SECTION 6

6. SYSTEM CONSTRUCTION

6.1 Introduction

Despite an excellent job being done of assessing the site and designing the disposal system, improper construction of a system can result in the premature failure of the system. Proper installation is one key to long term satisfactory performance. Failing systems cause many problems including: health and aesthetic concerns, wasted private and public funds, neighbourhood disputes, and the servicing of areas with collection and treatment systems where this should not be a priority. To reduce problems with system construction it is mandatory that anyone installing an on site system have a valid certificate of qualification.

6.2 Elevations

The elevation of the pipe in the field in relation to grade of the natural soil at the site will be given in the system details based on the conditions for the particular site. This pipe level will determine the elevation of the septic tank, and also the elevation at which the building sewer can leave the basement. This is critical on level sites and is often not considered by builders and home owners when planning basement levels and elevations of plumbing fixtures. Before the basement elevation or building sewer elevation are set, elevations of the system, the tank and the point at which the pipe leaves the basement wall should be calculated. A decision can then be made whether to:

1. set the basement floor above this level
2. have no plumbing in the basement
3. pump sewage to the septic tank from the basement or
4. pump all tank effluent to the disposal field.

It is likely that at times of snow melt or high rainfall most soils in Nova Scotia will be saturated to ground surface. If the tank outlet is below this level, water will back up into the tank. Depending on the drop on the line from the house to the tank, sewage may back up into the house or, at the very least, the plumbing will be slow draining. Unfortunately this often results in the home owner having a relief trench or overflow of some type installed which results in a permanent discharge of raw sewage. To prevent this from happening, where ever possible the elevation of the bottom of the outlet from the septic tank should be above the elevation of natural soil at the disposal field. This is shown in **Figure 1.A**.

The finished grade on top and around the field must be sloped to divert surface water away from the field. Most soils will handle the effluent if this surface water is removed from the area. It is very important to sod or seed the area over and around the disposal field. The sod will prevent erosion and the established root zone will have a greater permeability than the soil below. This root zone can play an important part in preventing effluent from reaching the ground surface before receiving adequate treatment.

6.3 Septic Tanks

Manufacturers' instructions must be followed for the installation of septic tanks.

Several types of commercially manufactured septic tanks are available. The most common is precast concrete. These tanks are sturdy, less expensive than some types, and do not require extra care in backfilling. The disadvantage is the weight and the fact that most precast tanks are made in two halves. Care must be taken to ensure that there is a good seal between the top and the bottom half of the septic tank, in order to control leakage into and out of the tank. There have been reports of well contamination and sewage leaking into foundation drains resulting from leaking joints in tanks. If two piece tanks are used, care must be taken to assure the joints fit and are properly sealed. In installations where water table or bedrock is less than 1 m below the tank, or in gravel soil conditions, consideration should be given to the use of a one piece tank.

A full tank weighs several thousand kilograms. Therefore, it is important to place it on solid, well compacted bedding material to avoid settlement. Tanks should not be placed on fill unless the material has been compacted in lifts of not more than 150 mm with a vibratory roller and must follow manufactures bedding requirements.

Plastic or fibreglass tanks have the advantage of being totally water tight and are much lighter than precast concrete tanks. The weight is a particular advantage when the tank must be installed in a confined area where reaching it with a boom truck is not possible. Backfilling plastic or fibreglass tanks require more care then concrete tanks. The **manufacturer's instructions for backfilling,** which may include the use of pea gravel, **must be followed.** Care must be taken while pumping out plastic or fibreglass tanks to prevent their collapse or floatation. Empty, reinforced plastic and fibreglass tanks have been known to pop out of the ground under high water table conditions. Therefore, these tanks must be anchored in position (usually with weights, or to a concrete slab) in accordance with the manufacturer's instructions.

The homeowner may be reluctant to have the tank pumped at the required frequency unless there is an easy access. Consequently, it is required that, if the top of the tank is more than 150 mm below ground surface, an extension must be provided over the main access cover so that the excavation required to reach the tank is kept to a minimum. A riser must be water tight to avoid infiltration into the tank. There are products available such as reinforced plastic risers and covers sealed to a gasket poured into the tank cover. This type of construction should eliminate problems due to leakage. To avoid a tragedy that could result if a child removed a cover, any covers light enough to be moved by a child should be locked shut or covered with a few centimetres of topsoil and sod.

Shearing of the pipe at the tank inlet, outlet, or at the foundation is a common problem. These problems can be minimized with proper tank and pipe bedding and the use of SDR 35 or stronger pipe. Some contractors use flexible joints next to the foundation wall and the tank to avoid this problem. The foundation should always be backfilled before the sewer line is connected because compacting the fill under the pipe is impossible once it is installed.

6.4 Water Tightness Testing for Septic Tanks, Holding Tanks and Siphon/Pump Chambers

When septic tanks, holding tanks and siphon/pump chambers are tested for water tightness, the following procedure must be followed:

1. Confirm with the tank/chamber manufacturer that the tank/chamber will withstand a hydrostatic pressure test

2. If the tank/chamber is installed below the groundwater level:
   - first remove any water from the tank/chamber
   - the tank/chamber must be secured in place to prevent flotation
   - the tank/chamber is to remain in place for a minimum of 30 minutes and then checked for any visible leaks

3. If the tank/chamber is installed above the ground water level,
   - the tank/chamber is to be filled to the invert of the outlet
   - the level may drop as much as 10 to 15 mm due to absorption into the concrete
   - ensure water level has reached a constant
   - check for any visible leaks after a minimum of 30 minutes
   - ensure the water level is still at the invert of the outlet

4. Any leaks must be repaired and the test repeated until the tank/chamber is watertight

6.5 Soil Damage during Construction

Avoiding construction damage to the soil is an important consideration. The installer must be aware that this is a potential problem despite the type of system being installed. The objective should be to install the system, as designed, without reducing the permeability of the natural soils surrounding the field. Smearing and/or compaction of the soil interface is the most common and destructive damage that occurs during construction.

To maintain the permeability of the natural soil, the voids between individual soil particles and clusters of particles must not be destroyed. Preventing the smearing and compaction of the soil interface is essential, i.e., the top and sides of the natural soil in the excavation. Smearing will increase with higher clay content and higher moisture content in the soil. It occurs when machinery such as a dozer blade or backhoe bucket slides over this soil interface. The moisture acts like a lubricant allowing the clay particles to slide over each other sealing off the voids. Compaction from the wheels or tracks of machinery or footsteps increases the density of the soil and reduces the number and size of voids. Both compaction and smearing will reduce the soil permeability even if they take place in only a thin layer on the interface. Smearing can be reduced by working only when the soil moisture content is low. Unfortunately, this means that at certain times of the year, such as in spring, conditions may not be suitable for the installation of disposal systems, and construction should be delayed until conditions improve.

The type of machinery also influences the amount of damage that will take place. Excavation with a dozer tends to smear the interface more than the use of a backhoe bucket. The use of a dozer also causes more compaction of the soil interface because the machine is passing back and forth over it. The heavier the machine, the greater the pressure from the tracks and therefore the more compaction that can be expected. A light machine sitting to the side of the excavation will cause the least amount of damage. After the excavation is completed, the system should be finished as soon as possible. An exposed interface may be subject to compaction due to heavy rainfall, machinery, or people walking on it. To remove some damage due to smearing or compaction, it is recommended that the interface on all excavations be hand raked.

In most soils the effluent will move laterally away from the system in the down slope direction before it has time to go vertically into the subsoil. For this reason, it is important to keep machinery on the up slope side of the excavation. If machinery is allowed on the down slope, it may compact or rut the soil through which the effluent should pass. This may result in effluent breaking to the surface before it is adequately treated.

6.6 C1 and C2 Systems

When constructing these systems the following points should be remembered:

1. Effluent flows laterally down the slope away from the field.
2. A long narrow trench following the site contour is required.
3. Trench bottom and down slope lip are level.
4. Surface water and possibly perched water table must be diverted around the system.

The following procedure should be followed when installing C1 or C2 systems:

1. Check grades from the proposed pipe elevation in the disposal field back to the tank and check the elevation of the building sewer where it will exit the foundation. Be sure the slope on the pipe meets the minimum requirements.

2. Using an accurate tripod-type level, set stakes at 3 to 5 metre intervals along the contour elevation that will be the lower lip of the trench. The length of the trench will be specified with the system design

3. If the area under the downslope buffers of a C2 is covered in a heavy sod, this area should be tilled to help the passage of effluent into the natural soil. If the area contains trees, these should be cut at ground level and any large stumps or roots removed before tilling the area. Excavation to be back filled with imported sand fill, especially downslope of the trench.

4. The contour trench is then excavated following the stakes to the depth and width specified on the design. The bottom of the trench will be level in both width and length. The trench will be of constant depth throughout the length.

5. Hand-rake the bottom and sides of the trench to remove smearing or compaction.

6. Determine where the solid line from the tank will enter the perforated pipe. Systems less than 30 metres in length can be end fed although centre feeding is preferred on all systems. A system greater than 30 metres must always be centre fed if it is not pressurized. If there is more than 60 metres of pipe, it must be pressurized

7. Spread a layer of filter sand, to the depth required for the system and not less than 75 mm, over the entire length and width of the trench.

8. Spread a minimum of 125 mm. of crushed rock on top of the sand. Note that the design of some systems may require more than the minimum of 125 mm. The rock should be graded as closely to the required pipe slope as possible, which will increase the crushed rock depth toward the effluent tee.

9. Place the perforated pipe on the rock and check to see that the slope on the pipe meets the specification of a drop of between 50 and 100 mm per 30 metres in a gravity fed system and is completely level (no slope) in a pressurized system.

10. Cap the ends of the pipe. If the system is pressurized, a 13 mm. hole should be drilled in the top of the pipe 150 mm from the end cap to allow air to escape when the pump discharges.

11. Cover the pipe with 75 mm of crushed rock.

12. Cover the rock with barrier material (geotextile).

13. Carefully backfill the trench with excavated material providing it is not frozen and any rocks greater than 75 mm have been removed. The finished cover over the distribution pipe should be between 300 and 450 mm. If a C2 type system is installed, place imported sand fill buffer to the depth and width as shown on the approval.

14. Cover the entire area with final cover material and sod or seed the area immediately to allow a sod and root zone to be established as quickly as possible.

15. Wherever possible all heavy equipment and excavated material should be kept on the up slope side of the trench to avoid compaction of soil down slope of the system.

6.7 C3 Systems

The following procedure should be followed when installing C3 systems:

1. As all C3 disposal fields are pressurized to provide even distribution, the elevation of the tank and building sewers are not usually as critical as with gravity fed systems. However, the proposed location of tank and pump chamber should be established to make sure all components of the system will fit together.

2. Use an accurate tripod type level to place stakes along the contour line where the toe of the distribution trench will be located. Stakes marking the toe of the imported sand fill can then be set at the proper distance from the trench stakes.

3. If the area under the proposed C3 imported sand fill is covered in heavy sod, this area should be tilled to help the passage of effluent into the natural soil. If the area contains trees, these should be cut at ground level and any large stumps or roots removed before tilling the area.

4. Place the amount of imported sand fill shown on the design.

5. Excavate a trench into the imported sand fill to the width and depth shown on the design. The trench bottom should be level along both its width and length.

6. Spread a layer of filter sand to the depth required for the system and not less than 75 mm, over the entire length and width of the trench. If the imported sand fill meets the specification for filter sand, the filter sand layer is not required.

7. Spread a minimum of 125 mm of crushed rock on top of the sand. Note that the design of some systems may require more than the minimum of 125 mm.

8. Place the selected or designed solid pipe on the rock and ensure it is level (no slope).

9. Cap the ends of the pipe. Drill 13 mm holes in the top of the pipe 150 mm back from the end caps to allow air to escape when the pump discharges.

10. Cover the pipe with 75 mm of crushed rock.

11. Cover the completed rock trench with barrier material (geotextile).

12. Carefully cover the entire system with imported sand fill and a layer of final cover material suitable for establishing a healthy sod layer. The finished cover over the distribution pipe should be between 300 and 450 mm.

13. Sod or seed the disturbed area as soon as possible after completion of the system.

14. Where ever possible all heavy equipment and excavated material should be kept on the up slope side of the trench to avoid compaction of soil down slope of the system.

6.8 C3 Systems on Uneven Surface Lots

Where uneven surface lots, boulder fields or undulating wooded areas are encountered and conditions are such that a C2 would be normally used, the following criteria and techniques apply for construction of a modified C3 system:

1. Disturb the location of the field as little as possible (scarifying before imported sand fill placement may be necessary in grassy field areas, but is unnecessary in wooded areas).

2. Place the imported sand fill along the route of the contour, filling hollows. Dress the imported sand fill so that the surface follows a contour (some boulders may protrude through).

3. Place filter sand, the bottom of the filter sand is to follow the contour.

4. Place crushed rock; the bottom of the crushed rock is to follow a contour.

5. Lay the distribution pipe level (the system will be pressurized).

6. Cover the pipe with 75 mm crushed rock.

7. Cover the crushed rock with geotextile (barrier material).

8. Cover with imported sand fill. (Refer to **Section 3.3.2** for specification.)

9. Landscape (final cover material and sod).

NOTE: For "humpy" ground such as old forest floor caused by rotten trees and stumps, it may be possible to create contour by levelling off some of the tops of the humps while minimizing the disturbance to the area where the buffer will go.

6.9 Mound Systems

The following procedure should be followed when constructing a mound system:

1. As all mounds are pressurized to provide even distribution, the elevation of the tank and building sewers are not usually as critical as with gravity fed systems. However, the proposed location of tank and pump chamber should be established to make sure all components of the system will fit together.

2. Locate the mound by placing stakes at the toe of the imported sand fill at the distribution trench location.

3. If the area under the proposed mound is covered in heavy sod, the area should be tilled to help the passage of effluent into the natural soil. If the area contains trees, these should be cut at ground level and any large stumps or roots removed before tilling the entire area.

4. Place the amount of imported sand fill shown on the design. Bring the sand up to the level of the top of the proposed trench.

5. Excavate the trench into the sand to the width and depth shown on the design. The trench bottom should be level in both width and length.

6. Spread a layer of filter sand to the depth required for the system and not less than 75 mm, over the entire length and width of the trench. If the imported sand fill meets the specification for filter sand, the filter sand layer is not required.

7. Spread a minimum of 125 mm of crushed rock on top of the sand. Note that the design of some systems may require more than the minimum of 125 mm.

8. Place the selected or designed solid pipe on the rock and ensure it is level (i.e., no slope).

9. Cap the ends of the pipe. Drill 13 mm holes in the top of the pipe 150 mm back from the end caps to allow air to escape when the pump discharges.

10. Cover the pipe with 75 mm of crushed rock.

11. Cover the completed rock trench with barrier material (i.e., geotextile).

12. Carefully cover the entire system with imported sand fill and a layer of final cover material suitable for establishing a healthy sod layer. The finished cover over the distribution pipe should be between 300 and 450 mm.

13. Sod or seed the disturbed area as soon as possible after completion of the system.

14. Where ever possible all heavy equipment and excavated material should be kept on the up slope side of the trench to avoid compaction of soil down slope of the system.

6.10 Area and Multiple Trench Systems

The construction of area and multiple trench systems follow similar procedures. The difference is that in an area bed, the entire field area is excavated whereas in a trench field individual trenches are dug.

The following procedure should be followed when constructing an area bed or trench field:

1. Check grades from proposed pipe elevation in the disposal field back to the tank and check the elevation of the building sewer where it will exit the foundation. Be sure the slope on the pipe meets the minimum requirements.

2. Place stakes to locate the trenches or sides of the area bed. Note that the long dimension of either type of system should run along the contour of the site, following the contour as closely as possible.

3. Excavate the area or trenches to the depth and width shown on the drawing/sketch.

4. Hand-rake the bottom and sides of the excavation to remove smearing or compaction.

5. Spread a 75 mm layer of filter sand meeting the specification over the entire length and width of the trench.

6. Spread a minimum of 125 mm of crushed rock on top of the filter sand. The crushed rock should be graded as closely to the required pipe grade as possible. It may be necessary to add additional crushed rock in some areas in order to achieve the required slope on the distribution piping and still maintain the minimum 125mm under the piping.

7. Place the pipe on the crushed rock. The header is a solid pipe, while the footer and connecting laterals between the header and footer are perforated pipe.

8. The slope on the header and the laterals must meet the specified drop of between 50 and 100 mm per 30 metre, with the footer remaining level.

9. For area bed systems the distribution pipes shall be placed as shown on the drawing/sketch a maximum of 1.5 metres from the wall of the excavation, but no less than 0.3 m.

10. The lateral pipes shall be equally spaced as shown on the drawing/sketch with the maximum spacing being 3.0 metres between each lateral.

11. Cap the ends of the pipe. If the system is pressurized, a 13 mm hole should be drilled in the top of the pipe near the end cap to allow air to escape when the pump discharges.

12. Cover the pipe with 75 mm of crushed rock.

13. Cover the rock with barrier material (geotextile).

14. Carefully backfill the trench with excavated material or clean permeable local fill, providing it is not frozen and any rocks greater than 75 mm have been removed.

15. Cover the entire area with final cover material and sod or seed the area immediately to allow a sod and root zone to be established as quickly as possible.

6.11 Sloping Sand Filters

The sloping sand filter is constructed in a similar manner to the C3 disposal field only the sand filter is located in an area excavated into the natural soil.

The following procedure should be followed when constructing a sloping sand filter system:

1. Starting at the proposed elevation of the bottom of the excavation at the toe of the sloping sand filter, work back and check proposed pipe elevation in the disposal field, the tank elevation, and the elevation of the building sewer where it will exit the foundation. Be sure slope on the pipe meets the minimum requirements. In some cases such as a malfunction replacement, where a discharge is unavoidable; effluent must be able to discharge from the toe of the filter. To allow this, the filter usually discharges to a ditch, watercourse or another area that will not pose a health risk. This discharge level will dictate the required elevation of the pipe, tank (in a gravity fed system), and building sewer elevation as it leaves the foundation.

2. Excavate the natural soil to the dimensions shown on the design. The bottom of the excavation must be level across its width and have a uniform slope, not less than 3%, as specified on the design, on the down slope side of the excavation.

3. If the sloping sand filter is located in the same area as an existing system, remove any pipe or rock in the immediate area of the filter to prevent the possibility of effluent short-circuiting into the old field and breaking out without adequate treatment.

4. Place the amount of sloping sand filter sand shown on the design. Bring the sand up to the level of the top of the proposed trench.

5. Excavate the trench into the sand to the width and depth shown on the design. The trench bottom should be level in both width and length.

6. Place the rock and pipe as was explained above for the C1 or C2 trench. If the system is to be pressurized, drill 13 mm holes in the top of the pipe near the end caps to allow air to escape when the pump discharges.

7. Cover the rock trench and top of the sloping sand filter sand with geotextile. Cover the geotextile with 300 to 450 mm of final cover material and seed or sod. If available, clean local permeable backfill may be substituted for 200 to 350 mm of final cover material but a minimum of 100 mm of final cover material must be placed on top. The seed or sod should cover the entire area to allow sod and root zone to establish as quickly as possible.

8. In the case of a malfunction replacement and where a discharge is unavoidable; if the toe of the system is in a ditch where erosion is possible or near a shoreline; the down slope side of the system should be covered with rock that will resist the action of the water.

6.12 Interceptors

When an interceptor is being installed, the following points should be observed:

1. Interceptor locations are specified in Section 3.6.

2. An interceptor should have a bottom uniform slope to allow flow of collected water.

3. Any excavation that passes between the disposal trench and the interceptor must be sealed with compacted clay material (see **Figure 1.B**).

4. If the interceptor discharge must pass under the disposal system, this discharge pipe must be solid and the trench must be sealed by backfilling with compacted clay material (see Section 3.6.1).

5. Where an interceptor trench is filled with crushed rock, the top of the rock should not be covered with topsoil or sod unless an interceptor swale is provided.

6. Roof water drainage should not be discharged into an interceptor. A solid drainage pipe carrying roof water may be located in the interceptor trench if it discharges down slope of the disposal field.

7. Traffic must be restricted to the up slope side of the disposal area during construction of an interceptor trench

8. The bottom of an interceptor shall follow the requirements in section 3.6.1 and be set at least 150 mm into impermeable soil or be a minimum of 150 mm below the bottom of the distribution trench.

6.13 Pipe Protection

When installing a portion of the distribution across a driveway and/or shallow installation, the pipe shall be protected from vehicle and frost damage. The distribution pipe shall be placed inside a larger diameter pipe, for example corrugated steel pipe, to prevent vehicle damage. Frost protection can be achieved by placing 50/75 mm rigid insulation over the distribution pipe where sufficient cover does not exist (greater than 1.5 metres). The insulation should extend to the width of the trench and ~3 metres beyond the edges of the driveway.