Water for the World

Constructing, Operating, and Maintaining Non-Conventional Absorption Systems
Technical Note No. SAN. 2.C.8

Non-conventional absorption systems have been developed for soil conditions where absorption is low or slight, or where ground water is close to the ground surface. Effluent from a septic tank discharges to special filter beds or into mounds of soil or sand for final discharge by drainage or evapotranspiration. Such methods are for despiration cases where usual soil absorption lines cannot work. Constructing non-conventional systems requires the services of an engineer or construction foreman experienced with the type of system being built. Constructing involves assembling labor, materials, and tools; staking the site; excavating or preparing the site; building a mound or refilling the excavation with special soil or sand; laying distribution pipes; and completing the system. These systems are self-operating and require little maintenance. They must be inspected periodically, and any problems must be corrected.

This technical note describes the elements involved in constructing and maintaining non-conventional systems. Read the entire technical note before beginning construction.

Materials Needed

Before construction can begin, the project designer must provide:

1. A location map similar to Figure 1.

2. Design drawings similar to Figures 2, 3, or 4.

3. A materials list similar to Table 1.

Useful Definitions

EFFLUENT - Settled sewage.

EVAPOTRANSPIRATION - The loss of moisture from the soil caused by direct evaporation and by the transpiration of moisture to the air by plants.

IMPERMEABLE - Not allowing liquid to pass through.

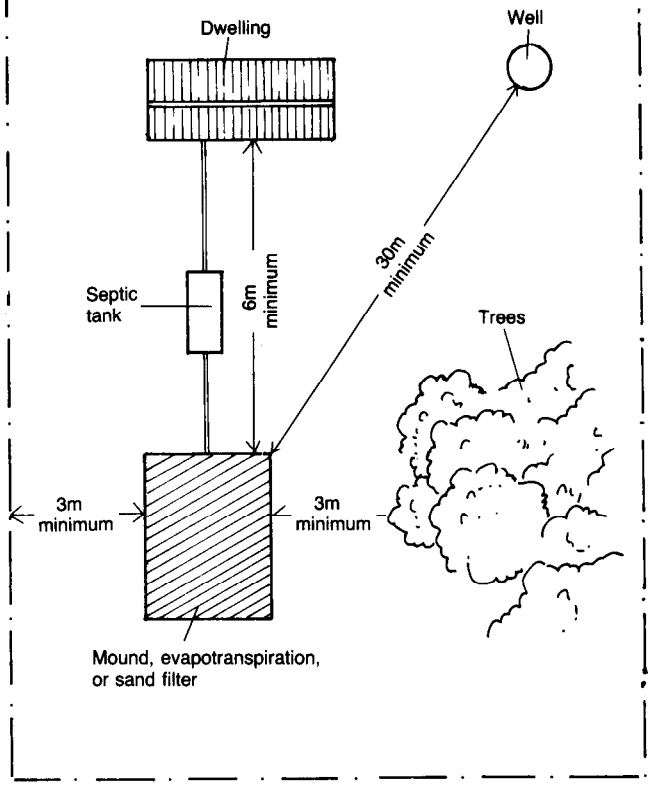

Figure 1. Location Map

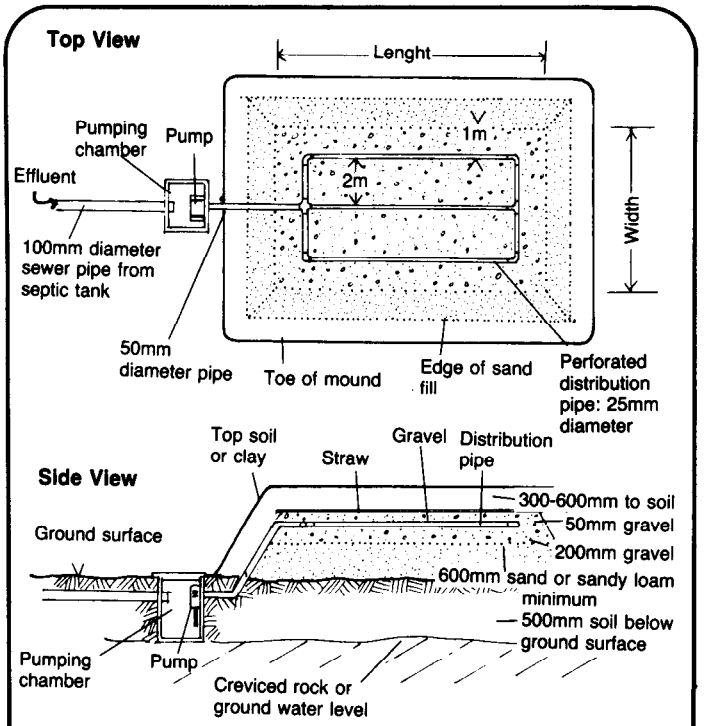

Figure 2. Mound System

Table 1. Sample Materials List for Mound Systems, Evapotranspiration System or Sand Filter

Item	Description	Quantity	Estimated Cost
Labor	Engineer or experienced construction foreman familiar with the system	1	____
	Surveyor, to lay out the system	1	____
	Workers	4-8	____
Supplies	Pump (capable of 110 liters per minute)	1	____
	Select filter sand; all must pass a 6mm screen; effective size 0.3-0.6mm; uniformity coefficient less than 3.5	____m^3	____
	Gravel; 3-6mm in size	____m^3	____
	Gravel; 18-36mm in size	____m^3	____
	Fill sand	____m^3	____
	Select vegetation	____	____
	Perforated pipe, 100mm diameter	____m	____
	Perforated pipe, 25mm diameter	____m	____
	Sewer pipe, 100mm diameter	____m	____
	Impermeable synthetic liner	____m^2	____
	Mortar	____	____
Tools	Shovels	4-8	____
	Wheelbarrows	2-4	____
	Trowel	2	____
	Containers for mixing mortar	2	____
	Surveying equipment	____	____

Total Estimated Cost = ____

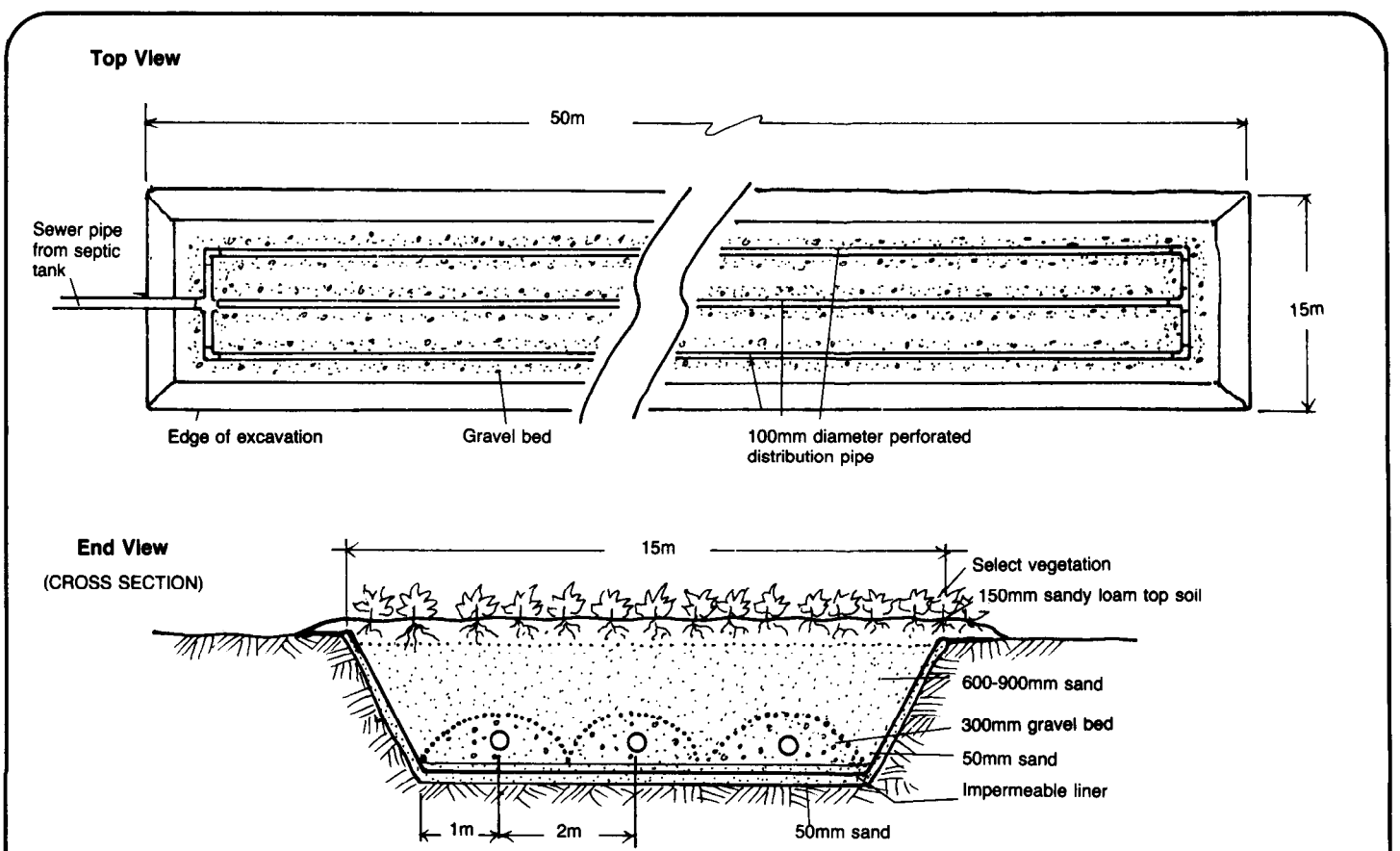

Figure 3. Evapotranspiration System

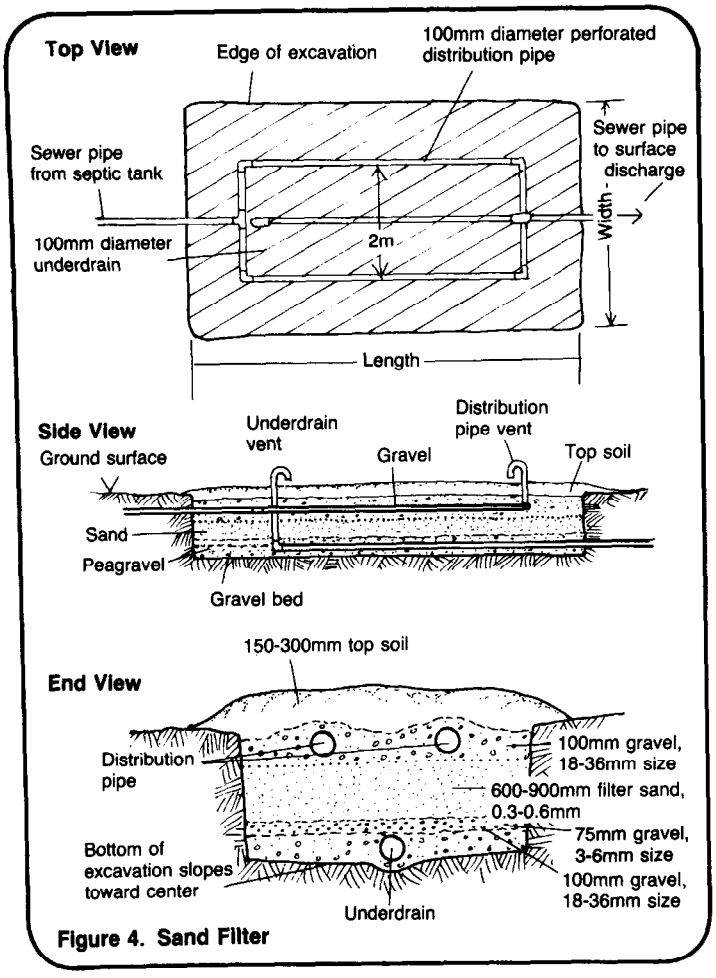

Figure 4. Sand Filter

Depending on local conditions, availability of materials, skills of workers and equipment, some construction steps will take only a few hours, while others may require a day or more. Read the construction steps and make a rough estimate of the time needed for each step based on local conditions. You will then have an idea of when during the construction process specific workers, materials, and tools must be available. Draw up a work plan similar to Table 2 showing construction steps.

Constructing a Mound System

1. Staking the Site. Using wooden stakes, mark the boundaries of the mound, the site of the pumping chamber, and the trenchline from the septic tank to the system.

2. Preparing the Site. Clear all vegetation from the site. Plow the ground surface within the boundaries of the mound to ensure better drainage of effluent. Throughout construction, avoid compacting material within the mound.

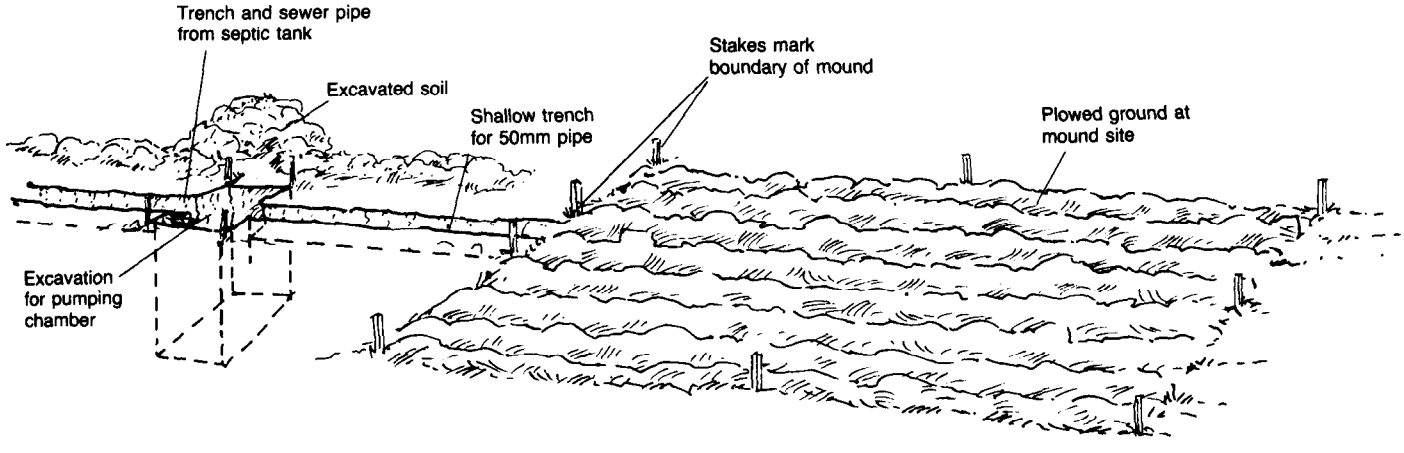

Figure 5. Preparing the Site for Mound System

Table 2. Sample Work Plan for Constructing a Mound System

Time Estimate	Day	Task	Personnel	Materials/Tools
2 hours	1	Stake out system on ground	Engineer or construction foreman experienced with mound system (always present); 2 workers	Location map; design drawings; surveying equipment; stakes
4 hours	1	Clear vegetation and plow ground	4 workers	Shovel, rakes, 2 hoes
4 hours	2	Excavate hole for pumping chamber and dig trench for sewer pipe	4 workers	4 shovels
4 hours	2	Lay sewer pipe	4 workers	10mm diameter plastic pipe; mortar
1 day	3	Build pumping chamber	1 worker skilled with concrete; 2 workers	Concrete mix; reinforcing material; trowel; wooden forms; wet straw
2 days	4-5	Begin building mound	4 workers	Shovels; wheelbarrows; sandy loam; gravel
1 day	6	Lay distribution pipe	4 workers	25mm diameter perforated plastic pipe; mortar; surveying equipment; gravel; straw
1 day	7	Install pump	1 worker experienced with pump installation	Pump and fittings; proper tools
3 hours	8	Connect pump to mound	2 workers	50mm diameter plastic pipe
6 hours	8	Complete mound	4 workers	Shovels; wheelbarrows; topsoil; grass seed

Excavate the hole for the pumping chamber and excavate the trenches from the septic tank to the chamber and the chamber to the mound site. Build a pumping chamber from reinforced concrete. It can be alongside the tank with a common wall between. The size and design of the chamber are determined by the engineer and depend, in part, on the pump which the chamber will house. For details on reinforced concrete, see "Constructing Septic Tanks," SAN.2.C.3. Lay sewer pipe from the septic tank to the pumping chamber, cover with soil, and carefully tamp. See Figure 5.

3. Building the Mound. Begin building the mound with sandy loam or other fill material approved by the engineer. Do not tamp. The minimum height of this layer is 600mm and the top must be level. Cover the sandy loam with a 200mm layer of clean gravel. See Figure 6.

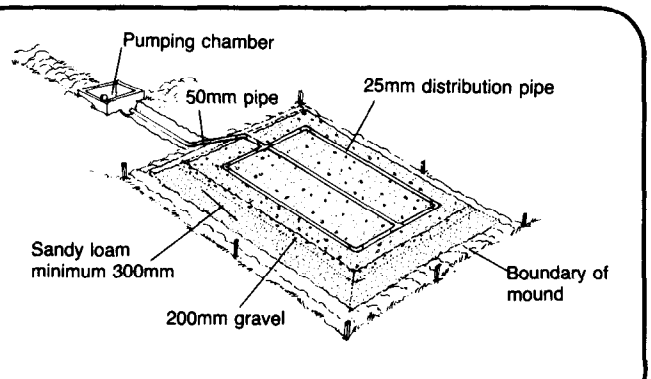

Figure 6. Building the Mound

4. Laying Distribution Pipe. Position 25mm diameter, perforated distribution pipes on the gravel with the perforations facing downward. The pipes should be level. Lay 50mm diameter pipe from the pumping chamber up the slope of the sandy loam. Connect it to the distribution pipe. Cover the distribution pipes with a 50mm layer of gravel and spread hay or straw over the gravel.

5. Completing the System. Install the pump in the pumping chamber and connect the 50mm diameter pipe leading to the mound. Connect the pump to its power source. Seal the pumping chamber and cover the pipe. Cover the entire mound with at least 300mm of topsoil or clay. Plant grass seed or lay sod on the mound. See Figure 7.

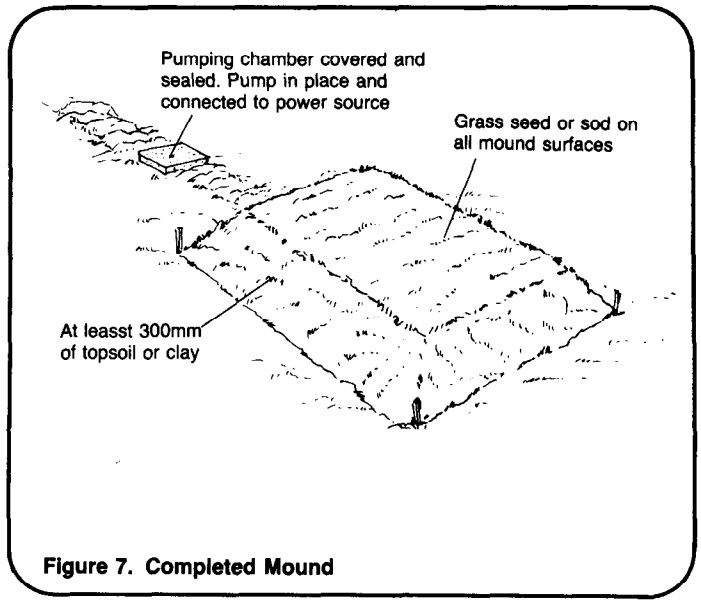

Figure 7. Completed Mound

Constructing an Evapotranspiration System

1. Staking the Site. Using wooden stakes, mark the boundaries of the excavation and the trenchline from the septic tank to the site.

2. Excavating the System. Dig the trenchline from the septic tank to the site and excavate the site to the design depth. Lay 100mm diameter sewer pipe from the septic tank to the site. Cover with soil and carefully tamp.

3. Lining the System. Spread a 50mm layer of sand on the bottom of the excavation to protect the liner. Carefully position the impermeable liner preferably of PVC plastic, across the bottom and up the four side walls as shown in Figure 8. Cover the liner with a 50mm layer of sand.

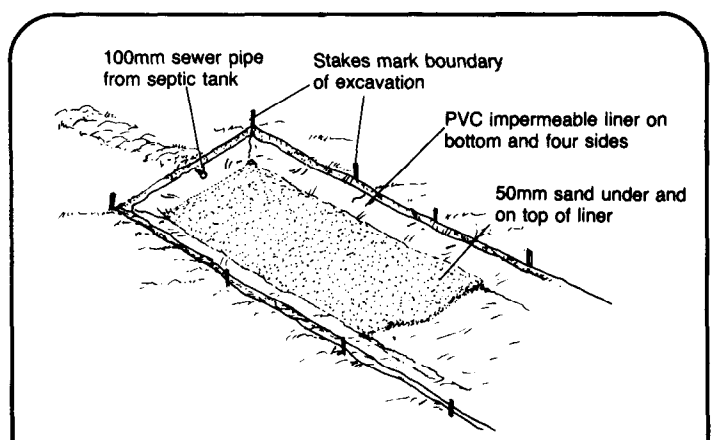

Figure 8. Preparing Evapotranspiration Site

4. Laying Distribution Pipe. Spread gravel beds for the distribution pipes. The beds are 150mm high and about 300mm wide. Position 100mm diameter perforated distribution pipes on the gravel beds with the perforations facing downward. See Figure 9. Cover the distribution pipes with a 50mm layer of gravel and spread hay or straw over the gravel.

5. Completing the System. Fill the excavation with 600-900mm of sand. Cover the sand with about 150mm of topsoil and mound the soil for surface drainage. Plant selected vegetation over the system. See Figure 10.

Constructing a Sand Filter

1. Staking the Site. Using wooden stakes, mark the boundaries of the excavation and the trenchline from the septic tank to the site.

2. Excavating the System. Dig the trenchline from the septic tank to the site and excavate the site to the design depth. Make the bottom of the excavation slope toward the center. Dig the trenchline for the discharge pipe. Lay 100mm diameter sewer pipe from the septic tank to the site and from the site to the point of discharge. Cover with soil and carefully tamp. See Figure 11.

3. Laying the Underdrain. Spread a 100mm layer of gravel, 18-36mm in size, on the bottom of the excavation. Position the 100mm diameter perforated underdrain on the gravel with the perforations facing downward. The underdrain should slope slightly downward to the discharge pipe. Cover the underdrain with a layer of gravel, 18-36mm in size. This layer must be level on top and 100mm thick at the edges. Cover the layer with 75mm of gravel, 3-6mm in size.

4. Placing the Filter Sand. Partially fill the excavation with 600-900mm of selected filter sand. See Figure 12. This sand must be approved by the engineer before it is put in the system. Flood the system with clean water to settle the sand.

5. Laying Distribution Pipe. Cover the sand with a 100mm layer of gravel, 18-36mm in size. Position 100mm diameter perforated distribution pipes

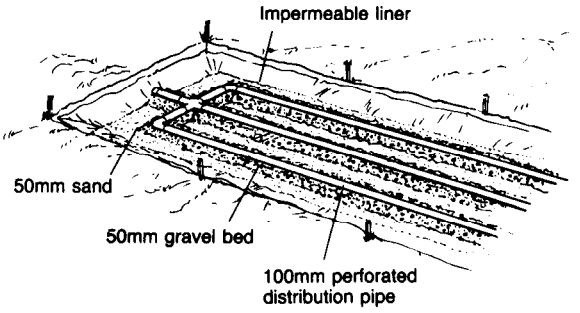

Figure 9. Laying Distribution Pipe for Evapotranspiration System

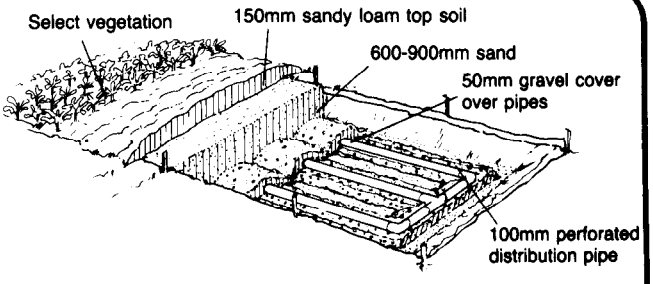

Figure 10. Completing Evapotranspiration System

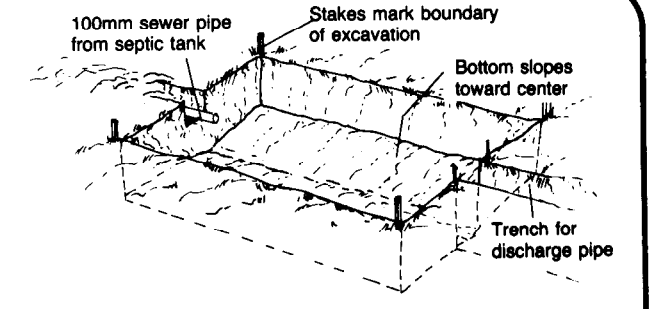

Figure 11. Excavating Site for Sand Filter

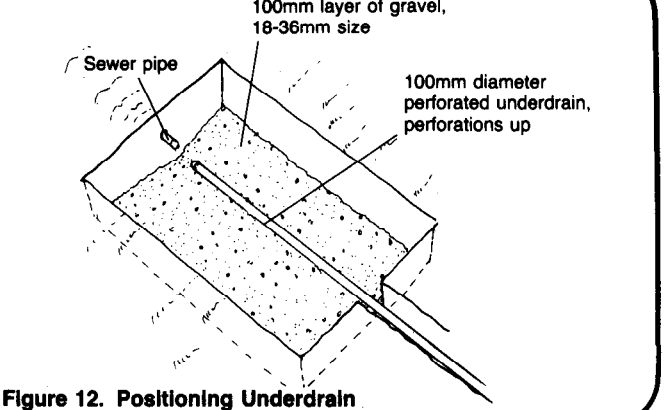

Figure 12. Positioning Underdrain

on the gravel with the perforations facing downward. Cover the distribution pipes with a 50mm layer of gravel and spread hay or straw over the gravel.

6. Completing the System. Fill the excavation with 150-300mm of topsoil and mound the soil for surface drainage. See Figure 13. Plant grass seed over the system.

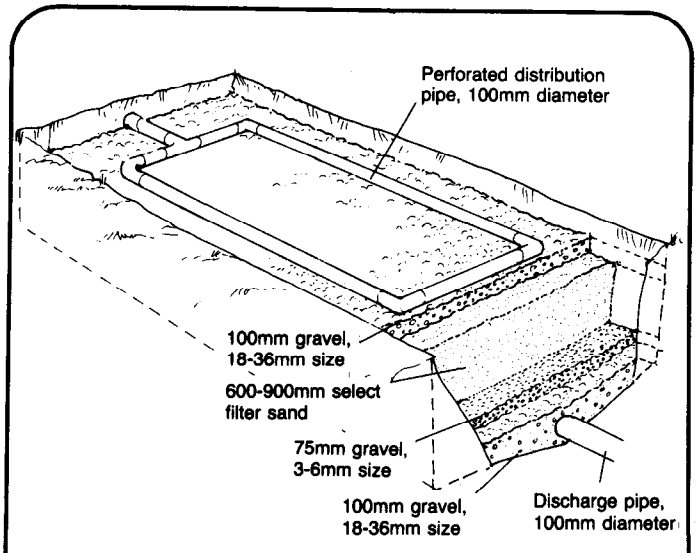

Figure 13. Building Sand Filter

7. Install the Dosing Siphon. The dosing siphon, shown in Figure 14, should be placed exactly in accordance with the manufacturer's directions. It operates on the compression of air volume under the bell.

Operating and Maintaining Mound Systems, Evapotranspiration Systems, and Sand Filters

These systems are self-operating. Effluent flows by gravity from the septic tank to the evapotranspiration system. It may do so to a sand filter, but with a great loss of efficiency. Mounds and sand filters work best if their pipes are filled two or three times per day.

In a mound system, the effluent enters the pumping chamber and must be pumped up to the distribution pipes as the mound will usually be higher than the tank. It flows through the distribution pipes, seeps down through the mound and drains safely into the natural ground.

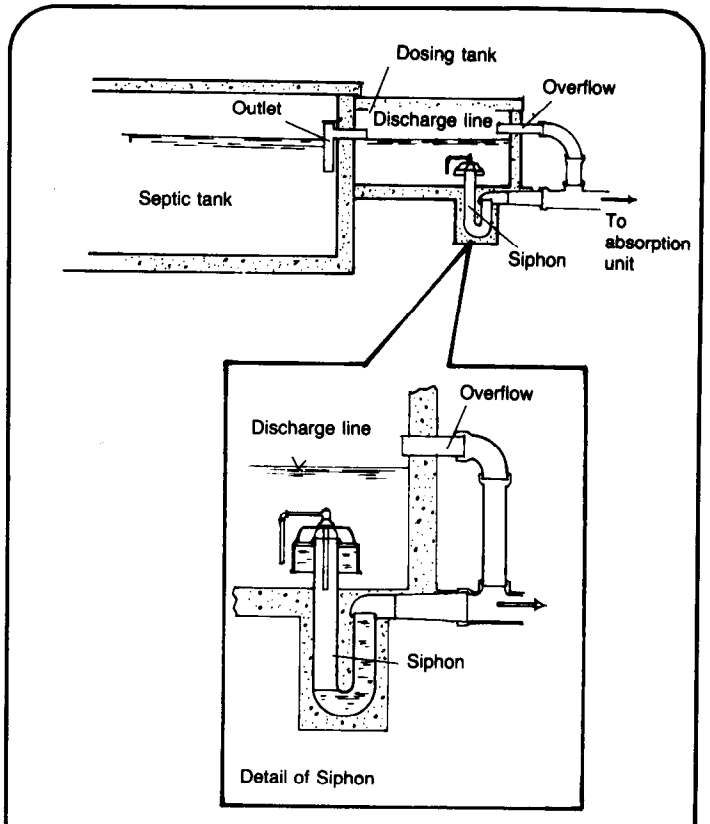

Figure 14. Siphon Installation

In an evapotranspiration system, effluent flows through the distribution pipes into the gravel beds to await evapotranspiration. The effluent is gradually drawn upward by capillary action into the sandy fill. This is the same process that draws oil or fuel up into the wick of a lantern. Effluent evaporates from the surface of the ground or is transpired by the cover plants into the atmosphere.

In a sand filter, effluent flows through the distribution pipes, filters down through the sand to the underdrain, and flows safely out the discharge pipe to a dry ditch or waterway. The point of discharge should be downstream from drinking water supplies. To fill the pipes fully two or three times per day, a dosing siphon, Figure 14, or pump is needed feeding from a collecting chamber after the septic tank. Filling the pipes makes full use of the filter.

Maintaining these systems involves inspecting for burrowings, erosion, and system failure.

Burrowings. Small holes or excavations on or near the system indicated the presence of dogs or other burrowing animals. These animals should be kept away. Set traps or erect fences if necessary.

Erosion. If wind, rain, or surface water causes erosion on or near the system, fill and mound with soil. Plant grass or other vegetation. If surface water is a problem, build small diversion dams and ditches to direct water away from the system.

System Failure. A system fails when it no longer absorbs effluent or when it absorbs effluent at a slower rate than it is received. Signs of failure are puddles, wet spots, and continual odors. In some cases, stop pages can be located and cleaned out.

When a system fails, it usually cannot be repaired. If the whole bed is clogged, the system will have to be rebuilt or replaced. Piping, liners and even gravel can be recovered for re-use.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

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