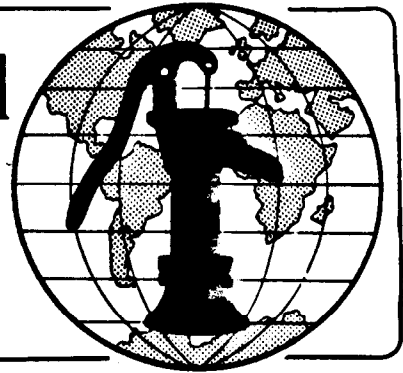


Water for the World



Constructing, Operating and Maintaining Subsurface Absorption Systems Technical Note No. SAN. 2.C.1

A subsurface absorption system is a trench, series of trenches, field, or pit that receives effluent from a septic tank and allows the effluent to soak safely into the ground. Constructing an absorption system involves digging a trench, field, or pit at the correct location; spreading gravel and laying drainpipe, or building side walls; and connecting the system to a septic tank with sewer pipe. A properly constructed subsurface absorption system can last 10 to 20 years. The system is self-operating and requires little or no maintenance. It must be inspected periodically and any problems corrected.

This technical note describes each step in constructing an absorption system. Read the entire technical note before beginning construction.

Useful Definitions

DRAINPIPE - Perforated or open-joint sewer pipe.

EFFLUENT - Settled sewage.

GROUNDWATER LEVEL - The level to which subsurface water rises during any given time of year.

PERMEABILITY - The ability of the soil to absorb liquid, such as sewage effluent.

PERVIOUS - Allowing liquid to pass through.

SEWER PIPE - Noncorrosive pipe, usually 100mm in diameter, made from concrete, vitrified clay, glazed tile, or plastic.

TRENCH GRADE - The continuous slope at the bottom of a trench.

Materials Needed

The project designer must provide three items before construction can begin:

1. Location map, similar to Figure 1, showing the correct site where the system is to be constructed. The map will show distances from the system to the septic tank, water supplies, dwellings, property lines, vegetation, and any other structures or prominent geographical features.

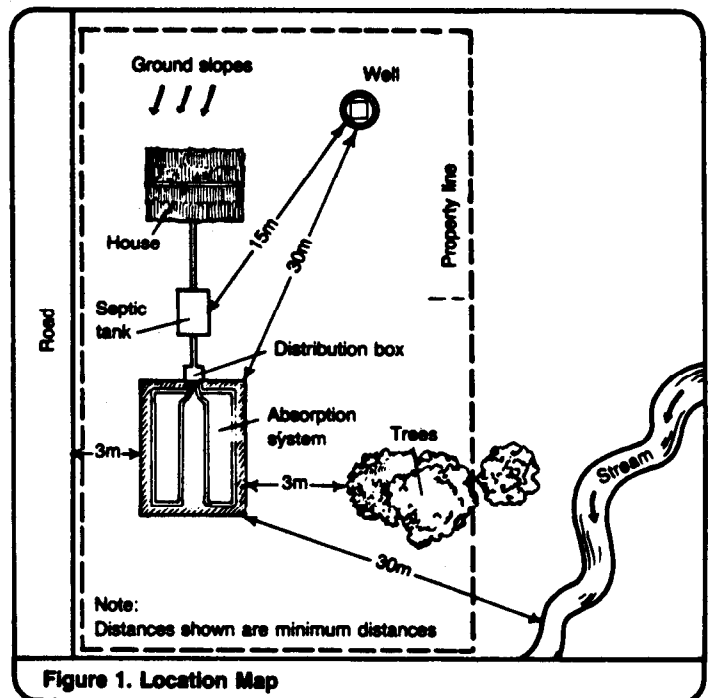


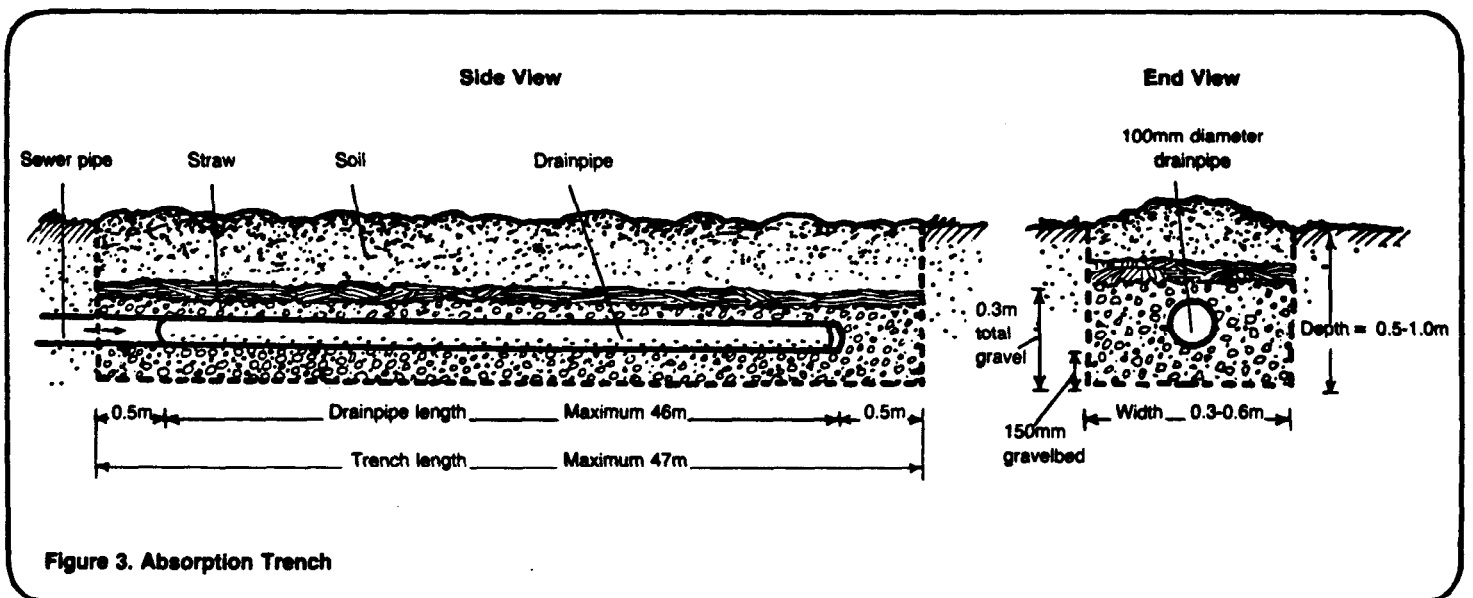
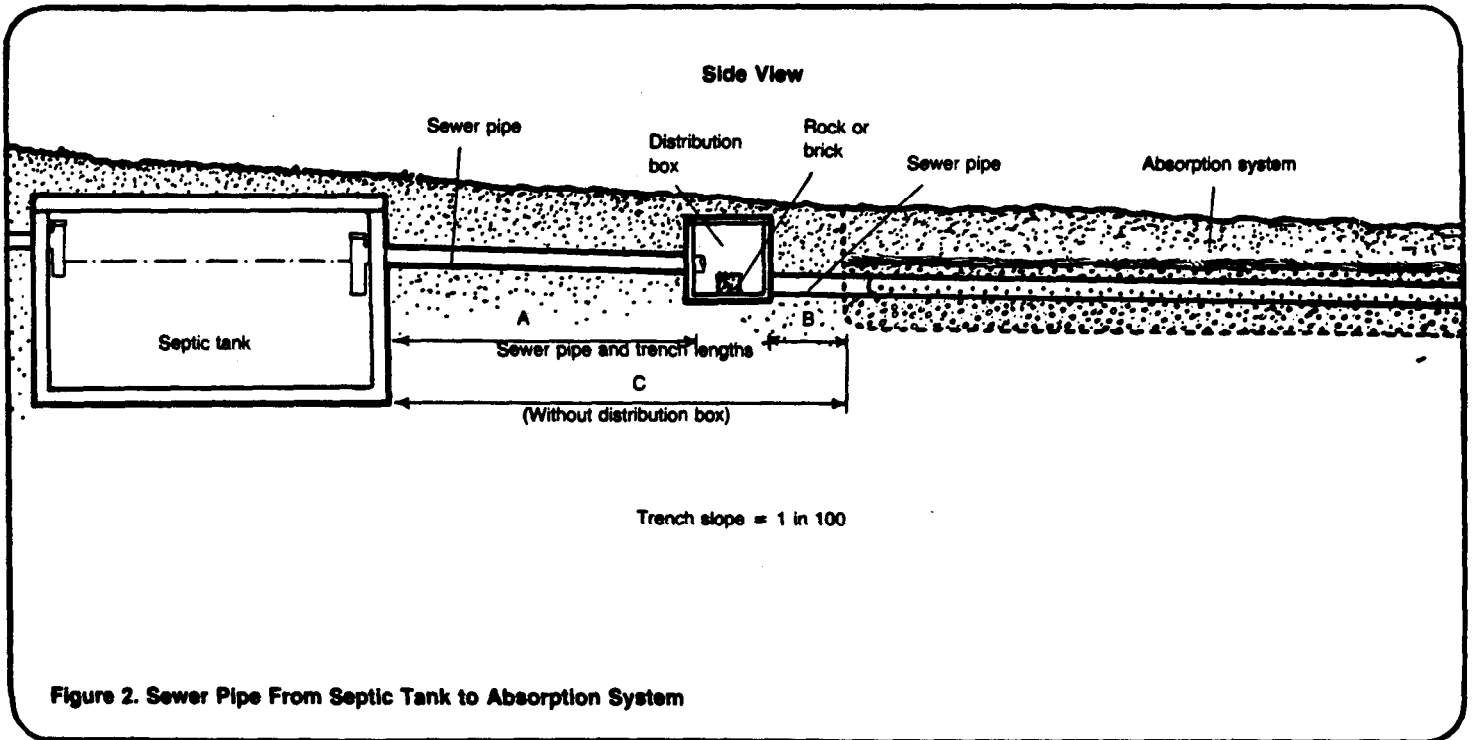
Figure 1. Location Map

2. Technical drawings, similar to Figure 2, for all systems; Figure 3, for a trench system; Figure 4, for a series of trenches; Figure 5, for a field system; Figure 6, for a distribution box; or Figure 7, for a pit

system. These drawings will show correct dimensions for excavation and construction, and correct lengths for sewer pipe and drainpipe.

3. Materials list, similar to Table 1, showing all labor, supplies, and tools needed to construct the system.

More detail on these documents may be found in "Designing Subsurface Absorption Systems," SAN.2.D.1. After the project designer has given you these documents, begin assembling necessary laborers, materials, and tools.



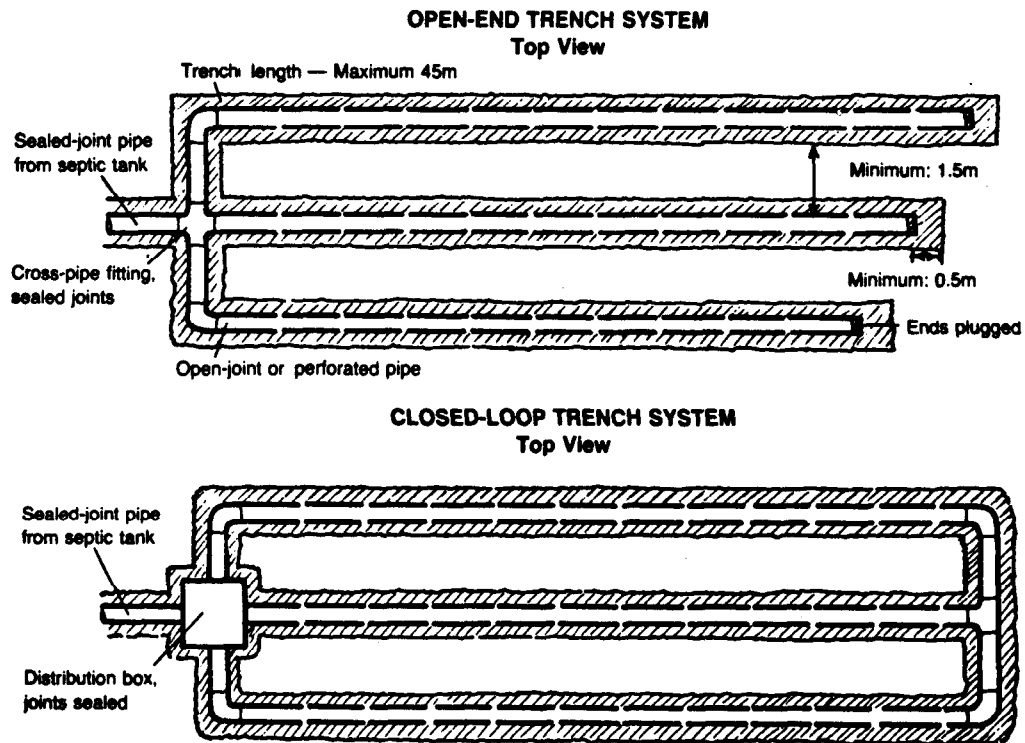


Figure 4. Multiple Trench Systems

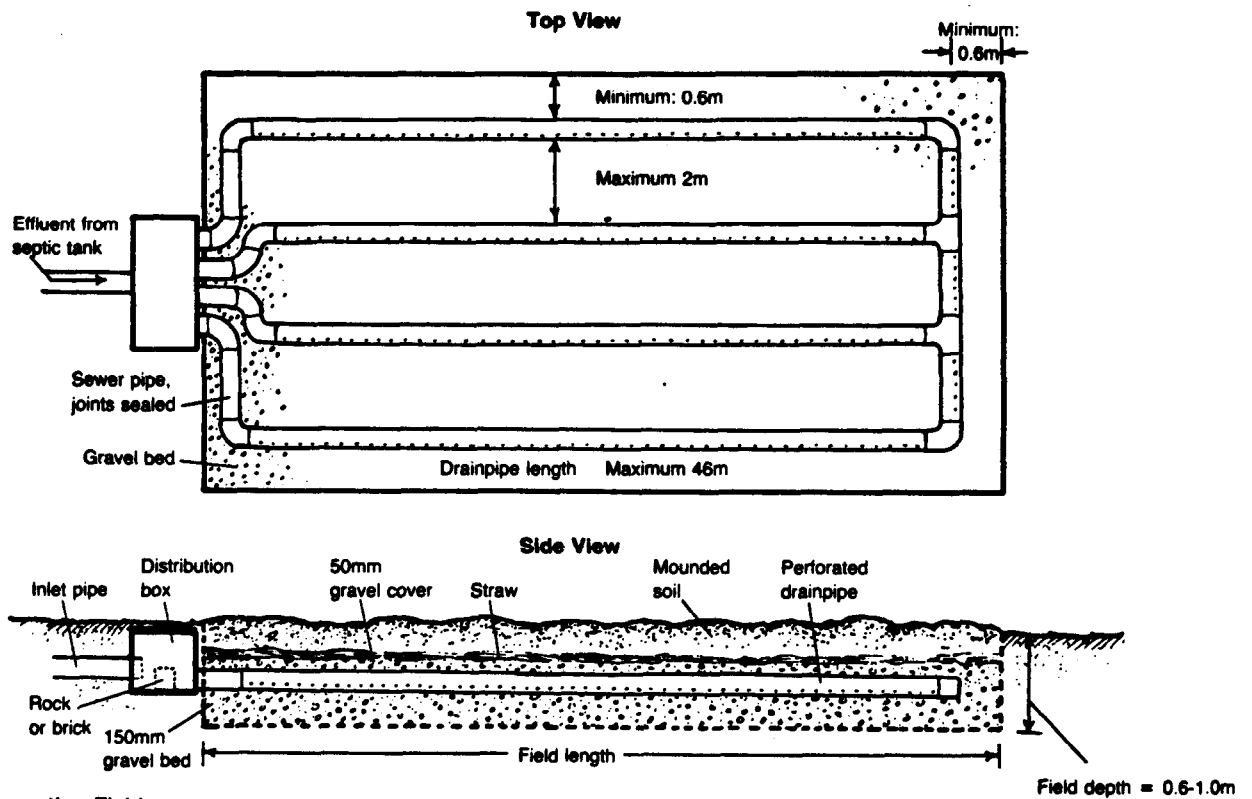


Figure 5. Absorption Field

Table 1. Sample Materials List

| Item | Description | Quantity | Estimated Cost |
|------------------------------------|--|--|----------------|
| Labor | Foreman | 1 | _____ |
| | Laborers (one experienced with concrete or mortar, if applicable) | 2 | _____ |
| Supplies | Wooden stakes for marking out system | _____ | _____ |
| | Sewer pipe: 100mm diameter, clay, concrete or plastic | _____ m, enough to reach from septic tank to absorption system | _____ |
| | Drainpipe: 100mm diameter, perforated or open-joint sewer pipe (open-joint sections 0.5m long) | _____ m, enough to construct trench, trenches, or field | _____ |
| | Gravel or crushed rock; clean size from 12 to 50mm | _____ m ³ , enough to fill trenches or field or wall space in pit | _____ |
| | Tar, mortar, or oakum (for sealing pipe joints) | _____ | _____ |
| | Tar paper or building paper (for covering open joints) | _____ m ² , enough to cover all joints | _____ |
| | Untreated paper, straw, hay, or grass (for covering gravel) | _____ | _____ |
| | If pit: Wood, poles, bamboo or other material for shoring sides | _____ | _____ |
| | If distribution box: Cement: portland | _____ m ³ | _____ |
| | Sand: clean, fine to 6mm | _____ m ³ | _____ |
| | Gravel: clean, 6 to 38mm | _____ m ³ | _____ |
| | Water: clear, enough to make stiff mix | _____ liters or gallons | _____ |
| Wooden boards (for building forms) | _____ | _____ | |
| Nails (for building forms) | _____ | _____ | |
| Tools | Rake or hoe | 1 | _____ |
| | Measuring tape | 1 | _____ |
| | Shovels | 2 (at least; one per worker) | _____ |
| | Wheelbarrow | 1 | _____ |
| | Carpenter's level or equivalent | 1 | _____ |
| | If pit or distribution box: Hammer | 1 | _____ |
| | Saw | 1 | _____ |
| | If concrete distribution box: Container (for mixing) | 1 | _____ |
| | Trowel | 1 | _____ |
| | Other | _____ | _____ |

Total Estimated Cost = _____

Table 2. Sample Work Plan for Constructing an Absorption System

| Time Estimate | Day Number | Task | Personnel | Tools/Materials |
|---------------|------------|--|---|--|
| 3 hours | 1 | Lay out system on ground with stakes | Foreman and one laborer (NOTE: Foreman present during all phases of construction) | Measuring tape, stakes |
| 2 hours | 1 | Dig trench from septic tank to site of distribution box | Two laborers | Two shovels |
| 2 hours | 1 | Lay sewer pipe from tank to box site, mortar joints, cover with dirt | Two laborers | Shovels, sewer pipe, mortar |
| 5 hours | 2 | Dig hole for distribution box | Two laborers | Shovels |
| 6 hours | 2-3 | Build distribution box | One skilled laborer | Wood, hammer, nails, metal sheeting, tar, mortar, four lengths of sewer pipe |
| 2 hours | 4 | Spread gravel in hole, install box | One laborer and one skilled laborer | Shovels, gravel |
| 3 days | 4-7 | Dig trenches for drainpipes | Two or more laborers | Two or more shovels |
| 4 hours | 8 | Spread gravel in trenches | Two or more laborers | Gravel, wheelbarrow, shovels |
| 1½ days | 8-9 | Lay open-joint drainpipe | Two or more laborers | Drainpipe |
| 2 hours | 10 | Cover open joints with tar paper | Two or more laborers | Tar paper |
| 4 hours | 10 | Cover drainpipe with gravel | Two or more laborers | Gravel |
| 2 hours | 10 | Cover gravel with straw | Two or more laborers | Straw |
| 1 day | 11 | Fill in trench with dirt and mound | Two or more laborers | Shovels |
| 1 day | 21 | Plant grass over system | One or two laborers | Rakes, grass seed |

Caution!

1. When digging a pit deeper than 1.5m, shore up the sides to prevent a cave-in, which could be fatal to a worker in the pit.

2. All subsurface absorption systems must be constructed at the exact site and to the dimensions specified by the project designer in order to protect water supplies and to ensure proper operation of the system.

General Construction Steps

Depending on local conditions, availability of materials, skills of workers, and so on, some construction steps will take only a few hours, while others may take days or even weeks. Table 2 shows a sample work plan for building an absorption system including time estimates for each step. Draw up a similar work plan with rough time estimates based on local conditions.

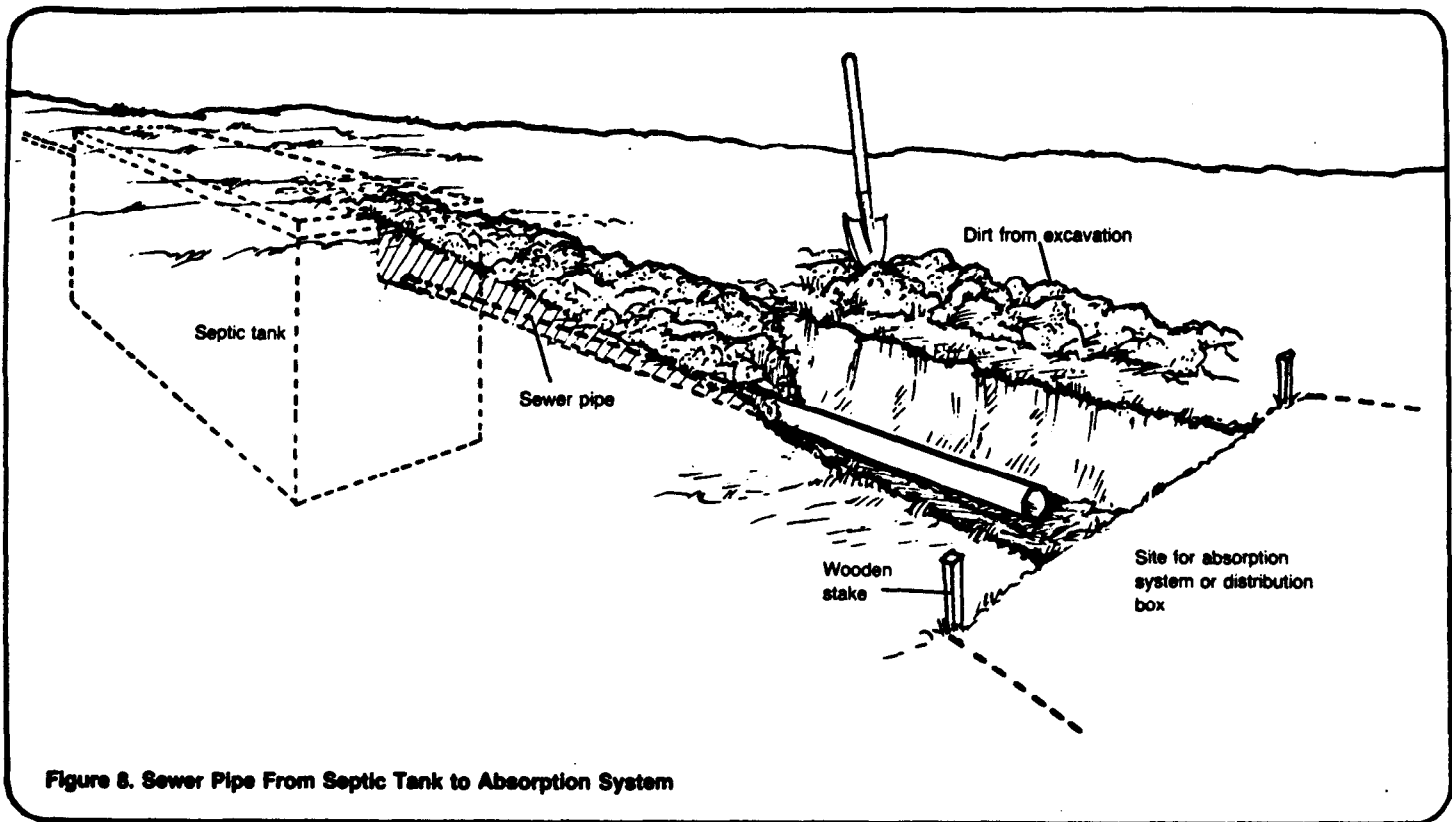


Figure 8. Sewer Pipe From Septic Tank to Absorption System

You will then have an idea of when specific laborers, supplies and tools must be available during the construction process. The following are construction steps for building an absorption system.

1. Assemble all materials, tools, laborers, and drawings needed to begin construction. Study all diagrams carefully.

2. Use the location map similar to Figure 1 and a measuring tape to determine the correct location for the absorption system, including distribution box or "cross" or "T" fitting, if applicable, and mark it on the ground with wooden stakes or pointed sticks. Mark the trench line for the sewer pipe from the septic tank to the site of the absorption system. Be certain the locations of the trench line and absorption system are correct before beginning construction as shown in Figure 8.

3. Dig the trench from the septic tank to the site of the absorption

system with a downward trench grade or slope of about one in 100, which means that the trench bottom drops one unit in elevation for every 100 units in length. The trench should slope evenly and should be as straight as possible. Avoid sharp bends. The trench need not be more than 0.3m wide and 0.3m deep, sloping downward to the absorption system site. In level or uneven ground, the trench may have to be deeper to attain the correct downward slope of one in 100.

If the system is a trench, series of trenches, or field, the end of the sewer pipe must be at least 0.45m underground when it enters the site of the absorption system. This is to ensure that the absorption system is deep enough to have sufficient cover. Check the depth of the sewer pipe trench where it enters the absorption system site. If it is less than 0.45m, dig the trench bottom steep enough to reach a depth of 0.45m at the edge of the absorption system site nearest the septic tank.

4. Lay sewer pipe in the trench. Seal all pipe joints with tar, mortar, oakum, or other local caulking material. Check the slope of the pipe to be certain that liquid will flow downward from the septic tank to the absorption system.

(NOTE: This pipe may have been installed during construction of the septic tank.)

Cover the sewer pipe carefully with dirt, mound the dirt to allow for settling, and gently tamp.

Construction Steps for a Single Trench System

1. Follow "General Construction Steps" 1 through 5.

2. Excavate the absorption trench to the length, width, and depth shown on the technical drawing provided by the project designer. The bottom of the absorption trench should be nearly level or slope gradually and evenly downward from the inlet end (septic

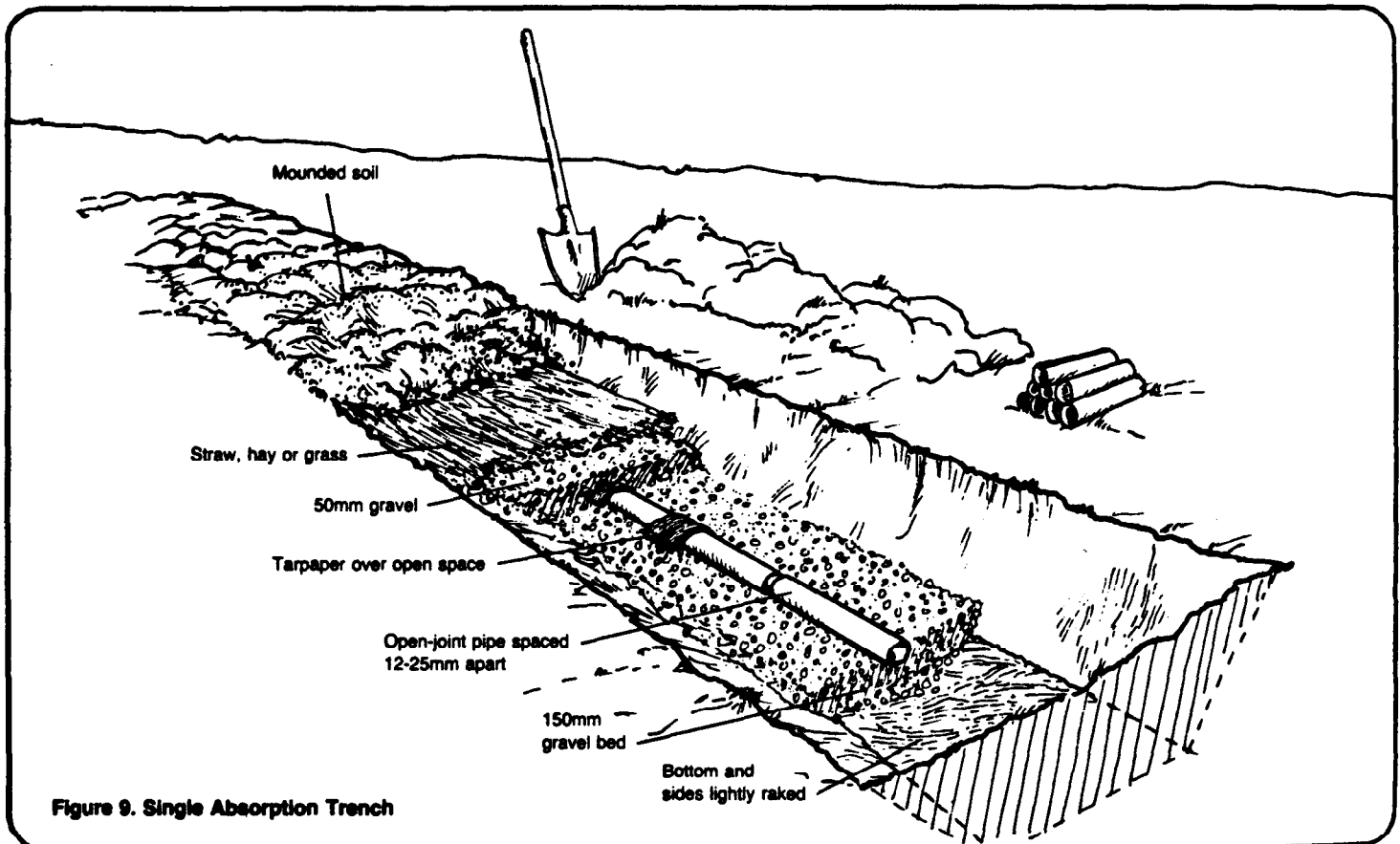
tank end) at no more than one in 200, as shown in Figure 9.

3. Lightly rake the bottom and sides of the trench with a rake or hoe. Do not walk in the trench after this step or the bottom will become compacted and lose permeability.

4. Spread 150mm of clean gravel or crushed rock along the entire length of the trench. The depth of the gravel must be uniform so the grade will remain gradual and even.

5. Lay the first section of drain-pipe in the inlet end of the absorption trench and mortar it to the end of the sewer pipe.

6. Lay the remainder of the drain-pipe in the trench. If perforated pipe is used, the perforations must face downward. If open-joint pipe is used, do not mortar the joints. Leave a space of 12 to 25mm between each pipe section. If non-perforated plastic pipe is available, either (a) drill



12mm holes 150mm apart in two parallel rows along the bottom of the pipe and use as perforated pipe, or (b) saw the pipe into 450mm sections and use as open-joint pipe. The drainpipe must be level or slope downward away from inlet end at no more than one in 200.

7. Plug the end of the last pipe section with cement, mortar, or other material that will not corrode.

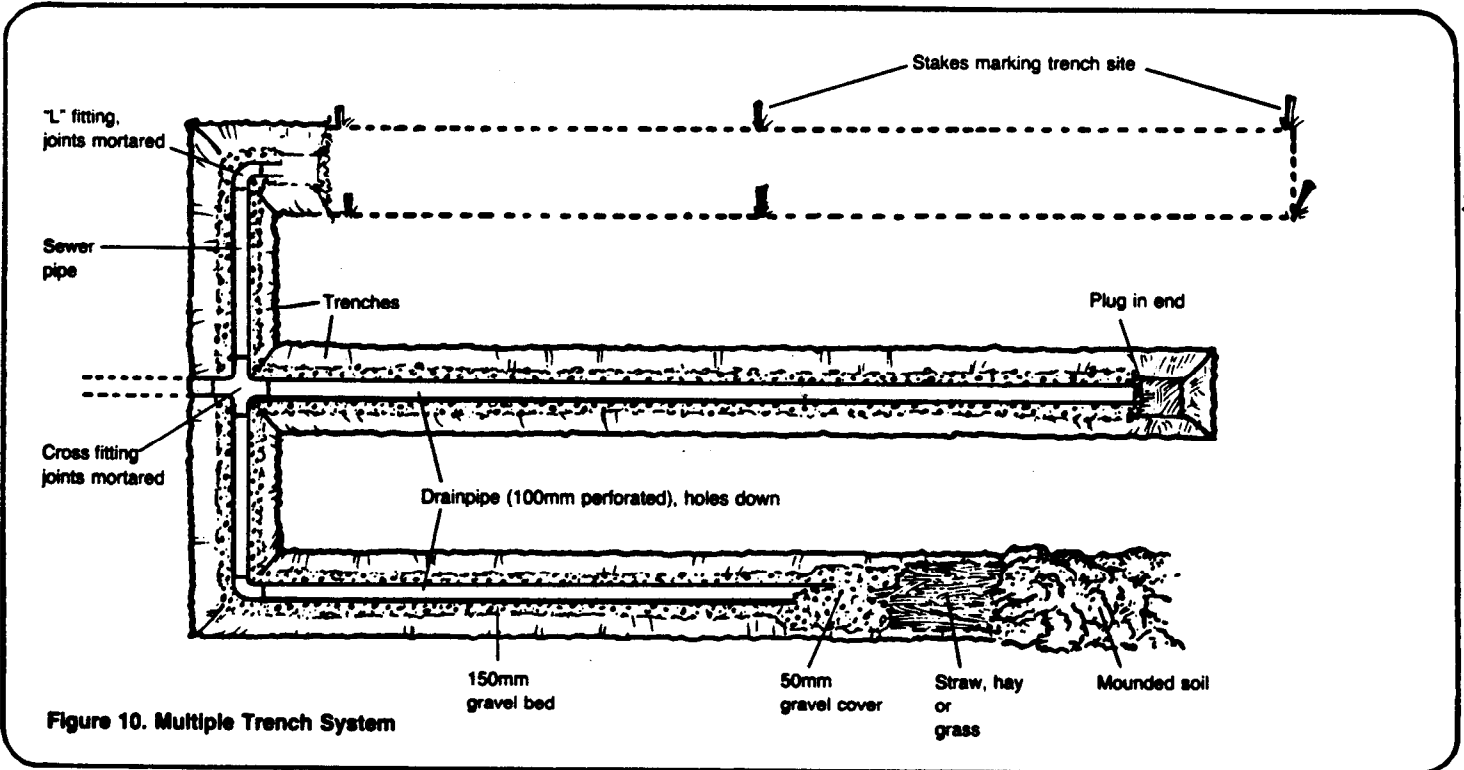
8. Cover the open joint between pipe sections with building or tar paper to prevent cover gravel from sifting in and clogging the system.

Construction Steps for a Series of Trenches

1. Follow "General Construction Steps" 1 through 5.

2. Dig the hole for the distribution box, "cross" fitting, or "T" fitting at the end of the sewer pipe, 150mm deeper than is necessary for the box or fitting alone. The bottom of the hole must be level.

3. Spread 150mm of gravel or crushed rock in the hole.



9. Fill the trench with gravel or crushed rock to a depth of 50mm above the top of the drainpipe.

10. Cover the gravel or crushed rock with untreated paper, straw, hay, or grass to prevent dirt from sifting into the gravel.

11. Fill the trench with dirt and mound it to allow for settling. Do not tamp.

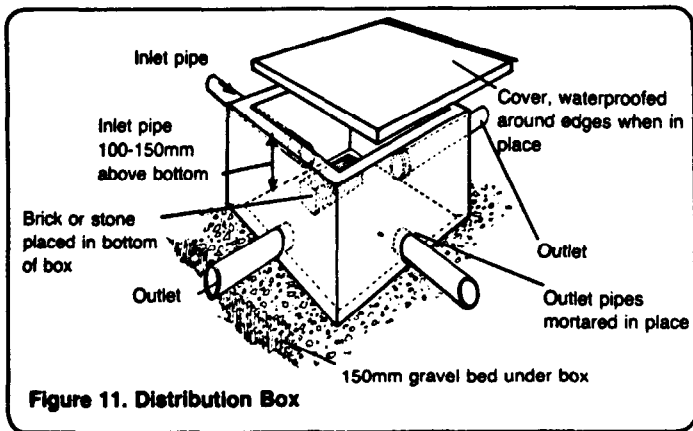
12. Plant grass over the system when the mound has settled, after a week or two. This will help prevent erosion by wind, rain, or surface water.

For a "cross" or "T" fitting:

4. Attach one end of the fitting to the sewer pipe and mortar the joint. The other ends of the fitting will be joined to the drainpipe as shown in Figure 10.

For a distribution box:

5. Build the box from wood, metal, brick, concrete block, or poured concrete to the dimensions on the technical drawing provided by the project designer. If the box is made from



brick and mortar, concrete block, or poured concrete, see "Constructing Septic Tanks," SAN.2.C.3, for details on working with these materials. A distribution box is shown in Figure 11.

5a. Make the bottom of the box level.

5b. Make the box watertight. If it is wood or metal, coat the inside with tar, or other waterproofing material. If the box is brick and mortar or concrete block, coat the inside with 12 to 25mm of cement mortar.

5c. Make the outlets to the absorption system level with the bottom of the box. The box will have two or more outlets, depending on the design. Make the inlet from the septic tank 100 to 150mm higher than the bottom of the box as shown in Figure 11.

5d. Build a watertight, secure cover for the box. The cover can be wood, metal, or concrete and should be strong enough to support the weight of an adult to prevent anyone from falling into the box.

5e. Place a brick or stone on the floor of the box after it is built to prevent effluent from flowing straight across the box to one outlet only.

5f. Extend the sewer pipe to the inlet of the distribution box and mortar the joint.

6. Lay sewer pipe from the outlets of the "cross," "T," or distribution box to the nearest end of each trench site, as shown in Figure 10. The sewer pipe must slope downward from the "cross," "T," or distribution box to

the trench site at no more than one in 100. Mortar all pipe joints including those at the outlets.

7. Secure the cover of the distribution box and waterproof around the edges with tar, oakum, or other waterproofing material. Cover the distribution box, "cross" fitting, or "T" fitting with dirt and gently tamp. Do this carefully because the distribution device must remain level.

8. Follow "Construction Steps for a Single Trench System" 2 through 6 for each trench and drain line.

For an open-end trench system:

8a. Plug the end of the last section of each drain line with cement, mortar, or other material that will not corrode.

For a closed-loop system:

8b. Attach "L" and "T" fittings, as called for in the design, to the last section of each drain line and lay drainpipes between these fittings. Mortar the joints at the fittings, but not the joints between drainpipe sections. This will prevent sewage effluent from accumulating at the corners of the system.

9. Follow "Construction Steps for a Single Trench System" 8 through 12.

Construction Steps for a Field System

1. Follow "General Construction Steps" 1 through 5.

2. Follow "Construction Steps for a Series of Trenches" 2 through 5.

3. Lay sewer pipe from the outlets of the distribution box, "cross" fitting, or "T" fitting to the nearest side of the field site. The sewer pipe must slope downward from the distribution device to the field site at no more than one in 100. Mortar all pipe joints, including those at the outlets.

4. Secure the cover of the distribution box and waterproof around the edges with tar, oakum, or other waterproofing material. Cover the distribution box, "cross" or "T" with dirt and

gently tamp. Do this carefully because the distribution device must remain level.

5. Excavate the field to the width, length, and depth specified on the technical drawing provided by the project designer. The field must be level. Lightly rake the bottom of the field with the rake or hoe.

6. Spread 150mm of clean gravel or crushed rock over the entire field.

7. Lay the drainpipe on the gravel to the length and configuration shown on the technical drawing in Figure 12. If perforated pipe is used, the perforations must face downward. If open-joint pipe is used, do not mortar the joints. Leave a space of 12 to 25mm between each pipe section. However, do mortar the joints where the drainpipes connect with the sewer pipes and at all "T" and "L" fittings at the

corners and far side of the field. The drainpipe must be level or slope downward away from the inlet side of the field at no more than one in 200.

8. Cover the open joint between pipe sections with building or tar paper to prevent cover gravel from sifting in and clogging the system.

9. Fill the entire field with clean gravel or crushed rock to a depth of 50mm above the top of the drainpipe.

10. Cover the gravel or crushed rock with untreated paper, straw, hay, or grass to prevent dirt from sifting into the gravel.

11. Fill the entire field with dirt and mound slightly. Do not tamp.

12. Plant grass over the system when the mound has settled, after a week or two. This will help prevent erosion by wind, rain, or surface water.

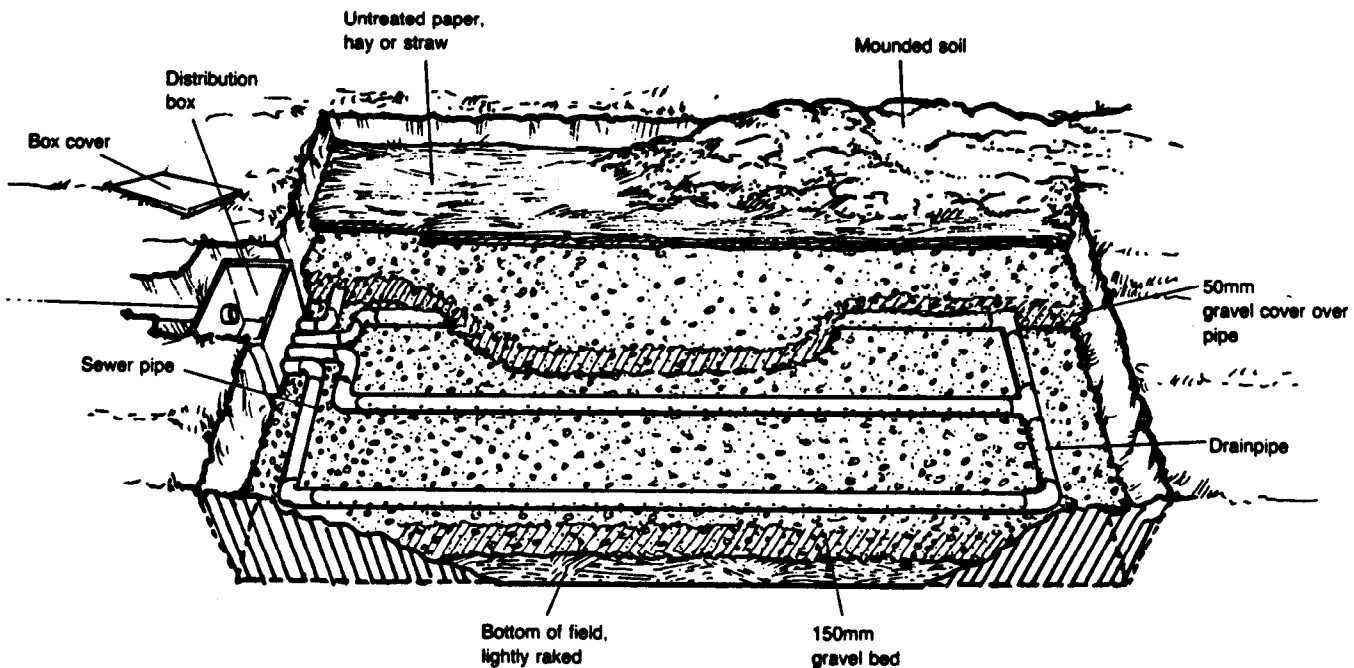


Figure 12. Absorption Field

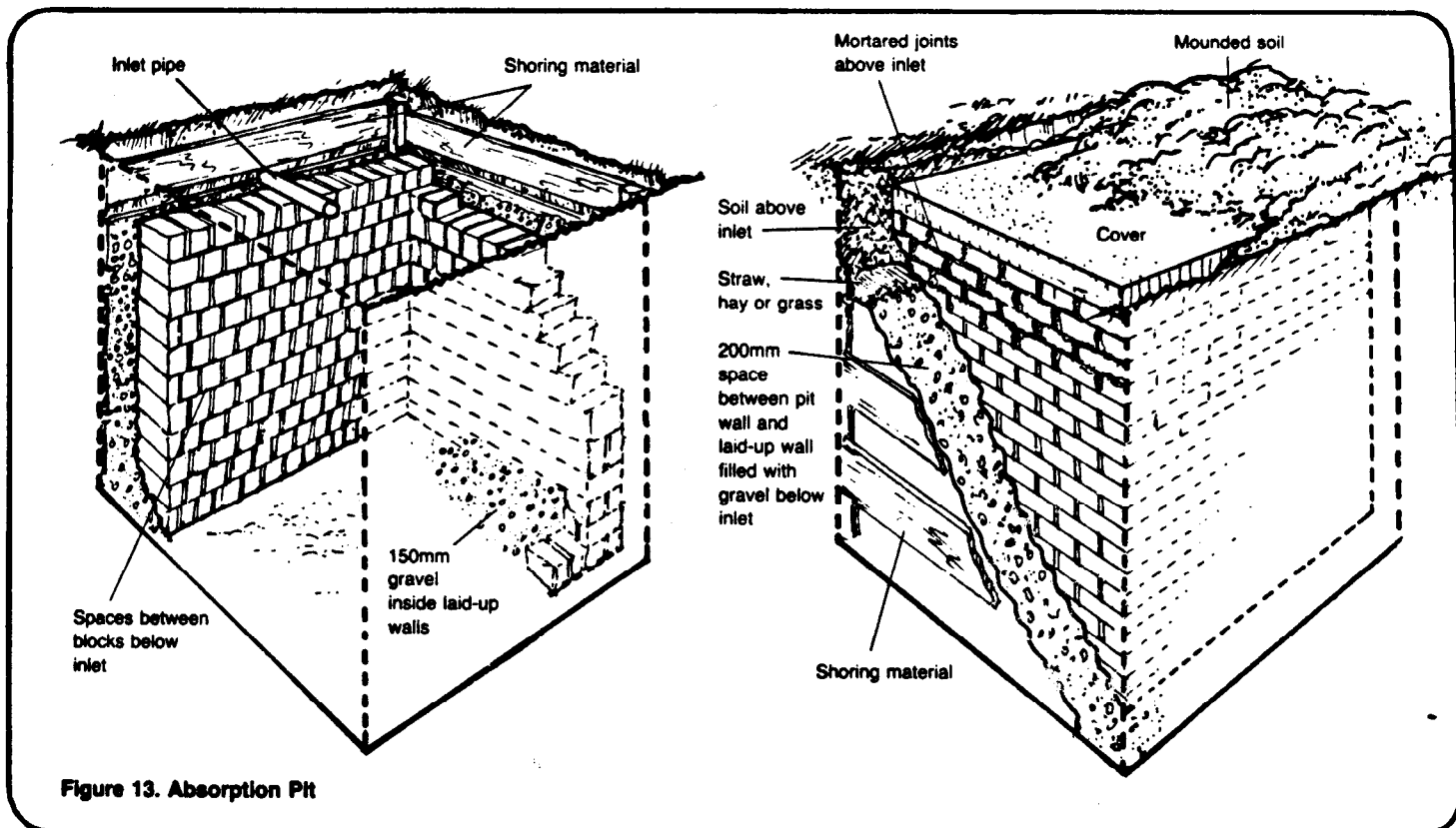


Figure 13. Absorption Pit

Construction Steps for a Pit System

1. Follow "General Construction Steps" 1 through 5.

2. Dig the pit to the dimensions and depth specified on the technical drawing provided by the project designer. The design depth is measured downward from the inlet pipe, not from the surface of the ground. If the pit is deeper than 1.5m, shore up the sides with logs, boards, bamboo, or other local material during excavation to prevent a cave-in, which could be fatal to a worker in the pit. As a further precaution, dig the pit so the sides slope slightly outward: one unit out for every 10 units deep.

3. Lightly rake the sides of the pit with a rake or hoe to ensure permeability.

4. Lay up the side walls using bricks, concrete blocks, or selected field stones. Make the walls about 300mm thick. Leave a space of 200 to 250mm between the outside of the laid-up wall and earth wall of the pit. This space will eventually be filled

with gravel. Do not mortar the laid-up walls below the inlet. Figure 13 shows an absorption pit.

5. Extend the inlet pipe 100 to 150mm beyond the inside of the laid-up wall when the wall reaches the level of the inlet. This will allow effluent to fall into the pit without flowing down the sidewall and impairing the permeability of that portion of the wall.

6. Continue laying up the side walls to within about 0.3m below the surface of the ground. Mortar the side walls above the inlet. The mortar will give additional strength to the side walls above the inlet.

7. Fill the space between the laid-up wall and the earth sides of the pit with clean gravel or crushed rock. This material may be added as the walls are laid. When the gravel reaches the level of the inlet, cover it with untreated paper, straw, hay, or grass. Fill in the remainder of the space with dirt.

8. Lightly rake the bottom of the pit and spread 150mm of clean gravel or crushed rock over it.

9. Construct a strong, waterproof cover that fits flush with the outside edges of the laid-up walls. The cover may be wood, metal, or reinforced concrete. It must be strong enough to support the weight of an adult to prevent anyone from falling into the pit. If the cover is made of wood or metal, waterproof it with tar, oakum, or other waterproofing material. If the cover is made of concrete, build it in sections (see "Constructing Septic Tanks," SAN.2.C.3, for details of working with concrete and building a cover in sections).

10. Set the cover in place and waterproof around the edges. Cover and mound with dirt. Do not tamp.

Operating and Maintaining a Subsurface Absorption System

When the absorption system is constructed and connected by sewer pipe to the septic tank, and the tank is connected by sewer pipe to the building to be served (see "Operating and Maintaining Septic Tanks," SAN.2.O.3), the system is ready to operate. Sewage will flow from the building to the septic tank, where it will remain for one to three days, allowing the solids to settle out. Effluent will flow from the tank to the absorption system and soak safely into the soil.

Maintaining the system involves inspecting it for burrowings, erosion, and system failure.

Burrowings. Small holes or excavations on or near the absorption system indicate the presence of dogs or burrowing animals. These animals should be kept away. Erect fences, if necessary.

Erosion. If there is erosion on or near the absorption system due to wind, rain, or surface water, fill and mound with dirt. Plant or resod grass over the system. If surface water is a problem, build small dams or trenches to divert it.

System Failure. An absorption system fails when the soil around it no longer absorbs sewage effluent, or when the soil absorbs effluent at a slower rate than it is received. When a system fails, it cannot be repaired. It must be abandoned and a new system built. When a system is failing, one or more of the following signs can be noted at or near the site: unusually lush growth; wet areas or puddles; continual odors.

An absorption system can fail for a number of reasons. Even though a failed system cannot be repaired, it is useful to know the major reasons for failure so they may be avoided in future systems:

- **Improper location.** The site was not adequately tested for soil suitability or groundwater levels; the test results were incorrectly used; or the results were ignored.

- **Improper design.** The system was not designed or constructed large enough, or the flow of sewage effluent substantially increased after the system was designed.

- **Improper construction.** The system was not constructed according to design specifications. This could mean a number of things: the trench slope was too steep; the drainpipe was incorrectly installed; the open joints were mortared or filled in with gravel; dirt was allowed to sift into the gravel.

- **Improper construction of distribution device.** The distribution box, "cross" fitting, or "T" fitting was not level, and the effluent flowed to only part of the system and that part became overloaded.

- **Improper operation of septic tank.** If the soil clogged with solids from the septic tank, it was not operating properly.