

INTRODUCTION

Subsurface wastewater disposal systems are used throughout the State of Maine in increasing numbers to treat and dispose of domestic and commercial wastewater. Maine, primarily a rural and agricultural state, relies largely upon small subsurface wastewater disposal systems. Public sewer systems often are uneconomical, unfeasible, or unavailable.

Soil percolation tests were utilized in Maine prior to 1974 to determine the suitability of soil and the appropriate design of disposal systems. The **Department of Human Services, Division of Health Engineering**, which is responsible for administering and enforcing the **State of Maine Subsurface Disposal Rules**, experienced significant problems with this method of determining soil suitability and septic system sizing. An unacceptable rate of malfunctioning disposal systems resulted, along with associated health hazards, nuisances and environmental degradation.

The concept of site evaluation for disposal system design began in Maine in the early 1970's as an improved and more reliable method for determining soil suitability and septic system design. Rules requiring on-site soil evaluations for design of all subsurface disposal systems became effective in July, 1974. They were significantly revised in May 1995.

Subsurface wastewater disposal design combines on-site soil evaluation, consideration of site features, and knowledge of engineering techniques resulting in a properly functioning system that will not allow harmful pollutants to accumulate to dangerous levels in the environment. Site evaluation requires a unique combination of knowledge of soil science, geology, and engineering. Licensed Site Evaluators are required to have the skill and ability to identify and accurately report soil textures and limiting factors so they can properly classify soils, determine soil suitability and the appropriate size of disposal systems. They must then use their knowledge of engineering techniques to design subsurface wastewater disposal systems to fit each unique site and specific applicant requirements.

Maine requires that individuals who design disposal systems be licensed. The **State of Maine Department of Human Services, Division of Health Engineering**, administers the licensing of these individuals. A person who is interested in becoming a **Site Evaluator** must have an educational background and experience that indicates he or she has a knowledge of soils and subsurface disposal design. Qualified individuals are permitted to take a written examination to prove they have the necessary skills and knowledge to design subsurface

wastewater disposal systems correctly. A person who successfully completes the written examination is permitted to take a field examination to illustrate his or her proficiency in soil profile description. Only after successfully completing the field examination will a person become a licensed Site Evaluator.

Maine also requires that **Local Plumbing Inspectors**, who permit and inspect the installation of subsurface wastewater disposal systems, be certified. A person who is interested in becoming a certified Local Plumbing Inspector must pass a written examination on their knowledge about the **State of Maine Subsurface Wastewater Disposal Rules**. A municipality will appoint a certified Local Plumbing Inspector to permit and inspect systems installed to the standards of those Rules.

The **Department of Economic and Community Development (DECD)** provides training in **Subsurface Wastewater Disposal Rules** and administers the **Certification Program** for Local Plumbing Inspectors. The Division of Health Engineering promulgates and interprets the Rules, reviews applications for variances and administers permits for installation of disposal systems through the Local Plumbing Inspector Program.

Maine **does not** require **Disposal System Contractors** to be licensed. Any individual installing disposal systems should be knowledgeable about the **State of Maine Subsurface Wastewater Disposal Rules** and proper construction practices of the industry.

The First Edition of this Handbook was written in 1979 by Albert Frick, and was primarily a basic handbook for the practice of Site Evaluation in Maine for subsurface wastewater disposal design. The Second Edition of this handbook was written in 1983 by Albert Frick and was an expanded and refined version of the previous handbook. This Third Edition has been expanded beyond the basics of site evaluation practice to include practices and methods of Local Plumbing Inspector administration and inspection and basic practices of disposal system construction and maintenance. Albert Frick and David Rocque collaborated in writing the Third Edition.

HOW TO USE THIS HANDBOOK

This material is presented as a training guide for individuals interested in Site Evaluation; Subsurface Wastewater Disposal System Design, Construction and Inspection. This handbook is written as a basic guide for a diverse group of potential readers (e.g. **site evaluators, local plumbing inspectors, planning board members, contractors, real estate brokers, and others** concerned with on-site subsurface wastewater disposal in Maine).

Chapter I	outlines the basic components of a subsurface wastewater disposal system and describes their function and utilization.
Chapter II	summarizes the important considerations of site evaluation .
Chapter III	discusses the basic principles of soil evaluation .
Chapter IV	concentrates on administration and inspection , including the proper methods for completing the application and inspection of systems.
Chapter V	addresses subsurface wastewater disposal system installation and construction techniques.
Chapter VI	describes home owners maintenance
Chapter VII	includes special problems and other considerations in more detail, perhaps for the more advanced reader.

This handbook is intended to be a supplementary handbook to the State of Maine Subsurface Wastewater Disposal Rules. A person interested in Site Evaluation should seek training and education in basic soils, classification, morphology, and subsurface disposal system design; as well as accompany a Licensed Site Evaluator during field work to gain valuable experience. A person interested in administration and inspection should accompany a Local Plumbing Inspector on field inspections. A person interested in Disposal System Construction should work with a qualified installer to gain valuable construction experience. There is no substitute for *hands-on* field experience.

Anyone interested in becoming a **Licensed Site Evaluator, Certified Local Plumbing Inspector, or Disposal System Contractor**, should become familiar with the **State of**

Maine Subsurface Wastewater Disposal Rules and pertinent Sections of this handbook. The **Local Plumbing Inspector (LPI)** will be most interested in Chapters I, IV and sections of Chapter V and VII. Chapters II and III will be of some interest to the Local Plumbing Inspector to provide insight into subject areas of the Site Evaluator. The **Site Evaluator** will be most interested in Chapters I, II, III, and sections of VII. The **Disposal System Contractor** would be most interested in Chapters I, V and sections of VII.

I. SUBSURFACE DISPOSAL DESIGN

SYNOPSIS:

This chapter discusses **domestic wastewater characteristics**, presents a general overview of the individual **components of subsurface wastewater disposal systems**, and explains the basics of how they work. This section should be of particular interest to local plumbing inspectors, site evaluators, and excavating contractors and should also provide background to planning board members, regulators and property owners.

TOPICS:

Domestic effluent characteristic, subsurface wastewater disposal system components: building sewer, treatment tank, septic tank filters, grease trap, effluent sewer, distribution box, disposal area, soil treatment of wastewater, stone bed, stone trench, proprietary leaching devices, concrete chambers, plastic chambers, plastic tubing system, Eljen In-Drains, grandfathered systems, distribution systems, gravity flow, pumping siphon, special systems.

DOMESTIC EFFLUENT

Normal household effluent consists of all the liquid household waste which is generated from the toilet, bath, kitchen and laundry. This material is composed of about 99.9 percent liquids and about 0.1 percent solids. The small percentage of solids and the microorganisms are the cause of health hazards and nuisances.

Approximately two-thirds of the solids in domestic effluent are organic compounds, primarily carbohydrates and fats. Organic compounds are the primary source of odors and nuisances, requiring large volumes of oxygen to render them stable, inoffensive, and nonhazardous. Other substances in effluent that are undesirable and potentially harmful are: pathogenic bacteria, infectious viruses, organic matter, toxic chemicals, and excess nutrients, such as nitrogen and phosphorus. These substances are a potential public health hazard, nuisance, and a source of pollution when not properly treated.

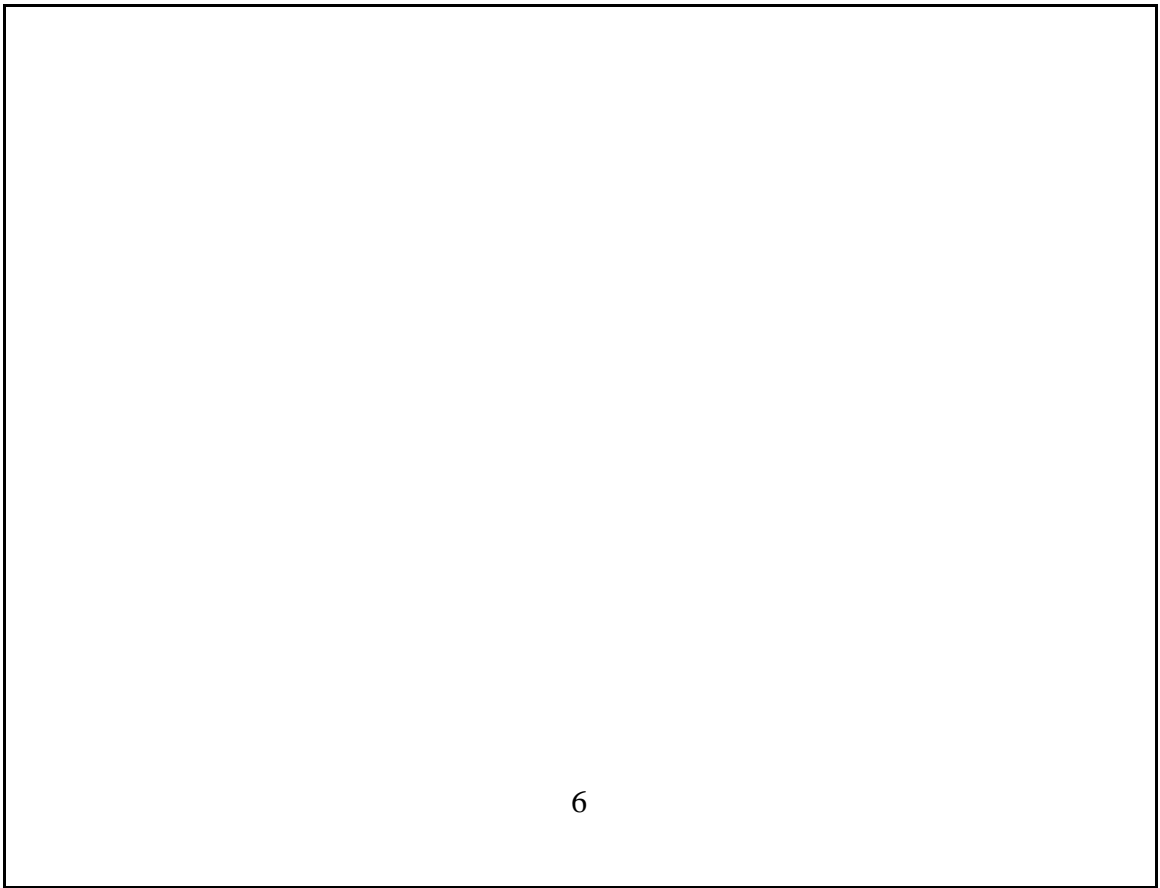
Design factors, utilized in the *Subsurface Wastewater Disposal Rules*, and used for

calculating the size of disposal areas, assume that the waste being treated is of the same quality as normal household effluent. When it is suspected that the effluent to be treated is of a different quality than domestic effluent, the suspended solids and biochemical oxygen demand should be measured and considered for adjusting the disposal area size. If the waste is a by-product of any textile, printing, furniture stripping, metal plating, paint, manufacturing, pharmaceutical, pesticide, petroleum, leather, rubber, plastic manufacturing or other hazardous waste materials; the application for the disposal system should be directed to the **Maine Department of Environmental Protection, Bureau of Hazardous Materials and Solid Waste Control (1-207-287-2651)**.

SUBSURFACE WASTEWATER DISPOSAL COMPONENTS

The essential features of a typical system are the building sewer, treatment tank, effluent line, distribution line, disposal area, and surrounding soil (see Figure 1). Many disposal systems also include a distribution or diversion box and some systems also utilize a pumping chamber or syphon.

A properly designed and sited disposal system will provide for adequate treatment and disposal of the wastewater prior to reaching the seasonal groundwater or soil surface. Failure to meet all necessary design criteria introduces a greater probability of failure and higher risk of creating a potential health or environmental hazard.



BUILDING SEWER

The building sewer is a water tight pipeline which is used to convey raw (untreated) wastewater from the dwelling to the treatment tank. It should extend a minimum of 8 feet from the building foundation to allow for ease of installation of the treatment tank. It is also good practice, in designing disposal systems, to keep the length of the building sewer as short as practical in order to reduce the possibility of blockage and to facilitate cleaning of the sewer line if it should become blocked.

TREATMENT TANK

The treatment tank functions as a conditioning device and provides for primary treatment of wastewater. The raw wastewater is detained in the treatment tank to allow it to be rendered more suitable for discharge to the disposal area. If raw wastewater were discharged directly to the disposal area, the pore spaces between the soil particles would quickly become clogged by the solid materials contained in the wastewater. Severe clogging results in the backing up of wastewater through the plumbing into the house or surfacing effluent near the disposal area. To minimize the likelihood of this occurrence, the raw wastewater is held for a period of one to three days in the treatment tank where it is subjected to a combination of physical, chemical and biological actions resulting in the conversion of the solid material to liquids and gases. The gases either escape through the house plumbing vent or mix with the effluent, and the clarified liquid is piped to the disposal area. Some of the solids remain in the tank as sludge or scum and must be removed periodically before they accumulate to the point where reduced retention capacity of the tank results. Reduced retention time of effluent in the septic tank will result in solids carryover to the disposal area. Pumping of the treatment tank every 3 to 4 years is generally considered a good maintenance practice. Some treatment tanks may need to be pumped more or less frequently, depending on the quality and quantity of wastewater generation.

The total solids in wastewater consist of dissolved or soluble solids, suspended or colloidal solids, and settleable solids. The dissolved and suspended solids remain in the wastewater and do not settle out. Settleable solids are removed from the wastewater by gravity if allowed sufficient time (the reason why septic tanks need to be periodically pumped). Primary treatment, which takes place in the treatment tank, is a settling process in which the settleable solids sink to the bottom by gravitation. Certain materials in the wastewater, known as scum and consisting of paper, grease, and similar constituents lighter than the

liquid wastewater, will rise to the top. These materials are prevented from entering the disposal area by baffles or tee's designed to trap the floating substances in the treatment tank (see Figure 2).

Septic tanks and aerobic tanks are the two types of treatment tanks recognized for use in Maine. Septic tanks produce an anaerobic environment and rely on anaerobic bacteria for treatment (see Figure 2). Aerobic tanks pump fresh air into the tank and rely on aerobic bacteria for treatment. The bacteria in aerobic treatment tanks, although more active, are also more sensitive and fragile to fluctuating conditions than anaerobic bacteria in septic tanks.

Presently, there are very few aerobic treatment tanks used in Maine. Current regulations do not allow for a reduction in the size of a disposal area with the use of an aerobic tank. Aerobic treatment tanks are relatively more expensive, need maintenance, and require electricity.

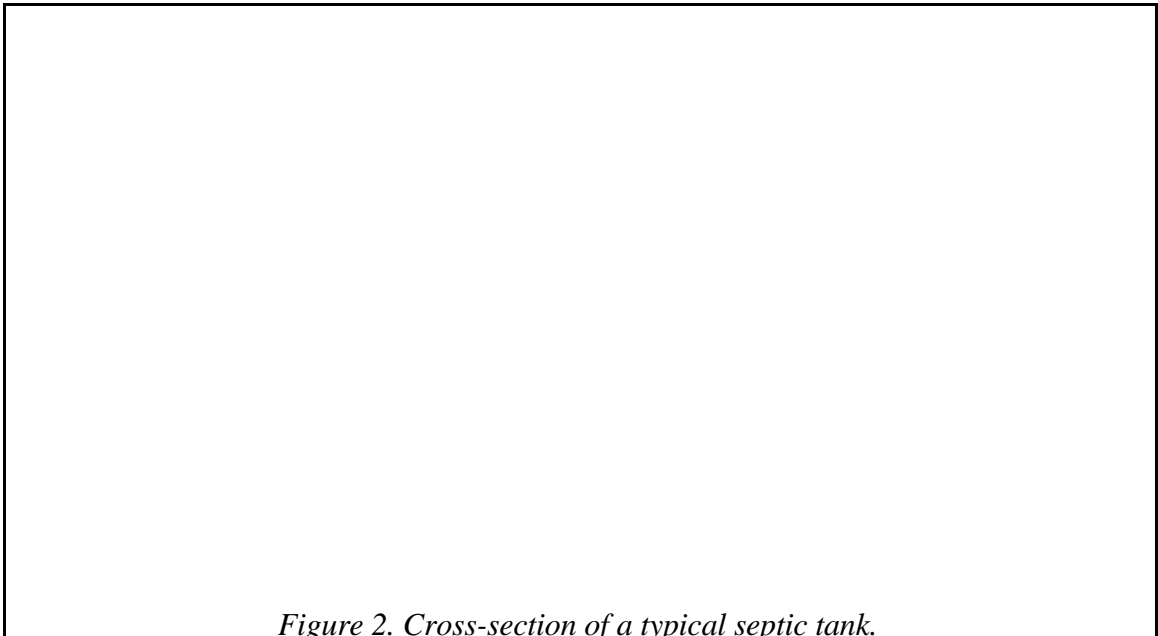


Figure 2. Cross-section of a typical septic tank.

Treatment tanks must be sited and designed such that they will not be subject to either surface water or groundwater infiltration. The treatment tank outlet should be above the seasonal high groundwater table to prevent groundwater from entering the tank, if at all possible. A treatment tank, placed in a soil that has a seasonal groundwater table above the treatment tank outlets or covers, should be installed with attention given to preventing surface and groundwater infiltration. Risers with grouted seams and covers should be considered for placement over all openings to prevent groundwater infiltration into treatment tank openings. Treatment tanks should be accessed through the cleanout cover when being

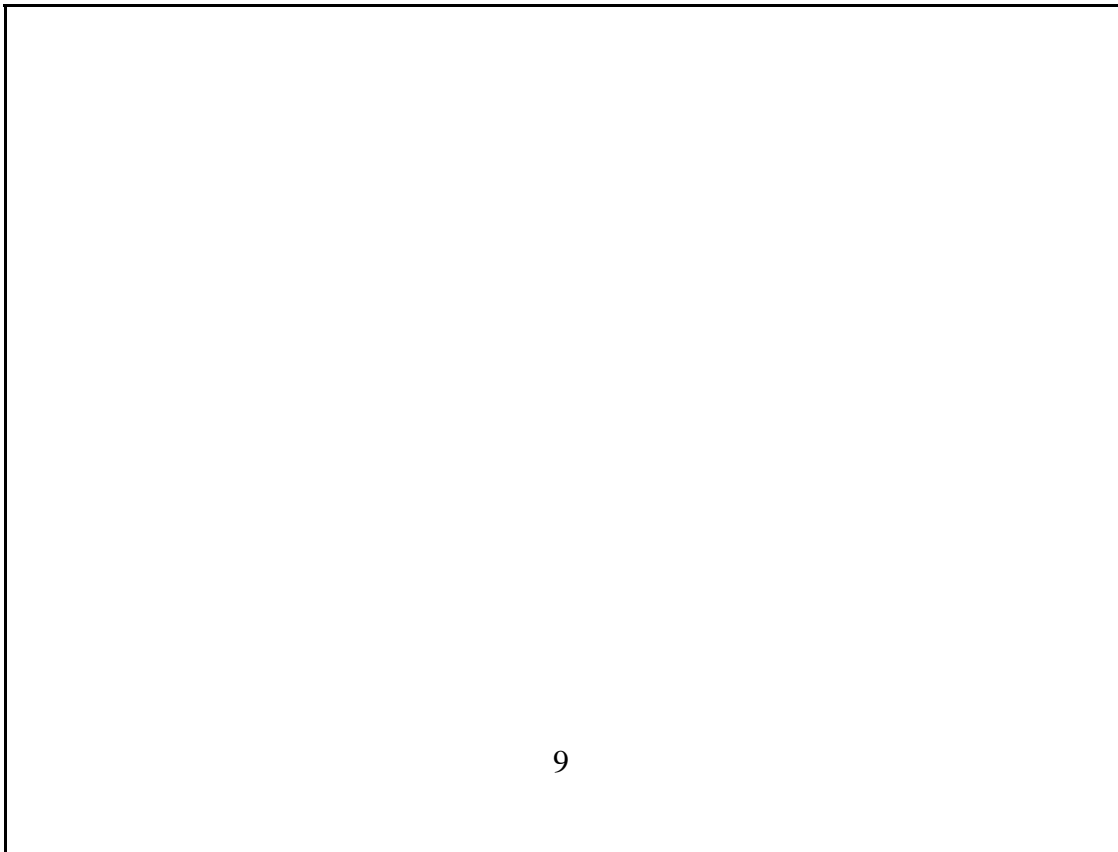
pumped, to allow the suction hose to reach all sludge accumulations.

Treatment tanks are commonly made of concrete or plastic. Metal treatment tanks are no longer permitted in Maine. Plastic tanks generally are more expensive, but have several advantages. They are lighter and can be installed in areas inaccessible to heavy equipment, since they can be hand-carried by several adults. However, their lightness can be a disadvantage when being installed in wet sites because they can float when empty. Plastic tanks do not corrode over a period of time when exposed to normal domestic wastewater, as do concrete tanks.

Monolithic or one piece treatment tanks are available for use. Monolithic tanks are less likely to leak than standard two-piece tanks. Care should also be taken to plug the small diameter hole in the bottom of the tank (commonly referred to as a *bung hole*), which is used to counter flotation when installing septic tanks in wet locations.

SEPTIC TANK FILTERS

There are a number of pre-manufactured filters available which can be installed on the outlet end of septic tanks to prevent carryover of suspended solids to the disposal area. Filters need periodic maintenance to remove solids. Failure to provide proper maintenance may result in wastewater backups into plumbing in the home. However, that risk is usually preferable to the more costly risk of disposal area failure. Refer to manufacturer's manuals for maintenance recommendations (see Figure 3).



GREASE TRAP

An external grease trap should be used with systems that will treat wastewater generated from a facility that has a likelihood of producing a significant quantity of grease in the wastewater (e.g. restaurant, school cafeterias). The standard, non-mechanical, internal grease traps have been shown to be ineffective in removing grease. It appears that the liquid cooking oils that are commonly used today are becoming more difficult to trap because they stay in emulsion longer.

An external grease trap essentially consist of a modified septic tank with the baffling modified (see Figure 4).



EFFLUENT LINE

The effluent line is a water tight pipeline which conveys treatment tank effluent to the disposal area. Disposal areas are generally gravity fed, but in instances where the disposal area is at a higher elevation than the treatment tank, pumping is required. The drop in elevation between the treatment tank outlet and a gravity fed disposal area is important. Sufficient drop is required to prevent a septic tank from backing up during periods of stress and causing the liquid level in the septic tank to rise above the baffles. When the liquid level in a septic tank rises above a conventional baffle, there is an opportunity for solids to flow unrestricted to the disposal area, potentially causing a failure. The greater the elevation drop between the septic tank outlet and the disposal area, the lower the possibility of solids reaching the disposal area by flowing over a conventional septic tank baffle during stress periods.

DISTRIBUTION BOX

A distribution box is utilized to ensure the uniform use of the entire disposal area(s) if more than one disposal line is required in a disposal area, or when using more than one disposal area in an equal distribution system. Distribution boxes also can serve as inspection ports for the evaluation of solids carryover or to view liquid levels in a disposal area, and to reduce the velocity of effluent flow in a pumped system.

A distribution box is a small tank with a single inlet and several outlets approximately 2 inches below the inlet (see Figure 5).

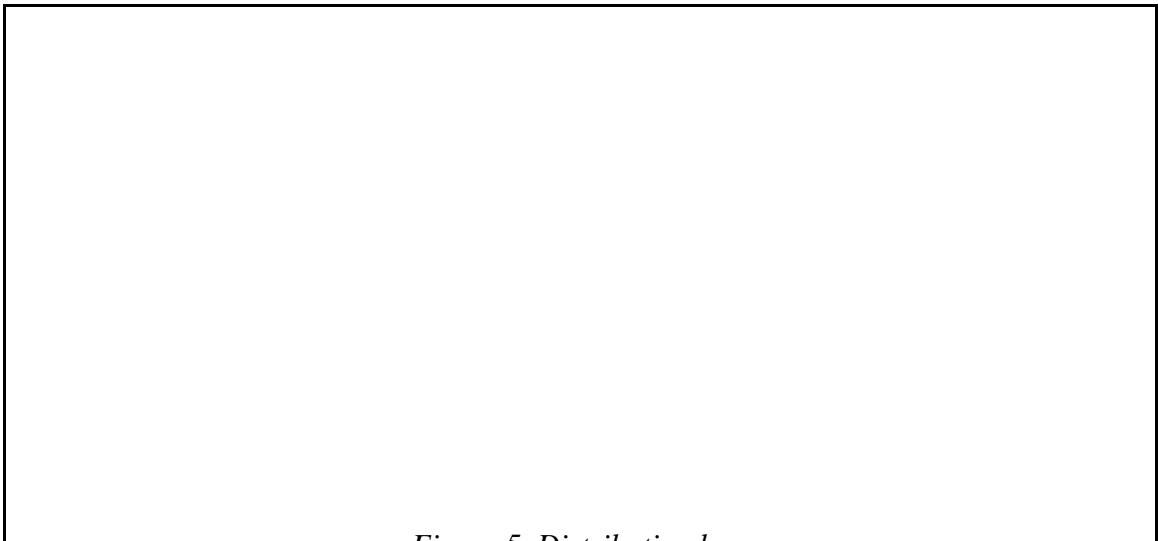


Figure 5. Distribution box

Distribution boxes can range from a small 3-outlet box to larger ones containing many outlets. The distribution box may also be fitted with a valve system which allows part of the disposal area to be utilized while the remainder is allowed to rest (diversion box). Resting part of the disposal area or one disposal area/trench will allow for bacterial and chemical decomposition of solids that have clogged soil pores, if sufficient time is allowed.

A distribution box is very useful when inspecting a failing disposal system to determine liquid levels, waste loading, solid carryover, and distribution patterns for possible problems. However, distribution boxes are prone to frost heaving which can potentially cause them to go out of level, resulting in unequal distribution of the flow. A common alternative to a distribution box is a plastic *tee* fitting or a manifold pipe. The use of a plastic *tee* fitting reduces the potential of frost heaving but eliminates a possible inspection port. Freezing can also be a problem, especially in cold winter months with no snow cover. Insulating the cover of distribution or diversion boxes is recommended. Connecting the effluent line to enter the distribution box from underneath is a method to help prevent freeze-up problems.

DISPOSAL AREA

A **disposal area** is the component which is comprised of stone, or proprietary leaching devices, and is designed to transmit wastewater into the surrounding soil. The partially treated wastewater from the treatment tank is discharged into the soil at a shallow depth by means of a disposal area (see Figures 6, 7, 8, 9, 10, 11 and 12 for examples). The disposal area serves to: absorb the effluent load from the treatment tank, provide a temporary storage area during periods of large water use, and additionally treat the effluent.

Soil Treatment of Wastewater

The soil, into which the effluent is discharged, serves three purposes: distributes and absorbs the effluent; provides microorganisms and oxygen for the treatment of the unstable compounds, bacteria and solids; and allows chemical and cation exchange reactions which remove nutrients from the wastewater.

When effluent exits the septic tank it is anaerobic. It is only partially treated and contains many solids, numerous anaerobic bacteria, viruses, and unstable compounds. Effluent from the septic tank must become aerobic before complete treatment is obtained. Effluent contains anaerobic bacteria and viruses as it moves into the soil area. The population of these organisms is reduced by exposure to an unfavorable environment in the surrounding soil media. Physical filtration of bacteria and viruses is not very effective because they readily pass through soil pores. However, filtration of the organic matter at the soil interface tends to restrict the food supply of bacteria. Aeration of the wastewater as it moves through the soil tends to create an environment hazardous to the survival of anaerobic organisms. The soil

may also contain some organisms that are toxic to the bacteria and viruses. Wastewater entering directly into a seasonal water table does not have adequate treatment other than dilution. The *Subsurface Wastewater Disposal Rules* require that a proper separation distance between the bottom of the disposal area and the seasonal high groundwater table be maintained to assure adequate treatment by providing a zone of aeration.

Distribution Piping

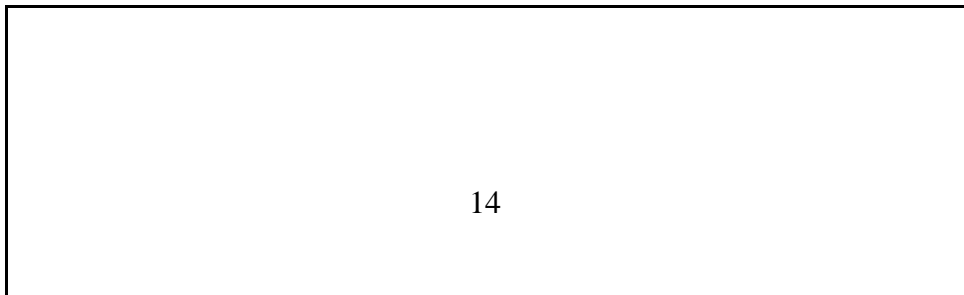
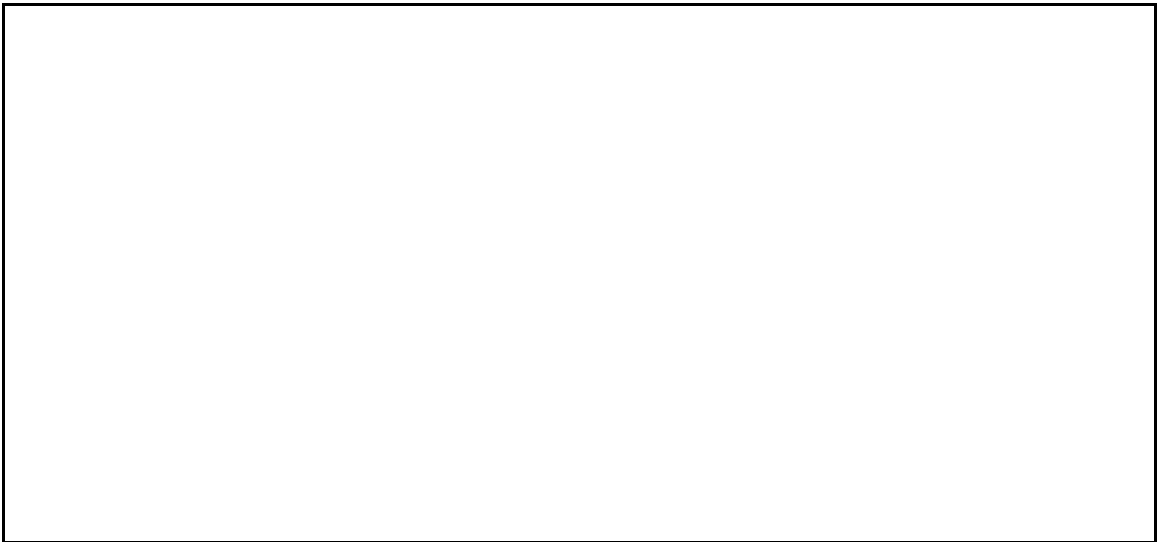
The *Subsurface Wastewater Disposal Rules* require distribution piping within all stone disposal areas (beds and trenches). Their purpose is to provide for as even a distribution of effluent as is practical, throughout the disposal area(s). Gravity flow systems have larger diameter pipes while disposal areas that receive wastewater from pumps with pressure distribution throughout the entire area have smaller diameter pipes. For low pressure dosed disposal areas, piping size, spacing, orifice opening diameter, and number are determined by calculations. The *U.S. Environmental Protection Agency's Design Manual for On-site Wastewater Treatment and Disposal Systems (EPA 625/1-80-012)* is a good reference in making these calculations.

Stone Bed Disposal Area

A stone bed disposal area acts as an underground retention area for effluent. Crushed stone (3/4 to 2_ inches in diameter) is used in the construction of a bed to provide void space for the storage of effluent and to allow it to drain into the surrounding soil (see Figures 6 and 7).

Sizing disposal beds is accomplished, by multiplying the design volume of wastewater, expressed in gallons per day, times the size rating parameter determined by the soil profile classification. This will be discussed in more detail in Chapter III.

Beds can vary in width. Narrow beds are more advantageous than wide beds because they increase the sidewall area relative to the bottom area which allows for a freer exchange of oxygen beneath the disposal area. A more aerobic environment results in development of a thinner biologic mat and correspondingly longer disposal area life span. Groundwater mounding is also less likely to occur in narrow beds than in wider beds. Narrow beds are particularly advantageous for placement on steeper slopes because they reduce the amount of fill required on the downslope side. The advantages of wide beds are that they are more easily installed with mechanical equipment and require less overall area for installation than narrow beds.



Stone Trench Disposal Area

A stone trench disposal area is essentially a narrow bed, approximately 2 to 3 feet wide and constructed of the same materials as the bed disposal area. The trench system is only practical on sandy, well drained sites. The stone trench disposal area is more labor

intensive than a bed disposal area since it is not as easily suited to mechanized construction; requiring more backhoe time, more land area and manual labor. Trench systems, although unpopular in the late 1970's and throughout the 1980's and into the early 1990's, has become more popular because they do a better job of treatment after considering the underlying ground water table response. This topic is discussed in more detail in Chapter VII, *Special Considerations, Groundwater Mounding Analysis*. The sizing of these systems is discussed in Chapter III (see Figure 8).

PROPRIETARY LEACHING DEVICES

Proprietary leaching devices are pre-manufactured structures of concrete, plastic or other gravel-less material which are used to create a void area beneath the soil. They replace the stone and distribution lines in conventional bed or trench disposal areas, although piping is still required for low pressure dosed systems. In all other aspects, they are similar to stone beds or trench disposal systems, in design, use and function. The Division of Health Engineering requires each product manufacturer to develop an installation brochure as part of the product approval process. Installers should refer to the manufacturer's instructions for installation guidance.

Each proprietary leaching device is rated by percent equivalence to a stone disposal area system, expressed in square feet. Variability in square foot equivalent is also given for each device depending upon disposal area layout. A higher rating is allowed for narrow linear configurations as compared to wider configurations, due to an advantage in the increased sidewall area. The sizing of these systems is discussed in Chapter III.

The advantages of proprietary leaching devices over the conventional stone bed designs are:

- € reduced area need for installation by 25% to 75%

- € reduced fill volumes required for installation

- € can be removed and reused to create a new system if failure occurs

- € can be installed without stone, an advantage at remote, hard-to-access sites

- € can be configured in terraces, stepping down the natural slope of the land

- € can be manufactured with sufficient strength or designed so that they may be installed under parking lots or traffic-laden areas. (Systems designed for vehicular traffic must have an H-20 loading rate).

The disadvantages of a proprietary leaching device over the conventional stone bed disposal system may be:

- € a higher initial cost

- € requirement for special materials or installation techniques.

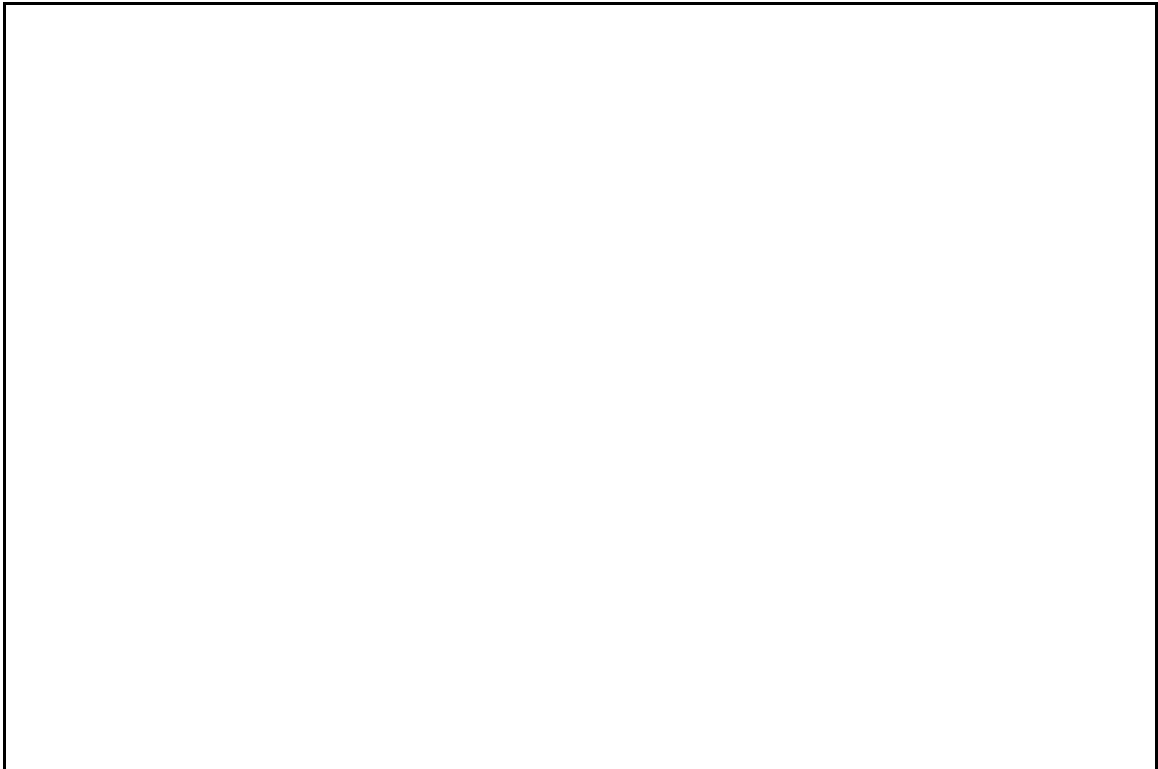
Concrete Chambers

Concrete chambers are rectangular-shaped devices which have four side walls and a top, but no bottom. They are installed using either trench or cluster configurations. Concrete

chambers are designed to store effluent discharged from a septic tank. Effluent then infiltrates into the soil beneath them. They can also allow effluent absorption through sidewall areas but only when installed in trenches and with stone applied to both sidewall areas. Concrete chambers are relatively heavy, requiring a lift truck to set them in place, but are quite strong and durable. These devices must meet the same siting requirements as stone beds. They must be installed per manufacturer's instructions (see Figure 9).

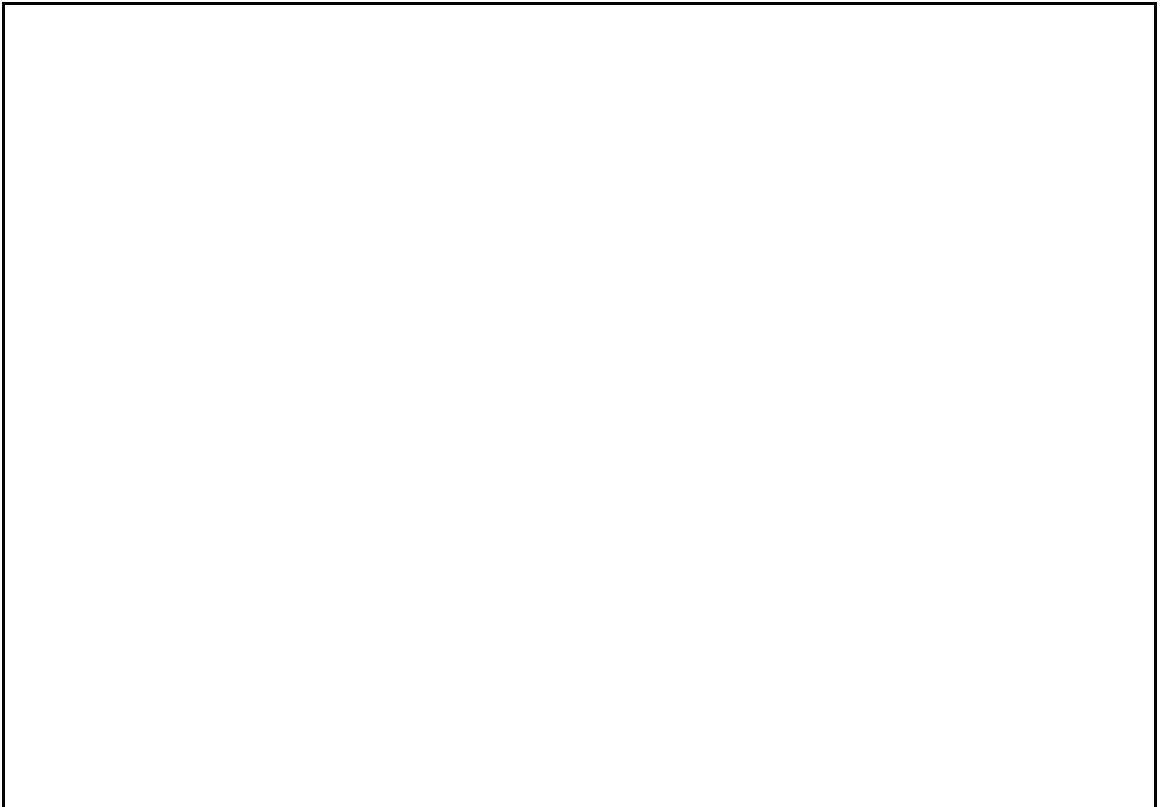
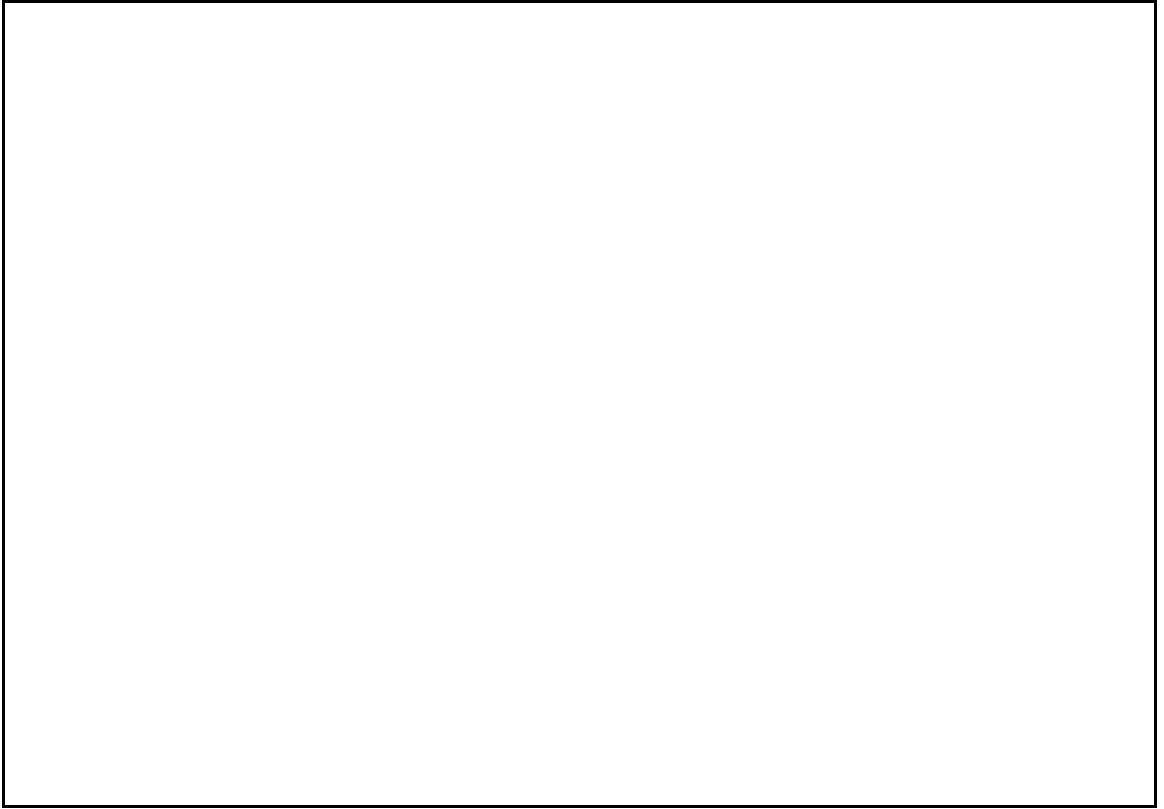
Plastic Chambers (Biodiffuser, Infiltrator, Contactor)

Plastic chambers perform the same function as concrete chambers but are lighter in weight and are designed to take advantage of sidewall area without the use of stone, when used in trench configuration. Some of these devices have numerous sidewall openings while others depend upon the wicking action of filter fabric. Plastic chambers can be used in either trench or cluster formation. More plastic chambers are required if they are used in a cluster configuration, due to decreased sidewall contact. Plastic chambers must meet the same siting requirements as stone beds and must be installed per the manufacturer's specifications (see Figure 10).



Plastic Tubing Systems (Geoflow, SB2)

Plastic tubing systems are designed to be installed as trenches because they rely heavily upon sidewall area. They have an advantage of being able to follow a contour more

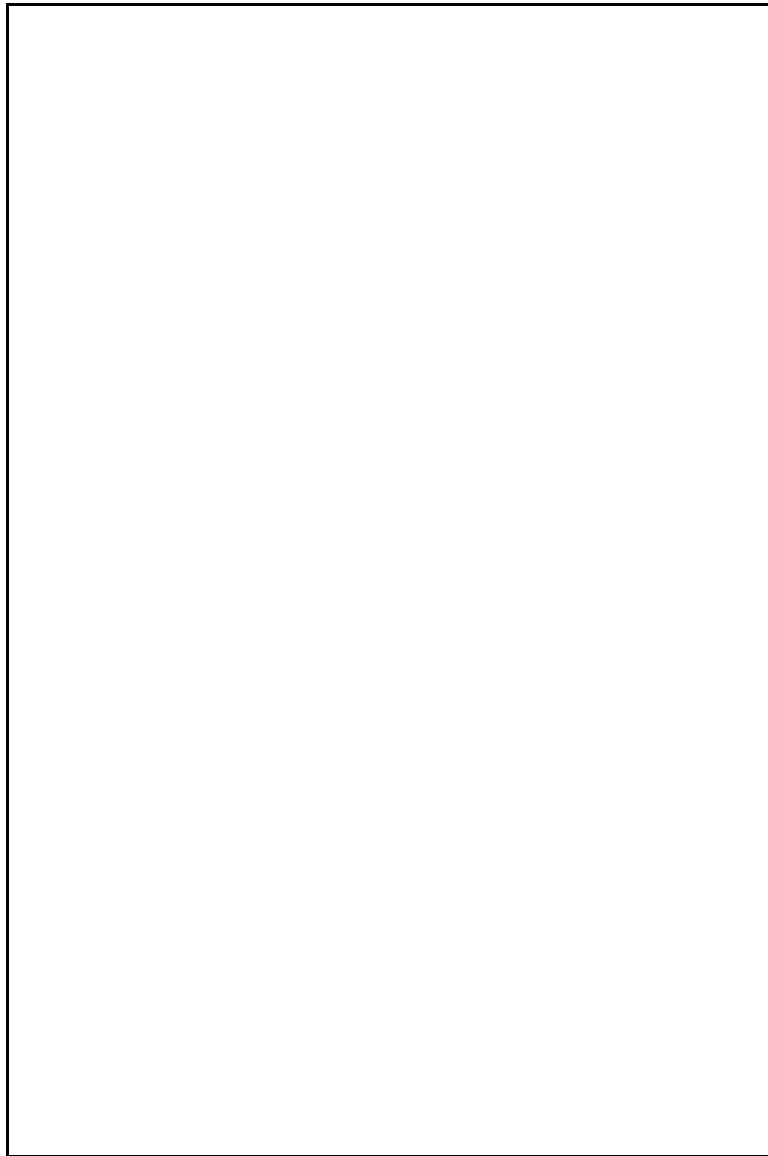


*Figure 11. Plastic Tubing System during construction
(photo by Thomas Caouette, Geo-Flow, Inc.).*

closely than other, more rigid systems. Plastic tubing systems must meet the same siting requirements as stone beds and must be installed as per the manufacturer's directions (see Figure 11).

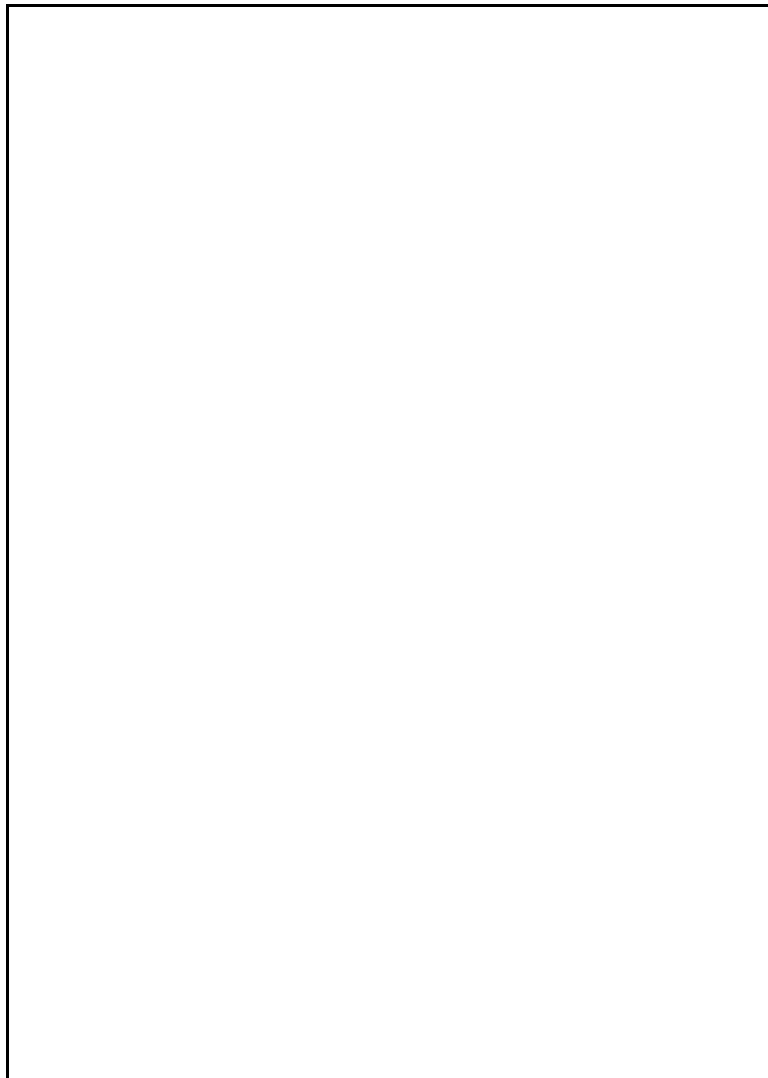
Eljen In-Drains

Eljen In-Drains are plastic devices that utilize a large surface area to treat effluent so that a relatively small infiltrative area is required. Effluent is primarily treated within multiple layers of plastic and filter fabric. This increases the long term acceptance rate of the soil. Eljen In-Drain systems must meet the same siting requirements as stone beds and must be installed per the manufacturer's directions (see Figure 12).



GRANDFATHERED DISPOSAL SYSTEMS

There are numerous *grandfathered* disposal systems still in use today. A *Grandfathered* system is one which no longer is permissible and was constructed prior to the existing *Subsurface Wastewater Disposal Rules*. A grandfathered system is permitted to continue to exist until the system malfunctions, at which time it must be upgraded to current standards (see Figure 13).



DISTRIBUTION SYSTEMS

Once effluent leaves a treatment tank, it must be directed to a disposal area by means of gravity flow, a pump or a siphon.

Gravity Flow

The preferred means of directing effluent to a disposal area for small systems is by gravity flow. Gravity flow eliminates the need for a mechanical device, which adds cost and has the potential to breakdown or become inoperative with a power outage.

The disadvantages to gravity flow are: it does not provide equal distribution of effluent throughout the entire disposal area and it must be directed to a disposal area located downslope of the effluent source.

Pumping

Pumping is necessary when the treatment tank outlet is lower in elevation than the proposed distribution line or when pressure distribution is required. Pumps raise the elevation of wastewater and allow it to enter a disposal area when gravity flow is not possible and provide for periodic dosage or pressure distribution. Pressure distribution results when dose volumes are matched with distribution pipe sizes and hole sizes in distribution pipes, so that effluent is forced into every part of the disposal area equally. Pump systems are more expensive than gravity flow systems. They also require electricity and periodic maintenance (see Figure 14).

Pumping stations should be sited in locations and at elevations which are not subject to either surface or groundwater infiltration. If this is not possible, provisions should be made to prevent infiltration by sealing and/or intercepting and diverting the water source.

Pumping is usually required when: 1) the suitable area is at a higher elevation on a parcel of land (for installation of a disposal area) and the elevation of the building sewer does not allow for gravity feed; 2) replacing an existing disposal area that can not flow by gravity from an existing septic tank because the original system had been placed in or very near to the seasonally high groundwater table; and 3) a pressurized or periodically dosed distribution system is desirable.

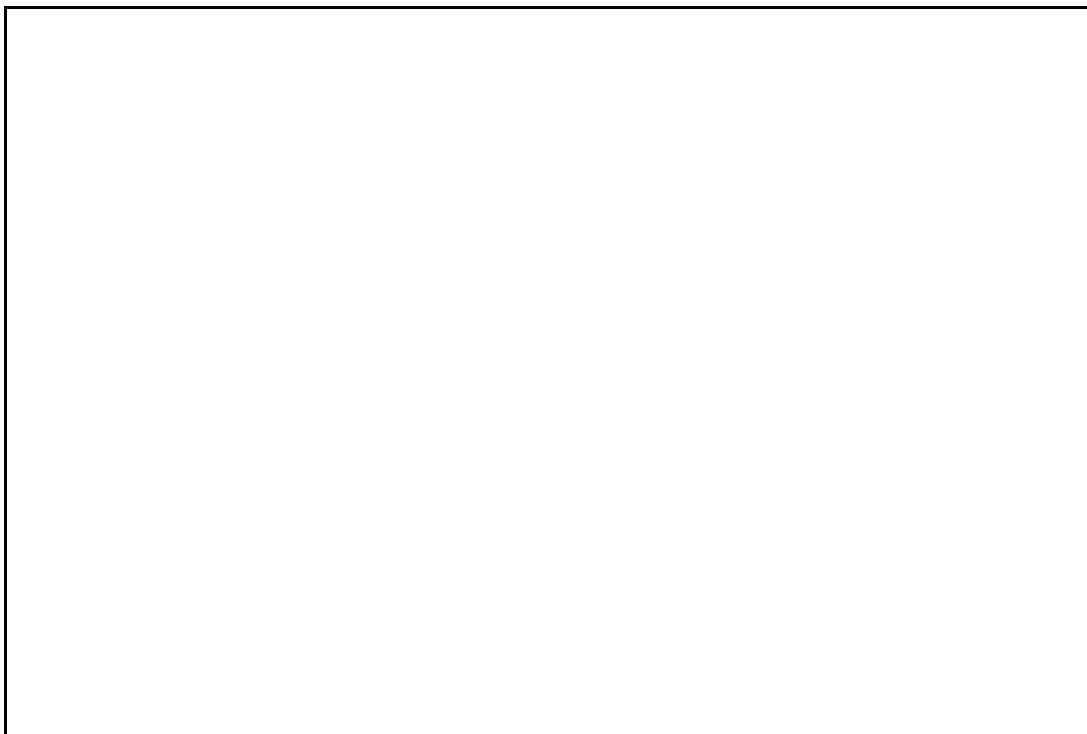
In systems which require pumping, an effluent pump is placed on the outlet side of the treatment tank or within the treatment tank to pump wastewater to the disposal area, after the solids have settled out. A sewage grinder pump or sewage ejector can be placed on the

building sewer drain to pump raw sewage, which contains solids, to a treatment tank. It is usually preferable to install an effluent pump when feasible rather than a sewage grinder pump or sewage ejector. Sewage grinder pumps and sewage ejectors are more costly than an effluent pump. They also require that the septic tank capacity be increased or a dual compartment tank be installed to provide for adequate primary treatment (see Figure 15).

Occasionally, a sewage ejector or grinder pump is installed within the basement of a structure to avoid setback conflicts associated with septic tanks. Care must be taken to utilize a pump, which has been properly sized, to accomplish the task of getting the wastewater to the desired elevation. Selection of the correct pump requires knowledge of head and friction loss calculations (see Figure 14).

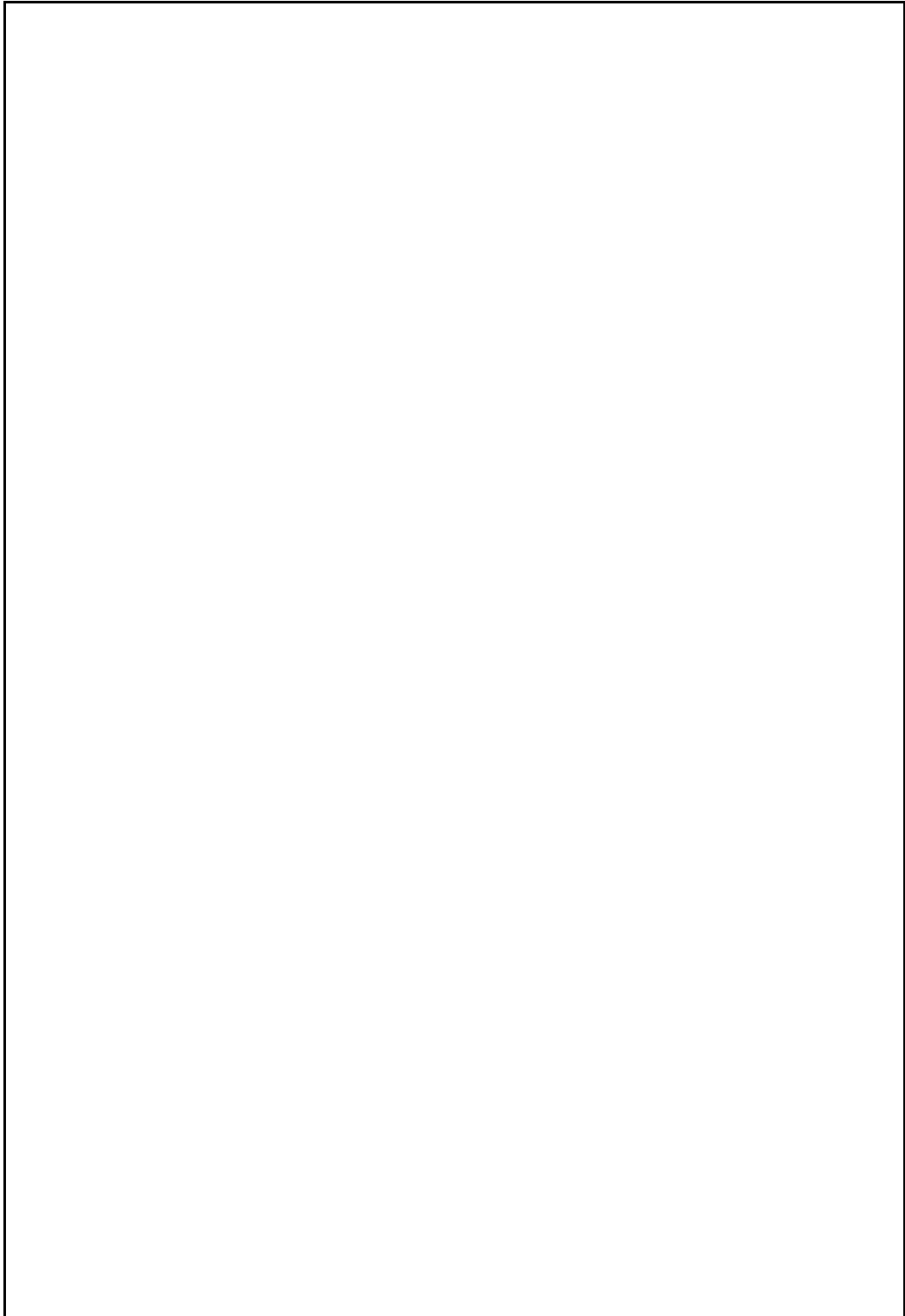
Siphon

A dosing siphon is non-mechanical and has no power requirements; however, it has no lifting ability and is relatively difficult to install properly and maintain. A dosing siphon only can be used when the disposal area is below the elevation of the outlet of the dosing tank. The advantage of dosing tanks is that they can provide for periodic dosage or pressure distribution to a disposal area(s), without electricity. Siphons are not commonly used in Maine.



SPECIAL SYSTEMS

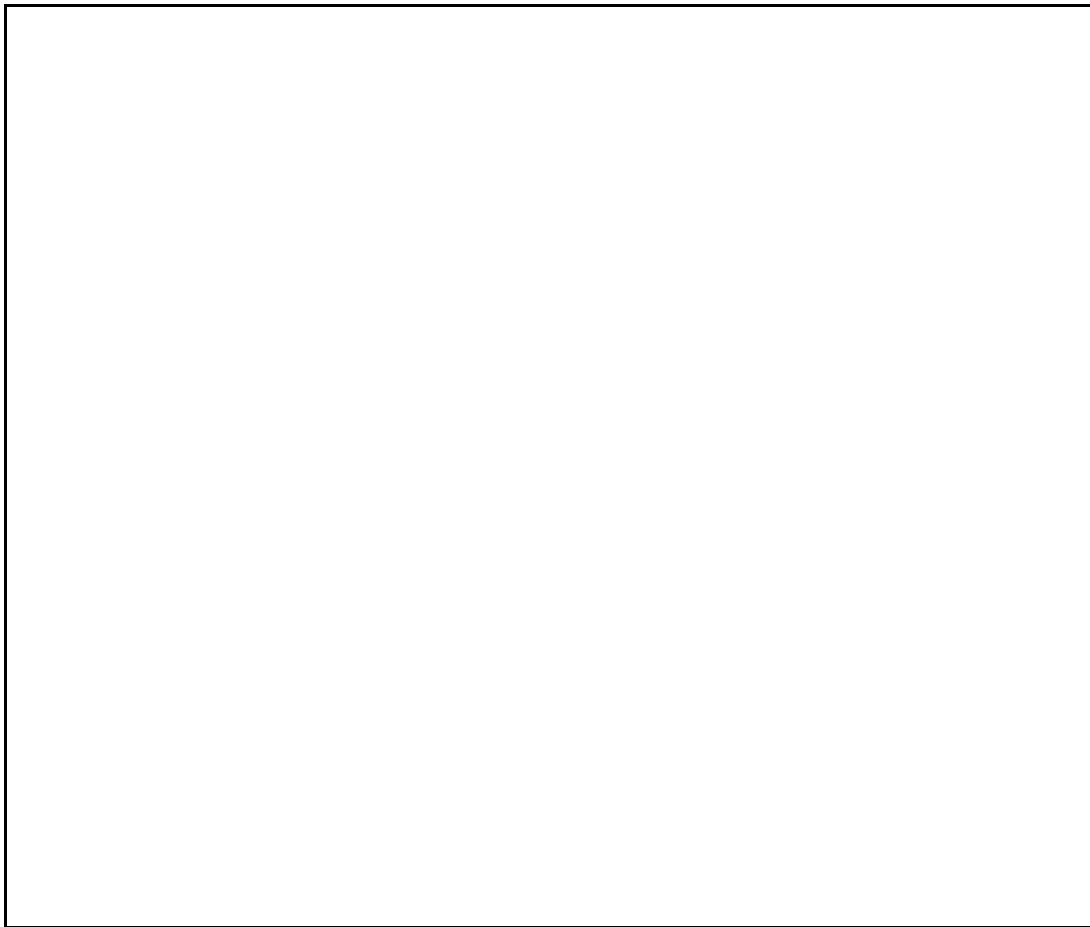
Systems which do not include all of the standard features of a subsurface wastewater disposal system, including building sewer, septic tank, effluent line and disposal area are considered special systems.



Alternative Toilets

Pit Privies:

Pit privies (commonly referred to as outhouses) are in-ground (soil based) systems designed to dispose of black wastewater only. They do not require piping or water for waste transport. Pit privies consist of an excavation below the ground surface or within fill, depending upon depth to limiting factor, and an enclosed vented building. Accumulated waste materials need removal from the excavation and then should be disposed of in an approved manner (see Figure 16).



Sealed Vault Privies:

Sealed vault privies are similar to pit privies in all respects except that the enclosed building sets upon a water tight tank. Black waste is directly deposited into the tank which must periodically be emptied in an approved manner. They are typically used at sites where soil-based systems can not be installed (see Figure 17).

Wet Willeys:

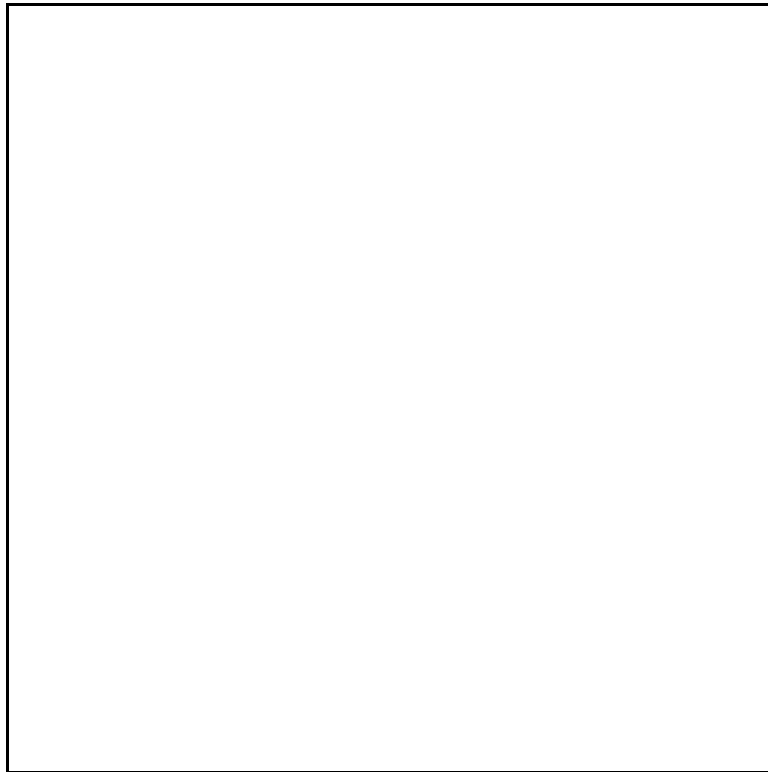
Wet willeys are basically pit privies, without an enclosed building. They are intended to be used only in remote, lightly-used, primitive campground or backpacking areas which are under the jurisdiction of the Maine Bureau of Public Lands. Wet willeys are comprised of a small excavation over which a seat with a hole in it is placed.

Composting, Incineration and Peat Toilets:

There are several waterless toilets **approved** for utilization in the State of Maine. Please refer to the *State of Maine, Subsurface Wastewater Disposal Rules* for the complete list of approved alternative toilets (see Figure 18).

Holding Tanks

Holding tanks are water tight receptacles for the temporary storage of black and/or gray waste water. Their use in Maine is restricted to situations where subsurface wastewater disposal is not possible or practical. Holding tanks are relatively expensive to maintain if they are subject to continual or large wastewater volume generation.



Gray Water Systems

Gray water disposal systems are designed to treat and dispose of only gray water. The construction of these systems is identical to combined waste systems in that they require a building sewer, septic tank, effluent line and disposal area.

Laundry Disposal Areas

Laundry disposal areas are designed to treat and dispose of gray water only from washing machines from residential dwellings. They do not require a septic tank but in all other aspects are similar to disposal systems for combined wastewater treatment. Though a

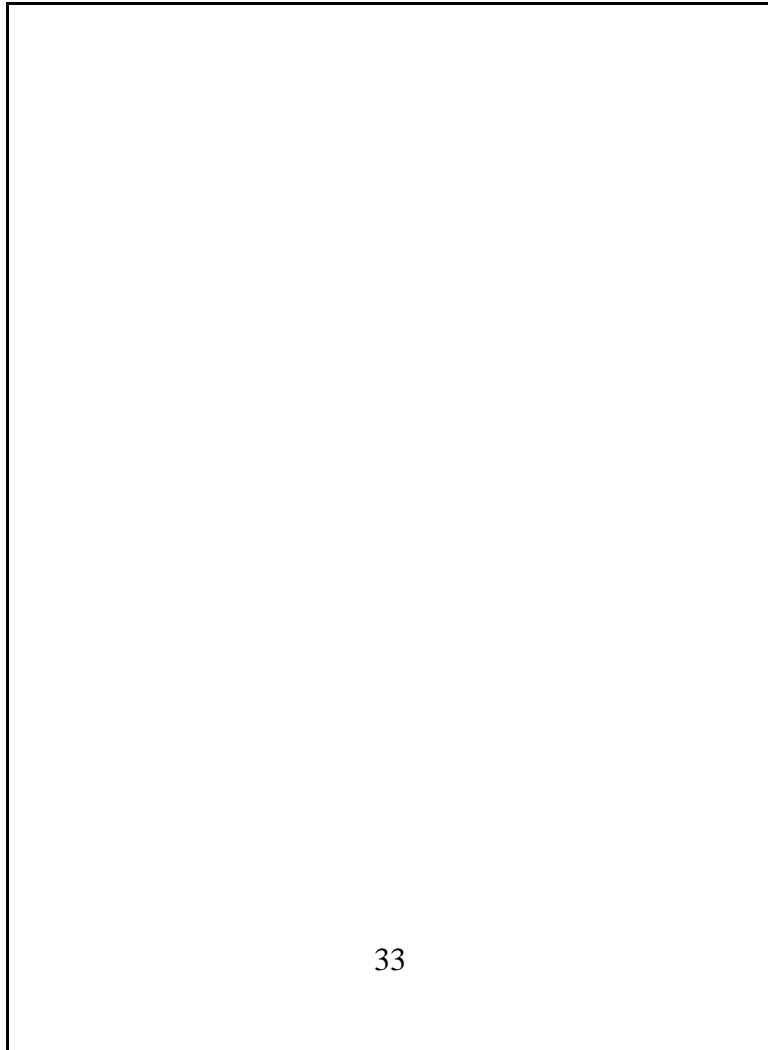
treatment tank is not required, it is recommended that a lint filter be used with laundry disposal systems.

Temporary Alternative Toilets

Portable chemical toilets, chemical privies or holding tanks may be used for fairs, carnivals, mass gatherings, encampments or other locations where people congregate for short periods of time, provided approval is first obtained from the Local Plumbing Inspector.

Primitive Disposal Systems

Primitive disposal systems are systems that are designed to dispose of gray waste from a plumbing fixture such as a sink or shower that is served by water which is hand carried or hand-pumped. They are based upon a minimum design flow of 25 gallons/day per fixture, for up to 3 fixtures, and can not rely upon an energy source for providing water. They do not require a septic tank and must have a building sewer/effluent line no greater than 2 inches in diameter. Primitive systems require location of a full-sized system reserve area in the event that pressurized water is desired in the future.



Peat Filters and Beds

Partially decomposed sphagnum moss, commonly referred to as peat, is a recognized medium for the treatment of septic tank effluent and is allowed by the State of Maine, Subsurface Wastewater Disposal Rules in the design and construction of disposal areas and pretreatment filters. Unique features of peat systems are:

- € wastewater treatment occurs in the peat itself, by microscopic fungi;
- € the clogging mat is not as hydraulically restrictive as in other types of disposal systems;
- € water movement occurs throughout the entire disposal field, in all directions;
- € they provide for greater nitrate reductions than in other types of disposal systems.

The Subsurface Wastewater Disposal Rules provide specific directions for the design and installation of peat disposal areas and pretreatment filters.

II SITE EVALUATION

SYNOPSIS:

This chapter discusses elements considered in evaluating a potential subsurface wastewater disposal system site. This section should be of particular interest to site evaluators and local plumbing inspectors. This chapter also can provide background information to excavating contractors, planning board members, regulators, and property owners.

TOPICS:

Site evaluation practice, field equipment, Minimum Lot Size Law, water body classifications, setbacks, fill calculations, design and field layout, elevation reference point

The practice of Site Evaluation is both an art and a science. It is an art in that the Site Evaluator must work simultaneously to design a disposal system that meets minimum code requirements, fit the design in with the natural landscape, and accommodate the property owners needs and interests. It is a science in that the Site Evaluator must be knowledgeable about soil science principles to make judgements regarding soil suitability for subsurface wastewater disposal and system design parameters. A Site Evaluator must be part engineer in order to accurately determine design flows, wastewater quality, and to properly design a disposal system in compliance with the Rules. Also, a Site Evaluator should work to accommodate the owners specific needs and usage patterns. The Site Evaluator must be very familiar with the *State of Maine Subsurface Wastewater Disposal Rules*, including policies developed by the Department of Human Services, Division of Health Engineering, Wastewater and Plumbing Control Program which is the State agency that has statutory jurisdiction over subsurface wastewater disposal in Maine. All these disciplines are applied as a Site Evaluator evaluates each parcel of land with it's own unique set of characteristics and limitations.

The most efficient and effective way to conduct a site evaluation is for the Site Evaluator and applicant (property owner, prospective buyer, real estate agent, developer) to meet on the lot. In this way, the Site Evaluator can work more closely with the applicant to meet his or her needs, as well as, explain why a preferred option may or may not be feasible, and allow the applicant to select from remaining alternatives. At a minimum, the Site Evaluator and

applicant must communicate so that the applicant's needs are fully understood by the Site Evaluator. It can also be beneficial to invite the Local Plumbing Inspector to the on-site investigation so that he or she can become familiar with the site and can answer questions regarding local ordinances or requirements which may arise. Some towns have adopted an ordinance requiring that the Local Plumbing Inspector be notified of scheduled on-site investigations. The Site Evaluator and Local Plumbing Inspector working together in the field make the permitting process smoother, particularly on difficult or controversial sites.

FIELD EQUIPMENT

Proper equipment is necessary for a site evaluator to perform his or her duties correctly. At a minimum, the following items should accompany the site evaluator to each job site:

Equipment to establish disposal area elevations relative to an Elevation Reference Point and to determine ground slope (see Figure 20).

Examples are:

- € tripod mounted level
- € transit
- € pop or hand held level
- € abney level

Equipment for excavation will be necessary regardless of whether or not power equipment is available for a particular job or jobs. The site evaluator is often required to verify the extent of suitable soils, check for bedrock depths, or observe soils in locations not accessible to power equipment.

Examples are:

- € tiling spade or sharpshooter shovel
- € standard spade
- € screw or bucket auger
- € steel sharpshooter shovel for working in frozen ground
- € crowbar for working in frozen ground/remove rocks/excavate hardpan layers
- € tile probe

Other equipment should include:

- € A measuring device, such as a pocket tape measure or six foot fold-out rule, to measure depths of soil horizons and other morphological features.
- € A measuring tape (100 to 300 feet) to lay out disposal bed and record pertinent horizontal distances.
- € A hip chain is useful on large, wooded sites, when working alone, for distance measurement.
- € A soil probe to check soil consistency, restrictive layers, and to obtain soil samples to determine soils texture and provide closer observations of soil wetness features. Typical soil probes include:
 - knives
 - screw drivers
 - pocket penetrometer
- € Nails to use for elevation reference points in trees, poles or other permanent marker.
- € Flagging to mark trees, poles or other features used as swing ties or other measuring points, including property lines and corners of the disposal area.
- € Wire flags or stakes to mark the corners of a disposal area and/or other disposal system features.

€ A machete or axe to clear brush, trees, etc. which would otherwise interfere with laying out a disposal area or obtaining measurements. An axe can also be used to drive nails into trees, poles, etc.

- € A clip board to place papers and/or forms on, as well as provide necessary support to write on. The clipboard is ideally one with a cover, to provide protection during inclement weather, and pockets for forms and other such materials.
- € Copy of the **State of Maine Subsurface Wastewater Disposal Rules**.
- € Information regarding **Permit-By-Rule** and **Natural Resource Protection Act Permits**, available from the **Maine Department of Environmental Protection**.
- € Information on the various types of subsurface wastewater disposal areas and septic system products. These can be referenced when designing or choosing a system design and to inform home owners of different products, and their specific requirements.
- € The **Munsell Soil Color Book** is valuable for evaluating soil colors and referring to for proper soil color terminology. This book is also useful to help determine the wetness class of a soil, and in identifying wetlands.
- € Copy of the *Maine Association of Professional Soil Scientists Soil Drainage Key* is also required for determining the drainage class of soils with thick plow layers.
- € Wetland Identification criteria is also helpful, particularly if the site evaluator is determining appropriate wetland setbacks. Copies of **U.S. Army Corps and Maine Department of Environmental Protection Wetland Rules and Regulations** should be available for reference.
- € Copies of published **Soil Surveys** for the county in which work is to be conducted. These are helpful in understanding the general soils of a property. They are available at Soil and Water Conservation district offices, located in most counties.
- € Copies of 7_ minute **U.S. Geologic Survey topographic maps** for the areas where a site is located. These are needed to determine whether any water course encountered is a major or minor water course.
- € Some Site Evaluators prepare field work forms to take with them when conducting field work. Such forms are particularly useful for assuring that all the necessary information is obtained during the first field visit. It is time-consuming and expensive to make repeat visits, due to simply forgetting some piece of information or a measurement.

€ Copies of well release forms, sample easement language and notification of intent to install a disposal system forms are also handy to have on hand.

LOCATION OF THE PARCEL OF LAND

Local Plumbing Inspector's and other reviewers of a parcel of land may not always be familiar with it's location. Therefore, it is necessary to include a site location map on the subsurface wastewater disposal application. Pertinent landmarks and intersections are noted with distances between them. For new system variances, a copy from a topographic sheet or the **Maine Atlas** is also required, showing the site location.

ARRANGEMENTS AND AGREEMENTS

In order for a Site Evaluator to conduct a successful on-site investigation, prior arrangements and agreements must be made. These include date and time of the on-site, whether or not the applicant or their agent will meet the Site Evaluator at the property, method for excavating test pits, who will notify **Dig Safe** (if applicable) regarding use of mechanized equipment, scheduled date for completion of necessary forms, fees charged and what they cover, research of local ordinances that may impact the proposed use of the property, and permits which may be required from local or State agencies. Both the Site Evaluator and applicant should reach an agreement regarding scope of services prior to the initiation of an on-site investigation. (For additional information on **Dig Safe**, see Chapter V.)

SITE SELECTION CONSIDERATIONS

There are many variables which must be considered by a Site Evaluator when selecting a site for a subsurface wastewater disposal system on a parcel of land. These include unique site characteristics or limitations, the applicant's needs or interests and compliance with the *Subsurface Wastewater Disposal Rules*. At a minimum, the following must be considered when selecting a disposal system site:

Size of Lot

The size of a parcel of land will have a direct bearing upon the selection of a site for a disposal system. Small lots have sites with limited potential due to setback limitations, particularly if a structure is already located on the property. The Site Evaluator should note property line bearings and dimensions. If possible, a copy of a plot plan or tax map should be used.

Type of Proposed Development and Size

In order to properly design a disposal system, it is necessary to determine the size and type of development proposed. For example, is the proposed development a single family dwelling (2 bedrooms), restaurant (30 seat capacity), apartment complex (30 units), and what

are the characteristics of the wastewater, if different from normal domestic wastewater?

Land Use Considerations (Proposed, Future)

Consideration should be given to future or existing land use activities on the property when siting a disposal system. Garden plots, firewood storage, vehicular traffic, potential building expansions, future swimming pool location, and other activities may affect layout of the system to some extent.

Applicant's Needs or Interests

The Site Evaluator should determine if there is a conceptual development plan with regards to road access, driveway and parking layout, type and proposed elevation of foundation (e.g. slab, crawl space, full foundation, daylight basement, walk-out basement, and grading schedule to help to determine a feasible site. It may help to determine the desire for internal plumbing in the basement floor in order to try to meet gravity flow.

Generally, the applicant will have a preference where the building should be located, if soil conditions will accommodate. First consideration should be given to the desired location. However, if limited suitable soils are available, the Site Evaluator may have to recommend alternative plans for the applicant so that the disposal system can be sited in accordance with the Rules. The Site Evaluator also should discuss disposal system options with the applicant so he/she can provide input into selecting an appropriate design. For example, the applicant may prefer to pump to a distant site as compared to having an above ground disposal area that will appear as a mound on the property near the development.

Zoning and Local Ordinances

A Site Evaluator must be aware of local ordinances and town zoning. Some communities have adopted local ordinances that are more stringent than the State's Rules regarding setback distances and minimum soil conditions, and have passed ordinances requiring that the Local Plumbing Inspector be notified of any scheduled on-site visit so that he or she may attend, if scheduling permits. There may be the need for additional local and State permits regarding either soil testing or installation of the disposal system. It is the Site Evaluator's professional responsibility to notify the property owner of the potential need for any known additional permits associated with a subsurface wastewater disposal system installation.

Easements

There are instances when an easement on abutting land, with suitable soils for installation of a disposal system, is required for proper wastewater disposal. An easement must be filed in the Registry of Deeds so that a disposal system can be installed and maintained on the consenting abutter's property. Permission from abutting land owners should be secured prior

to any soil testing or site work to avoid problems with trespass.

Minimum Lot Size Law

The Division of Health Engineering, Wastewater and Plumbing Control program also administers the Minimum Lot Size Law. This law states that no person shall dispose of wastewater from any single family residential unit by means of subsurface wastewater disposal unless such lot of land contains at least 20,000 square feet. In addition, for properties which abut waterbodies, 100 feet of frontage is required for each 300 gpd of wastewater generated. An exception is made for lots of record which contain less than 20,000 square feet, but which meet all other requirements of the Rules. For multiple unit housing or other land use activities, the lot must have 66.66 square feet of land area for each gallon per day of wastewater generated, and one foot of shore frontage for each 3 gpd of wastewater generated. Applications for waivers are needed if the required lot size versus wastewater generation ratio can not be achieved for the proposed use, and the lot is not grandfathered.

Example: A commercial development proposed to generate 750 G.P.D. would require a minimum lot size of 50,000 square feet (750 x 66.66). If that same development was on a waterbody, 250' of frontage would be required (750 ÷ 3 = 250').

Location of Water Bodies

It is the responsibility of the Site Evaluator to locate and classify all waterbodies on a property within 100 to 300 feet of the proposed disposal system and to ascertain whether they are major or minor waterbodies. Major waterbodies, those which are depicted on a 7.5 minute U.S.G.S. Topographic Map, require further setbacks from disposal system components than minor waterbodies (those not depicted on a 7.5 minute U.S.G.S. Topographic Map). The Site Evaluator must also locate all drainage ditches and drainage swales for appropriate setback purposes.

It is also the responsibility of a Site Evaluator to locate proposed disposal areas outside of wetlands and an adequate distance back from the wetland edge, as regulated by **U.S. Army Corp** and/or **Maine Department of Environmental Protection**. All wetlands are regulated by Maine DEP and require a minimum of a 25 foot buffer, except for replacement disposal system installations, when no practical alternative exists. In addition, no fill material may be eroded into the wetland. If the Site Evaluator is not adequately trained to identify and

delineate wetland boundaries, he or she should inform the applicant that work conducted is contingent upon an opinion rendered by a trained wetland professional as to the delineation of the wetland boundary, so that setbacks can be measured or established. See the section on Wetlands in *Special Considerations* (Chapter VII) for further details.

Slope of Terrain

Disposal areas are permitted on slopes of up to 20 percent by the *State of Maine Subsurface Wastewater Disposal Rules*. Disposal areas must be sufficiently set back from steep downhill slopes to allow for proper construction of the disposal area and fill extensions.

Surface Drainage

Surface drainage characteristics must be taken into consideration in the design of a system for it to function properly. Position in landscape can be used to make assumptions about surface drainage. In general, the greater the contributing watershed, the greater the potential for surface drainage to impact a site. Other contributing factors are roof runoff, road or driveway runoff and runoff from landscaping activities. Consideration of runoff rate and direction is necessary for planning diversion ditch locations. It is necessary to divert surface water away from an area considered for wastewater disposal.

SETBACKS FROM WELLS

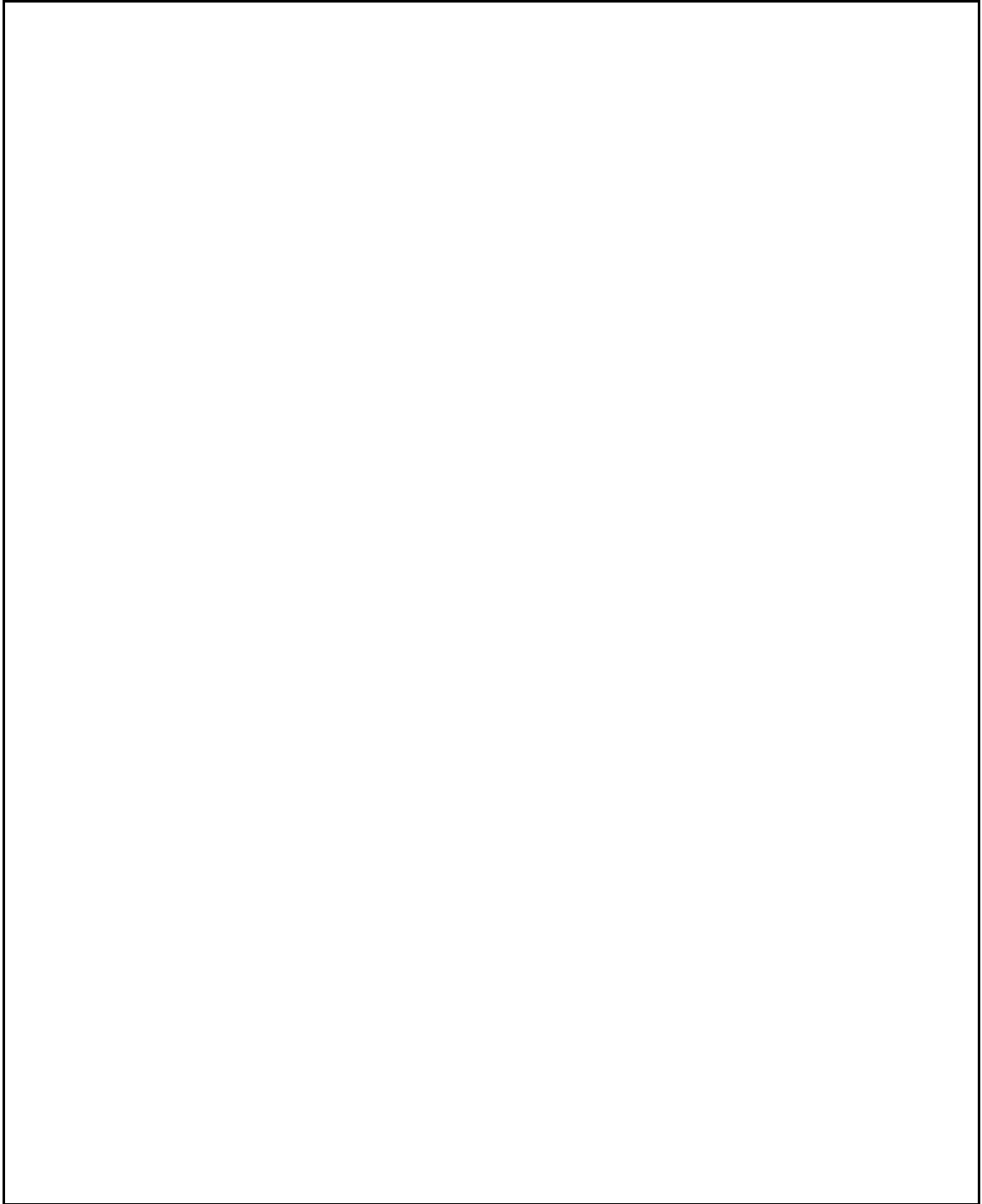
Disposal systems are required to be set back from wells and springs depending upon the wastewater disposal system size and well usage. The Site Evaluator must insure that the proposed location of the disposal system will not prohibit the property owner from having a reliable water supply on the property (see Figure 21). Consideration should be given to any limitations it may place upon abutting properties.

NATIVE VEGETATION

Native vegetation is often used as a general indicator of soil drainage conditions. Generally, the presence of alders, sedges, willows, cattails, and other vegetation typically found in wetlands suggest poor drainage conditions. The prevalence of tree throws and blow downs often indicate the presence of shallow soils or poor drainage. The presence of small knolls and depressions "micro relief" may indicate poorly to somewhat poorly drained conditions. An unexpected lack of vegetation may indicate droughty conditions, shallowness to bedrock, or disturbed soils. (See the discussion of wetlands in Chapter VII, *Special Considerations*, for more detail).

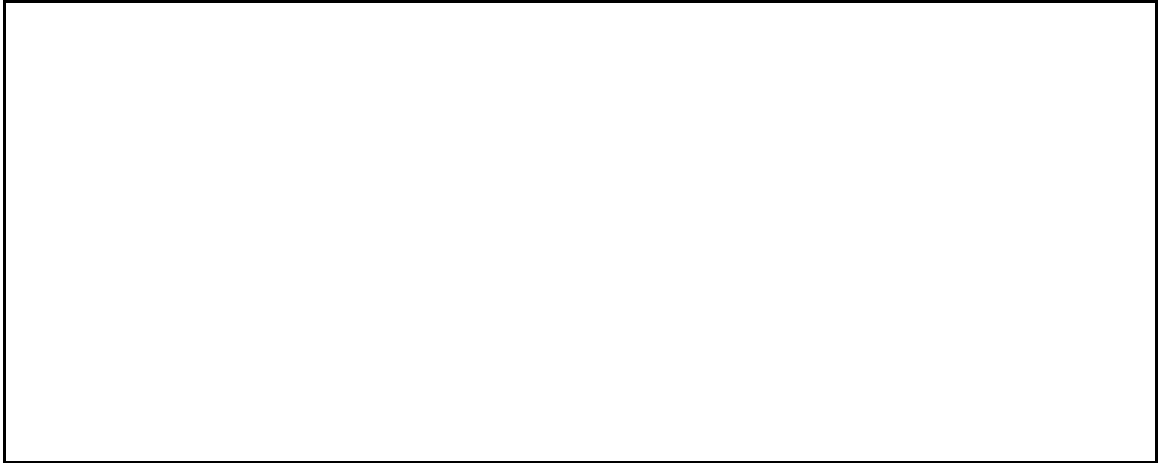
POSITION IN LANDSCAPE

An important consideration for the location of a subsurface wastewater disposal system is position in landscape. Sites on knolls are favorable because they have small contributing watershed and allow effluent to move away from the disposal area so that hydraulic overloading is not a likely threat. Sites in depressional areas typically are collection points for runoff and/or groundwater, and therefore hydraulic failure is a



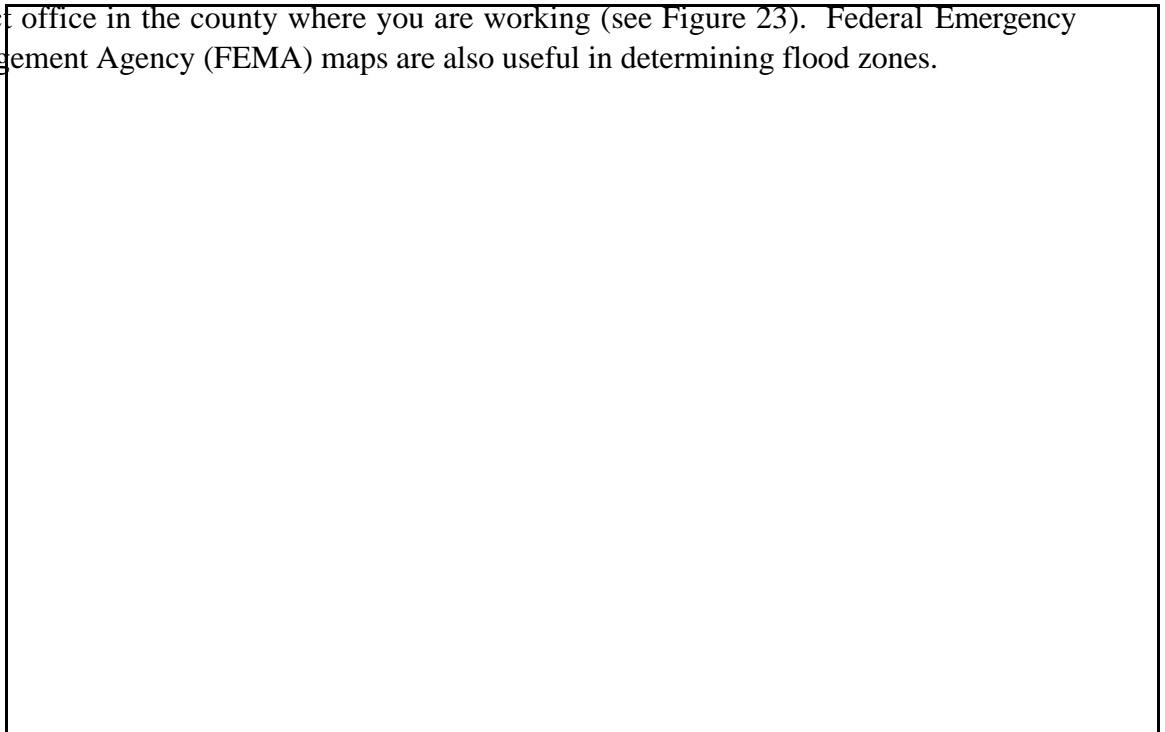
greater concern. Level sites located at the base of slopes may receive substantial runoff from upland areas. Side slopes, at the base of long slopes can also be subjected to large amounts

of runoff. Limitations of less favorable sites can be overcome by appropriate engineering techniques, if the limitations are correctly identified. Typically, curtain drains, surface water diversions and/or the use of fill are utilized to overcome runoff problems (see Figure 22).



FLOOD PLAINS

A Site Evaluator must be able to recognize flood plain zones (areas prone to seasonal flooding). System installation is prohibited or restricted on some flood plains. (See Chapter V, *Flood Plains* for more information). Referencing published soil surveys can be useful in determining where to expect flood plain soils. Contact the Soil and Water Conservation district office in the county where you are working (see Figure 23). Federal Emergency Management Agency (FEMA) maps are also useful in determining flood zones.



BEDROCK OUTCROPPING

Note outcroppings of bedrock because they typically indicate the presence of shallow soil depths in the vicinity of the outcrop. Landscape and bedrock surface contours can affect drainage conditions of shallow soils. A depression in the bedrock beneath the ground surface can collect groundwater to create poor drainage conditions in that localized area. Also, the potential to impact bedrock aquifers is significant when fractured bedrock is located beneath shallow soil cover. When bedrock is shallow or bedrock outcropping is prevalent, more than one test pit or soil probe should be used to determine representative soil depth conditions.

LOCATION OF OBSERVATION HOLES

A Site Evaluator must make soil observations within a proposed disposal area to determine soil conditions (see Figure 24). Professional discretion is used in determining the location and number of observation pits. Generally, shallow to bedrock or marginal conditions require several test pit evaluations. Larger disposal systems generally require a more comprehensive on-site soil review. Experience in field evaluation is useful for predicting soil characteristics with relation to landscape, geology, slope, and vegetation. Measurements to observation holes must be made on-site so that their accurate location can be shown on the site plan.

PUBLIC RELATIONS

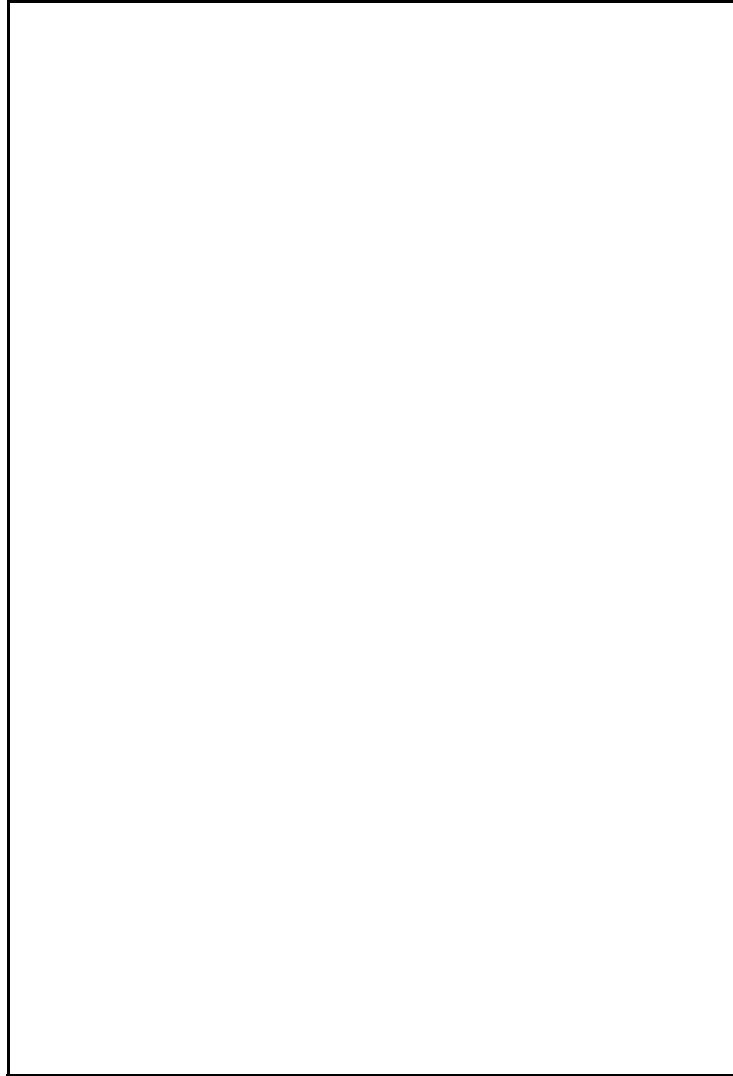
Site Evaluators should explain to the client what a site evaluation entails and the reasons for the investigation. It is important to discuss your field observations in relation to the requirements of the Rules so that the applicant gains an understanding of the site evaluation process. It also helps the Site Evaluator to maintain good public relations. The more information the client is given about the soil and site conditions, the more he or she can understand the disposal system design and construction needs. When more than one disposal system option is available, the client should be provided with sufficient information to make an informed choice.

DESIGN AND FIELD LAYOUT

The Site Evaluator should have a complete understanding of the proposed project before undertaking the investigation of site and soil conditions. The Site Evaluator can then select

the most appropriate system, based upon soil and site conditions, to meet the client's needs. Stakes or temporary markers are placed in the corners of the proposed disposal area to aid the contractor or developer in locating the site. Swing ties are taken for more permanent location of disposal field corners.

Systems parallel to the ground contour are preferable as they require less fill. Shallow, long, narrow systems take advantage of the more friable top soil horizons, reduce the potential for groundwater mounding, and have more sidewall area.



The Evaluator must record on the Subsurface Wastewater Disposal Application (HHE -200 Form), all of the pertinent features of the site which influence the design of the system. Important features (existing building wells, water bodies, test pits, property lines, etc.) are measured and located from permanent markers. The proposed corners of the disposal system are located by taking at least three measurements from 2 or more permanent, known, fixed control points (corner property marker, telephone pole, existing corner of building, tree that has been flagged and located and recorded as to type, diameter, etc.). A Site Evaluation is not complete until all of the necessary information has been gathered and reported on the soil and site characteristics.

ELEVATION REFERENCE POINT

An **elevation reference point (E.R.P.)** is required to indicate the finished elevation of a system. A permanent marker should be used for establishing a reference elevation. When there are existing dwellings or structures, the top of the building foundation or a concrete slab is a very good choice. On undeveloped lots, it is often times necessary to set an elevation reference point with a nail in a tree on the property or some other available permanent marker.

Establishing an elevation reference point is typically done with a hand level for small systems. A transit or tripod mounted level should be utilized if the system is large, the grade variations between sections of the disposal area are not within the eye level range of the Site Evaluator, and/or the proposed marker to be utilized as the elevation reference point is at a significant distance. A record of the point used must be recorded. If the point is a nail or some other type of marker, capable of being moved, then it is recommended that the relative height of the elevation reference point be noted. This height should be taken from the existing ground beneath it, so that any tampering can be easily detected.

A Site Evaluator must choose a location for the elevation reference point that will not be destroyed or disturbed during construction of the proposed area. If possible, the elevation reference point should not be within the limits of the disposal area fill extension.

SITE ACCESS

Access to the proposed site by trucks and heavy equipment necessary to construct the disposal system should be considered. If the site is not readily accessible with conventional equipment, due to distance between buildings, bedrock outcroppings, steep grades, drainages, etc., it should be noted on the plan and special considerations discussed. Also, other problems such as the need to acquire temporary access across abutting property, temporary repositioning or removal of outbuildings, requirements for hand-carrying, access in frozen conditions, temporary bridging, or other special considerations which are generally out of the ordinary, should be duly noted on the plans to advise applicant, contractor and inspector. Remote islands, small lots with limited spacing between buildings, and steeply sloping terrain are typical examples of special access problems.

III. SOIL EVALUATION

SYNOPSIS:

This chapter discusses basic principles of soil science, such as what is a soil, how to recognize and describe soil characteristics, and how to classify a soil for subsurface wastewater disposal purposes in Maine. This section should be of particular interest to site evaluators and should be of background interest to local plumbing inspectors, excavating contractors, planning board members, and property owners.

TOPICS:

Soil definition, soil profiles, soil formation, soil texture, soil structure, soil consistence, restrictive layer, wastewater movement in soil, soil parent material, seasonal water table, soil drainage classes, soil color, soil mottling, soil classification, disposal area calculations, fill calculations

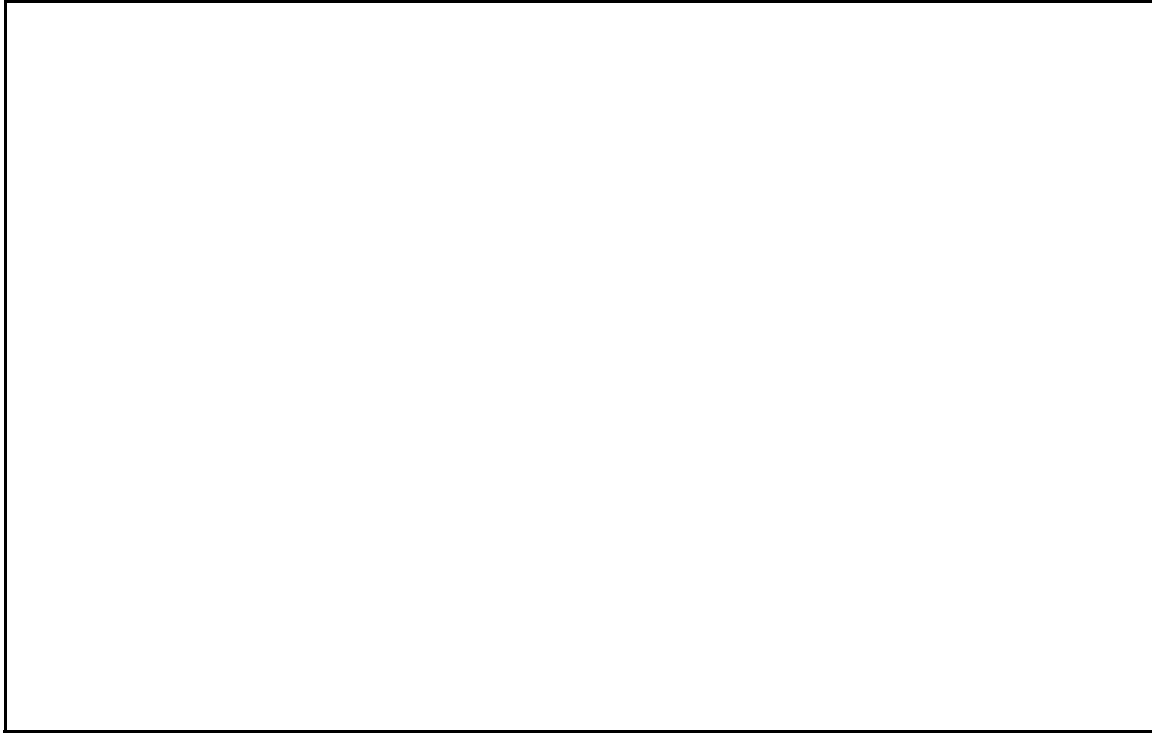
SOIL

Soil is the upper weathered and biologically molded part of the earth's crust that supports plant growth. Soil consists of solids, water and air. The average mineral soil is comprised of 50 percent by volume solids, of which approximately 45 percent is mineral and 5 percent organic. The remaining 50 percent is comprised of highly variable percentages of air and water which are subjected to great fluctuations (see Figure 25).

The mineral soil fraction is comprised of rock fragments and minerals which depend upon the type of material from which it was derived and the weathering environment. The organic portion is comprised of partially decayed and synthesized plant and animal residues. The soil solution contains small but significant amounts of dissolved solids; and is usually acidic in Maine due to biological activity and the type of vegetation.

Soil covers most of the land surface of Maine but it is highly variable both horizontally and vertically. The soil characteristics are influenced by the type of material from which it was derived (parent material), the climate, vegetation, topography and age. Local variations in soil conditions are usually due to variation in parent material and natural drainage conditions

which are related to its position in the landscape. Each soil has unique characteristics that make it possible to be identified and classified.



Individual soils are three dimensional. They may be few inches or several feet thick and are usually comprised of several layers (or horizons). Each horizon is identified by a combination of properties including color, texture, structure and consistence (density/firmness). Soil conditions can be relatively similar for extensive areas and can also be quite variable within several feet. Because of the possibility for variation within a very small area, the Site Evaluator must excavate a sufficient number of observation pits to assure that the conditions observed are indicative of the total area under the proposed system.

SOIL PROFILES

Soils are described by digging observation pits at least 12” below the limiting factor or until refusal and observing the exposed soil profile which consists of soil horizons. Soil horizons are differentiated by variations in soil characteristics (i.e. texture, structure, color, etc .). Site Evaluators should be primarily concerned with soil characteristics that influence the suitability of soils for wastewater disposal; although it is valuable for Site Evaluators to be familiar with the terminology used for soil descriptions in more sophisticated classification systems such as the **Natural Resources Conservation Service, U.S.D.A., Soil Taxonomy**. Horizons in soil taxonomy are classified using the combination of capital letters, **O,A,E,B,C**, and **R** along with lower case letters **a,e,g,h,i,m,p,r,s,w** and **x** as suffixes. All soil profiles have soil horizons, however, not all soil profiles will have all of the Master

Horizons. Recent soils, which have not had time to fully develop and disturbed soils are examples of soils which lack some of the Master Horizons.

Master Horizons

O Horizon: A layer of organic matter. Soils found in a forest or bog environment commonly have a surface layer consisting of leaves, twigs, humus or other organic material.

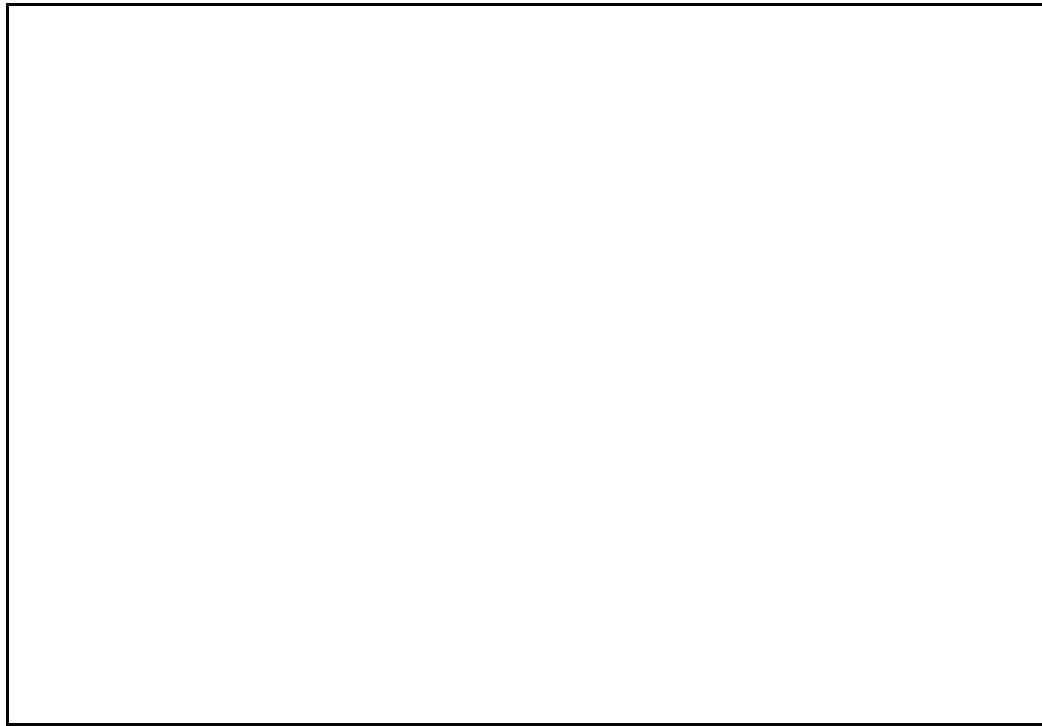
A Horizon: A surface mineral soil horizon characterized by a highly humified organic matter content intimately mixed with the mineral fraction. The A Horizon may have properties resulting from cultivation, pasturing or similar kinds of disturbance. When the A Horizon has been altered by cultivation, pasturing or similar kinds of activities, it is called an Ap (A plowed) horizon. An Ap horizon commonly is a combination of the O, A, E and parts of the B Horizons.

E Horizon: A layer of maximum leaching (eluviation) of iron, aluminum, and organic matter. The E horizon is usually lighter in color than the overlying or underlying horizons. An E Horizon is commonly found near the surface below an O or A Horizon and above a B Horizon. E Horizons are most commonly found in forested soils and are usually destroyed by cultivation. In cultivated or disturbed soils, the remnants of an E Horizon can be mistaken for low chroma (gray) mottles (spots or blotches different in shade or color from the soils predominant color that indicate periods of soil saturation).

B Horizon: The B Horizon generally forms directly below the E Horizon, when an E Horizon is present. In soils lacking an E Horizon, the B Horizon forms below the O or A Horizon. In soils where an E Horizon is or has been present, this horizon is characterized as the horizon of maximum accumulation (illuviation) of iron, aluminum and organic matter. A dark reddish brown to a yellowish brown color may be evident in the more developed B Horizons. In soils where an E Horizon has not developed, the B Horizon is usually more weakly expressed and may only exhibit color or structure development. These B Horizons are much duller in color than those that are strongly illuviated.

C Horizon: The C horizon consists of material from which the soil developed. It is typically unweathered but may have been slightly modified by weathering.

R Horizon: This symbolizes solid bedrock.



SUBORDINATE DISTINCTIONS WITHIN MASTER HORIZONS

- a** Highly decomposed organic material. Symbol is used with O.
- c** Concretions or hard nodules. Iron, aluminum concretions.
- d** Dense basal till usually associated with C.
- e** Organic material of intermediate decomposition. This symbol is used with O.
- g** Strong gleying. Indicates that iron has been reduced (oxygen removed) or that saturation with stagnant water has preserved a reduced environment. Gray and bluish gray colors prevail.
- h** Illuvial accumulations of organic matter. This symbol is used with B to indicate accumulation of dispersible organic matter, and

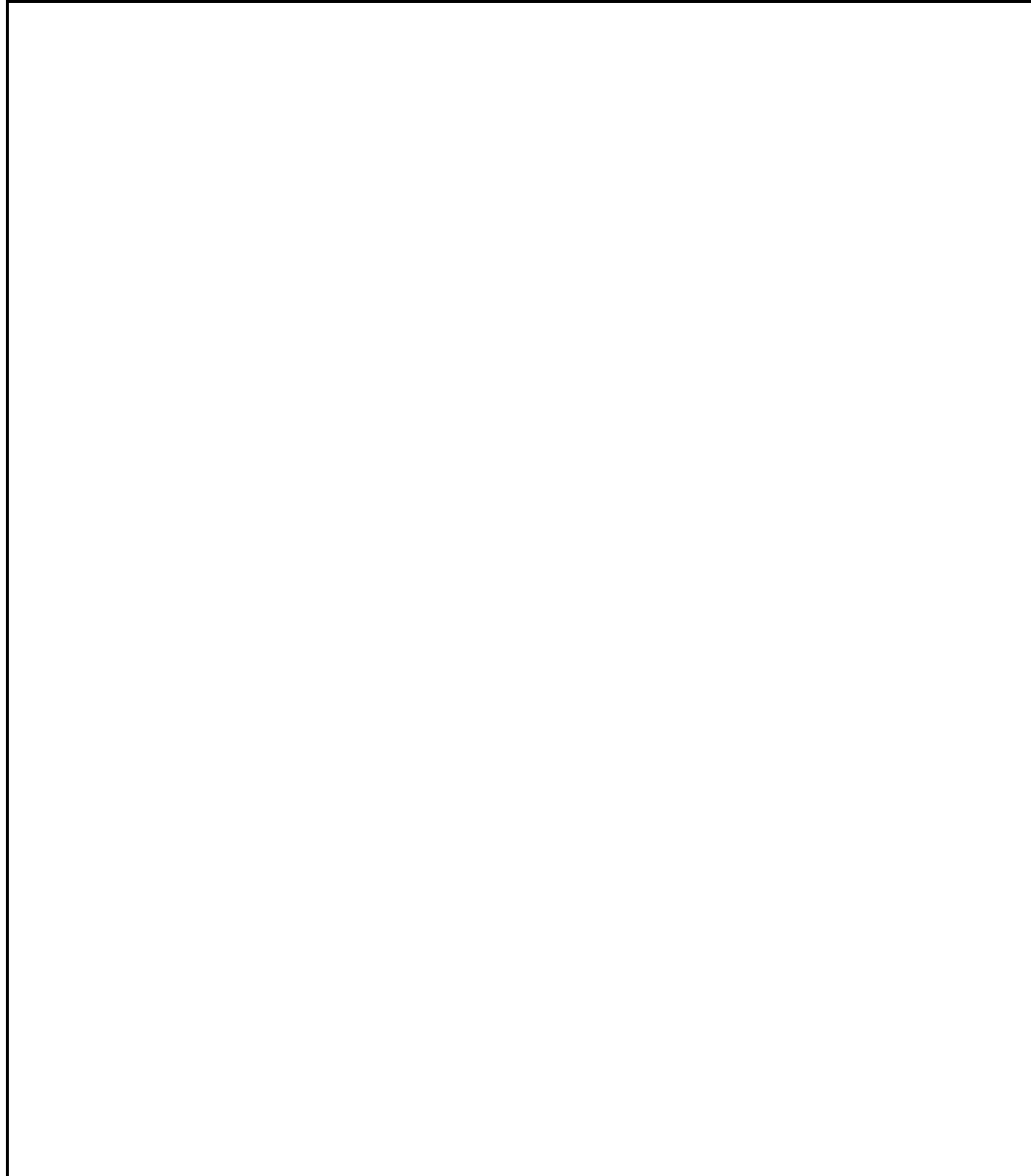
to a lesser extent sesquioxide complexes (iron and aluminum compounds).

- i** Slightly decomposed organic matter. Symbol is used with **O**.
- m** Cementation. Indicates continuous cementation where roots will not penetrate except through cracks. If iron is the predominant cementing agent **qm** is used.
- p** Plowing or other similar disturbance. This symbol is used most commonly with **A**, but can be used with **O**. A disturbed mineral horizon, even though once an **E**, **B**, or **C** horizon is designated **Ap** if it is or once was at the surface and contained a high percentage of organic matter.
- r** Weathered bedrock. This symbol is used with **C** to indicate weathered bedrock that can be dug with a spade.
- s** Illuvial accumulation of iron aluminum and organic matter. This symbol is used with **B** and may also be combined with *h* as **Bhs**.
- w** Development of color or structure. This symbol if used with **B** to indicate development of color or structure with little illuvial accumulation of material.
- x** Fragipan character. Used to indicate a fragipan or fragipan like layer that may not be genetically developed, but is firm, brittle or of high bulk density.

SOIL FORMATION

Soil formation in Maine has occurred since the last glacier retreated about 12,500 years ago. The major soil forming process resulting from weathering (interaction of climate, time, topography, vegetation and parent material) is podzolization. In podzolization, material is removed by leaching from the E horizon and deposited in the B horizon. The primary materials that are leached in Maine Soils are iron, aluminum and organic matter. The E horizon, from which these materials were removed, consequently becomes grayish to whitish

in color. The B horizon, where these materials are deposited, subsequently becomes dark reddish brown to yellowish brown. Soils in which the podzolization process is not intense enough lack strong color horizonation (see Figure 27). In extreme cases of podzolization, especially wet, sandy soils, the B horizon may be black.



SOIL TEXTURE

Soil texture refers to the relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically it refers to the proportions of clay, silt and sand which are the fine earth material less than 2 millimeters in diameter. These individually sized groups

of mineral particles are commonly referred to as soil separates (see Table 1).

Table 1. Soil Separates

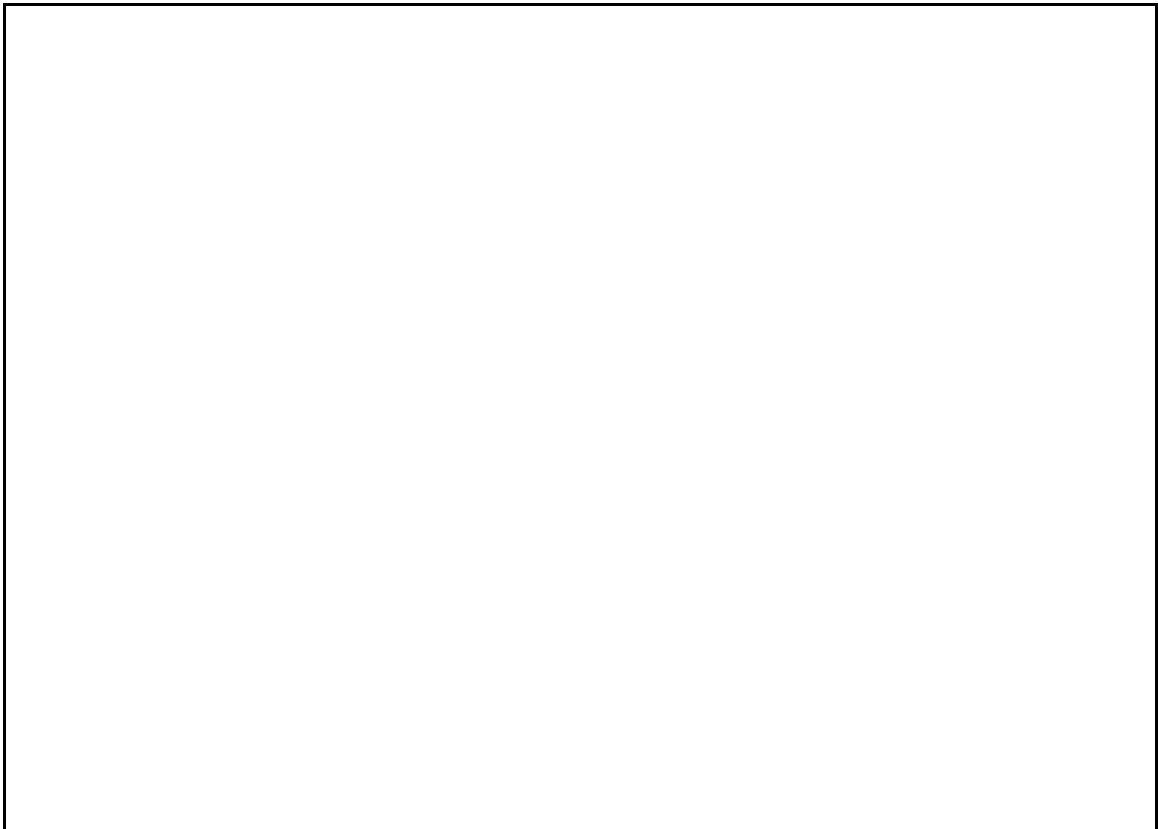
<u>Name of Separate</u>	<u>Diameter (range) mm.</u>
Very coarse sand	2.00 - 1.00
Coarse sand	1.00 - 0.50
Medium sand	0.50 - 0.25
Fine sand	0.25 - 0.10
Very fine sand	0.10 - 0.05
Silt	0.05 - 0.002
Clay	less than 0.002

Table 2. Feeling and appearance of various soil textural classes

Soil Textural Class	Soil Moisture Content	
	Dry Soil	Moist Soil
Sand	Loose, single grains which feel gritty. Squeezed in the hand the soil mass falls apart when the pressure is released.	Squeezed in the hand it forms a cast which crumbles when lightly touched.
Loamy Sand	Loose, single grains which feel gritty but enough fine particles to stain finger prints in palm of hand.	Squeezed in the hand it forms a cast which only bears very careful handling.
Sandy Loam	Aggregates are easily crushed. Very faint, velvety feeling initially, but as rubbing is continued, the gritty feeling of sand soon dominates.	Forms a cast which bears moderate handling without breaking. Doesn't form a ribbon between thumb and forefinger.
Loam	Aggregates are crushed under moderate pressure; clods can be quite firm. When pulverized, loam has a velvety feel that becomes gritty with continued rubbing.	Cast can be handled quite freely without breaking. Very slight tendency to ribbon between thumb and forefinger. Rubbed surface is rough.
Silt Loam	Aggregates are firm but can be crushed under moderate pressure. Clods are firm to hard. Smooth, flour-like feel dominates when soil is pulverized.	Cast can be freely handled without breaking. Slight tendency to ribbon between thumb and forefinger. Rubbed surface has a broken or rippled appearance.
Silty Clay Loam	Aggregates are very firm. Clods are hard to very hard.	Cast can be handled very firmly without breaking. Tendency to ribbon between thumb and forefinger with some flaking, greasy feeling, moderately sticky. Squeezed with proper moisture content into a long ribbon, sticky feel.
Silty Clay	Aggregates are extremely firm. Clods are very hard to extremely hard.	Cast can be handled extremely firmly without breaking. Extreme tendency to ribbon. Squeezed with proper moisture content into a very long ribbon, very sticky feel.

Texture of a soil horizon is a nearly permanent characteristic and greatly influences infiltration, permeability, aeration, drainage, cation exchange capacity, fertility and many other characteristics. Soil texture is one of the primary characteristics considered when designing disposal systems due to the large influence of texture on the characteristics of a soil. Disposal of liquids into the soil from a disposal area is through soil pores, between soil aggregates and through root channels. That is why it is important not to smear or compact native soils into which effluent is to flow. Smearing cuts off pores; compaction eliminates them. The soil pores vary in size with soil texture. Soil texture, soil structure, moisture content, and root penetration also effect the liquid movement through the soil.

The size of the soil pores, which is a function of texture, influences the permeability rate which in turn determines the amount of wastewater the soil can absorb. Soils with very fine textures (silt and silty clay) usually absorb effluent only at a very slow rate, while sandy soils with coarse textures usually absorb larger quantities of effluent over the same period of time.



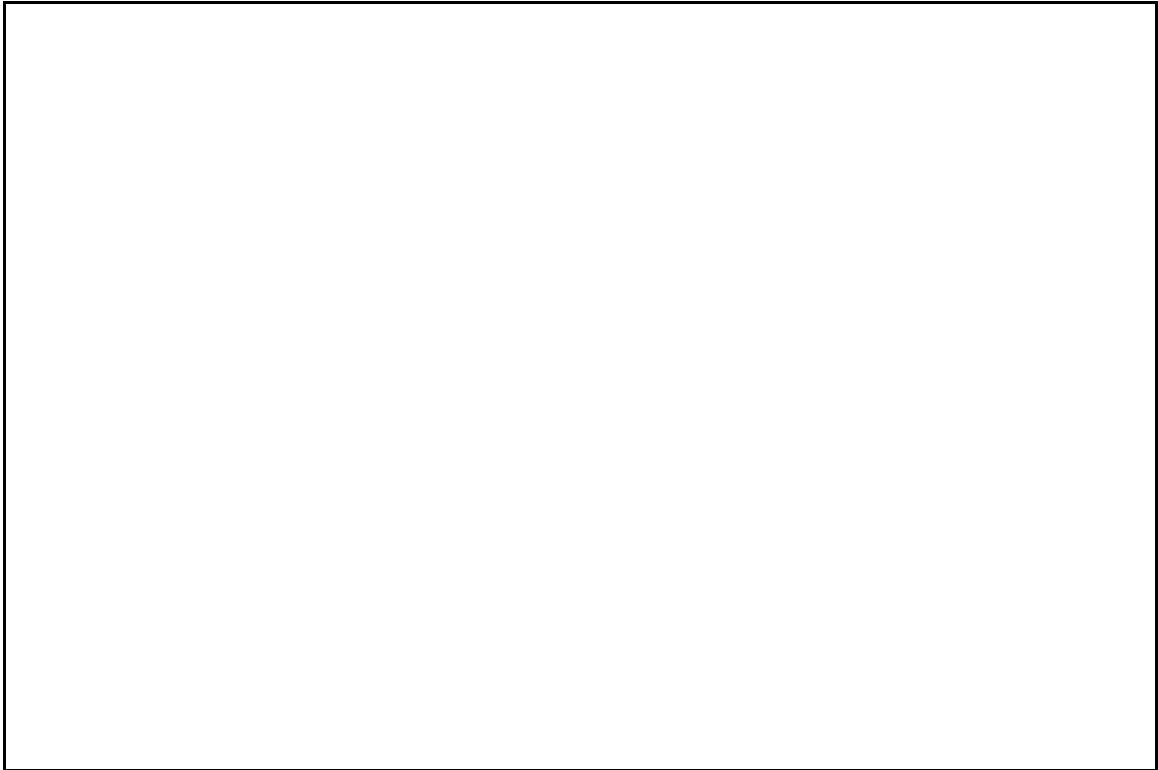
Rarely does soil consist completely of one separate. Classes of soil texture are based on different combinations of sand, silt and clay. The basic classes usually encountered in Maine

in order of increasingly finer texture are: sand, loamy sand, sandy loam, loam, silt loam, silt, silty clay loam and silty clay (see Figure 28). The determination of soil class is made in the field during an on-site investigation by feeling and observing the soil. This requires skill and experience by the Site Evaluator. Table 2 describes the various feelings and appearance of the soil textural classes (see Figures 29, 30 and 31).

The *Maine Subsurface Wastewater Disposal Rules* utilize the United States Department of Agriculture classification for size limits of soil separates. Table 1 lists the soil separates and diameter ranges. Significant proportions of fragments coarser than sand are recognized by an appropriate adjective **gravelly, stony, cobbly** (see Table 3).

Table 3. Coarse fragments versus particle size diameter

<u>Coarse Fragment</u>	<u>Size Diameter</u>
Gravel	up to 3"
Cobble	3" to 10"
Stones	more than 10"



When the soil volume contains 15 to 35% coarse fragments, the coarse fragment adjective is incorporated with the textural name (i.e. *gravelly sandy loam, cobbly sandy loam, etc.*). When the coarse fragments make up 35 to 60% of the soil volume, the word *very* is used as a modifier along with the coarse fragment and textural adjective terms (very gravelly sandy loam, very cobbly loamy sand, etc .) When the soil contains 60 to 95% coarse fragments, the word *extremely* is used as a modifier of the textural term. When the volume of coarse fragments is about 95% or more, and there is too little fine earth to determine the textural class, the terms gravel, cobbles, stones are used in place of fine earth texture.

SOIL STRUCTURE

Soil structure is the natural organization of soil particles into units separated by surfaces of weakness. An individual natural unit is called a *ped*. Soil can have simple structure, compound structure or no structure at all. Simple structure is structure comprised of one type of ped while compound structure exhibits large peds composed of smaller peds within. Several basic shapes of peds are recognizable in Maine soils (see Figure 32).

Observation of soil structure is important in determining internal soil water movement for

subsurface wastewater disposal design consideration. Granular structure is favorable to air and water movement in all directions and is usually found in upper soil horizons. Blocky structure allows for soil water movement in all directions, but commonly to a lesser degree than granular peds. Platy structure inhibits downward movement of soil water to various degrees and soil water movement is generally forced laterally. Platy structure is usually associated with a restrictive layer for subsurface wastewater disposal design consideration (see Figure 33). Prismatic structure is usually associated with the finer textured soils. There is very little internal soil water movement within prisms so that soil water movement generally is restricted to channels between prism faces or perhaps laterally across the top of the peds (see Figure 34).

Shape	Description
Granular:	Approximately spherical peds.
Blocky:	Block-like or polyhedral peds.
Platy:	Peds are flat, plate-like, and oriented horizontally.
Prismatic:	Peds with flat or slightly rounded vertical faces. Longer vertically than horizontally. Tops of prisms are normally flat.

Figure 32. Soil Structure

Friable soil structure is a primary reason that certain soil textures are suitable for disposal system installation but not for disposal area fill. Naturally occurring soils develop structure, over time, but that structure is destroyed when the soil is excavated and remolded. Studies have shown that soil permeability can be significantly decreased when remolded. It is therefore necessary to use fill which has single grain structure but which also has a small percentage of silt and clay sized particles (fines) to provide treatment for effluent.

SOIL CONSISTENCE

The cohesion among soil particles and adhesion to other substances is described by *soil consistence*. Soil consistence may be described in terms of soil strength which is the degree of resistance to breaking or crushing when force is applied. When evaluated at field moisture capacity, the terms of loose, very friable, friable, firm, very firm, extremely firm, or cemented are used. All other things being equal, the firmer the soil, the less permeable it is to wastewater movement.

SOIL RESTRICTIVE LAYER

A restrictive layer is a horizon in the soil that is resistant to downward movement of water and root penetration, and a cause of perched water tables. Lateral movement of water over the layer is common on steep slopes. Restrictive layers may exhibit platy or prismatic structure and firm, very firm, extremely firm or cemented consistence. Restrictive layers in Maine soils are found in firm basal till, fine textured sediments, or perhaps genetically formed in sandy loam or loamy sand horizons. Wet sandy soils can exhibit a restrictive layer from iron cementation. Soil science terminology refers to this as an *orstein* layer.

WASTEWATER MOVEMENT IN SOIL

The liquid movement from a disposal area into the surrounding soil is by gravitational (hydrostatic) pressure as well as capillary or matrix tension. Coarse textured soils (sands, or loamy sands) rely on the large pores for water movement and are primarily influenced by gravity pressure. Finer textured soils (silt loams, silts, silty clay loams) mostly depend on the smaller capillary pores for water movement. In small pores, capillary attraction tends to retard the pull of gravity and slow the percolation rate. Only in the larger soil pores does the water move with any degree of speed.



Soil permeability rates are subject to change with an application of wastewater over time. Wastewater application tends to promote an organic mat development at the interface of the outer surface of the disposal area and the surrounding soil media. Higher wastewater loading application (both in volume and quality) tend to promote higher organic mat development within a given soil type. Although there are some generalities regarding soil permeability rates and wastewater loading applications, there are significant variations between soil textural classes. Research has shown that soils generally have a higher permeability rate when exposed to clean water, resulting in little or no mat development. However, after an organic mat develops, which occurs when wastewater is applied, soil permeability rates decrease. Interestingly, the decrease in soil permeability rates, after being exposed to wastewater applications, is greater in coarse textured soils (i.e. sands & gravels) than it is in finer textured soils (silts and clays). This is because sands and gravels transmit water through gravity pores and generally do not have capillary pores. When a mat forms, water moves through it by capillary pores until it reaches the gravity pores of surrounding sand or gravel. Lack of matrix tension in the gravity pores creates a barrier to water movement. Finer textural soils do not offer such a barrier as they have both capillary and gravity pores.

SOIL PARENT MATERIAL

Parent material is the physical body of soil and its associated chemical and mineralogical properties at the starting point of soil formation. It is also the basis for the development of classification systems in the *Subsurface Wastewater Disposal Rules* (see Table 4) which recognizes 12 soil profiles. It is very helpful to have an understanding of the local surficial geology and glacial processes to assist in identification of parent materials.

There are 6 major types of parent material found in Maine.

Glacial Deposits

Glacial Till:

Material deposited directly by the glacial ice mass is called glacial till. It is the oldest and one of the most widespread surficial materials in Maine. Till generally overlies bedrock. Glacial till deposits in Maine are comprised of sediments of textural classes ranging from silt loam, loam, sandy loam and loamy sand. Angular coarse fragments of gravel, cobbles or stones are common (see Figures 35 and 36). Generally there is no evidence of stratification due to sorting by water flow. Till may contain thin, discontinuous beds of washed sediments, but pronounced bedding is rare. Large stones may be present at the surface or within the profile (see Figure 37).

There are two basic subcategories of glacial till; **basal till** and **ablation till**. Basal till was laid down at the bottom of a glacier. It ranges in texture from loamy sand to silty clay loam, is compact, and difficult to excavate. This kind of till is often called *hardpan*. Ablation till was deposited by the settling of particles from melting glacial ice. It is loose, sandy and easy to excavate. Ablation till may grade locally into stratified drift material. Stone fragments in basal till are primarily angular, whereas stones in ablation till are commonly both angular and rounded.

Stratified Drift Deposits

Stratified drift deposits were laid down by glacial meltwater streams from the last glacier. These deposits can be classified into two categories: 1) ice contact stratified drift and 2) proglacial outwash. Ice contact stratified drift include kames, kame terraces, eskers, and deltas. Proglacial outwash includes only outwash plains (see Table 5).

Table 4. Parent Materials in Maine

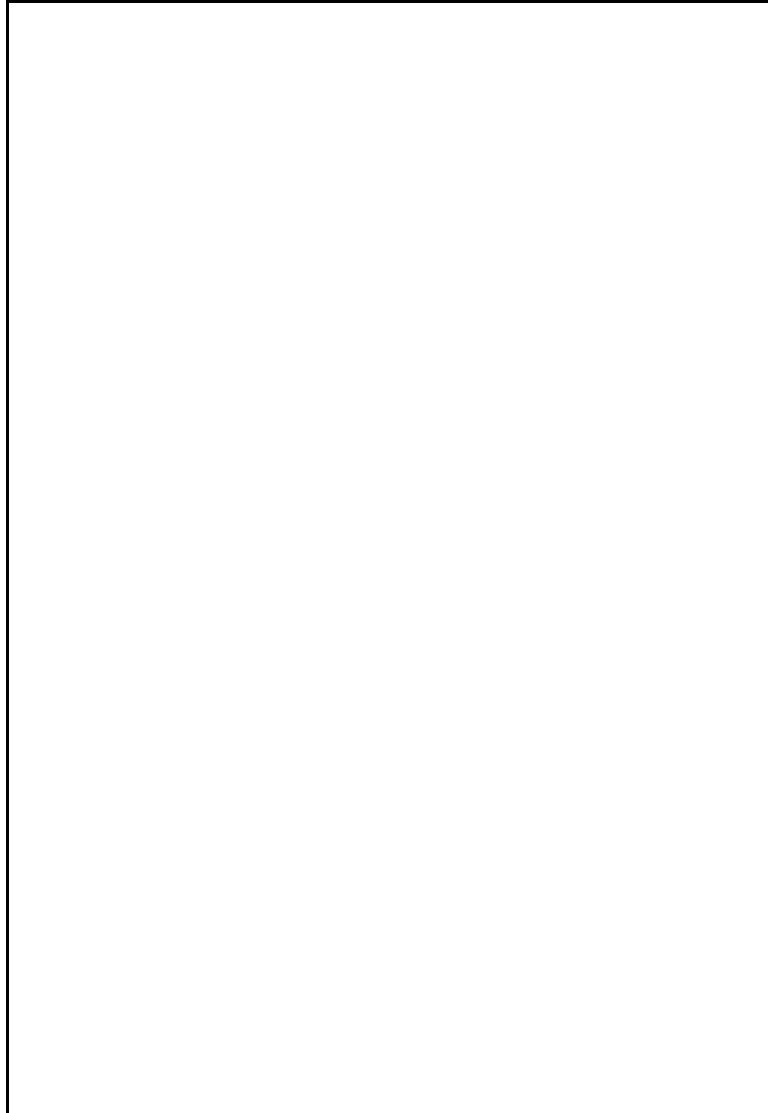
Glacial Deposits
Glacial Till (Non-Stratified Glacial drift): basal till, ablation till
Stratified Glacial Drift: ice contact stratified drift, kames, eskers, kame terraces, proglacial outwash
Water Deposits
Marine: ocean deposit
Lacustrine: lake sediment
Alluvial: river, stream deposit
Organic
Organic: peat bog, marsh, swamp



<i>Table 5. Stratified Drift Deposits Depositional Environment</i>	
<i>ICE CONTACT STRATIFIED DRIFT DEPOSITS</i>	
<i>Kame</i>	<i>Randomly deposited on, within, beneath, or adjacent to melting glacial ice.</i>
<i>Kame terrace</i>	<i>Usually deposited between stagnant ice and a nearby valley-wall; upper surface was graded by streams and is flatter than a kame.</i>
<i>Esker</i>	<i>Deposited in a tunnel within or beneath stagnant ice.</i>
<i>Delta</i>	<i>Built into a lake or the ocean; may have formed in contact with glacial ice or at the end of an esker, hence the varieties "kame delta" and esker</i>
<i>PROGLACIAL OUTWASH DEPOSITS</i>	

***Outwash
Plain***

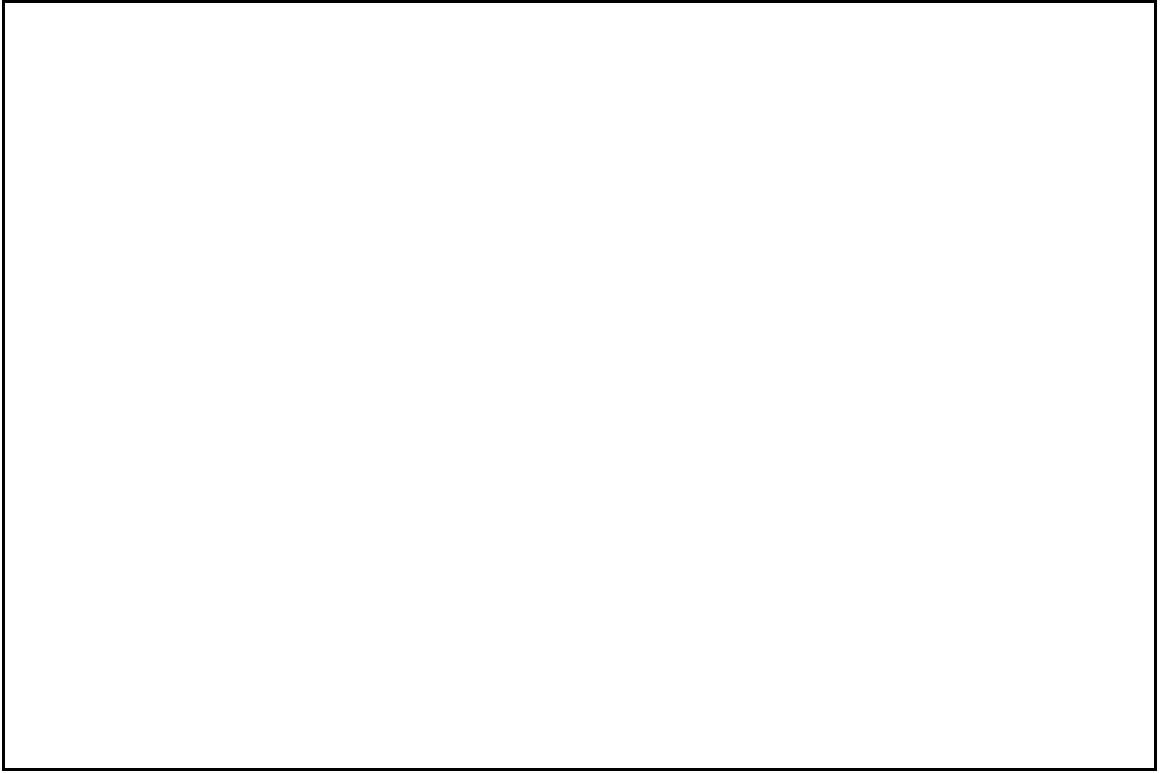
Formed beyond the margin of the glacier and may terminate in a delta if the meltwater stream entered standing water.



Each type of stratified drift deposit has unique characteristics and composition. However, all of the stratified drift deposits will exhibit some degree of stratification. Stratification is alternating layers of different but well sorted particles (see Figure 38). They range in textural classification from fine sand to gravel, and may have a finer textured cap.

Marine Deposits

Material deposited on an ocean floor is referred to as marine sediment (see Figure 39). Fine sediment washed out of the glacier that covered Maine during the *Ice Age* (Pleistocene), and accumulated on the ocean floor. The ocean, during that period, extended inland along the major river valleys. Marine deposits are found over 300 feet above present sea level in parts of Maine (see Figure 40).



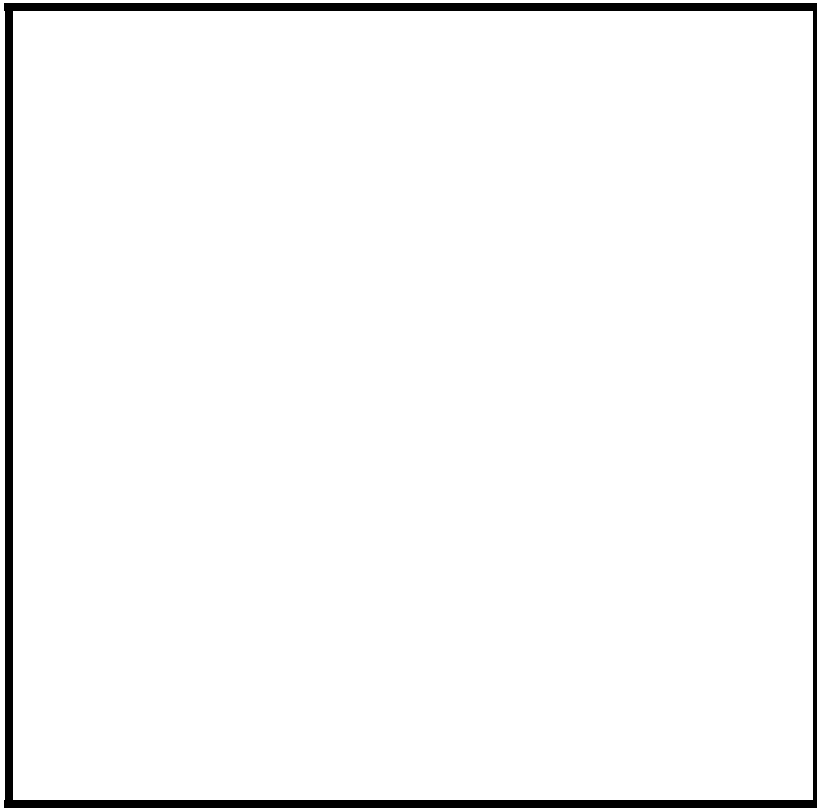


Figure 40. Extent of Glacial-marine clay in Maine (Thompson, 1978).

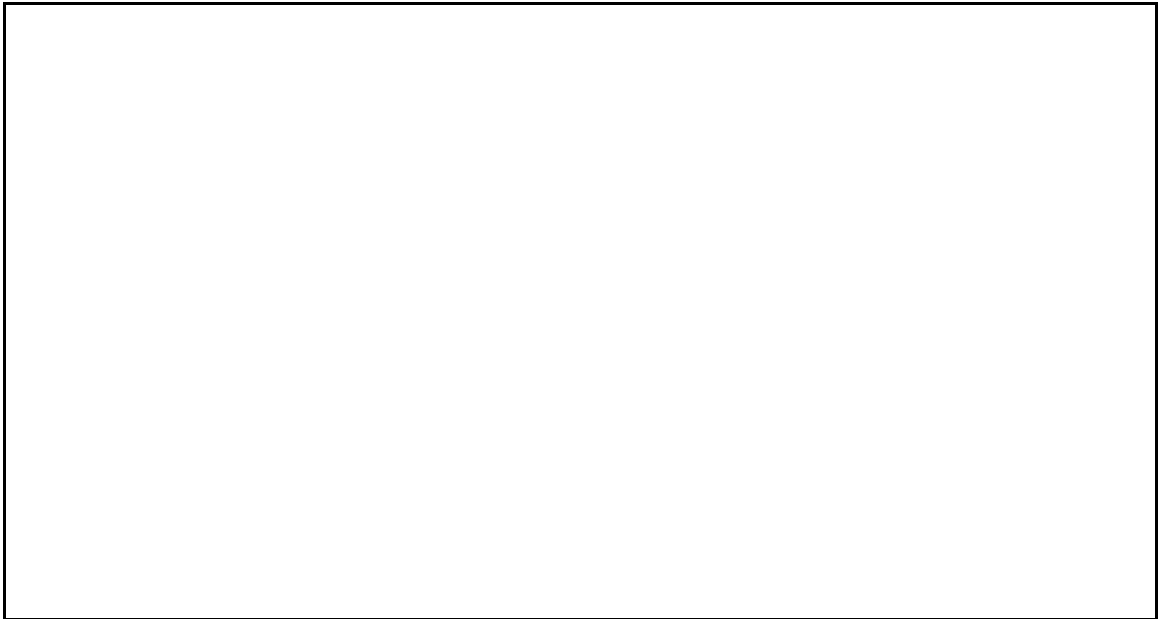
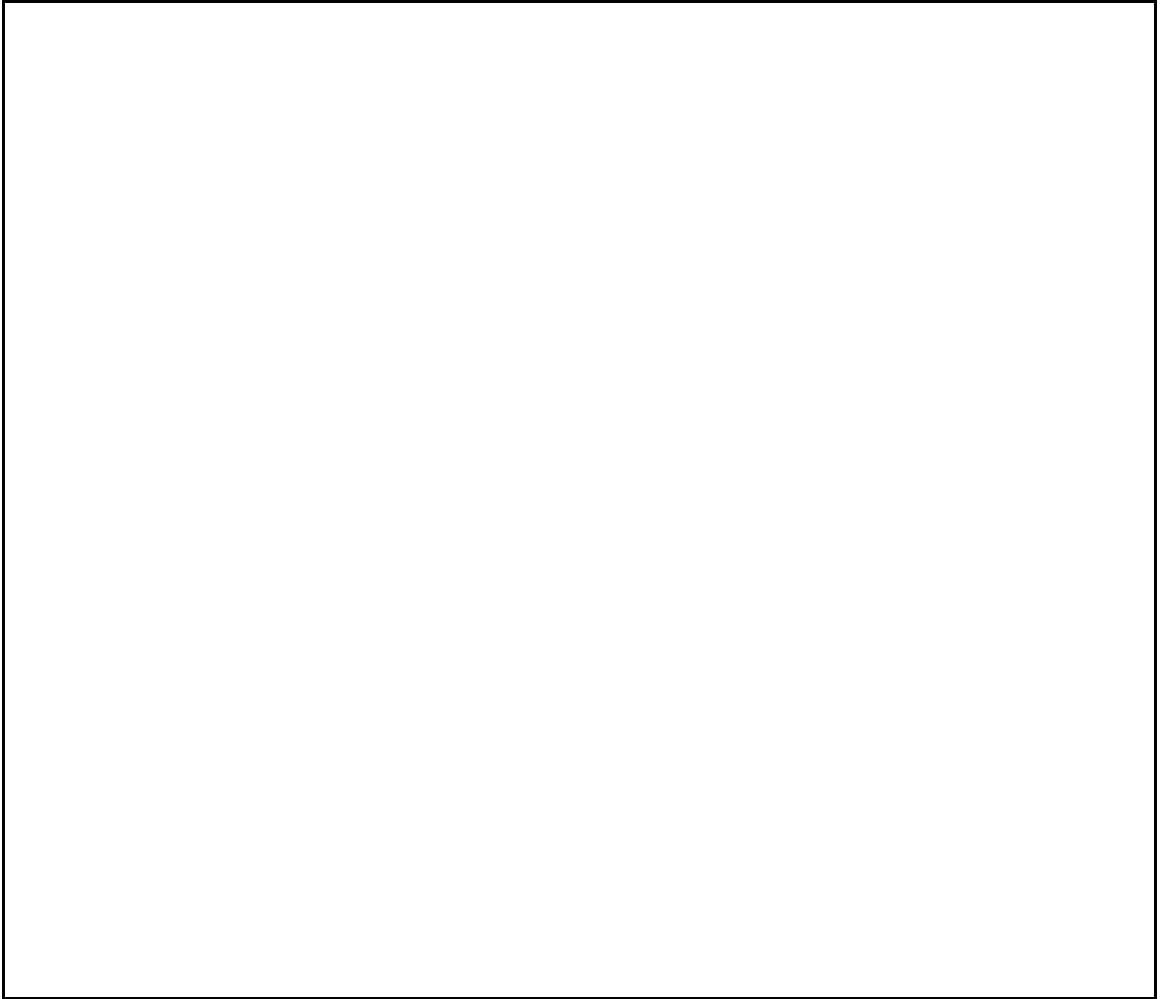
Terrain underlain by marine sediments is usually gently sloping. Marine sediments are often called clay but the correct textural class is usually silt loam, silty clay loam or silty clay. These types of deposits usually become firm and dense with increasing soil depth (see Figure 41).

Lacustrine deposits

Lacustrine deposits were laid down in lake bodies. The soil textures of lacustrine sediments are usually slightly coarser than marine sediments and they may exhibit thin horizons (lenses) of fine sand to sandy loam material in the substratum.

Alluvial Deposits

Water-deposited sediment found on flood plains and terraces along modern rivers is called alluvial deposits. These are young soils with very little soil horizonation (see Figure 42).



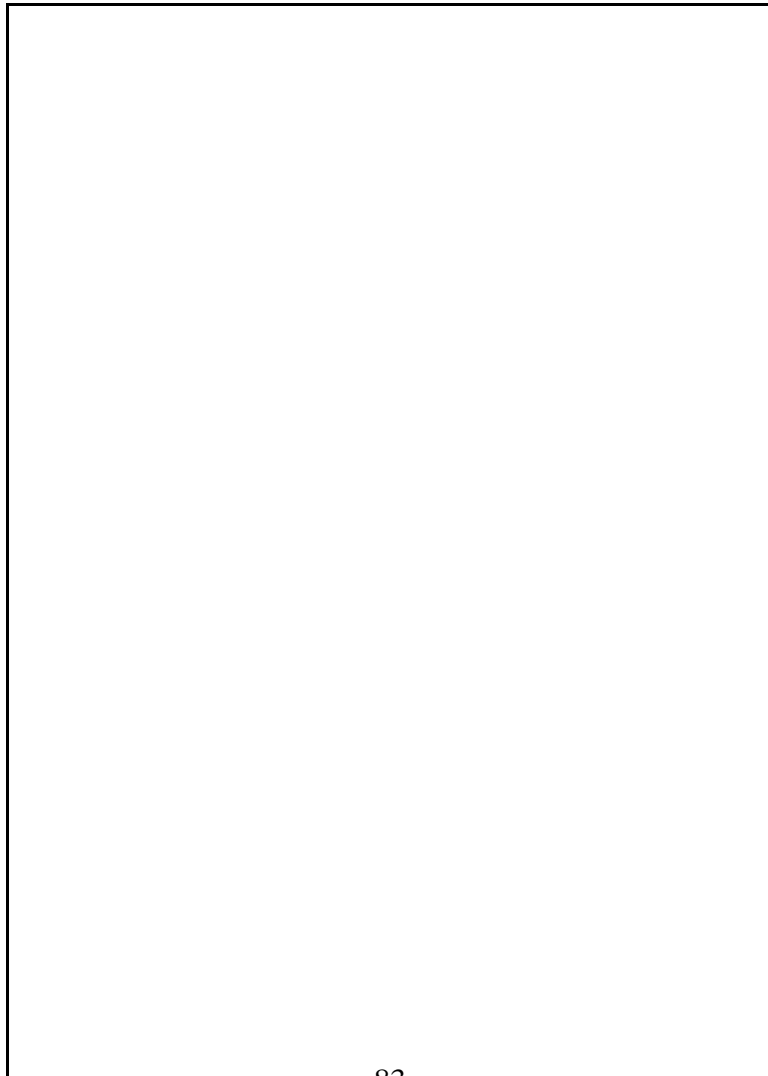
Organic Deposits

Soils comprised primarily of organic matter are usually found in swamps, bogs, and marshes.

To classify as organic soils, the surface organic layer must be at least 16" deep, but may be underlain by mineral soils below that depth. Occasionally, organic soils can be developed due to cold climates and not as a result of saturation.

SOIL COLOR

Observations of soil color are very useful because many important inferences can be made from soil color and patterns. Soil color is influenced by mineralogy, wetness, organic matter content, and genetic processes. Soil color does not have any known influence on the functioning of soil other than affecting absorption of heat at the soil surface. However, color is extremely important in providing clues toward understanding other physical, chemical and biological soil properties.



Commonly, dark colors in upper soil horizons suggest higher organic matter content than lighter colored soil horizons. Organic matter tends to build up in soils which have frequent organic matter additions (manured or other soil amendment added) or where microbial activity is reduced. In Maine, microbial activity is controlled by two factors; temperature and presence or lack of oxygen. When soil temperatures are below biologic zero (41° F) or soil oxygen is lacking, microbial activity is reduced or ceases. Very dark soil surfaces with soil drainage mottles or gray color just below the surface horizons may indicate poor drainage. **Note:** The *Maine Association of Professional Soil Scientists Soil Drainage Key* is a useful tool when attempting to determine the soil drainage class of soils with thick, dark surface horizons (see Appendix A).

The **Munsell Soil Color Chart** is a tool used to assist in determining the soil color (see Figure 43). Soil color is measured by comparison with approximately 200 different color chips systematically arranged according to their Munsell notation of hue, value and chroma. Hue is the dominant spectral color (wavelength of light). Value is the amount of light (lightness of color). Chroma is the strength of the color and increases with decreasing grayness. A light brownish gray color, for example, is denoted as 2.5Y 6/2 meaning that the color is of a 2.5Y hue, value of 6 and a chroma of 2. Munsell Color designation is not required for site evaluation reports. Objective description is acceptable, however, it is a very valuable tool for Site Evaluators. Becoming familiar with specific soil color designations is very helpful when inferring conditions of soil wetness. For more information on use of Munsell Charts, see the publication *Maine Wetlands and Their Boundaries* listed in the bibliography.

SEASONAL WATER TABLE

Knowledge of the times and depths at which a soil is saturated, generally referred to as the seasonal water table, is very important in evaluating soil suitability for subsurface wastewater disposal. The lack of oxygen is very influential on the biological, chemical and physical processes which take place in soils. The metabolic rate of aerobic bacteria is approximately seven times faster than anaerobic bacteria, hence organic decomposition is more rapid in an environment with oxygen (unsaturated) than one without oxygen (saturated).

Soil characteristics, climate, slope and landscape position influence soil saturation. Precipitation, runoff, infiltration, and permeability also affect the degree and duration of saturation. A soil at a higher elevation may have a lower water table or have a shorter

duration of saturation than the same soil at a lower elevation downslope. Although the depth to groundwater table changes greatly during and between years, most soils usually have typical times and depths of saturation.

The most commonly used method to determine depth to the seasonal water table is the observation of soil morphological features. A skilled observer can infer much about soil saturation from soil color, texture, structure, consistence and profile development. The observer must beware, however, of problem soils and the fact that morphological features associated with soil saturation only develop when the soil temperature is above biological zero, 41° F and the groundwater table is stagnant. (See Chapter VII, *Special Considerations, Problem Soils*).

SOIL DRAINAGE CLASSES

Soil drainage refers to the condition of soil saturation that exists in a soil and the frequency and duration of the periods of saturation. There are seven drainage classes recognized by the USDA Classification System, which are listed below in increasing order of saturation, duration and frequency.

Excessively drained:

Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, stony, or very shallow (less than 10"). Some are steep. All are free of soil morphological features associated with saturation.

Somewhat Excessively Drained:

Water is removed from the soil rapidly and the soils do not have a seasonal water table within 40 inches of the mineral soil surface. Somewhat excessively drained soils are similar to excessively drained soils in texture except that they have a thicker cap, if greater than 40" to bedrock, if shallow (between 10" and 20" deep), they are deeper than excessively drained soils.

Well drained:

Water is removed from the soil readily but not rapidly. Water is available to plants throughout most of the growing season. Wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of soil morphological features associated with saturation, within the upper 40".

Moderately well drained:

Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season. They

commonly have a slowly permeable layer within the substratum, periodically receive high amounts of rainfall, or runoff, or a combination of these.

Somewhat poorly drained:

Water is removed slowly, and the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of some plants unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly permeable layer, a high water table, additional water from seepage, or a combination of these.

Poorly drained:

Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Ground water is commonly at or near the surface for a long enough period during the growing season that most plants cannot be grown unless the soil is artificially drained. Poor drainage results from a high water table, a slowly permeable layer within the profile, seepage, or a combination of these.

Very poorly drained:

Water is removed from the soil so slowly that ground water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most plants cannot grow. Very poorly drained soils are found in level or depressed areas and they are frequently ponded.

SOIL DRAINAGE MOTTLES (REDOXIMORPHIC FEATURES)

Iron is one of the main coloring substances of soil. The color of the iron in soil is closely related to the amount of oxygen that is present. Air is absent or in short supply when soils become saturated or nearly saturated with water. When air is absent in the soil, iron exists in a ferrous or reduced state. This causes the soil to be gray in color. When there is an air supply as in well drained soils, the iron is in a ferric or oxidized state. This causes the soil to be yellowish or reddish in color. If, over a long period of time, a soil has been alternately wet and dry, a combination of both ferric and ferrous iron are found. This produces a mottled condition. Mottles which result from soil saturation are types of redoximorphic features.

Mottling is defined as spots or blotches of different color, or shades of color, interspersed with a dominant background (**matrix**) color. A seasonally fluctuating water table or intermittently perched water table, when the soil temperature is above biologic zero, usually results in the formation of brightly colored oxidized spots. These spots are called **high chroma mottles** or **redox concentrations**. Duller colored reduced spots are called **low chroma mottles** or **redox depletions**. Oxidation (bright colors) and reduction (dull colors)

are caused by alternating aerobic and anaerobic conditions attributable to a seasonally fluctuating groundwater table, or the intermittent presence of a perched water table. Not all mottling, however, forms as a result of soil saturation. Mottles can occur by soil cultivation, mixing by animals, and tree throws. These mottles are not redoximorphic features (drainage mottles) because they are not formed by a combination of reducing and oxidizing conditions in the soil. Other types of redoximorphic features are less common and include oxidized rhizospheres, organic streaking, concretions (cemented modules) and their dark Bhs horizons. They are usually found in sandy and/or oxygenated soils that are saturated.

Mottles (redox concentrations and/or redox depletions) can be described in terms of **quantity** and **contrast**. Quantity can be classified as **few**, **common**, or **many**, based upon the percentage of the observed surface that is occupied by mottles (see Table 6). Contrast can be described as **faint**, **distinct**, or **prominent** based upon the visual distinction that is evident between associated colors.

Table 6. Mottles, description

QUANTITY % of Mottling	
Few	Less than 2%
Common	2 to 20%
Many	More than 20%

CONTRAST Visual Distinction	
Faint	Evident only on close examination.
Distinct	Readily seen, but contrasts only moderately with the soil matrix background color.
Prominent	Contrasts strongly with the soil matrix background color.

Following are the major soil drainage classes used in the *Subsurface Wastewater Disposal Rules*. The different drainage classes are based upon depth to and duration of groundwater

tables.

Soil Drainage Class B (Well drained)

Drainage Class B soils usually have brighter colored subsoils and are free of drainage mottling to depths greater than 48". This indicates that water drains freely from the profile. Surface soil colors vary widely but are generally less dark than those of poorly drained soils.

Soil Drainage Class C (Moderately well drained)

Drainage Class C soils exhibit drainage mottling at 15 to less than 48 inches beneath the mineral soil surface. Water is removed from these soils somewhat slowly; the lower part of the profile is saturated for a short but significant part of the year. Drainage Class C soils commonly have a restrictive layer, seepage water, or a seasonally high groundwater table at a soil depth of 15 to 48 inches. Colors of the surface and upper subsoil are relatively uniform within each layer. Mottling becomes noticeable in the lower subsoil and may appear as yellow-orange and/or gray spots and blotches mixed with the natural brownish color.

Soil Drainage Class D (Somewhat Poorly Drained)

Drainage Class D soils have a seasonally high groundwater table at less than 15 inches to 7 inches beneath the mineral soil surface. They generally do not have brightly colored subsoils. Typically, Drainage Class D soils have darker colored surface horizons than Drainage Class B or C. They usually occur at the lower end of long slopes and may be adjacent to low depressional areas. If these soils have been cultivated, the plow layer will have disturbed soil horizons to a typical depth of 8" to 10". Evaluation of the seasonal high groundwater table when mottling extends to the base of the plow layer, will require an evaluation of the color of the plow layer and organic matter accumulation. The *Maine Association of Professional Soil Scientists Soil Drainage Key* is a very useful reference for making such determinations (see Appendix A).

Soil Drainage Class E (Poorly and Very Poorly Drained)

Drainage Class E soils have a seasonal or permanent water table at less than 7" below the mineral soil surface. These soils usually occur at the base of long slopes, in low depressions and at or near flat seepage areas. Condition E soils typically have dark colored surface horizons and may be dark throughout from organic matter accumulations. Gray colored subsoils are generally found at the base of dark

colored surface horizons. Evaluation of the seasonally high groundwater table often requires an evaluation of the surface horizon color and organic matter content, which may mask drainage mottles. The *Maine Association of Professional Soil Scientists Soil Drainage Key* is a very useful reference for determining soil drainage class of these soils.

POSITION IN LANDSCAPE AND SOIL CHARACTERISTICS AFFECTING DRAINAGE

The drainage of a soil depends upon how much of the water falling on the land enters the soil and how quickly it passes through the soil. The position of the soil in the landscape, slope, and size of upslope watershed all influence drainage (see Figure 44).

Flat land and depressional areas have very little runoff and may receive additional runoff from higher ground; most of which must drain through the soil. Poorer drained soils generally occur in these positions. Undulating or rolling land has more runoff and less water passing through the soil. Soils on upland knolls or on a side slope with a very limited watershed are usually well or moderately well drained, unless there is a restrictive layer perching the groundwater. Excessively drained soils occur on steep slopes where most of the water runs off and relatively small amounts of water enter the soil.



Texture of the soil also influences the natural drainage. Coarse textured soils usually drain better than fine textured soils. Fragipans, claypans, and bedrock all influence the natural drainage because they restrict the downward movement of water (see Figure 45).

CLASSIFICATION OF SOILS

A Site Evaluator must have the ability to recognize and describe parent materials, soil textures, consistency, soil colors, soil structure, drainage mottling (redoximorphic features), and restrictive layer. Soil characteristics that are pertinent to design of systems have been incorporated into the Classification System of the Rules (See Table 7).

A Site Evaluator examines the soil texture throughout the profile and observes the coarse fragments, shape of particles, soil structure, consistency and horizonations. Knowledge of the characteristics of parent material coupled with the ability to identify texture, will enable the Site Evaluator to classify the soil. Examination of the root depth, organic matter accumulation, soil structure, consistency, color and drainage mottling (redoximorphic features) are the soil characteristics that are considered when identifying soil drainage, reflected in the vertical columns of Table 7 of the *Subsurface Wastewater Disposal Rules* (see Figure 45 and Table 7).

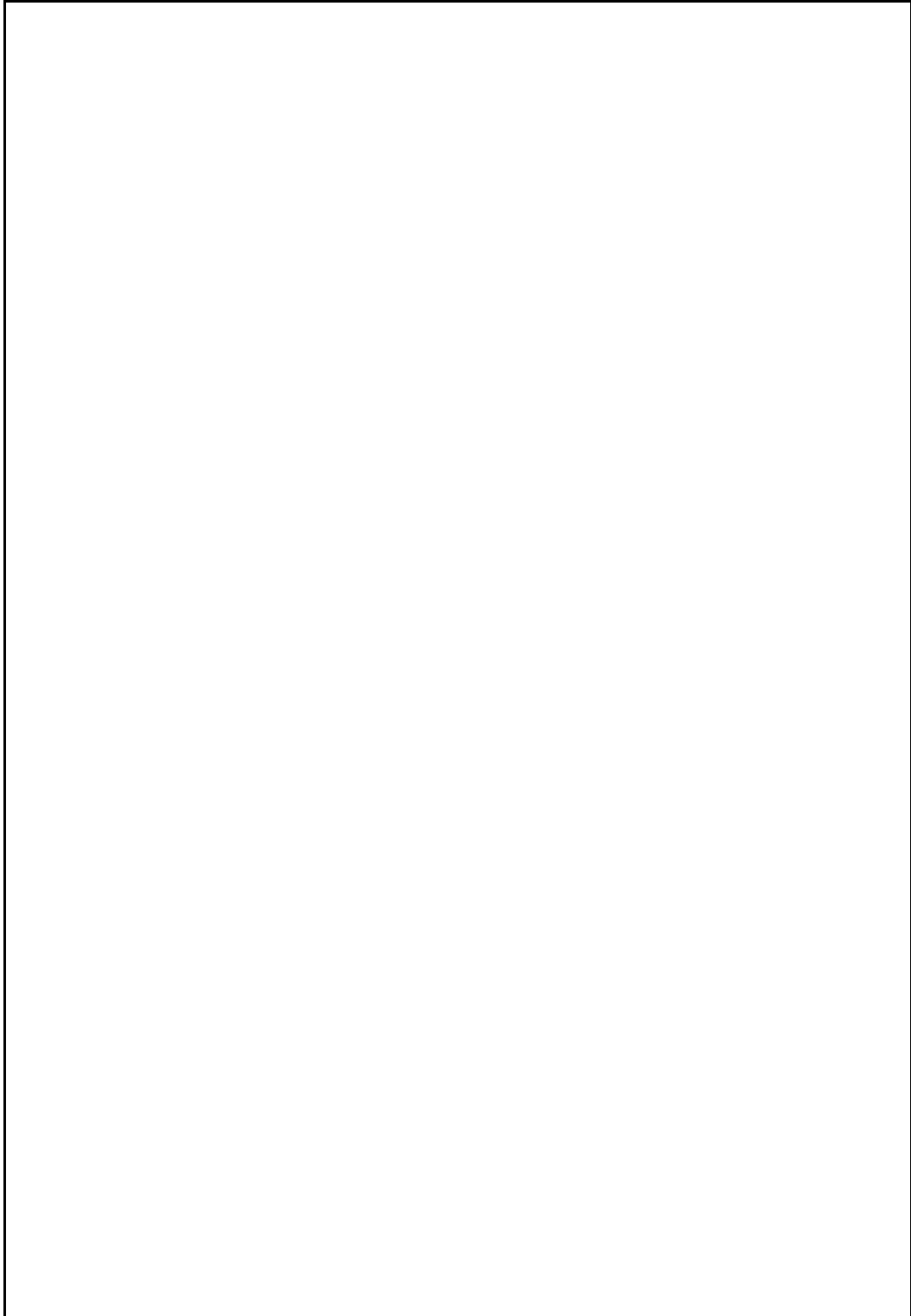


Figure 45. Natural drainage classes of soil and subsurface wastewater disposal classifications

Table 7. Soil Profile and Condition versus System Sizes in Maine

The size rating and design criteria to properly treat the wastewater is determined after the Site Evaluator classifies the soil profile and conditions in accordance with the Rules.

Soil Profile Classification

The State of Maine, Subsurface Wastewater Disposal Rules recognizes 12 soil profiles based primarily upon parent material but also taking into consideration soil texture, restrictive horizons and whether the soil is naturally developed or man-made.

Profile 1:

Profile 1 soil is derived from a fine grained glacial till parent material. The soil textures are commonly silt and silt loam but can also range from fine sandy loam to gravelly clay loam with the finer textures generally found in the lower soil horizons. Angular coarse fragments are typically found throughout the profile. Profile 1 soils are distinguished from Profile 8 and 9 soils by the presence of coarse fragments derived from glacial deposition. Profile 1 soils typically become restrictive with depth but are occasionally friable throughout. Stones and cobbles may be present.

Profile 2:

Profile 2 soil is derived from a medium grained glacial till which is friable throughout the profile. Soil textures generally range from loam to sandy loam but may also include lenses or pockets of loamy sand to sand. Angular coarse fragments are typically found throughout the profile. Stones and cobbles may be present.

Profile 3:

Profile 3 soil is similar to Profile 2 in both parent material and soil texture; however Profile 3 soil has a hydraulically restrictive horizon which Profile 2 lacks. Profile 3 soils are derived from basal glacial till which causes the firm substratum. Angular coarse fragments are typically found throughout the profile. Stones and cobbles may be present.

Profile 4:

Profile 4 soil is derived from ablation till and soil textures typically range from loamy sand to sandy loam in the upper soil horizons overlying loamy sand subhorizons. Because they are glacial till soils, they usually have coarse fragments throughout the profile. However, both angular and rounded coarse fragments can

be found, suggesting some water action. These soils are loose to friable throughout with no hydraulically restrictive horizon being found.

Profile 5:

Profile 5 soil is derived from glacial outwash or stratified drift parent material and can be distinguished from soils derived from glacial till soils by the evidence of water sorting. This soil typically has a loamy sand to sandy loam topsoil horizon which overlies fine to medium sand subhorizons. The sandy subhorizons may exhibit stratification and commonly have coarse fragments which are primarily rounded. Water sorting has generally removed the silt and clay sized particles from the subhorizon layers. These soils generally do not have a restrictive layer. Profile 5 soils occasionally have cemented layers (orstein) from the lateral and vertical movement and precipitation of iron, aluminum and organic matter. These cemented layers can become so restrictive that they create a perched water table above them. Large stones are generally not found in Profile 5 soils, however, rounded cobbles may be present.

Profile 6:

Profile 6 soil is derived from glacial outwash or stratified drift parent material (similar to profile 5 soils) but has a coarser textured subhorizon. The soil textures typically are loamy sand in the upper horizon overlying coarse sand or gravel subhorizons and is the coarsest soil profile recognized by the Rules. Coarse fragments are usually found and they are nearly always rounded due to water action. They can also have cemented layers, similar to Profile 5.

Profile 7:

Profile 7 soil is a mixed origin parent material soil. It is typically loamy sand to sandy loam glacial till or loamy sand to sand outwash material over marine or lacustrine sediment; but can also be loamy sand to sand outwash material overlying firm, basal till subsoils. A minimum of 15 inches of the coarser textured soil must be present for the soil to classify as a Profile 7. A restrictive layer is present in the lower horizons. There are coarse fragments typically found in the upper soil horizon and in the subhorizons of the basal till.

Profile 8:

Profile 8 soil is derived from lake (lacustrine) deposits. Soil texture typically ranges from loam to fine sandy loam surface horizons underlain by firmer silt to silt loam subhorizons. The subhorizons tend to be restrictive and may contain lenses or varves of fine sand to sandy loam. They are water sorted from a tranquil lake

depositional setting that allowed fine soil particles to settle out of suspension. Occasionally, during high runoff periods, fine sand particles will be carried into the lake, causing a soil texture of very fine sand to silt. Coarse fragments are almost always absent, a distinguishing characteristic between Profile 1 and Profile 8 soils.

Profile 9:

Profile 9 soil is derived from marine or estuary sediments. They are water sorted, in a similar fashion to Profile 8 soils. Profile 9 soils settled in a tranquil marine depositional setting that allowed for finer textured sediments to settle out. Typically, they consist of silt loam textured upper soil horizons overlying firmer silt loam to silty clay loam subsoils. Coarse fragments are generally absent throughout the profile. Profile 9 description does allow for the subhorizon to contain thin lenses of very fine sand to silt. Subhorizons tend to be firm and restrictive. The primary difference between a Profile 8 and a Profile 9 soil is the texture of the upper soil horizon; Profile 8 soils are coarser.

Profile 10:

Profile 10 soil is formed from organic matter which typically builds up due to saturated conditions. Organic soils have at least 16 inches to several feet of organic materials, in various stages of decomposition, on the soil surface. Organic soils generally indicate the presence of a wetland, however, they can also form in cold climates (high mountains and northeast coast).

Profile 11:

Profile 11 soil is commonly formed from deposits along rivers and streams (alluvial), flood plains or beach dunes. They are recent deposits, geologically, and typically do not have well-developed soil profiles. Profile 11 soils are quite variable in texture, depending upon the velocity and type of depositional environment. Textures typically range from sand to silt. Beach dunes are typically fine to medium sand and flood plains are typically very fine sand and silt. Because of the great variability on textures, disposal area sizing is based upon textures encountered at each specific site, using other soil profile ratings as guidance.

Profile 12:

Profile 12 soil is filled land, greater than 48 inches, placed upon the original soil surface. They will obviously vary greatly in texture, structure and consistency, depending upon the source of fill and do not have a typical soil profile description.

They can generally be determined by the observance of buried horizons which are typically found at the soil surface, the presence of artifacts, and/or presence of unnatural horizons and textural combinations.

Soil Depth Classes

Soil depth to bedrock is a design parameter in the Subsurface Wastewater Disposal Rules due to concern with contamination of groundwater in bedrock fractures. Once a contaminant reaches a bedrock fracture, it no longer is subject to further purification and simply undergoes dilution. The contaminant can potentially travel great distances in a bedrock fracture, potentially reaching a groundwater drinking source. Because of this potential phenomena and concerns with groundwater drinking supplies, a two foot separation is required from the bottom of a disposal area and the upper limits of bedrock. Soil depth classes are:

- AI = 0" to 12" to bedrock from mineral soil surface
- AII = 12" to 15" to bedrock from mineral soil surface
- AIII = 15" to 48" to bedrock from mineral soil surface

Soil Condition and Design Classes

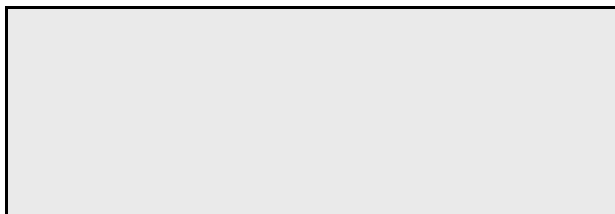
Typical (One Limiting Factor):

When Site Evaluators report soil profiles and design classes, the standard procedure is to first state the soil profile designation, followed by the design class.

Example: Sandy loam glacial till soil with a hardpan at 24 inches and a seasonal water table at 13 inches. This soil profile and design class would be recorded as a **3D** with a limiting factor at 13 inches

Atypical (More Than One Limiting Factor):

Occasionally, a soil profile will be encountered that has more than one limiting factor, such as a seasonal water table within 48 inches of the soil surface and bedrock. In such cases, the standard procedure is to list the soil profile first, followed by the bedrock depth class, a slash and then the drainage class.



Example: Sandy loam glacial till soil with no hardpan, water table at 18 inches and bedrock at 31 inches. This soil profile and design class would be recorded as **2AIII/C** with a limiting factor at 18 inches.

Most Limiting of Factors:

The most limiting factor is considered to be the factor and its separation distance that causes the disposal system to be at the highest elevation.

Example: Silt loam glacial till soil with a restrictive layer at 20 inches and bedrock at 24 inches. No drainage mottles or other evidence of a seasonal water table. This soil profile and design class would be recorded as **1AIII/B** with a limiting factor at 24 inches. The limiting factor is identified as being at 24 inches, bedrock, whereas the restrictive layer is nearer the surface, at 20 inches. The reason for this is because the bedrock requires a 24 inch separation (placing the disposal system on the soil surface), whereas the hardpan only requires a 12 inch separation (could cut 8 inches into the ground for a disposal system installation). Therefore, the bedrock is the more limiting of the two limiting factors observed.

Table 8. Sizing of Stone Disposal Areas from Table 7

<u>Soil Type</u>	<u>Soil Profile</u>	<u>Hydraulic Loading Rate (HLR) Area (sq. ft.) for each required gal/day of wastewater</u>
Coarse Sands, Gravels	6	2.0
Loamy Sands, Fine and Medium Sands	4, 5	2.6
Loams, Sandy Loams, Loamy Sands	2, 3, 7	3.3
Silt Loams	1, 8	4.1
Silty Clay Loams, Silty Clay	9	5.0

DISPOSAL AREA CALCULATIONS

The following formula is utilized by the *State of Maine, Subsurface Wastewater Disposal Rules* to calculate disposal area size:

$$\text{MAI} = \text{DF} \times \text{AF} \times \text{HLR}$$

Parameters:

MAI is the minimum square feet of stone/soil interface bottom and sidewall area below the invert of the distribution system required.

DF is the design flow reference from a table or as determined by actual measured reading, adjusted for peak days as determined from the Code (gals/day).

AF is the adjustment factor for wastewater strength entering the disposal area, taken from the Code. This number is derived from the formula $\sqrt[3]{[\text{BOD}_5 + \text{SS (expressed in mg/l)}] \div 240 \text{ mg/l}}$.

BOD₅= Biochemical Oxygen Demand (5-Day) (mg/l)

TSS = Total Suspended Solids (mg/l)

HLR is the hydraulic loading rate from Table 7 for the Soil Profile (sq. ft./gpd).

The **Minimum Area Interface** is the working area of the disposal system for a disposal bed or trench system. It is the stone/soil interface of the bottom and sidewall area below the elevation of the invert of the distribution lines.

The **Design Flow** (DF) or average daily wastewater generation is taken from tables in the Code that projects average daily flows in gallons/day, or from measured readings.

The **Adjustment Factor** will, in most domestic wastewater applications be equal to 1.0 unless it receives pre-treatment, in which case it will be less than 1.0, depending on the degree of treatment, but in no case will the Adjustment Factor be lower than 0.5. If the wastewater is from a facility producing high levels of wastewater strength, as measured in

biochemical oxygen demand and total suspended solids, the AF will be greater than 1.0, in accordance with its strength.

The **Hydraulic Loading Rate (HLR)** is the disposal area required for each gallon/day of wastewater generated. Coarse textured soils require less area to dispose of each gallon of wastewater than fine textured soils, due to their greater permeability.

Stone Disposal Beds

Stone disposal bed design utilizes the equation cited in *Disposal Area Calculations*. The sidewall area is relatively small and insignificant in wide beds. As bed design is elongated and narrowed, the sidewall area becomes significant (see example below).

Example:

WIDE BED: A 20' wide x 50' long bed area has 1000 square feet of bottom area.

The 20' x 50' bed has 70 square feet of *effective* sidewall area. The effective side wall area is calculated by multiplying the perimeter length by the depth of stone beneath the distribution pipe (expressed in feet).

$$\text{Perimeter} \times \text{Depth of Stone Below Pipe (ft):}$$
$$(50' + 50' + 20' + 20') \times 0.5' = 70 \text{ sq. ft.}$$

NARROW BED: If the bed were reconfigured to 10' wide by 100' long, it would have the same bottom area.

However, the *effective* sidewall area would significantly increase.

$$\text{Perimeter (ft)} \times \text{Depth of Stone Below Pipe (ft):}$$

$$(100' + 100' + 10' + 10') \times 0.5' = 110 \text{ sq. ft.}$$

[The intent of the Code is to encourage longer and narrower systems giving a credit to the sidewall area].

BED DESIGN EXAMPLE:

Profile 3

Hydraulic Loading Rate (HLR) = 3.3 sq. ft./gpd (Table 8)

Design Flow (DF) = 270 gpd

Adjustment Factor (AF) = 1.0

MAI = DF x AF x HLR

MAI = 270 gpd x 1.0 x 3.3 sq. ft./gpd

MAI = 891 square feet

To determine disposal area length:

1. Choose disposal area width and stone depth.

Example: Designer selects 20' wide disposal area and 12" stone depth.

2. Subtract effective end side wall area from MAI

$[(20' + 20') \times 0.50' = 20 \text{ sq. ft.}]$

$891 \text{ sq. ft.} - 20 \text{ sq. ft.} = 871 \text{ sq. ft.}$

3. Determine square foot equivalent for each linear foot of disposal area:

$[(20 \text{ square feet of bottom area} + [(1 + 1) \times 0.5] \text{ square foot of sidewall area})/\text{linear foot of bed} = 21 \text{ square feet of bed/linear foot.}$

4. Divide net MAI by square footage/linear foot:

$$871 \div 21 = 42'$$

A 20' x 42' bed is required in this example.

Narrow Beds (Trenches)

Narrow disposal bed (trench) design utilizes the same equation in *Disposal Area Calculations*. The sidewall of narrow bed (trench) systems are significant compared to the bottom area.

Example:

A narrow bed or trench 3' wide (average width of backhoe bucket excavation) with 12" of stone has 4 sq. ft. of *effluent* trench area per linear foot of trench.

Table 9 illustrates length of above stone trench required for each gallon/day of wastewater for various soil types per the *State of Maine Subsurface Wastewater Disposal Rules* (May 1, 1995).

NARROW BED (TRENCH) DESIGN EXAMPLE:

Profile 3

Hydraulic Loading Rate (HLR) = 3.3 sq. ft./gpd (Table 8)

Design Flow (DF) = 270 gpd

Adjustment Factor (AF) = 1.0

MAI = DF x AF x HLR

MAI = 270 gpd x 1.0 x 3.3 sq. ft./gpd

MAI = 891 square feet

If a typical 3' wide trench with 12" deep stone layer is selected, there is:

(3 square feet of bottom area + 1 square foot of sidewall area)/linear foot of bed = 4 square feet of trench/linearfoot (end area is insignificant)

$891 \div 4 = 222'$

A 3' wide x 222' long narrow bed (trench) with 12" of stone depth is required in this example.

Table 9.
**LINEAR FEET OF STONE BED* REQUIRED
 PER GALLON/DAY OF WASTEWATER FOR
 VARIOUS WIDTHS**

SOIL PROFILE	HYDRAULIC LOADING (SQ. FT/GAL)	WIDTH OF BED										
		3'	4'	5'	6'	7'	8'	9'	10'	12'	15'	20'
6	2.0	0.50	0.40	0.33	0.28	0.25	0.22	0.20	0.18	0.15	0.125	0.10
4, 5	2.6	0.65	0.52	0.43	0.37	0.33	0.29	0.26	0.23	0.20	0.16	0.12
2, 3, 7	3.3	0.82	0.66	0.55	0.47	0.41	0.37	0.33	0.30	0.25	0.20	0.15
1, 8	4.1	1.03	0.82	0.68	0.58	0.52	0.45	0.41	0.37	0.32	0.25	0.19
9	5.0	1.25	1.0	0.83	0.71	0.63	0.55	0.5	0.45	0.38	0.31	0.23

* Assumes a 12" deep stone bed and disregards end wall area.

Proprietary Leaching Device

The number of proprietary disposal devices required is determined by dividing the stone bed square foot equivalent afforded to each unit into the MAI. The equivalent rating depends on disposal area layout; a larger equivalent is given for trenches than for cluster designs due to an increase in sidewall contact (see Table 10). A smaller relative disposal area size is required for proprietary devices because of the absence of stone masking the interface area see following examples).

FILL REQUIREMENTS

The number of inches of fill required from final grade of a disposal area to the original grade is calculated and reported. The depth of fill required is determined by using the slope gradient, size of disposal area, depth of disposal area, soil profile condition (ie. depth to limiting factor) and the minimum separation distances from the bottom of the disposal area

to the limiting factor.

PROPRIETARY DISPOSAL DEVICE DESIGN

EXAMPLE 1:

Profile 3

Hydraulic Loading Rate (HLR) = 3.3 sq. ft./gpd (Table 8)

Design Flow (DF) = 270 gpd

Adjustment Factor (AF) = 1.0

MAI = DF x AF x HLR

MAI = 270 gpd x 1.0 x 3.3 sq. ft./gpd

MAI = 891 square feet

If an approved precast concrete chamber unit is selected that is 4' wide by 8' long/unit to be clustered. The Code specifies that this unit has an effective area of 64 square feet/unit.

$891 \div 64 \text{ sq. ft./unit} = 13.9 \text{ units (14 units)}$

EXAMPLE 2:

Profile 1

Hydraulic Loading Rate (HLR) = 4.10 sq. ft./gpd (Table 8)

Design Flow (DF) = 180 gpd

MAI = DF x HLR

MAI = 180 gpd x 4.10 sq. ft./gpd

MAI = 738 square feet

If an approved gravel-less fabric covered disposal area tubing that is 10 inches in diameter is selected, to be used in trenches, the Code specifies that this unit and design has an effective area of 5 sq. ft. per foot of unit.

$738 \text{ sq. feet area} \div 5 \text{ sq. ft./ft.} = 147 \text{ linear feet required.}$

**Table 10.
Proprietary Leaching Device Sizing**

Proprietary Leaching Device Type	Manufacturers	Effective Disposal Area Equivalent (sq ft/unit) ^d		
		Type (size)	Cluster	Trench
Concrete Chambers	<i>America Downeast Gagne & Sons G.E. Godding George Roberts Pre-Cast Superior</i>	4' X 8'	64	77 ^a , 90 ^b
		8' X 8'	128	154
	<i>Genest</i>	4' X 10'	80	93 ^c , 113 ^b
Plastic Chambers	<i>Bio-Diffuser</i>	low profile (11")	36	44
		standard (14")	36	50
	<i>Infiltrator</i>	standard (12")	36	44
		high capacity (18")	36	50
	<i>Enviro Chamber</i>	standard (16")	36	44
		high capacity (17")	36	50
	<i>Contactor</i>	"C"	30	38
		Contactor	30	40
Gravel-less Cloth		Tripdrain	64	90
	<i>Geo-flow</i>	10" dia	N/A	5.0/linear ft.
Gravel-less Cloth	<i>SB2</i>	8" dia	N/A	2.0/linear ft.
	<i>SB2</i>	10" dia	N/A	2.6/linear ft.
	<i>Eljen</i>	Type A (2' x 3')	24	24
		Type B (3" x 4")	48	48

a. 8' sides butted together

d. Based on May 1, 1995 Code, subject to

- b. 4' sides butted together
- c. 10' sides butted together

revisions. See latest Code for design purposes.

There are two common methods used for calculating fill depths and length of fill extension: **SLOPE** and **CORNER ELEVATION methods**.

SLOPE Method

The **SLOPE method** utilizes the field data collected by measuring one representative slope gradient of the existing ground at the location of a proposed disposal area. The slope is usually measured with a clinometer or abney level. Additionally, the elevation of the existing ground at the highest corner of the proposed system is measured, usually by a hand held level, relative to the established elevation reference point. This method is quick but less precise than the corner elevation method. It is most applicable when:

- € the disposal system is small;
- € the terrain is nearly level to gently sloping;
- € the slope is uniform throughout the proposed disposal area length;
- € the disposal area length is positioned directly perpendicular to the ground slope;
- € the system and proposed fill extensions are amply distanced from property lines.

CORNER ELEVATION Method

The **CORNER ELEVATION method** utilizes the field data collected by measuring the elevation of the existing ground at the corners of the proposed disposal system relative to the established elevation reference point. The elevations are usually measured with a hand held level or tripod mounted level. Any break in slope within the fill extension area is also usually recorded.

This method is more precise and sensitive to slope variations throughout the proposed disposal area. It is most applicable when:

- € the disposal system is large;
- € the terrain is steeply sloping;
- € the slope is not uniform or is complex;
- € the disposal area length is not exactly positioned perpendicular to the ground slope;
- € the system and fill extensions are near property lines.



SLOPE METHOD Example (see Figure 46):

Soil Conditions (used for design purposes) - **Profile 3, Condition C**

Depth to Limiting Factor (to be projected to Highest Elevation)	(L _f) (inches)	= 16"
Separation Distance to Limiting Factor	(S _d) (inches)	= 12"
Shoulder Width	(S _w) (feet)	= 3'
Shoulder Slope	(S _s) (0 to 3%)	= .03 (3%)
Length of Disposal Bed	(L) (feet)	= 45'
Original Slope	(S _i) (0 to 20%)	= .12 (12%)
Width of Disposal Bed	(W) (feet)	= 20'
Thickness of Disposal Bed	(D) (inches)	= 24"
Fill Extension Slope	(E _s) (25 to 50%)	= .25 (25%)

PARAMETERS TO BE CALCULATED BELOW:

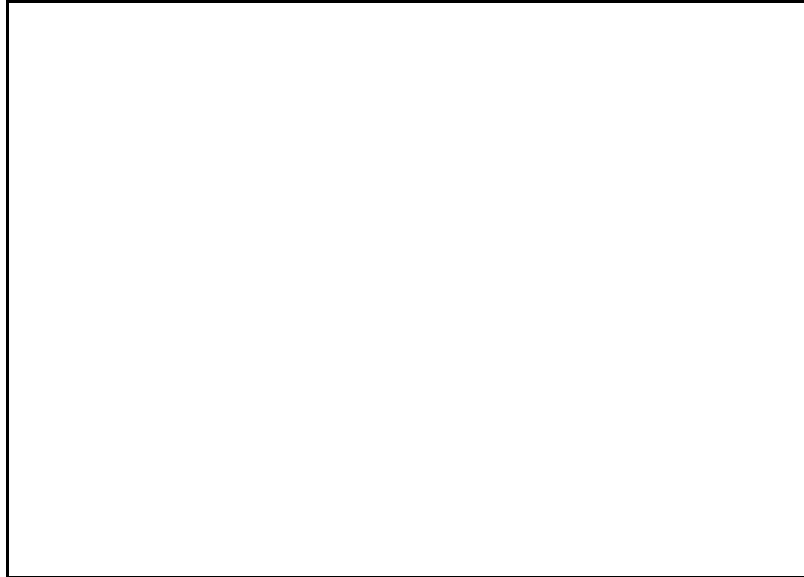
F _{up} = Fill Required Upslope (inches)	F _{dn} = Fill Required Downslope (inches)
F _{upS} = Fill required at Upslope shoulder (inches)	F _{dnS} = Fill required at Downslope Shoulder (inches)
Ext _{up} = Fill extension length upslope (feet)	Ext _{dn} = Fill extension length Downslope (feet)

SLOPE METHOD (Measure 1 representative slope of existing grade)

Calculation Example:

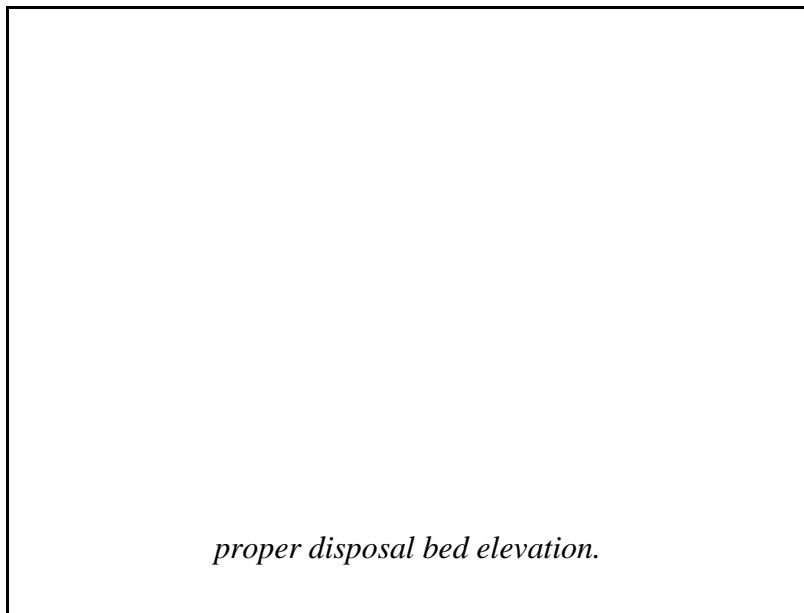
Average Slope Gradient (measured with SLOPE Method) (S_L) = 12% (.12)

F_{up} = D + S_d - L	F_{dn} = (12"/ft x W x S_i) + F_{up}
F_{up} = 24" + 12" - 16" = 20"	F_{dn} = (12"/ft x 20 x .12) + 20 = 28.8 + 20 = 48.8" or 49"
F_{upS} = F_{up} - [S_w x (S_s + S_L) x 12"]	F_{dnS} = S_w (S_L - S_s) x 12"/ft + F_{dn}
F_{upS} = 20" - [3' x (.03 + .12) x 12"]	F_{dnS} = 3 (.12 - .03) x 12"/ft + 49"
F_{upS} = 20" - 5.4" = 14.6" or 15"	F_{dnS} = 52.2" or 52"
Ext_{up} = (F_{upS} + 12 "/ft) + (E_s + S_L)	Ext_{dn} = (F_{dnS} + 12) + (E_s - S_L)
Ext_{up} = (15" + 12") + (.25 + .12)	Ext_{dn} = (52 + 12) + (.25 - .12)
Ext_{up} = 3.37' or 3"	Ext_{dn} = 33.3' or 33'



Calculation Example: Determining Disposal Area Elevations (See Figure 48)

Elevation of Disposal Area Bottom	$(E_{BB}) = \text{Elev at Highest Corner} - L_f + S_d$
	$(E_{BB}) = -24'' - 16'' + 12''$
	$(E_{BB}) = -28''$
Elevation of Top of System	$(E_{BS}) = E_{BB} + D$
	$(E_{BS}) = -28 + 24''$
	$(E_{BS}) = -04''$



Corner Elevation Method:

CORNER ELEVATION METHOD (EXAMPLE) (see Figures 47, 48 and 49):

Soil Conditions (used for design purposes) - **Profile 3, Condition C**

Depth to Limiting Factor (to be projected to Highest Elevation)	(L _r) (inches)=	16"
Separation Distance to Limiting Factor	(S _d) (inches)	= 12"
Shoulder Width	(S _w) (feet)	= 3'
Shoulder Slope	(S _s) (.00 to .03)=	3% (.03)
Length of Disposal Bed	(L) (feet)	= 45'
Width of Disposal Bed	(W) (feet)	= 20'
Depth of Disposal Bed	(D) (inches)	= 24"
Fill Extension Slope	(E _s) (.25 to .50)	= 25% (.25)

PARAMETERS TO BE CALCULATED BELOW:

- E_{BB} = Elevation of Disposal Area Bottom
- E_{BS} = Elevation of Disposal Area Surface
- S_{L1} = Slope of Existing Ground across width at one end
- S_{L2} = Slope of Existing Ground across width at other end
- S_{L3} = Slope of Existing Ground along upslope length
- S_{L4} = Slope of Existing Ground along downslope length
- F_{up(1)(2)} = Fill upslope required at each upslope corner
- F_{dn(1)(2)} = Fill downslope required at each downslope corner
- Ext up₍₁₎₍₂₎ = Fill extension length (feet) upslope at each corner
- Ext dn₍₁₎₍₂₎ = Fill extension length (feet) downslope at each corner
- F_{up S(1)(2)} = Fill at upslope shoulder side corner
- F_{dn S(1)(2)} = Fill at downslope shoulder side corner
- Flup₍₁₎₍₂₎ = Fill at upslope shoulder lateral corner
- Fldn₍₁₎₍₂₎ = Fill at downslope shoulder lateral corner

CORNER ELEVATION METHOD TO CALCULATE SLOPE (See Figure 49)

$$S_{L1,2} = \frac{[\text{Elevation at uphill corner (inches)} - \text{Elevation at Downhill Corner (inches)}] \div 12}{\text{Width of System (W)}}$$

$$S_{L1} = \frac{[-24 - (-48)] \div 12}{20}$$

$$S_{L2} = \frac{[-30 - (-65)] \div 12}{20}$$

$$S_{L1} = \mathbf{10\%}$$

$$S_{L2} = \mathbf{14.5 \text{ or } 15\%}$$

$$S_{L3,4} = \frac{[\text{Elevation Up}_1 - \text{Elevation Up}_2] \div 12}{\text{Length (L)}}$$

$$S_{L4} = \frac{[\text{Elev Dn}_1 - \text{Elev Dn}_2] \div 12}{45'}$$

$$S_{L3} = \frac{[-24 - (-30)] \div 12}{45}$$

$$S_{L4} = \frac{[-48 - (-65)] \div 12}{45'}$$

$$S_{L3} = \mathbf{1.1\% \text{ or } 1\%}$$

$$S_{L4} = \mathbf{3.1\% \text{ or } 3\%}$$

CORNER ELEVATION METHOD
DEPTH OF FILL CALCULATIONS
(see Figure 49)

The upslope fill at each corner is equal to the disposal area surface (E_{BS}) minus the grade measured at corner (Up).

$$\begin{aligned} F_{up1} &= E_{BS} - Up_1 \\ F_{up1} &= -04 - (-24) \\ F_{up1} &= 20" \end{aligned}$$

$$\begin{aligned} F_{up2} &= E_{BS} - Up_2 \\ F_{up2} &= -04 - (-30) \\ F_{up2} &= 26" \end{aligned}$$

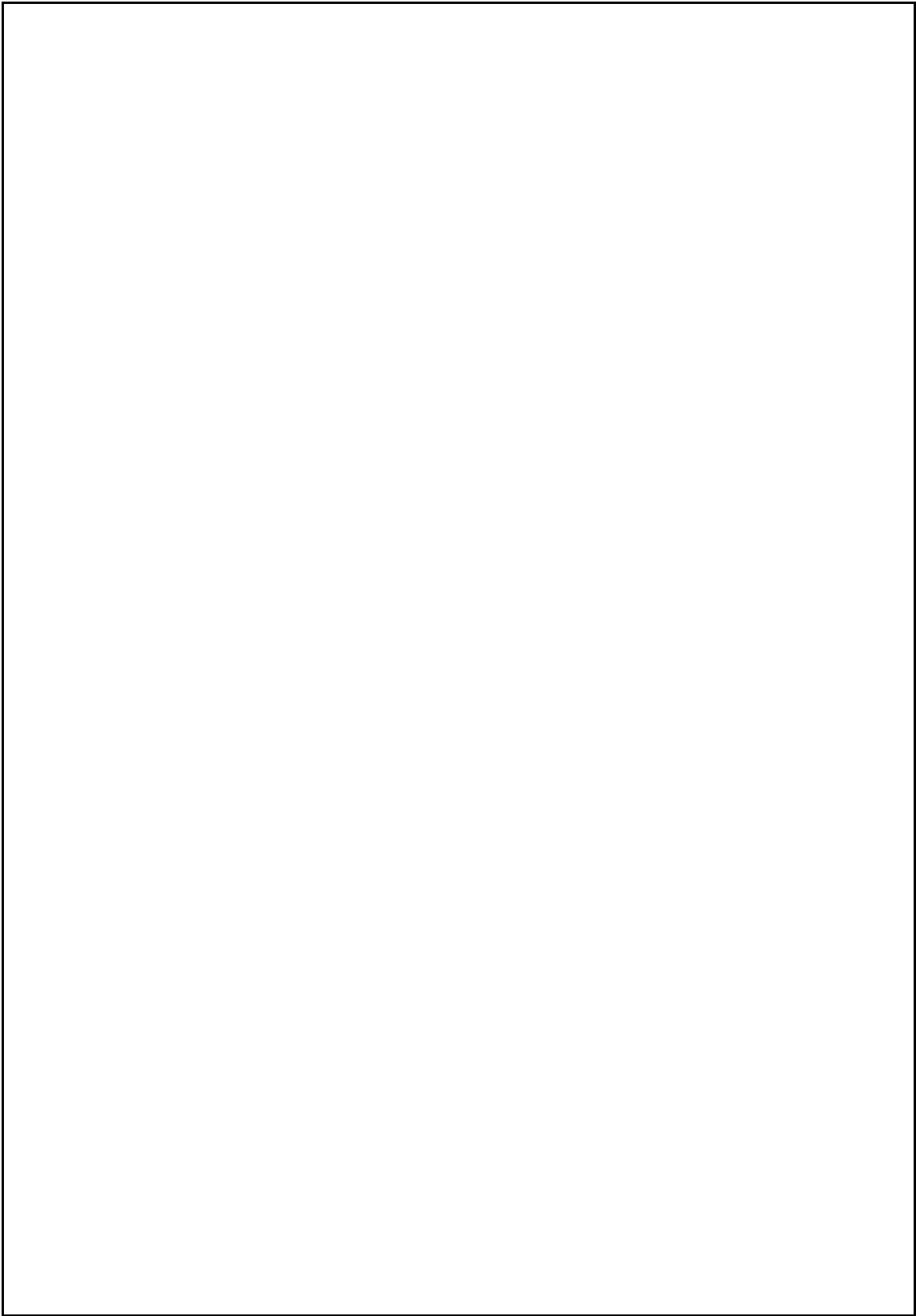
The downslope fill at each corner is equal to the disposal area surface (E_{BS}) minus the grade measured at corner (Dn).

$$\begin{aligned} F_{dn1} &= E_{BS} - Dn_1 \\ F_{dn1} &= -04 - (-48) \\ F_{dn1} &= 44" \end{aligned}$$

$$\begin{aligned} F_{dn2} &= E_{BS} - Dn_2 \\ F_{dn2} &= -04 - (-65) \\ F_{dn2} &= 61" \end{aligned}$$

The depth of fill at shoulders are calculated below:

$F_{upS_1} = F_{up1} - [S_W \times (S_{L1} + S_S) \times 12"]$	$F_{upS_2} = F_{up2} - [S_W \times (S_{L2} + S_S) \times 12"]$
$F_{upS_1} = 20" - [3' \times (.10 + .03) \times 12"]$	$F_{upS_2} = 26" - [3' \times (.15 + .03) \times 12"]$
$F_{upS_1} = 20 - 4.68" = 15"$	$F_{upS_2} = 26" - 6.48" = 20"$
$F_{dnS_1} = F_{dn1} + [S_W \times (S_{L1} - S_S) \times 12"]$	$F_{dnS_2} = F_{dn2} + [S_W \times (S_{L2} - S_S) \times 12"]$
$F_{dnS_1} = 44 + 3 (.10 - .03) \times 12"$	$F_{dnS_2} = 61" + 3 (.15 - .03) \times 12"$
$F_{dnS_1} = 44 + 2.52" = 47"$	$F_{dnS_2} = 61" + 4.32 = 65"$
$F_{lup1} = F_{up1} - [S_W \times (S_S + S_{L3}) \times 12"]$	$F_{lup2} = F_{up2} - [S_W \times (S_S - S_{L3}) \times 12"]$
$F_{lup1} = 20" - [3 \times (.03 + .01) \times 12"]$	$F_{lup2} = 26" + 3 \times (.03 - .01) \times 12"$
$F_{lup1} = 20 - 1.44 = 19"$	$F_{lup2} = 26" + .72" = 27"$
$F_{ldn1} = F_{dn1} - [S_W \times (S_S + S_{L4}) \times 12"]$	$F_{ldn2} = F_{dn2} - [S_W \times (S_S - S_{L4}) \times 12"]$
$F_{ldn1} = 44" - [3 \times (.03 + .03) \times 12]$	$F_{ldn2} = 61" + 3 \times (.03 - .03) \times 12"$
$F_{ldn1} = 44 - 2.16 = 42"$	$F_{ldn2} = 61" + 0 = 61"$
$Ext\ up_1 = (F\ upS_1 \div 12) \div (E_S + S_{L1})$	$Ext\ up_2 = (F_{upS_2} \div 12) \div (E_S - S_{L2})$
$Ext\ up_1 = (15" \div 12) \div (.25 + .10)$	$Ext\ up_2 = (20" \div 12) \div (.25 - .15)$
$Ext\ up_1 = 1.25 \div .35 = 3.57\ or\ 4'$	$Ext\ up_2 = 1.66 \div (.40) = 4.15\ or\ 4'$
$Ext\ dn_1 = (F\ dnS_1 \div 12) \div (E_S + S_{L1})$	$Ext\ dn_2 = (F_{dnS_2} \div 12) \div (E_S - S_{L2})$
$Ext\ dn_1 = (47" \div 12) \div (.25 - .10)$	$Ext\ dn_2 = (65" \div 12) \div (.25 - .15)$
$Ext\ dn_1 = 3.92 \div .15 = 26.11\ or\ 26'$	$Ext\ dn_2 = 5.58 \div (.10) = 54.2\ or\ 54'$
$Ext\ lup_1 = (F\ lup_1 \div 12) \div (E_S + S_{L3})$	$Ext\ lup_2 = (F_{lup_2} \div 12) \div (E_S - S_{L3})$
$Ext\ lup_1 = (19" \div 12) \div (.25 + .01)$	$Ext\ lup_2 = (27" \div 12) \div (.25 - .01)$
$Ext\ lup_1 = 1.58 \div .26 = 6.08\ or\ 6'$	$Ext\ lup_2 = 2.25 \div (.24) = 9.37\ or\ 9'$
$Ext\ ldn_1 = (F\ ldn_1 \div 12) \div (E_S + S_{L4})$	$Ext\ ldn_2 = (F_{ldn_2} \div 12) \div (E_S - S_{L4})$
$Ext\ ldn_1 = (42" \div 12) \div (.25 + .03)$	$Ext\ ldn_2 = (61" \div 12) \div (.25 - .03)$
$Ext\ ldn_1 = 3.5 \div .28 = 12.5\ or\ 13'$	$Ext\ ldn_2 = 5.08 \div (.22) = 23.10\ or\ 23'$



A Soil and Site Evaluation, along with a completed subsurface wastewater disposal design, is finalized in a three-page set of plans called a **Subsurface Wastewater Disposal Application HHE-200 form** (see Figures 50a, 50b and 50c). This form is the application for the permit to install a subsurface wastewater disposal system. This form will be processed as discussed in Chapter IV.

Figure 50a. Application for On-site Subsurface Wastewater Disposal System (Page 1)

Figure 50b. Application for On-site Subsurface Wastewater Disposal System (Page 2)

IV. ADMINISTRATION: PERMITTING AND DISPOSAL SYSTEM INSPECTION

SYNOPSIS:

This chapter discusses the administration and inspection of subsurface wastewater disposal systems. Included in this chapter are a discussion of permitting, forms issued by the Division of Health Engineering, and equipment needed for inspection.

This section should be of particular interest to the local plumbing inspector and regulators, and contains background information of interest to site evaluators, excavating contractors, planning board members, and property owners.

TOPICS:

State administration of Subsurface Wastewater Disposal Programs, Site Evaluator Program, Local Plumbing Inspector Program, permits, applications, forms, inspection practices, violations of Rules, record keeping

STATE ADMINISTRATION

The **Department of Human Services, Division of Health Engineering**, is the State agency responsible for administering the *Subsurface Wastewater Disposal Rules*.

The Division of Health Engineering is authorized by Maine Law, 22 MRSA, 42 to develop rules which provide the State of Maine minimum design criteria for subsurface wastewater disposal. The rules are meant to assure environmental sanitation and protection of public health. The *State of Maine, Subsurface Wastewater Disposal Rules* (10-144A CMR 241) govern siting, design, construction and inspection of subsurface wastewater disposal systems.

There are two exceptions:

€ *public sewer systems* and *overboard waste discharge systems* are administered by the **Maine Department of Environmental Protection**.

€ *hazardous waste materials* are regulated by the **Maine Department of Environmental Protection**.

The Division of Health Engineering assures compliance with the *Subsurface Wastewater Disposal Rules* through two programs: the licensed Site Evaluator Program and the Certified

Plumbing Inspector Program.

SITE EVALUATION PROGRAM

Since July 1974, the **Department of Human Services, Division of Health Engineering** has licensed persons to practice Site Evaluation. Site Evaluation is the practice of evaluating, reporting and applying basic soil and site conditions to subsurface wastewater disposal and system design. This is accomplished in compliance with the *State of Maine, Subsurface Wastewater Disposal Rules*. In order to become licensed, individuals must meet basic educational and experience criteria and also pass two exams. The written exam tests an applicant's knowledge of the Rules, design ability, and soils. Upon successful completion of the written exam, an applicant must then pass the field exam. The field exam tests the applicant's ability to describe, evaluate, and classify soil profiles. The applicant's soil descriptions are compared to a master description, created by comparing results of several experts who have described soil test pits before the exam is given. The successful applicant must demonstrate a thorough knowledge of the Rules, engineering design capabilities and soil science principles.

The **Site Evaluation** program is directly overseen by the **State Site Evaluator (SSE)**. The SSE not only reviews applications for Site Evaluators but also administers site evaluator exams and addresses issues involving questions or complaints regarding site evaluation. Field review of disposal systems on proposed sites are commonly performed by the SSE in administration of the program.

A person interested in becoming a licensed Site Evaluator should be very familiar with Chapters I, II and III before taking the Site Evaluator Examination. A licensed Site Evaluator is authorized to complete the Subsurface Wastewater Disposal System Application as described in Chapter III.

LOCAL PLUMBING INSPECTOR PROGRAM

The **Division of Health Engineering** is also responsible for administering the *Subsurface Wastewater Disposal Rules* and the Internal Plumbing Rules and appointing Local Plumbing Inspectors in the unorganized territories of Maine. Certification of Local Plumbing Inspectors is the responsibility of the **Department of Economic and Community Development Code Enforcement Officer Program**. A Local Plumbing Inspector is a Municipal or Department of Human Services appointed official charged with implementing the Rules and carrying out duties required by 30-A MRSA 4221. Local Plumbing Inspector applicants must pass a code enforcement exam section dealing with pertinent legal issues and basic enforcement techniques and exam sections covering both the *Subsurface Wastewater Disposal Rules* and the Internal Plumbing Rules. Certificates are issued to successful applicants. However, they must be maintained through continuing education. Once the exams have been successfully completed, the individual must then be appointed by the

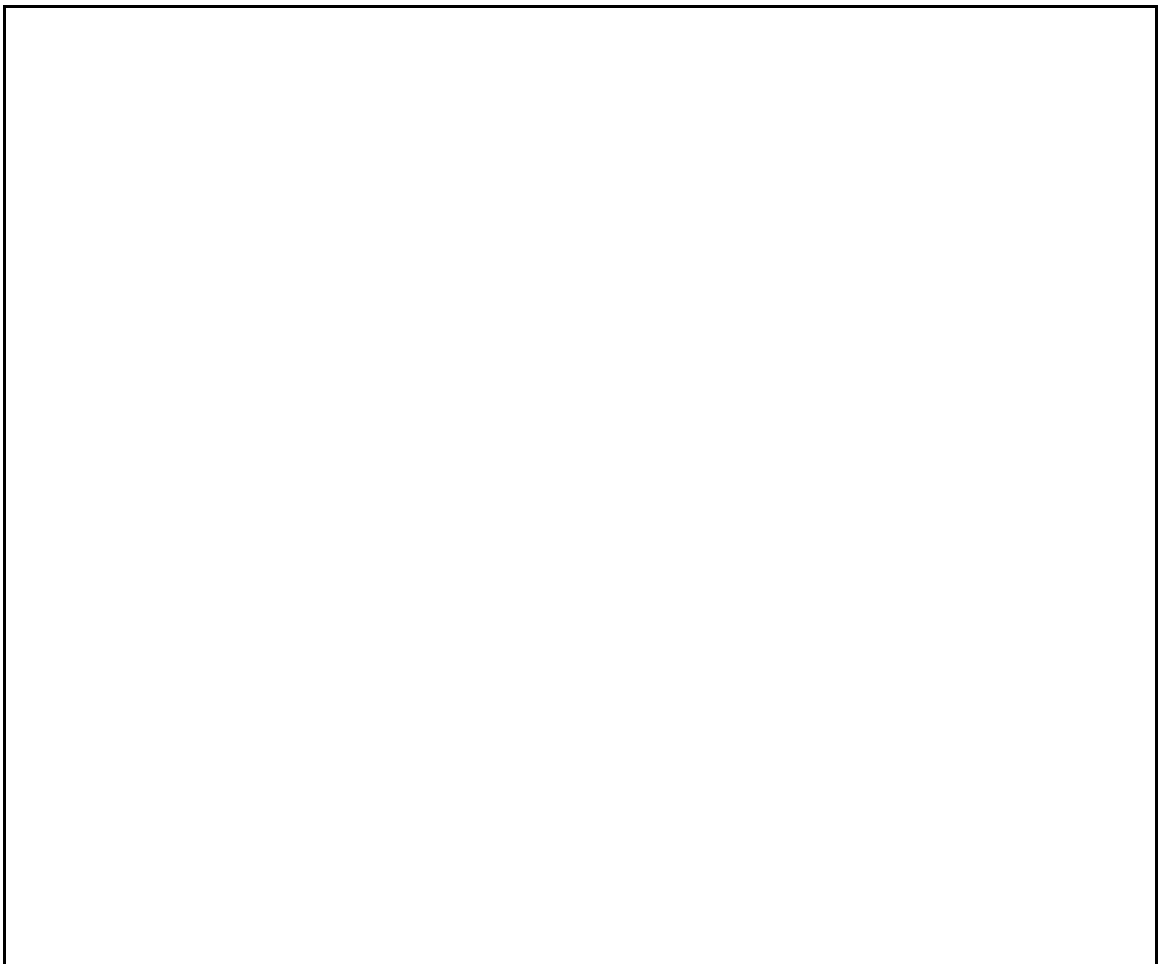
Municipality or, in unorganized areas of Maine, by the Department of Human Services. Responsibilities of Local Plumbing Inspectors include conducting inspections and issuing permits.

A person interested in becoming a Local Plumbing Inspector should be very familiar with Chapters I, IV and V before taking the Local Plumbing Inspector Examinations.

PERMITS, APPLICATIONS, AND ASSOCIATED ADMINISTRATIVE FORMS

Permits are required for any work related to Subsurface Wastewater Disposal Systems except for the following:

- € Maintenance of a pump, siphon or accessory equipment
- € Clearance of a stoppage
- € Sealing of a leak in a treatment tank, building sewer or effluent line.
- € Adding fill material or extending fill extension with notification of the Local Plumbing Inspector



In order for a Local Plumbing Inspector to issue a permit, he or she needs to determine that the application is complete, in full compliance with the current *Subsurface Wastewater Disposal Rules* and that full payment of the permit fee has been received see Figure 52).

The Local Plumbing Inspector should be presented with a subsurface wastewater disposal application, completed by a licensed Site Evaluator, by any applicant who wants to obtain a permit to install a complete disposal system or an individual disposal system component. A Local Plumbing Inspector may initiate the application for those applicants who want to replace the septic tank only. Work may not be started on any system until an application has a signed permit label attached to it. Permits are valid for up to two years. If no work has been started within two years, the permit becomes invalid.

It is the responsibility of the Local Plumbing Inspector to keep good records of permits issued. Permit labels are issued on sheets in sets of three; one is attached to an application for the Local Plumbing Inspector's records, a second is attached to a copy of the application for the owner, and the third is attached to a copy of the application for the State's records (see Figure 51). The State copy should be forwarded to the Department of Human Services Plumbing Program:

Department of Human Services
Division of Health Engineering
State House Station #10
Augusta, Maine 04333-0010

along with their share of the minimum basic permit fee.

Subsurface Wastewater Disposal Application Not Needed for Replacement Treatment Tank.

A subsurface wastewater disposal application completed by a Site Evaluator is not needed if an applicant wants to install a *replacement* treatment tank. Generally, the Local Plumbing Inspector has a supply of first pages of the Subsurface Wastewater Disposal Application in which the Local Plumbing Inspector can initiate the creation of the permit application by merely filling out the applicant's address information and denoting the size of the proposed replacement septic tank.

If the work goes beyond the replacement of only the treatment tank, then a subsurface wastewater disposal application completed by a Site Evaluator is required.

A **Subsurface Wastewater Disposal Application (HHE-200 form)** is required to be completed by a Licensed Site Evaluator for all complete subsurface wastewater disposal systems or for individual disposal areas. The application then needs to be reviewed and permitted by the Local Plumbing Inspector. A permit label is affixed to the subsurface wastewater disposal application if the Local Plumbing Inspector finds it acceptable. The permit label authorizes the work.

REVIEW OF SUBSURFACE WASTEWATER DISPOSAL APPLICATION (HHE-200 FORM)

The LPI should review a subsurface wastewater disposal application (HHE-200 form) for completeness before affixing a permit label. In addition, the LPI should be familiar with the Subsurface Wastewater Disposal System Application form on not any errors are present which must be corrected. A step-by-step breakdown of the HHE-200 form follows:

SUBSURFACE WASTEWATER DISPOSAL SYSTEM APPLICATION

Department of Human Services
Division of Health Engineering
Division of Health Engineering
Division of Health Engineering

PAGE 1

Caution: Permit Required

The Subsurface Wastewater Disposal System shall not be installed until a Permit is attached here by the Local Plumbing Inspector. The Permit shall authorize the owner or installer to install the disposal system in accordance with this application and the Maine Subsurface Wastewater Disposal Rules.

Street: 185 CORNFIELD ROAD
Subdivision Lot #
PROPERTY OWNERS NAME: Last: RIOUX First: MARK & SHARJ
Mailing Address of Owner: SAME
Daytime Tel #
Municipal Tax Map # 9 Lot # 24-18

1 → **Owner Statement**
I state that the information submitted is correct to the best of my knowledge and understand that any falsification is reason for the Department and/or Local Plumbing Inspector to deny a Permit.
Signature of Owner/Applicant _____ Date _____
Local Plumbing Inspector Signature _____ Date Approved _____

PERMIT INFORMATION

THIS APPLICATION IS FOR: 1. First Time System 2. Multi-User System 3. <input checked="" type="checkbox"/> Replacement System 4. Expanded System a. One-time exempted b. Non-exempted 5. Experimental System 6. Seasonal Conversion	THIS APPLICATION REQUIRES: 1. <input checked="" type="checkbox"/> No Rule Variance 2. <input type="checkbox"/> First Time System Variance (Municipal) 3. <input type="checkbox"/> First Time System Variance (State) 4. <input type="checkbox"/> Replacement System Variance a. <input type="checkbox"/> Local Plumbing Inspector approval b. <input type="checkbox"/> State & Local Plumbing Inspector approval 5. <input type="checkbox"/> Minimum Lot Size Variance 6. <input type="checkbox"/> Seasonal Conversion Variance	DISPOSAL SYSTEM COMPONENT(S) 1. <input type="checkbox"/> Non-Engineered System 2. <input type="checkbox"/> Primitive System 3. <input type="checkbox"/> Alternative Toilet Specify _____ 4. <input type="checkbox"/> Non-Engineered Treatment Tank 5. <input type="checkbox"/> Holding Tank _____ Gallons 6. <input checked="" type="checkbox"/> Non-Engineered Disposal Area (only) 7. <input type="checkbox"/> Separated Laundry System 8. <input type="checkbox"/> Engineered System (+2000 gpd) 9. <input type="checkbox"/> Engineered Treatment Tank (only) 10. <input type="checkbox"/> Engineered Disposal Area (only)
SIZE OF PROPERTY 68,220 S.F. ± SHORELAND ZONING Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	DISPOSAL SYSTEM TO SERVE: 1. <input checked="" type="checkbox"/> Single Family Dwelling Unit 2. <input type="checkbox"/> Multiple Family Dwelling Unit Number of Units _____ 3. <input type="checkbox"/> Other SPECIFY _____	TYPE OF WATER SUPPLY EXISTING DRILLED WELL

2 →

DESIGN DETAILS (SYSTEM LAYOUT SHOWN ON PAGE 3)

EXISTING TREATMENT TANK 1. <input checked="" type="checkbox"/> Concrete <input checked="" type="checkbox"/> Regular <input type="checkbox"/> Low Profile 2. <input type="checkbox"/> Plastic SIZE 1000 Gallons	DISPOSAL AREA TYPE/SIZE 1. <input checked="" type="checkbox"/> Stone Bed 900 Sq.Ft. 2. <input type="checkbox"/> Proprietary Device Sq.Ft. <input type="checkbox"/> Clustered <input type="checkbox"/> Linear <input type="checkbox"/> Regular <input type="checkbox"/> H 20 3. <input type="checkbox"/> Trench <input type="checkbox"/> In Ft. 4. <input type="checkbox"/> Other	GARBAGE DISPOSAL UNIT 1. <input checked="" type="checkbox"/> No 2. <input type="checkbox"/> Yes <input type="checkbox"/> Multi-compartment tank <input type="checkbox"/> Tank in series <input type="checkbox"/> Increase in tank capacity <input type="checkbox"/> Filter on tank outlet	CRITERIA USED FOR DESIGN FLOW (Show Calculations) SINGLE FAMILY DWELLING (3 BEDROOM)
PROFILE & DESIGN CLASS PROFILE DESIGN 3 C DEPTH TO MOST LIMITING FACTOR 24-30	DISPOSAL AREA SIZING 1. Small 2.0 2. Medium 2.80 3. <input checked="" type="checkbox"/> Medium-Large 3.30 4. Large 4.10 5. Extra-Large 5.00	PUMPING 1. <input checked="" type="checkbox"/> Not Required 2. <input type="checkbox"/> May Be Required 3. <input type="checkbox"/> Required DOSE _____ Gallons	DESIGN FLOW 270 (Gallons/Day)

4 →

SITE EVALUATOR'S STATEMENT

On 4/24/94 (date) I completed a site evaluation on this property and state that the data reported is accurate and that the proposed system is in compliance with the Subsurface Wastewater Disposal Rules.

5 → *Albert F Welch*
Site Evaluator Signature
ALBERT WELCH ASSOC., INC.
Firm Name
163 SE #
839-5563 Telephone
1/13/97 Date
Page 1 of 3 HHE-200 Rev 5/96

6→

1. **Property owners name and address.** The address where the disposal system is to be located is the property owner's name. In addition, name and address of the Applicant must be completed. The Applicant is the person who is seeking the permit and is to be contacted if any questions regarding the application arise. In most cases, the Applicant is the property owner, but occasionally the applicant is an agent for the property owner, such as a contractor or developer.

SUBSURFACE WASTEWATER DISPOSAL	
PROPERTY LOCATION	
Town or Plantation	BIXTON
Street	185 CORNFIELD ROAD
Subdivision #	PROPERTY OWNERS ONLY
Last: RIoux	First: MARK & SHARL
Mailing Address of Owner	SAME
Daytime Tel. #	

2. **Statement:**
owner or is seeking the

Owner Statement	
I state that the information submitted is correct to the best of my knowledge and understand that any falsification is reason for the Department and/or Local Plumbing Inspector to deny a Permit.	
Signature of Owner/Applicant	Date

Owner/Applicant
This is where the applicant, whichever permit, signs the

subsurface wastewater disposal application (HHE-200 form) as an indication that the information on the application is accurate. The applicant or owner is only responsible for information that he/she should be knowledgeable about, such as property size, structure, property lines, etc. It is not expected that the owner or applicant will be knowledgeable regarding soil evaluation or design specifications.

3. **Permit Sticker Location:** This is the location that the permit sticker is affixed to a subsurface wastewater disposal application (HHE-200) and represents that a permit has been issued, once the sticker has been affixed. The State supplies the LPI with 3 permit stickers for each permit number. One is affixed to the a copy of the subsurface wastewater disposal application (HHE-200) and returned to the applicant, a second is affixed to another copy of the HHE-200 form and sent to the State for their records. The third is affixed to a third copy of the subsurface wastewater disposal application (HHE-200 form) and kept by the LPI for his or her records. It is important for the LPI to keep good records of permits and to pass those records on to the town when their appointment expires. The LPI should also submit the State's share of the minimum basic permit fee. Any additional permit fees assessed by the town may be kept by the town in their entirety. State copies of the application and State fees should be submitted to:

Permit Sticker

The Subsurface Wastewater Disposal System shall not be installed until a Permit is attached here by the Local Plumbing Inspector. The Permit shall authorize the owner or installer to install the disposal system in accordance with this application and the Maine Subsurface Wastewater Disposal Rules.

Department of Human Services
Division of Health Engineering
State House, Station #10
Augusta, Maine 04333

Municipal Tax Map # _____
Lot # _____

Caution: Inspection Required

I have inspected the installation authorized above and found it to be in compliance with the Subsurface Wastewater Disposal Rules Application.

Local Plumbing Inspector Signature _____ Date Applied _____

This section also has a space for tax map number and lot number of the property where the disposal system is to be located. Filling this space out is optional and not required for permit issuance.

4. **Permit Information:** This section includes the following blocks, all of which must be filled out before a permit can be issued:
- a. **Application Type** - the form should indicate whether the application is for a first-time system (a property where no system is presently located); a multi-user system (three or more structures under different ownership using a single disposal

field; replacement system; expanded system; both exempted and non-exempted; experimental system; or seasonal conversion.

The LPI should pay particular attention to this section to be sure the appropriate box is checked off. Criteria which must be met vary according to the permit type requested. First time system criteria are the most stringent, and include application for properties where illegal systems are being replaced or where the property has been unused for many years and is in a state of disrepair. Multi-user systems only apply to systems where 3 or more structures, under different ownership, are to be served by a single system or a single system component, such as a disposal field. Replacement systems apply to the replacement of existing, legal subsurface wastewater disposal systems or proposed licensed overboard discharge systems (not to be confused with existing buildings that do not have a legal system). This category should not be confused with replacements where additional wastewater flow is to be generated, such as the addition of a bedroom, employees or the change from an alternative toilet to a flush toilet.

Systems with proposed additional flows are considered to be expanded systems and should be marked as such. Expanded systems should be separated into one of two categories: *one-time exempted* and *non-exempted*. **One-time exempted** systems are those that add one bedroom, replace an alternative toilet with a flush toilet, or, for commercial systems, increase design flow by 25% or less. All other expansions must be considered non-exempted expansions. **One-time exempted expansions** outside the shoreland zone need only meet replacement system criteria. **One-time exempted** expansions inside the shoreland zone need to comply with seasonal conversion criteria. **Structures only qualify for this category once.** All other expansions for those same structures systems designed for expanded wastewater flows can be installed, upon being permitted, or can be kept on file for future installation, should the existing system fail. If not installed upon being permitted, a copy shall be filed in the registry of deeds and all abutters must be notified by certified mail. This is to ensure that the proposed disposal area site is protected for future use.

The box for experimental system category is for those systems that are not considered as conventional and described in the Rules. No experimental system may be installed until approved by DHE. In addition, experimental systems

require the design of a conventional system which can be installed in the event that the experimental system fails.

The box for seasonal conversion is to be checked off if the structure is to be converted from seasonal to year-round use. This category only applies if the structure was in existence on December 31, 1981 and was not used as a principle structure between the years of 1977-1981. Any structure built since 1981 has been required to have a disposal system in compliance with rules which exceeded seasonal conversion criteria, so a seasonal conversion permit is not required. For seasonal conversion permits, the applicant must meet substantial compliance criteria.

- b. **Size of Property:** This box is for noting the property size, either in square feet or acres.
- c. **Shoreland Zoning:** This box is for noting whether or not the disposal system, (not structure) is to be located within 250' of a major water course/body. The Shoreland Zone of a wetland is not intended to be noted in this box.
- d. **Application Requirements:** This box is where the applicant indicates whether or not a variance is required, and, if required, what type of variance. A First Time System Variance (Municipal) is the box for New System Variances that can be approved by the municipality (soils variance only). First Time System Variance (State) is for all other first-time system variances that require state approval. It would also apply to non-exempted expansion systems, if they require a variance.

The box for replacement system variance applies to all replacement systems, including exempted expansions. In addition, the applicant must indicate whether the variance can be approved by the LPI or requires State approval (see the Rules for LPI limit of authority).

This block also includes categories for Minimum Lot Size variance and Seasonal Conversion Variance. The box for Minimum Lot Size variance should be marked if less than 66.66 square feet of lot size is available for each gallon of wastewater generated per day (all single family dwellings are considered to generate 300 gpd for this determination). In addition, if the structure is on a property which abuts a major waterbody/course, it must have 100' of frontage for each 300 gpd of wastewater generated.

Example:

A proposed project is on a parcel of land with 60,000 square feet and proposes to dispose of 1200 gallons per day.

$$60,000 \text{ sq. ft.} \div 1200 \text{ gpd} = 50 \text{ sq. ft. of land/gpd}$$

This would require a Minimum Lot Size Waiver. The property would need to be at best 79,992 sq. ft. to meet the Rule (ie. $1200 \text{ gpd} \times 66.66 \text{ sq. ft./gpd} = 79,992 \text{ sq. ft.}$)

- e. **Disposal System to Serve:** This box should indicate the type of structure to be served by the disposal system; single family dwelling, multi-family dwelling or other (such as restaurant, store, office, etc.).
- f. **Disposal System Component(s):** This is the box where the applicant indicates what the permit is for. Categories include:
1. **Non-Engineered System** - this category should only be checked off when the application is for an entire subsurface wastewater disposal system which will handle less than 2000 gallons per day.
 2. **Primitive System** - this category is for those systems serving dwellings where water is hand-carried or hand-pumped. They are designed for a minimum of 25 gpd and a maximum of 75 gpd (25 gpd per fixture for up to 3 fixtures). These system require the location of an area which is suitable for a full-size system, in compliance with the Rules, in the event that an applicant wishes to upgrade in the future. Primitive systems require an alternative toilet which is part of the application and do not require the alternative toilet box to be checked.
 3. **Alternative Toilet** - This box is for the permitting of an alternative toilet only when not part of a primitive system application. An alternative toilet is a non-water carriage toilet such as an outhouse, gas or compost toilet. The type of alternative toilet proposed should be specific.
 4. **Non-Engineered Treatment Tank** - This box is for a permit for the installation of a treatment tank only for a system which generated less than

2000 gpd of wastewater.

5. **Holding Tank** - If the application is for the installation of a holding tank, this box should be checked and the size of the tank specified. In addition, the type of holding tank (concrete or plastic) should be noted here or in the box where treatment tank specifications are noted.

If the holding tank is for a *new* building, the application for a commercial use must be less than 100 gpd or the municipality must have an approved *local holding tank ordinance*. Holding tanks commonly are for *replacement* systems.

6. **Non-Engineered Disposal Area (only)** - When a failing disposal field is to be replaced but the existing septic tank is to be retained, this box is to be checked. One of the more common errors on applications is checking off box #1, Non-Engineered system when, in fact, only a non-engineered disposal field is intended to be installed.
7. **Separated Laundry System** - This box is for the design and permitting of an alternative laundry disposal system only. If an alternative laundry disposal field is proposed as part of a non-engineered system, this box should not be checked.
8. **Engineered System (+ 2000 gpd)** - If a complete system, designed to handle 2000 gpd or more is to be permitted, this box should be checked. All engineered systems require designs by a Registered Professional Engineer and State approval prior to permitting.
9. **Engineered Treatment Tank (only)** - This box is to be checked when a permit is requested for installing a treatment tank only for a 2000 gpd or more system.
10. **Engineered Disposal Area (only)** - This box should be checked when the application is for the permitting of a 2000 or more gpd disposal field only.

g. **Type of Water Supply**: This box is for a description of the type of water supply to serve the structure seeking a permit. Common types of water supply are dug or drilled well and public water. Less common are spring or hand-carried.

4. **DESIGN DETAILS** - This section contains information regarding design criteria for the disposal system or system component, and includes the following:

- a. **Treatment tank** - This is where the applicant indicates the type and size septic tank proposed. If no tank is proposed, N/A should be written in this box. If a holding tank is proposed, treatment can be crossed off and holding written in. If the existing treatment tank is to be used, existing is often written above Treatment Tank and the size indicated below.
- b. **Profile and design class** - This block should indicate the soil profile and design class used to size the disposal field. It also includes depth to the most limiting factor, the limiting factor upon which the design is based. If more than one limiting factor is present, the most limiting of the two should be used. This category is not required for treatment tank only or holding tank applications.
- c. **Disposal area type/size** - This is the block where the applicant indicates the type, size and layout of the disposal area. If proprietary devices are to be used, it should be noted as to whether they will be clustered, linear, regular or placed in an area subject to vehicular traffic loads whereby *H-20 rated* is required. There is also a blank for “other”, where other systems, such as *peat*, can be indicated.
- d. **Disposal area sizing** - The multiplier for disposal area sizing (this number is multiplied times the design flow for sizing the disposal area) is indicated in this box. These numbers come from correctly identifying the soil profile and then consulting the appropriate sizing table of the Rules. If the wrong number is used, particularly a smaller number, the disposal area will be undersized.
- e. **Garbage disposal unit** - Since garbage disposal units generate 30% additional solids as compared to dwellings without them, provisions must be made to handle the additional solids load. Options available include: multi-compartment tanks, tanks in series, increased septic tank capacity, or a filter on the outlet end of the septic tank. It is very important that this section be completed.
- f. **Pumping** - If the disposal field is located at an elevation higher than the dwelling or treatment tank, pumping of the effluent will be required and should be noted in this block. The application should also indicate an appropriate dosage volume (generally 25 to 150 gal/dose for single-family residences).
- g. **Criteria used for design flow** - This block is where the design flow is shown and/or calculated. Design flow is based upon assumptions of averages from similar structures, as published in the Rules. Alternately, water use monitoring of the actual water usage, with appropriate adjustment factors, can be used.

6. **Site Evaluation Statement:** This section is where the Site Evaluator dates and signs the form, indicating that the information is accurate and design is in accordance with the Rules. The Site Evaluator must also print his/her name and include their telephone number so that they can be contacted in the event questions or concerns with the application arise.

PAGE 2

7. **Site Location Plan:** This is where the property location is shown upon which the proposed disposal field is to be installed. It should include sufficient landmarks and distances to allow for the LPI to find the property. If a new system variance is proposed, a copy from an atlas should be included.
8. **Site Plan:** The site plan is a drawing which shows the property as it exists, with the proposed disposal field or test pit locations. It should be drawn to scale and so indicated on the space provided. Permanent features within 100' (for designs of systems less than 1000 gpd systems), 200' (for design of systems more than 1000 gpd but less than 2000 gpd) and 300' (for the design of systems greater than 2000 gpd systems) should be shown, such as roads, wells, buildings, water bodies, driveways, tree lines, etc. A north arrow and slopes should also be shown. The drawing should be legible so that the LPI and contractor can accurately read it.
9. **Soil Description and Classification:** This section is where the Site Evaluator describes the soil as regards texture, consistency, color and mottling observation. The soil profile, condition, slope and limiting factor(s) are also indicated. It should be noted as to whether the observation was a test pit or boring and the depth of organic matter encountered. The Site Evaluator signs, dates and records his/her license number at the page bottom.

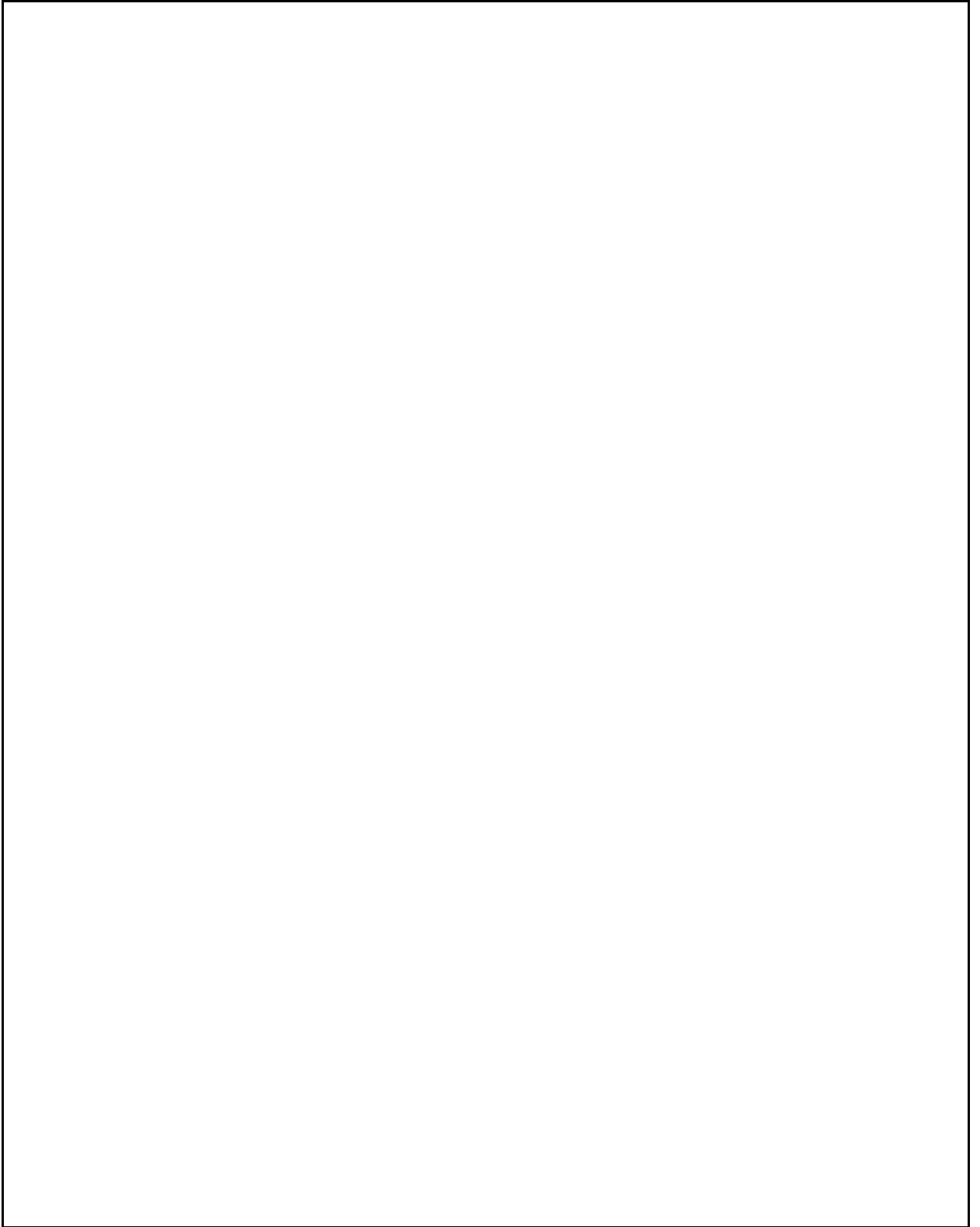
PAGE 3

10. **Subsurface Wastewater Disposal Plan:** This section is where the disposal area details are shown. It should include a scale, typically 1"=20' or greater (ie. 1"=100'), and any notes pertinent to the disposal system design. Details should include: disposal area plan view, showing proprietary device layout or piping, fill extensions, distribution box (if proposed) and 3' shoulder. Other details of

importance include swing ties, septic tank location, piping details pump station location (if used), grease interceptors (if used), and any other pertinent details, such as the elevation reference point (ERP) location and cross-section location.

11. **Construction Elevations:** This is the section where construction elevations are indicated. It is very important that this section be accurately completed. Depth of fill should be indicated as well as elevation of the reference point, bottom of disposal area and top of distribution lines or proprietary devices. The Local Plumbing Inspector should make sure that the elevation reference point (ERP) is a permanent mark and located outside of the disposal field and fill extension area. The location of the ERP should be described in this section so it can be located.
12. **Disposal Area Cross-Section:** The cross-section should provide sufficient detail so that the contractor can install the system as proposed by the Site Evaluator. It should include all disposal area components as well as fill extensions and stabilization measures. Curtain drains and diversion ditches, if proposed, should be shown as well as any designer specific details.

The Site Evaluator must sign, date and indicate license number at the bottom of page.



The Division of Health Engineering has forms that are utilized for administration of the Rules as shown on the following pages (see Figures 53, 54 and 55). Replacement System Variance Form (HHE-204) This form, along with a completed subsurface wastewater disposal application is required for Replacement System Variances (see Figure 53a,b). These are utilized when an applicant proposes to replace a disposal system on a site that does not comply with the existing Rules.

Figure 53a. Replacement System Variance Request (Page 1)(as of January 1995)

Figure 53b. Replacement System Variance Request (Page 2) (as of January 1995)

New System Variance Form (HHE-215) This form, along with a subsurface wastewater disposal application, is required for New System Variances (see Figure 54a,b). These forms are utilized when an applicant proposes new development on a site that does not comply with the Rules. If soil conditions are in non-compliance, the criteria of Table 11 can be utilized to determine approval potential.

Figure 54a. New System Variance Form (Page 1) (as of January 1995)

Figure 54b. New System Variance Form (Page 2) (as of January 1995)

Table 11. Soil, Site and Engineering Factors Used in Assessing
Potential for a New System Variance

Holding Tank Form (HHE-234) This form, along with a completed subsurface wastewater disposal application is required for a Holding Tank System applications (see Figure 55a,b).

A large, empty rectangular box with a thin black border, occupying the majority of the page below the text. It appears to be a placeholder for a diagram or figure mentioned in the text above.

Figure 55a. Holding Tank Form (Page 1) (as of January 1995)

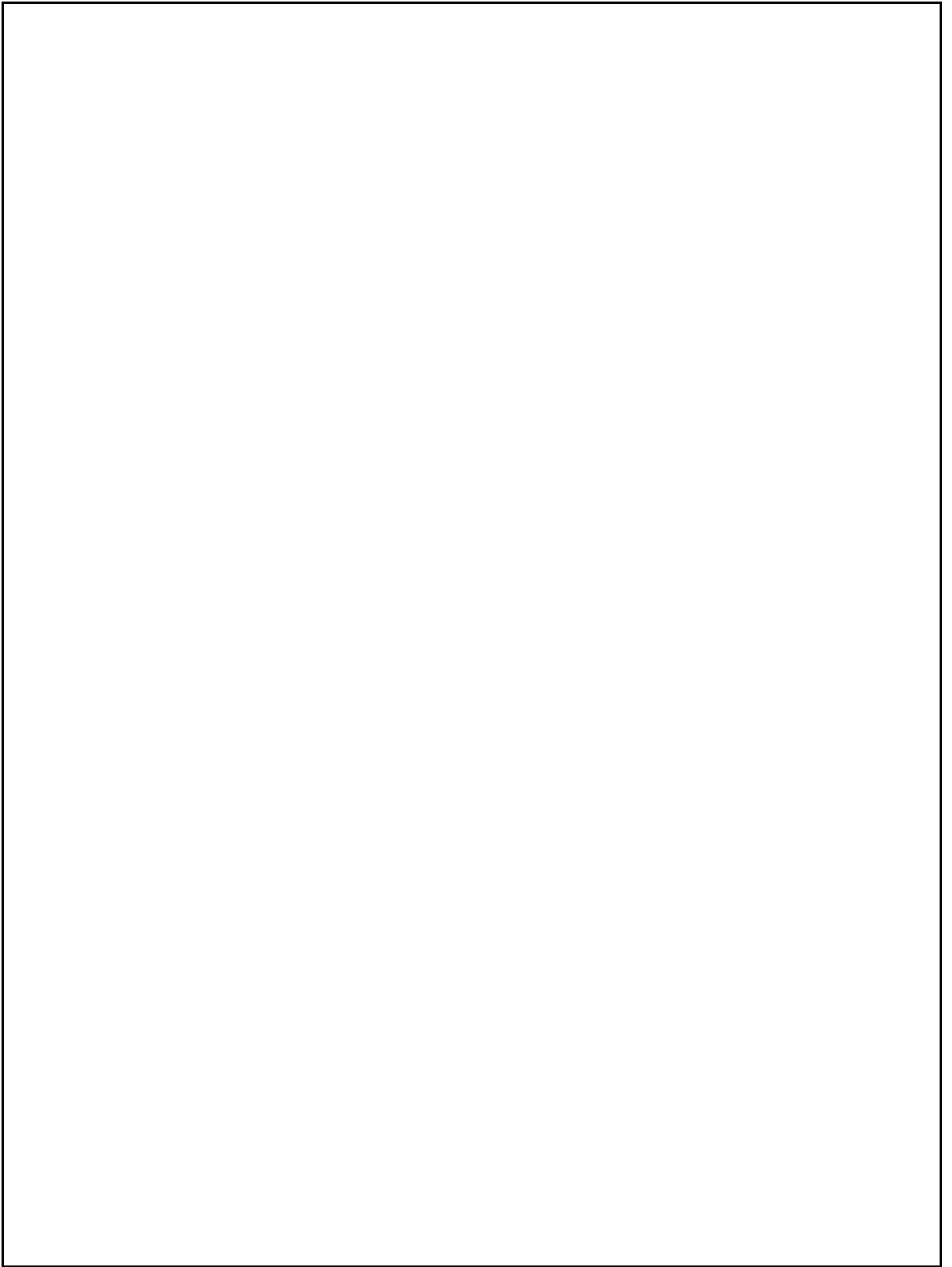


Figure 55b. Holding Tank Form (Page 2) (as of January 1995)

Seasonal Conversion Permits: A completed page one of the HHE-200 form (with seasonal conversion checked off by the Local Plumbing Inspector) is required for issuance of a seasonal conversion permit. Owners of Seasonal dwellings located in the Shoreland Zone (ie. within 250 feet of a classified water body) are required to obtain a Seasonal Conversion Permit prior to converting the dwelling to year-round use. The owner must demonstrate that the structure being converted has a disposal system installed in substantial compliance with the Rules. If the system is not in substantial compliance, one must be installed or the use of the dwelling will be restricted to seasonal use. Substantial compliance is approximately 80% compliance with setback and other applicable criteria.

Additional Required Forms In addition to the forms described above, permit applications occasionally require other forms such as:

- € **Well Setback Release form:** This is required when a disposal system component such as a septic tank or disposal area must be installed less than 100 feet from an abutter's well and/or less than the setback distance of an existing disposal system, from an existing well.
- € **Easement form:** This is required when a disposal system or component is installed on a property other than that of the applicant. They must be filed in the Registry of Deeds.
- € **Future Expansion of Replacement System form:** If an applicant is required to have a system designed in order to expand or for a change in use and doesn't wish to have the system installed at that time, the application and a cover document must be filed with the Registry of Deeds. In addition, all abutters must be notified by certified mail, of the intent to install the system at some future date including details of the planned location of the system. No abutter, so notified, may install a well which will prevent the installation of the system (Title 30-A Section 4211 3B).
- € **Deed Covenant** The Department may require the attachment of a deed covenant to a permit application before authorizing a permit to be issued. This is usually due to soil or site limitations. The covenant will spell out specific limitations as to the use of a property.

The Local Plumbing Inspector must review and act upon an application for subsurface wastewater disposal within a reasonable time. Permit denials shall state the reasons for denial, in writing. Disposal system permits are **not transferable**, however, amendments to a disposal system may be made at any time before work on the system is complete.

Such amendments are considered to be part of the original application and no additional fees can be assessed. The Local Plumbing Inspector can revoke a disposal system permit at any time if any false statements or misrepresentations of fact are discovered in the permit application or on the plans upon which the permit approval was based.

Permit fees must be collected by the Local Plumbing Inspector before any work can be undertaken on a disposal system. If work starts on a system, prior to issuance of a plumbing permit, a double permit fee may be assessed.

INSPECTIONS

One of the primary responsibilities of the Local Plumbing Inspector regarding subsurface wastewater disposal systems is **inspections**. The purpose of inspections is to insure that disposal system installation is in compliance with the *Subsurface Wastewater Disposal Rules*. Ideally, the Local Plumbing Inspector would conduct several inspections, starting before any site alteration occurs and continuing throughout the construction process. Due to time and financial limitations, however, only one inspection is required by the *Subsurface Wastewater Disposal Rules*. That inspection is required when installation of all components is completed but remains uncovered. Most Local Plumbing Inspectors become familiar with the workmanship of Excavating Contractors in their area, and can schedule additional inspections beyond the minimum in order to obtain a comfort level that the system is being constructed properly.

The contractor/installer must notify the Local Plumbing Inspector, at least 24 hours in advance, of the need for the required inspection. If any part of the system is covered, it is up to the discretion of the Local Plumbing Inspector whether or not it should be uncovered before completion of the inspection. A certificate of approval is only issued if the system is found to be in compliance with the Rules. If the system does not comply with the Rules, the Local Plumbing Inspector must issue a written correction order to the installer, which specifies what is required to bring the system into compliance and a reasonable deadline for completion of the correction.

Typical equipment required for inspections of subsurface wastewater disposal systems includes the following:

- € a pop level or tripod mounted level
- € a shovel for checking stone or fill
- € a carpenter's folding rule or engineers surveying rod
- € a 100 foot tape measure
- € a scale for measuring distances on a disposal plan
- € a two or three foot level

- € a log book or journal
- € a copy of the disposal system application
- € a camera

Areas which the Local Plumbing Inspector should pay particular attention during

inspections include:

- € Location of disposal system components
- € Elevation of bottom of disposal area
- € Level of bottom of disposal area
- € Elevation of top of pipes or proprietary leaching devices
- € Backfill texture
- € Size and cleanliness of stone, if used
- € Water tightness of all joints/seams
- € Inclusion of all system components specified on subsurface wastewater disposal application and attachments (such as manufacturer's specifications).
- € Location of wells within appropriate setback distances
- € Anything unusual, such as the presence of groundwater, compacted soil, erosional problems, etc.

Figures 56 and 57 illustrate two common methods Local Plumbing Inspectors use for field checking elevations of system components.

Anything questionable should be referred to the installer and/or designer.

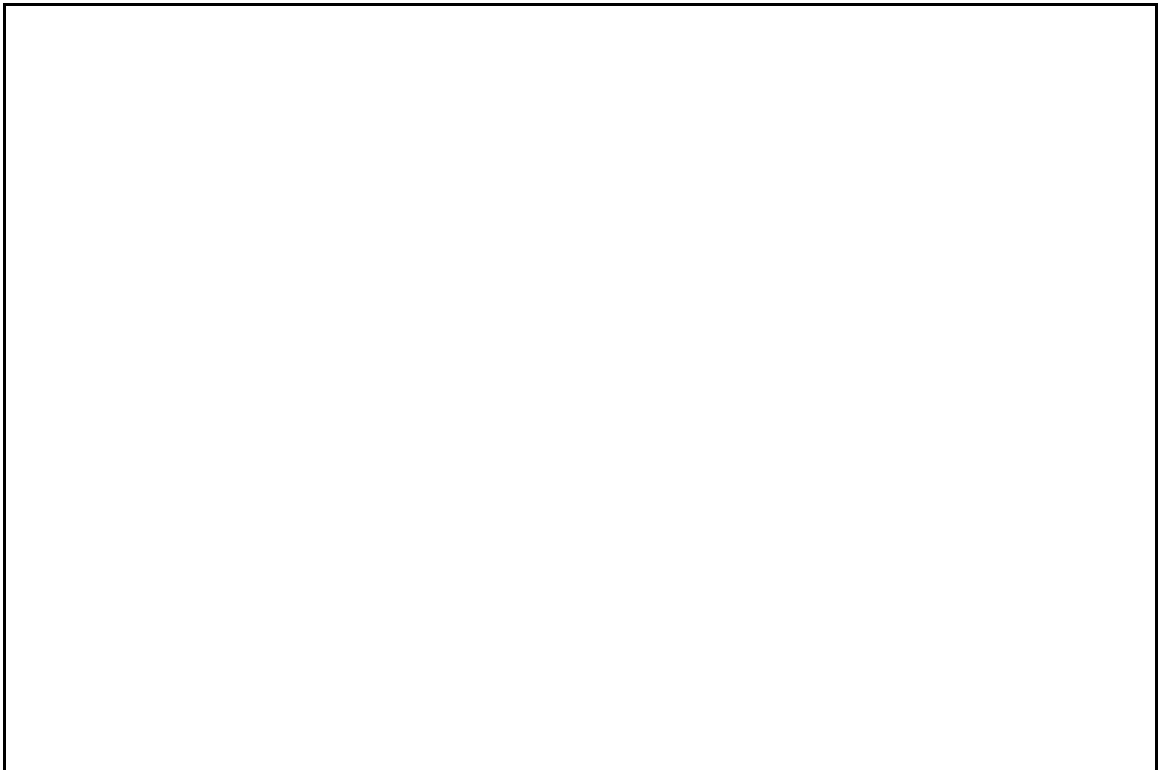


Figure 56. Local Plumbing Inspector inspecting elevation of disposal area, using a tripod mounted level. [NOTE: an elevation of the grade of the elevation reference point (ERP) is

*subtracted from the grade of the disposal area to give grade of the disposal area below ERP.
This distance is checked with design plans for accuracy].*

VIOLATIONS OF THE RULES

The minimum fine for any violation of the Rules is \$100, with a maximum of \$2500 for each offense (**30-A MRSA S 4452**). The municipality can utilize their own attorney to prosecute violators in court. Alternately, a Local Plumbing Inspector can be utilized if certified in District Court Procedures (Rule 80K) and authorized in writing by the municipal officials to represent the municipality in District Court (Rule 80K 30-A MRSA S 4221). The Department of Economic and Community Development Code Enforcement Officers Program offers certification and re-certification training programs.

RECORD KEEPING

It is the responsibility of the Municipality to keep records of permits, issued by the Local Plumbing Inspector, for public access. This information is very important when properties with existing structures that have subsurface wastewater disposal systems are being sold. Records should be kept as long as the system is in existence. Retrieval experience by municipalities has shown that filing of these records is best done by correlating with tax map and lot number, not alphabetically or chronologically.

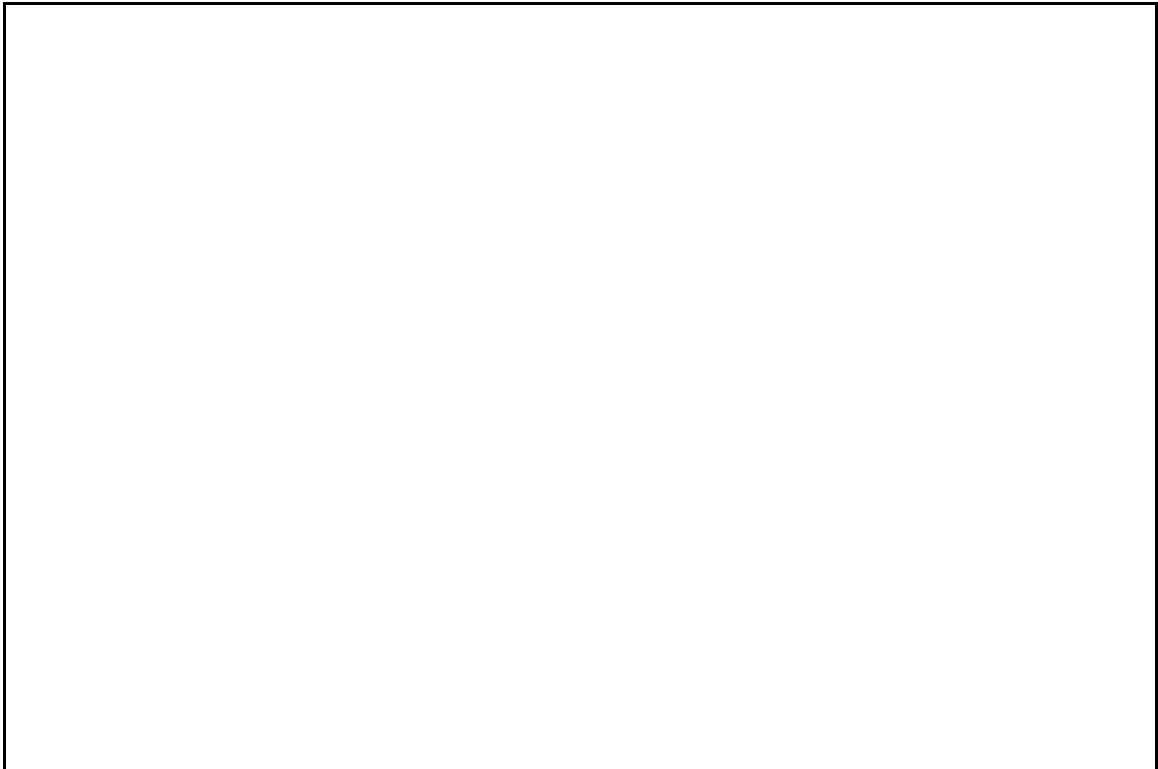


Figure 57. Local Plumbing Inspector inspecting elevation of disposal area using a hand held level. [NOTE: an elevation of the grade of disposal area below the established grade of the elevation reference point is being measured to assure the elevation conforms with plans.]

V. DISPOSAL SYSTEM INSTALLATION AND CONSTRUCTION

SYNOPSIS:

This chapter discusses installation practices and should be of particular interest to the excavating contractor, local plumbing inspector and site evaluators, while providing background information to the regulatory, planning board members, and property owners.

TOPICS:

Familiarity with *Subsurface Wastewater Disposal Rules* and specifications, Dig Safe, permits, installation, suitable weather and soil moisture conditions, site preparation, inspection, soil erosion and sediment control, clearing, septic tank installation, risers and covers, fill, piping, insulation, pump station, electrical wiring.

FAMILIARITY WITH SUBSURFACE WASTEWATER DISPOSAL RULES, SPECIFICATIONS, SPECIFIC SITE AND PROPOSED DESIGN

Excavating contractors should be knowledgeable with pertinent sections of the *State of Maine Subsurface Wastewater Disposal Rules* regarding disposal system components and installation techniques prior to attempting the construction of a disposal system.

The excavating contractor should visit the site several days prior to beginning construction so that he or she can become familiar with the site and the proposed design of the Site Evaluator. The contractor should be absolutely clear, after examining the plans, where the disposal area is intended to be constructed. Initial and final grades, based upon depth of fill required, should be relatively close to the proposed elevation in relation to the elevation reference point. If the excavating contractor is unclear about the exact location or elevation of the proposed system, or uncertain of any aspect of the plan, then he or she should call the designing Site Evaluator prior to initiating work.

DIG SAFE

DIG SAFE HOT LINE (1-800-225-4977) should be called prior to any excavation by power

equipment. **DIG SAFE** will send a representative to the project site to mark the location of underground utilities. Contractors should call DIG SAFE at least 72 hours before any excavation is done, except in an emergency. Recognized emergency situations can be called the day of the excavation. Failure to notify DIG SAFE could result in liability, if damage is done to underground utilities.

PERMIT

The excavating contractor should coordinate with either the property owner, applicant, or client, to determine who is responsible for obtaining the permit to install the complete disposal system or individual component.

The property owner is ultimately responsible for assuring that a permit was obtained. Ideally, the permit should be secured well in advance. This will provide adequate time to resolve any problems that may arise. The excavating contractor should not commence construction until after seeing a valid subsurface wastewater disposal system permit and any attached conditions of approval, if applicable.

INSTALLATION

Suitable Weather and Soil Moisture Conditions

Ideally, a subsurface wastewater disposal system should only be installed during suitable weather and soil moisture conditions. A disposal system installation is not permitted, except for replacing a malfunction, if the soil moisture condition is saturated. This requirement is extremely important on finer textured soils, due to the problem of smearing as discussed in Chapter III.

A simple field test can be performed to determine if the soil condition is too wet for working. When a clump of soil, taken from the depth of the excavation, can be rolled out with the fingers to form a wire or rod 1/8" in diameter and does not crumble when handled, the soil moisture content is too high to proceed under normal circumstances (see Figure 58).

Additionally, if possible, disposal areas should not be installed in frozen ground or when air temperatures are below freezing, especially if construction will take place over several days.

SITE PREPARATION

Site preparation varies somewhat, depending on whether portions of the proposed system are to be installed above or below the existing grade.

Soil Erosion and Sediment Control

Provisions should be made for stabilizing any soil disturbed during construction of a subsurface wastewater disposal system, particularly if the system is located adjacent to a water body, wetland, steep slopes, or in an otherwise sensitive area. An erosion and sediment control plan or specific measures may be necessary to comply with state or local permits for construction on some sites. Stabilization can be accomplished by any number of means, such as paving, mulching, use of geotextiles, etc. The most common method is by seeding and mulching. The appropriate fertilizer and seed mixtures should be specified as well as mulching requirements (such as tacking down). In addition, temporary erosion and sediment control measures such as staked hay bales or silt fence, may be advisable for sensitive areas. (See *Maine Erosion and Sediment Control Handbook for Construction, Cumberland County Soil and Water Conservation District, 1991*).



Clearing

Forested Sites:

All trees and shrubs should be cut and all stumps removed from the area directly beneath the disposal area and within the proposed fill extensions. Generally, all trees and shrubs that will be exposed to significant fills must be removed. Special trees that are desired and are located toward the outside limits of the fill may be left if fill depth is minor. It is recommended that the Site Evaluator and Local Plumbing Inspector be consulted regarding removal of any particular trees in question.

Field Sites:

Field sites do not need to have trees and shrubs removed, but do need to have hay or tall grass cut and removed. If not done, the grass or hay will be compressed and form a mat which will impede wastewater from reaching the underlying soil. If there are any agricultural undertrains, they should be removed from underneath the disposal area and fill extension. Ideally, field sites, after removing the vegetation, should be harrowed, plowed or rototilled to prevent matting and open the soil for effluent infiltration. Plowing or disking should be done along the contour.

SEPTIC TANK INSTALLATION

Septic tanks are available in monolithic (one piece) or standard (two piece) tanks. Monolithic tanks are less likely to leak than standard two-piece tanks. Care should also be taken to plug the small diameter hole in the bottom of the tank (commonly referred to as a *bung hole*). This hole is provided to counter floatation in wet locations. This hole should be permanently sealed, immediately after tank is in place, with grouting or other acceptable material for underwater use.

Risers and Covers

Openings surrounding inlet and outlet pipes should be permanently sealed with grout to prevent ground water infiltration and wastewater leakage. The inspection covers and cleanout covers of septic tanks installed in wet areas must be installed with risers and covers above the seasonal high ground water table or to the ground surface. The seams between the riser barrel and septic tanks must be properly sealed to prevent ground water infiltration (see Figure 59).

The location of all covers not installed extant to the ground surface should be located with swing ties from the existing building so the septic tank cleanout cover can be located easily in the future for pumping. A record of these distances should be given to the homeowner for the home files. The Code also requires all covers to have rebar attached in an X shape, so a metal detector can be used to locate the cover.

DISPOSAL AREA INSTALLATION

Fill

All fill used within a subsurface wastewater disposal area must be gravelly coarse sand with approximately 4% to 8% fines, passing a #200 sieve, approximately 15% to 30% gravel and no more than 2% clay. This texture has been determined to provide the best combination of permeability and treatment. If the fill material contains a greater percentage of fines, it's hydraulic capacity is decreased. If the fill contains fewer fines, then it does not provide adequate treatment of the effluent.

The only exception to this requirement is for fill material used to bring a disposal area to it's final grade. A minimum of 4 inches of top soil equivalent (any soil material with a sufficient content of fines and organic matter to support growth of vegetation for a suitable seed bed) should be applied to disturbed soil surfaces.

Preparation for proposed system to be below existing grade

If a portion of the system is to be installed beneath the existing grade, then the area of the proposed disposal system site should be excavated to the proposed elevation of the bottom of the disposal area. In addition, if the fill material is finer in texture than the original soil, a minimum of 4 inches should be **rototilled** or thoroughly mixed with the

teeth of a backhoe into the existing top soil layer to create a transition layer (see Figure 60).

The final grade of the bottom of the disposal area should be scarified and leveled by raking with a hand tool rake or alternatively, with the teeth of the backhoe. Care should be taken to avoid smearing or compaction of the soil while directly crossing the area with heavy equipment, once it has been scarified and leveled (see Figure 60).

Preparation of proposed system above ground

The area under the absorption system should be scarified by cultivating to a depth of 6 inches. Ideally, this is done by rototilling, plowing or discing to produce an unvegetated roughened surface. If a plow is used, then the plow furrow direction should be perpendicular (across) to the slope. Alternatively, the teeth of the backhoe can be utilized. In addition, if the fill material is coarser in texture than the original soil, then a minimum of 4 inches must be mixed into the existing top soil layer to create a transition layer.

Stone or Proprietary Leaching Device Installation

Clean stone or proprietary devices (chambers, etc.) should be installed on the prepared soil surface, as outlined above. Care must be taken to avoid any actions that may cause smearing or compaction of the prepared surface. Make certain stone or gravel does not feather to the fill extension edge because it will cause the effluent to breakout onto the ground surface at these points if insufficient fill is utilized. The prepared soil surface must be at the elevation specified on the subsurface wastewater disposal system application and must be level, to within one inch. Do not level the disposal area with stone or gravel because this will cause effluent to pond in one or more parts. The disposal area bottom area must be leveled with suitable fill material as outlined above. Stone, if used, must be clean and of uniform size, between 3/4 to 2_ " diameter. Using stone of various sizes decreases available pore space and reduces holding capacity.

Rows or Trenches:

When installing rows or trenches, it is important to maintain a minimum of three feet of undisturbed original soil or suitable fill material between stone or proprietary leaching devices, to avoid the wastewater from one row directly impacting the downhill neighboring row. This is especially important when serial distribution is used.

Proprietary Leaching Devices:

Proprietary leaching devices have product specific installation requirements. The installer should be familiar with proprietary leaching device manufacturer's

requirements prior to installing a disposal area which specifies their use.

1. Excavate elevation of bottom of disposal area

2. Level and scarify disposal area bottom

3. Add proper fill material, avoiding vehicular traffic

4. Spread fill material, avoiding compaction

Figure 60. Disposal System Preparation, illustrating Phases of Site Work
(photos by J. Bruce Johnson)

Fill Extensions

Fill extensions associated with disposal areas must be installed in accordance with the permitted application. The finished fill extension slope gradient can be determined by one of several methods:

1. Level and tape measure (see Figure 61).
2. Direct measurement using an abney level or clinometer.
3. Measuring the difference in elevation between the top and toe of fill and then dividing by the measured length of fill.

Example:

Top of fill = Rod reading of 5.0'

Toe of fill = Rod reading of 10.0'

Length of fill = 20'

~~$10' - 5' \div 20' = 5 \div 20 = 0.25$ or 25%~~

Fill extensions should be constructed of materials meeting the requirements of backfill, as specified in the Code. It should be free of foreign materials and large stones. The soil surface should be suitable for establishing a seed bed and be stabilized to prevent erosion.

Piping

Piping should be of approved materials. The soil material below all proposed gravity pipes should be properly compacted with a tamper prior to settling to assure firm bed for maintaining the installed pitch of the pipe. Gravity piping that is to be installed under areas exposed to vehicular traffic should be of materials suitable for the exposed weight of the traffic (Schedule 40, SDR 35, etc.). All piping joints should be permanently connected and sealed to prevent leakage.

Insulation

The disposal system should be constructed to prevent freezing during periods of extended cold weather. Generally, freeze-up problems occur in locations where wastewater ponds in shallow pipes exposed to cold temperatures. Usually problem areas within systems are found in shallow uninsulated distribution boxes, long building sewer and effluent lines that have insufficient pitch, piping that exists under pavement, or in pressure effluent lines that were neither installed below frost (4 to 6 feet), properly insulated, nor provided with check valve drainage (see Figure 62).



Insulation comprised of 2" thick, high density rigid polystyrene is commonly used for underground insulation. White bead board is not acceptable because it deteriorates with exposure to moisture.

Pump Station

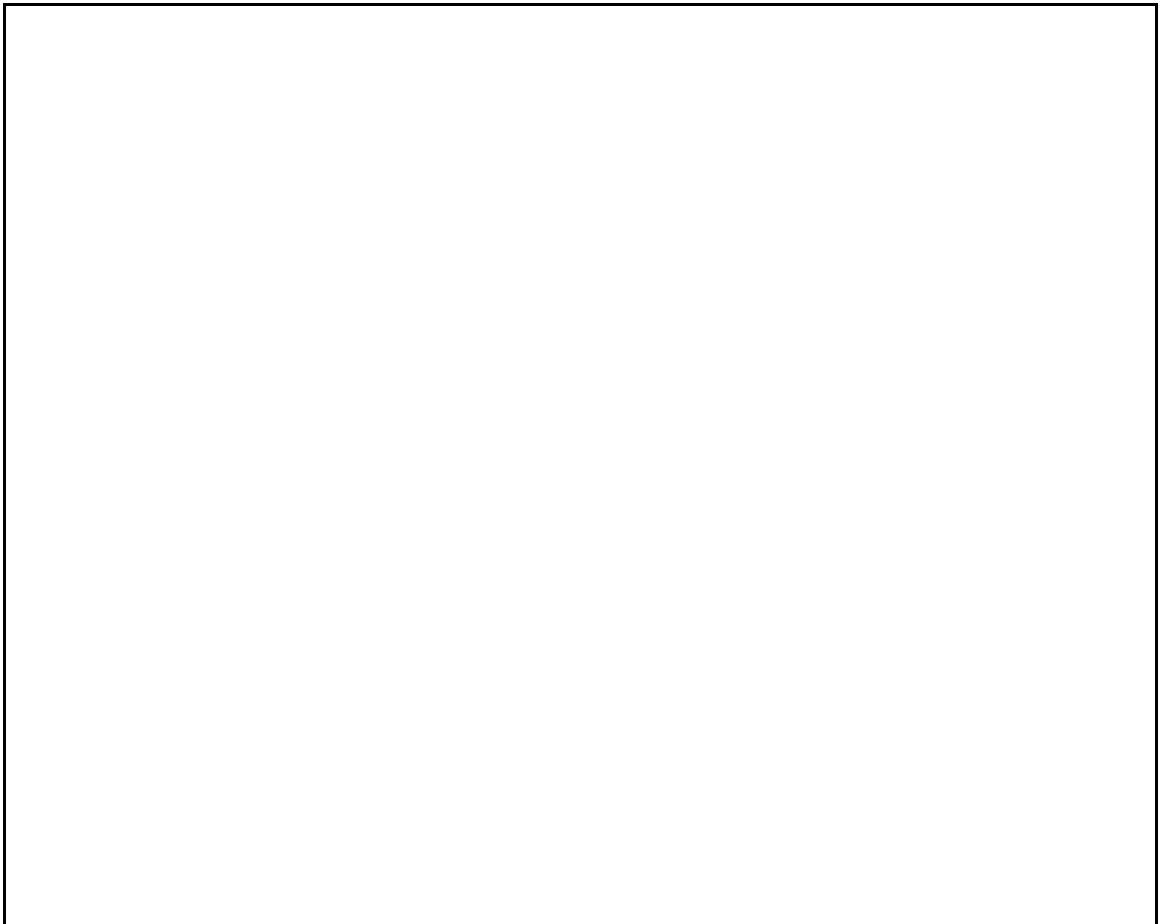
Pump stations require care similar to septic tanks with regards to preventing ground and surface water infiltration. Risers and covers should extend to the ground surface for ease of maintenance. Electrical power lines suitable for underground use should be a minimum of 18 inches below grade and buried below a marker tape (electric line caution) or installed in a

conduit pipe. Pumps and pump chambers must be sized in accordance with the Code and permitted applications. Pumps should be located on a pedestal within pump chambers so that they do not pump solids which may accumulate in the bottom of the pump chamber. When septic tanks are pumped during regular maintenance, pump chambers should also be pumped, to remove solids.

Electric Wiring

All electrical work must be installed per National Electrical Code by a licensed electrician or by a qualified homeowner.

Sewage is quite corrosive to electrical connectors. All electrical contacts and relays should be located outside the pump station (above ground next to foundation or direct burial). It is recommended that a non-oxidizing grease be applied to all connectors located in the pump station. A gas-tight seal should be provided on any electrical conduit pipe entering the pump station.



INSPECTION

The Local Plumbing Inspector (LPI) must be notified when a disposal system is ready for inspection. Ideally, this Local Plumbing Inspector should be given as much notice as possible.

After the Local Plumbing Inspector approves the system installation, it should be properly covered and stabilized as specified by the plans and/or Rules.

CONTRACTOR/DISPOSAL SYSTEM OWNER RELATIONS

The contractor should supply the property owner with an accurate record of swing ties from installed cleanout covers to building corners, in order for future ease of maintenance.

Additionally, the homeowner should be provided with written instructions on proper maintenance of the disposal system.

VI. OWNER'S RESPONSIBILITIES

SYNOPSIS:

This chapter provides basic guidelines for operation of a subsurface wastewater disposal system, and should be of particular interest to property owners and provide background information to others.

TOPICS:

Care and maintenance of septic tank, pumping of septic tank, care and maintenance of disposal area.

Not only does the septic system designer, installer and inspector have responsibilities regarding a disposal system, but so does the system owner. Failure of any of these parties, including the owner, to recognize and carry out their responsibilities can result in disposal system failure. The following is a listing of the minimum responsibilities an owner has regarding subsurface wastewater disposal systems.

MAINTAINING SUBSURFACE WASTEWATER DISPOSAL SYSTEM

Care and Maintenance of Septic Tank

The septic tank is an essential part of your subsurface wastewater disposal system. Proper care and maintenance of your septic tank protects the disposal area and will help prolong the life of the disposal system.

- € A "starter" is not necessary to stimulate bacterial action in a septic tank. The bacteria present in the domestic wastewater is adequate for bacterial action and will thrive under normal use.
- € The **U.S. Environmental Protection Agency** and the **Maine Department of Human Services, Division of Health Engineering** both discourage the addition of septic tank additives. Septic tank cleaners containing *halogenated hydrocarbon*

- compounds are prohibited in Maine (38 MRSA 1602).
- € Practice water conservation methods whenever possible.
 - € Normal amounts of household detergents, bleaches, and cleaners may be used without stopping the biological activity in the septic tank. Excessive amounts of any cleaners should not be used. Do not discharge solvents, paints, fuels, oils, hazardous or special wastes into the tank. This is prohibited by laws and regulations.
 - € Avoid disposing of greases, fats, coffee grounds, disposable diapers, feminine napkins, or other non-decomposable materials into the septic tank.
 - € Use of a garbage disposal increases the organic loading rate into a septic tank. Additional capacity or a septic tank filter is required.
 - € Avoid shock loading or doing excessive loads of laundry in rapid succession. Space the loads out over time to allow for a *rest* period between loads.

Pumping of the Septic Tank

Your septic tank should be pumped every 3 to 5 years, or as needed according to the actual use of the system, to remove accumulated solids for final disposal in an approved facility. The inlet and outlet baffles should be inspected with each pumping and replaced if necessary. The pumper should access the septic tank from the cleanout cover in order to allow pump hose to access all the sludge bottom.

The homeowner should keep a record in the home file of swing ties from the building corners to the access cleanout cover for ease of maintenance. This should be provided to septic tank pumper.

Care and Maintenance of the Disposal Area

- € Do not drive over your disposal area with automobiles, trucks, or heavy equipment unless your disposal area is specifically designed for these loads.
- € Maintain adequate vegetation or mulch over the disposal area unless the field has been designed under pavement.
- € Avoid siting gardens over disposal areas, because annual rototilling tends to erode the surface cover. Rototiller tines can cut into the disposal pipes and units.
- € Avoid tying dogs, who are inclined to dig, over disposal areas. Avoid siting horse or

cattle corrals over fields due to foot impact and erosion potential.

- € Vegetation with aggressive shallow root systems should not be grown near systems (willow trees, for example).

VII. SPECIAL CONSIDERATIONS

SYNOPSIS:

This chapter discusses more advanced and specific problems that should be of particular interest to individuals practicing in the field as Site Evaluator, Local Plumbing Inspector, Realtor, and owner of a disposal system. This section includes more advanced discussion of various commonly encountered problems or situations.

TOPICS:

Problem soils, wetlands, ground water monitoring, curtain drains, groundwater impact analysis, regulations, flood plains, coastal sand dunes, inspection reports, multi-user systems, malfunctions

PROBLEM SOILS

The typical procedures for determining soil profile and drainage class are described in Chapter III, *Soil Evaluation*. In most instances, those procedures are adequate for making proper soil profile and drainage class determinations. There will be occasions however, when soils are encountered in which standard concepts will not lead to the correct identification of the soil profile or drainage class. These are generally referred to as *Problem Soils*.

Soil Profiles

Soil profiles are classified by observing the number, type and sequence of soil horizons along with an evaluation of soil texture, structure, consistency, color, depth and parent material. Typical soil profiles are found in Table 7. Soils which do not have typical profiles include the following:

Recent Alluvial Soils

These soils are so young, geologically, that no soil horizon development may be present. They can generally be distinguished from other soil profiles in their location (near a river or stream) and particle size which were sorted by water (mostly fine sand and silt without stones).

Multiple Parent Materials

Occasionally, a soil profile will consist of more than one parent material within the 48" depth typically observed. Soil profile 7, from Table 7, is the only recognized mixed origin soil in the *Subsurface Wastewater Disposal Rules*. There are, however, other mixed origin soils which do not fall within the parameters of Table 7. When designing disposal areas for these mixed origin soils, the site evaluator must use common sense and base the design upon the soil profile from Table 7 that best describes the soil.

Disturbed Soils

Disturbed soils, which may cause difficulty in determining a soil profile, are generally those that have been filled or plowed, or have had upper soil horizons removed. **Cut soils** can usually be identified by the absence of typical horizons for the type of parent material observed. **Filled soils** can often be recognized by the observance of buried horizons typically found near the surface, the presence of man-made objects, and unexplained contrasts between the fill material and native parent material below.

Soil Drainage Class Determination Problems

Soil drainage class is usually determined by observing soil morphological features, especially the presence or absence of drainage mottles. Less frequently, soil drainage class is determined by groundwater monitoring. Problem soils include those soils found at high elevations or along the immediate coast, glacial tills on long slopes, soils that have been plowed or disturbed and sandy soils, all of which may not exhibit drainage mottles consistent with seasonal water table depths. For these soils, other indicators of seasonal wetness must often be used, such as thickness of the surface organic horizon (thicker horizons often mean wetter soils), matrix color of soil horizons (darker and deeper surface mineral soil horizons also usually indicate wetter soils), variable shades of color in the **B** horizon, cemented **B** horizons and organic streaking in the **B** horizon, indicating fluctuation in water table.

Cool Climate Soils

Soils at high elevations or along the northern Maine coast form in much cooler environments than at lower elevations or further inland. Therefore, biologic activity within the soil, necessary for drainage mottle formation, is greatly reduced. Some high elevation soils in Maine may be so cool that biologic activity only occurs within the organic matter horizon.

Glacial Till Soils on Long Slopes

Glacial till soils on long slopes may be saturated during the growing season but, because the

groundwater is moving within them and is not stagnant, reducing conditions may not be present. In such instances, drainage mottles will not form because microorganisms can get oxygen from the water. Usually these soils exhibit a buildup of organic matter within the soil.

Plowed or Disturbed Soils

Soils that have been plowed, particularly thick plowed horizons (Ap) may not exhibit drainage mottles within the plowed horizon due to masking by the organic matter. However, plowed or disturbed soils that are not saturated may exhibit mottles that are a result of mixing of soil horizons. Soils with thick **A** or **Ap** horizons should be evaluated for drainage class by using other tools such as the *Maine Association of Professional Soil Scientists Key to Soil Drainage Classes*.

Coarse Textured Soils

Coarse textured soils lack fine soil particles which most readily exhibit effects of reduction (low chroma mottles). These soils may not appear mottled, when in fact they are seasonally saturated.

Coarse textured soils in poorly drained situations may develop reddish or blackish cemented layers that are the result of iron, aluminum, or organic matter, precipitating out at the depth of the seasonal water table. Cemented layers may create a perched water table above them and should not be mistaken for well drained, oxidized colors.

WETLANDS

Wetlands are areas that are inundated or saturated by surface and/or groundwater at a frequency or duration sufficient to support vegetation typically adapted to life in saturated soil conditions. Wetlands generally include swamps, bogs, marshes, wet forests, meadows and similar areas.

Wetland Criteria

In order for an area to be classified as a wetland it must meet three criteria:

1. It must have **hydric soils**,
2. Evidence of **hydrology** must be present, and
3. It must have or be capable of supporting, under normal circumstances, **hydrophytic vegetation**.

Hydric Soil is a soil that, in its undrained condition, is saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. In Maine, soils which are classified as poorly or very poorly drained are considered hydric. The U.S.D.A. Soil Conservation Service has developed a list of soils meeting hydric soil criteria. That list can be obtained from any of the local Soil and Water Conservation District offices found in the State.

Hydrology is defined as permanent or periodic inundation or soil saturation to the surface, at least seasonally. It is the driving force behind wetland formation but it is also commonly the most difficult to establish in the field due to annual, seasonal or daily fluctuations. Field indicators of wetland hydrology include:

- € Visual observations of inundation
- € Visual observations of soil saturation
- € Water marks on woody vegetation in flood prone areas
- € Drift lines
- € Water borne sediments
- € Surface scoured areas

Hydrophytic Vegetation is defined as macrophytic plant life growing in water, soil or on a substrata that is at least periodically deficient in oxygen as a result of excessive water content. The U.S. Fish and Wildlife Service, in cooperation with the Army Corps of Engineers, EPA and the Soil Conservation Service has published the "National List of Plant Species that Occur in Wetlands". This list separates vascular plants into four basic groups, commonly called "wetland indicator status" based upon a plant species frequency of occurrence in wetlands. These groups are defined in Table 12.

Table 12. Wetland plant groups	
<u>Obligate Wetland Plants:</u>	greater than 99% probability of being found in Wetlands under natural conditions.
<u>Facultative Wetland Plants</u>	likelihood of being found in wetlands is 67% - 99%, under natural conditions.
<u>Facultative Plants:</u>	this group of plants is equally likely to be found in wetlands and non-wetlands under natural conditions.
<u>Facultative Upland Plants:</u>	likelihood of being found in non-wetlands is 67%- 99%, under natural conditions.

The Maine Fish and Wildlife service has a list of those plant species that are native to Maine.

Wetland Jurisdiction

The Army Corps of Engineers (ACOE) makes jurisdictional determinations and issues wetland permits for filling, dredging and other construction resulting in alterations on certain wetlands under Section 10 of the Rivers and Harbors Act of 1899. The ACOE provides the same function under Section 404 of the Clean Water Act for all other wetlands, with program oversight by the U.S. Environmental Protection Agency (EPA). With the combination of these two acts, activities within all wetlands, regardless of size, are regulated by EPA and the Army Corps of Engineers. The Maine Department of Environmental Protection regulates activities in or adjacent to coastal or freshwater wetlands, as defined in Chapter 2 of the Natural Resources Protection Act, Title 38 M.R.S.A. Sections 480-A through 480-U.

Wetland Delineations

Identification and Delineation of Wetlands must be made in accordance with the applicable regulatory agency requirements. Since those requirements frequently change, it is best to consult the appropriate agency(s) periodically for the latest guidance or requirements. For more information on wetland delineation criteria, contact the U.S. Army Corps of Engineers in Augusta, Maine for federal regulations or the local regional office of the Maine Department of Environmental Protection for state regulations or the local municipality for local ordinances.

GROUNDWATER MONITORING

When determining the seasonal high water table, soil morphological features are typically used. Occasionally, there is reason to believe that soil morphological features associated with wetness are not an accurate indicator of seasonal water table. In such instances, groundwater monitoring is a useful tool to verify seasonal water table depth.

Correlation with Soil Morphological Features

Since the standard procedure for determining soil suitability for subsurface wastewater disposal is observance of soil morphological features associated with wetness, the groundwater monitoring observance period should reflect the time period when those features normally develop. That is, when the soil, at a depth of 20" below the mineral soil surface,

is at or above 41°F. Therefore, soil water temperatures must be taken when measuring depth to water table. Acceptability of a site is only determined when the soil water temperature is at or above 41°F.

The time in the spring in Maine when soil temperatures reach this temperature is the start of the growing season (generally considered May 1 in most parts of Maine except for northern and higher elevations).

Monitoring Well Installation

In order for a groundwater monitoring well to function properly, it must be installed so that groundwater can freely enter, while at the same time preventing the entry of surface water.

Depth of the monitoring well should be at least 36" below the mineral soil surface, for permeable soils. For soils with restrictive horizons, at least one of the monitoring wells should be installed so that it does not extend through the restrictive horizon. This is to determine perched, seasonal water table presence and depths.

For soils where attempts have been made to lower the seasonal water table by use of a curtain drain or diversion ditch, at least one monitoring well should be placed above and one below the drain or ditch to determine its effectiveness.

* Additional details on groundwater monitoring can be found in the *Subsurface Wastewater Disposal Rules*.

Curtain Drain Installation

Curtain drains are an effective measure to lower the seasonal water table, in certain instances.

They include a friable topsoil, underlain by an impervious subsoil, where the contributing upslope drainage area is sufficient to create a perched, seasonal water table. Soil profiles, where curtain drains are generally the most effective, are profiles 1, 3 and 7. They may also be appropriate for soil profile 8, where the topsoil contrasts with the subsoil; and profile 5 where a cemented horizon is present. The *Subsurface Wastewater Disposal Rules*, provides additional specifications on design and installation of curtain drains.

GROUNDWATER IMPACT ANALYSIS

Groundwater Mounding Analysis

Groundwater mounding is the raising of the groundwater table within a certain area by the application of an increased volume of water to that area. Mounding probably occurs beneath all subsurface wastewater disposal areas to some degree, but does not generally become a problem until large volumes of wastewater must be disposed of in a limited area. In general,

sites with large volumes of proposed wastewater, restrictive horizons, and perched water tables are the ones which have the greatest potential for groundwater mounding impact.

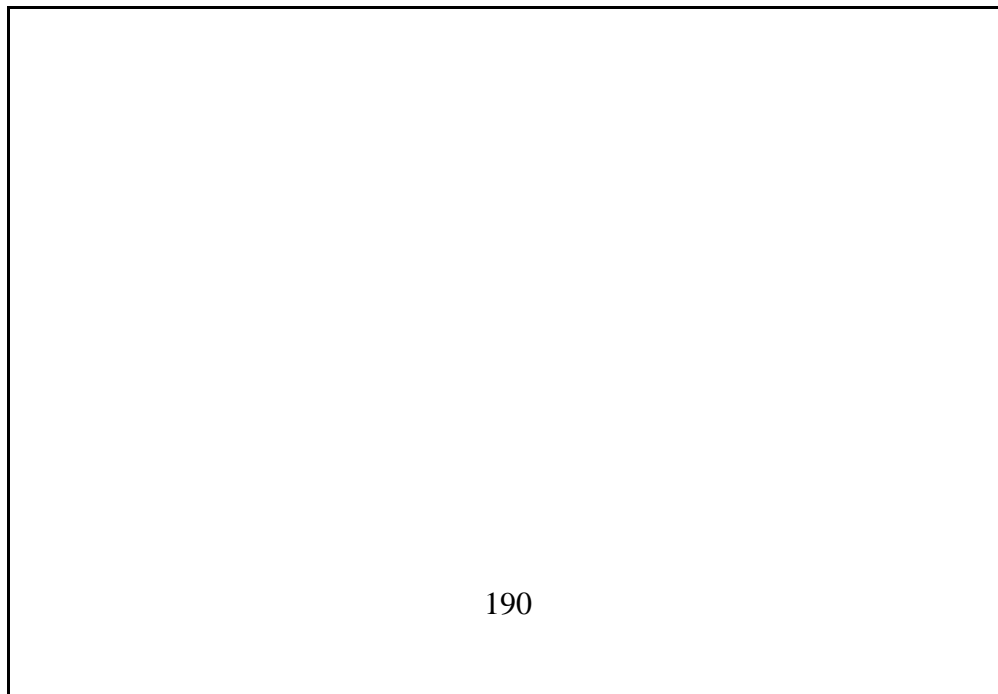
Nitrate-Nitrogen Impact Analysis

Nitrogen, a naturally occurring element, is essential for the life processes of all living organisms. When nitrogen combines with oxygen, however, to form NO₃ or nitrate-nitrogen the result is a potential public health hazard when levels in groundwater exceed 10 milligrams per liter. Nitrate-nitrogen can be a cause of oxygen deficiency in babies (*Methemoglobinemia-Blue Baby Syndrome*) and may be the limiting nutrient that controls eutrophication (algal blooms) in coastal marine waters, estuaries and some fresh water bodies.

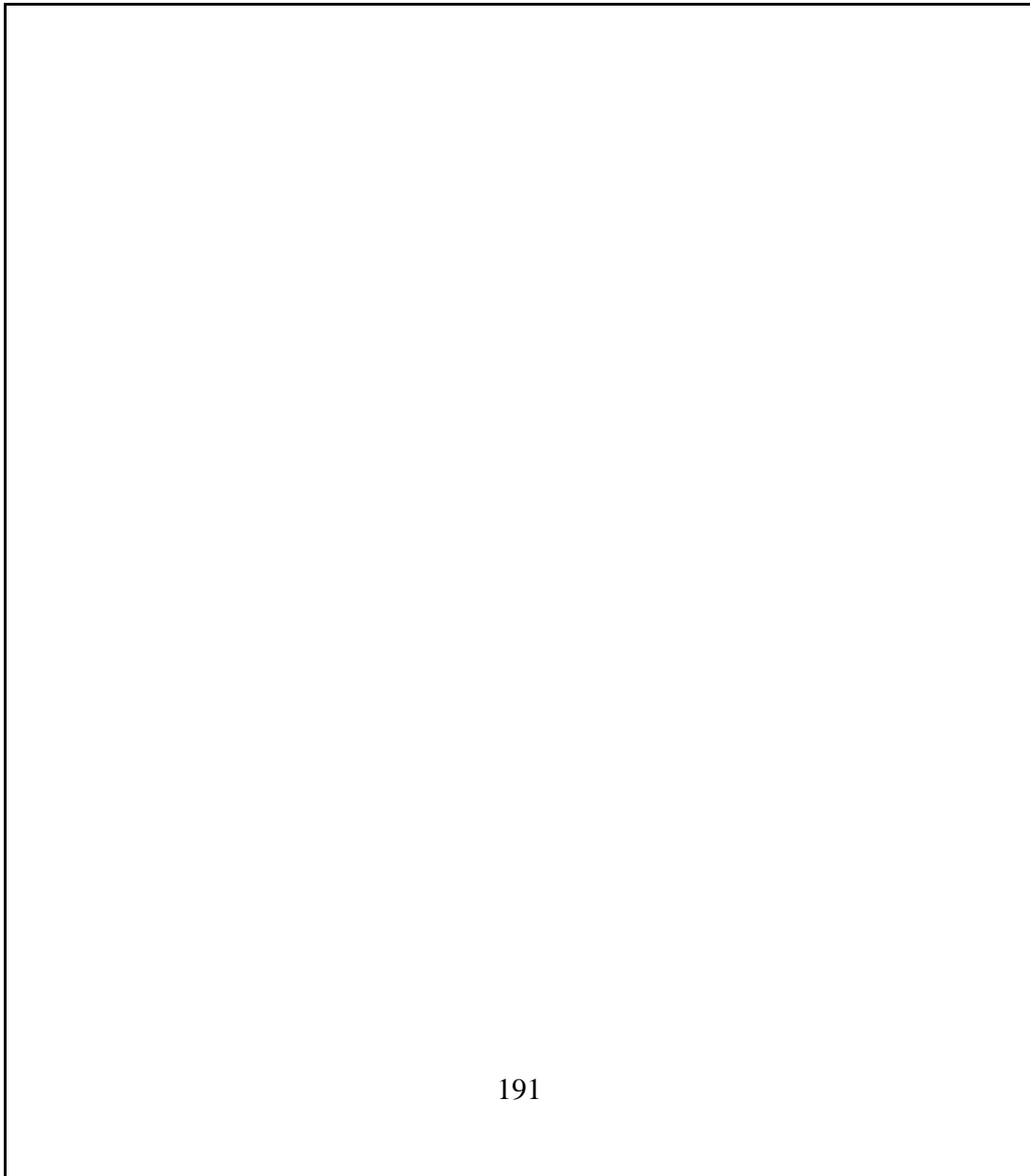
Studies have shown that average nitrate-nitrogen levels of domestic effluent are approximately 40 milligrams per liter. Since that is four times the legally allowed levels for drinking water, it is important to assure that NO₃ concentrations are reduced to acceptable levels by the time they reach drinking water supplies and water bodies. In general, mandatory disposal area setbacks are adequate to allow for nitrate dilution to acceptable levels prior to reaching water wells or water bodies. Because of the potential for mounding, however, larger systems may require an additional level of analysis to assure ground and/or surface water protection. Consultation with a Certified Geologist familiar with ground water hydrology may be required.

FLOOD PLAIN SITING

The *Subsurface Wastewater Disposal Rules* stipulate that new systems may not be installed on 10 year flood plains, and it is recommended that they not be installed in 100 year flood plains, if possible (see Figure 63).



The Site Evaluator is responsible for determining whether the site is within a flood zone. Flood Insurance Studies are currently available for approximately 100 inland and coastal communities in Maine. These studies contain a map of flood boundaries and flood profiles along water courses that indicate both the 10-year flood and 100-year flood elevations. Studies/maps should be available at town offices. Otherwise, contact the State Flood Plain Management Program at DECD (see Figure 64).

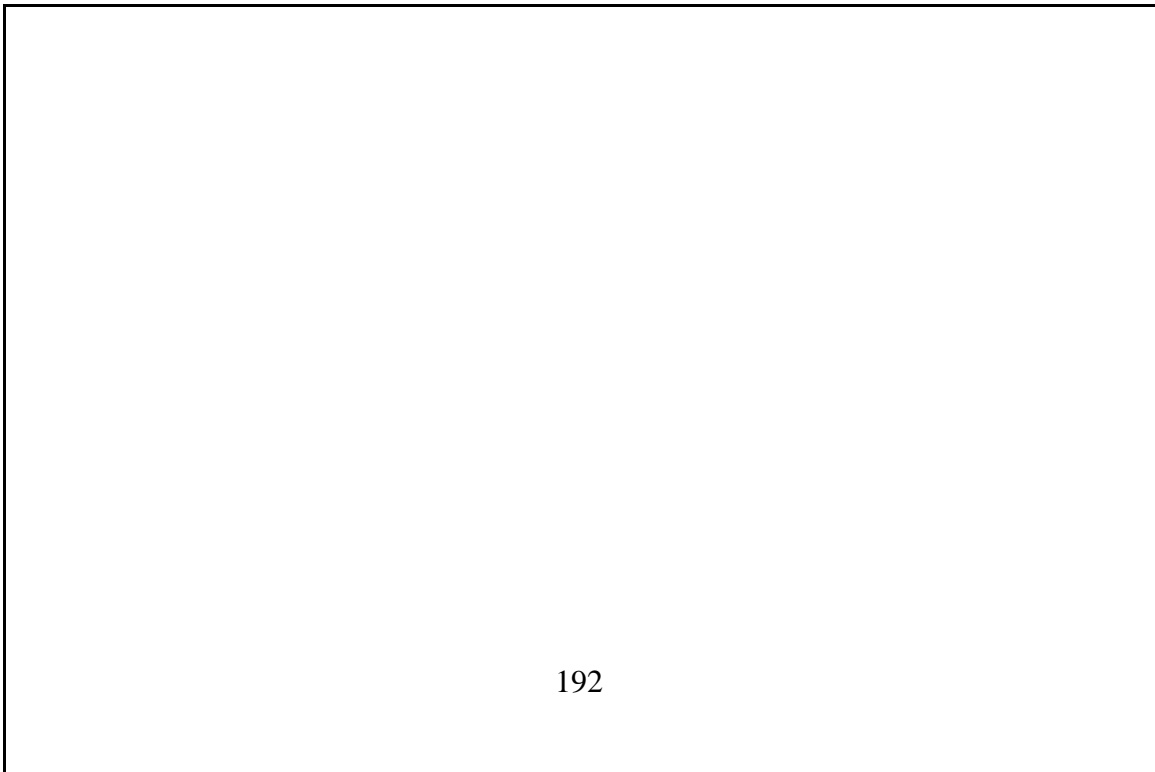


Flood Insurance Studies contain an Index Map that can be used to reference the appropriate Floodway map. The site in question can be located on the Flood Boundary and Floodway Map (FBFM) and the closest transect to the site (flood profiles) can be referenced, as well as, the closest bench marks. The 10-year and 100-year flood elevations for that site can then be extracted from the graph (see Figure 64). This elevation uses National Geodetic Vertical Datum of 1929 (NGVD) as the reference.

The topographic elevation of the proposed disposal site can be referenced to the closest bench mark and then compared with the referenced flood elevations to determine, conclusively, if the site lies within a flood zone.

If Flood Insurance Studies have not been made for a community, other studies such as the **Army Corp of Engineers, Soil Conservation Service** or **United States Geologic Survey** should be sought. If no published studies are available, then local inhabitants of the area should be consulted.

For **coastal** flood plain delineation, see the following Section on Coastal Sand Dunes.



COASTAL SAND DUNES

No person may undertake any project to build a permanent structure or alter any coastal sand dune without obtaining a permit from either the Department of Environmental Protection or the Board of Environmental Protection. If the structure proposed on a coastal sand dune requires subsurface wastewater disposal, then one must comply with the *Subsurface Wastewater Disposal Rules*.

Soil profiles of coastal sand dunes are classified as Profile 11. These soils are sandy and generally exhibit very little soil horizonation development due to their lack of stability and geologic age (see Figure 65). However, where these soils have been relatively stabilized to allow for vegetation of trees, they can exhibit some soil development. If the proposed site for the disposal area meets the requirements for setback and drainage, then a special disposal system can be designed by the Site Evaluator. A special system is required to overcome the severe limitations of low cation exchange capacity, very high permeability, and proximity to waterbodies. The *special* system recognized by Health Engineering is a *lined* disposal system.

A proposed disposal area for a residential dwelling must comply with the required setback distances from the **normal maximum high water line**. This is the line on the shore which is apparent because of a change in character of the soil, rock, or vegetation resulting from submersion or the prolonged erosion action of the water. In a tidal environment, the normal maximum high water line is the shoreline at the average spring tide elevation as referenced in the *Tide Tables (Annual) High and Low Water Predictions*, published by the National Oceanic Survey (see Table 15).

For example, a Site Evaluator is responsible for siting a disposal area on a relatively small parcel of coastal property on Goose Rocks Beach, Kennebunkport. The location of the normal high water line is questionable based upon field evidence of strand lines, and vegetation. The Site Evaluator can refer to the *Tide Tables (Annual) High and Low Water Predictions* and find the closest point along the Maine coast referenced in the publication. For this example, Kennebunkport is the closest referenced point and the average spring tide elevation is 9.9 feet. (See Table 15 Column "RANGES -Spring"). This elevation references Mean Low Water (MLW) as the datum. To convert MLW to NGVD, find the closest locality listed in Table 14 and subtract the corresponding number from MLW. The difference is the elevation expressed in NGVD. For this example, the closest locality listed in Table 12 is "Cape Porpoise" with the difference between MLW and NGVD listed as "4.08". Therefore: 9.90 (MLW) - 4.08 (Conversion Factor) = 5.82 (NGVD). Once this elevation has been calculated, its actual location on the site can be established. This method is generally the most accurate.

To determine the elevation on a particular site, it is necessary to begin with an established

bench mark in the vicinity and transfer the grade to the site. The bench mark on the site can then be used to establish the contour line that represents 5.82 feet NGVD. Once this is determined the normal maximum high water line can be delineated and the setback distances can be correctly identified and measured.

An easier, but less accurate method that can be utilized on sites where the setback distances are not as critical, is to schedule a site investigation at high tide on a "normal" day. The Tide Table, Annual (Table 15) indicates that high tide at Kennebunkport, for example, occurs 16 minutes later and is 0.5 feet lower than the respective daily time and high water level published for Portland. For example, May 16 is convenient for an on-site investigation. The published Tide Table for that particular day (Table 13) indicates that high tide at Portland will be at 1:40 P.M. and will be 9.1 feet MLW. Kennebunkport's high tide occurs 16 minutes later and is 0.5 feet lower as referenced in Table 15 Tidal Differences. A Site Evaluator could schedule an on-site visit in Kennebunkport on May 6 at 1:56 P.M. (1:40 P.M. + 16 minutes) and be there at the expected arrival of high tide for that day. The high tide at Kennebunkport is expected to be 8.6 feet MLW [9.1 ft. (High tide at Portland) - 0.5 (Adjustment factor) = 8.6 ft (High tide at Kennebunkport)]. These elevations refer to MLW and must be converted to NGVD with the use of Table 14 as previously explained, since Flood Boundary Floodway maps reference NGVD elevations.

At 1:56 P.M., a stake could be driven at the shoreline on that day. The water level that day is expected to be approximately 8.6 ft. MLW or 4.52 ft. NGVD. The water level at that time can be used as a reference to establish the field contour at 5.82 NGVD (representing the **normal maximum high-water line**) and the water level can also be used as a reference point to establish the approximate flood elevations on the site. (**The actual shore line that day would be subject to the wind and offshore weather conditions which reduces the accuracy of this method**).

Site Evaluators must assure that the proposed area for the disposal system is not on or in the coastal and estuary flood plain. The coastal and estuary flood plain is defined by the *Subsurface Wastewater Disposal Rules* as the land area within the V-Zone indicated by Flood Insurance Rate Maps [FIRM] or below the 10-year storm surge elevation, whichever is more restrictive. A V-zone is land area of special flood hazard subject to a 1 % or greater chance of flooding in any given year and is prone to additional hazard from high velocity water due to wave action. These areas are designated as Zones V, VI-V30 on a community's Flood Insurance Rate Map. The Flood Zones and their respective elevations can be referenced from FIRM Maps.

Difficult site specific questions may require consultation with a coastal geologist.

INSPECTION REPORTS

Site Evaluators, because of their expertise in subsurface wastewater disposal, are sometimes requested to evaluate the condition or potential of an existing disposal system. The request may be from loan institutions or prospective buyers prior to the sale of properties with an on-site subsurface wastewater disposal system, or from owners who desire to expand their businesses or dwellings and need to determine the adequacy of the facility.

The first step in conducting a septic system inspection is to gather as much information as possible from the system owners. Questions of the system owner or user should include:

- € What type of disposal system exists: (cesspool, trench, bed, dry well or other)?
- € How deep was it installed?

If the system was legally installed after 1974, there is a high probability that a copy of the application for the permit is available either at the Municipal Town Hall or with the Division of Health Engineering. The copy of the application would be a record of the

Table 13. Time and Heights of High and Low Waters, Portland, Maine

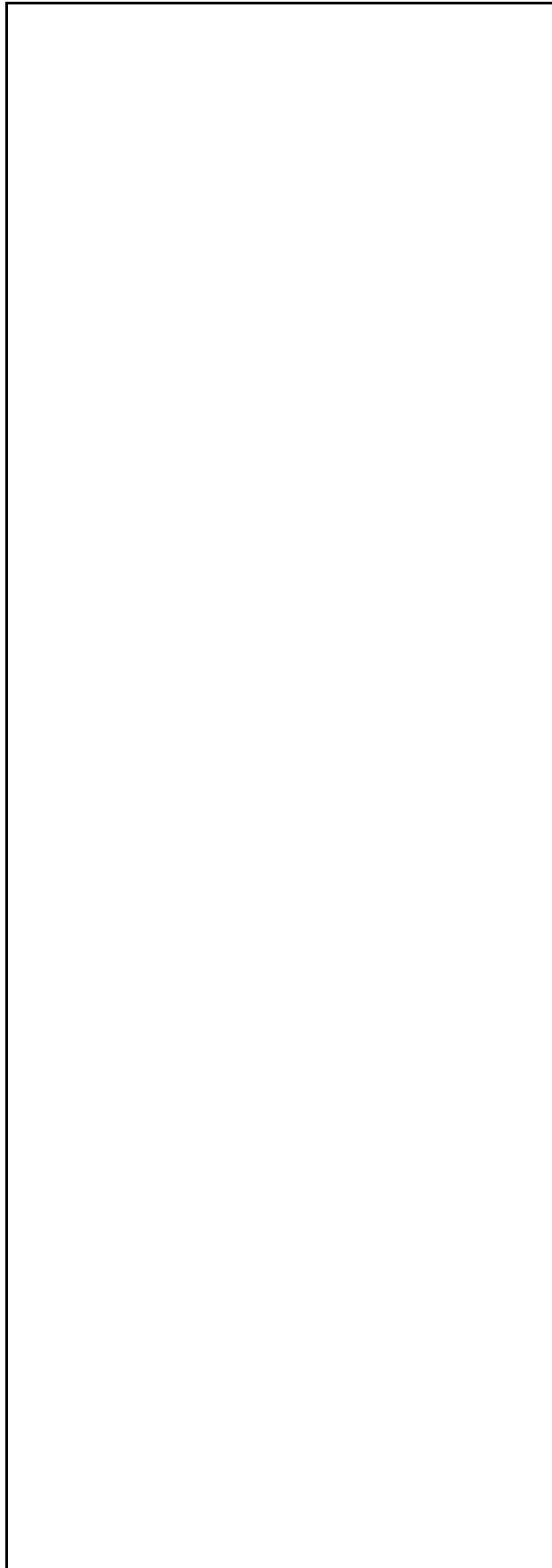
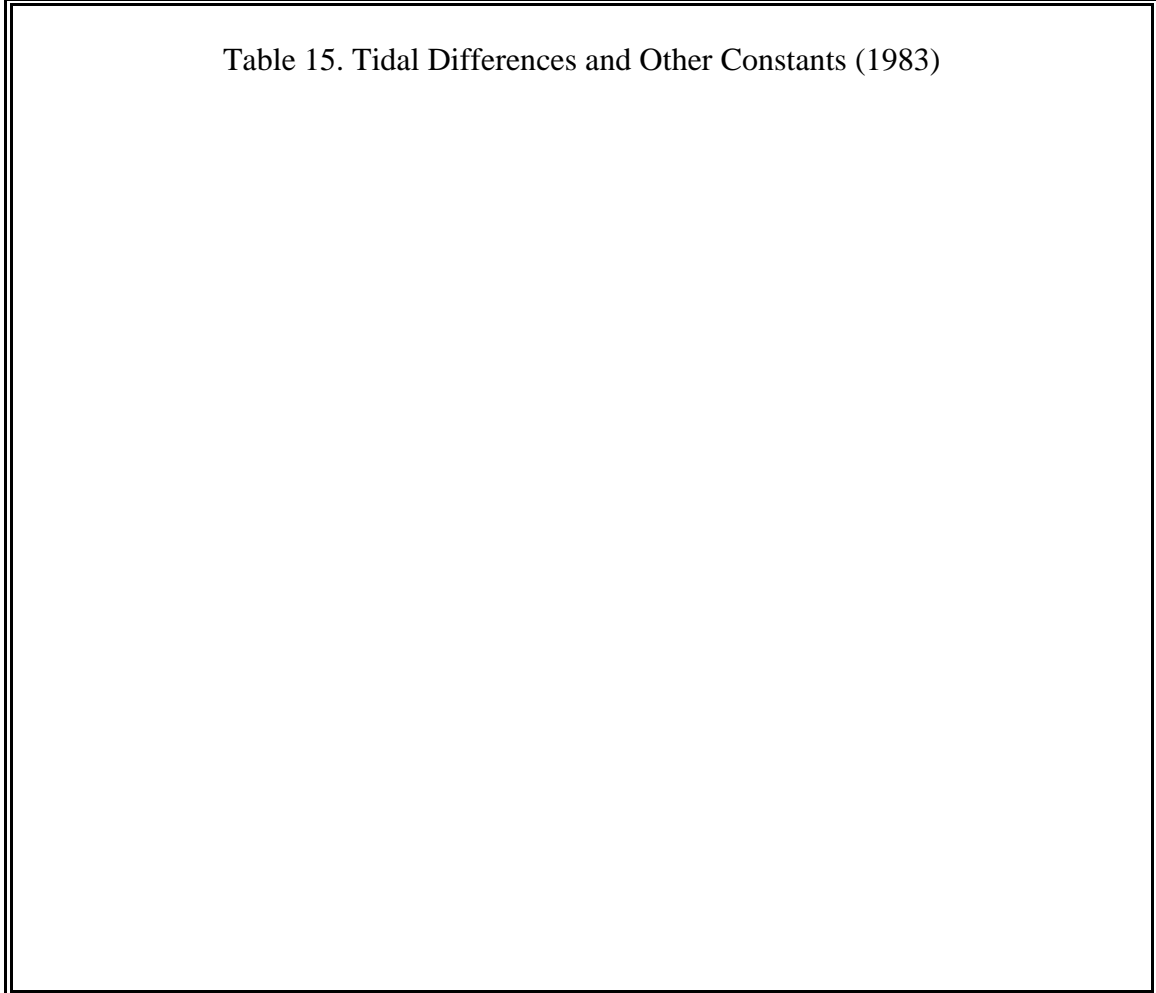


Table 14.
Mean low water to National geodetic vertical datum

Bench mark elevations above National Geodetic Vertical Datum may be obtained by subtracting the tabular difference from the published elevations above mean low water.

Locality	NGVD - MLW Feet	
Eastport.....		
9.00		
Cutler, Little River.....		6.91
Machiasport.....		6.14
Shoppee Point, Englishman Bay.....	6.94	
Jonesport, Sawyer Cove.....	5.75	
Sand Cove, Gouldsboro Bay.....	5.07	
Gouldsboro Bay (North End).....	5.10	
Prospect Harbor.....		5.08
Winter Harbor, Frenchman Bay.....	4.97	
Bar Harbor, Mt. Desert Island.....	5.16	
Southwest Harbor (Clark Point), Mt. Desert Island.....	4.93	
Bernard, Bass Harbor, Mt. Desert Island.....	4.79	
Blue Hill Harbor, Blue Hill Bay.....	4.90	
Belfast, Penobscot Bay.....	4.59	
Rockland, Penobscot Bay.....	4.50	
Port Clyde.....	4.38	
Otis Cove, St. George River.....	4.38	
Thomaston.....	4.53	
Jameson Point, (Davis Point) Friendship Harbor.....	4.43	
Jones Neck, Medomak River.....	4.45	
Waldoboro.....	4.62	
Muscongus Harbor.....		4.39
Moxle Cove, Muscongus Sound.....	4.39	
New Harbor, Muscongus Bay.....	4.28	
Fort Point, Pemaquid Beach, Johns Bay.....	4.23	
East Boothbay.....		
4.28		
East Edgecomb, Damariscotta River.....	4.41	
Newcastle, Damariscotta River.....	4.46	
Boothbay Harbor.....	4.28	
South Port, Townsend Gut.....	4.24	
Cross River (North End of Barter Island).....	4.30	
Wiscasset, Sheepscot River.....	4.37	
Sheepscot, Sheepscot River.....	4.67	
Back River Ferry, Westport Island.....	4.24	
Robinhood, Riggs Cove.....	4.12	
Phipps Point, Hockomock Bay.....	4.10	
Palace Cove (Mill Point), Sasanca River.....	3.94	
Sasanca River (Swett Point).....	2.70	
Upper Hell Gate.....	3.07	
Hunniwell Pt.(Fort Popham), Kennebec.....	3.83	
Bath, Kennebec River.....	2.44	
Brunswick, Androscoggin River.....	-0.05	
Portland.....		4.28
Cape Porpoise (Bickford Island).....	4.08	
York Harbor.....		3.98
Gerrish Island Wharf, Portsmouth Harbor.....	4.08	
Kittery Point, Pepperell Cove, Portsmouth Harbor.....	4.08	
Seavey Island(Portsmouth Naval Shipyard).....	3.83	

Table 15. Tidal Differences and Other Constants (1983)



original soil conditions reported, size and location of disposal system components, and design flow data. The theoretical potential for the system could then be calculated based upon current design specifications. An objective statement on the ability of the system could then be made based upon field assessment and theoretical design capacity.

Records of systems installed prior to 1974 are generally incomplete. The Division of Health Engineering does not have this information; neither do most municipalities. For the most part, systems constructed prior to 1974 would not meet current standards. The value of information gained by excavating into an old system is limited and offers a risk of damage. Determining what size components are existing is of some use however; an evaluation of what it would take to replace the existing system with its proposed increased wastewater flow is often of more value than attempting to determine the flow capacity of an old existing

disposal area constructed prior to 1974. Usually, records of systems constructed after 1974 can be located either at the Town Hall or at the Division

of Health Engineering Archives.

After gathering as much information as possible from the owners, the next step would be to conduct the physical inspection of the system.

The actual inspection steps will depend upon the type of disposal system, soil, and what information is available on the system's design. The following are suggested as minimum steps in an inspection program:

- € If a subsurface wastewater disposal system form (**HHE-200**) is available, use it to determine if the disposal system was installed as designed.

- € Locate the septic tank (if one exists) then inspect the inlet and outlet baffles. Are they in good working order? What is the solids and grease accumulation level? Has scum passed through the outlet baffle opening? Are the baffles present, in good working order, show evidence of solids passing through the opening? If the septic tank has too great a solids load, it is safe to assume solids have entered the disposal area and reduced its infiltrative capacity. Look for signs of groundwater infiltration or exfiltration.

- € If the distribution box is present, locate the cover, remove it and inspect for liquid level and solids accumulation.

Solids can also be checked for in the pipes outletting to the disposal area. If solids are observed in the distribution box or outlet pipes, it is safe to assume that some solids have entered the disposal area and reduced its infiltrative capacity. The liquid level in the distribution box will tell much about the function of the disposal area. A properly functioning disposal area should not have a liquid level greater than a depth of 25% of the outlet pipes.

- € If a pump station is used, the cover should be pulled and the tank should be inspected for solids carryover from the septic tank. Solids in the pump chamber, side walls and on the pump itself is evidence that solids have more than likely been pumped to the disposal area.

- € Locate the disposal area, if possible. Check for lush vegetation in spots over the surface, soft places or obvious areas where effluent has surfaced.

- € Site Evaluators can excavate a test pit beside the disposal area to determine limiting factor depth. If the limiting factor depth is shallow but the disposal system is completely below original grade, then the system is installed too deep to function

properly.

- € A test pit will also provide information as to soil type, so that a reasonable estimate of disposal system size can be determined. Compare existing disposal system size to the recommended size.
- € If little information is available about the disposal area and a water body or water course is nearby, a dye test might be appropriate to look for direct discharges.
- € Running water (with dye) for an extended period of time is helpful in detecting a system failure but an inspection of the septic tank should first take place. A wise system owner, particularly if the system is functioning marginally, might pump the tank the day before an inspection. That would mean 1000 gallons of water would have to be run before any would reach the disposal area.
- € If no distribution box is present, dig a test pit into the disposal system to determine effluent levels. Also, look for biologic mat evidence above current liquid levels for an indication of periodic stress. Look for thickness of biologic mat within the stone or beneath chambers (if used).
- € If the system is installed in shallow soils, particularly near water bodies, look for evidence of effluent and/or a biologic mat. If no effluent or biologic mat exists, a short circuit may exist where effluent is draining through bedrock seams. Short circuiting can also occur in very coarse textured soils and may be a problem in shoreland zoned areas, or where bedrock is located at relatively shallow depths below the ground surface.

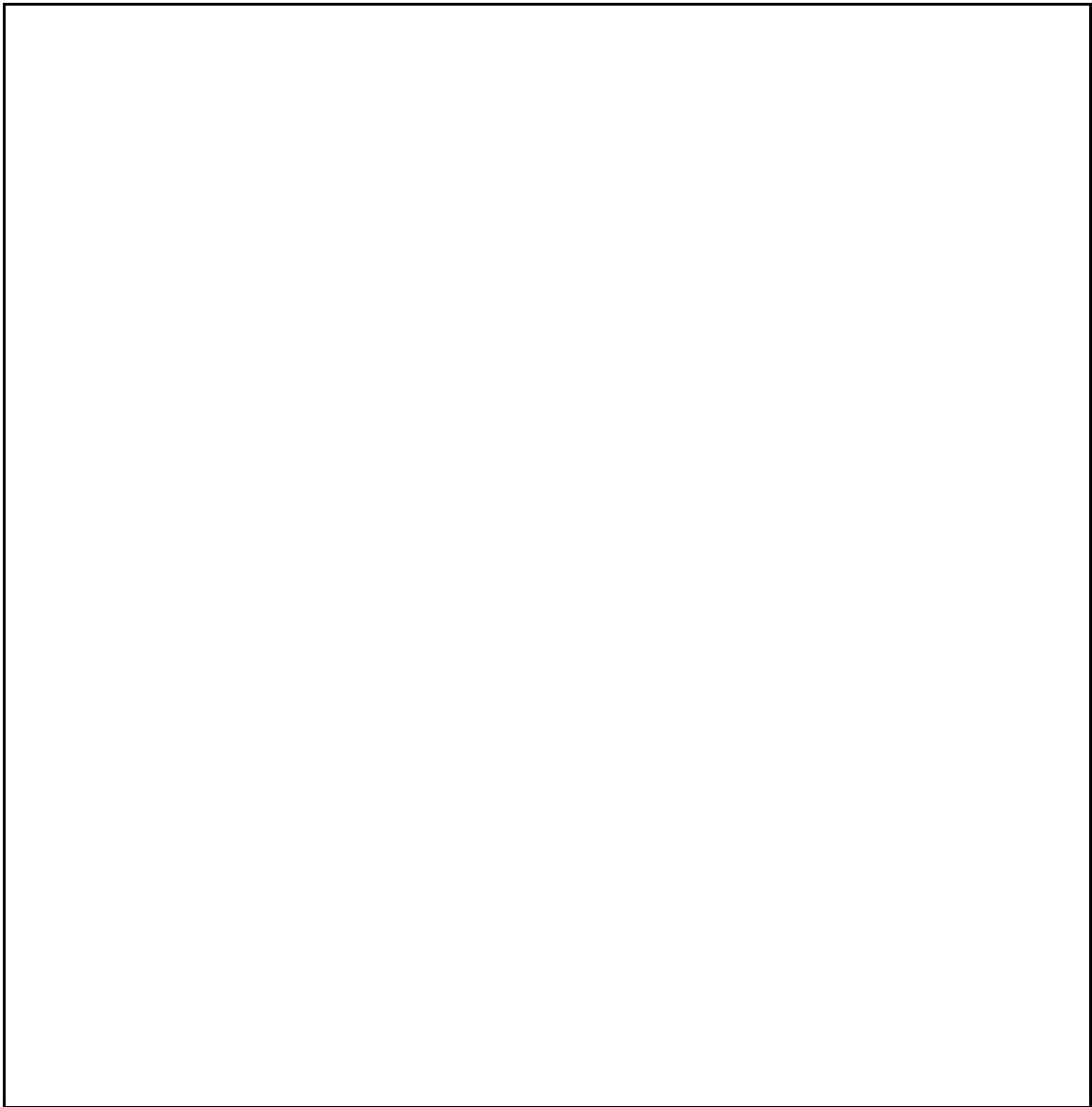
The report which is issued to the home owner or prospective buyer, after conducting a septic system evaluation, must be conditioned by how much hard data was available or gathered as compared to how much was assumed. If, however, a thorough investigation was conducted, then a reasonable expectation can be offered as to the proper function of a disposal system.

REGULATIONS

Multi-user (Cluster) systems

Under ideal circumstances, each individual building under one ownership should have its own disposal system. There are occasions, however, when that is not practical or possible and several structures must share a disposal system or parts of a system. When three or more structures, under different ownership, are proposed to be served by a single disposal system or disposal area, ownership of all parts of the system, beyond the building sewer, must be vested in an independent, legally established entity under Maine Law. This is primarily

because of many unique problems associated with shared systems, including determination of responsible parties for maintenance, repairs and other costs.



A cluster system may have a private sewer collection system flowing into a large septic tank to treat the total flow or it may have building drains flowing into individual smaller septic tanks. The wastewater, after receiving primary treatment in the septic tank or tanks may be pumped or gravity fed to a single subsurface disposal area or several fields on a common land area. (See Figure 67).

The cluster system is a relatively new concept in Maine that is being proposed more frequently; because the design can accommodate development interests on properties with site and soil limitations. However, cluster system proposals have been meeting with local opposition in many communities, due to increased complexity and unique problems associated with shared systems.

The engineering and technical design of cluster systems are well established. Generally, a cluster system is proposed for developing a parcel of land when a segment of the land area within that parcel is better suited for subsurface disposal than the remaining portion. Often times, shallow to bedrock or seasonal high groundwater table conditions prevail on the more poorly suited land area. Therefore, the design of the sewer collection system should address either potential groundwater infiltration, freeze up, or both. Septic tank, pumps, disposal area and other components must be designed and sized to properly treat and dispose of the wastewater.

A proposed cluster disposal system, that is not intended to be installed all at once, may present practical construction problems in the future. Any proposed modular approach to cluster system construction should address practical concerns such as: when the system will be installed, how will the system be expanded, how and where the wastewater will be re-directed during construction, and how the area will be dried out prior to construction.

MALFUNCTIONING SYSTEMS, TROUBLE SHOOTING AND REMEDIES

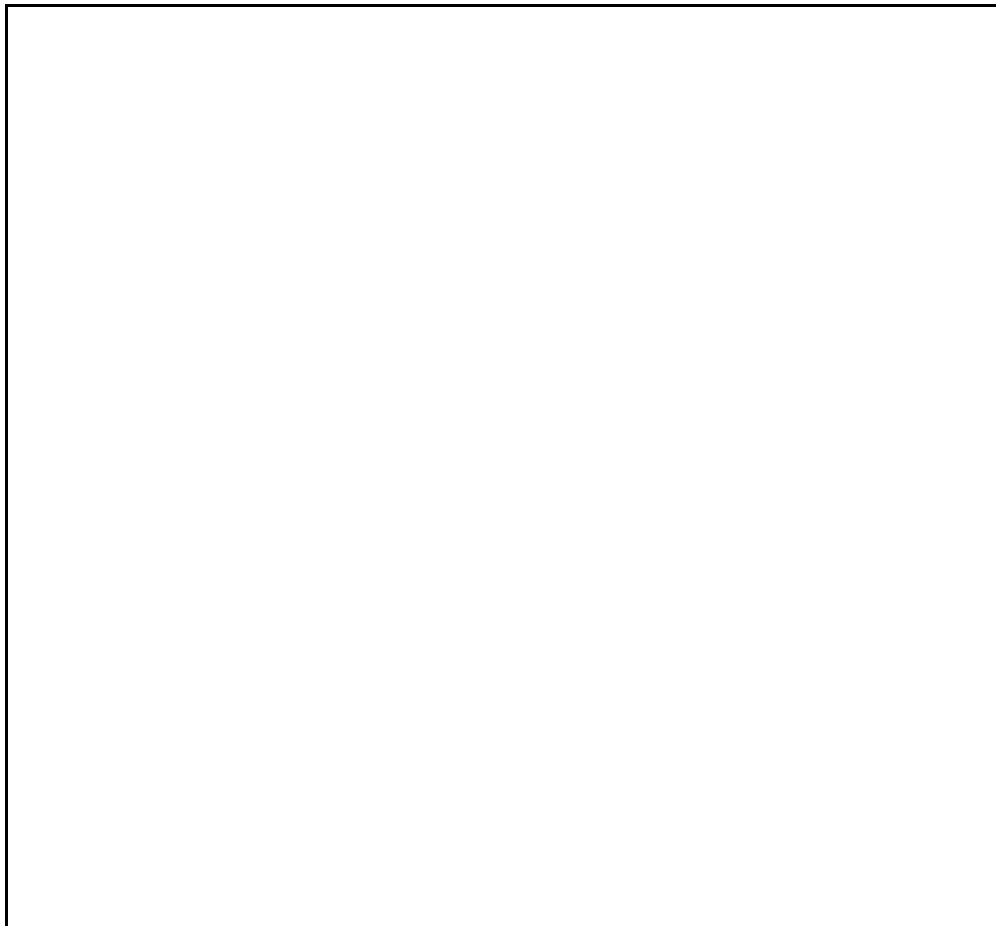
The various versions of the *Subsurface Wastewater Disposal Rules* have and continue to employ the best available technology regarding the design and installation of disposal systems. Unfortunately, however, that does not prevent those systems from occasionally malfunctioning prematurely. It is therefore necessary for Local Plumbing Inspector's and Site Evaluators to be able to determine when and why a disposal system is failing.

There are three common failures typically associated with disposal systems:

- € a back-up of effluent into the building
- € surfacing of effluent on the ground, causing a public nuisance or health hazard
- € effluent that is not properly treated by soil prior to discharge into ground and/or surface waters.

Failures can be caused by a number of factors, including:

- € Blockage of plumbing
- € Improper disposal system design
- € Improper disposal system installation
- € Improper disposal system use
- € Defective disposal system components

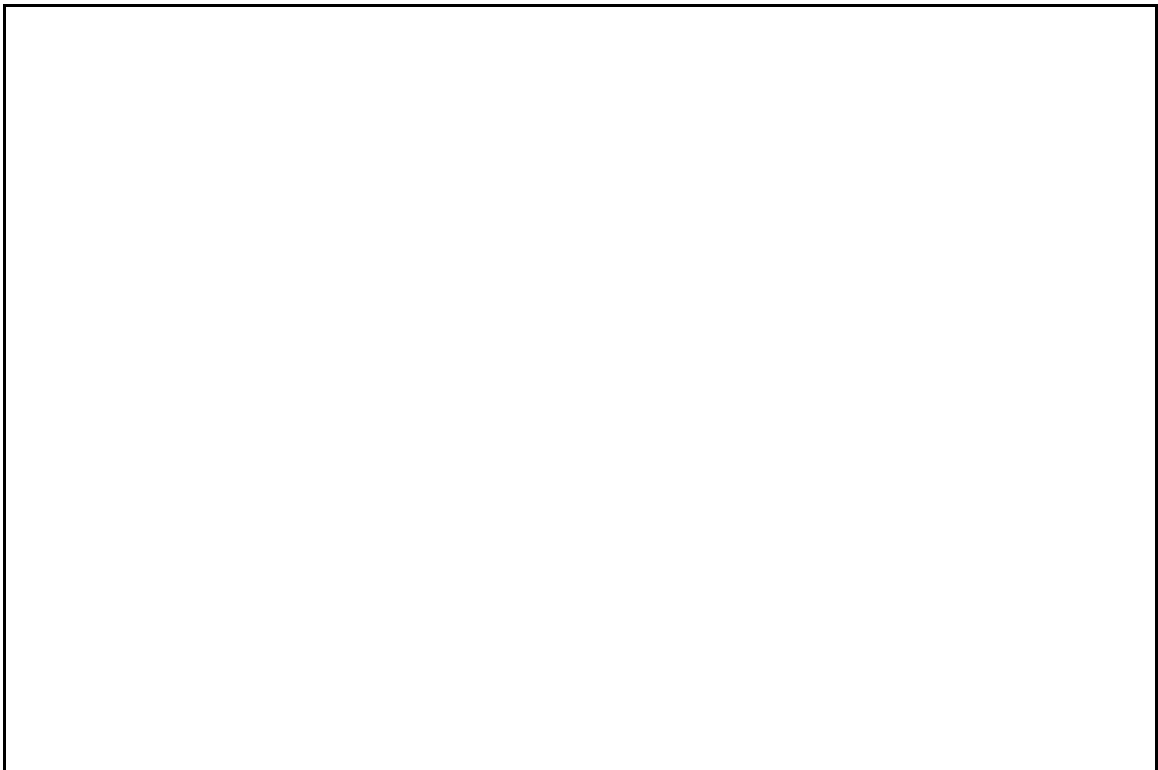


Sometimes, a disposal area that is not functioning properly can be corrected without replacing the entire system. The age of the system, quality of construction, size and integrity of system components, wastewater generation, usage, soil conditions, site conditions, potential for public sewer extension, economic factors, and risk acceptability must all be considered. Generally, the Division of Health Engineering does not recommend rejuvenating attempts to a system that was constructed prior to 1974.

Systems that were designed and properly installed after 1974 usually are more worthy of

rejuvenation attempts than older systems, or systems that were improperly sited. Systems that have been determined to have good chances of rejuvenation usually receive either: mechanical excavation of the sealed sidewall and disposal area expansion, or addition to fill extensions.

Mechanical excavation of a sealed sidewall and expansion of the disposal area is a procedure that is used most frequently on systems that have failed, due to the development of an impermeable organic mat at the interface of the disposal area and surrounding soil. Mechanical removal of the impermeable sidewalls and expansion of the disposal area has succeeded in correcting malfunctions when properly prescribed.



Adding fill material or extending fill extensions will not permanently correct a disposal area that has failed due to physical, chemical or biological clogging. However, adding or extending fill may be a valid solution for a disposal area that has been constructed above the original soil surface and is failing due to seepage breakout through the fill material or where the 3 foot shoulders were not fully installed. Hydraulic mounding may occur on modified sites, where the underlying original soils have relatively low infiltrative capacities and slow permeabilities, where compaction or smearing have occurred, fill extensions in the direction of the hydraulic gradient are minimal, and hydraulic loadings are moderate to high.

Wastewater in this situation readily permeates into the surrounding fill throughout the entire sidewall and bottom area of the disposal bed, but surfaces in, or at the edge of, the surrounding fill. Short circuiting may occur when a system was constructed with improper fill extensions or shoulders and when wastewater weeps through an area of least resistance to flow. The disposal area will not hold an excessive amount of wastewater when hydraulic mounding and short circuiting occur. If the disposal area is full of wastewater, filling the area should not be considered as a permanent solution.

Permits are not required for adding fill material or extending fill extensions, however, it is advisable that the Local Plumbing Inspector be notified of the activity.

GLOSSARY

Aerobic: A condition in which molecular oxygen is a part of the environment.

Aggregate: Many soil particles held in a single mass or cluster such as a clod, crumb, block, or prism.

Alternative toilet: A device, other than a water closet, designed to treat human waste only. Examples are: privies and compost, chemical, recirculating, incinerating, and vacuum toilets.

Anaerobic: A condition in which molecular oxygen is absent from the environment.

Backfill: Soil material that is suitable for use beneath and beside the disposal field, including fill extension.

Bedrock: A solid and continuous body of rock, with or without fractures, or a weathered or broken body of rock fragments overlying a solid body of rock.

Black wastewater: Wastewater derived from plumbing fixtures or drains that receive excreta supplemented wastewater.

Building sewer: That part of the plumbing system that extends from the end of the building drain and conveys its discharge to a public sewer, septic tank and disposal field, or other point of disposal.

Capillary: The attraction of water molecules to soil particles in small soil

pore openings of the approximate diameter of a hair (*Latin for "hair" is capilla*).

Cation exchange: The interchange between a cation (positively charged ion) in solution and another cation on the surface of any surface active material such as clay or organic matter.

Certificate of approval: A certificate signed by the plumbing inspector stating that a system has been installed in compliance with the disposal system permit application and the *State of Maine Subsurface Wastewater Disposal Rules*.

Cesspool: A covered excavation that receives wastewater or other organic wastes from a structure, and is designed to retain the organic matter and solids, but allows liquids to seep through the bottom and sidewalls.

Chroma: The relative purity or strength of color of soil; a quality that decreases with increasing grayness. Chroma is one of the three variables of color as defined in the Munsell system of color classification.

Clay: A particle size category consisting of mineral particles that are smaller than 0.002 millimeter in equivalent spherical diameter; also, a soil texture class having more than 40% clay, less than 45% sand, and less than 40% silt.

Clay loam: A soil texture class having 27

to 40% clay and 20 to 45% sand.

Coastal sand dune: Sand deposit within a marine beach system above high tide including, but not limited to: beach berm, frontal dune ridge, back dune area, and other sand areas deposited by wave or wind action.

Cobble: A rock fragment that is rounded or semi-rounded in shape and is between 3 and 10 inches in diameter.

Curtain drain: A trench to intercept laterally moving ground water and divert it away from a disposal area.

Design Flow: The wastewater flow that may reasonably be expected to be discharged from a facility on any day of operation.

Disposal area: An individual subsurface wastewater disposal system component, consisting of a closed excavation made within soil or fill material to contain disposal field stone, or approved proprietary devices.

Distribution box: A water-tight structure that receives septic tank effluent and distributes such effluent in equal portions to two or more disposal areas or distribution pipes with a disposal area.

Distribution pipe: A perforated pipe or one of several perforated pipes used to carry and distribute septic tank effluent throughout the disposal area.

Diversion ditch: A ditch to intercept and divert surface water runoff.

Drainage ditch: A manmade ditch receiving and diverting surface runoff or subsurface water. This does not include diversion of a naturally occurring water body.

Elevation Reference Point: An easily-identifiable point or object of constant elevation for establishing the relative elevation of observation holes and elevation of the components of the system.

Eluviation: The removal of soil materials in suspension from a soil leached horizon.

Fill material: Any soil, rock, or other material placed within an excavation or over the surface of the ground. The term is equivalent in meaning.

Flood plain, coastal and estuary: The land area within the V-Zone indicated by the Federal Insurance Rate Maps (FIRM) or below the 10-year storm surge elevation, whichever is more restrictive. The 10-year storm surge elevation in Maine is approximately the 8-foot National Geodetic Vertical Datum.

Flood plain, riverine: The land area within the 10-year flood zone indicated by Soil Conservation Soil Service Maps or other sources acceptable to the Department in the absence of Soil Conservation Service Maps. Note: Some municipalities restrict new development in the 100-year flood plain.

Gpd: Gallons per day.

Gleization: A process whereby the soil undergoes intense reduction caused by the soil being saturated and having the following conditions: being free of dissolved oxygen, having soil temperatures above biologic zero (41°F), and having the presence of food for microorganisms (organic matter).

Gleyed: A condition found in mineral soils (or mineral soil elements) resulting from intense reduction, generally with matrix colors of chroma 2 or less in loamy textured soils and chroma 3 or less in sandy soils. Mottles may or may not be present. This condition is characterized by low chroma colors including black, green, various shades of grey, and darker shades of brown or red.

Gravel: A rounded or semi-rounded rock fragment that is between 2 millimeters and 3 inches in diameter.

Gravitational pressure: The force of gravity acting on soil water which tends to pull the water downward.

Gray Wastewater: That portion of the wastewater generated within a residential, commercial, or institutional facility that does not include discharges from water closets and urinals.

Grease interceptor: A device in which the grease in wastewater leaving a structure is intercepted, congealed by cooling, accumulated, and stored for pump-out and disposal.

Grease trap: A device designed to retain grease from a single plumbing fixture.

Groundwater: Water below the land surface in a zone of soil saturation.

Groundwater aquifer: A rock or gravel formation that contains significant recoverable quantities of water that is likely to provide drinking water supplies.

Groundwater mounding: The rise in the groundwater table directly beneath a disposal system, due to the increase in liquid (i.e. wastewater) to the area.

Groundwater table: The upper surface of a zone of saturation.

H-20 wheel load: A wheel loading configuration as defined by the American Association of State Highway Officials for a standardized 1-ton-per-axle truck.

Hazardous waste: Any chemical substance or material, whether gas, solid, or liquid, that is designated as hazardous by the U.S. Environmental Protection Agency pursuant to the United States Resource Recovery and Conservation Act, Public Law 94-580.

Holding tank: A closed, water-tight structure designed and used to receive and store wastewater or septic tank effluent. A holding tank does not discharge wastewater or septic tank effluent to surface or ground water or onto the surface of the ground. Holding tanks are designed and constructed to facilitate

ultimate disposal of wastewater at another site.

Horizon, A: The mineral soil horizon that lies at or near the surface. These contain a

Horizon, Ap: The mineral soil horizon characterized by the mixing of O, A, and B horizons, caused by the action of plows, etc.

Horizon, B: The mineral soil horizon characterized by the maximum accumulation of materials such as iron and aluminum oxides and silicate clays.

Horizon, C: The mineral soil horizon that is little affected by the weathering process and lacks properties of O, A, E and B horizons. The C horizon may be either like or unlike the parent materials from which the upper soil horizons were formed. It is outside the zones of major biological activities and is little affected by the soil-forming processes.

Horizon, E: The mineral soil horizon in which the main feature is loss of silicate clay, iron, aluminum, or a combination of these, leaving a concentration of sand and silt particles and exhibiting obliteration of all or much of the original rock structure. It is usually lighter in color than the underlying B horizon and is usually found between A and B horizons, or O and B horizons.

Horizon, O: The organic soil horizon characterized by undecomposed or partially decomposed litter (such as leaves, pine needles, twigs, moss, and lichens) that has been deposited on the

strong admixture of humified organic matter that tends to impart a darker color than that of the lower soil horizons.

surface of the ground.

Horizon, hydraulically restrictive: A soil horizon, or zone within a soil profile, that slows or prevents the downward or lateral movement of water.

Horizon, limiting: Any soil horizon or combination of soil horizons, within the soil profile or any parent material below the soil profile, that limits the ability of the soil to provide treatment or disposal of septic tank effluent. Limiting horizons include bedrock, hydraulically restrictive soil horizons and parent material, excessively coarse soil horizons and parent material, and seasonal ground water table.

Horizon, soil: A layer within a soil profile differing from the soil above or below it in one or more soil morphological characteristics. The characteristics of the layer include the color, texture, rock-fragment content, structure, and consistence of each parent soil material.

Hue: The dominant spectral color, one of the three variables of soil color defined within the Munsell system of color classification.

Hydric soil: A soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor

the growth and regeneration of hydrophytic vegetation.

Hydrology: The science dealing with the properties, distribution, and circulation of water.

Illuviation: The build-up or accumulation of soil material usually carried from an overlying horizon.

Intermittent watercourse: A stream, brook or wetland area that flows less than 6 months of the year.

Invert: The floor, bottom, or lowest portion of the internal cross section of a closed conduit, used with reference to pipes or fittings conveying wastewater or septic tank effluent.

Lacustrine deposits: Deposits laid down in lake bodies. Lacustrine deposits are usually slightly coarser than marine sediments and may exhibit lenses of fine sand and sandy loam material in lower portions of the soil profile.

Lined disposal field: A filtration layer of backfill placed directly beneath and adjacent to a disposal field.

Malfunctioning system: A system that is not operating or is not functioning properly. Indications of a malfunctioning system include, but are not limited to, any of the following: ponding or outbreak of wastewater or septic tank effluent onto the surface of the ground; seepage of wastewater or septic tank effluent into parts of buildings below ground; back-up of wastewater into the building served that

Hydrostatic pressure: The pressure exerted by the gravitational weight of a column of water (see gravitational pressure).

is not caused by a physical blockage of the internal plumbing; or contamination of nearby water wells or surface water bodies.

Marine deposits: Fine sediments deposited on the ocean floor. These deposits are usually silt loam, silty clay loam, or silty clay. These deposits usually become firm and dense with increasing soil depth.

Matrix color: The predominant color of the soil in a particular horizon.

Mineral soil: Any soil consisting primarily of sand, silt, and clay, rather than organic matter. In general, the organic carbon content is less than 20% by weight.

Mottles, drainage: Soil color patterns caused by alternating saturated and unsaturated soil conditions. When saturation occurs while soil temperatures are above biological zero (41°F), iron and manganese will become reduced and exhibit subdued shades such as grays, greens, or blues. When unsaturated conditions occur, oxygen combines with iron and manganese to develop brighter soil colors such as yellow and reddish brown. Soils that experience seasonally fluctuating water tables usually exhibit alternating streaks, spots, or blotches of

bright oxidized colors with reduced dull, or subdued, colors. The longer a soil is saturated and in an anaerobic condition, the greater is the percentage of color that will be subdued. Soils that are never or rarely exposed to free oxygen are considered totally reduced or gleyed.

Munsell system: A system of classifying soil color consisting of an alpha-numeric designation for hue, value, and chroma, such as "7.5YR6/2", together with a descriptive color name, such as "strong brown".

Normal high water line-riverine, stream, lake, and pond: That line on the shore or bank that is apparent from visible markings, changes in the character of soil, rock, or vegetation resulting from submersion or the prolonged erosion action of the water.

Observation hole: An observation hole dug by hand, back-hoe, or auger, or a soil core taken intact and undisturbed using a probe.

Orstein: A soil layer in the **B** horizon of coarse textured soils that is cemented with iron or organic matter.

Parent material: The unconsolidated and more or less unweathered mineral or organic matter from which the soil profile is developed.

Perched seasonal ground water table: A seasonal ground water table that occurs immediately above a hydraulically restrictive soil horizon.

Redoximorphic features (Drainage

Mottling: A color pattern observed in soil consisting of blotches or spots of contrasting color. The term "mottle" refers to an individual blotch or spot.

Percolation: The downward movement of water through the soil.

Perennial watercourse: A stream or brook that flows greater than 6 months of the year.

Permeability: The rate at which water moves through a unit of soil or rock material.

Pit privy: An alternative toilet placed over an excavation where human waste is deposited.

Pore (soil): Space between soil grains.

Pressure distribution: A method of directing wastewater to a disposal area by means of a pump to assure even flow throughout the area.

Primitive disposal area: A minimal disposal area designed specifically to treat gray wastewater originating from a non-pressurized water supply.

Proprietary disposal device: A device utilized in disposal areas as an alternative to a disposal area with a bedding of stone and one or more distribution pipes.

Mottles): Redoximorphic features

associated with wetness result from the reduction and oxidation of iron and manganese compounds in soil after saturation with water and desaturation, respectively. The reduced iron and manganese ions are mobile and may be transported by water as it moves through the soil. Certain redox patterns occur as a function of the patterns in which the ion-carrying water moves through the soil, and of the location of aerated zones on the soil. Redox patterns are also affected by the fact that manganese is reduced more rapidly than iron, while iron oxides more rapidly upon aeration. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in the soil. Wherever the iron and manganese is oxidized and precipitated, it forms either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redox process in a soil may result in redoximorphic features that are defined as follows:

Redox concentrations: These are zones of apparent accumulation of Fe-Mn oxides, including:

- (1) Nodules and concretions, i.e. firm, irregularly shaped bodies with diffuse boundaries if formed *in situ* or with sharp boundaries in weathered soil horizons;
- (2) Masses, i.e. soft bodies of variable shapes within the matrix; and

- (3) Pore linings, i.e. zones of accumulation along pores which may be either coatings on the pore surfaces or impregnations from the matrix adjacent to the pores.

Redox depletions: These are zones of low chroma (2 or less) where either Fe-Mn oxides alone or both Fe-Mn oxides and clay have been stripped out, including:

- (1) Iron depletions, i.e. zones which contain low amounts of Fe and Mn oxides but have a clay content similar to that of the adjacent soil matrix.
- (2) Clay depletions, i.e. zones which contain low amounts of Fe, Mn and clay.

Refusal: Depth of excavation limited by the inability to dig deeper with implement being used which is usually caused by encountering bedrock or firm basal till.

Rock fragment: A fragment of rock, contained within the soil, that is greater than 2 millimeters in equivalent spherical diameter or that is retained on a 2-millimeter sieve.

Sand: A particle size category consisting of mineral particles that are between 0.05 and 2 millimeters in equivalent spherical diameter. Also a soil textural class having 85% or more sand along with a maximum of 15% silt and clay. The percentage of silt may not be more than 1.5 times the percentage of clay.

Saturated: A condition in which all easily drained voids between the soil particles are temporarily or permanently filled with water.

Scum: A mass of wastewater solids floating on the surface of the wastewater and buoyed up by entrained gas, grease, or other substances.

Seasonal conversion permit: Written **Septage:** All sludge, scum, liquid, or any other material removed from a septic tank or disposal area.

Septic tank: A water-tight receptacle that receives the discharge of untreated wastewater. It is designed and installed so as to permit settling of settleable solids from the liquid, retention of the scum, partial digestion of the organic matter, and discharge of the liquid portion into a disposal area.

Septic tank effluent: Primary treated wastewater discharged through the outlet of a septic tank and/or an approved sand, peat, or similar filter.

Septic tank filter: A device designed to keep solids and grease in the septic tank.

Serial distribution: A method of distributing septic tank effluent between or within a series of disposal areas so that each successive disposal area receives septic tank effluent only after the preceding disposal areas have become full to the bottom of the invert.

Setback distance: The shortest

authorization issued by the plumbing inspector to allow the conversion of a seasonal dwelling unit located in a shoreland zone to year-round use.

Seasonal ground water table: The upper limit of seasonal ground water. This zone may be determined by identification of soil drainage mottling or by monitoring, or **MAPSS** drainage key.

horizontal distance between a component of a system and certain site features or structures.

Shoreland zone area: All land area within 250 feet, horizontal distance, of the normal high-water line of any great pond, river or salt water body; or within 250 feet, horizontal distance, of the upland edge of a freshwater or coastal wetland; excluding any forested wetland; or within 75 feet, horizontal distance, of the normal high-water line of a stream.

Silt: A particle size category consisting of mineral particles that are between 0.002 and 0.05 millimeters in equivalent spherical diameter. It also means a soil textural class having 80% or more of silt and 12% or less of clay.

Silt loam: A soil textural class having 50% or more of silt and 12 to 27% clay; or 50 to 80% of silt and less than 12% clay.

Site evaluation: The practice of investigating, evaluating, and reporting the basic soil and site conditions that apply to wastewater treatment and disposal along with a system design in compliance with

the *State of Maine Subsurface Wastewater Disposal Rules*.

Site Evaluator: A person licensed to practice Site Evaluation in Maine.

Sludge: A relatively dense accumulation of wastewater solids that settle to the bottom of a septic tank. These solids are relatively resistant to biological decomposition and collect in the septic tank over a period of time.

Soil aggregate: A naturally occurring
Soil horizon: See definition, "Horizon, soil."

Soil material: Soil as well as any naturally occurring unconsolidated mineral deposit that is not bedrock.

Soil profile: A vertical cross section of the undisturbed soil showing the characteristic soil horizontal layers or soil horizons that have formed as a result of the combined effects of parent material, topography, climate, biological activity, and time.

Soil saturation: The state when all the pores in the soil are filled with water. Water will flow from saturated soils into a observation hole.

Soil structure: The naturally occurring arrangement, within a soil horizon, of sand, silt and clay particles, rock fragments, and organic matter that are held together in clusters or soil aggregates.

Soil texture: The relative proportions of

unit of soil structure consisting of particles of sand, silt and clay, organic matter, and rock fragments held together by the natural cohesion of the soil.

Soil color: The soil color, particularly as determined by comparison of the moist soil with color chips contained in a Munsell soil color book.

Soil consistence: The resistance of a soil horizon to deformation.

sand, silt, and clay in a soil.

Stone: A rock fragment that is rounded or semi-rounded in shape and greater than 10 inches in diameter.

Stratified drift deposits: Deposits laid down by glacial meltwater streams from the last glacier. All stratified drift deposits exhibit some degree of alternating layers of different but well-sorted particles.

Stream: A free-flowing body of water from the outlet of a great pond or the confluence of two perennial streams (as depicted on the most recent edition of a United States Geological Survey 7.5 minute topographical map or, if not available, a 15 minute topographic map) to the point where the body of water becomes a river.

Subsurface wastewater disposal system: Any system designed to dispose of waste or wastewater on or beneath the surface of the earth; includes, but is not

limited to: septic tanks; disposal areas; grandfathered cesspools; holding tanks; pre-treatment filter, piping, or any other fixture, mechanism, or apparatus used for those purposes.

System: See definition, "Subsurface wastewater disposal system."

Till: Deposits of glacial material laid down in place. These deposits are neither sorted nor stratified and consist of a heterogeneous mixture of silt, sand, gravel, cobbles, and stones.

Value: The relative lightness or intensity of a color, one of the three variables of soil color defined within the Munsell system of classification.

Vault privy: An alternative toilet that retains human waste in a sealed vault.

Wastewater: Any liquid waste containing animal or vegetable matter in suspension or solution, or the water-carried wastes from the discharge of water closets, laundry tubs, washing machines, sinks, dishwashers, or other source of water-carried wastes of human origin. This term specifically excludes industrial, hazardous, or toxic wastes and materials.

Water course: A channel created by the action of surface water and characterized by the lack of upland vegetation or the presence of aquatic vegetation and by the presence of a bed devoid of top soil containing waterborne deposits on exposed soil, parent material or bedrock.

Till, ablation: Till deposited by the settling of soil particles and rock fragments from the melting glacial ice. It is loose, sandy, and easy to excavate.

Till, basal: Till laid down at the bottom of the glacier. It is fine-grained, compact, and difficult to excavate.

Variance: Written authorization that permits some act or condition not otherwise permitted by the *State of Maine Subsurface Wastewater Disposal Rules*.

Water well: A bored, drilled, or driven shaft or a dug hole, that extends below the seasonal ground water table and is used as the primary drinking water supply.

Wetland: Area that has a predominance of hydric soils and that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions.

Wetland, coastal: All tidal and sub-tidal lands; all lands below any identifiable debris line left by tidal action; all lands with vegetation present that is tolerant of salt water and occurs primarily in a salt water or estuarine habitat; and any swamp, marsh, bog, beach, or contiguous lowland subject to tidal action during the maximum spring tide level as identified in tide tables published by the National Ocean Service. Coastal wetlands may

include portions of coastal dunes.

Wetland, freshwater: Freshwater swamp, marsh, bog, or similar area that is inundated or saturated by surface or ground water at a frequency and for a duration sufficient to support, and normally does support, predominantly wetland vegetation.

APPENDIX A

MAPSS
Soil Drainage Key (Page 1)

Soil Drainage Key (Page 2)

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