SECTION 1

1 INTRODUCTION

1.1 PURPOSE OF THE GUIDELINES

These Guidelines have been established and adopted by Nova Scotia Environment in accordance with *Regulations Respecting On-site Sewage Disposal Systems*, which became effective on March 27, 2007.

These Guidelines are not intended to be a comprehensive design manual covering every aspect of on site sewage disposal system design. There are numerous references available regarding soil hydraulics and other aspects of on site sewage disposal that can be of value to the designer.

The Regulations requires that design or selection of an on-site system take into account guidelines, policies, or standards established or adopted by the department.

These Guidelines include requirements that supplement those in the Regulations.

They also repeat, in summary or in whole, for the convenience of the user, relevant requirements of the Regulations. A user is cautioned that:

- if there is any uncertainty or ambiguity in comparing the Guidelines and Regulations, the Regulations govern.
- the Guidelines do not repeat some requirements of the Regulations, particularly those related to purely procedural matters.

The Guidelines are intended to be used as an educational and technical manual by qualified persons, installers of systems, and staff of Nova Scotia Environment that have an interest in the planning, design, selection, installation, operation and maintenance of on-site systems.

Further information related to the Guidelines can be obtained from the regional offices of Nova Scotia Environment.

1.2 CONTENT OF THE GUIDELINES

The content of the Guidelines reflects the fact that most on-site sewage disposal systems serve single unit residential dwellings. Section 4 deals with system selection and applies specifically to single unit residential systems and Section 5 deals with system design.

The information contained in the Guidelines, specifically Section 5, applies to the design of on-site systems that serve multi-unit residential, industrial, institutional and commercial properties.

The Guidelines also include information and instructions regarding; evaluation of sites to determine their suitability for on-site systems, system construction, operation and maintenance, and other topics that are listed in the Table of Contents. The diagrams are

intended to clarify and supplement the text and are not engineered drawings. The drawings should be read in conjunction with the text.

1.3 INTRODUCTION TO ON-SITE SYSTEMS

This section provides a summary of some of the information regarding on-site systems that is provided in more detail in other parts of these Guidelines.

Figure 1.A shows a typical system, and indicates the role of different components in treatment and disposal of sewage and protection of public health and the environment.

A **building sewer** is the pipe that connects a building to the rest of a disposal system. This pipe must be the required size of 100 mm, watertight, and laid at a minimum slope of two percent. In some cases it may be necessary to pump wastewater from the building to a septic tank.

A **septic tank** is a settling tank that holds the sewage long enough — usually 48 hours—to allow for settling and floating solids, fats and greases to be removed. This prevents these materials from clogging the disposal field and the surrounding soil. The tank also provides storage for sewage solids, and allows them to partially decompose. The tank will hold about a 3-year accumulation of solids in normal use, after which the tank should be pumped. Septic tanks must be watertight—to prevent sewage from escaping, and to prevent ground water from entering and occupying space intended for the treatment of sewage. They must also be accessible for maintenance and repair.

Septic tank effluent (sewage leaving the tank) will contain reduced concentrations of settlable or floatable solids, but it will still be contaminated by fecal bacteria and fine organic solids.

An **effluent line** is the pipe that connects the septic tank to a disposal field. In some cases it may be necessary to pump effluent to the disposal field.

A **disposal field** is intended to distribute septic tank effluent into the soil, and may provide treatment of the effluent.

Components of a disposal field (**Figure 1.A**) include:

- **Sod** over a disposal system is essential, because it provides frost protection, protects against erosion, sheds surface water, and stores water that does soak in to the soil until it evaporates or is returned to the atmosphere by plants.

- **Final cover material** supports the sod. It also provides frost protection, storage for surface water until it evaporates, and allows oxygen and other gases to pass into and out of the disposal field.

- A synthetic **barrier material** prevents clean local backfill material from migrating into the crushed rock and clogging the disposal field.

- Most systems use **gravity distribution pipe**, with a slope and hole spacing intended to evenly distribute the effluent. For longer systems or systems that cannot be gravity fed, **pumps or siphons and pressure distribution piping** will be necessary.

- **Crushed rock** surrounds the distribution pipe and distributes effluent from the septic tank over the disposal area. It provides protection for the distribution pipe and storage and distribution of the effluent.

- **Filter sand** beneath the crushed rock provides a location for the formation of the **clogging mat**, which will form after several months of system operation. The clogging mat is a layer of solids, consisting of solids from the septic tank effluent, microbiological organisms and their by-products. The microorganisms digest the organic materials in the effluent. The clogging mat has a very low permeability, and, at periods of high flow, effluent will pond within the distribution trench (i.e., the gravel layer) in order to generate enough pressure to force the effluent through the clogging mat and into the surrounding soil.

- The **infiltrative surface** is the top of the natural soil beneath the field. Care must be taken during construction to prevent damage to this surface, which could block soil pores and prevent effluent from entering the soil.

- The **soil** beneath the disposal field plays an important role in determining the design and the size of on-site fields. The soil removes harmful pathogens before the effluent reaches ground water, which may supply a well or re-appear in a stream or lake. As effluent from a disposal field passes through a silty soil, particulate matter is physically filtered out in a relatively short distance. Most bacteria, viruses or other potentially disease-causing organisms (pathogens) are not able to pass through long distances of unsaturated soil. They are retained within the first few feet of soil, where the numbers are greatly reduced in a hostile environment. In saturated soils the organisms may travel much greater distances. When effluent enters a heavy gravel with little or no fine material (silt and clay particles), it will pass through the voids so quickly that pathogens can be transported hundreds of feet.

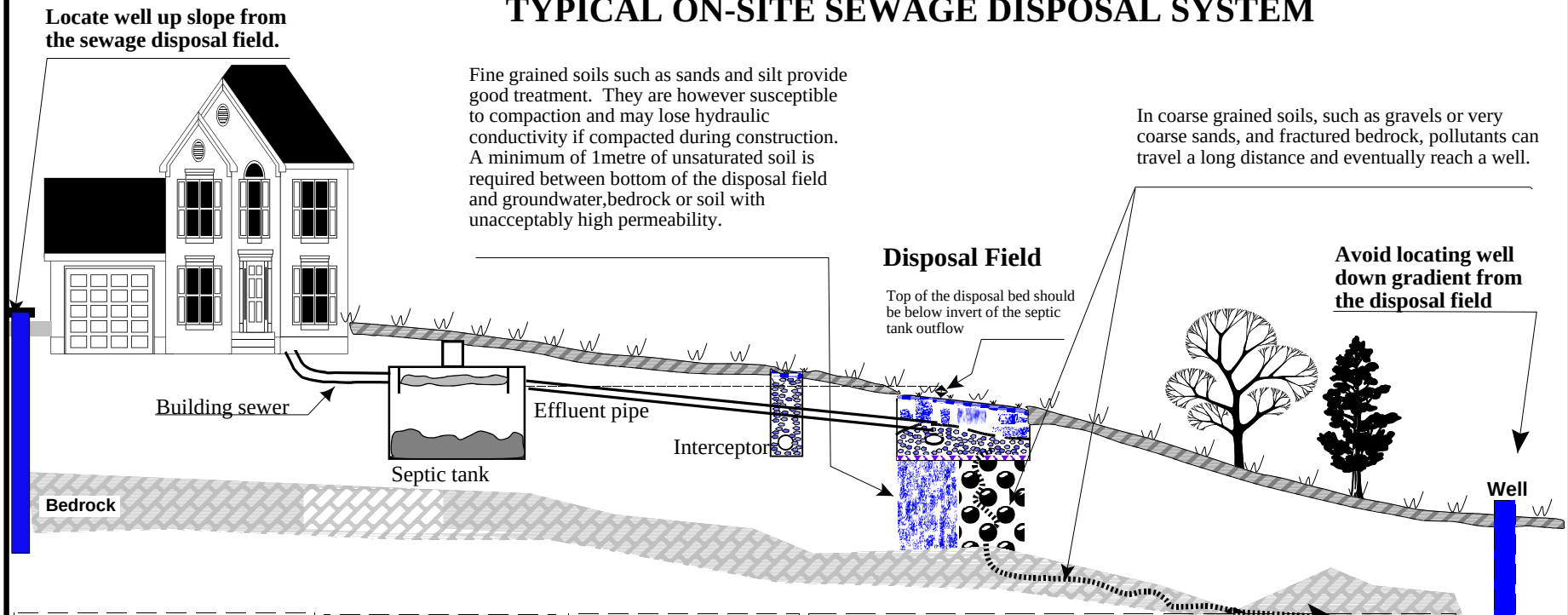
For all systems, a minimum soil thickness is maintained between the bottom of the disposal field and ground water or bedrock, which may contain fractures or openings that can carry effluent into the ground water. If the natural soil is too coarse to provide this protection, a built-up disposal system must be designed to include an additional sand layer (**imported sand fill material**) over the coarse soil. In situations where the natural soil is so tight that effluent will travel horizontally before it can slowly enter the soil, selection/design of the system focuses on provision of an adequate distribution area.

Surface water and roof drainage should be directed away from a disposal field. Surface and ground water entering a disposal system can cause the hydraulic capacity of the field to be exceeded. For this reason some locations should be avoided for siting of a disposal field. In many locations an **interceptor trench system** (**Figure 1.B**) will be required to divert surface water and/or lower a water table.

In some situations the typical system **(Figure 1.A)** may not be appropriate, and alternatives that are permitted by the Regulations and comply with these Guidelines may be used.

FIGURE 1.A

TYPICAL ON-SITE SEWAGE DISPOSAL SYSTEM



RESIDENTIAL WASTE WATER

Parameter	Concentration Mg/l
Total solids	680-1000
Volatile solids	380-500
Suspended solids	200 290
Volatile susp. Solids	150-240
BOD5	200-290
COD	680-730
Total nitrogen	35-100
Ammonia	6-18
Nitrates/Nitrites	<1
Total phosphorus	18-29
Total coliform	10E10-10E12
Fecal coliforms	10E8-10E10
pH	7.5
Detergents	37-43
Grease	16-21

Hazardous chemicals: cleaners,personal care products, paints, polish etc.
Toluene, chloroform, methylene chloride, 1,4 dichlorobenzene, As,Cd,Cu,Pb,Hg etc.
Concentrations 1-64 ppb.

SEPTIC TANK TREATMENT

The objective of the septic tank is to separate settlable and floatable materials from wastewater and store and provide a limited anaerobic digestion of those materials in the same tank.
The removal of soluble BOD can also take place but conversion to cellular material is not significant.
Removal efficiency depends on detention time and flow conditions in the tank.
REMOVAL:
BOD5 - 60%
SS - 70%
Total nitrogen - 20%(storage)
Phosphate - 15 - 30%
Oil and grease - 70-80%
Coliforms are not significantly reduced in septic tanks.

SEPTIC TANK EFFLUENT

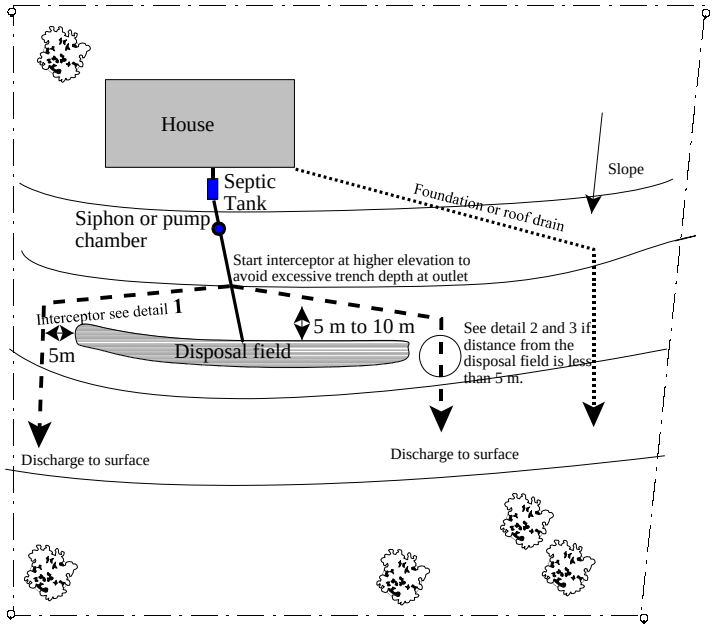
Parameter	Concentration Mg/l
Suspended solids	- 75
BOD5	- 140
COD	- 300
Total nitrogen	- 40
Total phosphorus	- 15
Total coliforms	- 3.4E6
Fecal coliforms	- 4.2E5
Ammonium	- 38

SOIL TREATMENT
Bacteria removal is accomplished by filtration, adsorption, death rate (antagonistic organisms, lack of nutrient, moisture content, etc).
Viruses are removed by filtration, precipitation, adsorption , biological enzyme attack, natural die-off .Virus removal is controlled more by adsorption than by filtration . Cation exchange properties of soils, mineralogy, texture, pH, and temperature, etc. influence virus attenuation.
Unsaturated flow condition in the soil beneath a septic system result in good aeration, slow travel, long residence time, good effluent-soil contact, and opportunity to die-off is very important in microorganism removal.
Microorganisms move only a few meters (0.3 to 1.5) in unsaturated soil but much larger distance in saturated soil. Distances up to 850 m have been reported. Traveled distance depends also on soil texture, with higher retention in fine textured soils (silts clays).
Organic substances are removed by decomposition, filtration, incorporation into microbial cells. Five feet of unsaturated flow should remove most of BOD5 and Suspended Solids. (2 to 1 mg/l).
Nitrogen is present mostly as ammonia in raw sewage. The biodegradation of organic-N may occur in biomat and undrlying soil releasing more ammonia. (Amonification).
In aerobic conditions nitrification can occur in two steps converting ammonia to nitrites (NO2)(Nitrosomonas) and then nitrates (NO3)(Nitrobacter). In anaerobic conditions denitrification may occur reducing nitrates to gaseous form.(Pseudomonas, Achromobacter,)
Nitrogen is removed by adsorption, volatization (ammonia), plant uptake dillution. Nitrates are highly mobile and can travel a considerable distance in groundwater.
Most phosphates reacts vigorously with soils. Phosphate ions are removed by adsoption, precipitation and plant uptake. Phosphorus transport through the soil is more likely to occur in coarse textured noncalcareous soils that are low in organic content.

For general information only

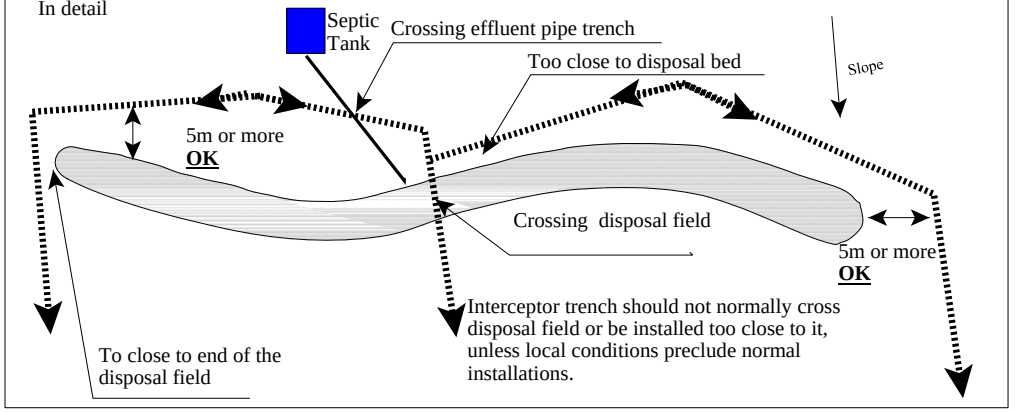
FIGURE 1.B

INTERCEPTOR TRENCH AND SWALE



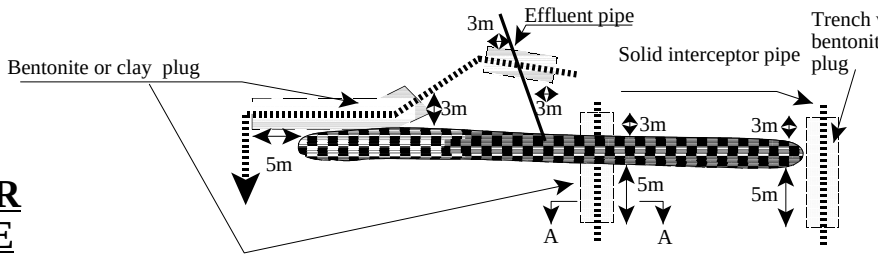
POTENTIAL PROBLEM AREAS AT INTERCEPTOR LOCATION

Special precaution must be taken to ensure that water from the interceptor does not enter the disposal system or flow from the disposal field does not enter interceptor. Some areas where this may happen are outlined below.



DETAIL 2

LOCATION AND EXTENT OF BENTONITE/CLAY PLUGS



NOTES:

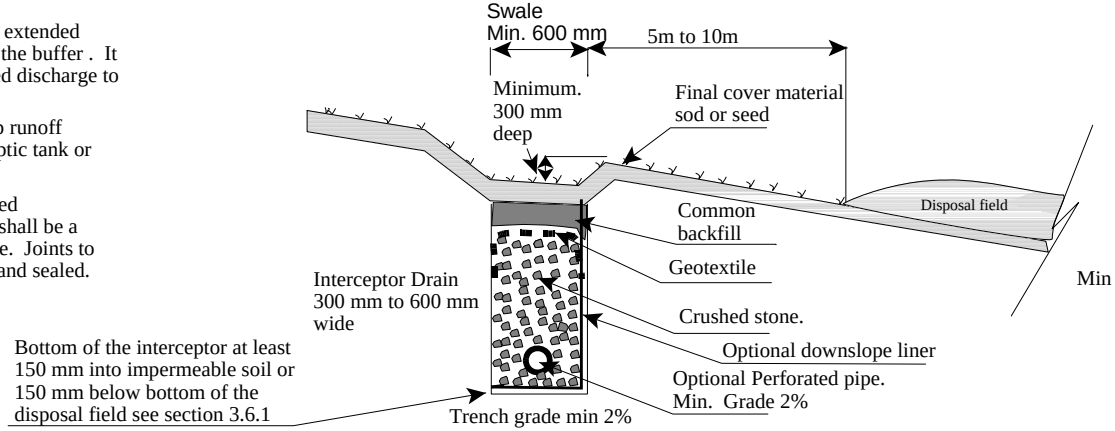
Foundation and roof drains must not be connected to interceptor drain or discharge in vicinity of disposal field, septic tank or pump chamber

Interceptor trench should be extended minimum 6 m below end of the buffer . It must provide an unobstructed discharge to the surface.

Lot should be graded to keep runoff away from disposal field, septic tank or pump chamber.

If a downslope liner is utilized (optional) the liner material shall be a 20 mils HDPE geomembrane. Joints to be lapped at least 0.5 meter and sealed.

DETAIL 1 INTERCEPTOR DRAIN/SWALE



DETAIL 3

A-A

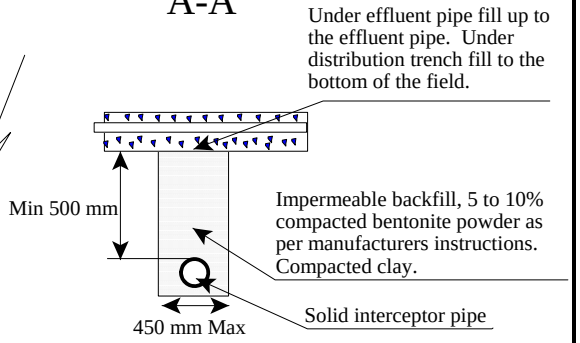
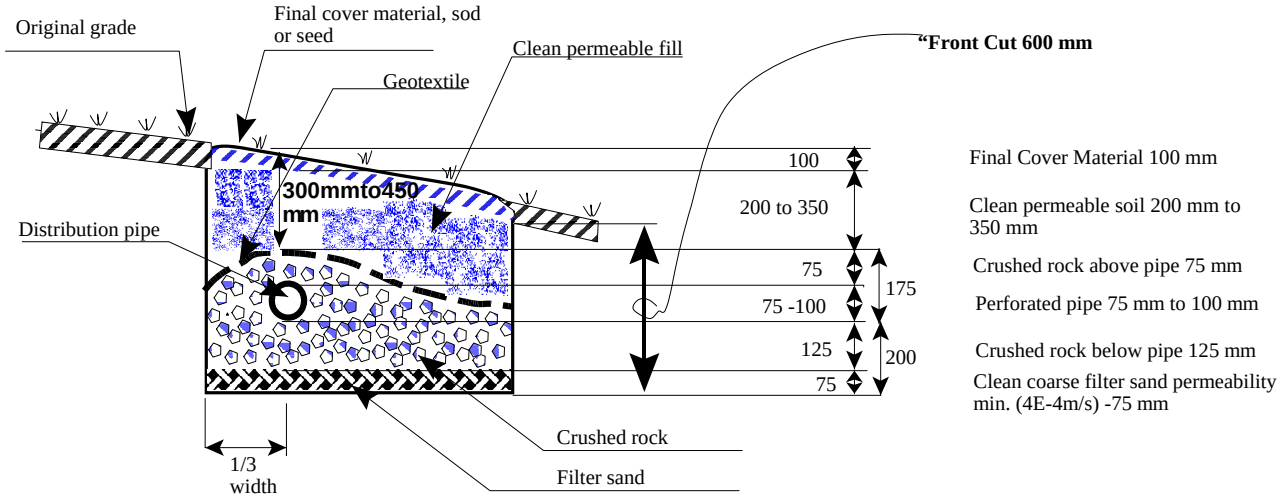


FIGURE 1.C

TYPICAL CONTOUR SYSTEM CROSS-SECTION

All dimensions in millimeters (mm)

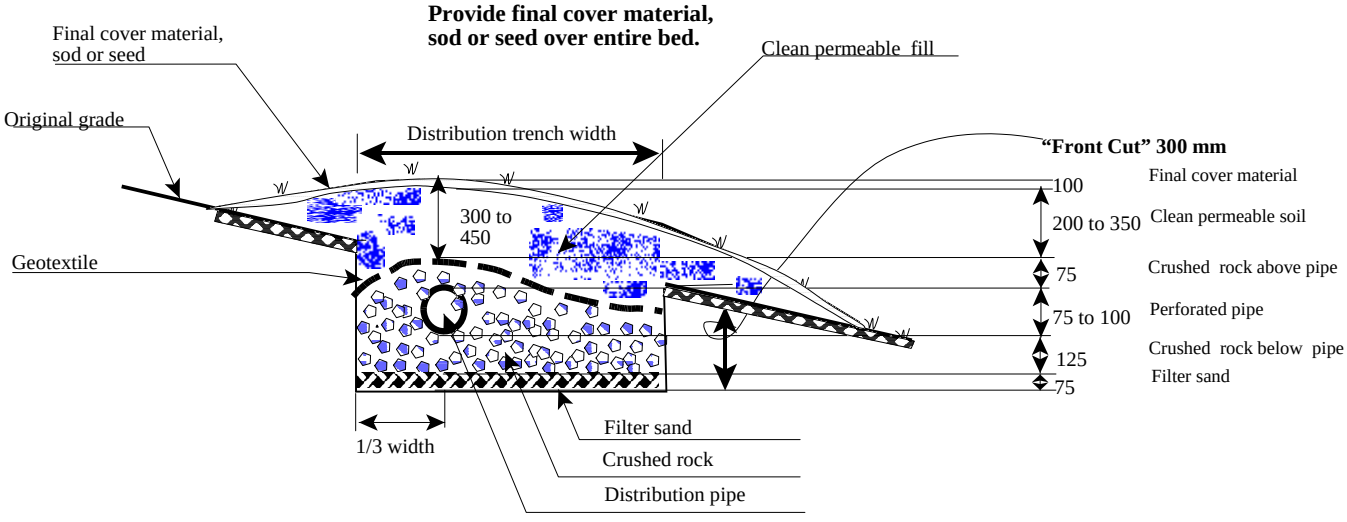
C1



Minimum 1 meter separation from bedrock, water or too permeable soil

C1 raised

Extend buffer minimum 1 meter on each side of the trench.
Provide final cover material, sod or seed over entire bed.



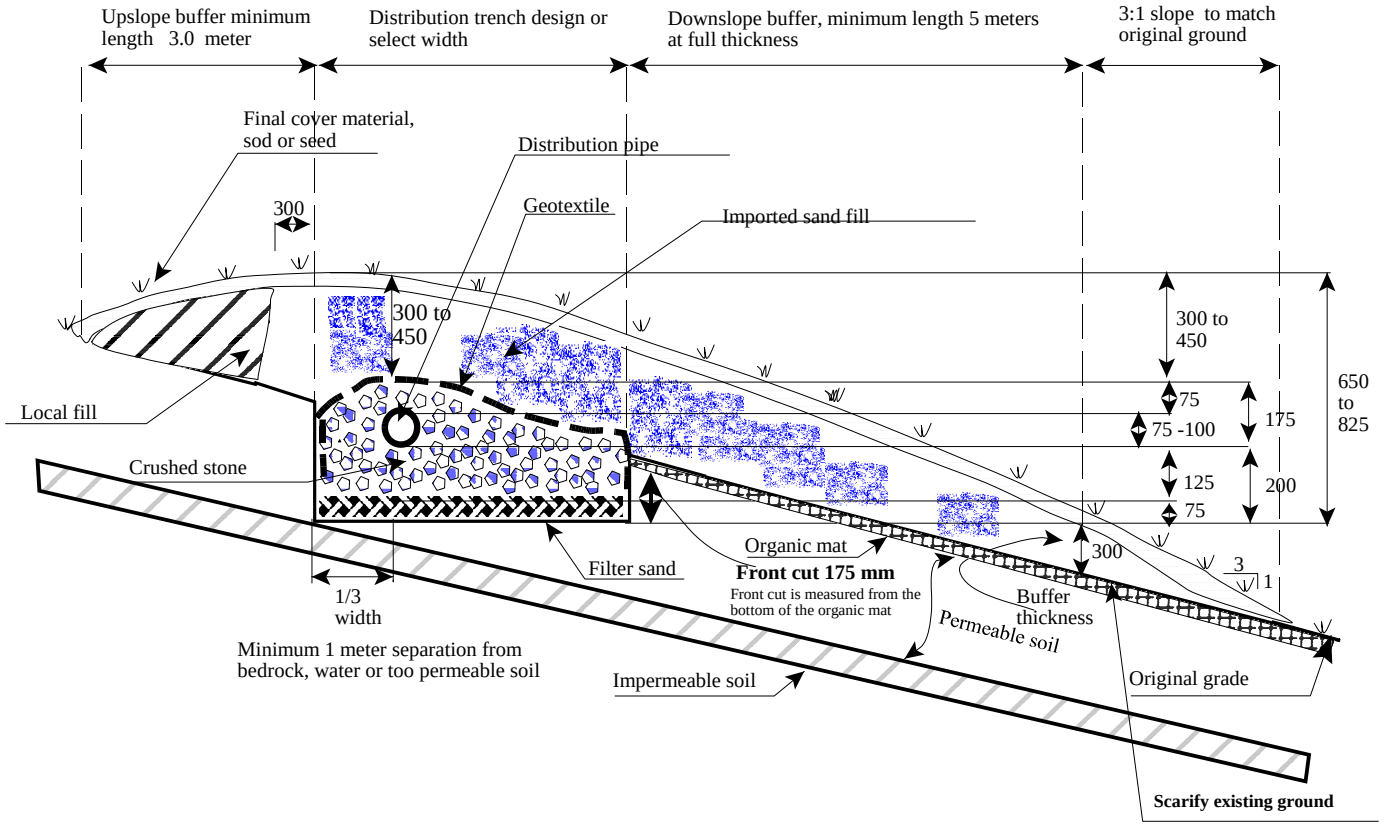
Minimum 1 meter separation from bedrock, water or too permeable soil

FIGURE 1.C continued

TYPICAL SYSTEM CROSS- SECTION

[All dimensions in millimetres (mm)]

C2



C2 raised

Cross-section dimensions are the same as above unless otherwise stated.

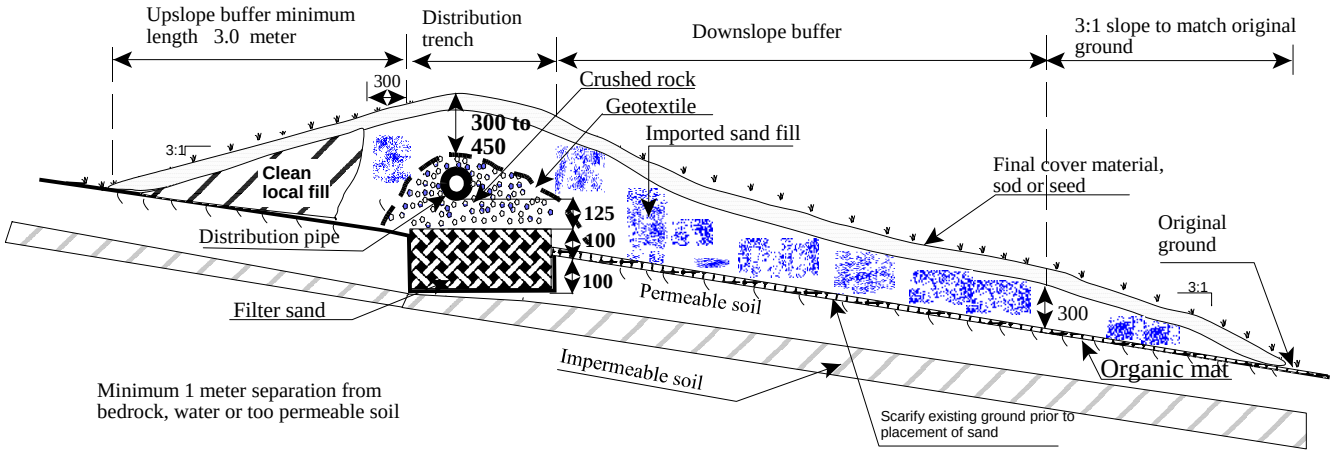
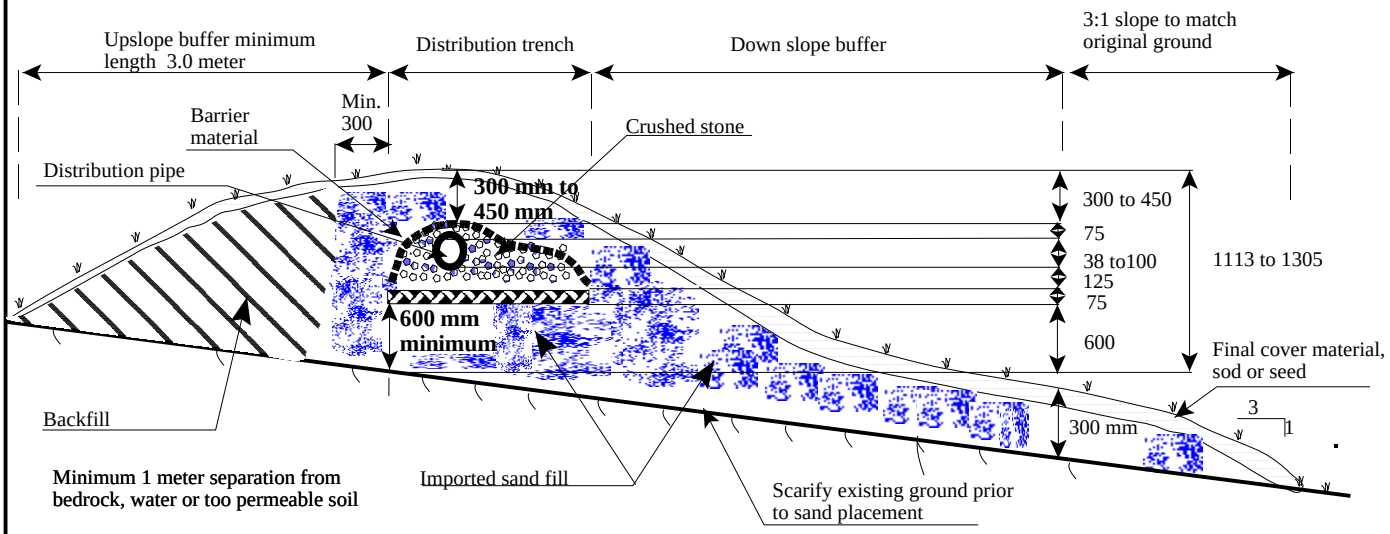
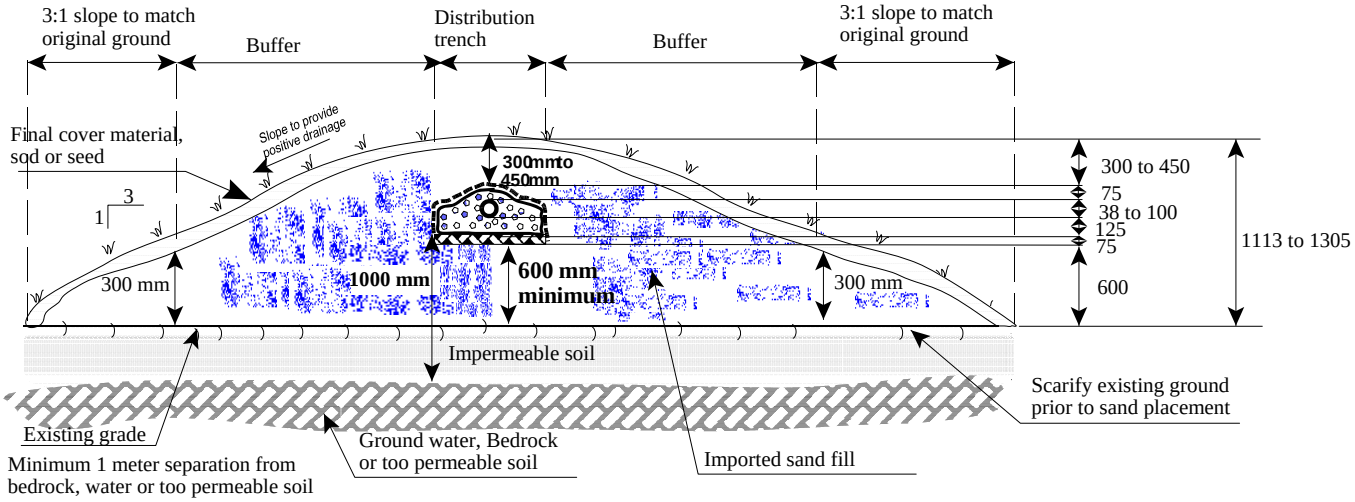


FIGURE 1C continued
All dimensions in millimetres (mm)
Minimum required

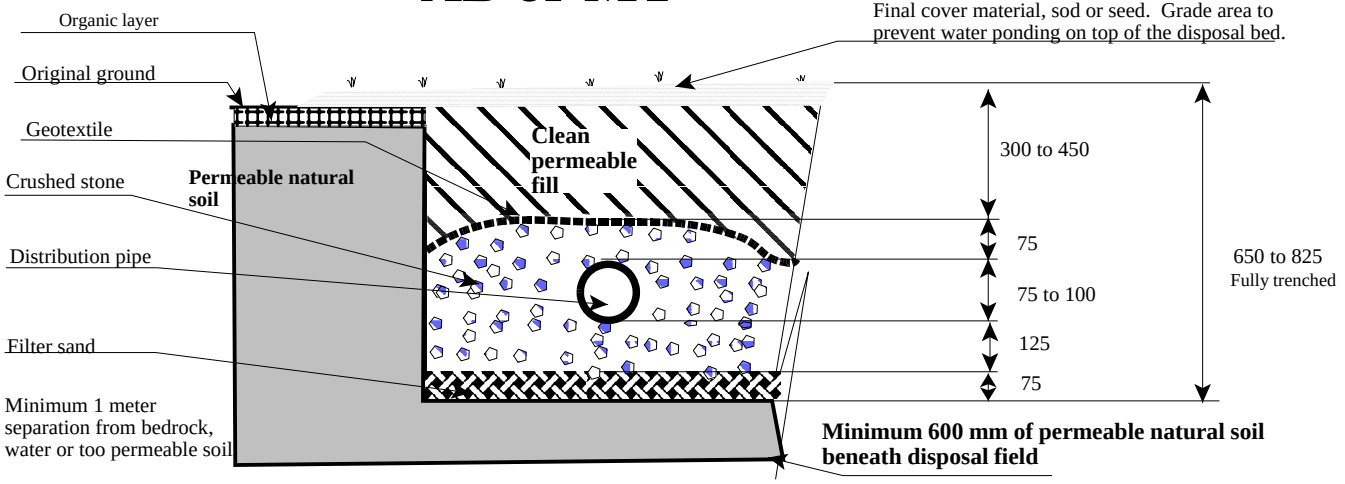
C3



MOUND



AB or MT



1.4 CARE OF ON-SITE SYSTEMS

Proper routine maintenance is a key to long term satisfactory operation of an on-site sewage disposal system. This is the responsibility of the owner. Unfortunately, too few people realize the importance of regular maintenance and it is only carried out when a problem arises and irreversible damage has been done to the system. Some people purchase homes with on-site disposal systems and do not even know such a system exists until they have problems.

Lack of maintenance can result in system malfunctions and costly repairs. Evidence that an on-site system has been properly maintained and protected may significantly assist in resale of a property.

Most on-site systems are intended to perform reliably with minimal attention except for regular inspection and pumping of the septic tank. The following sections provide advice about the maintenance and care of an on-site system.

1.4.1 What Should Not Go Down the Drain

An on-site sewage disposal system consisting of a septic tank and disposal field is designed to handle all normal household waste waters. The disposal system can handle body wastes, wash water and laundry wastes including moderate amounts of bleach.

However, it is important that the property owner recognize that for trouble free-operation of these systems there are limits on materials that can be discharged to an on-site system, and on the amount of sewage a system can handle.

Table 1.1 includes examples of materials that can affect the performance of an on-site system because they:

- cannot be treated by an on-site system, and may contaminate water supplies or the environment and/or
- will affect the performance of the system, and result in extra maintenance or repair, or require system replacement.

Garbage grinders should not be installed unless the size of the septic tank is increased by 20 percent to handle the additional load of solid materials.

Backwash water from water treatment devices should not be discharged to an on-site sewage disposal system unless the system has been specifically designed by a Qualified Person 1 (Professional Engineer) to accept such a discharge.

Water from basement drains/sumps, foundation/footer drains and roof drains must not be discharged to the on-site sewage disposal system as they are an uncontrolled source of water and may overload the disposal system.

Septic tank additives are not needed for proper operation of a septic tank, and may damage the septic tank and disposal field and contaminate ground water. Use of additives that cause

solids to be washed from a septic tank into a disposal field may result in clogging of the field, with the result that it may need to be replaced.

Facilities such as restaurants must have grease chambers. Grease chambers must be placed ahead of the septic tank and properly sized. The grease must be physically removed. Chemical compounds used to dissolve grease must not be added to grease traps. They will clean out the trap, but the dissolved grease may resolidify in the disposal field, causing failure of the system.

TABLE 1.1

DO'S and DON'T'S IN THE USE OF AN ON-SITE SYSTEM

Do's	Don'ts
Do spread automatic washer use over the week rather than many loads on one day.	***Don't*** overload the system with high volumes of water.
Do make a permanent record of where the key parts of your system are located for future maintenance, such as tank pump outs or field repairs.	***Don't*** discharge water treatment backwash to an on-site system unless the system has been specifically designed by a Qualified Person 1 (Professional Engineer) to accept such a discharge.
Do keep records of pump outs and maintenance.	***Don't*** allow large amounts of fats, plastics, chemicals or solvents to enter the system.
Do use water conserving devices where possible. Low flush toilets and shower heads are commonly available.	***Don't*** enter a septic tank without proper ventilation. Sewer gases can be fatal.
Do have manually cleaned lint traps on your automatic washer.	***Don't*** allow vehicles or heavy equipment to drive over the disposal field. This may compact the soil or crush the piping.
Do have your septic tank pumped out regularly.	***Don't*** discharge water from basement drains/sumps, foundation/footer drains or roof drains to an on-site sewage disposal system.
Do check any pumps, siphons or other moving parts regularly.	***Don't Flush:***
Do remove or prevent trees with large root systems growing near the disposal field.	coffee grounds disposable diapers sanitary napkins cigarette butts paints thinners photographic chemicals other chemical wastes dental floss kitty litter tampons condoms varnishes pesticides waste oils
Do maintain a healthy grass cover over the disposal field to prevent erosion and encourage water evapotranspiration.	
Do keep surface water from up slope or roof drains away from the disposal field.	
Do check your interceptor trench regularly to ensure that it is free flowing.	

1.4.2 Water Use and Conservation

The minimum design capacity of a residential on-site system, which could include seasonal, rental units, is 1000 litres/day.

Systems for larger dwellings, dwellings with fixtures such as hot tubs that use additional water, and commercial establishments, must be appropriately designed for higher flows.

Problems can result if the design capacity is exceeded, because the excess flow can wash out solids from a septic tank (which can clog a disposal field), or because the excess flows can exceed the hydraulic capacity of the field. Ways to avoid these problems, in new and existing buildings, include:

- fix leaking plumbing fixtures
- distribute water use where possible, e.g., use the clothes washer once each day rather than many times on a single day
- reduce normal water use in showers and sinks
- install water conserving fixtures, especially ultra-low flush toilets
- assure that the septic tank is watertight
- assure that the system is located and protected to avoid unnecessary surface water, ground water, or roof drainage.
- install, and regularly record the water meter, which can detect leaking fixtures or excessive water use that can overload a system.

If the area near the disposal field appears to be saturated during wet times of the year, it may be necessary to reduce water usage by adopting one of the measures listed above. See Section 7 for more detail.

1.4.3 Maintenance

If septic tanks are not cleaned regularly, excess accumulated solids will be carried into the disposal field and may result in irreparable soil clogging. The solids may also clog the tank inlet or outlet and cause sewage to back up into the building.

The average septic tank should be pumped about once every three years, depending on the degree of use and the nature of materials that enter the system. Routine inspection may indicate that an individual tank can be pumped less frequently; tanks that are heavily used or abused may need to be pumped much more often.

Never enter a septic tank. It could be fatal! If it is necessary you should consult Nova Scotia Labour and Advanced Education for their procedures on Confined Spaces.

Grease traps should be inspected regularly. If the chamber is half full, it should be pumped by a registered septic tank cleaner.

Operation of pumps and siphons should be routinely checked.

The sod cover over the disposal field should be maintained, to prevent erosion, and reduce the amount of precipitation or runoff that enters the field.

Large trees should be removed from the immediate area of the disposal field to prevent roots from clogging the pipes, providing channels for short circuiting of effluent, or damaging the system, if the tree is uprooted.

Tanks in seasonal systems should not be emptied prior to the winter season, because of the possibility that they may be damaged by frost.

1.4.4 Access, Protection, and Other System Features

The owner of any on-site system should know, or find out, where the septic tank and disposal field are located.

Watertight access must be provided for inspection, maintenance, and pump out of a septic tank. This may require a watertight riser and cover to bring the access opening close to the ground surface. Owners of existing systems that are not easily accessible should consider installing easier access. Section 3 of these Guidelines provides information about risers and covers for septic tanks.

Vehicular traffic should not be allowed to travel over a disposal system, because of the risk that distribution pipes may be crushed, or the field damaged.

Prospective and existing owners, and those who design and select systems, should consider features that can improve the performance and assist inspection of on-site systems:

- Septic tank filters are designed to intercept solids that might otherwise escape from a septic tank and block a disposal field. They are expected to require regular cleaning when the septic tank is inspected or pumped. If they require more frequent cleaning, it is assumed that the materials that blocked the filters would otherwise have reached the disposal field, causing potentially serious and expensive damage. **(Figure 1.D)**

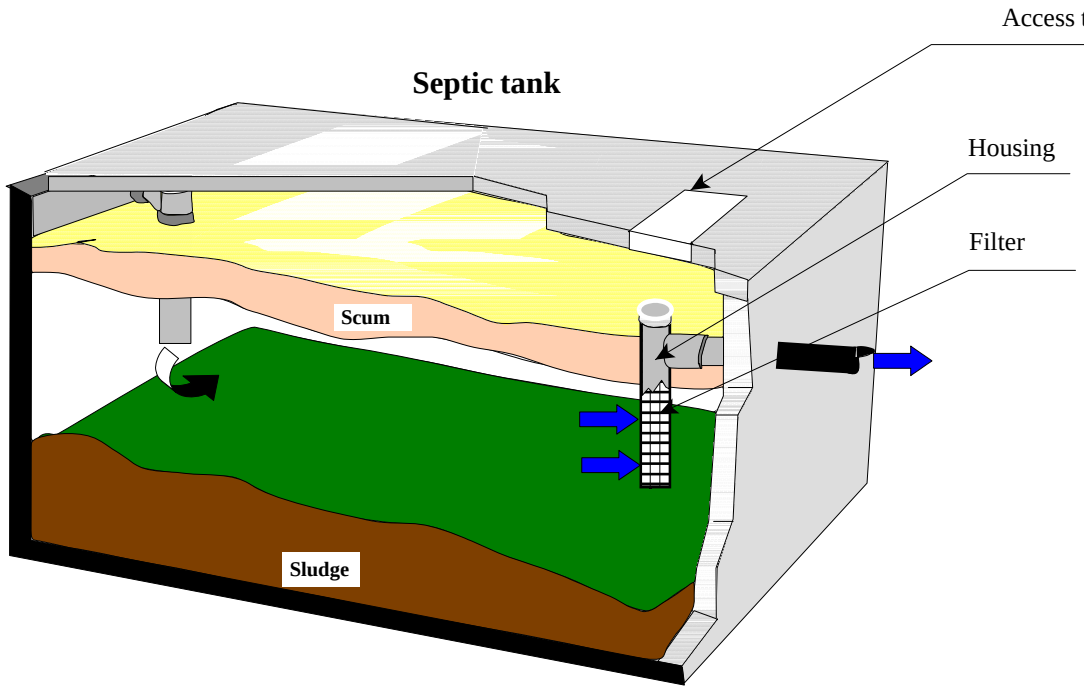
- Inspection ports installed in a disposal system allow for periodic inspection of effluent levels in the system, and can help to anticipate and diagnose problem.

- A water meter will allow the home owner to compare actual water use with the capacity of the system, and help to guide decisions about water conservation.

These devices are not currently required in the Regulations or by this guideline but may be stipulated in an approval. They are inexpensive compared with the cost of the system, or of system repair and replacement.

FIGURE 1.D

EFFLUENT FILTER



NOTES:

Effluent filters are provided to reduce a solids load to the disposal field. They usually consist of a plastic screen or mesh through which the effluent must pass before flowing to the disposal field. This prevents the passage of large particles and also slows the flow velocity to allow better settling of smaller particles.

Filters are usually installed in tee at the outlet from the septic tank.

Depending on the design they filter out particles larger than 1.5 mm to 3mm.

According to manufactures information filters can reduce TSS by 50% to 90% and BOD by 30% to 60%.

Filters must be selected and maintained according to manufactures guideline depending on hydraulic and organic load.