SYSTEMS WITH 1974 REPAIR PERMITS

TABLE 5-1. COUNTY-WIDE SUBSURFACE SYSTEM PERFORMANCE

Condition	Number of systems[a]	Percent
Satisfactory	1266	52.1
Unobservable	255	10.5
Marginal	325	13.4
Failing	584	24.0
Totals	2430	100.0

[a]Residential units only.

Source: Reference No. 2 and 1969-70 Lane County Environmental Survey

TABLE 5-2. STUDY AREA SUBSURFACE SYSTEM PERFORMANCE

Area	Number of subsurface systems	Percent satisfactory	Percent unobservable	Percent marginal	Percent failing
Oakridge 25[a]	12	75.0	8.3	16.7	0.0
Oakridge 50[a]	134	53.0	16.4	25.4	5.2
Blue River	86	39.5	34.9	11.6	14.0
McKenzie Bridge	167	47.3	34.1	7.2	11.4
Noti, Vaughn	150	47.3	12.0	9.3	31.3
Cheshire	59	59.3	8.5	16.9	15.3
Elmira	208	55.8	1.9	16.3	26.0
Crow	70	42.9	7.1	25.7	24.3
Lorane	48	50.0	4.2	8.3	37.5
Saginaw	172	48.3	4.7	16.9	30.2
Dexter	74	33.8	4.1	16.2	45.9
Jasper	208	61.5	4.8	15.9	17.8
Marcola	106	38.7	8.5	17.9	34.9
Culp Creek	198	48.5	6.6	7.6	37.4
Area-wide values	1692	49.8	11.0	14.5	24.7

[a]Unsewered portion.

high of 75 percent in a small nonsewered portion of the Oakridge area. Failing systems ranged from less than 10 percent in the nonsewered Oakridge areas to a maximum of 46 percent in Dexter.

The above analyses implicitly assume that unobservable systems were satisfactory. As a practical matter, it is much more likely that some of those systems were also marginal or failing, making those percentages higher than the values shown.

Blue River and Elmira Areas. In addition to examining septic tank system performance at one point in time (1969-1970) in the entire study area, an attempt was made to determine survival curves for septic tank systems in two specific locations with widely differing soil characteristics: Blue River and Elmira. The conclusion drawn from that attempt, however, was that insufficient information exists from which accurate curves can be drawn. Interested readers can find the details of the analysis in Appendix B.

Summary

A summary of the findings about septic tank systems performance in Lane County and conclusions drawn therefrom, is as follows:

1. Using the most precise record of system age at failure, that is, repair permits and building permits, the median age of failing systems is less than 10 years.

2. If Assessment and Taxation Roll information is also used to estimate ages of systems which have failed and for which the owner has contacted the county, the median age at failure is raised to between 10 and 15 years.

3. Less than one homeowner in 10 can be expected to contact the county in order to obtain a repair permit for a failing system.

4. Only 50 percent of subsurface sewage disposal systems were found to be operating satisfactorily, and approximately 25 percent were found to be failing, on both a county-wide basis and in the study area in the 1969-1970 environmental survey. The definition of failure in the survey, however, included direct discharges of dishwashers and and clothes washers to the ground surface, as well as sewage surfacing from drainfields.

5. Insufficient information exists in county records from which to accurately define a survival curve for septic tank systems. This is not a criticism of the county's record system, which is above average. Administrative records rarely produce the detailed information necessary for accurate survival curves.

6. Of those failing systems known to the county, and for which the county has both definite construction and repair dates, about one-third failed within five years of installation, about half failed between six and ten years after installation, and a total of 81 percent failed within ten years of installation.

AREAS OUTSIDE OREGON

Over the years, a significant amount of information has been accumulated on the effective life of septic tank systems, although the quantity of information is very small in comparison to the number of systems which have been built and the number of people they have served. Four sets of data on septic tank system survival were found in the literature reviewed for this study, and are described below. The first set is taken from U.S. Public Health Service field studies throughout the country and from a study done in Alaska; the second source is a publication from Fairfax County, Virginia; the third concerns septic tank systems in Connecticut; and the fourth describes recent experiences in Marin County, California. While other public agencies were also contacted, including San Mateo County, California, the University of Wisconsin, and the Georgetown Divide Public Utility District in El Dorado County, California, either no detailed information on system performance was available or the management system had not been in operation for a long enough time to permit the collection of performance data.

Nationwide Information

In studies conducted by the U.S. Public Health Service between 1957 and 1962, the Robert A. Taft Engineering Center reported the results of field surveys of septic tank systems in various parts of the country. The results of those studies, displayed as survival curves, are shown in Table 5-3 and Figure 5-3, together with results from similar studies in Anchorage and Fairbanks, Alaska. As indicated, the best survival rate was 70 percent in 12 years, and the majority of the curves trend toward 100 percent failure within 12 years. As noted earlier, "failure" in these cases means the existence of surfacing sewage from drainfields, which in many systems is correctable either by use of an alternate drainfield or moderate repairs to the existing drainfield. Of particular interest in Table 5-3 and Figure 5-3 is that Polk County, Iowa, with a reportedly good percolation rate, had a failure rate over four times that of Dallas County, Texas, with a percolation rate generally considered unsatisfactory for soil absorption systems. This apparent discrepancy points out a fact that has been confirmed several times in recent years; that is, the percolation rate of soils is not a good design parameter and is rarely the cause of system failure.

Fairfax County, Virginia

At first glance, another recent source of data on septic tank survival rates contradicts the above results. This information is specific to septic tank

TABLE 5-3. SEPTIC TANK SURVIVAL CURVE STUDY AREAS

Curve no.[a]	Study area	Number of obser-vations	Persons per house-hold	Septic tank capacity gallons	Drain-field length feet	Average percola-tion rate, min/inch	Number of test holes	Refer-ence[b]
1	Maricopa Co., Arizona	25	3.4	500-1000	pits			3
2	Mecklenburg Co., N.C.	19	3.2					4
3	Wyandotte Co., Kansas	56	3.0	810	250			4
4	Polk Co., Iowa	205	3.3	1000	220	13.2	30	4
5	Tarrant Co., Texas	22	3.9	625	273	34	11	4
6	Dallas Co., Texas	349	4.0	810	295	105	35	4
7	Alexandria, La. and St. Louis, Mo.	440	4.1	500-600	200-300			5
8	Shreveport, La.	609						5
9	Fresno Co., Calif.	160	4.0	1000	pits			3
10	San Diego Co., Calif.	164	3.9	1000	pits			3
11	Fairbanks, Alaska	32	4.4	810	pits			6
12	Anchorage, Alaska	120	4.7	750	pits			6

[a] See Fig. 5-4.
[b] See Appendix A.

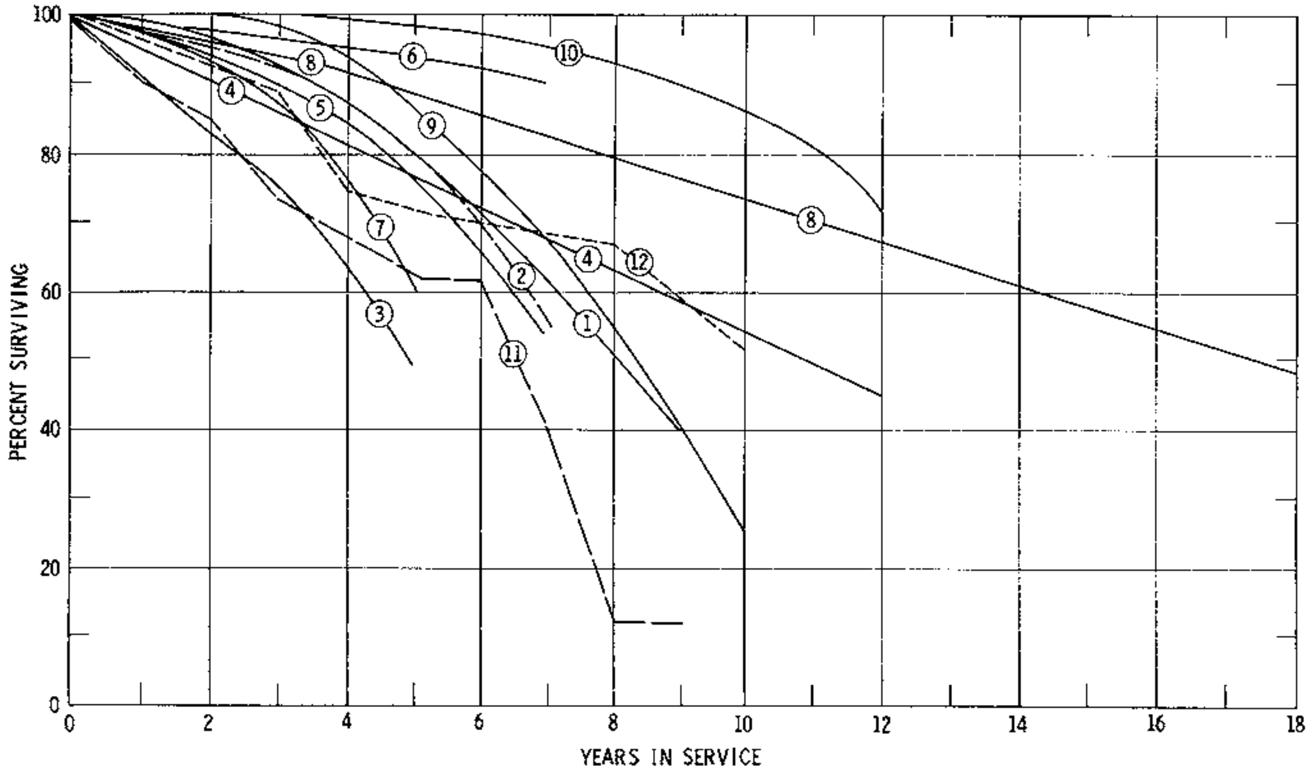


FIG. 5-3 SEPTIC TANK SYSTEM SURVIVAL CURVES

systems installed in Fairfax County, Virginia, and was published in 1975.[7] The officials from the county health department reviewed the installation and repair permits dating back to 1952, and concluded that the average life of a sewage disposal system with an absorption field or seepage pit is between 20 and 30 years. The article points out, however, that certain limitations must be placed upon the results of this type of investigation. As stated in the article, "These survival data are based on permits for installation and repair for systems in subdivisions. It is possible that some systems may have been malfunctioning for years without having been repaired, and some may have been repaired without the department's knowledge (to avoid the necessity of connecting to public sewers)." If the Lane County ratio of more than 10 actual failures to one application for a repair permit, a result of the human tendency to save money whenever possible, is also applicable in Fairfax County, then the service life of systems is this study is probably greatly overstated.

Glastonbury, Connecticut

In 1973 the Connecticut Agricultural Experiment Station conducted a review and analysis of the repair permit records of the town of Glastonbury, population 22,000, which was judged to be especially well suited to an analysis of the service life of septic tank systems since it includes about 70 percent of the dominant soil types in Connecticut.[8] Repair permit records of the Town Health Department were examined in a manner similar to that reported earlier in this chapter for Lane County, and information was collected on 493 systems which had failed since 1960, the beginning of the town's voluntary repair permit system. Unlike this study, however, the authors defined a "successful" system as one which has not been given a repair permit for failure requiring ". . .enlargement of the drainfield or installation of a new one." Specifically, the report states that, "A 'success' was defined as a system that operates satisfactorily or is endured by the owner without repair through the year." While such a definition might be acceptable for systems in isolated rural areas, it cannot be considered acceptable in urban or urbanizing areas where surfacing sewage constitutes a public health hazard and a violation of state regulations whether or not the owner is willing to endure the condition. An analogous definition would be to say that an act in violation of legal statutes is illegal only if reported or detected by law enforcement agencies. Using the definitions of failures and successes given above, the report shows that the average life of systems in Glastonbury is about 27 years - very much the same as was found by the study in Fairfax County, Virginia, and for similar reasons.

A second finding of the Glastonbury report was that performance of septic tank systems was poorer in areas with only slight soils limitations (high permeability and well-drained) than in areas with severe soils limitations (low permeabilities and poorly drained) - a result similar to that found in the USPHS studies. While the authors of the Connecticut report felt that the definitions of limitations should be changed, it is our opinion that better performance was achieved in the poorer soils, and therefore better able to pass septic tank effluent through the clogging mat at the soil-water interface.

Marin County, California

Experience in Marin County, California over the last five years offers some interesting data; this is an area where mandatory maintenance practices are being enforced. The details of this program are outlined in the next chapter, but the results from the viewpoint of septic tank system performance are summarized here. The county now has about 400 systems installed and operating under new maintenance procedures which include mandatory biennial inspection. Of this total, 142 have been inspected at least once, and only three failures have been observed. Two of these were the result of misapplications; one was installed in a high groundwater area, and the other was used to serve a dog kennel which was hosed down with large quantities of water. Therefore, only one documented failure has been observed in five years among systems with proper installation and conventional use. This is close to a 100 percent survival rate, which is superior to all of the curves shown in Fig. 5-3. The key factor in Marin County, in our opinion, is a seepage trench surface area requirement from two to four times greater than that required in Lane County and other areas reported herein,since all other factors are essentially the same in all cases.

El Dorado County, California

The Georgetown Divide Public Utility District in California was the first agency in the United States to implement a septic tank maintenance district responsible for the design, maintenance, and repair of individual sewage disposal systems. Although the program began in 1971, the District, whose jurisdiction is limited to one subdivision at this time, has no records available on failure frequency of the systems under its care for two reasons: (1) since the subdivision is in a rural recreational area, there are very few permanent residents and most systems are used for only a part of each year; and (2) there are only about 120 systems under the District's management at the present time, 35 to 40 of which were installed after March 1976.

Summary

Review of available literature on septic tank system performance in areas outside Oregon reveals the following significant points:

1. The number of published analyses of septic tank system performance is very small when compared to the number of people served by these utility systems.

2. In those analyses that are published, only a small fraction include field surveys or inspections to verify rates of survival or failure.

3. When repair permit records based on voluntary homeowner repair requests are used to calculate drainfield life without periodic field surveys, the average age before failure appears to be 25 to 30 years.

4. Where inspection or surveys have been combined with a review of office records, average length of service before failure has been less than 10 years.

Taken together, the four preceding points reaffirm a statement made in a Brown and Caldwell report nearly 10 years ago: "One of the greatest factors leading to misconceptions about the adequacy of septic tanks is the lack of accurate records of performance, especially on the local level. Wherever comprehensive surveys have been conducted, however, the results consistently refute the assumption of satisfactory service even though the difficulties inherent in detecting failures tend to bias such surveys toward acceptable system performance."[10]

An additional factor which must be taken into account, however, is that most systems reviewed in this chapter employed design, construction, and maintenance practices which have been generally recognized as inadequate only within the last five to 10 years, even though the first basic research revealing inadequacy was performed 20 years ago by McGauhey and others at the University of California. An example of one type of inadequate design criteria is the absorption area used to design subsurface systems in Connecticut until 1961. As noted in the report regarding Glastonbury, only 25 sq ft of absorption area was required per person for soils with a percolation rate faster than 5 minutes per inch.[8] For a 3-bedroom house this would mean the use of about 125 sq ft of soil absorprion area --slightly more than one-half Oregon's present minimum requirement and roughly one-third of its minimum requirement prior to 1974.

CHAPTER 6

BEST EXISTING MANAGEMENT PRACTICES

As described in Chapter 4, there are five basic elements involved in proper management of septic tank systems. These elements are site evaluation, design, installation, maintenance, and repair. In Oregon, as in most other states, these elements are managed by the application of a set of rules which have been arrived at primarily through a blend of pragmatism and political expediency. This is not said in criticism, for any knowledgeable observer can recognize the fact that the present rules represent a vast improvement over the virtual total lack of regulation that existed less than 30 years ago. The very nature of septic tank systems, however, defies precise technical evaluation and compels all rule-makers to resort to a measure of pragmatism.

Within the last 20 years there have been major contributions to the technical literature dealing with the basic mechanisms of septic tank drainfield function and failure. The first significant research in this area was conducted at the University of California Sanitary Engineering Research Laboratory under the direction of P.H. McGauhey. Subsequent significant work has been reported by Healy and Laak at the University of Connecticut and by Bouma at the University of Wisconsin.

McGauhey, in a 1973 state-of-the-art review, set forth seven basic criteria as the most important in septic tank drainfield function:[1]

1. Continous inundation of the infiltrative surface must be avoided.

2. Aerobic conditions should be maintained in the soil.

3. Initially, the infiltrative surface should be typical of an internal plane of undisturbed soil.

4. The entire infiltrative surface should be loaded uniformly and simultaneously.

5. There should be no abrupt change in particle size between trench fill material (rock) and the infiltrative surface.

6. The leaching system should provide a maximum of sidewall surface per unit volume of effluent, and a minimum of bottom surface.

7. The amount of suspended solids and nutrients in the septic tank effluent should be minimized.

Items 4 and 5, while recognized by most researchers as theoretically desirable, cannot be achieved in practice without extraordinary expense in drainfield construction. While best for the drainfield, they are therefore not necessarily best for the householder. The relative merit of trench sidewall and bottom area is not yet established beyond question. McGauhey identified sidewall area as the most important infiltrative surface.[2] Bouma, however, recommends the use of trench bottom area for design, with the sidewall area regarded as a "plus".[3] Healy and Laak recommended the use of both trench sidewall and bottom area.[4] We believe that at present the arguments for use of trench sidewall area are most compelling, but the illustration serves to emphasize the point that even the most knowledgeable authorities in the field must, in the final analysis, make pragmatic judgements.

The description of "best recommended practice" is an exercise in the application of pragmatic technical judgements. Under current design and construction regulations, a septic tank system once installed is unavailable for further evaluation except for observation of failure. We can therefore define by field observation that the drainfield system was too small, but there is no way that we can identify the ones that are too big. Since bigger, in terms of drainfield design, is almost always better, best recommended practice poses a problem of defining a nebulous set of criteria for a system that is just big enough. The goal must be not elimination of all failures, but reduction of the number and frequency of failures to a level which will produce a satisfactory level of environmental sanitation while assuring the homeowner that he may continuously occupy his dwelling.

Design

Best recommended practice must squarely face one basic design concept, which is that an individual household disposal system cannot be designed for average conditions because the individual home is too small to permit statistical averaging to occur. If individual household systems are designed on the basis of community-wide average values, half of all the systems installed will be too small, because statistically half of all homes will be above average and half below. A more reasonable concept is design for a condition which will encompass about 90 percent of all cases. The State of Oregon has recognized this concept in setting design flow values for individual homes. State rules require allowance for 75 gallons per capita per day (an average value), but require the assumption of two persons per bedroom, which is a conservative value probably valid for 90 percent of all homes.

The design of septic tank systems may be considered in two parts: the septic tank, and the drainfield.

Septic Tank Design. Best recommended practice for septic tanks should include the following:

1. Adequate capacity to achieve at least 24 hours retention in the tank after the accumulation of solids and scum for a period of about four years.

For a four-bedroom home this would require a tank with a capacity of about 1200 gallons, which is recommended as the minimum for a private home.[5]

2. Access from finished grade to the tank interior to permit routine inspection and pumping.

3. Durable construction - either concrete or fiberglass, but not metal.

Drainfield Design. For any given design, the life of individual soil absorption systems will vary depending on the site characteristics, household water use, and attention to septic tank pumping. Some systems will fail early and some will last indefinitely. Soil absorption systems should be evaluated on a basis which, on the average, will provide a level of environmental sanitation equivalent to that obtainable from a conventional sewerage system. One way to approach this evaluation is to define a "median", or "control" system, which can be reasonably expected to last 15 years before failure. A more conservatively designed system will have a longer life expectancy, and a less conservative system a shorter one. The most important technical information available to date supports the following assumptions:

1. The life of a soil absorption system, properly installed, is directly proportional to the amount of infiltrative surface area, so long as soil percolative capacity is above a limiting value.

2. A gravity-fed absorption system in fine-grained soils with 450 sq ft of infiltrative surface area per bedroom is defined as a control system and will last for 15 years. Less infiltrative surface area will result in a proportionately shorter life. Infiltrative surface should be calculated on the basis of trench sidewall area only.[2]

3. A control soil absorption system, supplemented after failure with a second identical system and an alternating valve, may thereafter be operated by alternately resting each half and will last for the life of the dwelling.

4. Systems smaller than a control system will have to be supplemented at shorter intervals until the total installed infiltrative surface equals that of two control systems. Thereafter, the systems may be rested alternately and will last for the life of the dwelling.

5. Coarse-grained soils which permit clogging in depth at the infiltrative surface will accept higher application rates.[2,4] For coarse-grained soils a control system may be defined as 250 sq ft of infiltrative surface area per bedroom. A coarse-grained soil would be one at least as porous as coarse sand.

6. Seasonal high groundwater should not rise higher than three feet below the bottom of the drainfield trench for a period longer than one to two weeks.

7. Drainfield trenches should be installed in series on slopes and looped on level ground. The use of distribution boxes should be discontinued since evidence to date indicates that they offer no advantage and, in fact, usually end up diverting most of the liquid to one part of the system.[6]

8. Variations and gradations within these assumptions should be applied only by a skilled technician.

Assumptions 2, 5, and 6 above are all more restrictive than corresponding standards in current Oregon regulations for subsurface sewage disposal.

One other aspect of system design is the method of delivery of septic tank effluent to the drainfield. Delivery in large doses (one or two per day) is in accordance with several of McGauhey's seven basic criteria, but imposes additional capital expenses for either pumping or the use of a dosing siphon, and requires additional operation and maintenance expenses. Whether or not dosing provides enough benefit to justify these additional costs has not been determined to date and is therefore not included in our list of best recommended practice.

Finally, construction of the second identical system is not recommended as necessary at the time of initial installation for two reasons: (1) use of the assumptions listed above will in our judgement reduce the frequency of system failures to a level which provides satisfactory service and protection of public health, and (2) a significant number of systems, possibly 5 to 10 percent using the assumptions above, will never fail during the life of the home being served, and requiring initial construction of the second drainfield would be an unnecessary penalty for these system owners. While the replacement system need not be constructed with the first system, it should be designed with the first system. This sequence will ensure that the second system can be installed without having to damage the first system.

Information regarding the distance of pollutant travel from septic tank systems and drainfield regeneration is described in Appendix D.

Site Evaluation

The site evaluation, which determines the suitability of a given site for the installation of a septic tank system, is a key element in effective septic tank management. A properly designed system installed in the wrong location will still be subject to early failure. Of particular importance are the factors of soils, groundwater, and lot configuration. For a successful site evaluation program it is important that the evaluation be performed by a qualified technician with sufficient background and experience to draw sound technical conclusions from his field observations.

Soils. Quite naturally, the nature of the surface soils has a major effect on the function of soil absorption systems. Three factors are of particular concern: permeability, depth to impermeable layer, and depth to creviced bedrock.

It is a well-recognized fact that soil absorption systems will not work in soils that will not absorb water. Tight clays and other soils of low permeability generally preclude the consideration of soil absorption systems. Sixty minutes per inch as measured by the percolation test is often used as the lower limit of permeability for soil absorption systems, but the authors believe this value to be unnecessarily restrictive. In a well-drained and properly constructed soil absorption system, a percolation rate of 120 minutes per inch can be more than adequate to support the rate of infiltration from the disposal trench into the adjacent soil. It is important, however, that higher percolation rates not be used as an excuse for reducing the area of infiltrative surface in the drainfield trenches. Percolative capacity of the soil is a limiting criterion and not a design parameter. Except for those coarse-grained soils where in-depth clogging to the infiltrative surface can occur, the infiltrative surface clogs at about the same rate regardless of the percolative capacity of the soil.

Even though surface soils may have adequate permeability, a soil absorption system will not work properly if a shallow impermeable layer prevents downward percolation of the wastewater. A shallow impermeable layer may lead to an accumulation of perched water which will flood the disposal trench and cause clogging of the trench infiltrative surface. An unsaturated soil column of about 3 ft is generally accepted as adequate for effective draining of fine-grained soils.

Three ft. of travel through unsaturated-fine grained soils is also about the minimum necessary for effective removal of bacteria.[7] Experience has shown that unsaturated soil is an excellent medium for the removal of pathogenic bacteria and viruses. Wastewater may flow for long distances through crevices in bedrock, however, without such purification. One goal of an adequate soil absorption system, therefore, is to achieve an adequate distance of travel through unsaturated soil before the wastewater enters crevices in underlying bedrock. A commonly accepted value for the minimum depth of unsaturated soil is two to three ft for fine-grained soils and up to 10 ft for coarser soils.[8]

Groundwater. There is abundant documentation in the technical literature for the fact that high groundwater has a detrimental effect on the function of a septic tank-soil absorption system. Inundation of the infiltrative surface due to seasonal high groundwater of perched water on top of an impervious layer leads to rapid failure of the soil absorption system which can be reversed only by an extended rest period. A commonly used limiting value for seasonal high groundwater in fine-grained soils is three feet below the bottom of the drainfield trench. For coarser, granular soils a lower value may be acceptable.

For a minimum-depth drainfield trench with 12 inches of gravel fill, with the top of the gravel at natural ground surface and covered by a soil cap about 12 inches deep, limiting depth to seasonal high groundwater is four ft. This allows for about 3 ft. of unsaturated soil column below the bottom of the trench. Drainfield trench inundation for as short a period as 30 to 60 days can cause clogging of the infiltrative surface. Sauer, et al report that ponding on sand filters (an ideal infiltrative surface) caused the surface to virtually seal up in as little as 45 days.[9] An effort should be made to assess seasonal high groundwater in terms of the maximum level likely to be encountered during the life of the drainfield.

Lot Configuration. The proposed drainfield site must be evaluated for several factors related to the size and configuration of the parcel. These include:

1. The maximum ground slope in the drainfield area should not exceed 25 percent.

2. An area meeting all of the criteria for the initial drainfield construction must be set aside for future construction of a replacement drainfield in event that the first drainfield fails.

3. All necessary set-back requirements must be met for the septic tank, the drainfield, and the replacement drainfield area.

4. The site must provide truck access at a location and elevation which will permit the septic tank to be pumped when necessary.

Installation

Control of septic tank installation should include both construction inspection and the preparation of record drawings.

Inspection. Septic tanks are normally free of construction defects. The drainfield, however, is susceptible to serious damage from poor construction practice. At least one inspection, and preferably two, should be made during drainfield construction to control the worst abuses.

Surface smearing of trench walls and bottom is probably the worst offense in the entire construction process. Surface smearing, which is accentuated by the use of excavating equipment and is most severe when the soil moisture content is high, will compact and seal the infiltrative surface before the drainfield is ever placed in operation. The condition can be corrected by scarifying the trench walls after excavation is completed, but in actual practice this is seldom done. An inspection after trench construction but before drain rock placement is necessary to catch and correct surface smearing.

Compaction of the drainfield area by the use of heavy or vibratory equipment during construction of the drainfield or the adjacent dwelling can reduce the percolative capacity of the soil to a value substantially less than that measured by the percolation tests before construction began.

Siltation of the bottom area can occur if the trench sides are allowed to spall or surface runoff is permitted to enter the open trenches. Siltation of the rock fill will occur if an effective barrier such as straw or untreated paper is not provided to limit the entrance of smaller particles (fines) from the soil backfill. In either case, the capacity of the drainfield will be reduced.

Improper trench backfill can lead to severe consequences. Insufficient backfill, or backfill which settles excessively, will result in surface depressions which become ponding basins for surface water, thereby increasing the hydraulic load on the subsurface field. Over-compaction of the trench backfill, on the other hand, can destroy the shallow drain lines. Although this risk has been substantially reduced by the shift from terra cotta tile to plastic drainfield pipe, heavy equipment should still be excluded from the initial and the replacement drainfield sites at all times.

Trench bottoms are presently leveled by using a hand-level and a surveyor's rod inserted at two points in the trench. While not as critical as the factors described above, a better approach to checking trench levels would be either to check the elevation of more than two points in each trench, use a survey transit instead of a hand-level, or use a transit and check elevations at more than two points. If distribution boxes are installed they should be checked for level installation by filling with water in accordance with Lane County's present procedure.

Other steps which also could be taken to improve installation practices include regularly scheduled regional training and review sessions for sanitarians involved in installations inspections, and a procedure for testing and certification of system installers who are now licensed solely on the basis of successful completion of an application, filing of an application fee, and posting of a bond.

Record Drawings. It is essential for maintenance inspection and repair work that an accurate drawing of the septic tank system be prepared at the time of construction. One of the duties of the construction inspector on his last inspection should be the preparation of a drawing showing the precise location of the septic tank and all drainfield lines, referenced to permanent features such as large trees and structures. This drawing will become a permanent part of the records for that parcel.

Maintenance and Repair

The design and construction practices previously described will not by themselves guarantee the perpetual satisfactory performance of a septic tank system. At best, they will delay the date of failure for several years. To achieve a quality of service comparable to that provided by a community sewerage system, an effective surveillance and maintenance program must be established. Such a program would include the periodic inspection of each septic tank system and would assure that septic tanks were pumped and defective systems repaired or replaced as necessary.

Frequency of Inspection. Experience in Marin County, California, where a formal septic tank maintenance program has been in operation for over five years, indicates that septic tank systems should be inspected not less frequently than once every two years. Marin County experience is discussed in detail at the end of this chapter. Each inspection should include a check of the sludge and scum accumulations in the septic tank and should consider the expected performance of the drainfield during wet weather. Evidence of drainfield failure should be followed up with required repairs, and evidence of incipient problems should be noted for careful future attention. Septic tanks should be pumped whenever the accumulated sludge depth reaches or exceeds 1/4 of the total liquid depth, or when the scum layer approaches the bottom of the tank scum baffle.

Corrective Procedures. A program of thorough and regular inspection of septic tank systems conducted by trained inspectors will reveal system malfunctions as they occur, or shortly thereafter. When defects are uncovered, prompt and effective remedial action should be taken.

Problems affecting the septic tank or the distribution system are normally straightforward and simply corrected at relatively low cost. Failure of a drainfield, however, requires the design and construction of a replacement system and is as complicated as the original system design. The reservation of a drainfield replacement area equivalent to 100 percent of the original drainfield will insure that a replacement field can be installed.

Management Agency

Regulation of the construction, operation, and maintenance of septic tank systems requires that a governmental agency be vested with necessary regulatory powers. In Oregon, the state has preempted authority relative to design and construction and assigned that authority to DEQ. Aside from the functions of rule-making and appeals, however, which continue at the state level, DEQ has recognized that control of construction and repair can best be effected at the local level. It has therefore followed a program of contracting with the counties to perform these regulatory functions.

Two major requirements must be satisfied by any program which is established to control septic tank installation and operation. First, procedures must be established to require individual homeowners to participate in the surveillance and inspection program and to obtain compliance with required preventive and corrective maintenance, and second, the cost of the program must be borne by the septic tank owners included in the program. It is inequitable to ask those city dwellers who are paying for sewers to subsidize through county taxes a surveillance program for unsewered residents of Lane County.

One method which will satisfy these requirements is the mandatory issuance of biennially renewable permits for residences surved by septic tank systems.[10, 11] The issuance of these permits would be dependent upon satisfactory compliance with the requirements of the inspection program, and permit fees could be established to cover the cost of the program. The fee required should be the subject of a separate study.

The law now protects the right of homeowners with existing septic tanks to continue their use as long as no nuisance or hazard to the public health occurs. The approval of all new septic tank construction, or the continued use of a system once alterations or repairs become necessary, however, could be made conditional upon the issuance of renewable permits.

Inspection of all septic tank systems under the jurisdiction of the regulating agency should be carried out by trained personnel. Right of reasonable access to private property for such purposes should be guaranteed by a county ordinance which is strictly enforced. Inspections should determine the general condition of the septic tank system with particular reference to any structural defects, the need for sludge pumping, and signs of current or recent failure of the drainfield. Where evidence of possible failure appears, additional inspections scheduled for periods of adverse conditions should be arranged. The inspection should verify the proper alternation of parallel drainfields where such a system is employed. An inspection program is effective only when conducted by experienced and qualified inspectors under professional guidance.

A report of inspection should be promptly transmitted to the homeowner giving the results of the inspection and defining any required or suggested action to correct or prevent failure. The homeowner should be notified of the time limit set for mandatory corrective work and the procedure for reporting compliance.

The regulatory agency should be held responsible for the following:

1. Interpreting and distributing septic tank general design criteria and operating procedures, including the definition of areas where septic tank installations are prohibited.

2. Processing applications for new septic tank systems and repairs on existing systems.

3. Interpreting site characteristics and developing a specific design for each particular installation.

4. Issuing construction or repair permits for all septic tank work and collecting permit fees.

5. Inspecting and approving all new construction and repairs.

6. Issuing biennally renewable permits for all residences within its jurisdiction.

7. Notifying homeowners of repairs, replacement, or maintenance which must be accomplished within a given period.

8. Confirming homeowners compliance with maintenance and corrective procedures, and renewing use permits.

9. Initiating legal action against violators of mandatory procedures.

With the preceding responsibilities vested in the regulating agency, the applicant then becomes responsible for the following:

1. Preparing and submitting the application for construction of a septic tank system.

2. Constructing the system.

3. Pumping of the septic tank by a licensed septic tank pumper when required by the regulating agency.

4. Repairing damage to the septic tank system.

5. Constructing the replacement drainfield when required.

The successful control and administration of the program herein recommended is totally dependent on the regulating agency charged with its accomplishment. This agency must be given sufficient staff, funds, and authority, both to attack the problem with flexibility under a rational rather than a codified approach, and to enforce and stand firm on decisions which must of necessity often be based upon professional judgment. The relative merits of the institutional alternatives which might be used to manage septic tanks in Lane County are discussed in detail in Chapter 7.

BEST PRACTICES OUTSIDE OREGON

A review of current practices in public agencies around the country showed that there were only two areas where management practices are being applied which approach the best management practices for septic tank systems described above. One of those areas is Marin County, California, and the other is the Georgetown Divide Public Utility District, also in California. Other areas, including the State of Wisconsin, are in various stages of proposing changes in present management techniques, but the two programs described below are the only ones known to be in operation for any significant length of time.

Marin County, California

Marin County, California, located immediately north of San Francisco across the Golden Gate, has about the same population as Lane County, although it is only about one-fourth as large. The county has developed primarily as a surburban area whose economic base is derived largely from the income of commuters who work outside the county. A surge of residential development following World War II produced thousands of homes served by septic tank systems, and as time passed a large proportion of the systems failed. The nuisances and public health hazards resulting from failing septic tanks prompted the county in 1967 to engage Brown and Caldwell to study the problem of individual disposal systems and recommend practical solutions for the county.

After a thorough review of the problems in Marin and the technical literature on septic tank systems, Brown and Caldwell recommended a set of design criteria and a septic tank ordinance.

Recommended Design Criteria. The septic tank design criteria for Marin County were developed with the goal of producing septic tank systems which would provide a quality of sewerage service comparable to that provided by a community sewerage system. The basic design and construction requirements, set forth in Table 6-1, made several major changes from the standards which were then in force in Marin County. Most significant are the following:

1. The minimum size for a septic tank is 1,200 gallons.

2. Drainfield surface area considers only the drainfield trench sidewalls, and the minimum surface area recommended is 1,200 square feet.

3. The amount of drainfield surface area required does not vary with soil permeability, although a limiting soil percolation criterion of 120 minutes per inch is used to evaluate site suitability.

4. A minimum drainfield replacement area is required, equal to 100 percent of the initial drainfield area.

5. A minimum lot size for a septic tank system is one acre to allow room for two drainfields, setbacks, and local variation of on-site soil suitability.

6. Allowable annual maximum groundwater elevation is three feet below the bottom of the drainfield trench.

Recommended Maintenance Program. It was a basic premise of the recommendations for Marin County that satisfactory performance of septic tank systems depends on the establishment of an administrative structure which will assure that the systems are properly operated and maintained. Proper operation and maintenance includes periodic inspection of each system so that septic tanks are pumped when necessary and defective systems are repaired or replaced.

A Marin County ordinance requires that the County Health Office issue an occupancy permit before any building not connected to a sanitary sewer may be

TABLE 6-1 . SEPTIC TANK SYSTEM DESIGN AND CONSTRUCTION CRITERIA

Item	Recommended Value
Septic tank size, gallons	
Four bedrooms or less	1200
For each additional bedroom, add	250
Distribution boxes	not permitted
Sewer wells	not permitted
Drainfield design	
Minimum allowable percolative capacity, minutes per inch	120
Trench surface area used for design	sidewall
Trench surface area, square feet	
Minimum	1200
Per bedroom	600
Trench width, inches	12-18
Gravel depth below tile, inches	24-36
Depth from trench bottom to seasonal high groundwater, feet	3
Minimum trench spacing, feet	6
Drainfield replacement area required, percent	100
Minimum lot size, acres	1.0
Lot size dependent on slope	yes
Minimum setback, feet, from septic tank to	
Buildings	5
Property lines	5
Wells	100
Creeks or streams	25
Cuts or embankments	25
Swimming pools	10
Water lines	10
Walks and drives	5
Large trees	10
Minimum setback, feet, from drainfield to	
Buildings	10
Property lines	5
Wells	100
Creeks or streams	100
Cuts or embankments	100
Swimming pools	25
Water lines	10
Walks and drives	5
Large trees	10

Source: Brown and Caldwell. Sewerage Study, County of Marin. 1967. 192 pp.

occupied. Brown and Caldwell recommended that these occupancy permits be renewed annually contingent upon satisfactory maintenance and performance of the septic tank system as determined by an annual inspection. It was further recommended that administrative control of the program be vested with the County Health Department, which has historically been charged with control of individual household disposal systems. It was recommended that the new controls be applied to all new septic tank systems constructed within the county and that they further be applied to all existing systems as a condition of the issuance of a modification or repair permit.

Adopted Program. After nearly four years of discussion, the Marin County Board of Supervisors adopted Ordinance No. 1861, providing regulations for the design and maintenance of individual waste disposal systems. A copy of that ordinance is included in Appendix C. The ordinance vested administrative control of septic tanks with the Marin County Health Officer, authorized the Health Officer to issue regulations governing the design and construction of septic tank systems, and established the legal basis for enforced inspection and for repair of defective systems. Violations of the ordinance are punishable under the nuisance abatement provisions of the Marin County Code.

The adopted program varies in some respects from the program recommended by Brown and Caldwell. The principal changes reflected in the adopted ordinance are the following:

1. The ordinance applies only to new septic tank systems constructed after the date of the ordinance. All pre-existing systems, whether or not they are functioning satisfactorily, are specifically excluded from the provisions of the new ordinance.

2. System inspections and occupancy permit renewals are performed biennially instead of annually.

3. Representatives of the County Health Officer cannot enter the premises to inspect a septic tank system without first receiving the owner's consent, or, failing in that, obtaining an inspection warrant pursuant to applicable law. This weakens somewhat the enforcement provisions as originally recommended, which would have given right of access to the owner's premises with a warrant unless the owner elected to deny access.

Acting under the rule-making authority granted by Ordinance No. 1861, the County Health Officer adopted without change the recommendations for site selection and design presented in the Brown and Caldwell report. Those regulations, together with the county's application procedure, are also included in Appendix C.

The County Health Office, acting through the Director of Environmental Control, proceeded at once to implement the new ordinance, and all septic tank systems installed since the fall of 1971 have been constructed and maintained in accordance with the adopted regulations.

Administration and Scope of Present Program. Administration of the new septic tank ordinance has been delegated by the Director of Environmental Control to a single registered sanitarian, who to date has been able to administer the entire program, county-wide, unaided. His duties include the following:

1. Site inspections prior to issuance of a construction permit.

2. Review of the results of site percolation tests. The County Sanitarian does not normally perform the percolation tests.

3. Issuance of construction and repair permits.

4. Obtaining permission of the property owner to perform biennial inspections.

5. Performance of biennial inspections.

6. Supervision of enforcement proceedings against non-conforming systems.

At about the time that the new septic tank ordinance was adopted in 1971, a number of economic, political, and social factors combined to slow down considerably the rate of installation of septic tank systems which had been experienced in the preceding decade. As a result, the total number of systems installed under the new ordinance does not exceed about 400, and installations are proceeding at the rate of about 100 per year. This slow rate of growth, combined with the political decision to exclude all pre-existing systems from the provisions of the new ordinance, has had the beneficial effect of permitting the deliberate implementation of a totally new concept in septic tank system management. As a result, the administrative procedures have been set up, tested and are functioning smoothly without the administrative problems which often attend the too-rapid implementation of a new program. The Marin County experience, therefore, represents a fair test of the basic concepts that it embodies. It is interesting to note that the Director of Environmental Control attributes the slow-down in septic tank system construction entirely to outside factors, and does not consider adoption of the new regulations to be a factor in the slow-down.

The program administrators recognize that continued growth, even at a slow rate, will soon require staff additions, because the number of biennial inspections increases continuously. Each year the number of inspections performed must equal approximately half of all the systems covered by the ordinance. It is the opinion of the program administrators that most of the chores involved in the biennial inspections can be handled adequately by technicians below the level of County Sanitarian.

Biennial Inspections. The procedures used in conducting biennial septic tank system inspections are as follows:

1. Two years from the date of system installation or from the last biennial inspection a form letter is sent to the property owner, signed by the Director of the Division of Environmental Health, informing the owner that an inspection is required. A copy of the letter is included in Appendix C.

2. Within 14 days, the owner must pay the $20 renewal fee, schedule an inspection by a representative of the Division of Environmental Health, and have the septic tank manhole cover removed. The homeowner may, at his option, have the inspection performed by a licensed septic tank pumper in the presence of a representative of the Division of Environmental Health.

3. The results of the inspection are recorded on the form which is included in Appendix C.

4. If the inspection is satisfactory, a new Certificate of Inspection is issued (Appendix C).

5. If repair or pumping is required, the owner must submit proof of repair or pumping before the new Certificate is issued.

6. Non-complying owners may be punished under the county ordinance for nuisance abatement.

Up to the end of August, 1976, 205 systems covered by the new ordinance had come due for biennial inspection. A total of 142 inspections had been completed, 35 had been deferred because the properties had not been occupied for a full two years, and 28 owners had failed to respond to the request for access. Follow-up letters and telephone calls have been directed to those owners who failed to respond, but to date no warrants have been sought or abatement proceedings undertaken. All in all, it is the opinion of those in charge of the Marin County program that it has worked exceptionally well.

Observed Performance. Two facts of particular interest stand out in the reports of the program to date. The first is the fact that the county now has some 400 septic tanks installed under the new ordinance over a period of five years, of which 142 have been inspected at least once, and only three failures have been observed. Two of these were the result of misapplications. One was installed in a high groundwater area, and the other was used to serve a dog kennel which was hosed down with large quantities of water. This leaves only one documented failure in five years which resulted after proper construction and conventional use. While the time period is short for evaluation of the design criteria, these first results are extremely encouraging.

The second fact of major interest is that 28 percent of the inspections have indicated that the septic tank needed pumping after only two years in service. Again, while more time is necessary to definitely establish a distribution of pumping frequencies, this is consistent with the prediction contained in the Brown and Caldwell report that the average period between pumpings would be about four years in that the actual two-year percentage of systems requiring pumping fits a distribution of approximately 25 percent every two years or less, 50 percent of all systems about every four years, and 25 percent every six years or more.

An interesting observation reported by the field inspector is that sludge depth in the septic tanks inspected has been about the same as scum depth. Since scum depth is the easiest to measure, this relationship, if it holds true for most cases, would greatly simplify the determination of need for septic tank pumping.

Program Critique. The septic tank control program in Marin County was carefully considered in advance of adoption, and since adoption has gotten off to a slow, carefully controlled start. These factors have combined to produce a program which is functioning with creditable smoothness. Nevertheless, on any new program such as the one in Marin County, an overview after five years of operation produces some observations regarding ways in which the program could be improved. These observations are presented below in two groups: those suggested by Marin County personnel, and those recommended by Brown and Caldwell as an outside observer.

The following observations by Marin County personnel charged with administering the septic tank control program are worthy of note:

1. The program has gotten off to a slow, deliberate start, but is beginning to build to the point where more personnel will be needed. Administrative control of the maintenance and inspection program lends itself readily to computerization, and a program of this nature should be tailored from the start for computer control.

2. The Director of Environmental Sanitation believes that initial control of septic tank construction should remain a county function, but he believes that an extensive maintenance and inspection program can be most efficiently administered through local agency control.

3. County policy has dictated that septic tank control programs should receive the practical minimum of publicity. Some personnel charged with administering the programs believe that more good publicity would improve public understanding and acceptance.

4. Marin County attempts to discourage the development of subdivisions using septic tank systems. The burden is placed on the applicant to prove "social benefit". The county attempts to get dry sewers constructed when the subdivision is built. The matter is always referred to the local district most likely to eventually assume control of the subdivision, and the local district's advice is followed.

5. The program administrator has found that a carefully prepared "as-built" diagram of each system, prepared at the time of the construction inspection, is a valuable aid in performance of the biennial inspections.

As an outside observer involved in preparation of the report which led to the adoption of the Marin County program, we offer the following comments:

1. Perhaps most important of all is the fact, supported by the initial five years of careful observation and control, that septic tank systems can be made to work if the control agency is willing to enforce the regulations necessary to make them work.

2. The legal basis for enforcement of inspections is weak. The inspector must have either the written approval of the owner or a warrant before he may enter the owner's premises. The ordinance and the inspection program would be strengthened considerably if the inspector needed a warrant only in cases where the owner had registered written disapproval of the inspection.

3. The program addresses only new system construction. While this program works well, it ignores the problems associated with the vast majority of septic tank systems in the county, which were constructed under the old ordinance. The cause of environmental sanitation would be better served if a politically acceptable basis could be developed for bringing pre-existing septic systems under control of the new ordinance as a condition of the issuance of a repair permit.

Georgetown Divide Public Utility District, California

Located in El Dorado County, California, the Georgetown Divide Public Utility District (GDPUD) currently employs one full-time environmentalist to manage the septic tank systems for a subdivision of homes in a rural recreational area of the Sierra Nevada foothills. Due to the large number of system failures in the area prior to 1970, the district was formed to provide central management services to the Auburn Lake Trails subdivision through the formation of a special sewer improvement district within the GDPUD. Presented below are both the powers and policies of the district and a description of performance observed to date.

Present Program. GDPUD is authorized through its environmentalist to carry out the following tasks:

1. Conduct site evaluations.

2. Design specific on-site systems to serve individual lots.

3. Inspect installation of all systems.

4. Inspect and maintain the systems after installation.

5. Monitor water quality to determine the effect of the individual systems on water leaving the subdivision.

The district is also empowered to require the installation of public sewers when and where necessary.

All installed systems are inspected semi-annually, and more frequently if there is any problem with a specific system. Cost to the homeowners in the area is presently $12 per year which is billed by the District at the rate of one dollar per lot per month. Commercial lots are billed at the same rate.

Observed Performance. As noted in Chapter 5, performance and frequency of septic tank pumping cannot be assessed at this time due to insufficient time and numbers of systems. Most homes in the subdivision are only occupied for parts of the summer and winter seasons. In addition, about 35 of the 120 systems in place at the time this report was written were installed after March 1976.

CHAPTER 7

FEASIBLE MANAGEMENT STRATEGIES

The goal of a strategy for individual disposal system management should be the attainment of an acceptable level of environmental sanitation for the individual homeowner by the most cost-effective and efficient available means. A basic premise of this report is that this goal can be attained through application of the best technical practices, as defined in Chapter 6. The practical questions which remain to be answered, then, relate to the financial and political feasibility of establishing in Lane County a management structure which can apply some or all of these best practices. In this Chapter, the description of alternative strategies follows a definition of the two components of each strategy and a description of the characteristics of existing agencies. An evaluation procedure is then outlined, and the alternatives for each strategy component are evaluated accordingly.

MANAGEMENT STRATEGY COMPONENTS

The two basic components of each management strategy in this evaluation are: (1) management functions and related technical practices, and (2) the powers,organization, and policies of the management entity. Each component is defined further below.

Functions and Practices

An evaluation of management systems begins with the set of functions and practices which management must perform - "functions" being the tasks performed and "practices" being the way in which functions are carried out. When these are understood the structure, powers, and procedures of the agencies needed to perform the functions may be explained using combinations of the 14 functions listed in Table 7-1.

The first six of the listed functions deal with the management elements of site evaluation, design, and installation; all are presently carried out to some extent by the Lane County Water Pollution Control Division, as described in Chapter 4. Functions 7, 8 and 9 pertain to maintenance and are not currently performed by any agency. Functions 6 and 10, regarding regulation of pumpers and installers and disposal of septage, are presently carried out by DEQ. Functions 11 through 14 pertain to system failure and repair and are a part of the services currently provided by Lane County.

TABLE 7-1. MANAGEMENT FUNCTIONS

Management element	Functions
Site Evaluation	1. Perform on-site evaluation and record results
Design	2. Establish design standards
	3. Approve or perform site design
Installation	4. Issue or deny construction permit
	5. Inspect construction and record as-built information
	6. Regulate installers
Maintenance	7. Establish operation and maintenance standards
	8. Perform periodic maintenance inspections
	9. Enforce tank pumping when required
	10. Regulate pumpers and disposal of septage
Repair	11. Approve or perform repair design
	12. Issue repair permits for failing systems
	13. Inspect repairs and record as-built information
	14. Enforce repairs

The following description of practices will include a definition of the physical method by which each function is implemented, the level of personnel required to perform the function, and possible enforcement procedures where applicable. Since DEQ has not delegated authority to qualified counties to perform Functions 2, 6 and 10, those functions, and the practices associated with them, will not be discussed further. The reader who wishes information on best management practices for these functions may refer to Chapter 6.

Powers, Organization, and Policies

The agencies selected to perform management functions must be vested with the powers necessary to manage effectively. Ten powers related to the conduct of an individual waste disposal system management program are listed in Table 7-2. Five of these are mandatory for the proper functioning of a management agency, and five are optional powers, any one or more of which may be used within specific management strategies.

The first five powers would be used by an agency with relatively limited management of individual systems, while the optional powers would be used by agencies with much greater individual system control and involvement.

These powers can be held by any one of a number of agencies - the present County Water Pollution Control Division,for example, or a new special district, or a private entity carrying out day-to-day administrative duties under authority delegated to it by a public agency. Table 7-3 lists possible implementing agencies which are described in the section of this chapter concerning alternative organizations, powers, and policies.

The only policy alternative discussed in this report deals with the number of systems to be included in the proposed management programs. In theory, this number could vary anywhere from a limited number of systems in a specific local area to all existing and future systems in Lane County.

Two other types of districts were considered briefly, but eliminated from detailed discussion and evaluation: a Metropolitan Service District, and a Port District.

The Metropolitan Service District, although expressly authorized to provide sewerage service, was eliminated both because such districts are mainly intended for areas where services cannot be adequately provided by other agencies and because of pending state legislation which may restrict the ability of such a district to provide the services being considered in this study. The possibility of establishing or using a Port District as a management agency was eliminated because there is no advantage to be gained from the use of a district which, although having broad powers, does not have express authority to provide sewerage services and is not basically intended for that purpose.

TABLE 7-2. MANAGEMENT AGENCY POWERS

Mandatory powers

1. The power to issue regulations.
2. The power to enforce its regulations.
3. The right of access to private property.
4. The power to levy and collect appropriate fees.
5. The power to determine and assess the benefit to any property served and to collect that assessment from each property owner.

Optional powers

6. The power to own, purchase, lease, and rent both real and personal property.
7. The power to accept and use state and federal grants, and sufficient authority to meet grant requirements.
8. The power to undertake debt obligations and to sue and be sued.
9. The power to plan and control how and when community sewerage service will be provided.
10. The power to delegate responsibility to qualified persons and to contract for performance of any or all management functions, or for the use of any real or personal property necessary to perform such services.

TABLE 7-3. POSSIBLE IMPLEMENTING ENTITIES

1. City
2. County
3. Sanitary Authority
4. Sanitary District
5. County Service District

ALTERNATIVE FUNCTIONS AND PRACTICES

Numerous technical alternatives exist which would either maintain or change the implementation of the five management elements (Table 7-1) of Lane County's individual waste disposal program. The alternatives described in this chapter, however, are combinations of present functions and practices with those functions and practices which comprise best management practice for (1) maintenance, (2) installation of new systems, and (3) system repairs.

The present functions and practices for site evaluation and design are excluded from the alternatives described below since, in our judgement, present practices used in evaluating sites for possible use of a septic tank drainfield system, as described in Chapter 4, are best management practice and need not be considered for change. The design element is comprised of: (1) establishing design standards, and (2) performing or approving site designs. Lane County has no authority to change design standards since this function is presently, and for the foreseeable future, pre-empted by the Department of Environmental Quality. However, the present practice of using sanitarians and registered engineers to perform or approve site designs, in accordance with the detailed design standards promulgated by DEQ, constitutes best management practice for this function, thereby eliminating it and the entire design element from further consideration. Three elements remain, then, which can either be managed in the present manner or changed to improve the performance of septic tank systems in Lane County: (1) installation, (2) maintenance, and (3) repair. Because of the similarity of the installation and repair elements, they are hereafter considered together. Lane County has received a letter from DEQ stating that local governmental entities are not prohibited by state statute either from adopting maintenance requirements or from establishing an inspection fee.

Installation of New Systems and System Repairs

Only two sets of alternative functions and practices exist regarding new installations and system repairs. The two alternatives are: (1) present practices, and (2) best practice as defined in Chapter 6.

Referring to Table 7-1, no new functions need to be added to those currently carried out by the County Water Pollution Control Division to achieve a level of best practice since those functions meet the requirements for best practice for installation and repair. The practices used to carry out Function 5 (Inspect Contruction and Record As-Built Information) and Function 14(Inspect Repairs and Record As-Built Information), however, would be improved by performing two construction inspections instead of one as at present. The new inspection would occur after trench excavation, but prior to backfill with drainfield rock. This inspection would permit the sanitarian or soil scientist to more accurately verify trench depth and slope, and to detect any smearing or compaction of infiltrative surfaces which may have taken place during construction. The practices used in approving or performing repair designs (Function 11) would also be improved by insuring that the design will permit the repair system to be used alternately with the existing drainfield in future operation.

System Maintenance

A total of five alternative strategies involving various practices and enforcement procedures were developed to carry out Functions 7, 8, 9 and 10 in Table 7-1. In order of increasing public agency involvement, the alternative strategies are as follows:

1. The homeowner retains responsibility for deciding when septic tank system maintenance is required, guided by operation and maintenance recommendations developed by the managing agency and published through a public information program.

2. The managing agency performs regular maintenance inspections of the septic tank and drainfield and recommends tank pumping to the homeowner, without enforcement authority.

3. The managing agency performs regular maintenance inspections and levies a fine against the homeowner who fails to take the required action.

4. The managing agency performs regular maintenance inspections and, if the homeowner fails to take action, carries out the required action by itself or by contract and then presents a bill to the homeowner for the work done.

5. The managing agency owns each system and is responsible for all maintenance, as well as installation and repairs.

Maintenance Alternative 1. This alternative is essentially present practice, with increased emphasis on a public information program. In this alternative, the present educational program carried out by the county to encourage more frequent septic tank pumping would be enlarged and emphasized. Examples of practices which could be used in Alternative 1 include the following:

- Printing additional materials regarding the importance of septic tank pumping.

- Publishing regular articles for distribution to Lane County residents through all three information media: newspaper, radio and television.

- Distributing printed maintenance instructions to septic tank owners both through County staff members and through licensed pumpers and installers.

- Periodically attending public meetings in local areas served by septic tank systems.

Maintenance Alternative 2. Alternative 2 includes the practices of Alternative 1, but adds the function of regular inspections, performed by the managing agency at recommended intervals of not more than two years. The inspections could be conducted by sanitarians or trained technicians, and the result of the inspection would be a report to the property owner regarding the status of his or her system. Items inspected would include the levels of sludge and scum in the septic tank plus the condition of the septic tank and drainfield. Surfacing sewage would be recorded as a drainfield failure. The inspection report under this Alternative could recommend tank pumping if found necessary, but could not require pumping. If the drainfield were found to be failing, however, present regulations in ORS Chapter 454 and Oregon Administrative Rules Chapter 340, Division 7, could be used to enforce repair of that portion of the system.

Right of access for the managing agency to conduct the inspections would be granted by ordinance, with allowance for specific written refusal by the property owner.

Maintenance Alternative 3. The basic concept of Alternative 3 is to add new functions and practices to the maintenance element in order to achieve best existing management practice as defined in Chapter 6. The functions added would be items 7, 8 and 9 in Table 7-1 which include establishing operation and maintenance standards, performing periodic maintenance inspections, and enforcing septic tank pumping when required.

Operation and maintenance standards would, as a minimum, include the following items:

1. A requirement that systems be inspected not less than once every two years (biennially).

2. A requirement that septic tanks be pumped when inspection indicates that the sludge depth will reach or exceed one-fourth of the total liquid depth, or that the scum layer will reach the bottom of the tank scum baffle before the next inspection.

The second new function would be performance of the maintenance inspections as defined in Alternative 2.

The third new function would be enforcement of pumping when necessary. The enforcement procedure would be based on authority given to the managing agency by ordinance, to require septic tank pumping if found necessary in the inspector's report. Documentation of satisfactory inspection issued to the property owner could be provided in the form of an inspection certificate, renewable at the time of each inspection. The certificate would be renewed either on the inspector's finding that no maintenance was necessary, or upon provision by the owner of proof that the tank had been pumped as specified. Failure to perform required pumping would result in a fine, or series of fines, levied against the property owner as a penalty for noncompliance. An administrative appeals procedure would also be established for the protection of the property owners.

If the inspection report notes that repairs are required, the necessary work can be carried out using present repair permit procedures.

Maintenance Alternative 4. The only differences between Alternative 3 and 4 would be the enforcement procedure.The managing agency would establish standards of operation and maintenance, and perform inspections exactly as described in Alternative 3.

Instead of using a fine as a penalty for noncompliance, however, the managing agency would have the tank pumped after a specified period of time, possibly through its authority to abate nuisances. The cost of pumping would then be billed to the property owner. An appeal procedure would also be established in this alternative. The inspection certificate would be renewed either upon a report of no required maintenance when the property owner submitted proof of pumping, or upon completion of pumping conducted for the managing agency.

Right of access in this alternative could be provided by a dedicated easement for each lot included in the program. Easements could be obtained either voluntarily or through payment of just compensation to the property owner.

Maintenance Alternative 5. Under Alternative 5, the managing agency would own the septic tank system and would, therefore, take upon itself the responsibility for satisfactory maintenance of each system in the program, including regular inspections and necessary pumping carried out by licensed pumpers. A dedicated easement would also be necessary for implementation of this alternative, but enforcement procedures for pumping would not. The homeowner would pay for his system through a combination of initial charges and monthly billings, as homeowners in sewered areas do.

Summary. A list of technical alternatives is presented in Table 7-4.

ALTERNATIVE POWERS, ORGANIZATION, AND POLICIES

The following Sections deal with three basic issues: (1) the powers necessary to carry out the functions previously described; (2) the agencies which possess these powers; and (3) policies regarding desirable number of systems in the management program. The powers of five statutory districts and public agencies are described, including those of the present managing agency - Lane County.

TABLE 7-4. INITIAL TECHNICAL ALTERNATIVES

Installation of New Systems and Repairs
1. Continue present practices.
2. Perform two construction inspections.
Maintenance Alternatives
1. Continue present practice, but emphasize public information program.
2. Perform regular maintenance inspections; recommend action to homeowner.
3. Perform regular maintenance inspection; levy fine for no action.
4. Perform regular maintenance inspections; have work completed and bill for cost if homeowner fails to take action.
5. Agency owns and maintains systems in program.

Powers of Statutory Agencies

All of the agencies listed in Table 7-3 are specifically authorized by Oregon Revised Statutes (ORS) to provide sewage treatment and disposal services. A comparison of the statutory powers of the five public agencies with the powers listed in Table 7-2 shows that all five agencies possess the ten mandatory and optional powers, either expressly or inherently, in their statutes. The authority for access to private property, while not stated in the ORS chapters pertinent to the individual agencies, derives from the general police powers of public agencies. That is, governmental bodies have the right of access to prevent or stop the occurrence of public harm, and also have the right to exercise the power of eminent domain to perform an act for the public good.

Other Characteristics

Pertinent characteristics of cities, counties and special districts relative to septic tank system management are displayed in Table 7-5. Common to each of the five public agencies is the fact that only registered voters may participate in elections. Common to special districts is the fact that a formation election may be held if petitioned for by 15 landowners or owners of 10 percent of the acreage in the proposed district, whichever is the greater number of petition signatures.

City. Cities have the statutory power to construct and operate sewage disposal systems and, pursuant to ORS 224.020, may provide such service outside their corporate limits. Unincorporated areas, thus served, may gain representation either by annexation or consolidation. In the latter case, a new city charter is negotiated between the unincorporated area and the pre-existing city. Thus, the service area for a city is, for practical purposes, limited to its corporate boundary. There is no limit to financial indebtedness a city may incur for sewerage purposes, although no revenue or general obligation bonds may be passed without an election.

County. As noted in Table 7-5, the county board of commissioners governs and is elected by voters throughout the county, including both incorporated and unincorporated areas. While a county is authorized to provide sewerage services under ORS Chapters 203 and 454, its police powers for enforcement do not apply within cities unless consent to those powers is expressly given by the cities.

Authority to set user fees is not expressly given in existing statutes, but there is inherent authority in the general rule of law that the authority to charge for use is incidental to the authority to provide a utility.[2] Financing capital improvements generally obligates residents of the entire county unless a special assessment area is established for that purpose. Tax rates may not exceed two percent of the true cash value of all property in the county. In addition, bond elections require a county-wide vote, and all taxation and exemptions therefrom must also be put before all county voters (ORS 203.055).

TABLE 7-5. PERTINENT CHARACTERISTICS OF EXISTING AGENCIES

Agency	Jurisdiction	Formation	Governing body	Financing
City	May provide extra territorial sewerage	Petition (20% voters) and boundary commission approval	City Council	1. No limit to taxation although voter approval needed for taxation above 6 percent. 2. No limit on bonds for sewers[b]
County	Incorporated and unincorporated areas[a]	Already formed	Board of county commissioners	1. Ad valorem taxation not to exceed 2 percent of true cash value of property assessed
Sanitary authority	Incorporated and unincorporated areas[a]	Motion of county governing body or by election, and boundary commission approval	Five-member sanitary authority board chosen from and by electors	1. Ad valorem taxes as necessary. 2. G.O. and revenue bonds cannot exceed 13 percent true cash value of property assessed
Sanitary district	Unincorporated areas only	Motion of county governing body or by election, and boundary commission approval	Three to five member board who must be voters and landowners	1. No limit on ad valorem taxation. 2. G.O. and revenue bonds cannot exceed 13 percent true cash value of property assessed.
County service district	Incorporated and unincorporated areas[a]	Motion of county governing body or by election, and boundary commission approval	Board of county commissioners	1. Ad valorem taxes to 1/2 mill/yr. 2. G.O. and revenue bonds cannot exceed 13 percent true cash value of property assessed.

[a]Cities can be included only with their approval.
[b]ORS 287.004(4).

Sanitary Authority. Sanitary authorities have been established by statute in ORS Chapter 450 to deal with problems of sewage disposal, drainage, insect control, and related concerns by "... the cooperation and integrated effort and support of unincorporated and incorporated areas". These special districts are governed by a five-member board chosen from and elected by qualified voters residing within the authority.

The board is authorized to adopt and enforce all necessary and proper regulations or ordinances for the control of sewage disposal. A sanitary authority may also construct, operate, or maintain sewage disposal systems for any area within the authority. Portions of such systems may be constructed outside the authority where necessary or expedient, and service may be furnished to discrete areas outside the authority by contract. An authority may also contract for joint use or operation of a sewage disposal system with any agency or private entity, and may purchase all or portions of systems from the same public or private entities. Cities may be included within a sanitary authority as noted above, but only with their consent. The geographic area included within a sanitary authority may be any portion of one or more counties and need not be contiguous.

A sanitary authority is formed by an affirmative motion of the governing bodies of the county or counties involved, or by an election requested by 15 percent of the registered voters in the proposed authority area, or 100 registered voters, whichever is less. No election for formation is required unless a written request for such is filed by the time of the final hearing. The boundaries of the proposed service areas and the formation of the authority are subject to the approval of the Local Government Boundary Commission, in Lane County, as are all other proposals for the formation of new cities or districts.

A sanitary authority has the same inherent authority to establish, set, and collect user charges or fees as does a city, county, or other special district. Ad valorem taxes may be levied by an authority in support of general obligation bonds for construction. As stated in Table 7-5, both general obligation bonds and revenue bonds are issuable upon voter authorization, but total bonded indebtedness may not exceed 13 percent of the true cash value of assessable property within the authority.

Sanitary District. Sanitary districts may be formed in accordance with ORS Chapter 450 for the purpose of providing sanitation facilities, with specific authorization to construct, operate, and maintain sewage collection and disposal systems, and to maintain and operate solid waste collection and disposal sites. Such districts may be formed in one or more counties, and may have non-contiguous parts, but must remain outside the corporate limits of cities. They may, however, enter into agreements and contracts with cities to provide or jointly maintain and operate sewage collection and disposal works.

The powers of a sanitary district are exercised by a board of either three or five members who must be both registered voters and freeholders residing within the district. Formation procedure is the same as that for a sanitary authority, except that a county governing body may initiate formation of a sanitary authority for reasons of public health but may not do so for a sanitary district. Election and voting procedures and boundary definitions are also identical to those of sanitary authorities.

Authority to levy user charges or fees in a sanitary district is an inherent general power, as it is for other public agencies. A district may levy ad valorem taxes to finance authorized projects. General obligation and revenue bonds must be approved by voters in the district, but improvement bonds, which are levied for strictly local improvements, do not require voter approval. The debt limitation on total outstanding district bonds is 13 percent of true cash value.

County Service District. Service districts may be established within a county under ORS Chapter 451 to provide services related to sewage works, drainage, street lighting, parks and recreation, flood control, water supply, and solid waste disposal. Such a district may include any area or areas, contiguous or not, in a single county under the control of the county board of commissioners. No part of a city may be included in a service district without a resolution of consent from that city (ORS 198.720).

Formation of a county service district (CSD) may be initiated by (a) the county board of commissioners, (b) a petition signed by a sufficient number of registered voters or landowners in the county, or (c) by certification of the existence of a health hazard in the proposed service area. Election and voting procedures are the same as those for sanitary districts and sanitary authorities, and the county commissioners are the governing body.

Among other possibilities, a CSD may finance the construction, operation, or maintenance of service facilities by property assessments, service or user charges, connection charges, ad valorem taxes, the sale of bonds, or any combination of the above. Ad valorem taxes for the construction, operation, or maintenance of service facilities are limited to one-half mill per year, not to exceed five years, on each dollar of true cash value of taxable property. Bond issuance requires district voter authorization, and all outstanding bonds must total less than 13 percent of the true cash value of assessable property within the district.

Numbers of Systems in the Program

The basic policy decision to be made is: How many systems should initially be included in the program? This section describes five possible answers to that question.

1. The program would apply to local areas only and would include systems installed after the program begins, existing systems which require

repair after the program begins, and the systems of any homeowners who wish to join the program voluntarily.

2. The program would apply to local areas only, but would include all systems, new and existing, in that area.

3. The program would apply throughout the study area (areawide) and would include systems installed after the program begins, existing sys- which require repair after the program begins, and the systems of any homeowners who wish to join the program voluntarily.

4. The program would apply throughout the study area and would include all systems from Alternative 3, plus all new and existing systems in specified local areas.

5. The program would apply throughout the study area and would include all systems, new and existing.

The local areas mentioned in Alternatives 1, 2 and 4 could be communities, rural residential areas, or urbanizing areas outside cities which either have high septic tank system failure percentages, are located in areas with adverse site conditions, or express a desire to join the program on their own.

SUMMARY OF STRATEGY COMPONENT ALTERNATIVES

The two preceding sections of this chapter have described two alternative practices for installation of new systems and repairs, five alternative strategies for maintaining septic tank systems, five statutory agencies capable of managing a septic tank system program, and five possible program sizes as measured by the number of systems to be included in the program. These alternatives are listed in Tables 7-4 and 7-6 and are summarized below.

The two alternative installation strategies involve only a change in technical practices for carrying out existing functions of the County Water Pollution Control Division. The alternative maintenance strategies include a range of possibilities from continuing present functions and practices up to and including the alternative of designating a public agency to own all septic tank systems. Public agencies which are capable of managing an individual waste disposal managment program include cities, Lane County, a sanitary authority, a sanitary district, and a county service district. Finally, the five alternative program sizes range from including only newly installed systems, repaired systems, and voluntary entries into the program in local areas to the ultimate possibility of including all septic tank systems throughout the entire study area.

Considering all possible combinations of these alternative strategy components, there are a total of 250 alternative programs which would be described

TABLE 7-6. INITIAL INSTITUTIONAL ALTERNATIVES

Program size		Possible managing agencies	
1.	Local areas only - new systems, repaired systems, and volunteers.	a.	City
		b.	Lane County
2.	Local areas only - all systems, old and new.	c.	Sanitary authority
		d.	Sanitary district
3.	Areawide - new systems, repaired systems, and volunteers.	e.	County service district
4.	Areawide - systems in Alternative 3 plus all systems in specified local areas.		
5.	Areawide - all systems, new and old.		

and evaluated. Since this is obviously an unmanageable number, the next two steps in the evaluation process will (1) define a set of evaluation criteria, and (2) reduce the 250 alternatives to a reasonable number for final evaluation.

BASIS FOR EVALUATION

Any proposed program, project, or strategy should be evaluated in terms of (a) the results which can be expected, (b) the likelihood of putting the program into operation in the first place, and (c) the costs which will be incurred in running the program. Four evaluation criteria are set forth here:

1. The management strategy or component must be effective in achieving desired objectives.
2. The strategy or component must be relatively easy to implement.
3. Manpower requirements for the strategy or component must be reasonable.
4. Costs of program or component management and costs to the homeowner must be reasonable.

Each of these criteria is described in more detail below.

Effectiveness

The effectiveness of any management strategy or strategy component can be measured by the degree of improvement achieved in environmental sanitation in Lane County and by the increase in expected drainfield life beyond the present median of approximately 10 years. Ideally, effectiveness should be measured statistically; where this is not possible subjective judgements must be made. Included in the measure of effectiveness of an alternative is the reliability with which expected gains in environmental sanitation and drainfield life can be made. That is, with what degree of certainty can it be said that a gain is made, and if initial gains are made, can they be sustained?

It should be noted here that protection of groundwater quality is not included in the measure of effectiveness. This is because the principal method for achieving that goal,when using septic tank systems,is through regional land use planning to prevent placing large numbers of systems on the roof of a single groundwater aquifer.

Ease of Implementation

No program will be undertaken until the homeowners affected by that program decide, through appropriate administrative and legal channels, to undertake it. As a general rule, those programs which make the smoothest transition from the planning stage into implementation are those which do not require radically different administrative procedures, those which have the fewest controversial features, and those which have the lowest cost. Each of these factors is considered in the subsequent evaluation process. One additional factor in the ease of implementation is also considered: flexibility of the management strategy to meet changing future conditions, including septic tank system performance in different areas of the county, growth patterns in rural residential areas and urbanizing areas, and other environmental or social factors.

Manpower Requirements

Manpower requirements for a septic tank system management program, as discussed in this report, are those of the administering agency only. They do not include, for example, the manpower required for pumping septic tanks and hauling septage to the nearest disposal point. The time required for that work is assumed to be performed by privately owned, licensed pumpers, and the cost for that service is based on the unit costs set forth in Chapter 3. The labor requirements for any strategy are based on County Water Pollution Control Division evaluation of present requirements and estimates for proposed programs. As such, the estimates of manpower requirements for management are independent of the type of agency administering the program, but may be affected by the size of the agency.

The evaluation of manpower requirements for an alternative strategy includes consideration of whether the requirement is too large in light of expected benefits, and whether the requirement is too small to support a management staff, as might occur for a proposed program in a local area.

Program Cost

Program costs were evaluated in two parts: (1) total program cost, and (2) the average cost per homeowner. Costs of all alternative strategies are made up of four components: management agency costs, new system installation costs, pumping costs, and cost of repairs. Management agency costs are based on manpower requirements and 1976-77 salary costs of technical, professional, clerical and administrative personnel provided by the County Water Pollution Control Division. Costs of installations, pumping, and repairs are based on 1976 costs provided by licensed pumpers and installers.

Homeowner costs were calculated by assuming that the costs of new installation, pumping, and repair would be paid directly to licensed pumpers and installers, while an inspection fee is assumed to cover management agency costs for maintenance alternatives. The cost of site evaluation, design, and installation inspection work by the management agency are covered either by the current new system application fee ($75) and construction permit fee ($25), or by monies from the county General Fund.

SCREENING OF ALTERNATIVES

Previous chapters and sections of this report have described the available information on septic tank system performance (Chapter 5) and management practices (Chapter 6), both in Lane County and elsewhere, as well as the feasible management strategy components which could be combined into a single program for use in Lane County. This material provides the foundation for the remaining portion of this chapter and the subsequent chapter. Evaluation of alternatives begins with screening the alternative strategy components with evaluation criteria just described. The second section of the evaluation is a final analysis of the remaining alternatives concluding with selection and description of the recommended strategy.

Alternatives were screened using the criteria of effectiveness and ease of implementation to eliminate those alternative components which are substantially less effective in improving levels of environmental sanitation, or are significantly more difficult to undertake than other alternatives, or both. Alternative functions and practices were screened first, followed by alternatives for numbers of systems in the program and possible managing agencies. The screening process was carried out by Brown and Caldwell together with staff members of the County Water Pollution Control Division and L-COG.

Functions and Practices

Two alternatives for installation of new systems and system repairs have been described, together with five alternative maintenance procedures. Both installation alternatives were retained for detailed analysis, although best installation practice would be significantly more effective than present practice. Implementation of the best practice of inspecting installations twice would, however, entail new management agency costs and manpower, which will be evaluated in detail.

Among the maintenance alternatives, it is our judgement that Maintenance Alternative 1 (present practice with increased public education) would not significantly increase regular voluntary pumping of septic tanks above the 20 to 30 percent of homeowners now doing so. This alternative was therefore eliminated from further consideration due to its probable lack of effectiveness.

Maintenance Alternative 2 (regular inspections plus maintenance recommendations), as a minimum, adds significantly to the data base, or information base, from which future system performance can be evaluated; more importantly, it would locate and identify most of the failing drainfields which now go undetected. Although it would also induce more system owners to pump their septic tanks when necessary, we would not expect that substantially more than half of all residential septic tank system owners would follow the pumping recommendations of system inspectors. While relatively non-controversial because of the lack of enforcement procedures, the inspection fee which would have to be charged to support the costs of this program is likely to cause some level of controversy. Therefore, the gain in effectiveness would be partially counterbalanced by resistance to implementation. This alternative obviously merits further evaluation.

Maintenance Alternative 3 calls for regular system inspections, notification of the owner if maintenance is required, and enforcement of tank pumping, if necessary, by levying a fine after a reasonable period of time. This is essentially the practice presently carried out in Marin County, California, referred to in Chapter 6. We expect that this alternative would be very effective both in adding to the information base concerning systems performance and, more importantly, in extending the life of residential systems by two to five years. We would also expect that 80 to 90 percent of the homeowners in the program would voluntarily comply with notifications to pump their septic tanks. The major disadvantage of this alternative, of course, is that it would be controversial and therefore relatively difficult to implement, since a new ordinance would have to be enacted to provide for regular inspections, a fine for non-compliance, and a procedure for collecting the fine. Because of its significant advantages and disadvantages, this alternative will be evaluated in more detail.

Maintenance Alternative 4 is the same as Alternative 3 except that the managing agency would enforce tank pumping and would bill the homeowner for expenses incurred. The major advantage of this alternative is that the total percentage of tanks being pumped when necessary would be nearly 100 percent of the systems in the program. The disadvantage accompanying this increase in effectiveness would be an equal or greater increase in controversy due to the intensified enforcement procedures. In addition, the managing agency may have to provide its own pumping service if licensed pumpers find association with punitive procedures to be harmful to their business. This alternative also deserves further evaluation.

Maintenance Alternative 5 (agency ownership of all systems) guarantees that 100 percent of the systems in the program will receive regular inspections and necessary maintenance and is, therefore, the most effective of the five alternatives. At the same time however, implementation of the program is probably the most difficult. First, while the onus of enforcement procedures would be removed, since the managing agency would own and retain responsibility for each system, the proposed alternative would still be controversial because homeowners would lose control of the management and cost of a piece of equipment located on their private property. In addition, costs and administrative difficulties taken on by the managing agency will increase markedly. This alternative has been proposed in several areas around the United States, but only in instances where new systems are being built since, where two or more homes are served by a single system, construction costs are eligible for grants from the federal Environmental Protection Agency. Since construction grant procurement is not an objective of this program, and because the level of public agency involvement does not appear warranted by the relatively small additional increase in program effectiveness, however, this alternative was eliminated from further consideration.

Summarizing the screening of management functions and practices, both originally proposed installation alternatives will be evaluated in detail, but only Maintenance Alternatives 2, 3, and 4 were carried forward for analysis. All three maintenance alternatives involve regular septic tank system inspections. The latter two also include enforcement of pumping, Alternative 3 by fines and Alternative 4 by pumping under agency direction and billing the homeowner for costs incurred. Each of these alternatives would also include a procedure for handling appeals. Final technical alternatives are listed in Table 7-7.

Number of Systems and Managing Agency

Five alternatives regarding numbers of septic tank systems to be included in a management program are described earlier in this chapter (Table 7-6), together with five possible public agencies which could implement and manage an individual waste disposal program. As a practical matter, the type of management agency and the geographic area included in the program are not totally independent. A special district or a city, for example, is not well suited to manage a county-wide program, while Lane County or a county service district would be. For this reason, the alternative policies regarding the size of the program and alternative management agencies were evaluated together.

The first alternative regarding numbers of systems in the proposed program would cover only local areas and would include only new systems, systems requiring repairs, and voluntary program entrants. This alternative must be rated poor in terms of effectiveness of improving environmental sanitation in Lane County as a whole, even if the selected local areas were those with known high percentages of failing systems, because of the extremely small number of systems which would be included initially and because existing failing systems would not be identified until they voluntarily apply for repair permits. While this alternative should be relatively non-controversial and easy to initiate and manage, its lack of effectiveness precludes further consideration.

The second program size alternative would also consider local areas only, but would include all systems, existing and new, in the program from its inception. From an areawide viewpoint, this is more effective than the first alternative but less effective than one which considers the total county area. From a local viewpoint, however, this alternative would be far more effective than the first alternative because all systems are included. In areas with a high percentage of failing systems, or areas with adverse site conditions, for example, present systems would be inspected and failures repaired in the first few years the program was in operation. In addition, all systems would benefit from regular inspection of sludge and scum levels in septic tanks. Implementation of this alternative would be more difficult than Alternative 1, however, due to resistance of owners of existing systems which have been operating to their owners' satisfaction without maintenance inspections and inspection fees. This

TABLE 7-7. FINAL TECHNICAL ALTERNATIVES

<u>Installation of New Systems and Repairs</u>	
1.	Continue present practices.
2.	Perform two construction inspections.
<u>Maintenance Alternatives</u>	
2.	Perform regular maintenance inspections; recommend action to homeowner.
3.	Perform regular maintenance inspections; levy fine for no action.
4.	Perform regular maintenance inspections; if homeowner fails to take necessary action have work completed and bill for cost.

alternative warrants further evaluation due to both its potential improvement in environmental sanitation and its accompanying potential for difficulty in implementation.

The third program size alternative considers the entire 208 Project study area, excluding the Eugene-Springfield Metropolitan Area, and proposes to include (a) systems installed after the program begins, (b) systems receiving repair permits after the program begins, and (c) systems voluntarily placed in the program from throughout that area. This alternative would produce a satisfactory level of effectiveness in improving environmental sanitation conditions. The number of systems in the program would be small initially, but would grow by 700 systems or more per year - far more than could be anticipated in any local area. The disadvantage of this alternative is that it would not identify all failing systems within two years as would an alternative that includes all systems. Systems brought into the program through application for a repair permit in this alternative would principally be those whose owners voluntarily apply for a permit. The principal advantage of this alternative, as with the first alternative, is its relative ease of implementation. That is, there is likely to be relatively little controversy since existing systems would not be included in the program to begin with. Overall, this alternative deserves further evaluation.

The fourth program size alternative when analyzed closely is actually not an independent alternative, but a combination of the second (all systems in local areas) and third (new systems areawide) alternatives described above. Because evaluation of this fourth alternative would merely be a re-evaluation of the two previous alternatives, it is eliminated from further consideration.

The final program size alternative is that which would initially include all systems in the program throughout the study area. This alternative must be rated excellent in terms of effectiveness because regular inspections conducted as part of the maintenance program would, as a minimum, identify all failing drainfields in the study area and lead to their correction within the first few years of the program. This alternative would therefore bring about the maximum improvement in environmental sanitation in the least amount of time. The ease of implementation of the program, however, would have to be rated poor because of controversy caused by the proposal of such an extensive program including all existing systems. The failure of this same proposal in Marin County, California, testifies to the difficulty of implementing this alternative. Despite its effectiveness, therefore, this alternative is eliminated from further evaluation.

Of the five types of agencies which could manage an individual waste disposal program in a local area (Table 7-6), three were retained for further evaluation in connection with alternatives for local areas: Lane County, a county service district, and a sanitary authority. The possibility of forming a city for the sole purpose of managing septic tank systems when many other responsibilities would have to be undertaken concurrently is remote, and, at the same time, the territorial jurisdiction of a city is limited. The use of a sanitary district was also eliminated from further consideration simply because a sanitary authority shares all the same advantages and disadvantages of a sanitary district, but can serve incorporated areas as well as unincorporated areas, which a sanitary district cannot. Both the county and the county service district were retained for consideration because the county service district possesses advantages in taxation of localized areas that a county does not have.

For areawide alternatives, Lane County and a county service district are the logical choices for agencies which might manage an individual waste disposal program. A city is obviously impractical in this alternative, and a sanitary authority or sanitary district would be less desirable than the county or service district because the latter two types of agencies were specifically created to cover whole counties or the greater part thereof. There seems to be little reason, for example, to form a new agency and elect a second governing body to cover the same geographic area and administer the same kind of program which is already in operation in Lane County.

Final Alternative Strategies

As a result of the screening process carried out by L-COG staff, Lane County staff, and Brown and Caldwell, the number of program alternatives selected for final evaluation was reduced to those shown in Tables 7-7 and 7-8.

Final technical alternatives, as shown in Table 7-7, consist of two alternatives for installation practices and three alternatives for maintenance. The three maintenance alternatives all contain provision for regular system inspections by the managing agency, but differ in the enforcement powers which would be applied to correct observed deficiencies.

Two basic alternatives for program size are described in Table 7-8, each with two or more possibilities for managing agencies. One program size alternative considers local areas only; the other considers only an areawide program. As noted in the screening process, the two program size alternatives are not mutually exclusive, and both alternatives could be adopted if desired.

EVALUATION OF FINAL ALTERNATIVES

The program alternatives remaining after the screening process are analyzed in the following sections of this chapter for management manpower requirements, program costs, effectiveness, and, where appropriate, ease of implementation.

Management Program Manpower and Costs

Management manpower requirements and associated costs are described below both for new installations and for maintenance and repair work. The costs of performing all three types of work are calculated assuming the use of present practices first, and then proposed best practices. Management costs include actual field work on the specific work described, plus office overhead and

TABLE 7-8. FINAL INSTITUTIONAL ALTERNATIVES

Program size		Possible managing agencies	
2.	Local areas only - include all systems, new and old.	a.	Lane County
		b.	County service district
		c.	Sanitary authority
3.	Areawide - include new systems, repaired systems, and volunteers.	a.	Lane County
		b.	County service district

administrative services connected with that same work. The costs shown here do not, however, include expenses presently incurred by Lane County for site evaluations performed without charge in accordance with ORS 454.755, nor do they include expenses for enforcement procedures or activities in land development management currently carried out by the Water Pollution Control Division.

New Installations. Manpower requirements for managing a septic tank system installation program include staff field and office work for site evaluation, system design, and installation inspection. Table 7-9 shows the manpower required for each 100 systems newly installed, both under present practices (one construction inspection during installation) and for the best installation practice of conducting two inspections. As noted previously, site evaluation and design are presently performed in accordance with best management practice; therefore, there is no change in manpower requirement between present practice and best practice. Manpower required for best installation practice, however, is nearly double that for present practice. This results from the fact that best installation practice requires two inspections instead of one. Since site evaluation and design comprise the greater portion of total manpower requirements associated with construction, the total manpower required for installing 100 systems in accordance with best practice is only 17 percent greater than present practice. Total management agency costs for installing 100 systems, however, increase by approximately 25 percent, from $6,800 to $8,400, as shown in Table 7-10.

The second component of the total cost to a homeowner for a newly installed system is the cost of actual installation. Use of best installation practice would affect the cost of installation in those instances when inspection of the trench walls before filling with drain rock showed smearing. When this condition was found by the inspector, the installer would have to rake the walls to re-open the soil pores. The staff of the Water Pollution Control Division estimates that a five percent overall increase in the cost of trench construction would result from conducting two inspections instead of one.

Maintenance and Repair Work. Manpower requirements for maintenance and repair functions include time for inspections, communication with system owners, report writing, and related clerical and administrative time. Inspections would be required both for maintenance (routine biennial inspection of septic tank contents and drainfield performance) and for installation of system repairs. Manpower requirements for the above tasks are shown in Table 7-11 for each 100 existing systems under three different assumptions of maintenance and repair practice: (1) present practice in which no maintenance inspections are made and time for repair permit work includes only one construction inspection; (2) biennial maintenance inspections and repair of all identified failures using present single inspections on the installation of new systems and repairs, and (3) biennial maintenance inspections and repair of all identified failures using two inspections on the installation of both new systems and repairs.

As stated in the notes to Table 7-11, it is assumed that biennial inspections will increase the number of systems requiring repairs simply by identifying failed

TABLE 7-9. MANAGEMENT MANPOWER REQUIREMENTS FOR SYSTEM CONSTRUCTION

Alternative	Man-days required for installing 100 systems[a]		Total man-days
	Site evaluation plus design	Installation	
1. Present practice	62	19	81
2. Best installation practice	62	33	95

[a]Includes technical, specialist, and administrative time.

TABLE 7-10. MANAGEMENT AGENCY COSTS FOR SYSTEM CONSTRUCTION

Alternative	Costs for installing 100 systems, dollars[a]		Total cost, dollars
	Site evaluation plus design	Installation	
1. Present practice	5,500	1,300	6,800
2. Best installation practice	5,500	2,900	8,400

[a]Includes salary costs for technical and specialist services, plus overhead, administration, and support.

TABLE 7-11. MANAGEMENT MANPOWER REQUIREMENTS

FOR MAINTENANCE AND REPAIR

Alternative	Man-days per year required for 100 installed systems [a]		
	Maintenance	Repair	Total
I. Present practice	0	1[b]	1
II. Best maintenance practice; present repair practice	11[c]	4[d]	15
III. Best practice for maintenance and repair	11[c]	4[e]	15

[a] Includes technical, specialist, clerical, and administrative time.

[b] Assumes 1.5 percent annual rate of application for repair permits; other failures not reported.

[c] Assumes 50 out of 100 systems inspected per year.

[d] Assumes 8 percent failure rate; all failures reported.

[e] Assumes 6.7 percent failure rate; all failures reported.

systems which otherwise would not have been reported. Alternative II in the table assumes that the real rate of failure will be reduced from approximately 10 percent per year at present (equivalent to a 10-year average system life) to eight percent per year (average life of 12.5 years) by regular septic tank pumping and that all failures will be reported and repaired. Alternative III assumes a further reduction in failure rate from eight percent to 6.7 percent per year (average life of 15 years) through the conduct of two inspections for each new system and system repair. Labor requirements in Alternatives II and III are the same because increased time spent on construction inspections is balanced by the decreased number of systems requiring repairs.

Two points need to be made here:

1. Best maintenance practices referred to in Alternatives II and III in Table 7-11 are applicable to Maintenance Alternatives 3 and 4, (Table 7-7) which enforce septic tank pumping either by fines or by having the work done and billed to the owner; Maintenance Alternative 2 would probably not reduce the rate of system failures to less than nine percent per year, since it depends on voluntary pumping by the homeowner upon recommendation of the inspection report.

2. The estimated failure rates shown in Table 7-11 are judgements of improvement in average system life, made, unfortunately, without specific data as a basis, since no such data exist. It should also be emphasized that while average system life is assumed to increase from 10 to 15 years by implementation of best technical practices, some individual systems will be affected much more dramatically. Implementation of best installation practice, for example, will prevent many systems from failing within five years after installation - a frequent occurrence with present practice.

Total labor requirements for maintenance and repair are expected to increase from approximately one man-day per year for every 100 systems in the ground with present practices, to 15 man-days per year with best practices, as shown in Table 7-11. Table 7-12 shows that the corresponding management labor costs would increase by a factor of slightly more than 20, from $50 per 100 installed systems per year to $1,100 per 100 installed systems per year.

<u>Homeowner Costs</u>

While the annual management costs for installing 100 systems or maintaining 100 installed systems are informative in themselves, the total cost to the homeowner is easier to understand. The following paragraphs compare direct homeowner costs of construction, maintenance, and repair for program alternatives involving those technical practices, as well as some indirect costs. Because homeowner costs include both installation and maintenance costs, the costs of all technical alternatives listed in Table 7-7 are discussed together below.

TABLE 7-12. MANAGEMENT COSTS FOR

MAINTENANCE AND REPAIR

Alternative	Costs per year required for 100 installed systems, dollars [a]		Total cost dollars per year
	Maintenance	Repair	
I. Present practice	0	50[b]	50
II. Best maintenance practice; present repair practice	800[c]	300[d]	1,100
III. Best practice for maintenance and repair	800[c]	300[e]	1,100

[a] Includes salary costs for technical and specialist services, plus overhead, administrative, and support costs.

[b] Assumes 1.5 percent per year application rate for repair permits; other failures not reported.

[c] Assumes 50 of 100 systems inspected per year.

[d] Assumes 8 percent failure rate; all failures reported.

[e] Assumes 6.7 percent failure rate; all failures reported.

The current variability in septic tank system performance, combined with variations in site conditions, make any attempt to quantify an "average" condition fruitless using present practices. For this reason, three different conditions were analyzed to demonstrate the range of possible costs of present practice. One benefit of best installation and maintenance practices would be to reduce the variability in length of system life before failure.

Basic Assumptions. The following assumptions were made in all cost calculations:

- 3-bedroom house
- 1200-gallon septic tank
- 200 square feet of trench sidewall per bedroom
- Cost of pumping plus travel = $120
- Construction permit fee = $100
- Repair permit fee = $25
- System life - 50 years

Other factors vary between alternatives and are explained in the discussion of each alternative. Annual costs were calculated assuming an interest rate of eight percent. Costs of installation, maintenance, and repair were assumed to remain constant into the future. Although this latter assumption is obviously incorrect, its use in analyzing the relative costs of various alternatives is still valid, since all costs are likely to rise at approximately the same rate. Therefore, while each alternative will actually incur higher costs than are shown here, the alternatives can be expected to remain in the same relative positions with respect to cost.

Present Practice. As an example of cost calculation procedures used on all subsequent analyses, Table 7-13 shows the installation costs and maintenance costs for a system constructed under present practice. This system is assumed to require construction of a replacement drainfield after 10 years. Thereafter, it will be operated for the remaining 40 years by using the two drainfields alternately and pumping the septic tank only once every 10 years. The total annual cost for this set of assumptions is $137 over the 50 year life of the system.

The cost of two other common repair conditions, also assuming present installation and maintenance practices, are compared with the first example in Table 7-14. The costs in the second column assume that a second replacement drainfield must be constructed after 20 years. This case could occur, for example, if the original drainfield were seriously damaged during construction of

TABLE 7-13. HOMEOWNER COSTS ASSUMING PRESENT PRACTICE AND FAVORABLE REPAIR CONDITIONS

Item	Construction cost, dollars[a]	Annual cost, dollars[b]
Installation and repair costs		
Initial installation		
Septic tank	370	
Drainfield, 300 ft	642	
House sewer, 50 ft	125	
Construction permit	100	
Total	1237	101
Replacement drainfield[c]	730	28
Maintenance costs[d]		
Pumping every 10 years @ $120 per occurrence	-	8
Total annual system cost		137

[a]Based on December 1976 cost levels.

[b]Based on 8 percent interest over a 50-year economic life.

[c]Installation required only once, after 10 years.

[d]Assumes that the septic tank is pumped only when drainfield failure occurs. This represents present practice.

TABLE 7-14. VARIATION IN HOMEOWNER COSTS ASSUMING PRESENT POLICIES

Item	Annual cost, dollars		
	1 drainfield replacement @ 10 years	2 drainfield replacements, 10 years and 20 years	1 drainfield replacement @ 5 years
Initial installation	101	101	101
Drainfield replacement	28	41	41
Septic tank pumping[a]	8[b]	8[b]	14[c]
Total annual cost	137	150	156

[a]Assumes that the septic tank is pumped only when drainfield failure occurs.

[b]Pumping every 10 years.

[c]Pumping at fifth year and every 10 years thereafter.

the first replacement drainfield (as now happens) so that alternative use of the two systems was not possible. The end result of that assumption would be an increase in total annual cost to $150, slightly less than 10 percent more than the cost of the first case. The third repair condition shows the effect of an early failure which would require construction of a replacement drainfield in the fifth year. Thereafter the two drainfields would be alternated at 10-year intervals. This condition is equivalent in cost to the construction of two replacement drainfields. The added cost of pumping the septic tank in the fifth year raises the total annual cost of this case to $156 per year.

The three cases shown in Table 7-14 do not represent extreme conditions, since many existing systems would have costs both much higher and much lower than those shown. The calculated annual costs do provide an indication of the magnitude of current system costs and show that some common repair conditions cause annual cost changes of about 15 percent. In each case the cost of initial installation is the major component of total annual cost.

Best Practice. Annual costs were also calculated for three conditions representing the use of best installation practice, best maintenance practice, and a combination of best installation and maintenance practices. Assumptions made in the three cases, in addition to the basic assumptions described earlier in this section on homeowner costs, are that (1) best installation or best maintenance practice by themselves will increase the life of an "average" drainfield by three years; (2) the combination of best installation practice and best maintenance practice will increase drainfield life by five years; (3) in each case care is taken to protect the initial drainfield during construction of the replacement so that the two can be alternately used thereafter; (4) a maintenance inspection is made every two years and the septic tank is pumped every four years; (5) a $20 inspection fee is charged for each maintenance inspection, as in Marin County, California, and (6) there is a direct cost increase to the homeowner of $20 for improved installation practices. These assumptions are made to permit a quantitative economic comparison of the three cases on a common basis. While the assumptions will not be true in all cases, we expect them to be representative for most septic tank systems. Assumptions 1 and 2 are based on the fact that present system life is approximately 10 years, and our judgments that (a) best practice for design, installation, and maintenance will result in an average life of 20 years - a 10-year extension, and that (b) best installation and maintenance practices alone will extend average system life by one-half the theoretical maximum, i.e. five years. Assumption 6 is an estimated value of the average increase in labor cost for installation due to improved inspection of installations. Since the present construction permit fee and repair permit fee are set by state statute (ORS 454.745), it is assumed that the increased costs for two construction inspections can be recovered from septic tank system owners either through taxes or by some other means.

Annual costs of these alternative technical practices are shown in Table 7-15 together with the costs of present practices previously calculated. Costs paid by the homeowner for best installation practice are essentially the same as those for

TABLE 7-15. SUMMARY OF ANNUAL HOMEOWNER COSTS FOR TECHNICAL ALTERNATIVES

Alternative	Annual cost, dollars
Present practice, one drainfield replacement at tenth year	137
Present practice, two drainfield replacements - tenth and twentieth years	150
Present practice, one drainfield replacement at fifth year	156
Best installation practice, one drainfield replacement at 13th year	137
Best maintenance practice, one replacement at 13th year	160
Best installation and maintenance practice, one replacement at 15th year	162

present practice with favorable repair conditions ($135/year). Annual costs to the homeowner for biennial inspections and septic tank pumping at regular four-year intervals, however, are slightly more than 20 percent higher than for best installation practice only, due to an annualized cost of $37 for inspection fees and pumping.

Several conclusions can be drawn from the information in Table 7-15:

1. Annual costs of best practices for installation and maintenance may not be less expensive than some present practices based on direct installation, maintenance, and repair costs only.

2. Annual cost of best practices are essentially the same as those of common cases using present practices, even when using the rather conservative assumption of only a 3 to 5-year extension for implementation of best practices. If best practice increases system life more than 3 to 5 years, which is likely, costs will more strongly favor best practice.

3. The most expensive alternative (best maintenance practice) increases annual cost by only $25 over present practice with favorable repair conditions and over use of best installation practice only.

4. While the cost of best practice for installation and maintenance is more expensive than present practice, an improved level of environmental sanitation would be achieved. Failures would be less frequent, and those that did occur would be promptly detected and corrected.

5. The cost of best practice for installation and maintenance is significantly less than the annual cost of a community sewerage system, since many small community systems result in annual costs to the homeowner in excess of $200.

While the costs to the homeowner of septic tank management systems as shown in Table 7-15 can be reasonably assessed, there also are hidden costs which result from improper management of septic tanks. While virtually impossible to quantify, these costs are nonetheless real. These costs include:

1. The decrease in property value which takes place if one or more homes on a block have failing septic tanks.

2. The risk of high costs to each homeowner if an area is forced to construct sewers because of a declared public health hazard.

3. The loss in value of a home which does not have sufficient area in which to construct a replacement drainfield.

Each of these is a major consideration favoring the use of the best available installation and maintenance practices.

Effectiveness of Technical Alternatives

While the technical alternatives were evaluated for effectiveness in the screening process, Table 7-16 presents a summary analysis of the relative effectiveness of the final technical alternatives only. Present installation practices are rated poor mainly because they permit some 20 to 30 percent of system failures to occur within five years of construction, as shown in Chapter 5. Regular maintenance inspections without enforcement are rated fair, relatively lower than other maintenance alternatives. Although this alternative provides a mechanism for identifying failing drainfields, it relies on homeowner initiative for correction. Installation Alternative 2 and Maintenance Alternative 4 are rated good based on the probability that their use will extend average drainfield life by three to five years or more and reduce the frequency of drainfield failures. Maintenance Alternative 3 is rated satisfactory because septic tank pumping frequency, and the resulting increase in drainfield life, are expected to be greater than Alternative 2, but less than Alternative 4.

The ratings in Table 7-16 are relative to the level of environmental sanitation which could be expected from a well-operated and well-designed community sewerage system. In this regard, a combination of Installation Alternative 2 and Maintenance Alternative 4 could be rated good to excellent, and a combination of Installation Alternative 2 and Maintenance Alternative 3 could be rated good.

Recommended Technical Alternatives

Based on an overall consideration of effectiveness, ease of implementation, staff requirements for a management program, and cost to the homeowner, both in the screening process and in the final evaluation, the combination of Installation Alternative 2 and Maintenance Alternative 3 is recommended as the preferred technical strategy for the proposed individual waste disposal management program. This combination will institute two inspections during construction of each drainfield system and will require biennial maintenance inspections. Proper maintenance will be enforced by fines for noncompliance, but with an accompanying appeal procedure established to protect the property owner.

Institutional Alternatives

The effectiveness and ease of implementation of the final institutional alternatives listed in Table 7-8 are given further consideration below. Manpower requirements and management costs are not evaluated here, since they were analyzed separately in the preceding section. While the efficiency of the alternative management agencies is discussed herein, approximate total management manpower requirements and costs can be calculated for any size program by multiplying the unit costs in the previous section by the number of systems included. A specific example is described in Chapter 8.

TABLE 7-16. EFFECTIVENESS OF TECHNICAL ALTERNATIVES

Alternative	Rating[a]
<u>Installation of New Systems and Repairs</u>	
1. Continue present practices.	Poor
2. Perform two construction inspections.	Good
<u>Maintenance Alternatives</u>	
2. Regular inspections; recommend action.	Fair
3. Regular inspections; enforce pumping with fines.	Satisfactory
4. Regular inspections; enforce by having work done and billing homeowner.	Good

[a]Relative ratings are: poor, fair, satisfactory, good, excellent.

Effectiveness. The effectiveness of each of the five remaining institutional alternatives in improving environmental sanitation is rated in Table 7-17. As shown, each alternative is a combination of a geographic area (local area or areawide), the number of systems included, and a management agency.

Alternatives 2a and 2b (Table 7-17) would include all septic tank systems within specific local areas in a management program administered at the county level. For 2a, the management agency would be county government, for 2b, a county service district. In each case all presently failing systems would be identified and repaired within the first few years of the program, and the expected life of all drainfields in the program would be extended by a minimum of three to five years. In addition to gains in environmental sanitation, management of the program by Lane County or a county service district should result in a more reliable and efficient program than one conducted by a sanitary authority. The county-level program should be more reliable because the county commissioners are more isolated from local political pressures than the members of a sanitary authority governing board, and at the same time are somewhat more autonomous in being able to resist pressures from the state. Management by the county would also tend to be more efficient than a local sanitary authority both because greater resources of expertise and experience tend to be found in larger agencies, and because a minimum number of about 1,500 to 1,700 existing systems would be required to keep one man busy full-time in a new agency, based on the management manpower requirements listed in Tables 7-9 and 7-11. Other advantages of a county-level agency would include relative uniformity of enforcement and ability to reduce administrative costs by using computerized control for billing and record-keeping.

The principal advantage of a local sanitary authority (Alternative 2c) might be its responsiveness to local public sentiment. The specific composition of the governing body, however, would actually determine the level of responsiveness.

The local effectiveness of including all systems in a local area in a management program is rated excellent where management would be at the county level and good if management comes from a local sanitary authority. When viewed from the vantage point of the total study area, however, a local program can be rated only satisfactory, regardless of what agency manages the program, simply because of the limited extent of the program.

Alternatives 3a and 3b (Table 7-17) are areawide programs which would include in the management program only new septic tank systems, systems identified by repair permit applications as failing, and systems whose owners volunteer to be included in the program. The management agency would be county government for 3a and a county service district for 3b. The effectiveness of an areawide program is rated only fair locally, but good for the total study area. The "fair" rating for Alternatives 3a and 3b is based on the fact that they would not rapidly identify and enforce the repair of failing systems, even in local areas with a

TABLE 7-17. RATING OF INSTITUTIONAL ALTERNATIVES

Alternative		Rating[a]	
		Effectiveness[b]	Ease of implementation
2a.	Local areas; all systems; Lane County management.	Excellent/ satisfactory	Satisfactory
2b.	Local areas; all systems; county service district.	Excellent/ satisfactory	Fair
2c.	Local areas; all systems; sanitary authority.	Good/ satisfactory	Poor
3a.	Areawide; new systems, repairs and volunteers; Lane County management.	Fair/good	Good
3b.	Areawide; new systems, repairs and volunteers; county service district.	Fair/good	Satisfactory

[a]Relative rating: poor, fair, satisfactory, good, excellent.

[b]First rating is with respect to local areas; the second is for total study area.

high percentage of failing systems - a likely reason for selecting a local alternative. An areawide program including new systems, repaired systems, and volunteers is rated good with respect to the total study area, however, because over a period of about 10 years the program would include in excess of 6,000 systems, based on the projections in Chapter 3 and the present rate of application for repairs. In that 10-year period, the managing agency would be able to develop its procedures and staff slowly and carefully.

Ease of Implementation. Management of all systems in a local area by Lane County, a county service district, and a local sanitary authority (Alternatives 2a, 2b, and 2c in Table 7-17) are rated satisfactory, fair, and poor, respectively, with regard to relative ease of starting the program and flexibility in operating it. Lane County management of all systems in one or more local areas (Alternative 2a) is rated satisfactory for the following reasons:

1. No new agency would have to be formed, nor would new technical staff members have to be hired initially. More staff would, of course, be necessary as the program developed.

2. As local areas throughout the study area were defined, they could be brought into the program with relative ease.

3. Septic tank system owners in localized areas may prefer a local agency to govern their program, rather than the county.

4. A drawback to all three options under Alternative 2 is that some owners of existing systems, particularly those who believe their systems to be functioning satisfactorily, would resist mandatory inclusion in a management program.

Use of a county service district as a management agency in local areas (Alternative 2b) is rated fair, or lower than Alternative 2a, because of the procedure required to form the special district. Once formed, however, the staff of the service district could be drawn from the present staff of the County Water Pollution Control Division. Alternative 2c, use of a sanitary authority to manage all systems in local areas, is rated lower than either of the other two local alternatives because:

1. A new special district would have to be formed, including election of a governing body.

2. A separate staff would have to be developed.

3. Bringing future local areas into the authority would be more difficult than if the county were managing the program.

The only advantage Alternative 2c might have is that residents within the authority might prefer the right to elect board members from within the boundaries of the authority, rather than having the program administered by the county commissioners.

Among the areawide alternatives, Lane County management of the program (Alternative 3a) is rated good because (1) neither a new agency nor a new staff would have to be developed; (2) new systems would automatically be brought into the program from the entire study area, and (3) the resistance expected from owners of existing systems would be avoided by excluding them from the program initially. Alternative 3b (areawide management by a county service district) is rated satisfactory, or slightly lower than Alternative 3a, simply because it calls for formation of a new special district, with all the attendant difficulties of the formation process.

Recommended Institutional Alternatives

We recommend, on the basis of the preceding evaluation, that a combination of Institutional Alternatives 2a and 3a become part of the management strategy for septic tank systems in Lane County. Implementation of both these alternatives would place the management of the program under the Lane County Commissioners and within the scope of work of the present Water Pollution Control Division. The program could be initiated by first including only new systems throughout the study area constructed after the program begins, plus all systems receiving repair permits after that date, plus all voluntary entrants into the program.

The management program should also be given the flexibility to include all systems in any specific local area which either desire to enter the program or can be defined as requiring management of all systems due to a high rate of failure or other appropriate concerns. A geographic boundary for such a local area could be defined either through formation of a Local Improvement District or through a public hearing process.

RECOMMENDED MANAGEMENT STRATEGY

The recommended management strategy for septic tank systems in the study area consists of the combined technical and institutional recommendations as described in Table 7-18. In summary, the recommended program:

1. Would be managed by Lane County.

2. Would include all new systems and repaired systems installed after the program starts, as well as voluntary entries and specified local areas defined to be appropriate for inclusion.

3. Would use best practice for installation of new systems and system repairs.

4. Would implement biennial inspections of all systems in the program with necessary homeowner action enforced by fines.

TABLE 7-18. RECOMMENDED MANAGEMENT STRATEGY

Strategy component	Recommendations
Managing agency	Lane County
Program size	Include all new systems and system repairs throughout the study area installed after the start of the program, and include all voluntary entries into the program. Provide the authority to manage all systems in specifically defined local areas as appropriate.
Installation	Use best installation practices for new systems and repairs, including two construction inspections.
Maintenance	Initiate biennial inspections of all systems in the program with inspection report recommendations enforced by fines.

Two additional points need recognition here. The first is that the best practices recommended for this program will not result in the use of all best recommended practices described in Chapter 6. DEQ has pre-empted authority to specify design criteria for septic tank systems, and has not, in our judgment, specified best present practice in those criteria. Therefore, the gains in extension of drainfield life which can result from the program recommended here represent only about one-half of those which could be attained by implementation of best design practice as well as best installation and maintenance practices. The second important point is that implementation of the recommended management program does not mean that other technical practices can be relaxed. Therefore, some areas will always be unsuitable for septic tank systems, even with the program recommended herein.

CHAPTER 8

EFFECTS OF RECOMMENDED MANAGEMENT PROGRAM

Alternative technical and administrative management strategies for septic tank systems were defined and evaluated in Chapter 7 and the most suitable program was recommended for adoption. The recommended program would be administered by Lane County and would include all new systems and system repairs installed after the program is adopted, plus voluntary entities. An additional recommendation is that the county be given the authority to manage all systems in specifically defined local areas in which better management could achieve improved performance. Technical changes from present procedures would include two construction inspections instead of one, and biennial maintenance inspections of septic tanks and drainfield. Fines would be the basic enforcement tool used to achieve compliance. Subsequent sections of this chapter discuss expected benefits and costs of the program, its effect on land use, and specific effects expected in the Pleasant Hill area.

PROGRAM BENEFITS

Principal benefits of the recommended program can be described in two related categories: (1) improved system performance, and (2) improved environmental sanitation. Expected improvements in both categories are discussed in the following paragraphs. Other indirect benefits will also be achieved by the program, but are not described in detail here. These include basic factors, such as each owner in the program knowing he has a septic tank system, as well as related consumer protection factors - a public record of the maintenance and recent status of each system available for use in home transfers, for example.

Improved Performance

One additional construction inspection specifically to determine trench dimensions and sidewall surface condition prior to backfilling with drain rock, together with biennial maintenance inspections, is expected to lengthen average drainfield service life from approximately 10 years at present to about 15 years. This estimate is based solely on our firm's past experience and professional judgement, since there is no documented evidence to support accurate determination of average life of systems in Lane County. We expect a significant portion of this improvement in average drainfield life to come from the prevention of early failures due to faulty construction practices. The expected 50 percent improvement in service life is one-half of what we believe could be achieved if best design practices described in Chapter 6 were adopted by DEQ in addition to Lane County's adoption of installation and maintenance practices described herein. We expect the recommended program to reduce the number of systems which fail within five years of installation, and increase the number of systems which last for 20 to 25 years or more before failing.

Improved Environmental Sanitation

An increase in average septic tank system life before failure will result in a corresponding decrease in the number of systems producing surfacing sewage at any one time. By definition, then, extension of system service life will improve environmental sanitation. The following sections consider the relative effect of this improvement in areas of various densities.

Rural Areas. Improved septic tank system service life on farms and large rural lots will obviously do less to minimize public health hazards than will improved system life in more densely populated areas. In recognition of this fact, rules permit new systems in designated rural areas to be considered for approval even when they do not meet current design regulations. Zoning classifications in Lane County which are presently included in this rural area category are Exclusive Farm Use 20 (EFU), Farm Forestry 20 (FF 20), Agriculture-Grazing-Timber Raising 20 (AGT), and AGT-5. The number following each zone name indicates the minimum parcel size permitted in that zone without a variance or a zone change. EFU and FF zones were approved by DEQ as rural areas for subsurface sewage disposal in May, 1974. Both AGT zones were approved in December, 1974. Non-conforming parcels within each of the above zoning classifications were also declared eligible for consideration under the rural area rule for subsurface sewage disposal in April, 1975.

While public health protection through improved septic tank system performance is not an overriding concern in these rural areas, environmental sanitation for individual farm families would be improved by the recommended program. As a practical matter, the close attention to construction and maintenance called for in the program may be very beneficial to those rural systems which are approved but do not conform to DEQ design rules. These systems are especially likely to fail within a few years of construction if they are not carefully constructed and maintained.

Rural residential areas with lot sizes of one to five acres can be expected to benefit more than agricultural areas from improvements in septic tank performance. In the more densely populated areas failing septic tanks represent a greater public health hazard because of the greater danger of disease transmission, even if the average life of the septic tank systems is the same as for agricultural areas.

Urban Fringe Areas and Growth Centers. Maximum expected benefits from the recommended program will occur in urban fringe areas and growth centers, which are defined here as areas with lots smaller than one acre. Such areas contain the greatest possibility of an outbreak of a communicable disease caused by surfacing sewage from a septic tank system. Assuming that physical site conditions will permit the use of septic tank systems at all, urban fringe areas and growth centers may find that the recommended program is essential to their present way of life. These are the areas where failing septic tanks are most likely to result in declaration of a health hazard area, leading to forced annexation to acquire sewer service or formation of a public sewerage agency for the same purpose.

Urbanizing areas with lot sizes less than one acre also face the danger of being declared public health hazard areas due to groundwater contamination. As stated earlier in this report, septic tank systems are not designed or intended to remove nitrates from sewage. The proper procedure for preventing septic tank effluent from causing nitrate accumulation in groundwater, therefore, is through regional planning which restricts the use of permanent septic tank systems principally to areas with large lot sizes, and allows only small populations to concentrate in urban fringe areas and growth centers served by septic tanks. The program recommended in this report, therefore, will not protect groundwaters from nitrate accumulation.

PROGRAM COSTS

Three different types of cost are of interest in this chapter: (1) direct cost to the homeowner, (2) the indirect cost caused by the need to dispose of greater annual volumes of septage than would occur without the maintenance aspect of the program, and (3) increased county manpower requirements. Each cost category is considered below.

Homeowner Costs

As described in Chapter 7, the cost to the individual homeowner for participating in the recommended management program is expected to be less than $20 per year more than present costs over the life of the system. In cases where use of best construction and maintenance practices prevents either the need for multiple drainfield replacements or early construction of a second drainfield, the cost of the recommended program will be less than $10 per year more than the cost of present practice.

Septage Volumes Requiring Disposal

If the recommended maintenance program is implemented, all new systems in the study area will have their septic tanks pumped on the average of once every four years. This will represent an increase in frequency of about a factor of 3, since information collected and described in Chapter 3 shows that, on the average, tanks are currently pumped slightly less often than once every 12 years, and usually only when house plumbing is clogged or when sewage appears on the ground surface over the drainfield.

A comparison of expected future volumes of pumped septage with and without the recommended maintenance program is shown in Table 8-1 and Fig. 8-1, based on the following assumptions:

1. Under present practice, now and in the future, 8 percent of all systems are pumped each year. Under recommended maintenance practice, 25 percent of all new systems will be pumped each year, in addition to 8 percent of all unfailed systems installed prior to adoption of the management program.

2. Failed systems will be transferred to the management program.

3. The new maintenance program will start in 1980.

4. The average size of septic tanks installed before 1975 is 750 gallons and after 1975 is 1000 gallons.

As shown in the table and corresponding figure, septage volumes are expected to increase by approximately double by the year 2000 due to implementation of the recommended maintenance program in 1980. For the study area considered in this report, which excludes the Eugene-Springfield metropolitan area, the 100 percent increase amounts to an annual volume increase of about 1.6 million gallons in the year 2000. By 1990 there will be a 60 percent increase over present practice - an increased annual volume of 850,000 gallons.

While the greater volumes produced under the recommended program represent manageable quantities (the Eugene-Springfield regional treatment plant will be treating approximately 50 million gallons of sewage per day in the year 2000), detailed planning and action is required in the near future to determine desirable, appropriate, and economical disposal methods. At the present time the only DEQ approved septage disposal sites within the study area are municipal sewage treatment plants. If this disposal method continues to be the only one used in the area, the regional treatment plant to be located in Eugene may be the only available disposal site. The Springfield plant will be abandoned within five years and several other agencies discourage pumpers from using their plants due to odors and the adverse effect of septage on plant effluent quality. Consequently, alternative disposal methods warrant investigation. One feasible alternative appears to be collection and stabilization in water-filled lagoons, followed by land disposal.

Management Manpower Requirements

The additional manpower requirement which the recommended management program will impose on the county is difficult to estimate, since it requires

TABLE 8-1. PROJECTED ANNUAL SEPTAGE VOLUMES

Program characteristics	Year		
	1980	1990	2000
Total systems in place [a]	16,380	20,530	23,650
Systems not under maintenance program [b]	16,380	14,820	13,410
% pumped/year	8	8	8
Septage volume, mil gal [c]	1.0	0.9	0.8
Systems under maintenance program [b]	0	5,710	10,240
% pumped/year	-	25	25
Septage volume, mil gal [d]	0	1.3	2.4
Total septage volume with recommended program, mil gal	1.0	2.2	3.2
Total septage volume with present practice, mil gal	1.0	1.3	1.6

[a] From projection in Fig. 3-5, for study area only.

[b] Assumes one percent of existing systems obtain repair permits each year and are transferred to maintenance program.

[c] Millions of gallons; assumes all tanks are 750 gallons.

[d] Assumes all new tanks are 1000 gallons.

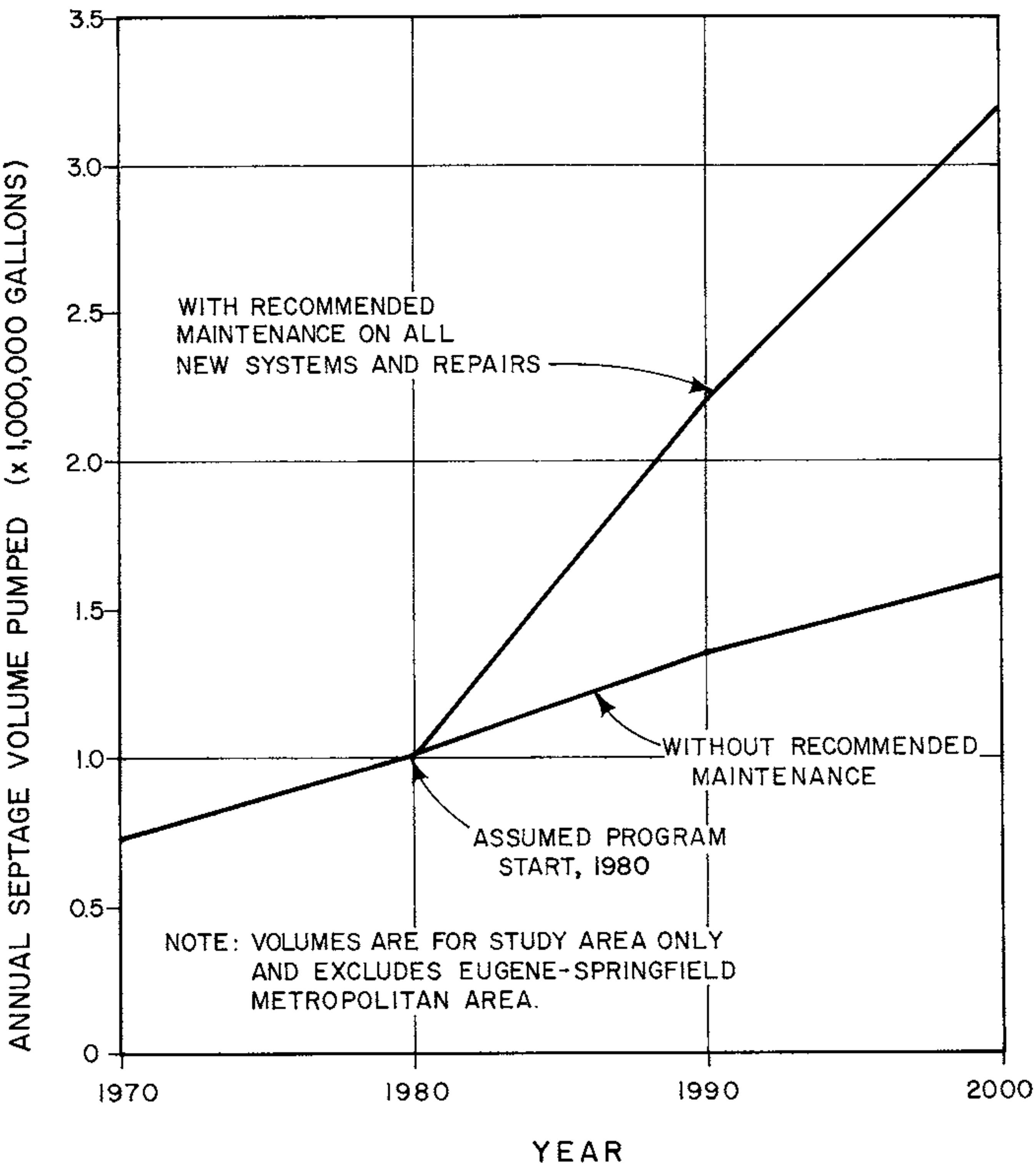


FIG. 8-1 FUTURE PUMPED SEPTAGE VOLUMES

assumptions of the rate of change of three different variables: (1) growth of rural areas, (2) the rate at which existing system repairs will be reported to the county, and (3) the number of septic tank system owners who will voluntarily enter the management program in any given year. The values shown in Table 8-2 were calculated based on the following assumptions for these variables:

1. Between 350 and 400 new systems will be installed in the study area each year from 1979 through 1984 as shown in Fig. 3-5.

2. The number of reported repairs entering the management program each year will be one percent of the total systems in the study area, or between 160 and 170 systems per year.

3. The number of voluntary entries will be 10 percent of the number of new installations, or 35 to 40 systems per year.

Based on the above assumptions, Lane County would have to expend 120 additional man-days, or about one man year, in the first year of the program, and about four additional man-years on the program by 1984. It must also be remembered that the projections in Table 8-2 do not include either the coastal area of the county or the Eugene-Springfield metropolitan area. If the entire county were to be included in the program, all values shown in Table 8-2 would have to be multiplied by a factor of three.

EFFECT ON LAND USE

The recommended program will have no effect on present land use. Design criteria, including requirements for drainfield size, replacement area, and setbacks, are what determine the lot size necessary to accommodate septic tank systems. The program recommended herein calls only for changes in installation and maintenance practices, not design. The anticipated improvement in system performance and environmental sanitation could have an effect on the land use planning process, however, in the form of increased pressure both for higher density growth in existing development centers and for increased numbers of development centers within the study area.

EXAMPLE AREA - PLEASANT HILL

In order to illustrate the effects of the recommended plan, the Pleasant Hill study area is used in the following discussion to test the impacts of the program in a specific area. The Pleasant Hill area was chosen by the Lane County Environmental Management Department planning and pollution control staff as a representative area for this purpose. It is an area which is expected to grow significantly in the next 10 to 20 years, is presently served by septic tank systems, is located relatively close to the Eugene-Springfield metropolitan area and treatment plants, and is situated on soils which present severe restrictions to the use of septic tank-drainfield systems.

TABLE 8-2. ESTIMATED NEW MANPOWER REQUIREMENTS TO MANAGE RECOMMENDED PROGRAM[a]

Year	Installations	Repairs & Volunteers	Installed systems in program	Additional man-days required [b]
1979	350	160	510	120
1980	350	195	1,055	197
1981	400	210	1,665	289
1982	400	210	2,275	374
1983	400	220	2,895	451
1984	400	220	3,515	548

[a] For study area only, excluding Eugene-Springfield metropolitan area.

[b] 135 Man-days is approximately equal to one new employee.

Area Description

Located 10 to 15 miles southeast of the Eugene-Springfield area on Highway 58, the Pleasant Hill study area shown in Fig. 8-2 contains approximately 1950 acres. Of that total, nearly 90 percent is made up of the combination of farm-forestry land (800 acres) and agriculture-grazing-timber raising lands (900 acres). With three exceptions, minimum parcel sizes for zoning are a part of the name of the zone classification as described earlier in this chapter. The three exceptions include Surburban Residential (RA), which has a one acre minimum parcel size, and Commercial (C) and Public Reserve (PR) areas which have no set parcel size. The commercial area shown in Fig. 8-2 includes two acres of Limited Commercial (C1) and 7.51 acres of Neighborhood Commercial (C2). The overall composition of the planning area by zoning classification is shown in Table 8-3. Table 8-4 presents a breakdown of the zoning classifications with specified parcel sizes of five acres or less, and shows that 47 percent of the more urban zones are as yet undeveloped. In comparison to the 243 developed and nonconforming parcels in Table 8-4, there are only slightly more than 30 developed FF20 parcels in the planning area. The more urban zones, then, have about 8 times the number of septic tank systems than the rural zone does.

Soil Suitability

The suitability of soils in the Pleasant Hill area for septic tank systems is shown graphically in Fig. 8-3. As indicated in that figure, the soils are predominately classified either as unsuitable for septic tank systems in accordance with current DEQ regulations, or as having severe restrictions on suitability. Soils with severe restrictions in most cases would require system modifications or a variance from design regulations. Table 8-5 lists some of the characteristics of the predominant soil series in Pleasant Hill. The information contained in Table 8-5 and Fig. 8-3 is a representation of soil maps and descriptions in the files of the Lane County Environmental Management Department. A further explanation of how this information is used is presented in the following section.

For those areas where site conditions do not permit drainfield installations in accordance with DEQ regulations, certain modifications in design are acceptable under the Rural Areas/Variance provisions of DEQ rules. Lane County staff has gained operational acceptance for three rationally developed design modifications which enhance the chances of system success in these cases. The decision as to which, if any, of these modifications will give reasonable hope of satisfactory life for a septic tank system installed under the variance provisions depends on the characteristics of each site.

System Performance

No sanitary surveys have been made in the Pleasant Hill area; therefore no numerical values can be used to judge system performance. From the viewpoint of the staff of the County Water Pollution Control Division, however, existing systems in the area have been and are performing reasonably well; that is, the number of reported failures in Pleasant Hill is roughly equal to or less than the

TABLE 8-3. ZONING OF PLEASANT HILL PLANNING AREA

Zoning classification	Area, acres
AGT-5	906
RA	121
C	22
FF20	800
GR10	37
PR	57
Total	1943

TABLE 8-4. DEVELOPMENT STATUS OF PLEASANT HILL URBANIZING AREAS

Zone	Total area, acres	Developed area			Undeveloped		Nonconforming areas		
		Acres	Percent	No. of parcels	Acres	Percent	Acres	Percent	No. of parcels
AGT-5	906.0	368.5	41	135	425.0	47	112.5	12	47
RA	121.2	62.3	51	50	57.2	47	1.7	2	3
C	22.1	9.5	43	8	12.6	57	-	-	-
Totals	1,049.3	440.3	42	193	494.8	47	114.2	11	50

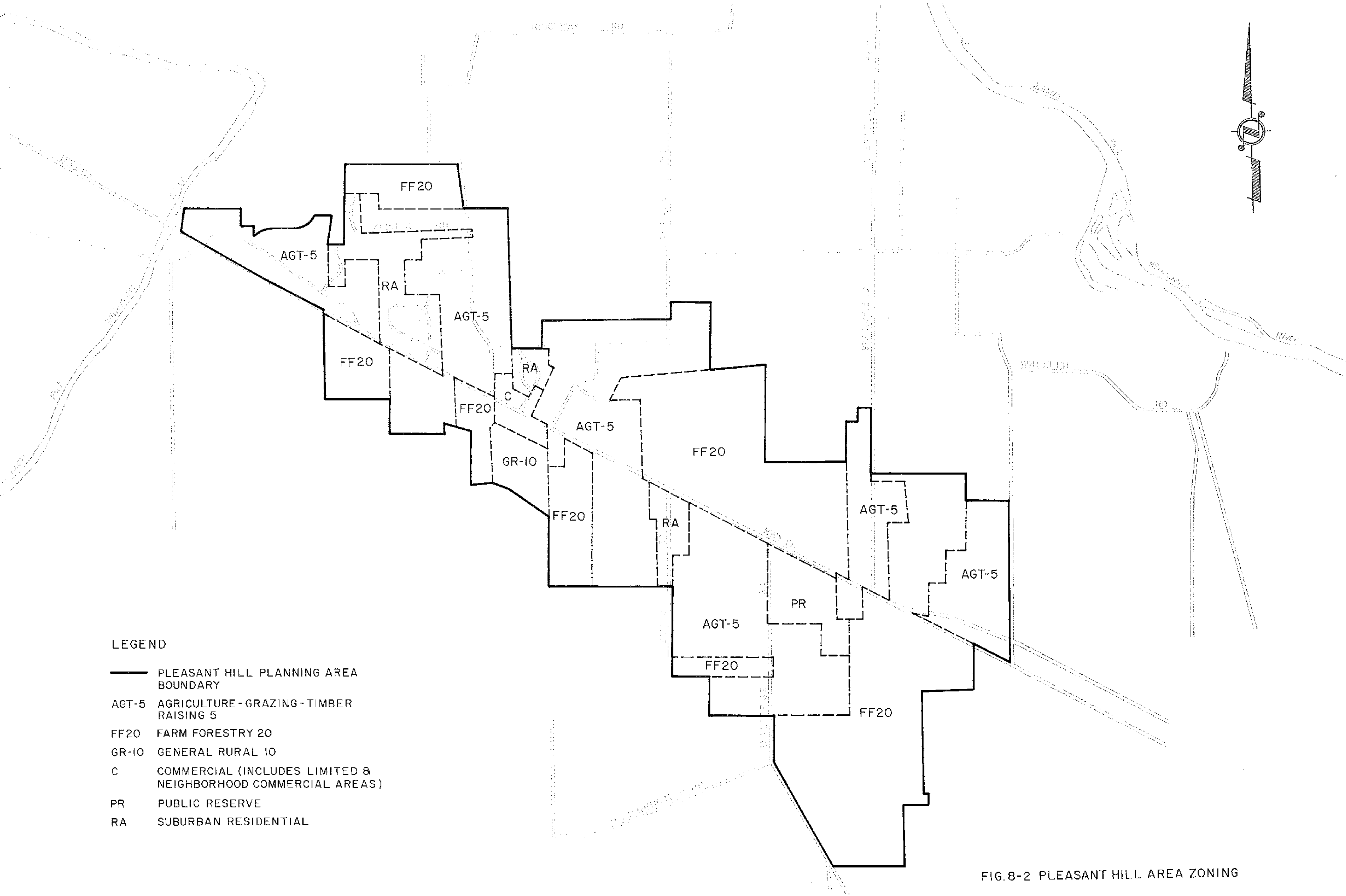


FIG. 8-2 PLEASANT HILL AREA ZONING

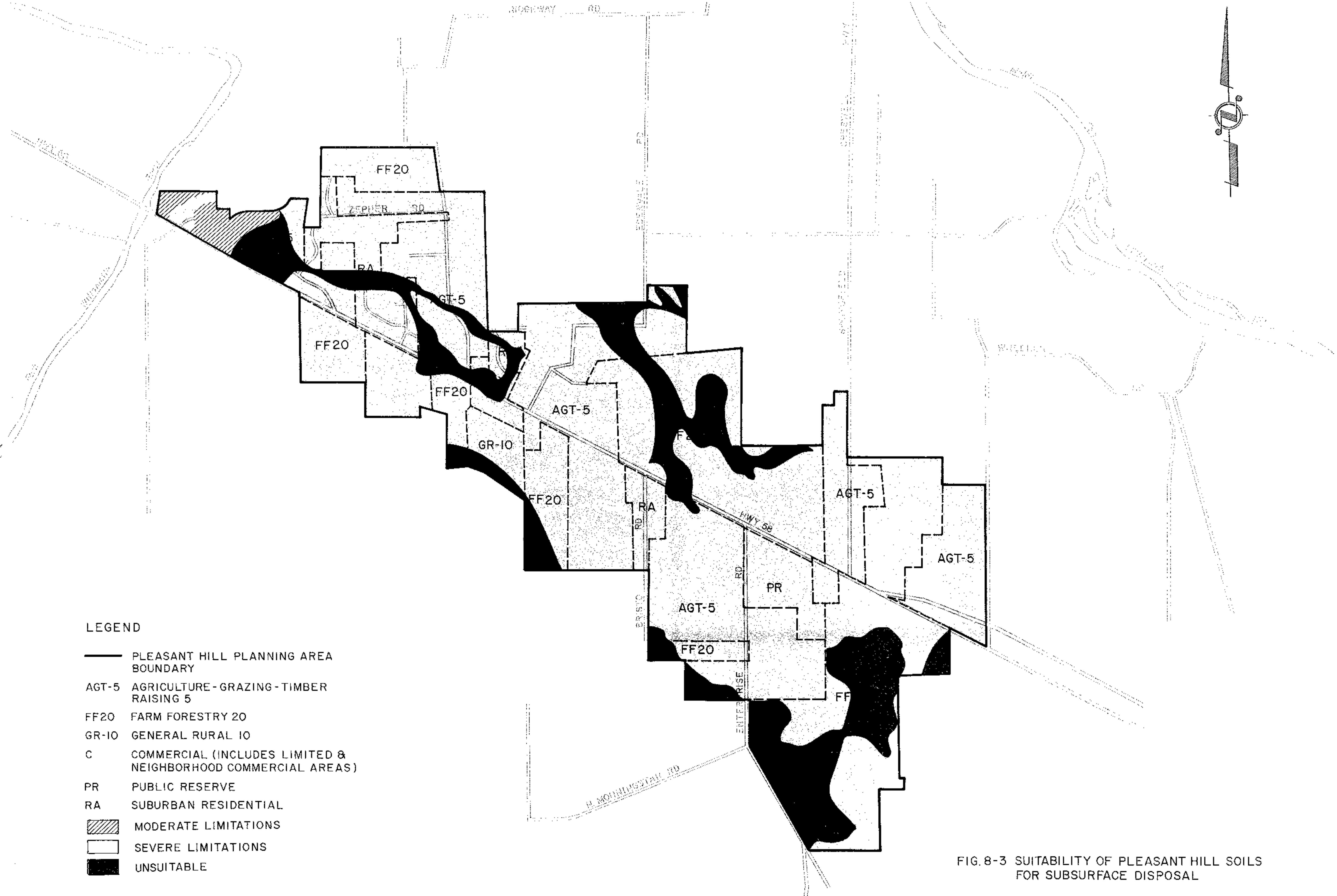


FIG. 8-3 SUITABILITY OF PLEASANT HILL SOILS FOR SUBSURFACE DISPOSAL

TABLE 8-5. PLEASANT HILL AREA SOILS SUITABILITY FOR SEPTIC TANK SYSTEMS

Soil series	Texture	Suitability	Limitations [a]	Modifiable
Chehalis	Silty clay loam	Moderate	2,6	Yes
McAlpine	Silty clay loam	Unsuitable	1,3,4,5	No
Coburg	Silty clay loam	Moderate	1,2	Yes
Awbrig	Silty clay	Unsuitable	1,2,3,4,5	No
Salem	Gravelly silty loam	Severe	1,2,3,5,6	Yes
Clackamas	Gravelly loam	Severe	1,2,3,4,5,6	Yes
Courtney	Gravelly silty loam	Unsuitable	1,3,4,5,6	No
Salkum	Silty clay loam	Severe	1,3	Yes
Salkum	Silty clay loam	Severe	1,3,7	Yes
Noti	Loam	Unsuitable	1,6	No
Linslaw	Loam	Severe [b]	1	Yes

[a] Limitations Key: (1) perched groundwater; (2) regional groundwater; (3) restrictive zone; (4) impervious zone; (5) coarse grain soils; (6) no serial distribution; (7) no equal distribution.

[b] Unsuitable in commercial area due to disturbance of surface soils by construction, landscaping, or other means; no modifications possible in these areas.

number of failures reported in most other areas of the county each year. The reason for this performance is attributed mainly to satisfactory construction practices, since most septic tank systems in Pleasant Hill have been installed since 1965.

Present Program Procedures

Under current regulations for subsurface disposal systems, the first step taken by the Lane County Water Pollution Control Division upon receipt of an application for a septic tank permit to construct a new system in Pleasant Hill would be to conduct an evaluation of the proposed site. Prior to the actual site visit, however, the county sanitarian would review the county's files for information on the characteristics and suitability of the site for a drainfield. While the actual suitability of any particular site can only be determined by a site evaluation, review of the data already on file provides the sanitarian with a background to start from and a set of specific items to look for.

If the disposal site meets current regulations, the owner may proceed to construct his system from the design sketch and specifications provided by the county. One construction inspection would be conducted just before the system is covered. From that time on, assuming the construction is satisfactory, the owner retains complete control over the maintenance and repair of his system, unless another person notices surfacing sewage from the system and reports that fact to the county.

If the site evaluation shows that the site does not meet current regulations, several options are possible and are automatically analyzed by County personnel. First, if the site is in either an AGT5 or an FF20 zone in Pleasant Hill, both of which are designated rural areas, the owner may still have his system considered for approval. If the site is in an RA zone, the owner could request a variance from current regulations, request additional investigation of the site, or apply for use of an alternative or experimental system. If construction approval is obtained by any of the above methods, responsibility for operation and maintenance steps would lie solely with the system owner following satisfactory completion of construction.

Effects of Recommended Program

The effects of the recommended management program for septic tank systems are described below in five parts. The description assumes that Pleasant Hill is not designated as a local area in which all systems would be included in the program, but is an area in which only new systems, repairs, and volunteers are included. The five subject areas for which effects are described are land use, homeowner costs, system performance, septage volume pumped, and management manpower requirements.

Land Use. As noted earlier in this chapter, there would be no change in land use caused by implementation of the recommended program, since approval of new septic tank systems would continue under the presently-used DEQ regulations regarding site characteristics.

Based on a 3 percent compound rate of growth for the Pleasant Hill area estimated by the Lane County Planning Division, the number of systems in the Pleasant Hill area can be expected to increase from roughly 270 in 1973 to approximately 340 systems in 1980 and about 450 systems by 1990. If the present ratio between systems in AGT5, RA, and the more rural zones continues, about 160 of the new systems will be installed in residential areas. It is more likely, however, that the present ratio will not continue, since DEQ regulations will make approval easier for construction permits in designated rural areas rather than in RA zones, when both areas have soils with severe limitations or unsuitable soils.

Homeowner Costs. In addition to the costs associated with construction and maintenance of septic tank systems under current regulations, homeowners in the Pleasant Hill area under the recommended program would (a) pay about five percent higher constructions costs, (b) pay a system inspection fee of $20 every other year, and (c) pay for having septic tanks pumped every four years, on the average, rather than less frequently as at present.

System Performance. While the County Water Pollution Control Division staff describe present performance of systems in Pleasant Hill as reasonably good, implementation of the recommended program should extend the average life of systems in the program by three to five years, and should prevent many early failures due to poor construction practices. Under the predominantly severe site limitations in Pleasant Hill, the management program would produce a reduced incidence of surfacing sewage. The reduction in frequency of failures, in turn, would reduce public health hazard, maintain or increase property values, and minimize the possibility that community sewerage or annexation to a neighboring community would be required.

Septage Volumes. Assuming that the recommended program begins in 1980, approximately 40 percent more septage would be produced each five years than with a continuation of present pumping practices as shown in Fig. 8-4. By 1990, under the management program, 56,000 gallons would be pumped from 152 systems in the program plus 298 non-program systems. Correspondingly, 31,000 gallons would be pumped from the same 450 systems if there were no management program. The incremental volume due to the program in 1990, then, is 25,000 gallons, 80 percent greater than without the program.

Management Requirements. Management manpower requirements for administration of the recommended program in Pleasant Hill in the first year of the program (assumed to be 1980) and in 1990 were estimated to illustrate the effect of this one area. Manpower requirements were based on an assumed number of

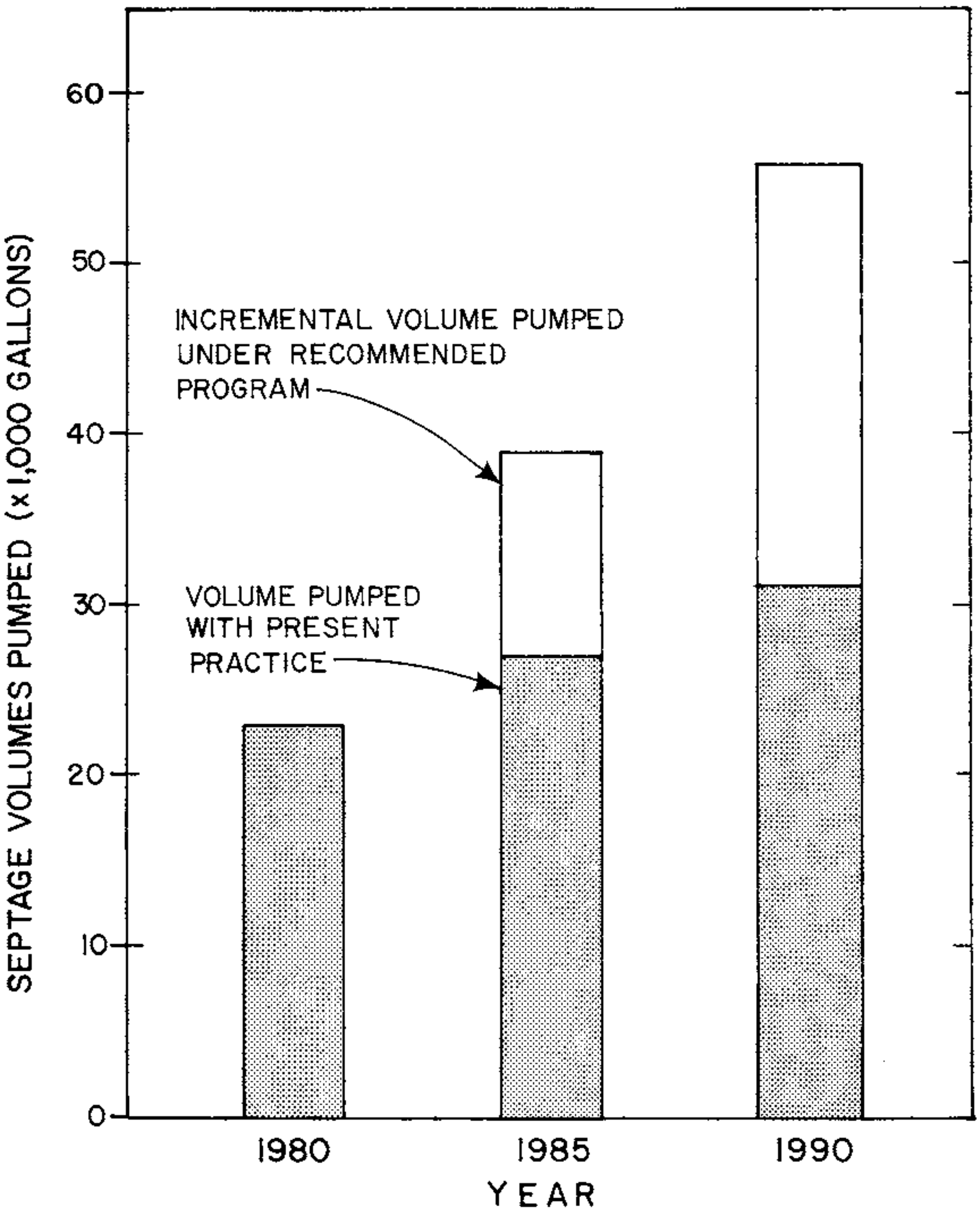


FIG. 8-4 COMPARISON OF SEPTAGE VOLUMES IN PLEASANT HILL

340 systems in the planning area in 1980, 450 systems in 1990, 11 to 13 new installations per year, one voluntary entry to the management program each year, and four repaired systems brought into the program each year. The impact of these figures on the management agency would be to require slightly more than four man-days in 1980 and 26 man-days in 1990.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

SURVIVAL CURVE ANALYSIS

APPENDIX B

SURVIVAL CURVE ANALYSIS

As noted in Chapter 5, Blue River and Elmira were chosen as areas in which to attempt the determination of survival curves because of the widely differing soil conditions in these two locations. Elmira, located approximately 15 miles west of Eugene, has developed in an area of fine-grained soils and high seasonal groundwater. Blue River, on the other hand, is situated about 40 miles up the McKenzie River east of Eugene in alluvial soils that are relatively coarse-grained and porous.

Since the purpose of drawing a survival curve is to show the percentage of systems in a fixed population still functioning at any time after they are installed the most accurate method of constructing the curves is to use the results of periodic sanitary surveys to plot the number of surviving systems over a period of time. The result of only one survey was available for this study, however. Therefore, a two-point line was defined, assuming, as the first point, 100 percent survival of the systems, at the time of construction and using as the second point the median age of the systems in each area at the time they were surveyed in 1969. Locating the second point on the curve required five steps. First, the location description - township, range, section, and tax lot number - for each home with a subsurface system at the time of the survey (Blue River - June 1969, Elmira - December 1969) was taken from the original survey field notes. Second, the list of location descriptions was used to determine the age of the system on that lot, using both Building Permit records and Assessment and Taxation Records. Third, the list of systems was screened to eliminate all those recorded as failures due to surface discharge of washing machine effluent, and those estimated or determined to have been built prior to 1950, in order to develop a list of systems which are assumed to be conventional septic tank-drainfield systems. The remaining list of systems included 76 units in Elmira and 22 units in Blue River. Fourth, the median age of systems built since 1950 was determined. Finally, the percentage of failing systems was determined from the field survey notes and subtracted from 100 percent to determine the percentage surviving. The resulting survival curves for both areas, shown in Figure B-1, indicate 100 percent survival of all systems built since 1950 in Blue River (median age, eight years in 1969), and 93.5 percent survival of all systems built in the Elmira area since 1950 (median age, 11 years in 1969).

The outcome of the survival-curve analysis, while showing little difference in failure rates between the two areas, also shows much higher survival rates than were expected in either area when compared to soil and groundwater conditions, to survival curves for systems in areas outside Oregon, and to results in Lane County reported in Table 5-2. Two factors tend to cast doubt on the results shown in Figure B-1,however. First, the actual age of systems whose date of construction was estimated from Assessment and Taxation (A & T) Rolls is unknown. Second, the analysis for Blue River and Elmira assumes that systems found to be performing either satisfactorily or marginally in 1969 had not failed prior to that date.

The actual date of construction of the subsurface system, if different from the date that the residential dwelling appeared on the A & T Rolls, could tend to make the apparent time rate of failure either higher or lower than the actual rate. For example, if a new home appeared on the A & T Rolls in 1950, but the subsurface system was not constructed and used until some time later, the median age of all systems in the area would be less than has been estimated and the apparent rate of failure of systems in the area would be higher than the actual rate. The apparent rate would be lower than the actual rate, however, in those cases in which a house was recorded on the A & T Rolls in 1948, thereby eliminating it from the survival-curve analysis, but its subsurface disposal system was not built or used until 1949 or later. Failures from this group would not be counted, thereby making the apparent failure rate less than the actual rate.

The validity of the second assumption - that "satisfactory" systems had not failed in the past - has already been discussed in the previous section on data from repair permit information, where it was shown that only one homeowner in 12 in Blue River, and one in 18 in Elmira, applied for county repair permits following the 1969 survey.

Perhaps the most important lesson in this analysis is the fact that record systems rarely support an evaluation of septic tank performance that is of unquestioned accuracy. Almost invariably we are forced to draw general conclusions from minor bits of usable information.

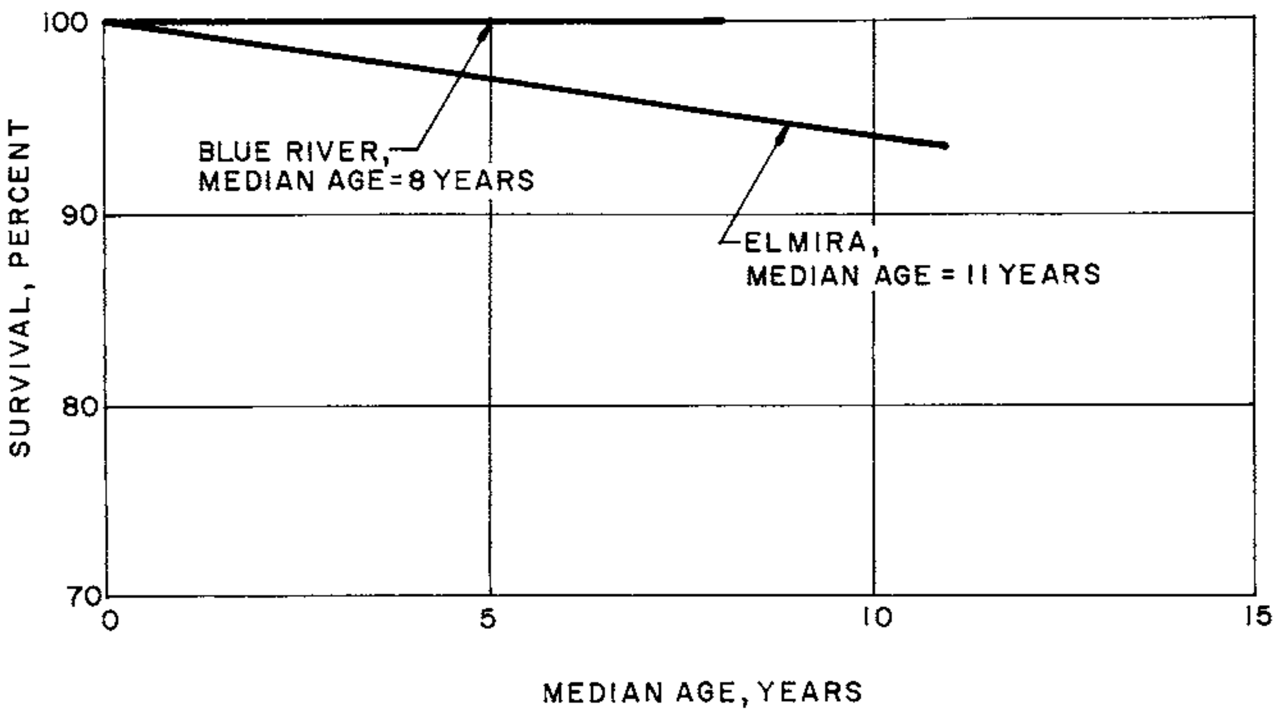

FIG. B-1 SURVIVAL RATE COMPARISON

APPENDIX C

MARIN COUNTY REGULATIONS

ORDINANCE NO. 1861

An ordinance of the board supervisors, of the County of Marin, adding chapter 18.06 to the Marin County Code, providing regulations for the design and maintenance of individual sewage disposal systems.

The Board of Supervisors of the County of Marin does hereby ordain as follows:

Section 1, Chapter 18.06 is hereby added to the Marin County Code to read as follows:

CHAPTER 18.06
INDIVIDUAL SEWAGE DISPOSAL SYSTEMS

Section 18.06.010. Purpose. The provisions of this Chapter are intended to insure that the disposal of sewage shall be accomplished in a safe and sanitary manner in order to protect the public health, safety and welfare to the greatest extent possible.

Section 18.06.020. Applicability. This Chapter is applicable to all individual sewage disposal systems proposed to be constructed after the effective date of this ordinance. Any sewage disposal system for which a permit was previously issued pursuant to the provisions of Chapter 18.04 is not subject to the provisions of this chapter.

Section 18.06.030. Definitions. HEALTH OFFICER. The term "health officer" means the Marin County Health Officer or his authorized representatives.

INDIVIDUAL SEWAGE DISPOSAL SYSTEM. The term "individual sewage disposal system" means and includes any system of piping, treatment devices or other facilities (excluding chemical toilets) that store, convey, treat or dispose of sewage which is discharged anywhere other than into a public sewer system.

PERSON. The term "person" shall include any person, firm, association, corporation, or any members, agents or employees of the foregoing.

PUBLIC SEWER SYSTEM. The term "public sewer system" means any publicly owned and maintained system of sewage conveyance, piping, or any part thereof, that transports sewage away from the properties of origin to publicly owned and operated sewage treatment and disposal facilities.

SEWAGE. The term "sewage" means any and all wastes, substance, liquid or solid, which contain or may be contaminated by human excreta, excrement, offal or feculent matter or matters, or substances of any kind or nature that may be injurious or dangerous to health either directly or indirectly.

Section 18.06.040. Prohibited Acts. It shall be unlawful for any person to do any of the following without first obtaining approval from the health officer in accordance with the provisions of this chapter and the regulations issued hereunder:

(a) Construct, alter, replace an individual sewage disposal system or a component element thereof, which system is subject to the provisions of this chapter.

(b) Construct, rebuild, use, occupy or maintain any residence, place of business or other structure where persons reside, congregate or are employed, which is not provided with a means of disposal of sewage by connection to a public sewer system or which is "not" provided with a sewage disposal system for which a prior permit was issued under Chapter 18.04.

Section 18.06.050. Connection to Public Sewer System and Alternatives. Sewage disposal shall be by means of a connection to a public sewer system if the nearest sewer is within 400 lineal feet of the parcel in which the structure generating the sewage is to be constructed. This requirement may be waived by the health officer if he finds connection to a public sewer is legally or physically impossible. If the health officer determines that connection to a public sewer is unfeasible, an application may be filed for a permit for an alternative method of sewage disposal, utilizing an individual sewage disposal system.

Section 18.06.060. Regulations. The health officer is authorized to issue regulations, providing guidelines and criteria to carry out the purposes of this chapter. Such regulations shall be approved by the Board of Supervisors prior to their effectiveness. The health officer is authorized to waive any particular requirement imposed by such regulations if he determines that the general purposes of this chapter will be achieved by such waiver.

Section 18.06.070. Application and Fee. All applications for individual sewage disposal systems shall be submitted in writing to the Marin County Department of Public Health, on a form supplied by the health officer. The application shall be accompanied by a fee of $20 to assist in covering the costs of initial design review and field inspection. Applications shall contain all appropriate information regarding the site and the proposed system.

Section 18.06.080. Health Officer Review. If, after investigation, the Health Officer determines that the construction of the proposed facility is in accordance with the terms of this chapter and any regulations issued pursuant thereto, and will not be injurious to the public health and welfare, he shall approve or conditionally approve the application for an individual sewage disposal system. Such approval may be made subject to such conditions as the health officer deems necessary to insure compliance with this chapter, any regulations issued pursuant thereto. Any such approval shall become null and void under the following circumstances:

A. The work authorized has not been commenced within one year after approval, unless an extension of an additional one year has been granted by the health officer.

B. Construction of the approved system is commenced but subsequently abandoned for a continuous period of 90 days.

C. Construction of the approved system is not proceeding in accordance with the terms of approval.

Section 18.06.090. Certificate of Inspection. If the individual sewage disposal system is completed in accordance with the terms of the health officer's approval, a certificate of inspection shall be issued by the health officer which certificate shall be effective for a period of 2 years. The health officer may revoke any certificate issued hereunder if he determines that the individual sewage disposal system does not comply with the provisions of this chapter, the regulations issued hereunder, or the conditions of the certificate.

Section 18.06.100. Biennial Inspection and Renewal. Every individual disposal system constructed pursuant to this chapter shall be subject to a biennial inspection to assure their continued proper functioning and for the purpose of renewing the certificate of inspection. The health officer shall renew a certificate of inspection for a 2 year period when the following conditions have been met:

A. A report of inspection of the individual disposal system by an authorized inspector indicates that the system is operating in a satisfactory manner.

B. Proof of a septic tank pumping by a licensed septic tank pumper is submitted, when such pumping is required by the report of the inspector.

C. Proof of repairs or alterations to an individual sewage disposal system is submitted, when such repairs have been required by the report of the inspector.

D. A deposit of the $20, renewal fee is made with the County Health Department.

Section 18.06.110. Recordation and Transfer of Certificate. The certificate of inspection shall be recorded by the health officer with the County Recorder, identifying the property by assessor's parcel numbers. The certificate of inspection is transferable to a subsequent grantee or transferee of the property, effective for the balance of the two (2) year period.

Section 18.06.120. Defective Systems. Following the biennial inspection covered above, if an individual sewage disposal system is found to be defective, the prior certificate of inspection may be extended for a period not to exceed 6 months beyond its normal expiration date, provided that corrective measures as recommended by the inspector are being undertaken.

Section 18.06.130. Enforcement. It shall be the duty of the county health officer or his duly authorized representative to enforce the provisions of this chapter and the regulations issued thereunder. He may enter any premises at any reasonable hour, with the owner's consent, to inspect the individual sewage disposal system to determine if it is functioning satisfactorily. Should for any reason, the owner's consent not be obtained, the health officer shall first obtain an inspection warrant pursuant to applicable law.

Section 18.06.140. Appeals. If an applicant or holder of a certificate of inspection is dissatisfied with any action or determination of the health officer pursuant to this chapter, he shall have the right to appeal to the Board of Supervisors, in writing, within ten days after notification of the action of the health officer. Upon receipt of said appeal, the Board of Supervisors shall set a hearing within fifteen days. The appellant shall be given notice thereof at the address shown on the application by registered or certified mail. At the conclusion of the hearing, the Board of Supervisors shall render a decision which shall be final.

Section 18.06.150. Violations. Violations of this Chapter shall be punished as provided for in Title 1 of the Marin County Code.

SECTION II. Severability. If any section, subsection, paragraph, sentence, clause or phrase of this ordinance is for any reason held to be invalid or unconstitutional, such validity or unconstitutionality shall not affect the validity or constitutionality of the remaining portions of this ordinance, it being expressly declared that this ordinance and each section, subsection, paragraph, sentence, clause and phrase thereof would have been adopted, irrespective of the fact that any one or more other section, subsection, paragraph, sentence, clause or phrase be declared invalid or unconstitutional.

SECTION III. Effective Date. This ordinance shall be and is hereby declared to be in full force and effect as of thirty days from and after the date of its passage and shall be published once before the expiration of fifteen (15) days after its passage, with the names of the Supervisors voting for and against the same in the Reporter, a newspaper of general circulation, published in the County of Marin.

The foregoing ordinance was passed and adopted at a regular meeting of the Board of Supervisors of the County of Marin, State of California, held on Tuesday, the 19th day of October, 1971, by the following vote:

AYES:	Supervisors	Arnold M. Baptiste, John F. McInnis, Michael Wornum, Louis H. Baar
NOES:	None	
ABSENT:	Supervisor	Peter R. Arrigoni

/s/ LOUIS H. BAAR
Chairman of the Board of Supervisors

ATTEST:
/s/ GEO. H. GNOSS, Clerk
Reporter No. 843; October 26, 1971

DEPARTMENT OF ENVIRONMENTAL SERVICES

COUNTY OF MARIN

Civic Center, San Rafael, California 94903
Telephone: (415) 479-1100

Tom Severns, Director
William L. Desmond, Director Environmental Control
Joel E. Rubey, Environmental Hearing Officer

Re: BIENNIAL SEPTIC TANK SYSTEM
INSPECTION AND CERTIFICATE RENEWAL

____
Property Address

Dear Property Owner(s): Parcel No. Date of Installation

Your septic tank system was inspected two years ago and under Marin County Code Section 18.06.100, a biennial inspection of the system is again required to assure its continued proper functioning and to renew the certificate of inspection. A twenty dollar ($20) renewal fee is also required by the Code.

If you wish to have the inspection made by a representative of the Division of Environmental Health at no cost other than the renewal fee, and you will arrange to have the septic tank covers removed, a member of our staff will perform the inspection. For information concerning preparation for the inspection, please call 479-1100, Extension 2711.

If you prefer, you may have the inspection made by a licensed septic tank pumper or licensed septic tank contractor (either may be located in the yellow pages of the telephone directory). A representative of the Division of Environmental Health must be present during this inspection, and the licensed septic tank pumper or septic tank contractor can arrange for this. You will be responsible for payment of the licensed pumper or contractor's fee in addition to the fee for renewal of the certificate of inspection.

The required inspection is to be carried out within 14 days of receipt of this letter. Failure to proceed will necessitate legal action on the part of Marin County as per Title I of the Marin County Code.

Thank you in advance for acting promptly in this matter.

Very truly yours,

CAROLYN B. ALBRECHT, M.D.
MARIN COUNTY HEALTH OFFICER

William L. Desmond
William L. Desmond, Director
Division of Environmental Health

CBA/WLD:lj

OWNER: ____________________

ADDRESS: ____________________

Property Inspected

Address: ____________________

A.P. # ____________________ Date ____________________

Biennual Private Sewage Disposal System Inspection
Marin County Code 18.06

SEPTIC TANK
1) Leak
2) Cracks
3) Tees Inlet
Outlet
4) Scum
5) Sludge

Licensed Septic Tank Pumping Co.

Septic Tank Needs Pumping ____________________

Septic Tank DOES NOT Need Pumping ____________________

Signature

LEACH FIELD AREA

1) Effluent Leakage

2) Odor

Any Change in Original Conditions:

Comments:

Division of Environmental Control

Inspector: ____________________

COUNTY OF MARIN
DIVISION OF ENVIRONMENTAL CONTROL
INDIVIDUAL WASTE DISPOSAL SYSTEM

CERTIFICATE OF INSPECTION

Name ______________________________

Property Street Address ______________________________

Assessor's Parcel Number ____________________ Inspection Date ____________________

Proof of satisfactory installation and/or operation of the Individual Waste System serving the above indicated property having been made, this Certificate of Inspection is hereby granted and is valid until ____________________. It is the responsibility of the property owner that this waste system shall not create any nuisance or health hazard at any time. Violations of Chapter 18.06 of the Marin County Code may result in revocation of this certificate or may result in legal action taken against the owner. This certificate is transferable to a subsequent grantee or transferee in the event this property is sold prior to the biennial expiration date. The new property owner shall then be responsible for the satisfactory operation of this individual waste system.

This certificate has been duly recorded with the County Recorder, County Code 18.06.110.

Carolyn B. Albrecht, M.D.
Marin County Health Officer

____
Authorized Representative

HS/417-044-173-DC

APPENDIX D

SUBSUFACE POLLUTANT
AND DRAINFIELD
REGENERATION

APPENDIX D

SUBSURFACE POLLUTANT TRAVEL AND DRAINFIELD REGENERATION

Two questions of importance to the design and maintenance of septic tank systems are: (1) how far do pollutants travel once they are discharged from the septic tank, and (2) once a drainfield is clogged, under what conditions will it recover its infiltrative capacity, and how long does that recovery take? The former question has caused a number of investigators to make field and laboratory observations, resulting in a relatively large quantity of data. The importance of the latter question, however, has not been commonly understood. Consequently, relatively limited information is presently available on the subject of drainfield regeneration methods and rates of recovery. This appendix summarizes current available knowledge on both questions.

It is worth noting here that the volume of information pertaining to the above questions should be increasing much faster in the future than it has up to the present time. The cause of the expected increase is a set of changes that the U. S. Environmental Protection Agency is currently making in its research priorities and requirements for funding and conducting wastewater facilities planning. The effect of these changes will be to bring far more emphasis to consideration and analysis of onsite sewage systems, including septic tank systems.

Summary of Findings

A summary of the principal findings in this literature review is presented below:

1. In aerobic, fine-textured, unsaturated soils, most bacteria, solid particles, and some dissolved chemicals will be removed within a distance of 60 centimeters (2 ft) to 90 centimeters (3 ft).

2. If any one of the three favorable conditions cited above are not present at a specific site, bacteria may travel a hundred meters or more.

3. Stable chemicals dissolved in percolating septic tank effluent may travel for several kilometers.

4. Regulatory setback distances are not intended to apply to all situations, and greater distances should be used where less than ideal conditions exist, unless a full field investigation of hydrogeologic conditions at the site concludes that minimum distances are acceptable.

5. Somewhere between six months and two years of resting is required to restore a drainfield to its original infiltrative capacity. The use of hydrogen peroxide to chemically unclog drainfields shows promise of

success, but is in the experimental stage at present and must only be carried out by knowledgeable personnel under controlled conditions.

Subsurface Pollutant Travel

As with most questions regarding soil systems, there is no single answer to the question of how far pollutants travel underground after leaving a septic tank system. In general, the answer can be stated as follows:

1. Most solid particles, including bacteria and viruses, not trapped in the septic tank are removed from septic tank effluent within a few centimeters of the drainfield trench surface when the surrounding soil is not saturated with water.

2. Essentially all solid particles, and many soluble pollutants, are removed from percolating septic tank effluent within 60 centimeters (2 ft) of the trench infiltrative surface in unsaturated soils.

3. Chemical pollutants not removed from percolating effluent within the first meter of subsurface travel are limited in their travel distance only by their stability. That is, there is essentially no limit to the travel distance of stable chemical compounds not adsorbed or filtered out by soils and near-surface bacterial action. Travel distances of several kilometers have been recorded.

4. The potential travel distance of degradable chemical compounds, is limited in most instances by their tendencies to change chemically.

5. Solids and micro-organisms penetrating through the clogging mat at the drainfield trench surfaces may travel a hundred meters or more (a) where water saturates the soils below the drainfield trench surface, (b) where creviced bedrock exists at shallow depths, and (c) where coarse-grained soils extend from the ground surface to the water table. Only rare instances are reported of micro-organisms traveling distances greater than 150 meters (500 ft).

There are of course special conditions in which the above general statements do not apply. Specific information on pollutant travel found in technical literature in Brown and Caldwell's files and the files of the Lane County Water Pollution Control Division is described in the following paragraphs.

Bacteria and Viruses. Bacteria behave like other particulate matter in soils in that they are removed by straining, sedimentation, entrapment, and adsorption.[D1] Factors affecting bacterial survival and movement include both physical and chemical characteristics such as soil type, temperature, and pH; bacterial adsorption to soil particles and the extent of soil clogging; soil moisture and nutrient content; and predatory micro-organisms which feed on bacteria. Liquid flow regime in the soil is also a key factor, in that higher degrees of purification can be achieved under unsaturated flow regimes, particularly in non-aggregated soils (sands or loamy sands for example).[D2] Both bacteria and viruses tend to survive longest in warmer soils of neutral pH which are high in both nutrient content and soil moisture.

Viral movement has been studied less intensively than the movement of bacteria, due in part to the lack of reliable methods of capturing and analyzing viruses. In general, however, the same factors contribute to the removal and die-off of both bacteria and viruses. "Results of experiments on travel of bacterial pollution range from laboratory studies with sand and soil columns to field observations in which little if any knowledge exists of the extent of channeling, variation in permeability, and other pertinent factors."[D3]

A literature review on the subject of bacteria travel from subsurface disposal systems performed over 20 years ago by the University of California noted that travel in controlled field tests exceeded 25 meters (80 ft) in one instance, and the distance reached in that case was 71 meters (232 ft).[D4] In more recent observations, harmful bacteria were found to be generally absorbed in the first 3 meters (10 ft) of travel in sands 0.15 millimeters or less in size, but might travel 7.5 meters (25 ft) or more per day in very coarse material where the rate of groundwater is 7.5 meters (25 ft) per day. The same reference cites tests conducted by the U. S. Army in which a virus removal efficiency of 99.999 percent was achieved in 60 centimeters (2 ft) of a well-sorted sand of particle size averaging 0.12 millimeters.[D5] The author of the report citing these removals drew the following conclusions from his review of the travel of bacterial pollutants:

- "Bacteria and viruses travel with the flow of water; they do not travel or move against the current."

- "For an ideal system the maximum length of travel of biological pollutants with groundwater ranges between 50 and 100 feet."

- "Pollution travel in nonsaturated systems is considerably less than that in saturated systems in that maximum length of travel appears to be in the vicinity of 10 feet."[D5]

Several other authors have also noted that a few feet of aerobic, unsaturated soil will reduce bacteria, or certain types of virus, below detectable levels, while the same removal may require over 60 meters (200 ft) in coarse-textured, saturated soils.[D3, D6, D7] In further support of the above findings, additional recent field observations have shown (a) that tracer bacteria have moved 29 meters (94 ft) through shallow bedrock fractures in as little as 24 to 30 hours,[D8] (b) that viruses and bacteria moved 180 meters (600 ft) or more in unsaturated, unconsolidated silty sands and gravel,[D9] and that typhoid bacteria from a septic tank contaminated a well 60 meters (200 ft) away, a distance traveled in 36 hours by a tracer dye injected into the septic tank system.[D2]

Another example of proper operation of a septic tank soil absorption system is provided by researchers at the University of Wisconsin who found that in an unsaturated medium sand soil the kinds and numbers of bacteria found in the liquid 30 centimeters (1 ft) below and 30 centimeters (1 ft) to the side of the trench were similar to natural soil flora.[D10]

Two investigators make special note of the fundamental fact that the texture or grain size of soils is a dominant factor in subsurface bacterial travel, and the finer the texture, the shorter the travel distance will be.[D5,D6]

Chemicals. Discussion of the travel of chemical pollutants from a subsurface disposal system must be divided into two parts: (1) stable compounds which are neither physically trapped, chemically changed, nor biologically degraded in the aerobic soil layers, and (2) compounds which can be adsorbed, degraded, or chemically changed.

The status of knowledge, and significance of travel of stable compounds was summarized in 1966 as follows:

"Experimental studies have produced little evidence of the distance of travel of most stable soluble chemicals because of the space limitation of experimental setups. However, from the standpoint of engineered soil systems for quality management this fact is of little importance. Any chemical which is not removed or altered in the clogging zone or in the soil overlying the water table must be presumed to be unaffected by the soil system and so beyond the ability of the soil system to remove."[D3]

Recent authors cite past studies in which stable chemical compounds such as gasoline, phenols, and herbicides have moved from approximately one kilometer up to 32 kilometer (20 miles) from their source.[D1,D11] Common pesticide residues are noted to move very slowly downward in a soil profile.[D1] ABS, a slowly biodegradable constituent of detergents which was banned from further use in the mid-1960's, was found by different observers to have traveled from 330 meters (1100 ft) to 460 meters (1500 ft).[D3,D11]

Chloride is another mobile chemical component, noted to have moved some 400 meters (1300 ft) from its source in one case and 60 meters (200 ft) in a 24-hour period in another.[D11] While both common and mobile, chloride has more significance as a pollution tracer than as a pollutant itself.

In a recent field study in a rural South Carolina county, 45.6 percent of more than 200 water samples taken from shallow and deep wells contained arsenic concentrations greater than the mandatory health limit of 0.05 mg/l. Statistical analysis of data from the study suggested that septic tank effluent was at least partially responsible for contaminating the shallow water supply sources, including arsenic contamination. Synthetic detergents used by the families in the region were determined to be the source of the arsenic.[D12]

Aside from the types of stable organic chemicals described above, the two compounds of greatest interest are nitrogen and phosphorus. Both elements are present in sewage effluent and both can contribute to biostimulation and eutrophication in lakes and streams. The nitrate form of nitrogen is also significant since it becomes a health hazard to infants at concentrations above 10 mg/l expressed as nitrogen. The general situation regarding removal of nitrogen (N) and phosphorus (P) by soil systems was well described recently as follows:

"In most cases soil disposal systems are incapable of removing the major portion of the N from the percolating septic tank effluent but are reasonably efficient in removing P. However, where systems are located in sandy soils or in shallow soils over creviced bedrock, removal of both N and P may be grossly inadequate, leading to obvious groundwater pollution and possible public health problems."[D13]

Nitrogen is predominantly in the form of ammonia when it emerges from a septic tank. Two reactions occur in most soils, however, which rapidly diminish the ammonia in effluent percolating from drainfields. The first is that ammonia in solution undergoes sorption to soil particles almost immediately.[D13] Paralleling this chemical reaction, however, is the biological reaction which converts ammonia to nitrate. Once converted from the ammonia form to the nitrate form by the aerobic crust of a drainfield, nitrogen moves easily for great distances with percolating septic tank effluent. Reasons for this are that nitrate has a negative ionic charge and is soluble. Therefore, the soil cation exchange capacity is ineffectual in sorbing the nitrate.[D1] The stable nitrate ion has been found to concentrate to levels 10 times greater than normal groundwater levels within 40 days beneath a new soil absorption field and to 65 times above normal levels within 65 days in one case.[D11]

While the literature is by no means clear on the fate of phosphorus in soils, there are numerous reports attesting to the fact that soils are capable of immobilizing large amounts of phosphorus. Most forms of this nutrient are retained in soil systems by a combination of adsorption, replacement, and precipitation reactions. The rate, extent, and permanence of retention in soils is a function of both soil characteristics and groundwater characteristics.

"It seems reasonable to conclude that although most soils can retain large amounts of phosphorus, the system, like most such systems, can be overloaded either by applying too much phosphorus or by applying it too rapidly."[D14]

At two locations, soluble phosphorus concentrations significantly larger than background were detected in groundwaters at locations of 30 meters (100 ft) and more down gradient from the sites. In addition several studies showed that phosphorus, initially retained on soils, can be redissolved and transported away by waters of low phosphorus concentration.[D14]

Investigators at the University of Wisconsin found that:

"Phosphorus can move downward 50-100 cm per year through 'clean' silica sand, but movement in loams, silt loams, and clays is much slower (5-10 cm per year). Thus, except in coarse soils, over 10 years would be required for the phosphorus to move as much as 3 feet."[D10]

Minimum Separation Distances. In light of the preceding information on subsurface pollutant travel, a question could be raised regarding the reliability of setback distances, such as those for Oregon in Table 4-2 of this report, in protecting water supplies from contamination by septic tank systems.

The basic answer to that question is contained both in the Oregon Administrative Rules and in U. S. Public Health Service Manual of Septic-Tank Practice. Oregon regulations state that the distances shown in Table 4-2 are regarded as minimum separation distances and that, "Greater separation distances will be required if . . .the disposal system will adversely affect the quality of any public waters of the state." The Manual of Septic-Tank Practice qualifies its table of horizontal separation distances as follows: "Since the distance that pollution will travel underground depends upon numerous factors, including the characteristics of the subsoil formations and the quantity of sewage discharged, no specified distance would be absolutely safe in all localities. Ordinarily, of course, the greater the distance, the greater will be the safety provided." Both documents, therefore, note that the tabulated distances will not provide protection to water supplies in all situations.

The above message is repeated and emphasized by several of the documents included in this literature review. University of Wisconsin investigators note that, "It is impossible to state with certainty the precise number of feet of soil which will retain contaminants."[D2] A second author states his opinion in two comments:

"Because of the many variables involved in the determination of a 'safe' distance of a domestic well from a potential source of pollution no single set of distances will be reasonable for all conditions.

"Spacing requirements should, whenever possible, be based on local factors because no one set of distances will be adequate and reasonable for all conditions."[D5]

Taking into account all of the above information, the following conclusions appear to summarize the use of setback distances to provide protection to water supplies:

1. Tabulated separation distances should be treated as minimum values, applicable to ideal conditions of deep groundwater overlain by aerobic, fine-textured, unsaturated soils. Under these conditions, published separation distances should provide adequate protection against bacterial pollution.

2. Protection against stable chemical toxicants can only be provided by removal at the source; that is, chemical toxicants should not be permitted to enter septic tank systems at all.

3. Current information on the factors affecting subsurface pollutant travel is such that a relatively accurate estimate can be made only when a detailed field investigation is carried out at each site in question. That investigation would have to include hydrologic and geologic conditions as well as soil conditions.

Drainfield Regeneration

Two methods of regenerating drainfield trench infiltrative surface areas (walls and bottom) are currently in use. One, resting, has been used for many years, but without knowledge of how long a rest period is required to recover full infiltrative capacity. The second, chemical oxidation using hydrogen peroxide, is a recent practice.

Resting (Natural Regeneration). University of California researchers in 1966 noted that recovery of capacity took much longer for subsurface systems than for surface disposal systems, but cited no specific time requirement.[D3] This same report presents a clear and detailed explanation of the mechanism of regeneration, i.e. bacterial oxidation of the organic clogging mat under aerobic conditions.

In 1969, two Brown and Caldwell authors noted that, "Several years of rest for the original drainfield should effect sufficient recovery to allow subsequent periodic alternation of the two drainfields."[D15]

The most detailed field test on this subject found during this study was that performed by the Army Medical Laboratory in Fort Detrick, Maryland. In their study of the fate of bacteria and viruses at a surface infiltration site, they found that a black, asphaltic-appearing layer developed 45 centimeters (18 in.) to 60 centimeters (24 in.) beneath the surface of the infiltration cells. In one cell, rested from April to November, the layer was visibly seen to recede with time and to be completely gone at the end of eight months.[D9]

Other authors note in recent articles, that, (1) "... if a septic system is rested two years, it will work satisfactorily when put back in operation..."[D16], and (2) that clogging materials are broken up, and infiltrative capacity restored, after several months of resting.[D10] University of Wisconsin investigators recommended that two beds be used alternately by diverting wastewater from one to another every six months.[D10]

The present state of knowledge, then, is that somewhere between six months and two years is required to restore infiltrative capacity by resting. This time requirement means that a second, or replacement, bed must be available to allow continued use of the disposal system while the clogged bed is resting.

Chemical Oxidation (Induced Regeneration). Laboratory and field tests have been made using hydrogen peroxide to regenerate clogged drainfield. In two instances, field analyses showed that, after proper preparations and application of a peroxide solution to a clogged drainfield, water began infiltrating through the anaerobic crust after about 2 hours, and crusts appear to have been totally dissolved in about 48 hours. A crusted area began reforming almost immediately after regeneration in this manner, but one system was noted to have been still operating satisfactorily 15 months after peroxide treatment.

In the view of investigators at the University of Wisconsin: "It is, therefore, cheaper and safer to use smaller amounts of peroxide in an intelligent preventive maintenance program rather than wait for systems to fail." The principal drawback to regeneration with this strong oxidizing agent is that failure to follow recommended safety procedures can produce explosive results and extensive drainfield damage.[D17]

APPENDIX D

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