CHAPTER 2

STRATEGY FOR ONSITE SYSTEM DESIGN

2.1 Introduction

A wide variety of onsite system designs exist from which to select the most appropriate for a given site. The primary criterion for selection of one design over another is protection of the public health while preventing environmental degradation. Secondary criteria are cost and ease of operating and maintaining the system. The fate of any residuals resulting from the treatment and disposal system must be considered in the selection process.

Figure 2-1 summarizes wastewater management options for onsite systems. Because of the wide variety, selection of the system that prevents public health hazards and maintains environmental quality at the least cost is a difficult task. The purpose of this chapter is to present a strategy for selecting the optimum onsite system for a particular environment. At each step, the reader is referred to the appropriate chapters in the manual for site evaluation, and subsequent system design, construction, operation and maintenance, and residuals disposal.

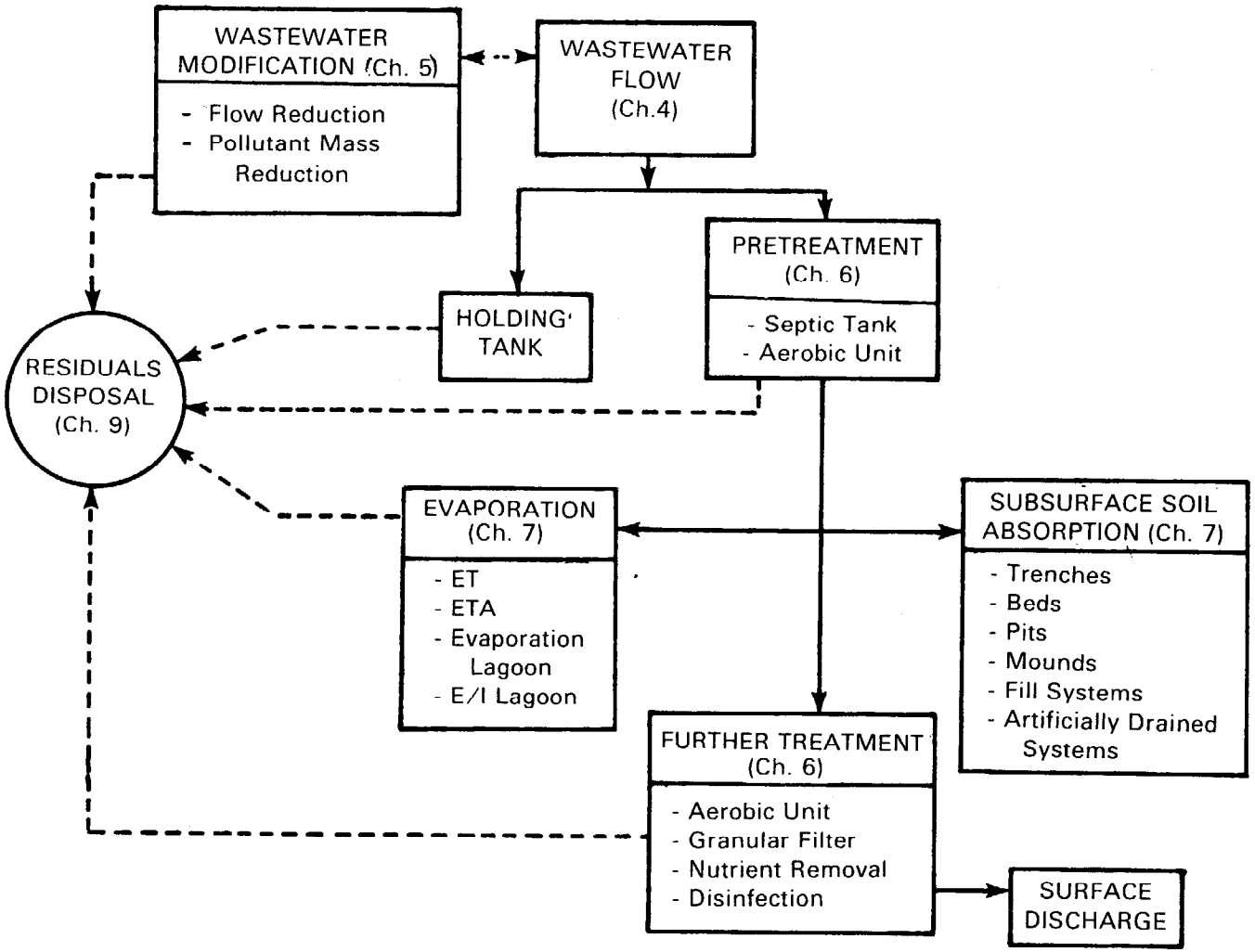
2.2 Onsite System Design Strategy

Traditionally, subsurface soil absorption has been used almost exclusively for onsite disposal of wastewater because of its ability to meet the public health and environmental criteria without the necessity for complex design or high cost. A properly designed, constructed, and maintained subsurface absorption system performs reliably over a long period of time with little attention. This is because of the large natural capacity of the soil to assimilate the wastewater pollutants.

Unfortunately, much of the land area in the United States does not have soils suited for conventional subsurface soil absorption fields. If soil absorption cannot be utilized, wastewater also may be safely disposed of into surface waters or evaporated into the atmosphere. However, more complex systems may be required to reliably meet the public health and environmental criteria where these disposal methods are used. Not only are complex systems often more costly to construct, but they are also more difficult and costly to maintain. Therefore, the onsite system selection strategy described here is based on the assumption that

FIGURE 2-1

ONSITE WASTEWATER MANAGEMENT OPTIONS



subsurface soil absorption is the preferred onsite disposal option because of its greater reliability with a minimum of attention. Where the site characteristics are unsuitable for conventional subsurface soil absorption systems, other subsurface soil absorption systems may be possible. Though these other systems may be more costly to construct than systems employing surface water discharge or evaporation, their reliable performance under a minimum of supervision may make them the preferred alternative. Figure 2-2 illustrates the onsite system design strategy discussed in this chapter.

2.2.1 Preliminary System Screening

The first step in the design of an onsite system is the selection of the most appropriate components to make up the system. Since the site characteristics constrain the method of disposal more than other components, the disposal component must be selected first. Selection of wastewater modification and treatment components follow. To select the disposal method properly, a detailed site evaluation is required. However, the site characteristics that must be evaluated may vary with the disposal method. Since it is not economical nor practical to evaluate a site for every conceivable system design, the purpose of this first step is to eliminate the disposal options with the least potential so that the detailed site evaluation can concentrate on the most promising options.

To effectively screen the disposal options, the wastewater to be treated and disposed must be characterized, and an initial site investigation made.

2.2.1.1 Wastewater Characterization

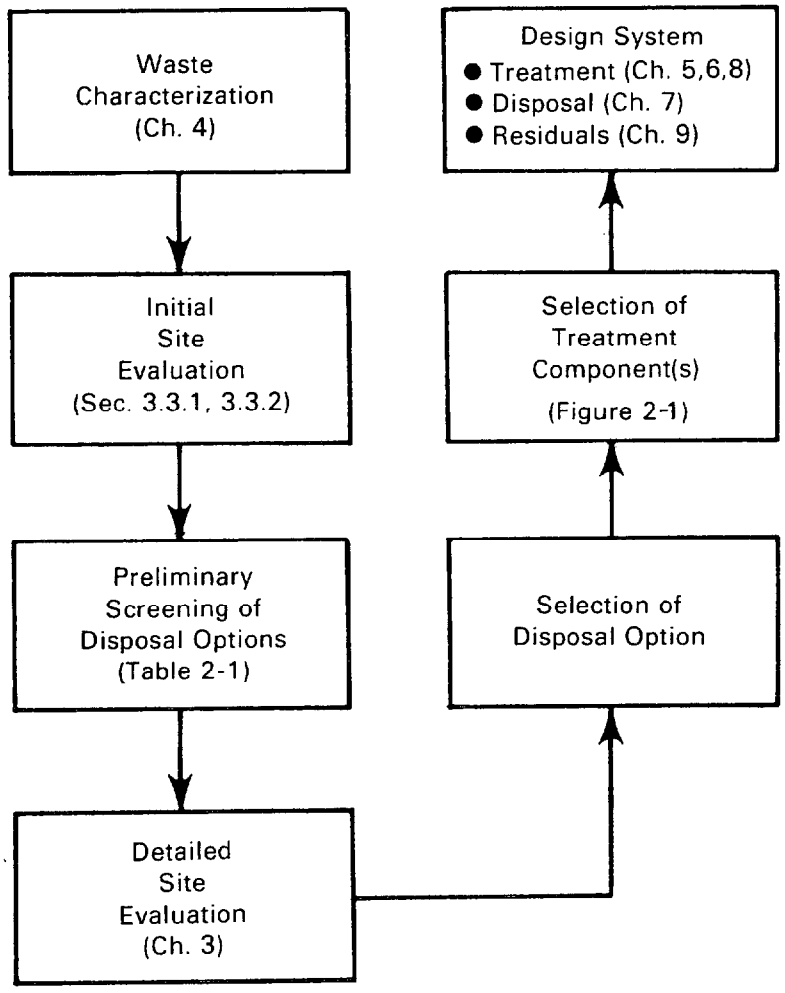
The estimated daily wastewater volume and any short- or long-term variations in flow affect the size of many of the system components. In addition, the concentrations of various constituents can affect the treatment and disposal options chosen. Characteristics are presented in Chapter 4 for wastewater from residential dwellings as well as from commercial operations.

2.2.1.2 Initial Site Evaluation

All useful information about the site should be collected. This may be accomplished by client contact, a review of available published resource information and records, and an initial site visit. Client contact and a review of published maps and reports should provide information regarding the soils, geology, topography, climate, and other physical

FIGURE 2-2

ONSITE SYSTEM DESIGN STRATEGY



features of the site (See 3.3.1 and 3.3.2). An initial site visit should also be made, and should include a visual survey of the area and preliminary field testing, if required, with a hand auger (See 3.3.3). From this site visit, general site features such as relative soil permeability, depth and nature of bedrock, depth to water table, slope, lot size, and landscape position should be identified. Sources of information and evaluation procedures for site evaluation are detailed in Chapter 3.

2.2.1.3 Preliminary Screening of Disposal Options

From the wastewater characteristics and site information gathered in this step, a preliminary screening of the disposal options can be made using Table 2-1. This table indicates the onsite disposal options that potentially may work for the given site constraints. The potentially feasible disposal options are identified by noting which ones perform effectively under all the given site constraints. Note that with sufficient treatment and presence of receiving waters, surface water discharge is always a potential disposal option.

As an example, suppose a site for a single-family home has the following general characteristics:

1. Very rapidly permeable soil
2. Deep bedrock
3. Shallow water table
4. Five to 15 percent slope
5. Large lot
6. Low evaporation potential

From Table 2-1, the disposal options most applicable to the example site constraints are:

1. Mounds
2. Fills
3. Surface water discharge

The design sections in Chapter 7 would be consulted at this point to determine the specific characteristics to be evaluated at the site in order to select the most feasible disposal options.

TABLE 2-1

SELECTION OF DISPOSAL METHODS UNDER VARIOUS SITE CONSTRAINTS

Method	Site Constraints											
	Soil Permeability			Depth to Bedrock			Depth to Water table		Slope			Small Lot Size
	Very Rapid	Rapid-Moderate	Slow-Very Slow	Shallow and Porous	Shallow and Nonporous	Deep	Shallow	Deep	0-5%	5-15%	15%	
Trenches		X	X[2]			X		X	X	X	X	X[4]
Beds		X				X		X	X			X
Pits		X				X		X	X	X	X	X
Mounds	X	X	X	X	X	X	X	X	X	X		
Fill Systems	X	X[1]	X[1]	X	X	X	X	X	X	X	X	X[4]
Sand-Lined Trenches or Beds	X	X	X[2]			X		X	X	X[3]	X[3]	X[4]
Artificially Drained Systems		X				X	X		X	X	X[3]	
Evaporation Infiltration Lagoons		X	X[5]			X		X	X			
Evaporation Lagoons (lined)[4,5]	X	X	X	X	X	X	X	X	X			
ET Beds or Trenches (lined) [4,5]	X	X	X	X	X	X	X	X	X	X[6]		
ETA Beds or Trenches[4]		X	X			X		X	X	X	X	X

[1] Only where surface soil can be stripped to expose sand or sandy loam material.

[2] Construct only during dry soil conditions. Use trench configuration only.

[3] Trenches only.

[4] Flow reduction suggested.

[5] High Evaporation potential required.

[6] Recommended for south-facing slopes only.

X means system can function effectively with that constraint.

2.2.2 System Selection

With the potentially feasible disposal options in mind, a detailed site evaluation is performed. The information collected is used to identify the system options that meet the public health and environmental criteria. If more than one system is feasible, final selection is based on results of a cost effective analysis. Local codes should be consulted to determine which onsite treatment and disposal methods are permitted in the area.

2.2.2.1 Detailed Site Evaluation

A careful, detailed site evaluation is needed to provide sufficient information to select the most appropriate treatment and disposal system from the potentially feasible system options. The evaluation should be performed in a systematic manner so as to insure that the information collected is useful and in sufficient detail. A site evaluation procedure is suggested in Chapter 3, including descriptions of the tests and observations to be made. This procedure is based on the assumption that subsurface soil absorption is the preferred method of disposal. If subsurface absorption cannot be used, techniques are explained for evaluating the suitability of a site for surface water discharge or evaporation.

2.2.2.2 Selection of Most Appropriate System

The disposal option selected after the detailed site evaluation dictates the quality of the wastewater required prior to disposal. If suitable soils exist onsite to employ one of the subsurface soil absorption methods of disposal, the quality of the wastewater applied need not be high due to the assimilative capacity of the soil. Where suitable soils do not exist onsite, other methods of disposal that require a higher quality of wastewater may be necessary. These wastewater quality requirements are established during the site evaluation (Chapter 3). Wastewater reduction and treatment options are selected to meet the required wastewater quality.

Altering the characteristics of the wastewater generated can have a major impact on the design of the treatment and disposal system. Alteration can be beneficial in reducing the size or complexity of the system. Chapter 5 describes a variety of wastewater reduction options.

Chapter 6 provides detailed information regarding the design, construction and operation of various treatment options. Selection of the most appropriate treatment option is based on performance and cost. Various onsite systems may be synthesized from the data presented in Chapters 5 and 6. As an example of the synthesis of treatment and disposal systems following the detailed site evaluation, assume that all three disposal options selected in 2.2.1.3 proved to be feasible.

Examination of the first two disposal options indicates that only minimal pretreatment may be required. Thus, two systems might be:

1. Septic tank - mounds
2. Septic tank - fill

If groundwater quality is a constraint, however, it may be necessary to develop other systems. Thus, if nitrogen discharges from the disposal system to the groundwater must be controlled, the two treatment-disposal systems may be revised to include the following:

1. Septic tank - mound - denitrification
2. In-house toilet segregation/graywater - septic tank - fill

Note that a variety of other systems may be developed as well. The other disposal option listed in 2.2.1.3 is surface water discharge. Several treatment options exist if the wastewater is disposed of by discharge to surface waters. Filtration and disinfection may be required as part of those treatment options, depending on the water quality requirements of the appropriate regulatory agency.

Residuals produced from the treatment processes also require safe disposal. This must be considered in the selection of the treatment and disposal system. Chapter 9 provides information regarding the character, required treatment, and methods of ultimate disposal of various residuals produced.

2.2.3 System Design

Once all the components are selected, design of the system follows. Chapters 5, 6, 7, 8, and 9 should be consulted for design information.

2.2.4 Onsite System Management

Past experience has shown that onsite management districts have many benefits, including improved site selection, system design, construction, and operation and maintenance. Management districts also facilitate the use of more complex systems or larger systems servicing a cluster of several homes. These districts can take many forms with varying powers. Chapter 10 provides an overview of management options for onsite systems.